CSP Approach to Science

Contents

Working Scientifically

Working Scientifically – Overview

Science end of year expectations

5 Types of investigations

Fair test planning sheets

Links across the curriculum

Maths across the science curriculum

English across the science curriculum

Assessments

PLAN planning matrices

Year 1 – 6 individual pupils science assessment records

TAPS overview

Focused assessment tasks

The CSP Approach to Primary Science

Introduction

A collaboration between

The Catholic Schools Partnership
CSP
A Teaching School Alliance of Bradford & Keighley

Teaching from the Heart
'Putting the humanity back into education'

The Catholic Schools Partnership
CSP
A Teaching School Alliance of Bradford & Keighley

CSP Science Mission: To grow our pupil's science capital

CSP Vision for Science

WHY/INTENT

Through our science curriculum at the CSP, we nurture enquiring minds, fuel curiosity and unlock scientific potential.

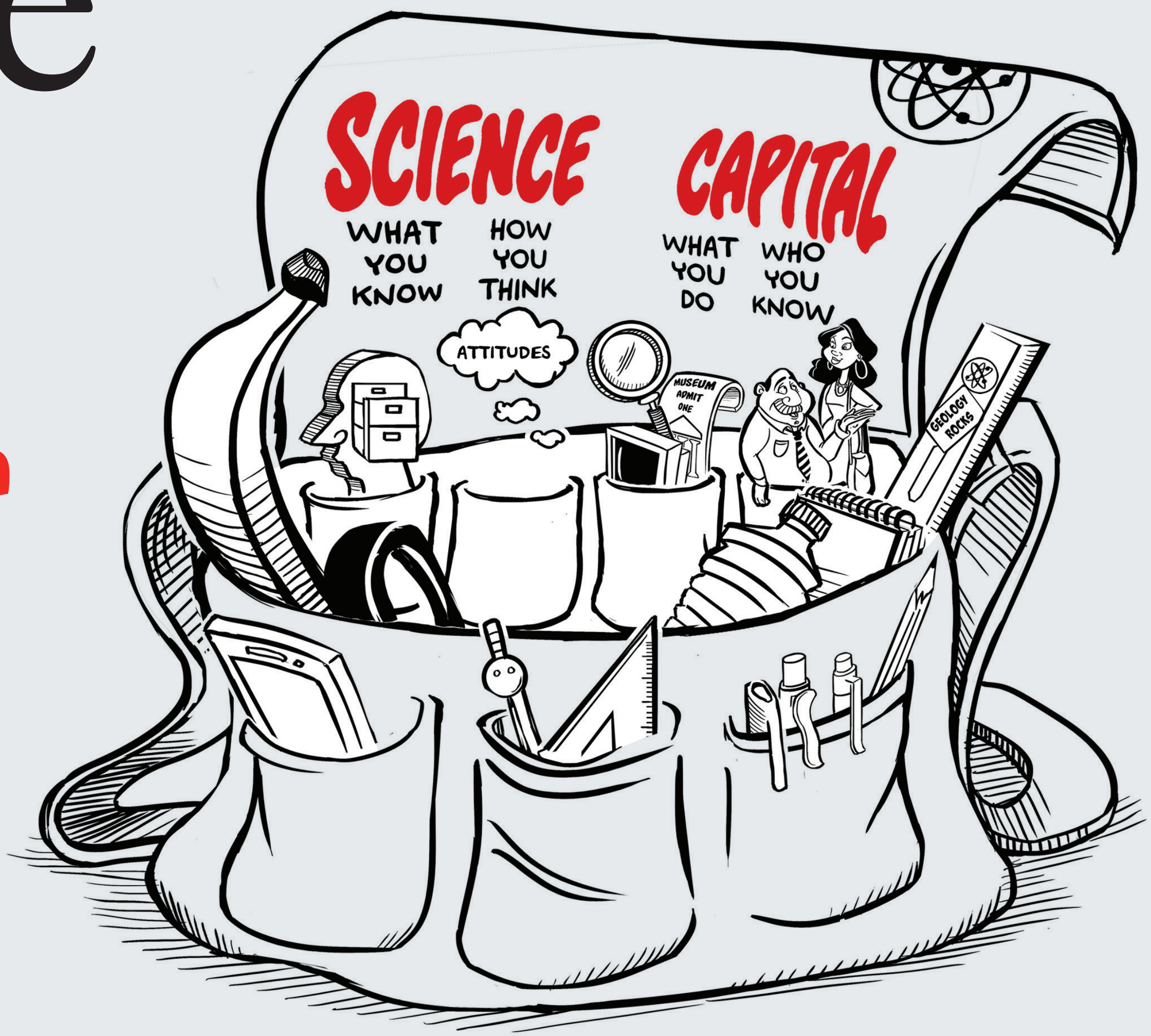
HOW/IMPLEMENTATION

Science is best when we:

- Nurture enthusiasm for learning
- Have fun and engaging scientific opportunities both in and out of school
- Give children time to play and explore
- Make our learning purposeful and real
- Learn through practical hands-on and minds-on activities
- Seize every opportunity to develop scientific skills, knowledge and a sense of awe and wonder
- Exude our enthusiasm and passion for STEM
- Find and share STEM opportunities in the local area with our school community
- Develop our scientific skills
- Learn through 5 types of enquiry – observing over time; identifying & classifying; pattern seeking; research; comparative & fair testing
- Ask and answer questions
- Make links with other subjects e.g. reading, writing, art and maths
- Record and share our learning in a variety of ways, to a range of audiences

Science capital

made clear



| @enterprisingsci | #sciencecapital | www.enterprisingscience.com |

Science capital – **the key points**

- Science capital is a concept that can help us to understand why some young people participate in post-16 science and others do not. In particular, it helps shed light on why particular social groups remain under-represented and why many young people do not see science careers as being 'for me'.

- The concept of science capital can be imagined like a 'holdall', or bag, containing all the science-related knowledge, attitudes, experiences and resources that you acquire through life. It includes what science you know, how you think about science (your attitudes and dispositions), who you know (e.g. if your parents are very interested in science) and what sort of everyday engagement you have with science.

- Research evidence shows that **the more science capital a young person has, the more likely s/he is to aspire to continue with science post-16 and to see themselves as having a science identity.**

- The concept of science capital is drawn from the sociologist Pierre Bourdieu's concept of capital (referring to economic, cultural and social resources) – in short, Bourdieu proposes that **the more you have of the 'right sort' of capital, the better you are able to 'get on' in life.**

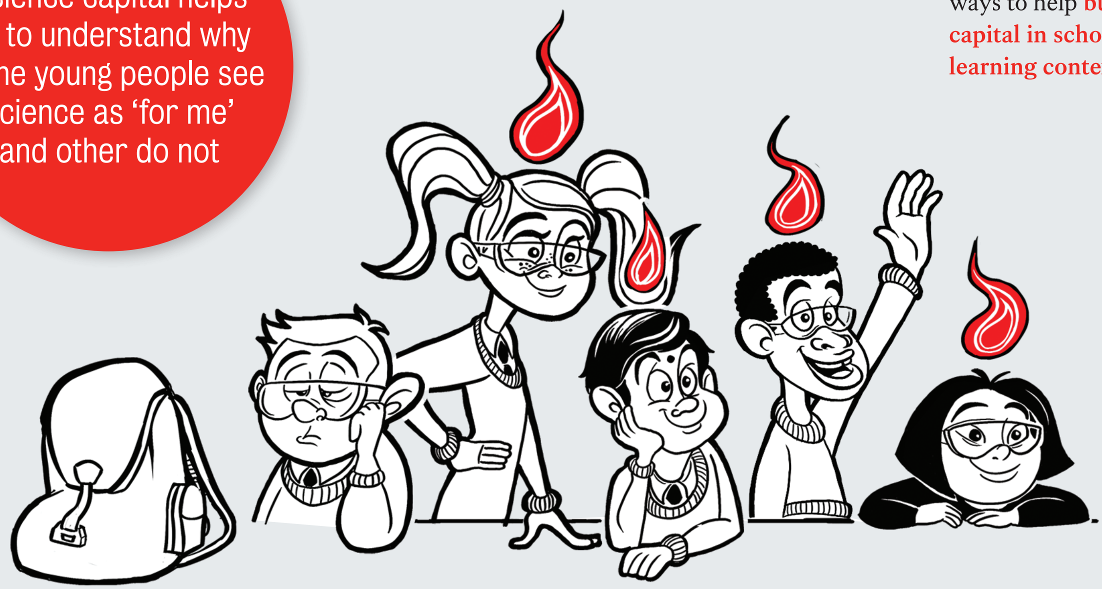
- In the Enterprising Science project we are developing our understanding of the concept of science capital and are also researching its implementation in practice. We are exploring ways to help **build young people's science capital in schools and informal science learning contexts.**

- To date, we have formulated and explored the concept in relation to **young people** (school students), but we think there is useful potential for further developing and applying the concept to adults.

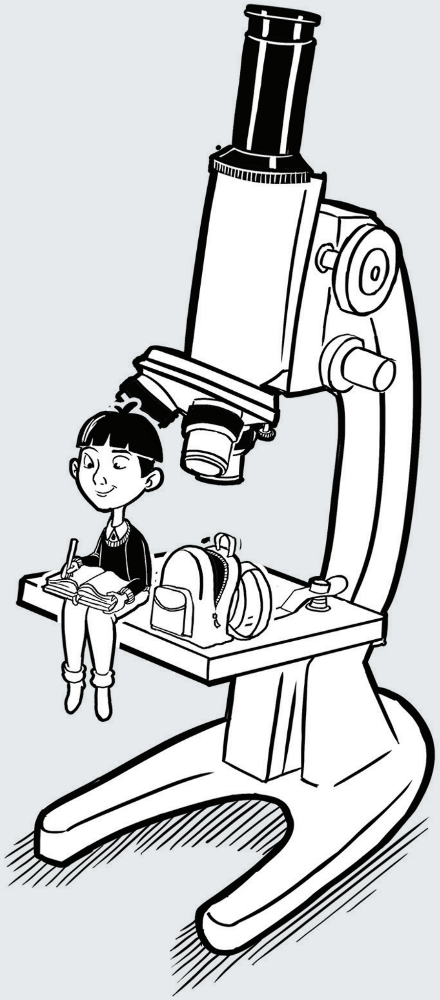
- Our hope is that **building science capital** will have a positive effect on young people's lives – not just in terms of encouraging more young people to continue into science, technology, engineering and mathematics (STEM) jobs, but more importantly, we hope that building science capital is a **tool for social justice,** to help improve people's lives and life chances.

- Science capital is a broad and diverse concept, which includes a wide range of knowledge, experiences, attitudes, behaviours and practices. However, our statistical analysis has identified 8 key dimensions of science capital. These dimensions are the aspects of science capital which are most closely related to post-16 participation and for fostering a sense that science is 'for me'. That is, the more a young person has, the more likely they are to plan to continue with science in the future.

Science capital helps us to understand why some young people see science as 'for me' and other do not



Key dimensions of science capital



1. Scientific literacy: a young person's knowledge and understanding about science and how science works. This also includes their confidence in feeling that they know about science.

2. Science-related attitudes, values and dispositions: this refers to the extent to which a young person sees science as relevant to everyday life (for instance, the view that science is 'everywhere').

3. Knowledge about the transferability of science: understanding the utility and broad application of science qualifications, knowledge and skills used in science (e.g. that these can lead to a wide range of jobs beyond, not just in, science fields).

4. Science media consumption: the extent to which a person, for example, watches science-related television, reads science-related books, magazines and engages with science-related internet content.

5. Participation in out-of-school science learning contexts: how often a young person participates in informal science learning contexts, such as science museums, science clubs, fairs, etc.

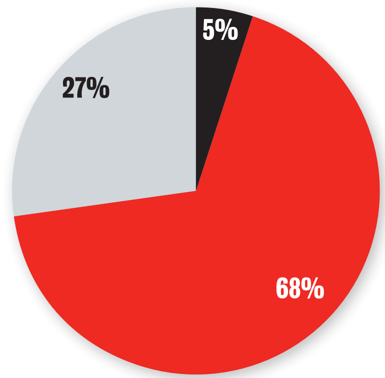
6. Family science skills, knowledge and qualifications: the extent to which a young person's family have science-related skills, qualifications, jobs and interests.

7. Knowing people in science-related roles: the people a young person knows (in a meaningful way) in their family, friends, peer, and community circles who work in science-related roles.

8. Talking about science in everyday life: how often a young person talks about science out of school with key people in their lives (e.g. friends, siblings, parents, neighbours, community members) and the extent to which a young person is encouraged to continue with science by key people in their lives.

The Enterprising Science national survey of 3,658 11–15 year olds in England found that:

- **5%** have 'high' science capital – these students more likely to be boys, South Asian and socially advantaged
- **68%** have medium levels of science capital
- **27%** have low science capital



Myth-busting: **clarifying common misconceptions**

The concept of science capital is gaining prominence within science education and informal science learning policy, practice and research. The concept is useful because it provides a common language and framework that resonates with the experiences and observations of many stakeholders across these fields.

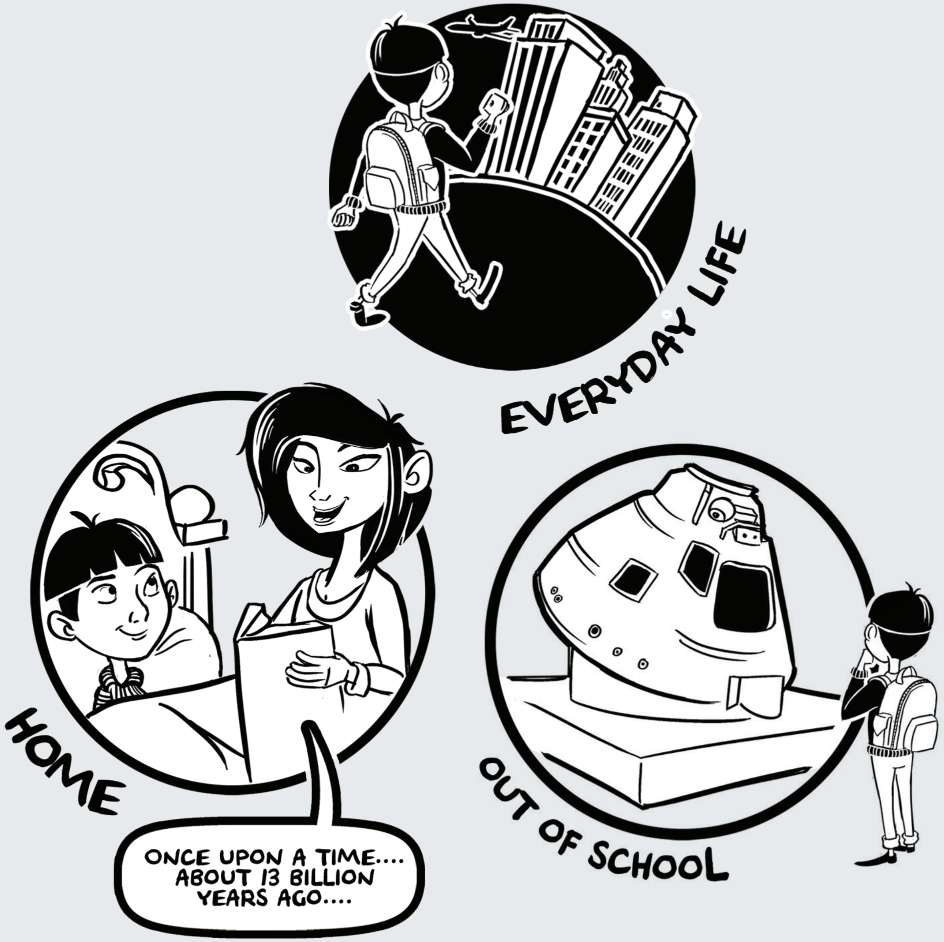
However, we have noted that, as its usage spreads, science capital is not always clearly understood and is often interpreted in different ways. Here we outline – and clarify – some common misconceptions.

Common misconceptions	Clarification
Science capital is the same as science literacy	Science literacy (science knowledge, skills and appreciation of science) is an important part of science capital – but science capital is not just science literacy. Science capital also includes other practices including what you do, who you know, and what your family values.
Science capital is just cultural capital	Students with high science capital also tend to have high cultural capital – that is, on the whole, students with high science capital are more likely to come from socially advantaged backgrounds and those with low science capital are more likely to come from disadvantaged backgrounds. However, this is not always the case. For instance, a socially advantaged student may have low science capital and a socially disadvantaged student may have high science capital, depending on their specific science-related resources. In other words, science capital is not reducible to cultural capital and statistical analysis shows that science capital produces a finer-grain analytic lens for predicting young people's science aspirations and science identity, compared to cultural capital.
Science capital is the main/ only factor affecting science aspirations and participation in science	Science capital is an important factor influencing science aspirations and participation in science but is not the only factor and it does not operate in isolation. Our research highlights the importance of multiple factors, including gender, ethnicity, teachers, educational systemic factors, issues of representation and the culture of science, and so on. In other words, a student with high science capital will not automatically pursue post-16 science – but students with high science capital are significantly more likely to aspire to post-16 science. Most importantly, they are more likely to see science as being 'for me'.
It is easy to measure science capital	The complexity of the concept of science capital does not lend itself to easy or quick measurement. Our analyses of a large number of survey questions ('items') has identified a smaller set of c.14 items which have the strongest statistical relationship to science aspirations and science identity. We suggest that these items represent a useful 'backbone' to the concept of science capital, which is amenable to measurement. However, it would not be meaningful to measure science capital quantitatively through a smaller number or subset of these questions (for instance via a very short 'exit poll'). We also believe that an interest in quantitatively 'measuring' science capital should not over-shadow the importance of qualitatively understanding the ways in which science capital 'works' in practice.

Common misconceptions	Clarification
The main value of science capital is as a quantitative 'instrument' for measuring change	Although we hope that our science capital surveys might offer practitioners and researchers a concrete way to explore, compare and map changes in science capital (e.g. as the result of an intervention), this also needs to be approached with caution and care, recognizing that this is a pragmatic and blunt application of the concept. We see a key value of science capital being its potential as a reflective tool to help us to understand the influences affecting a young person's participation (or not) in science. It is also equally valuable as a concept for informing policy and practice.
Science capital is fixed	Science capital is not fixed: what capital you possess will change over time and will depend on context. Our argument is that educators are able to help to build a student's science capital, by valuing and linking students' experiences from home with science, and by addressing the different science capital dimensions in their practice.
A science capital approach means building the human capital of individuals	Because science capital incorporates a number of dimensions, building science capital will inevitably require a holistic approach. But it also requires changes to the wider context – because the value of a student's capital will be shaped by the context that they are in. It is therefore important to focus on changing institutional and system-wide structures and policies to enable more forms of science capital to be recognized and valued.
A science capital approach is only beneficial to particular social groups/types of student	Our research, and findings from teachers who have been adopting a science capital approach with diverse groups of students (from socially privileged, high attaining students in the independent sector to socially disadvantaged low attaining students in urban comprehensive schools), shows that it can be beneficial for all young people and teachers.
We know everything we need to know about science capital	Understanding science capital is a work in progress! We are studying the ways in which educators can most effectively build science capital. From our data so far, it seems that small but cumulative changes in practice – valuing students' home experiences; encouraging science-based conversations out of school – are effective.

Adopting a science capital approach in practice

There is no single 'science capital approach', however, the following are some core principles that characterise what we would consider to be a useful and authentic science capital approach that could be enacted in policy and practice.



Key principles for adopting a science capital approach

- **Reflective** – a science capital approach is about a change in mind-set and pedagogy. It is not reducible to resources or activities.

- **Comprehensive** – a science capital approach means recognising and addressing as far as possible all the key dimensions of science capital (e.g. not simply focusing on, say, science literacy).

- **Holistic and structural** – a science capital approach requires recognising that efforts need to be targeted as much at systems, institutions, local areas and families as at the young people themselves.

- **Nuanced** – a science capital approach entails an understanding of the complexity of the concept and the issues involved. It seeks understanding of the issues, and does not just focus on quantitative 'measurement'.

- **Commensurate with the dimensions of science capital** – a science capital approach means ensuring that initiatives do not work against the key dimensions of science capital. For instance, only promoting the value of science as leading to careers in science would negate efforts to explain the transferability of science qualifications for all sorts of jobs and careers.

- **Fundamentally concerned with social justice** – a science capital approach is about trying to understand, identify, monitor and challenge inequalities. It means recognising the importance of power and how inequalities are perpetuated in society. A science capital approach is primarily concerned with helping to achieve improved life chances and outcomes for diverse individuals and communities.

- **Focused on trying to improve the wider system** – because the value of science capital is determined by the context, a science capital approach means paying meaningful attention to the institutions, systems and social relations within which people are located. It is about making sure that science contexts are supportive and offer value for everyone – not just the few. For instance, schools or museums could find ways to recognise, value and promote the varied interests, skills and experiences that diverse individuals, families and communities bring with them.

- **Collaborative and realistic** – building science capital is a challenging and complex endeavour. It means recognising that improving science participation entails changes and challenges for the whole STEM ecosystem and that there is no silver bullet (that is, a single approach or stakeholder is unlikely to be able to change the world alone). It is best attempted in partnership and with a long-term mind set!

Enterprising Science research

Enterprising Science is a five-year partnership between King's College London and the Science Museum, funded by BP (2013-17). This research and development project uses the concept of science capital to understand how young people from all backgrounds engage with science and how their engagement might be supported.

"When I've used a science capital approach with my class they don't misbehave, they're all very engaged and enjoy the discussion."
Year 10 Science Teacher

"The science capital principles give you a way to understand visitors and potential visitors, how they engage with science, what they bring to the table and what they want from you"
Senior audience researcher, Science Museum

"When one student starts, they all want to talk. They can lead the discussion"
Year 9 Science Teacher

Science capital in schools

In 2015/16, the Enterprising Science project has piloted **a science capital pedagogical approach** with 10 teachers in 6 secondary schools across London. In 2016/17 the pilot is being extended to schools in Manchester, Bradford and York.

The science capital pedagogical approach aims to support teachers in delivering their usual curriculum content and complement existing practice. It includes:

- Addressing the eight dimensions of science capital across existing schemes of work.
- Eliciting, valuing and linking students' prior knowledge and experiences from home, family and social contexts to school science.
- Highlighting the relevance and transferability of science for students' daily and future lives.
- Building young people's sense that 'science can be for me'.

Emerging feedback from teachers shows that they believe the approach can **enhance student engagement** in lessons, and **reduce behavioural problems.**

Science capital in the informal science learning sector

Over the course of the project, we have been exploring ways of developing a science capital approach for the informal science learning sector. The main tenets of this work include:

- Using the eight key science capital dimensions as a reflective tool to inform the design of programmes and exhibitions.
- Finding ways to elicit, value, reflect and link the varying experiences and knowledge of diverse audiences with programmes/exhibitions to create a more inclusive space for more visitors.
- Working in collaboration with schools to make better, more effective and inclusive use of museum visits and resources, which centre on eliciting and valuing the cultural knowledges and interests of diverse students and linking these with science.
- Conceiving a science capital approach in the ISL sector as complementary but integral to the wider science engagement ecosystem (which includes formal education, careers guidance, industry outreach etc.).

To find out more about our work

Visit our KCL project website:
www.kcl.ac.uk/enterprisingscience

Watch our 2 minute animation explaining the concept of science capital: http://bit.ly/sciencecapitalexplained

Follow us on Twitter: @enterprisingsci

Read our journal article, describing how we conceptualise and are developing the concept empirically: http://bit.ly/scicapjrst

Read some of our publications:

Archer, L., Dawson, E., Seakins, A. & Wong, B. (2016). Disorientating, fun or meaningful? Disadvantaged families' experiences of a Science Museum visit. Cultural Studies of Science, (iFirst), DOI: 10.1007/s11422-015-9667-7

Archer, L., Dawson E., DeWitt, J., Seakins, A. & Wong, B. (2015). "Science capital": a conceptual, methodological, and empirical argument for extending Bourdieusian notions of capital beyond the arts. Journal of Research in Science Teaching, 52(7), 922-948

Archer, L., Dawson, E. Seakins, A., DeWitt, J., Godec, S. & Whitby, C. (under review) "I'm gonna be a man here": Performances of masculinity and engagement with science during a school/museum intervention

Dawson, E., Archer, L., Seakins, A., DeWitt, J. & Godec, S. (under review) Selfies & Science Engagement: Girls Identity Performances in a Science Museum

DeWitt, J. et al (forthcoming) Dimensions of Science Capital: Exploring its potential for understanding student science participation

King, H., Nomikou, E., Archer, L. & Regan, E. (2015). Teachers' understanding and operationalisation of 'science capital'. International Journal of Science Education, 37(18), 2987-3014

Read the summary report of the science capital practitioner seminar:
sciencemuseum.org.uk/transforming-practice

This publication was written by the King's College London team: Louise Archer, Emily Dawson, Jennifer DeWitt, Spela Godec, Heather King, Ada Mau, Effrosyni Nomikou and Amy Seakins.

bp

KING'S College LONDON

SCIENCE MUSEUM

Design: RF Design, www.rfportfolio.com Approved by brand@kcl.ac.uk, April 2016

@enterprisingsci #sciencecapital www.enterprisingscience.com

Growing your science capital at school

What you know	How you think
NC Prior knowledge Experiences from home Experiences outside school *How do you find out what knowledge/experiences children are bringing with them to the classroom?*	Attitudes towards science Believing you can be a scientist *How can you support children to develop positive attitudes to science? Positive, engaging experiences in school. Aspirations, images, role models.*
Who you know	**What you do**
People children meet/know that work in science *STEM Ambassadors, links with secondary school, local businesses, university, parents; British Science Week; Bradford Science Festival; Otley Science Festival; (http://imascientist.org.uk/)*	Activities that children engage with related to science *High quality T & L; PSQM; science clubs, visits/visitors.*

Science capital is much more than just delivering the National Curriculum programs of study. You could use this grid to audit your current state position.

Growing your science capital at home.

September	October	November
Science Selfie – take a picture of you doing something scientific and share it with school. 	**Go for an autumn walk** 	**Notice the Night** 
December	**January**	**February**
Recycle your rubbish – make a collage with your materials from Christmas wrapping/boxes/packaging etc. 	**Feed the birds** – feed your local birds and take part in the RSPB Big Garden Birdwatch. 	**Go for a winter wander.** 
March	**April**	**May**
Science Week - Look out for British Science Week activities in your local area. BRITISH SCIENCE WEEK	**Step into spring.** 	**Muscle Madness** – go your local park and keep fit. 
June	**July**	**August**
Weather watch Record the weather, temperature, sunrise and sunset times for the month of June. What patterns can you spot? 	**Up, up and away!** Make something that flies. It could be a paper aeroplane, a parachute, a kite or a catapult.  Or why not try making a rubber band cannon. http://www.rigb.org/families/experimental/rubber-band-cannons	**Awesome August** 50 things to do before you're 11 ¾ How many of these things can you do?  https://www.nationaltrust.org.uk/features/50-things-to-do-before-youre-11--activity-list

Science Leaders you will need to share these ideas (or your own) with your school community on a month by month basis via, email, newsletter or twitter and display the outcomes.

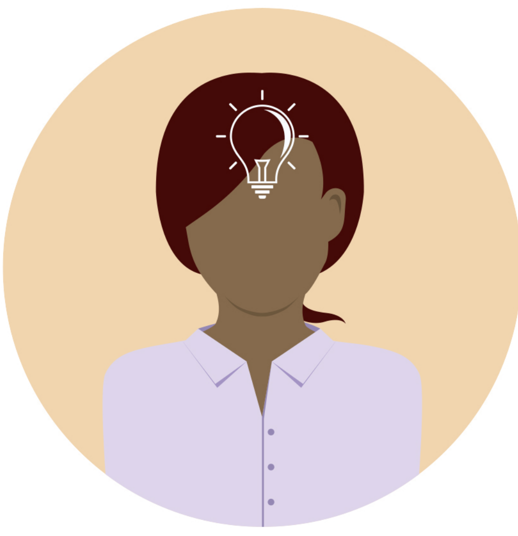
CSP Science Mission: To grow our pupil's science capital

What Kind of Scientist Could I Be?

You might think that a scientist is a person in a white lab coat who spends their life peering down a microscope, but there are many different sorts of career in science, technology, engineering and maths.

The Communicator
Combining science and technology expertise with an understanding of their audience's needs, Communicators tell the world about the amazing work scientists do. They work in areas like TV, advertising, regulation and public affairs.

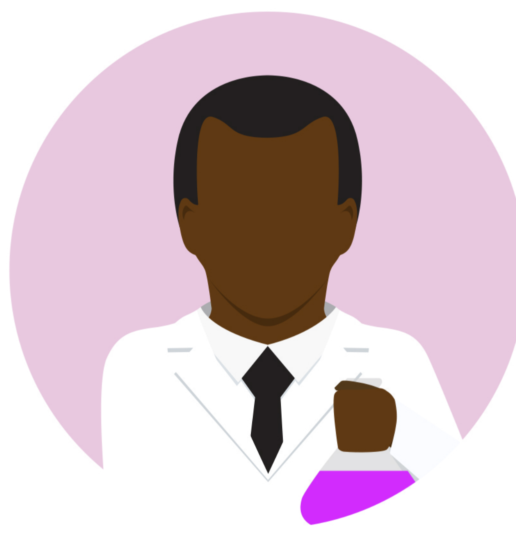
The Developer
Developers transform other people's discoveries into something practical. They enjoy solving problems and often work on creating new products or services, developing new technologies or applying existing knowledge to new situations.



The Entrepreneur
Entrepreneurs use scientific inventions to make money and create jobs for other people. Their scientific and business knowledge and entrepreneurial flair allow them to see opportunities for innovation.

The Explorer
Boldly going where no one has gone before, Explorers are on a journey of scientific discovery. They bring a fresh, creative approach to research, and are happy taking risks. It's hard to predict what they might find, and that's half the fun!

The Investigator
Investigators piece together bits of information to map out the scientific landscape so that others can more easily find their way. They are good at seeing connections between ideas, and often work in a team.



The Service Provider
Service Providers work in special laboratories, carrying out key scientific tasks like testing or setting up experiments. They are essential in areas such as the health service, investigating crimes and food science, as well as in research and education.

The Policy Maker
Policy Makers use their science knowledge to ensure that the law and government policy are based on sound evidence. They need strong communication, people and negotiation skills, and must be able to make difficult decisions.

The Professional
Professionals with excellent science and technology skills are in huge demand across all industries, not just in the obvious industries like pharmaceuticals or IT, but also in marketing, product development, finance and insurance.

The Regulator
Regulators make sure that science and technology are practised safely. They must communicate well with the public and other scientists, building trust and confidence. For example, Regulators check that our food is safe to eat.

The Teacher
Trained in science, Teachers use their passion for their subject to inspire students. Working in and with schools, colleges, universities, they pass on their knowledge and enthusiasm and help to develop tools for teaching and learning.

Want to be a Scientist?

If you like the sound of any of these kinds of careers, talk to your teacher about which subjects will help you become a scientist.

Produced by Ada Lovelace Day:
www.findingada.com or @findingada

Based on the Science Council's Ten Types Of Scientist:
www.sciencecouncil.org/10-types-scientist

Supported by ARM:
www.ARM.com

The CSP Approach to Primary Science

Science Leadership

A collaboration between

The Catholic Schools Partnership
CSP
A Teaching School Alliance of Bradford & Keighley

Teaching from the Heart
'Putting the humanity back into education'

Improving primary science

Developing *great science* subject leadership

Great ideas for primary science leaders from schools that value science.

wellcome trust

“

Where science has a good profile within the school as a result of dedicated leadership, and where staff are expected to teach exciting, investigative science with access to high-quality expertise, children are likely to enjoy learning the subject.” [1]

Cover images:
Irchester Community Primary School

Wellcome Images

Primary Science: Developing good practice in leading primary science

Why should we care about science?

The short answer is because science is a core subject in the national curriculum (in England). But science is much more than just a compulsory subject: science inspires children, encouraging them to be inquisitive about the world, nurtures their innate curiosity and enables them to develop a range of skills that are useful across their learning. By the end of primary education children start to make up their minds about whether science is for them. We think science is for everyone, not just those who want to continue into science-based careers; having an understanding of science allows people to make informed decisions about new technologies, their health and other important matters. We should all champion primary science and make sure that every child has a positive experience of science throughout their primary school education.

Good leadership of science is essential at primary school. This leaflet provides support for you as a primary science leader (PSL), based on good practice in schools that value science.

Background

In 2013 the Wellcome Trust conducted an online survey to find out how PSLs are deployed in schools. The responses and follow-up case studies, written up in a report available on our website,[2] released a wealth of information and advice that can help support you as a science leader, whether you are new-in-post or at a school that is looking to improve its science teaching.

We know that taking on responsibility for leading science may be your first taste of leadership, and that like many primary teachers you may not have a strong science background. However, this need not be a barrier to leading exciting primary science – there is support to help you develop expertise in both teaching and leadership. This leaflet will help you get started by leading you to reflect on science in your school and begin planning its improvement.

Key questions

- What is your shared vision for primary science?
- How should you develop and use your science expertise?
- How do you evaluate the science curriculum?

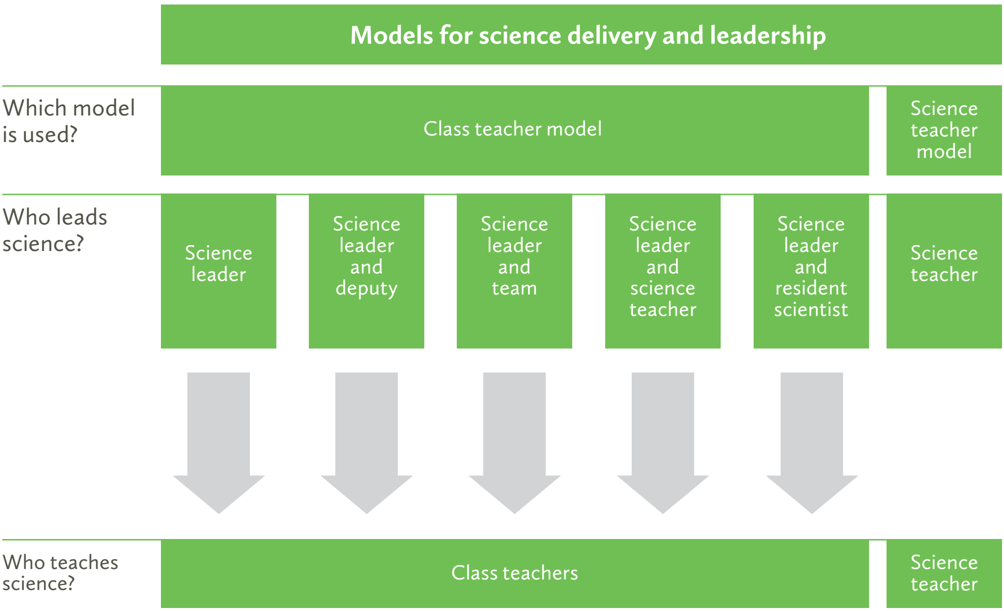
How is science led in primary schools?

Very few schools employ a specialist science teacher who leads and teaches all the science in the school.

In most schools science is taught by class teachers, one of whom takes on the role of science leader. But there are variations of this model, which reflect different schools' contexts and priorities for strategic improvement in science.

Schools that give science a high profile use rigorous self-evaluation to choose which leadership model is most appropriate for them. Our report explores the advantages of the different models in detail[3].

> "The model chosen (for science teaching and leadership) makes the best use of the skills of each member of staff."[4]



What expertise does a good science leader need?

Inspiring science teaching arises from science leaders that place scientific enquiry at the heart of their school's science curriculum and understand how children learn science. But many teachers have not studied science beyond the statutory requirement[5] and worry about their weak subject knowledge and low confidence in dealing with pupils' questions about tricky bits of science. It is essential that all schools have (or have access to) a PSL who has an appropriate level of science expertise, as described in the box opposite[6]. You may not have the expertise to start with, but you can build it by accessing high-quality science CPD and gaining recognition for your development.

> "With regards to CPD, it's the science leader's responsibility to stay up to date and to identify appropriate courses."[7]

Defining the expertise of a PSL

Subject knowledge
A PSL should have a deep understanding of the scientific concepts within the Key Stage 1 and 2 national curricula, supported by a working understanding of the scientific concepts within the Key Stage 3 national curriculum. A PSL should be confident in the use of scientific vocabulary and know how to research science topics and guide their pupils to do the same.

Pedagogical knowledge
A PSL should have knowledge of an appropriate range of teaching methods suitable for the content concerned. Their knowledge should cover enquiry-based pedagogies, practical activities, out-of-classroom learning, group work and problem solving, digital technologies, and formative assessment practices. It should also include an understanding of the key features that result in the successful implementation of these pedagogies and how to evaluate their impact on pupils.

Subject leadership
A PSL should have a whole-school vision for science and be able to lead its development by instigating appropriate initiatives, including providing CPD to colleagues, monitoring progress and contributing to the strategic development of learning in school.

What does a good science leader do?

A good science leader ensures that all pupils can develop their understanding of the big ideas of science, and learn the skills needed to work like a scientist, because their teachers are confident practitioners who deliver an enquiry-rich curriculum with access to appropriate resources.

They plan improvement that:

- builds their school's science curriculum
- raises standards for pupils
- leads colleagues to teach science better.

Most science leaders manage resources, support science curriculum development, monitor teaching quality and pupil achievement, and lead staff meetings to share ideas and skills. But less than a third are involved directly in strategic planning and development within their schools, despite this being essential to raising the profile of science and the achievement of pupils. Science leaders are able to develop a whole-school vision for science when school leadership teams value science as a core subject that builds skills across the curriculum and include it fully in strategic planning.

Questions on science leadership

- What is the whole-school vision for science?
- How do you monitor it?
- How does it link strategically with the school improvement plan?
- How is science expertise used in your school to teach and to lead science?
- What provision do you need to develop your expertise and keep your skills up to date?

How does good science leadership improve science teaching?

Building the science curriculum

Many new science leaders tell us that their first task is to organise their current resources. It's a good place to start – you need to know what you have – but there's more to it than that. Children need to develop independent learning skills and the ability to design their own investigations and take measurements with increasing accuracy. They should be able to select the resources and equipment they need to do this. Teachers also need to have confidence in using the resources themselves and know how to do so safely.

Science doesn't just take place in the classroom either. Children need to explore different environments – this is vital for all strands of science, not just biology. Access to a suitable range of environments is essential. Some schools make use of partnerships or schemes to help them develop outdoor learning environments or enrich their curriculum[8]. Free loans of equipment, such as microscopes, and visits from local scientists provide a rich experience for children too.

Questions for reflecting on resources and environments for teaching science

- How do science resources in your school compare with recommended benchmarks?[9]
- Do you have what is needed to teach the statutory curriculum and enable pupils to work scientifically?
- What message about science is given by the state of the resources?
- Are they age-appropriate?
- Are some resources not used because teachers aren't sure how to use them?
- Do resources and environments enrich and enhance learning?
- Do you prepare an annual budget for science that accounts for consumable items and the replacement and enrichment of resources?

Our published case studies[10] highlight the strategic ways that science leaders have developed their curricula beyond the statutory minimum, making science exciting and inspiring for pupils, teachers and parents[11]. These schools have a vision for science that is shared by the whole school community.

Questions for reflecting on the science curriculum

- How does your science curriculum ensure pupils develop conceptual understanding and science skills?
- Is the curriculum flexible enough to encourage children to ask lots of questions and investigate?
- Does it match skill development in maths and English?
- How is assessment incorporated into planning?
- Does it make science seem relevant to the children attending your school?
- What does your science curriculum say about your vision for science?

> "Children love the hands-on nature of the subject and the opportunities to really get involved in big, practical experiments using scientific equipment."[12]

Raising standards for pupils
Monitoring teaching, pupil achievement and progress in science is essential, but the outcomes of this monitoring should be used strategically to secure even better science.

- ☑ data analysis
- ☑ learning walks
- ☑ moderating assessment
- ☑ observing lessons
- ☑ planning
- ☑ pupil focus groups
- ☑ team meetings
- ☑ work scrutiny
- ☑ other ideas

Many teachers worry about assessment in science. If a teacher is not secure about science concepts, can their assessment be accurate? A child might use a key word that suggests understanding but unless probed further, mastery cannot be confirmed. When assessment is inaccurate children may develop misunderstanding or be put off science, thinking that it is too hard. Assessment needs to be planned carefully and must be integral to teaching; science leaders need dedicated management time to work with colleagues, both in school and in local networks, to develop robust practice.

Sometimes science leaders deliver specialist lessons in a trade-off with a teacher leading another subject area so that pupils have challenging science lessons. While this ensures better quality teaching for some lessons, it does not allow pupils to develop their learning across other subjects or enable teachers to develop their skills in subjects that they are less confident to teach; team teaching is preferable as it shares teachers' expertise and develops skills that will raise pupils' achievement. Where opportunities for team teaching are included in strategic planning, teachers are enabled to teach science well and pupils benefit.

Questions on pupils' experiences

- Does science teaching reflect your whole-school vision for science?
- How do pupils develop science skills through working scientifically?
- Are pupils enthusiastic about learning science? How does attainment in science compare with other core subjects for all pupils?
- What strategic actions would improve learning?

Leading colleagues to teach science better

Science leaders recognise that a whole-school vision for science encourages consistency throughout the school, through shared ownership and strategic planning. But they also say that anxiety over weak subject knowledge and low confidence in teaching in a scientific way are barriers to science being as good as it can be; access to high-quality science continuing professional development (CPD) is the factor most likely to help them improve science in their schools.

> "Ensuring that each class teacher has the best subject knowledge possible is the priority for the science leader."[13]

New science leaders want to access CPD that will equip them with good subject knowledge and pedagogical skills that they can share with their colleagues. They need time out of the classroom to coach other staff to teach science and mentor them to increase confidence. One school told us that after completing high-impact Science Learning Centre courses[14], their science leader would be timetabled for one school year to teach science alongside all other teachers, to raise science to an 'outstanding' level in the school. This school valued subject-specific CPD and expected that it would have a significant impact.

A range of CPD is available; you need to audit your needs against the expected impact to select the most appropriate provision.

Questions on leading others' in teaching science

- Which areas of subject knowledge do colleagues need most support with?
- How confident are teachers with assessment of science?
- What methods of support have the greatest impact on pupils' science? How do you know?
- How does support for colleagues link with all other aspects of your leadership role?

Science leaders frequently network with one another to do learning walks or to moderate assessments. Including colleagues from secondary schools helps everyone to understand how children progress in science and can prevent the overuse of some practical investigations. Online networks are great for sharing ideas and solving queries.

Looking for more?

Free resources

National STEM Centre (nationalstemcentre.org.uk)
Primary Science Teaching Trust (pstt.org.uk)
Wellcome Trust (wellcome.ac.uk)

Professional development

Science Learning Centres provide professional development courses that have bursaries to cover most of the costs (www.sciencelearningcentres.org.uk)

School support

Association for Science Education (www.ase.org.uk)
Primary Science Quality Mark (www.psqm.org.uk)

1. Wellcome Trust. The Deployment of Science and Maths Leaders in Primary Schools. London: Wellcome Trust; 2013, 3.

wellcome.ac.uk/stellent/groups/corporatesite/@msh_peda/documents/web_document/wtp056231.pdf

2. Wellcome Trust. The Deployment of Science and Maths Leaders in Primary Schools. London: Wellcome Trust; 2013.

wellcome.ac.uk/stellent/groups/corporatesite/@msh_peda/documents/web_document/wtp056231.pdf

3. Wellcome Trust. The Deployment of Science and Maths Leaders in Primary Schools. London: Wellcome Trust; 2013.

wellcome.ac.uk/stellent/groups/corporatesite/@msh_peda/documents/web_document/wtp056231.pdf

4. Wellcome Trust. The Deployment of Science and Maths Leaders in Primary Schools. London: Wellcome Trust; 2013, 29.

wellcome.ac.uk/stellent/groups/corporatesite/@msh_peda/documents/web_document/wtp056231.pdf

5. The minimum science qualification required for primary teaching in England is a GCSE in science, or its equivalent.

6. This definition has been endorsed by the Education Committee of the Royal Society. wellcome.ac.uk/Education-resources/Education-and-learning/Our-work/Teacher-training/WTS052326.htm

7. Wellcome Trust. The Deployment of Science and Maths Leaders in Primary Schools. London: Wellcome Trust; 2013, 14.

wellcome.ac.uk/stellent/groups/corporatesite/@msh_peda/documents/web_document/wtp056231.pdf

8. Join the Primary Resources community group at nationalstemcentre.org

9. SCORE (Science Community Representing Education) has produced a set of resourcing benchmarks for teachers and school practitioners to use when planning science budgets and equipping classrooms. score-education.org/publications/publications-resourcing-benchmarks

10. Wellcome Trust. The Deployment of Science and Maths Leaders in Primary Schools. London: Wellcome Trust; 2013.

wellcome.ac.uk/stellent/groups/corporatesite/@msh_peda/documents/web_document/wtp056231.pdf

11. nationalstemcentre.org/primaryscience

12. Wellcome Trust. The Deployment of Science and Maths Leaders in Primary Schools. London: Wellcome Trust; 2013, 26.

wellcome.ac.uk/stellent/groups/corporatesite/@msh_peda/documents/web_document/wtp056231.pdf

13. Ibid.

14. www.sciencelearningcentres.org.uk

Published in December 2015

Wellcome Trust
We are a global charitable foundation dedicated to achieving extraordinary improvements in human and animal health. We support the brightest minds in biomedical research and the medical humanities. Our breadth of support includes public engagement, education and the application of research to improve health. We are independent of both political and commercial interests.

Wellcome Trust
Gibbs Building
215 Euston Road
London NW1 2BE, UK
T +44 (0)20 7611 8888
F +44 (0)20 7611 8545
E contact@wellcome.ac.uk
www.wellcome.ac.uk

Subject Leader Timeline

2. Where is the school now (in terms of your vision)?

Write a commentary about each statement that features in your vision.

Base your commentary on evidence from book scrutiny, planning scrutiny, pupil interviews, learning walks, staff audit/conversations, data etc.

4. How will you achieve your vision? What steps will you take?

- Break the year down into half terms
- Write a simple list of what you want to achieve in each half term. Be realistic. Consider how much time you have and the other things your colleagues are being asked to do.
- Consider if you can you work with colleagues to combine what you are both trying to achieve
- Plan how and when you will monitor the impact of your actions
- Consider any training/resources you/your colleagues will need

1. Vision

I want (your subject) to:

What do you want your subject to look like/sound like/feel like?

3. Whole School Priorities

How will your subject contribute to achieving the whole school priorities?

- challenging for all
- outdoor learning
- independent learning
- problem solving/investigative opportunities

5. Share your vision

- Check out your vision/action plan with the curriculum leader
- Share and agree your vision/action plan with SLT
- Share your vision/action plan with your colleagues – sell it to them. What's in it for them?
- Walk the walk!
- Make your subject visible in your school

SELL! SELL! SELL!

Report summary

Maintaining curiosity

A survey into science education in schools

Physicians take an oath that commits them to 'first do no harm'. The best science teachers, seen as part of this survey, set out to 'first maintain curiosity' in their pupils. The most successful schools visited during this survey had adopted this as a key principle in teaching science and this not only fostered enthusiasm for the subject in their pupils but helped them to fulfil their potential.

We need better science education to secure a strong foundation for a successful and technological society. The new National Curriculum for 2014 sets out why we teach science in schools:

> 'A high-quality science education provides the foundations for understanding the world through the specific disciplines of biology, chemistry and physics. Science has changed our lives and is vital to the world's future prosperity, and all pupils should be taught essential aspects of the knowledge, methods, processes and uses of science. Through building up a body of key foundational knowledge and concepts, pupils should be encouraged to recognise the power of rational explanation and develop a sense of excitement and curiosity about natural phenomena. They should be encouraged to understand how science can be used to explain what is occurring, predict how things will behave, and analyse causes.' [1]

This report highlights the importance of teaching science for understanding. For pupils to achieve well in science, they must not only acquire the necessary knowledge, but also understand its value, enjoy the experience of working scientifically, and sustain their interest in learning it. Pupils in schools need to discover the concepts revealed through observing scientific phenomena and conducting experimental investigations for themselves. Then they are more likely to continue to study science and use that learning for work, for family, and to contribute as informed citizens.

[1] National Curriculum in England: science programmes of study, Department for Education, 2013; www.gov.uk/government/publications/national-curriculum-in-england-science-programmes-of-study.

The report also reflects and explores the concerns often voiced by employers, higher education, and the scientific community's professional bodies, that too many school leavers are not well-enough equipped scientifically with practical, investigative and analytical skills. These are vital if young people are to flourish in a technological world and to contribute to economic development. The government's review of GCSE and A-level qualifications provides a timely opportunity to ensure that the skills of scientific enquiry are assessed as an integral part of these qualifications.

The report is set out in three sections. Part A describes primary provision, Part B secondary provision, and Part C explains evidence-based factors that promote achievement in science. Inspectors visited 91 primary and 89 secondary schools, including 53 with sixth forms, and six special schools, between summer 2010 and spring 2013. The best teaching in these schools:

- was driven by determined subject leadership that put scientific enquiry at the heart of science teaching and coupled it with substantial expertise in how pupils learn science
- set out to sustain pupils' natural curiosity, so that they were eager to learn the subject content as well as develop the necessary investigative skills
- was informed by accurate and timely assessment of how well pupils were developing their understanding of science concepts, and their skills in analysis and interpretation so that teaching could respond to and extend pupils' learning.

The majority of the teachers observed were skilful in teaching interesting science lessons and inspectors judged the majority of the lessons (69%) they saw as good or outstanding. However, a minority of the secondary schools visited were preoccupied with test and examination results as ends in themselves at Key Stage 4, rather than aiming to establish pupils' understanding and application of scientific ideas through practical enquiry-based approaches to learning.

Where disadvantaged pupils study academic GCSEs, they achieve as well as other pupils when teachers hold the same high expectations for all. GCSEs provide the greatest range of routes for pupils to access further science study at 16. However, too few 16-year-old girls continue studying physics nationally. Not enough subject leaders analyse why pupils of both genders either continue or stop studying science subjects after the age of 16. Uninspiring teaching was one reason pupils gave to inspectors to explain why they did not wish to continue studying science. Another was not seeing the purpose of what they were studying, other than to collect examination grades.

There were common weaknesses in a significant minority of lessons in both the primary and secondary schools visited:

- activities did not match each pupil's prior learning, so that some pupils wasted time or did not complete work
- pupils became disengaged from learning and more able pupils in particular were not given work that was challenging enough
- teachers failed to provide pupils with feedback that really helped them to improve their work.

In nearly half of the primary schools visited senior leaders were not setting targets for science and were not tracking pupils' progress in the subject. This was because they no longer saw science as a priority, despite its place as a core subject in the National Curriculum.

A very low proportion of the subject leaders in the survey had received specific professional development in providing leadership for science. However, schools that had provided science-specific professional development were much more likely to be judged as outstanding in their overall effectiveness of science.

Key findings

- In the best schools visited, teachers ensured that pupils understood the 'big ideas' of science.[2] They made sure that pupils mastered the investigative and practical skills that underpin the development of scientific knowledge and could discover for themselves the relevance and usefulness of those ideas.
- Attainment in science up to 2012 has risen year by year at all key stages, and girls attained better than boys at all key stages. Despite this, too many girls do not continue to study physics or related subjects at 16.
- Leaders in the schools visited were not monitoring and evaluating the reasons why their pupils, both boys and girls, pursued routes other than science at 16.
- Science achievement in the schools visited was highest when individual pupils were involved in fully planning, carrying out and evaluating investigations that they had, in some part, suggested themselves.
- Although the quality of teaching was at least good in the majority of the schools visited, lessons in both primary and secondary schools often lacked sufficient differentiation to allow pupils, especially the more able, to build on their prior learning and make good progress.

[2] For a useful, school-level cataloguing of the 'big ideas', see: W Harlen (ed) *Principles and big ideas of science education*, Association for Science Education, 2010; www.ase.org.uk/bookshop/books-for-subject-leaders/.

- The quality of feedback to pupils on how they might improve their science understanding was a common area for improvement in the primary and secondary schools visited, regardless of the school's overall effectiveness in science.
- Teachers who coupled good literacy teaching with interesting and imaginative science contexts helped pupils make good progress in both subjects.
- A significant minority of leaders in the primary schools visited were failing to ensure full coverage of the science National Curriculum. They did not track pupils' progress in science effectively and were not setting challenging targets for improvement in science. For these leaders, science was no longer a priority.
- The effectiveness of science in both the primary and secondary schools visited was much more likely to be outstanding when teachers and subject leaders had received science-specific training. However, most of the primary teachers had not received such training, and most of the science leaders in both phases had not received leadership training that was specific to science.
- Timetables in a significant minority of the primary and secondary schools visited did not allow enough time for teaching science through regular, enquiry-based learning. This limited pupils' opportunities to develop the practical skills necessary for future work in science, technology or engineering. This included restricting science to irregular 'science days' in primary schools, and limiting the teaching time for the three separate science GCSEs to the same amount as for a double science award in secondary schools.
- In most of the schools visited, pupils from Key Stage 1 to Key Stage 4 had limited opportunities to work independently, particularly to develop their individual manipulative skills in practical work, because teachers only required them to work in pairs or small groups.

Main report published November 2013
www.ofsted.gov.uk/resources/130135

Piccadilly Gate
Store Street
Manchester
M2 7LA

T: 0300 123 1231
Textphone: 0161 618 8524
E: enquiries@ofsted.gov.uk
W: www.ofsted.gov.uk

No. 130135

Report summary

Successful science

An evaluation of science education in England 2007--2010

This report draws on the results of visits by inspectors to 94 primary, 94 secondary schools and two special schools between June 2007 and March 2010. These schools were selected broadly to represent the profile of schools in England, but excluded schools in Ofsted's categories of concern. It also draws on the outcomes of subject conferences organised by Ofsted. During the past year, 2009–10, inspectors reported on post-16 science education in 31 colleges and their reports have also formed part of the evidence.

There has been an improving trend in the provision of science education over the period of this report, especially in secondary schools, but there are areas that need further improvement, particularly in primary schools. The most important focus for schools is to ensure that pupils are engaged and challenged by their work in science, particularly in scientific investigation and how science works. Students need access to relevant courses that provide them with clear, high-quality pathways through their education, allowing them to attain the highest standards possible, both in the short term and when they progress to further and higher education. The best schools are already doing this.

Achievement in science was either good or outstanding in just over two thirds of the schools visited. While this overall proportion of 'good or outstanding' was similar for primary and secondary schools, there was a larger proportion of secondary schools where achievement was judged to be outstanding. Overall levels of attainment in primary schools, as measured nationally by teacher assessment data, were broadly similar to those observed during the previous inspection cycle; however, attainment at the higher levels was slightly reduced. Over the same period, success rates for separate science subjects at GCSE level have increased significantly: in 2010 around 12,000 more students than in the previous year were awarded grades A* and A at GCSE in each of the three separate sciences of biology, chemistry and physics.

The highest-performing schools, both primary and secondary, had clear priorities for raising standards and had several features in common. These included rigorous monitoring and evaluation of performance, aligned with challenging target-setting for individual pupils. The schools focused strongly on improving the quality of teaching and learning, with staff within science departments planning together and sharing good practice. These characteristics are explored later in the report.

In both primary and secondary schools, teaching in science was at least good in around three quarters of the schools visited. This proportion is higher than for schools' overall performance in teaching and learning. Science, being a core subject, is a priority area for schools compared with the foundation subjects.

While the quality of teaching in the primary and secondary schools visited was similar overall, there was a slightly higher proportion of outstanding teaching in the secondary phase. Teaching was good when teachers had a clear understanding of what knowledge, understanding and skills were to be developed; understood how development in scientific enquiry promotes effective learning; understood the relationship between concepts and the cognitive demand they make; and were clear about what pupils already knew, understood and could do. The impact of good teaching was seen when pupils understood clearly the standards they had achieved; knew what they needed to do to improve and were involved in peer and self-evaluation; took part in decision-making, discussion, research and scientific enquiry; and were engaged in science that had relevance to their lives. In none of the schools visited was science teaching overall inadequate.

Primary teachers' take-up of science-specific continuing professional development was low in the schools surveyed. While much of the professional development they received overall was relevant to science, it was often generic, for example being focused on improving teaching and learning or assessment generally. In just under two thirds of the primary schools where science-specific continuing professional development was evaluated, it was no better than satisfactory. In the secondary schools where this provision was evaluated, the picture was better: nearly six out of 10 secondary schools had professional development for science that was good or outstanding.

The curriculum in the best schools, both primary and secondary, engaged pupils' interest and enthusiasm and promoted good progress in knowledge, understanding and skills in science. Again, the curriculum was more often outstanding in the secondary schools visited than in the primary schools. This was achieved best through collaboration among teachers on planning for science and the effective sharing of good practice. In secondary schools, the introduction of a wider range of courses since September 2006 has been beneficial. In the last year covered by this report (2009–10), entries at GCSE for each of the three separate sciences increased by approximately 30,000. The entitlement of students achieving Level 6 in science at the end of Key Stage 3 to study the three separate sciences at GCSE has promoted recruitment to post-16 A-level science courses. Schools that entered students inappropriately for vocational courses such as BTEC limited their choice of pathways through post-16 education.

Post-16 science education has been inspected in both schools and colleges. Science provision was good or outstanding in 15 of the 31 colleges where science and mathematics were a focus for inspection and was inadequate in five. The proportion that was inadequate is a matter of concern, as is the proportion of good and outstanding provision which was lower than that earlier in secondary education. The strengths and weaknesses seen in science in these colleges were also often evident in school sixth forms. Since the last report, lessons where notes are simply dictated to students were seen less frequently. Good practices seen in Key Stage 3 and 4 have been transferred to sixth form teaching. These included more frequent assessment being used to inform planning and teaching, more rigorous target-setting and regular monitoring of progress.

In the schools visited in 2007–10, assessment was better overall than it was for the schools featured in the last three-yearly report. It was good or outstanding in just over three quarters of the secondary schools and slightly under two thirds of the primary schools visited. In the secondary phase, there was a greater focus on the performance of individuals, with effective monitoring and tracking systems that allowed their progress to be identified. In a welcome development, a smaller proportion of schools in this survey compared only the performance of classes and cohorts rather than individuals. The increased focus on individuals' performance and that of different groups provided a good basis for intervention with them and promoted progress more effectively.

Overall, teachers used information and communication technology (ICT) effectively in their teaching. In both primary and secondary schools, ICT was used to present pupils with experiences that could not be provided first-hand. Teachers used ICT to build ideas pictorially and diagrammatically, using data from a range of sources, including the internet. Laptops were used to capture, manipulate and display data to enhance learning and promote the development of scientific skills. The use of ICT in the outstanding schools involved pupils in interactive presentations and independent research.

The removal of the requirement for statutory tests in science at the end of Key Stages 2 and 3 has helped schools to avoid an undue concentration on revision in Years 6 and 9 and freed teachers to be innovative in planning their teaching and in enriching the science curriculum. The increased range of courses for students at Key Stage 4, including the three separate sciences and vocational science, has also provided breadth in the science curriculum to meet the needs of a wider range of students, although not all the students surveyed have benefited from this yet.

Key findings

- In the schools which showed clear improvement in science subjects, key factors in promoting students' engagement, learning and progress were more practical science lessons and the development of the skills of scientific enquiry.
- Although pupils' progress in science was good or outstanding in 70% of the primary schools visited, a lack of specialist expertise limited the challenge for some more able pupils. Progress was outstanding in one in 10 of the primary

schools visited, compared to one in six of the secondary schools. This is reflected in the slight decline since 2007 in the performance of higher-attaining pupils in teacher assessments in science at the end of Key Stages 1 and 2.

- Progress of students in science was good or outstanding in around two thirds of the secondary schools visited. Some improvements in achievement were observed in lessons during the course of visits, often associated with courses that were better matched to students' needs. National standards have increased slightly in Key Stage 3 over the period of the survey. The proportion of A* to C grades awarded at Key Stage 4 has remained approximately the same but the proportion of students achieving grades A* and A has increased.
- The removal of the requirement to carry out statutory tests in science at the end of Key Stages 2 and 3 has encouraged teachers to plan engaging schemes of work in science that avoid an undue focus on revision in Years 6 and 9. It has provided scope to vary the length of key stages appropriately and provide greater enrichment.
- Standards at A level in science subjects as seen in national data have shown a steady rise over the period of this report. In the schools visited, this improvement was associated with teaching which, increasingly, engaged students more actively in their learning. This development was less evident in the colleges visited.
- Science was good or outstanding in 15 of the 31 colleges where it was inspected; it was satisfactory in 11 and inadequate in five. No other post-16 curriculum area in colleges was judged to have such a high proportion of unsatisfactory provision.
- The introduction of the new science GCSEs in September 2006 resulted in a greater number of courses being provided to meet the needs of all students. In the schools surveyed, these have been successful, in the main, in allowing more higher-attaining pupils to study three separate sciences. This has contributed to the increased recruitment of students to A-level courses in the sciences.
- The availability of vocational courses had a positive impact on the motivation and achievement of students for whom academic programmes were less suitable. However, some schools had used these courses too extensively, entering students for vocational rather than academic qualifications and, as a result, restricting students' opportunities to study A-level sciences.
- More rigorous monitoring and tracking have provided a better basis for teachers to plan with individual students in mind. This development aligns with greater challenge for many students through more effective target-setting.
- Despite some positive initiatives, such as the Primary Science Quality Mark and the Association for Science Education's publication for primary schools 'Be safe', there has been insufficient professional development in science to tackle the lack of confidence among primary teachers, particularly in their understanding of scientific enquiry skills and the physical sciences.

- Lack of specialist training, and their normally short tenure in the role, limited the effectiveness of the science coordinator in developing teaching and raising achievement in some of the primary schools visited.
- Secondary teachers in particular benefited from attending courses at the network of Science Learning Centres, but too few of the schools visited had taken advantage of this high-quality provision.

Main report published 7 January 2011
www.ofsted.gov.uk/publications/100034

Royal Exchange Buildings
St Ann's Square
Manchester
M2 7LA

T: 0300 123 1231
Textphone: 0161 618 8524
E: enquiries@ofsted.gov.uk
W: www.ofsted.gov.uk

No. 100034

Ten principles of science education

1. Throughout the years of compulsory schooling, schools should, through their science education programmes, aim systematically to develop and sustain learners' curiosity about the world, enjoyment of scientific activity and understanding of how natural phenomena can be explained.

2. The main purpose of science education should be to enable every individual to take an informed part in decisions, and to take appropriate actions, that affect their own wellbeing and the wellbeing of society and the environment.

3. Science education has multiple goals. It should aim to develop:
   - understanding of a set of 'big ideas' in science which include ideas of science and ideas about science and its role in society
   - scientific capabilities concerned with gathering and using evidence
   - scientific attitudes.

4. There should be a clear progression towards the goals of science education, indicating the ideas that need to be achieved at various points, based on careful analysis of concepts and on current research and understanding of how learning takes place.

5. Progression towards big ideas should result from study of topics of interest to students and relevance in their lives.

6. Learning experiences should reflect a view of scientific knowledge and scientific inquiry that is explicit and in line with current scientific and educational thinking.

7. All science curriculum activities should deepen understanding of scientific ideas as well as having other possible aims, such as fostering attitudes and capabilities.

8. Programmes of learning for students, and the initial training and professional development of teachers, should be consistent with the teaching and learning methods required to achieve the goals set out in Principle 3.

9. Assessment has a key role in science education. The formative assessment of students' learning and the summative assessment of their progress must apply to all goals.

10. In working towards these goals, schools' science programmes should promote cooperation among teachers and engagement of the community including the involvement of scientists.

https://www.ase.org.uk/bigideas

14 Big Ideas in Science

1 All material in the Universe is made of very small particles.

2 Objects can affect other objects at a distance.

3 Changing the movement of an object requires a net force to be acting on it.

4 The total amount of energy in the Universe is always the same but energy can be transformed when things change or are made to happen.

5 The composition of the Earth and its atmosphere and the processes occurring within them shape the Earth’s surface and its climate.

6 The solar system is a very small part of one of millions of galaxies in the Universe.

7 Organisms are organised on a cellular basis.

8 Organisms require a supply of energy and materials for which they are often dependent on or in competition with other organisms.

9 Genetic information is passed down from one generation of organisms to another.

10 The diversity of organisms, living and extinct, is the result of evolution.

Ideas *about* science

11 Science assumes that for every effect there is one or more causes.

12 Scientific explanations, theories and models are those that best fit the facts known at a particular time.

13 The knowledge produced by science is used in some technologies to create products to serve human ends.

14 Applications of science often have ethical, social, economic and political implications.

https://www.ase.org.uk/bigideas

Science Staff Questionnaire

Please answer the following on your science/educational background	YES	NO
Is your degree Science, Technology, Engineering or Maths based?		

Please rate the following statements (1 the least and 10 the most)	1	2	3	4	5	6	7	8	9	10
How do you rate your confidence in teaching practical science?										
Do you feel you have enough support in lessons to teach practical science in an orderly and constructive manner?										
Do you think your school has adequate resources to successfully teach science in a practical way?										

Please answer the following questions on teaching practical science in school	Agree Strongly	Agree	Neutral	Disagree	Disagree Strongly
I prefer the children to do practical activities rather than me demonstrating to them					
I am happier when children are carrying out investigations rather than working from instruction sheets and cards					
I am confident in identifying all the relevant variables in an investigation					

NAME YEAR GROUP

Please answer the following questions on teaching practical science in school	Agree Strongly	Agree	Neutral	Disagree	Disagree Strongly
I frequently encourage children to investigate their own ideas					
I am confident in enabling children to manager their own investigations and select their own equipment					

Please answer the following questions on assessment of science	Agree Strongly	Agree	Neutral	Disagree	Disagree Strongly
I am confident in judging how well children are achieving in their investigations and how to help them improve					
I am confident in accurately judging children's National Curriculum' levels of knowledge and understanding (*if applicable*)					

Please answer the following questions on science in the classroom	Agree Strongly	Agree	Neutral	Disagree	Disagree Strongly
II am confident when teaching sciences within the clear structure of our teaching scheme					
I am happy to answer the questions about science that children ask					
I like to set science in everyday contexts and to enrich it with examples outside the National Curriculum					
I understand the science I teach well enough to identify children's misconceptions					
I understand the science I teach well enough to confidently set challenging tasks and questions for more able children					

NAME **YEAR GROUP**

Please answer the following questions on science in the classroom	Agree Strongly	Agree	Neutral	Disagree	Disagree Strongly
I find it straightforward to explain things simply but accurately and adapt my teaching for the youngest and least able children					
I enjoy teaching science					
Children in my class enjoy science a lot					

NAME **YEAR GROUP**

Pupil voice in science

How often do you have science?
What is science?
What do you like about science?
How could your teacher/school improve science?
What's your favourite part of science?
Do you work in groups or on your own in science? Which would you prefer?
What do you find hardest in science?
Is there anything about science you don't like?
Do you have any other comments about science in your school?

Pupil Voice

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Science is fun					
Science lessons are interesting					
I look forward to science lessons					
My teacher explains scientific ideas clearly					
Science lessons make me think					
We often have discussions in science					
I enjoy solving problems in science					
I enjoy doing experiments in science					
The science we learn is relevant to everyday life					
Additional comments					

Useful Websites for Science

There are many useful websites for science. Here's a few key ones to get you started.

https://explorify.wellcome.ac.uk/ A free resource of engaging, creative science activities has been designed to spark curiosity, discussion and debate. From video to hands-on activities, it's easy to get Explorifying!

https://www.ase.org.uk/ The Association for Science Education (ASE) is the largest subject association in the UK. We are an active membership body that has been supporting all those involved in science education from pre-school to higher education for over 100 years; members include teachers, technicians, tutors and advisers.

https://pstt.org.uk/ PSTT is a charitable trust helping to improve the teaching and learning of primary science across the UK.

https://www.stem.org.uk/ Resources, courses and information to support your STEM.

https://www.rigb.org/families/experimental A series of short films making it fun, easy and cheap to do science experiments at home with your children.

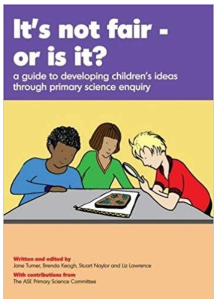
https://www.woodlandtrust.org.uk/naturedetectives/ A huge range of nature-based activities. Great for spotter sheets, ID cards etc.

My favourite books for using to teach primary science

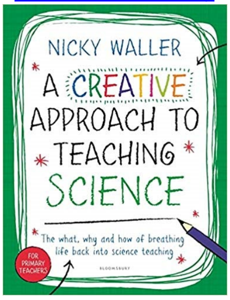
I'm often asked for recommendations for books to help teachers with science. Here are a few of my favourites that are great for ideas, subject knowledge or to have in the classroom for children to read.

Made you look, made you think, made you talk is full of ideas for science lessons in Key Stage 1. All the activities can be done with cheap household items and minimal preparation time.
Click here to buy

Look, think, talk is full of ideas for science lessons in Key Stage 2. All the activities can be done with cheap household items and minimal preparation time.
Click here to buy

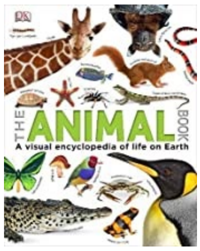


It's not fair – or is it? This book describes different types of science enquiry, how they help with developing understanding and how children's scientific enquiry skills develop. It will help you to broaden the range of science enquiries that your children experience.
Click here to buy

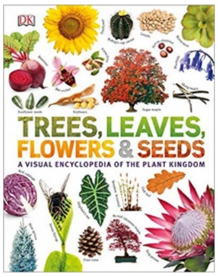


A Creative Approach to Teaching Science is filled with exciting and innovative ways to teach and meet the objectives for primary physics, chemistry and biology from Years 1-6.
Click here to buy

Be Safe! The essential publication for getting advice on the healthy & safety aspects of practical science and technology in primary schools. A must-have for every science leader.
Click here to buy

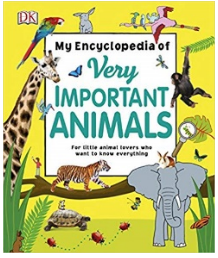


The Animal Book DK This children's reference book is the ultimate guide on animals for young children and budding naturalists. The 'Tree of Life' at the start of the book will show you how species are connected, as well as guiding you through everything from microscopic life to fish, birds, reptiles and mammals.
Click here to buy



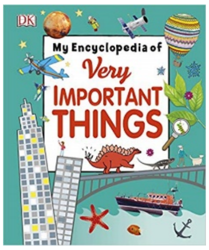
Trees, Leaves, Flowers & Seeds DK Packed with more than 1,000 incredible images and full of fascinating facts, this beautiful children's book takes you on an exciting expedition through the wonders of the plant kingdom.

Click here to buy



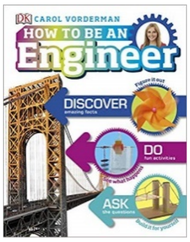
My Encyclopedia of very important animals DK For little animal lovers who want to know everything. From birds and frogs to sharks and dogs, this book is perfect for KS1.

Click here to buy



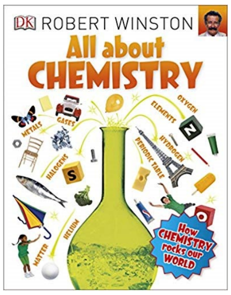
My Encyclopedia of Very Important Things DK Full of fun facts, colourful illustrations, and games that will feed a child's imagination and quench their thirst for knowledge, whilst supporting the National Curriculum. This is the perfect book for children of 4 – 7 yrs.

Click here to buy



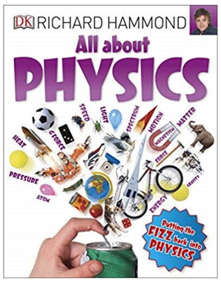
How to be an engineer DK As well as simple engineering projects for children to try, DK's How to be an Engineer will teach children how to think like an engineer, including materials, building, machines, getting around, and energy.

Click here to buy



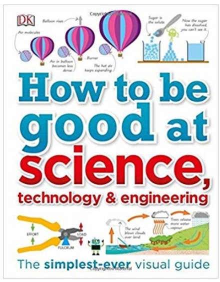
In **All About Chemistry,** Robert Winston guides children of all ages through the explosive world of atoms, elements and the periodic table. These are great for pupils, but also for teacher subject knowledge.

Click here to buy

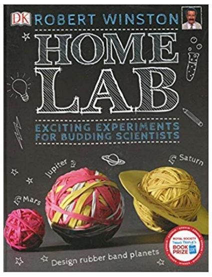


Physics doesn't just happen in a lab - it happens in the kitchen, in your bath, in a car! **All About Physics** shows you how science affects everything, from roller-coasters to fighter pilots.

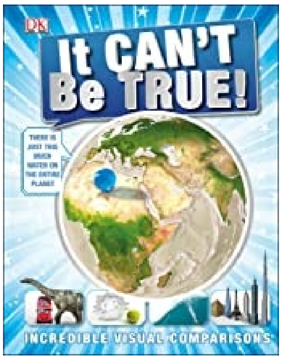
Click here to buy



How to be Good at Science, Technology, and Engineering is the perfect book to inspire and educate inquisitive young minds and prepare them for the future. This book is a lovely visual guide for teachers, parents and their children, with all core curriculum areas of science included. Ideal for KS2 classes.
Click here to buy

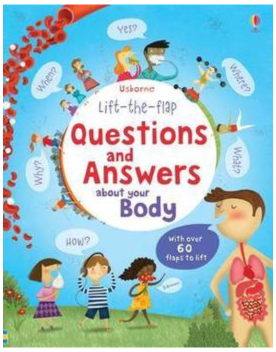


Winner of the Royal Society's Young People's Book Prize 2017, this jam-packed collection of fun and simple science experiments for kids is perfect for the classroom or home.
Click here to buy



It Can't be True! Not strictly a science book, but I love this visual, fact-filled book. A great way to engage children that love facts and to put reading into science lessons or vice-versa. Did you know that the Moon is the same size as Australia? Or that a blue whale's heart is as big as a car? And the colossal squid has eyes the size of beach balls? Prepare to be amazed by the fact-packed

Click here to buy



This Lift-the-Flap book contains the answers to the many questions that curious children have about their bodies, including 'How do I smell?' 'What makes me burp?' 'Why do I need to wash my hands?' 'Why is blood red?' and many more. There are many more science related books in this series. Ideal for KS1/Lower KS2.
Click here to buy

There are many books out there for primary science, and these are just a few of my favourites. Basically, in my estimation you can't go wrong with a DK, an Usborne or a National Geographic!

Happy reading!

The CSP Approach to Primary Science

CSP Science Curriculum

A collaboration between

The Catholic Schools Partnership
CSP
A Teaching School Alliance of Bradford & Keighley

Teaching from the Heart
'Putting the humanity back into education'

Year 1 - Humans

- identify, name, draw and label the basic parts of the human body and say which part of the body is associated with each sense.

We want our children to have a lifetime of health and wellness. In year one, we want our children to :

· have a greater awareness of their bodies—how they work, move, grow and change

· make choices that will help to keep their body healthy

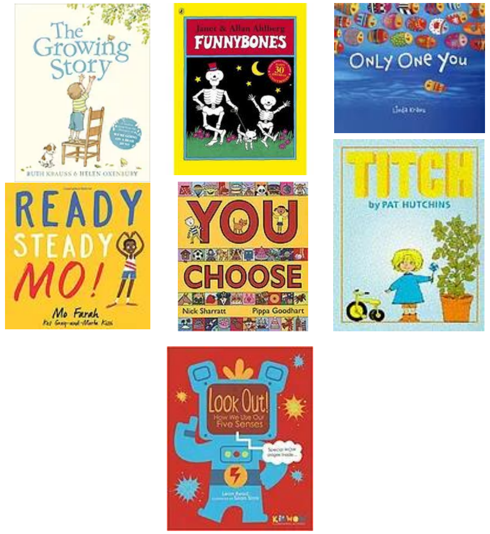
Regular Activities:

PE / playtime — reinforce body parts. How do we feel before, during and after exercise? How do we keep safe and what equipment do we need to do this? The daily mile.

Snack time — reinforce healthy eating; hygiene; names of fruit/veg; part of the plant eaten; using your senses; where does it grow and what plant does it come from?

Weather watch (Geography) — wearing appropriate clothing and talking about what to wear. Talking about the weather daily and looking at BBC weather for different places around the UK – London, Edinburgh, Cardiff, Belfast and Bradford.

Books to read:



By the end of year one children will be able to:

Talk about and describe their body.

Make comparisons between themselves and others.

Talk about their senses and how they use them everyday.

Talk about how they've changed during year one (history link). Measure themselves over the year and compare to other animals/buildings/vehicles (Maths).

Look after their own health e.g. brushing their teeth (the singing dentist), washing hands, drinking water, choosing appropriate clothing etc.

Vocabulary

Body parts — fingers, skin, eyes, nose, ear, tongue, skeleton, spine, skull.

Sense, touch, see, smell, taste, hear

Comparative vocabulary – bigger, smaller taller, shorter, longer, narrower, wider

Possible Curriculum Links

Art – Alberto Giocometti – sculptures. Self Portraits – Picasso, Hockney, Warhol.

Computing – Use IT to create pictures of people, record themselves and their changes over the year (termly).

Provision:

Role play areas e.g. doctors, hospital, kitchen, gym.

Experiences:

Cartwright Hall, Yoga instructor, Visit Medical Centre, Cbeebies Dr Ranj Get Well Soon, Visit Eureka

Year 1 – Humans Investigations

Observing over time	Identifying and classifying	Pattern seeking	Research	Comparative and fair testing
• How have we changed as we have got older? • How will/have we changed over Year 1?	• Can we identify everyone in our class by our fingerprints? • What other ways can we use to identify children in the class?	• Big grabs – Do the children with biggest hands grab the most…? • Are our hands and feet all the same size? • Which hand/foot does our class use the most? • Do the people with the longest legs jump further? • Do taller people have longer arms? (Mr Mackintosh's Raincoat Factory problem)	• What happens when we go to the dentist/opticians? • How much sleep do we need? • How do athletes train? Link to Mo Farrah book.	

Opportunities for Working Scientifically

- Observe, describe and compare ourselves.
- Sort ourselves.
- Ask questions about ourselves/humans.
- Measure ourselves and our teachers (standard and non-standard units).
- Record data on tables e.g. What is the most popular birth month in our class? What is our favourite fruit? Where is our favourite place to visit? Link to pattern seeking investigations.

Working Scientifically words we need to know

- Observe – to look closely or watch carefully
- Describe – say what something is like
- Compare – talk about how things are different or the same
- Sort – arrange into different groups
- Measure – find out the size or amount of something
- Record – write down information
- Data - information
- Patterns – the way something usually happens

Year 1 – Animals

- Identify common animals, including fish, amphibians, reptiles, birds and mammals.
- Know which common animals are carnivores, which are herbivores and which are omnivores.
- Describe and compare the basic parts of common animals.

We want our children to develop a love of nature and a sense of caring for our planet. We want them to be inspired and awed by the natural world. In year one, we want our children to :

- Know that the world is full of varied and interesting species of animals.
- To have a love of, an interest in and a care for animals.

Regular Activities:

Tell me time – Put up a picture of an animal and ask the children to tell you about it.

What am I? – Give children clues (page from animal book) about an animal and children use the clues to guess which animal you are.

The art of noticing – Watch film clips and do “the art of noticing.”

Odd one out - explorify.wellcome.ac.uk

Same, same but different – compare animals – graphic organiser.

Show me – Give children measurements of animals and ask them to show you how big that is.

Find me – Find me something that is the same size, height or weight as…

Books to read:

By the end of year one children will be able to:

Talk about animals that they are interested in.

Talk about and describe different animals.

Talk about what animals eat.

Talk about where animals live.

Compare animals.

Talk about how they can look after animals/ our world.

Vocabulary

Head, body, eyes, ears, mouth, teeth, leg, tail, wing, claw, fin, scales, feathers, fur, beak, talons, skin, hair, coat, paws, hooves, carnivore, herbivore, omnivore, mammal, reptile, amphibian, bird, fish, invertebrate, vertebrate, insect, backbone, spine, skeleton
Comparative vocabulary – bigger, smaller taller, shorter, longer, narrower, wider, heavier, lighter, quickest, fastest, slowest

Possible Curriculum Links

Art – sketches of animals, collage of animals (links to materials), printing, animals prints.

Geography – which continents do animals live in? Where are the worlds seas/oceans? Which places do animals live in? Where animals travel to?

DT – Bird feeders.

Provision:

Role Play: Vets, Zoo

Experiences:

Vet visitor, Tropical World, Visit from bearded dragon, RSPCA, Dogs Trust, Askham Bryan, The Deep, Watch Octonauts, David Attenborough clips, Deadly 60

Year 1 – Animals Investigations

Observing over time	Identifying and classifying	Pattern seeking	Research	Comparative and fair testing
• If we watch an animal for a few minutes, where does it go and how far does it move? • Spring watch – How have our animals changed?	• How can we sort our animals? • We think that there are animals all around us: What lives in our trees? Does anything live in the grass? What lives in the hedge? What lives in soil? • What birds visit our school grounds? • What animals live in the sea?	• Birds are coming to our bird table. Do different birds come at different times of day? Do they prefer different types of food? (Link RSPB Big Garden Bird Watch) • Do birds with the same beaks eat the same type of food?	• How can we attract more birds in to our school grounds? • Which animals is the…? • Why are some animals endangered (in trouble)?	• How does changing the colour of a feeder affect the number of birds visiting our bird table?

Opportunities for Working Scientifically

- Observe, describe and compare animals (consider application of English skills).
- Sort animals.
- Ask questions about animals.
- Measure animals (standard and non-standard units).
- Record data on tables e.g. What is our favourite animal? Animal measurements (wing span of birds).

Working Scientifically words we need to know

- Observe – to look closely or watch carefully
- Describe – say what something is like
- Compare – talk about how things are different or the same
- Sort – arrange into different groups
- Measure – find out the size or amount of something
- Record – write down information
- Data - information

Year 1 – Plants

- Identify plants that are commonly found in gardens and in the wild.
- Identify common deciduous and evergreen trees.
- Name the different parts of common plants and trees.

We want our children to develop a love of nature and a sense of caring for our planet. We want them to be inspired and awed by the natural world. In year one, we want our children to :

- Know that the world is full of varied and interesting plants.
- To have a love of, an interest in and a care for plants by **growing things throughout the year**

Regular Activities:

Grow plants all year – indoor plants, outdoor plants, herbs, seeds, lettuce.

Tell me time – Put up a picture of a plant and ask the children to tell you about it.

What am I? – Give children clues (page from plant/animal book) about a plant and children use the clues to guess which plant you are.

The art of noticing – Go on a seasonal stroll and do “the art of noticing.”

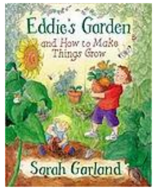
Odd one out - explorify.wellcome.ac.uk

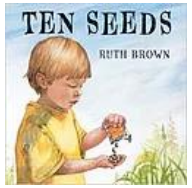
Show me – Give children measurements of plants and ask them to show you how big that is.

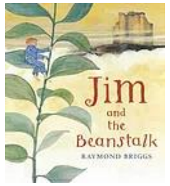
Find me – Find me something that is the same size, height or weight as…

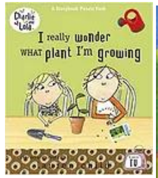
Snack time — reinforce healthy eating; hygiene; names of fruit/veg; part of the plant eaten; using your senses; where does it grow and what plant does it come from?

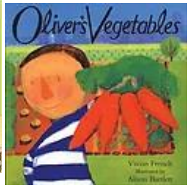
Books to read:

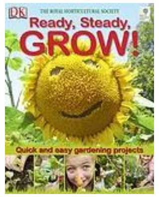


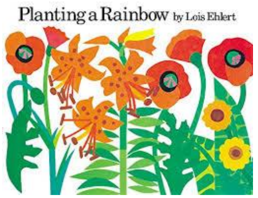












By the end of year one children will be able to:

Talk about and notice plants throughout the year.

Talk about and describe different plants.

Talk about what plants we eat.

Talk about how to grow plants.

Compare plants.

Talk about how they can look after plants/ our world.

Vocabulary

Leaf, flower, blossom, petal, fruit, berry, root, seed, trunk, branch, stem, bark, stalk, bud.
Names of trees in the local area.
Names of garden and wild flowering plants in the local area.

Possible Curriculum Links

Art – sketches of plants, rubbings, printing with leaves, collage.

Geography – where does our food come from? Where are our parks or green spaces in Bradford, UK?

DT – Sewing a flower. Cooking with grown ingredients

Provision:

Role Play: Garden Centre, Florist, Allotment, Fruit and veg stall

Experiences:

Seasonal walks in local parks/gardens, visit to local allotments, visit to a garden centre, visit from gardener/parks department, talk to a chef, talk to a

Year 1 – Plants Investigations

Observing over time	Identifying and classifying	Pattern seeking	Research	Comparative and fair testing
• Spring watch – How have our plants changed? • Autumn watch – How have our plants changed? • How do different trees change in the Spring, Summer, Autumn and Winter? • How do plants change as they grow? (plant diary) • Observe a bunch of daffodils and look at how they change over time. • Observe the plants that we are growing over time.	• How can we sort our plants? • What plants can we eat? • We took lots of pictures of plants on our walk how can we identify them? • We have collected lots of fallen leaves how can we sort them? • All the seeds have fallen out their packets how can we sort them? • We want to make fruit drinks out of citrus fruits how many different types are there:?	• We notice that our apples have 5 seeds do all apples have the same number of seeds? • Do the biggest fruits have the most seeds? • Do different trees change at different times? • Do taller trees lose their leaves before other trees? • Do all flowers have the same number of petals? (can stretch to odd and even)	• Which plant is the…? • Do any plants grow without soil? • How do plants survive in very wet or dry places? • How do our plants get their food? • Where does food come from? • How do we get chocolate? • How much bread does a field of wheat make? • Which plants live in the pond/ lake/sea?	• Do we need to make sure we plant the seeds the right way up? • How does changing the way we grow our plants make a difference to the way that they grow?

Opportunities for Working Scientifically

- Observe, describe and compare plants (consider application of English skills).
- Sort plants, leaves, flowers, seeds etc...
- Ask questions about plants.
- Measure plants (standard and non-standard units).
- Record data on tables e.g. What is our favourite plant, flower, herb, fruit, vegetable? Plant measurements.

Working Scientifically words we need to know

- Observe – to look closely or watch carefully
- Describe – say what something is like
- Compare – talk about how things are different or the same
- Sort – arrange into different groups
- Measure – find out the size or amount of something
- Record – write down information
- Data - information
- Table – a set of facts or figures arranged in row or columns

Year 1 – Everyday Materials

- Tell the difference between an object and the material it is made from.
- Identify everyday materials, including wood, plastic, glass, metal, water and rock.
- Describe the simple properties of different everyday materials.
- Use the properties of everyday materials to compare and group them together.

We want our children to appreciate the gifts that the Earth gives us, how and why they are used. We want our children to care for the Earth and be considerate consumers. In year one, we want our children to :

- Find out what things are made from
- Talk about how things are made
- Begin to recycle and put their litter in bins

Regular Activities:

Tell me time – Give the children an object and ask the children to tell you about it (encourage them to use all of their senses).

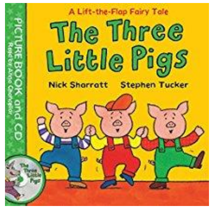
20 questions – Give children a selection of objects.

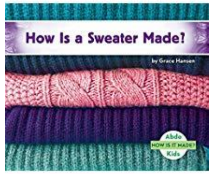
The art of noticing – Go on a texture walk and do "the art of noticing."

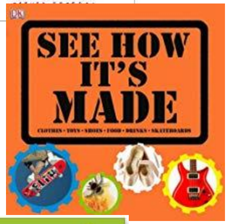
Odd one out - explorify.wellcome.ac.uk

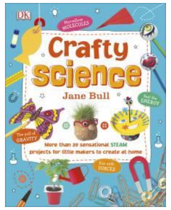
Tidy up time/Recycling time/Litter picking/Green leaders

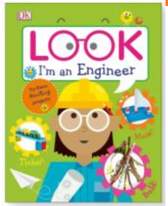
Books to read:











By the end of year one children will be able to:

Talk about and notice objects throughout the year.

Talk about and describe different objects/materials.

Talk about the objects that we use.

Talk about how to make objects.

Compare objects.

Talk about how we look after our objects or belongings.

Vocabulary

Object, material, wood, plastic, glass, metal, water, rock, brick, paper, fabric, elastic, foil, card/cardboard, rubber, wool, clay, hard, soft, stretchy, stiff, bendy, floppy, waterproof, absorbent, breaks/tears, rough, smooth, shiny, dull, see through, not see through

Possible Curriculum Links

Art –collage of animals (links to materials), collage with plants, sculpture using clay.

DT – Sewing a flower, making a bird feeder, building structures out of different materials.

History – What are castles/ armour/ boats/ diving suits/ swim suits made of?

Provision:

Role Play: Castle, Kitchen, Construction area (with everyday objects), Junk Modelling, Den Building

Experiences:

Local Walks, Watch Cbeebies - Do you know? Royal Armouries, Skipton Castle, The Deep, talk to carpenters, builders, dressmakers, knitters, artists,

Year 1 – Everyday Materials Investigations

Observing over time	Identifying and classifying	Pattern seeking	Research	Comparative and fair testing
• How do things change over time if we bury them in the ground?	• How can we sort our objects? • Which clothes will keep us: cool, warm, dry on our trip? • I have a parcel to send in the post how can we sort the packaging to find out which will keep my parcel safe and dry? • Which objects are magnetic/non-magnetic? • Which objects float/sink?		• How is … made? (CBeebies Do you know?)	• How can you make a paper fish go further? • There's a hole in my bucket what is the best material for mending it? • What's the best material to wrap Humpty Dumpty in to stop him from breaking? • Which is the best materials to mend my umbrella? • Which are the stretchiest liquorice laces?

Opportunities for Working Scientifically

- Observe, describe and compare objects.
- Sort objects
- Ask questions about objects
- Record data on tables e.g. How much litter did we find in the playground? How many objects are made of out different materials?

Working Scientifically words we need to know

- Observe – to look closely or watch carefully
- Describe – say what something is like
- Compare – talk about how things are different or the same
- Sort – arrange into different groups
- Record – write down information
- Data – information
- Table – a set of facts or figures arranged in row or columns

Year 1 – Seasonal Change

We want our children to be aware of the world around them, how it changes and how this affects living things and the environment.   In year one, we want our children to :

- Talk about the seasons and how they affect the world around them
- Talk about the weather

- observe changes across the four seasons
- observe and describe weather associated with the seasons and how day length varies.

Regular Activities:

Monthly seasonal stroll around schoolgrounds/local park to notice the changes in plants, animals, weather, clothing we are wearing etc.

As part of your walk take photos, sketches etc. Gather objects from the park etc. Write ‘Art of Noticing’ poems; simple sentences etc.

Daily weather watch

Use BBC weather app to monitor the weather in the 4 capitals of the UK and Bradford. Talk about similarities and differences and why they might happen (link to N,S,E,W).

Encourage children to take turns to ‘give the weather forecast’.

Playtimes

Encourage children to look at the weather and make decisions about what to wear. Talk about the weather if you are on duty!

Books to read:

By the end of year one children will be able to:

Name the seasons and the time of year associated with them.

Talk about and notice the seasons throughout the year.

Talk about and describe the seasons.

Talk about what we do to adapt to different seasons e.g. clothes, activities, physical environment, food

Talk about the plants and animals of different seasons and what they do.

Compare seasons.

Vocabulary

Weather (sunny, rainy, windy, snowy etc.), seasons (Winter, Summer, Spring, Autumn), sun, sunrise, sunset, day length, temperature, longer, shorter, darker, lighter, colder, warmer

Possible Curriculum Links

Geography – look at weather around UK and the world

Maths – record temperature each day; measure rainfall; record number of daylight hours;

Art – seasonal drawings, paintings, collages, photos.

ICT – Greenscreen weather forecasts

Provision:

Role Play: Weather station, Beach, Travel Agent, Winter landscape, Airport

Experiences:

Local Walks, watching the weather forecast,

Year 1 – Seasonal Change Investigations

Observing over time	Identifying and classifying	Pattern seeking	Research	Comparative and fair testing
• How does the temperature change over the day, month, year? • How does the weather affect what we eat and wear? • **Daily weather observations.**	• Which objects/clothes would I use for the seasons? • Which activities would I do in which season? • It's getting dark. Which clothes are good to wear outside so that I can be seen?	• It's windy and rainy today. Is it always windy when it's raining? • When is the wettest and windiest season? • The litter collects in one corner of the playground. Does the wind always blow in that direction?	• Why do we have seasons? • Why does it snow etc. • Is the weather the same in other countries as it is in ours? • How do I keep safe in the sun? Cold? Rain? Snow/ice?	• Which gloves will keep my hands dry in the rain/snow?

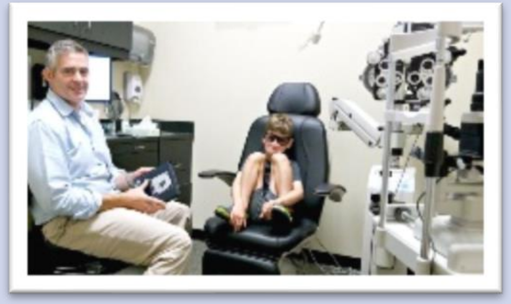
Opportunities for Working Scientifically

- Observe, describe and compare seasons.
- Sort objects into seasons.
- Ask questions about the seasons.
- Measure temperature, rainfall etc.
- Record data on tables e.g. rainfall, hours of daylight, type of weather, favourite season, favourite weather.

Working Scientifically words we need to know

- Observe – to look closely or watch carefully
- Describe – say what something is like
- Compare – talk about how things are different or the same
- Sort – arrange into different groups
- Measure – find out the size or amount of something
- Record – write down information
- Data – information
- Table – a set of facts or figures arranged in row or columns
- Temperature – how hot or cold something is

Year 1 Humans

Real life scientists	Careers in Science – Could you be a…?
 Dr Ranj is a real doctor who helps poorly children.	 Doctor
 Dr Chris and Dr Xand are both doctors and studied medicine at Oxford University.	 Dentist
 Florence Nightingale was a nurse in Victorian times. She began to organise and train nurses – something that hadn't been done before.	 Nurse
	 Optician

Year 1 Animals

Real life scientists	Careers in Science – Could you be a…?
 Steve Backshall is a BAFTA-winning English naturalist best known for BBC TV's Deadly 60.  Jess French presenter for CBeebies and vet.	 Farmer  Vet  Dog walker  Zoo keeper

Year 1 Plants

Real life scientists -	Careers in Science – Could you be a…?

The Rich Brothers studied landscape gardening at university and run their own garden design business.

Alan Titchmarsh is a professional gardener, journalist, TV presenter and author. He was born in Ilkley and started his career as a gardener for Bradford Council.

Beth Chatto - pioneering gardener won 10 successive gold medals at the Chelsea flower show.

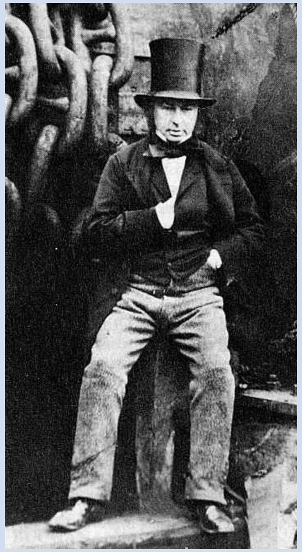
Gardener

Florist

Tree surgeon

Park Keeper

Year 1 Everyday materials

Real life scientists	Careers in Science – Could you be a…?
 Maddie Moat is a TV presenter and film maker. She presents 'Do you know' on Cbeebies.	 Firefighter  Chef
 Ismbard Kingdom Brunel was a very famous Victorian engineer. He designed and built bridges, railways, ships, train stations and even a hospital.	 Mechanic  Tailor

Year 1 Seasonal change

Real life scientists	Careers in Science – Could you be a…?
 Paul Hudson is a Weather presenter on BBC. He was born and brought up in Keighley. He went to university to study physics.	 Weather forecaster (Meterologist)

Year 2 - Humans

We want our children to have a lifetime of health and wellness. In year 2, we want our children to :

· Talk about how humans grow, live and survive

· Make choices that will help to keep their body healthy

- notice that humans have babies which grow into adults
- find out about and describe the basic needs of humans, for survival (water, food and air)
- describe the importance of exercise, eating the right amounts of different types of food and hygiene.

Regular Activities:

PE / playtime — reinforce body parts. How do we feel before, during and after exercise? How do we keep safe and what equipment do we need to do this? The daily mile.

Play time — healthy choices – fruit and milk.

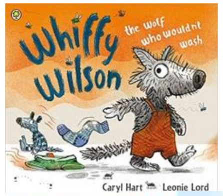
Washing hands – before lunch and after going to the toilet.

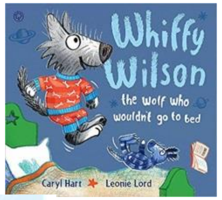
Go Noodle

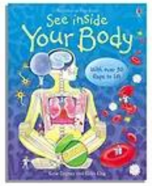
Wake up, Shake up

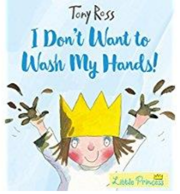
Mile a Day

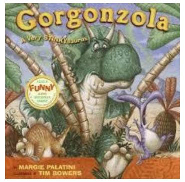
Books to read:

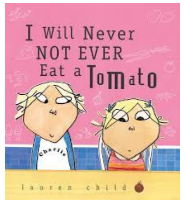


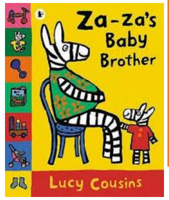












By the end of year two children will be able to:

Talk about and describe how to look after themselves – what foods are best to eat; why we need to exercise; why and how to rest.

Make comparisons between themselves and people that are older and younger than them

Look after their own health e.g. brushing their teeth (the singing dentist), washing hands, drinking water, choosing appropriate clothing, appropriate activities, bedtimes etc.

Vocabulary

Offspring, growth, child, young/old stages exercise, heartbeat, breathing, hygiene, germs, disease, food types - meat, fish, vegetables, bread, rice, pasta.

Comparative vocabulary – bigger, smaller taller, shorter, longer, narrower, wider, healthy, unhealthy.

Possible Curriculum Links

PE – Body Coach

Geography – food and where it comes from, how people survive around the world and their home,

DT – tents, den building

Out door learning – forest schools, making fire

Provision:

Role play areas e.g. doctors, hospital, kitchen, gym, dentist

Experiences:

Yoga instructor, Visit Medical Centre, Cbeebies Dr Ranj Get Well Soon, Eureka, YouTube Singing Dentist, Bradford Bulls/Bradford City Players to visit, Visit from a doctor/dentist, Visit a gym

Year 2 – Humans Investigations

Observing over time	Identifying and classifying	Pattern seeking	Research	Comparative and fair testing
• How do humans change from babies to adults? • How will/have we changed over Year 2? • How much water do I drink over the day? Week? Month? • How much coffee does my teacher drink over the day? Week? Month	• How can we sort our foods?	• The bigger the sneeze the further the spray. (Model with squeezy water bottle) • Are the oldest children in our class the tallest? • Are the oldest adults the tallest?	• What are the healthiest ways of cooking our food? • What happens if we go without some food? • What happens if we have too much food? • What happens if we get too hot/too cold? • How long can we survive without food air water? (secondary research only – ha ha!) • How would you stay warm in the arctic?	

Opportunities for Working Scientifically

- Observe, describe and compare humans, types of exercise, before/during/after exercise, foods and drinks, shelter/homes, clothes.
- Sorting food, clothing, shelter.
- Ask questions about babies and adults, exercise, diet, hygiene etc.
- Measure ourselves and our teachers (standard/non-standard units).
- Record data on tables e.g. birthdays, heights, brothers/sisters, how many time you wash your hands, water/coffee drunk

Working Scientifically words we need to know

- Observe – to look closely or watch carefully
- Describe – say what something is like
- Compare – talk about how things are different or the same
- Sort – arrange into different groups
- Measure – find out the size or amount of something
- Record – write down information
- Data - information

Year 2 - Animals

We want our children to be inspired and awed by the natural world. In year two, we want our children to :

- Talk about how to care for animals.
- Talk about how animals grow.

- notice that animals have offspring which grow into adults
- find out about and describe the basic needs of animals, for survival (water, food and air)

Regular Activities:

Tell me time - Animal of the day including its offspring.

Noticing baby animals that we see over the seasons.

Talking about children's pets.

Divide the children in to 2 groups – parents and offspring mix them up and find your baby. Link to Year 1 work and include reptiles, amphibians, fish, birds, mammals and invertebrates.

Top trumps cards - baby animals, dogs

Books to read:

By the end of year two children will be able to:

Talk about how to look after a pet.

Describe how animals help humans.

Talk about baby animals and their parents.

Describe how baby animals change as they grow.

Compare baby animals with their parents and other baby animals.

Vocabulary

Offspring, growth, young/old stages, breathing, survive, oxygen

Comparative vocabulary – bigger, smaller taller, shorter, longer, narrower, wider.

Possible Curriculum Links

PSHE – Looking after animals, kindness, empathy, responsibilities

Maths – how much time and money does it cost to keep a pet? How often do we have to feed/wash a pet?

English – Writing a pet owner's guide. Writing a letter to the Head teacher for a school pet.

Provision:

Role play areas e.g. pet shop, zoo, animal shelter,

Experiences:

Watch Spring watch, Dogs Trust, visit a pet shop, visit a zoo, talk to a vet, Visit Tropical World, Visit a farm in Spring

Year 2 – Animals Investigations

Observing over time	Identifying and classifying	Pattern seeking	Research	Comparative and fair testing
• The frogspawn has turned into frogs. How do animals change from babies or eggs in to adults? E.g. frogs, chicks (consider incubating eggs) • Do different animals change and grow at different rates? • How has my pet changed over time?	• Can you match the baby to their parent? Do this physically like a treasure hunt. • Can you match the pet equipment/food to the pet?	• Can you spot any patterns in the life cycles of animals?	• What is the school's favourite pet? • Which is the cutest baby animal? • How do I look after a…? • How many days can a…survive without food/water/air?	

Opportunities for Working Scientifically

- Observing, describing and comparing animals and their offspring.
- Observing, describing and comparing pets and their offspring.
- Sort animals, pet equipment etc… (see above)
- Ordering life cycles.
- Ordering pets by height, weight, easiest to keep. Measuring animals, babies, pets.
- Record information on tables and bar charts – children carry out surveys.

Working Scientifically words we need to know

- Observe – to look closely or watch carefully
- Describe – say what something is like
- Compare – talk about how things are different or the same
- Sort – arrange into different groups
- Order- to arrange things in a pattern E.g. tallest to shortest
- Measure – find out the size or amount of something
- Record – write down information
- Table – a set of facts or figures arranged in row or columns
- Bar charts – a graph where information is show in bars
- Survey – a set of questions you ask others to gather information

Year 2 – Living Things and their Habitats

We want our children to be inspired and awed by the natural world. In year two, we want our children to :

- Talk about and describe the different places that animals and plants live in.
- Talk about what animals eat and who eats them!

- explore and compare the differences between things that are living, dead, and things that have never been alive
- identify that most living things live in habitats to which they are suited and describe how different habitats provide for the basic needs of different kinds of animals and plants, and how they depend on each other
- identify and name a variety of plants and animals in their habitats, including microhabitats
- describe how animals obtain their food from plants and other animals, using the idea of a simple food chain, and identify and name different sources of food.

<u>Regular Activities:</u>

Tell me time – Animal/plant of the day in its habitat.

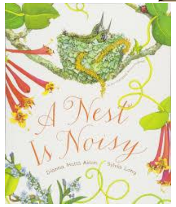
Who lives in a habitat like this? Habitat/animal/plant hunt.

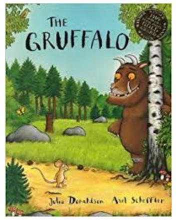
Art of noticing – using short video clips from the BBC.

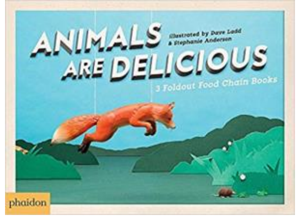
explorify.welcome.ac.uk – have a look at these resources.

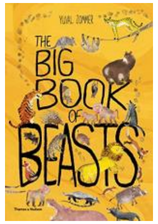
Oddizzi - habitats

Books to read:









<u>By the end of year two children will be able to:</u>

Talk about and describe different habitats.

Explain how an animal is designed for its habitat.

Describe how animals and plants get what they need to survive from their habitat.

Order a simple food chain.

Say if something is living, dead or never been alive.

<u>Vocabulary</u>

Living, dead, never been alive, suited, suitable, basic needs, food, food chain, shelter, move, feed, names of local habitats e.g. pond, woodland etc., names of micro-habitats e.g. under logs, in bushes

<u>Possible Curriculum Links:</u>

Art/DT – Junk modelling, animal with a moving part in its habitat. Create a diorama of an animal in its habitat.

Geography – link habitats to locational knowledge – including oceans. Mapping the habitats in our school grounds. Map a microhabitat.

<u>Provision:</u>

Small world different habitats,

<u>Experiences:</u>

Habitat walks in school grounds and local area, habitat workshop – environment explorer at Cliffe Castle, Who's coming to dinner workshop – Cliffe Castle, visit the woods – St Ives

Year 2 – Living Things and their Habitats Investigations

Observing over time	Identifying and classifying	Pattern seeking	Research	Comparative and fair testing
• They've just cut the grass on the school field. How does it change as it starts to grow again? • How do habitats change over the year? Time-lapse videos.	• We think there are animals all around us. What lives in our school grounds? in Horton Park? In our tall trees? In the hedge? In the soil? In our minibeast hotel?	• Where do we found the most snails, spiders, worms, woodlouse?	• How do plants survive in very wet or very dry places? • Do any plants grow without soil? • Why do animals migrate?	• Can you design a home for a hedgehog/ minibeast? Resources on Explorify website.

Opportunities for Working Scientifically

- Observing, describing and comparing habitats.
- Sorting animals and plants in to their habitats.
- Plan how to collect data for the pattern seeking question.
- Explain where the different habitats are/what they are like/ how the animals and plants are designed to survive there. You could extend this to include environmental issues e.g. habitat loss, pollution and declining species.

Working Scientifically words we need to know

- Observe – to look closely or watch carefully
- Describe – say what something is like
- Compare – talk about how things are different or the same
- Plan– decided in detail what you are going to do before you do it
- Patterns – the way something usually happens
- Explain – give information or say why

Year 2 – Plants

We want our children to develop a love of nature and a sense of caring for our planet. We want them to be inspired and awed by the natural world. In year two, we want our children to :

- Know that the world is full of varied and interesting plants.
- To have a love of, an interest in and a care for plants by **growing things throughout the year**

- observe and describe how seeds and bulbs grow into mature plants
- find out and describe how plants need water, light and a suitable temperature to grow and stay healthy.

Regular Activities:

Grow plants all year – indoor plants, outdoor plants, herbs, seeds, lettuce.

Plant bulbs in Autumn 1 – ready for Spring. Plant bulbs in Spring 1 – ready for Summer. Plant bulbs in Summer – ready for when they return in Autumn.

Tell me time – Put up a picture of a seed/bulb and ask the children to tell you about it. Children to predict what they think it will grow in to and draw it.

What am I? Plant of the day – Give children clues (page from plant book) about a plant and children use the clues to guess which plant you are.

Odd one out - explorify.wellcome.ac.uk

Show me – Give children measurements of plants/seeds/bulbs and ask them to show you how big that is.

Find me – Find me something that is the same size, height or weight as…

Books to read:

By the end of year two children will be able to:

Talk about how to grow a variety of plants.

Describe different seeds – what they look like, what they grow in to and how we use the plant.

Talk about how to grow a variety of bulbs.

Describe different bulbs – what they look like, what they grow in to and how we use the plant.

Talk about the parts of the plants we eat.

Vocabulary

Leaf, flower, blossom, petal, fruit, berry, root, seed, trunk, branch, stem, bark, stalk, bud, light, shade, sun, warm, cool, water, grow, healthy.
Names of trees in the local area.
Names of garden and wild flowering plants in the local area.

Possible Curriculum Links

Geography - Grow a cress world map.

Art – Create observational drawings of seed heads and seeds – Autumn

Pottery of seed heads

DT – Talk about how we use seeds in cooking.

Provision:

Role Play: Children being gardeners, practical area where they can plant seeds and dig up plants – looking at them.

Experiences:

Make a salad that uses stems, leaves, seeds, bulbs, roots and flowers, plant throughout the year, interview Mrs Jackson – gardening club, visit an allotment, visit Harlow Carr RHS garden Harrogate – workshops.

Year 2 – Plants Investigations

Observing over time	Identifying and classifying	Pattern seeking	Research	Comparative and fair testing
• How do our seeds change as they germinate? (Timelapse) • How long do our seeds take to germinate? • How do our plants change as they grow? • How long does it take us to grow a pumpkin for the Harvest festival? (plant in year 2 and eat it in year 3)	• All the seeds have fallen out of their packets. How can we sort them? • Do different seeds grow in to different plants? • All the bulbs in the garden centre are muddled up. How can we sort them out?	• Do taller plants grow from bigger seeds? • We notice that our apples have 5 seeds do all apples have the same number of seeds? • Do the biggest fruits have the most seeds?	• Which plants live in the pond/ lake/sea? • Do any plants grow without soil? • How do plants survive in very wet or dry places? • How do our plants get their food? • How much bread does a field of wheat make? • How do we get chocolate? • Do plants grow in the desert/polar regions?	• Keep the supermarket herb pots on your windowsill. How long can we keep them alive for? What happens if we don't water one of them? What would happen if we under/over water them? Etc…

Opportunities for Working Scientifically

- Observing, describing and comparing seeds/bulbs/plants/fruits.
- Sorting seeds and bulbs as above.
- Order seeds e.g. smallest to largest. Order bulbs e.g. heaviest to lightest.
- Measure seeds/bulbs and plants.
- Explain how to grow and care for plants.
- Explain how plants help us to live.

Working Scientifically words we need to know

- Observe – to look closely or watch carefully
- Describe – say what something is like
- Compare – talk about how things are different or the same
- Sort – arrange into different groups
- Order- to arrange things in a pattern E.g. tallest to shortest
- Measure – find out the size or amount of something
- Explain – give information or say why

Year 2 – Materials

We want our children to appreciate the gifts that the Earth gives us, how and why they are used. We want our children to care for the Earth and be considerate consumers. In year two, we want our children to :

- Talk about what things are made from and why
- Making or using familiar objects from a variety of materials and working out which one is the most useful E.g. a bag, plate, cup, fork etc.
- Begin to have an appreciation for engineering and product design.

- Identify and compare the suitability of everyday materials, including wood, metal, plastic, glass, rock, brick, paper and cardboard for particular uses.
- Find out how the shapes of solid objects made from some materials cans be changed by squashing , bending, twisting and stretching.

Regular Activities:

Tell me time – Give the children an object and ask the children to tell you about it (encourage them to use all of their senses).

20 questions – Give children a selection of objects.

Odd one out , Zoom in zoom out, What if? - explorify.wellcome.ac.uk

Tell me why time - Give the children an object and ask why it has the properties it does. E.g. why do your trainers have bumpy soles?

Books to read:

By the end of year two children will be able to:

Talk about and describe different objects/materials.

Talk about the properties of everyday objects that we use.

Talk about how they've made objects and things that went well or could be improved.

Which object is the most suitable for a task. E.g. Which one of these bags is best for carrying my marking home in?

Which material is the most suitable for an object. E.g. Which bag will protect my books from the rain?

Vocabulary

Object, material, wood, plastic, glass, metal, water, rock, brick, paper, fabric, elastic, foil, card/cardboard, rubber, wool, clay, hard, soft, stretchy, stiff, bendy, floppy, waterproof, absorbent, breaks/tears, rough, smooth, shiny, dull, see through, not see through, opaque, transparent and translucent, reflective, non-reflective, flexible, rigid, Shape, push/pushing, pull/puling, twist/twisting, squash/squashing. Bend/bending, stretch/stretching

Possible Curriculum Links

Art – sculpture using clay, mod-rock, wire, Plastercine

DT – Sewing a flower, cooking looking a the properties of the equipment, building structures out of different materials.

History – What were things made from in the past and how and why has it changed?

Provision:

Role Play: Kitchen, Construction area (with everyday objects), Junk Modelling, Den Building

Experiences:

Local Walks, Watch Cbeebies - Do you know? Industrial museum, local building sites, local play area, playground, talking to the caretaker about how they maintaining the building and what they have to do, visit from some who uses materials E.g. Product Designer.

Year 2 – Materials Investigations

Observing over time	Identifying and classifying	Pattern seeking	Research	Comparative and fair testing
• How does the state of our school uniform change as we wear it everyday? • How does my school bag change as I use it?	• We want to make an umbrella. There are lots of materials we can use to make it. How can we sort these materials to find out those that work and those that don't? • I have a parcel to send in the post how can we sort the packaging to find out which will keep my parcel safe and dry?	• The thicker the material of the bag the more weight it can hold. E.g. paper bag, knitted bag, bag for life, leather bag, plastic bag. • True, False or prove it – If I put a heavy weight on a lump of Plastecine it will squash it flatter.	• How is … made? (CBeebies Do you know?) • When was glass and plastic first used? • How is Lego made? • What does an engineer do?	• What's the best fabric for my bag? • Which is the best materials for Cinderella's mop? • Children to carry out consumer surveys. E.g. Which water bottle/packed lunch box would you recommend?

Opportunities for Working Scientifically

- Observe, describe and compare objects.
- Sort objects
- Ask scientific questions about objects and use information to answer them
- Plan how to collect data to answer questions – with help
- Measure
- Talk about what might happen and what did happen
- Plan a simple fair test – with help
- Test out their own/someone else's ideas
- Explain why
- Record information on tables and bar charts

Working Scientifically words we need to know

- Observe – to look closely or watch carefully
- Describe – say what something is like
- Compare – talk about how things are different or the same
- Sort – arrange into different groups
- Plan– decided in detail what you are going to do before you do it
- Fair test – a test where only one thing changes at a time and everything else stays the same
- Record – write down information
- Table – a set of facts or figures arranged in row or columns
- Bar charts – a graph where information is show in bars

The CSP Approach to Primary Science

Working Scientifically

A collaboration between

The Catholic Schools Partnership
CSP
A Teaching School Alliance of Bradford & Keighley

Teaching from the Heart
'Putting the humanity back into education'

WORKING SCIENTIFICALLY

Science in the EYFS

Science is all about exploring and understanding the world around us

You don't need to know all the answers!

Science by its very nature is about making the most of the knowledge you have and trying to find out the answers to the questions you don't know the answers to.

A simple 'I'm not sure...let's see if we can find out' is a great way to embrace all that science is about and to encourage children to do the same.

It is not enough to provide children with lots of opportunities for exploration and investigation as part of their ongoing play. We cannot just give them science-based experiences and expect them to have the correct terms to hand. Adults need to offer children the **language of science.**

Adult interaction needs to be enthusiastic, relevant and most of all a part of the child's ongoing play experience.

Role of adults

Giving children the opportunity and means to explore, observe, question and investigate the world around them.

The language of enquiry

Encouraging language based around exploring and investigating. 'What if…', 'How', 'If', and 'Why'?

Giving children the tools to be able to ask questions and formulate theories to be tested and situations to be investigated.

The language of objects & equipment

Using the senses to explore objects and pieces of equipment.

Talking with children as part of their investigations it is easy to see opportunities for building this type of language.

The language of processes

Helping children to build the vocabulary that they need to explain what they found out, using terminology e.g. melting, moving, growing, loud.

It is really important to remember the significance of **'process rather than product'** if science is to benefit children's life-long learning skills. Science offers the opportunity to focus on key skills such as questioning, trying out theories, investigating and adjusting our thinking. These skills can be used throughout the children's learning in all other areas and subjects.

Statutory requirements

During years 1 and 2, pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content:

- asking simple questions and recognising that they can be answered in different ways
- observing closely, using simple equipment
- performing simple tests
- identifying and classifying
- using their observations and ideas to suggest answers to questions
- gathering and recording data to help in answering questions.

WORKING SCIENTIFICALLY

Statutory requirements

During years 3 and 4, pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content:

- asking relevant questions and using different types of scientific enquiries to answer them
- setting up simple practical enquiries, comparative and fair tests
- making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers
- gathering, recording, classifying and presenting data in a variety of ways to help in answering questions
- recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables
- reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions
- using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions
- identifying differences, similarities or changes related to simple scientific ideas and processes
- using straightforward scientific evidence to answer questions or to support their findings.

Statutory requirements

During years 5 and 6, pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content:

- planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary
- taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate
- recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs
- using test results to make predictions to set up further comparative and fair tests
- reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations
- identifying scientific evidence that has been used to support or refute ideas or arguments.

Science Y1

By the end of **Y1** children should be able to:

- Observe, describe and compare using simple science words
- Sort things
- Ask science questions
- Collect evidence to answer some questions
- Measure using non-standard units
- Test out ideas with help
- Talk about what might happen and what they found out
- Write and draw about science
- Record on a simple table

Science Y2

By the end of **Y2** children should be able to:

- Observe, describe and compare using science words
- Sort and order observations
- Ask scientific questions and use information to help answer them
- Plan how to collect data to answer questions, with help
- Measure using non-standard, then standard units
- Talk about what might happen and compare it to what did happen
- Plan a simple fair test, with help
- Test out their own/someone else’s ideas
- Explain why (in a simple way)
- Record information on tables and bar charts
- Talk, write and draw about science

Science Y3

By the end of **Y3** children should be able to:

- Observe, describe and compare using Key Stage 2 scientific vocabulary
- Group and order observations giving scientific reasons
- Ask scientific questions and use information/collect data to answer them
- Predict what might happen and begin to explain why using everyday ideas
- Measure in standard units
- Test out their own/someone else's ideas
- Plan a fair test with help
- Explain observations using cause and effect
- Draw simple tables and bar charts to record their own observations/data
- Talk about observations/results and begin to use scientific facts to explain them
- Find and talk about simple patterns in results
- Communicate findings in a variety of ways
- Talk about how to improve their own work

Science Y4

By the end of **Y4** children should be able to:

- Observe, describe and compare using Key Stage 2 scientific vocabulary
- Group and order observations giving scientific reasons
- Collect evidence/find information to test out an idea/prediction or answer a question
- Predict what might happen and begin to explain why using everyday ideas and scientific facts/ideas
- Measure in standard units
- Select equipment, with help
- Plan ways to test out their own/someone else's ideas
- Set up a fair test and explain why it is important to do so
- Draw tables and bar charts to record observations/data
- Explain observations/results using cause and effects and scientific facts and ideas
- Explain what the evidence shows and whether it supports any predictions
- Identify and explain simple trends and patterns in results
- Communicate findings in a variety of ways
- Talk about how to improve their own work

Science Y5

By the end of **Y5** children should be able to:

- Observe, describe and compare in careful detail
- Sort and classify with precise reasons
- Make predictions and explain why
- Plan how to collect evidence/information/data to test out an idea/prediction or answer a question
- Measure precisely in standard units
- Select the most suitable equipment for the task
- Plan ways to test out their own/someone else's ideas
- Set up and carry out fair tests
- Repeat observations and measurements
- Draw tables, bar charts and simple line graphs to record observations/data
- Interpret and predict from bar charts and line graphs
- Explain observations/results using cause and effects and scientific facts and ideas
- Explain what the evidence show and whether it supports any predictions
- Identify trends and patterns in data and explain using scientific facts and ideas
- Begin to identify scientific evidence that has been used to support or refute ideas or arguments
- Select the most appropriate way to communicate findings, evaluating the evidence as well as describing it
- Talk about how to improve their own work giving reasons

Science Y6

By the end of **Y6** children should be able to:

- Observe, describe and compare in careful detail using the correct language
- Sort and classify with precise reasons
- Make predictions based on scientific facts and ideas
- Collect evidence/information/data to test out an idea/prediction or answer a question from a wide range of sources
- Measure precisely in standard units
- Select the most suitable equipment for the task
- Plan ways to test out their own/someone else's ideas
- Independently set up and carry out fair tests
- Decide when to repeat observations and measurements
- Choose the most appropriate way to record and present results
- Interpret and predict from bar charts and line graphs
- Explain observations/results using cause and effects and scientific facts and ideas
- Explain what the evidence shows and whether it supports any predictions
- Identify trends and patterns in data that do not fit and explain using scientific facts and ideas
- Identify scientific evidence that has been used to support or refute ideas or arguments
- Select the most appropriate way to communicate findings, evaluating the evidence as well as describing it
- Evaluate their work and suggest ways to improve their work giving reasons

Observing over time

- Observing over time helps us identify and measure events and changes in living things, materials and physical processes and events
- Observations may take place over time spans from minutes or hours, to several weeks or months
- Observing over time provides opportunities for children to be actively involved in making decision about what and how to observe and measure, and the best ways to record the changes that occur
- These types of enquiries provide rich contexts for children to learn about the important of cycles, systems, growth and decay, and other types of changes

Examples of observing over time

- Do different animals change and grow at different rates?
- How do humans change as they get older?
- The lawn has just been cut, how does the grass change as it starts to grow again?
- How does food change as it goes mouldy?
- How do things change over time if we bury them in the ground? Do all things rot?
- How quickly will this wet sponge dry?
- How does the Moon’s appearance change over a month?
- When is it noisiest in our classroom? When is it quietist?
- How do our seeds change as they grow?
- Which are the quickest plants for us to grow to eat?
- How long does our snowball last? What happens if we sprinkle salt on it?
- Which bits on an ice-hand will melt first?
- How does our tree change over the year?
- How does the weather change over a week/month/year?
- Veg tops – Look, think, talk.
- Slow melt – Look, think, talk
- Water cycle seedlings – Look, think, talk
- Shaky changes – Look, think, talk
- Celebration candles – Look, think, talk

From ‘It’s not fair – or is it?’ Jane Turner et al

Identifying and classifying

- These key scientific activities help us make sense of how the world is organised
- As children get older they begin to work out what things are by observing closely, learning names of different things, noticing characteristics, similarities and differences, and learning how characteristics can be used to group things together
- These types of enquiries provide valuable contexts for children to learn about the rich variety of living things, rock and soil types and materials

Examples of identifying and classifying

- The seeds have fallen out of their packets. How can we sort them?
- The plants in the garden centre are muddled up. How can we sort them?
- What sort of micro-organisms are useful to us? How can we make a guide to them?
- Can we identify everybody in our class by their fingerprints? What other ways can we use to identify children in our class?
- Mrs Feedem wants to reorganise her corner shop. Can we give her some different ideas for sorting them?
- We have 14 types of glue in the cupboard. They all seem to do a different job. Can we find a useful way to sort them out?
- Can we make a key to identify which planet is which?
- Can we identify what was living millions of years ago from looking at fossils?
- We're making a magnetic game. How can we sort out things that are magnetic and those that aren't?
- Can you create a key to identify these sweets?
- How many ways can you sort these vehicles?

Pattern seeking

- In pattern seeking enquiries children observe, measure and record events and systems. They also collect and interpret data from secondary sources
- In these activities children try to answer questions by identifying patterns in the observations and measurements they record
- Sometimes children will find a direct relationship between variables (e.g. the thicker strings on a guitar produce deeper notes), sometimes the relationship is less obvious
- These types of enquiries provide rich contexts for children to learn about habitats, adaptation and interdependence, diet, health and disease, microorganisms, weather and the solar system.

Examples of pattern seeking

- Where do we find most snails, spiders or woodlice?
- Do birds with the same beaks eat the same kind of food?
- Do bigger fruits have the most seeds?
- Do taller trees or trees with bigger leaves lose their leaves first?
- Do all flowers have the same number of petals?
- Do taller plants grow from bigger seeds?
- Do taller children have largest feet?
- Can the people with the biggest hands grab the most objects?
- Are things that are magnetic always good conductors of electricity?
- I think little things take longer to melt. Is there a pattern in how long it takes different sized snowmen/ice lollies to melt?
- How many turns of the clockwork key are needed to make our toy go 1 metre, 2 metres etc? Is there a pattern?
- Is there a pattern between the size of the planet and the time it takes to orbit the sun?
- Colourful caterpillars – Look, think, talk

From ‘It’s not fair – or is it?’ Jane Turner et al

Research

- These types of enquiry refer to using secondary sources to answer questions
- Children can learn to compare and evaluate information from different sources; distinguish fact from opinion and recognise conflicting evidence and bias; and recognise that don’t have definite answers
- Researching something that interests them enables children to answer their own questions and stimulates them to ask and answer more questions

Examples of research

- How much sleep do we need?
- How can we tell the time without clocks?
- What diseases can we be vaccinated against?
- Why don’t cranes fall over?
- Why do archaeologists and diamond hunters need to know about rocks?
- What is the loudest noise ever recorded?
- Why do birds migrate? Which birds migrate the furthest?
- Do any plants grow without soil?
- When is a helicopter more useful than an aeroplane?
- When was plastic first used? What was the impact of us of its invention?
- How are caves formed?
- Where does salt come from?
- How has scientists’ model of the solar system changed over the century?

Comparative and fair tests

- These tests enable children to explore relationships between variables
- In *comparative* tests children compare one event with another, e.g. does the red car go faster than the green car?
- In more complex comparative tests children compare several different materials, events or artefacts, controlling conditions and variables to ensure validity, e.g. which is the best material for mopping up spilt water, when children control the size of the material and the time to soak up the water
- Children carry out a *fair test* to identify a causal relationship between two variables. They identify a variable to change that can be quantified and test the effect of changing it on another variable, keeping all the other variables the same, e.g. how does changing the height of a ramp affect how quickly a toy car rolls down it, where the type of car, and other relevant variables are kept the same.
- Fair tests are only suitable when variables are numeric and can be changed, e.g. investigating the relationship between the surface area of parachute and the falling time
- Comparative tests are used when categoric variables are compared, e.g. the material a parachute if made from

Examples of comparative and fair tests

- Do woodlice move more in dark or light conditions?
- Do we need to make sure that we plant the seeds the right way up?
- The dentist said some drinks harm your teeth. Which drinks are the most harmful do us?
- Some bread is flat and some is big and fluffy. How does changing the amount of sugar, water or temperature affect the amount our bread rises?
- The school's sports kits are very dirty. What is the best way to get them clean? What difference does the type of soap make?
- We're making some bubble mixture. What happens if we change any of the ingredients in the recipe?
- Which are the best tea bags?
- It's icy outside. Which of our shoes have the most grip?
- How does changing our parachutes affect how our toy figures fall?
- What makes a difference to how far a balloon rocket can go?
- Does changing the size of a musical instrument affect the pitch or loudness of the sound?
- We want to put a star on the magician's wand for the pantomime. Which material makes the best reflector?

From 'It's not fair – or is it?' Jane Turner et al

PLAN

Primarily Science

We are investigating...

The **variables** we could change	The **variables** we could **measure/observe**
We **will** change	We **will** measure/observe

Our **question** is...

If we change what will happen to ?

To make it a **fair test** we will keep these **variables** the same	Our **predictions** are...

DO

Table of results

We will **change**	We will **measure/observe**

Measure

Primarily Science

Our graph shows..

Change

REVIEW

Primarily Science

Our question is...
When we change [ ] what will happen to [ ] ?

Which prediction most closely supports the results?	
	Can you **describe** how?
	Can you **explain** why?
	Can you **explain** why using scientific language?
Are there any unusual results? Can you explain why?	

Have you answered the question? What have you found out? Our **conclusion** is....
What can you do to improve your investigation? How could you change your plan to obtain better results?

The CSP Approach to Primary Science

Links Across the Curriculum

A collaboration between

The Catholic Schools Partnership
CSP
A Teaching School Alliance
of Bradford & Keighley

Teaching from the Heart
'Putting the humanity back into education'

The CSP Approach to Primary Science

Links Across the Curriculum

A collaboration between

The Catholic Schools Partnership
CSP
A Teaching School Alliance of Bradford & Keighley

Teaching from the Heart
'Putting the humanity back into education'

PLAN Primary Science – Supporting Assessment

Planning Matrices

The Association for Science Education
Promoting Excellence in Science Teaching and Learning

Structure of the resources

Each resource contains the relevant National Curriculum statements for the unit of work and prior learning, a planning matrix, annotated work and a summary sheet.

The matrix provides an interpretation of the key learning of the National Curriculum statements, and suggestions of key vocabulary. In order to meet the expectations pupils must firstly understand the key concept and then be provided with opportunities to apply that knowledge. This is a key planning tool.

The Planning Matrix

		Key Learning	Possible Evidence
Secure	Show understanding of a concept by using scientific vocabulary correctly	Overview paragraph describing curriculum Key vocabulary – list of words	Possible ways to demonstrate key learning, particularly correct usage of vocabulary
	Applying knowledge in familiar related contexts, including a range of enquiries	Suggestions of contexts to use.	Possible ways to demonstrate that a pupil has gone beyond recall of facts and can apply the key learning, for example using the vocabulary and basic principles to produce explanations, usually within Working Scientifically contexts.

Y1 Plants

1. identify and name a variety of common wild and garden plants, including deciduous and evergreen trees
2. identify and describe the basic structure of a variety of common flowering plants, including trees

	Assessment guidance	Key learning	Possible Evidence
SECURE	Shows understanding of a concept using scientific vocabulary correctly	Growing locally there will be a vast array of plants which all have specific names. These can be identified by looking at the key characteristics of the plant. Plants have common parts but they vary between the different types of plants. Some trees keep their leaves all year whilst other trees drop their leaves during autumn and grow them again during spring. **Key vocabulary** Leaf, flower, blossom, petal, fruit, berry, root, seed, trunk, branch, stem, bark, stalk, bud Names of trees in the local area Names of garden and wild flowering plants in the local area	Can name trees and other plants that they see regularly Can describe some of the key features of these trees and plants e.g. the shape of the leaves, the colour of the flower/blossom Can point out trees which lost their leaves and those that kept them the whole year Can point to and name the parts of a plant, recognising that they are not always the same e.g. leaves and stems may not be green
	Applying knowledge in familiar related contexts, including a range of enquiries	Make close observations of leaves, seeds, flowers etc. Compare two leaves, seeds, flowers etc. Classify leaves, seeds, flowers etc. using a range of characteristics Identify plants by matching them to named images Make observations of how plants change over a period of time When further afield, spot plants that are the same as those in the local area studied regularly, describing the key features that helped them	Can sort and group parts of plants using similarities and differences Can use simple charts etc. to identify plants Can collect information on features that change during the year Can use photographs to talk about how plants change over time

Y1 Animals – see next sheet for human statement

1. identify and name a variety of common animals including fish, amphibians, reptiles, birds and mammals
2. identify and name a variety of common animals that are carnivores, herbivores and omnivores
3. describe and compare the structure of a variety of common animals (fish, amphibians, reptiles, birds and mammals, including pets)

	Assessment guidance	**Key learning**	**Possible Evidence**
SECURE	Shows understanding of a concept using scientific vocabulary correctly	Animals vary in many ways having different structures e.g. wings, tails, ears etc. They also have different skin coverings e.g. scales, feathers, hair. These key features can be used to identify them. Animals eat certain things - some eat other animals, some eat plants, some eat both plants and animals. **Key vocabulary** Head, body, eyes, ears, mouth, teeth, leg, tail, wing, claw, fin, scales, feathers, fur, beak, paws, hooves Names of animals experienced first-hand from each vertebrate group N.B. The children need to be able to name and identify a range of animals in each group e.g. name specific birds and fish. They do not need to use the terms mammal, reptiles etc. or know the key characteristics of each, although they will probably be able to identify birds and fish, based on their characteristics. The children also do not need to use the words carnivore, herbivore and omnivore. If they do, ensure that they understand that carnivores eat other animals not just meat.	Can name a range of animals which includes animals from each of the vertebrate groups Can describe the key features of these named animals Can label key features on a picture/diagram Can write descriptively about an animal Can write a What am I? riddle about an animal Can describe what a range of animals eat
	Applying knowledge in familiar related contexts, including a range of enquiries	Make first hand close observations of animals from each of the groups Compare two animals from the same or different group Classify animals using a range of features Identify animals by matching them to named images Classify animals according to what they eat	Can sort and group animals using similarities and differences Can use simple charts etc. to identify unknown animals Can create a drawing of an imaginary animal labelling its key features Can use secondary resources to find out what animals eat, including talking to experts e.g. pet owners, zoo keepers etc.

Y1 Humans – see previous sheet for animal statements

4. identify, name, draw and label the basic parts of the human body and say which part of the body is associated with each sense

	Assessment guidance	Key learning	Possible Evidence
SECURE	Shows understanding of a concept using scientific vocabulary correctly	Humans have keys parts in common, but these vary from person to person. Humans (and other animals) find out about the world using their senses. Humans have five senses – sight, touch, taste, hearing and smelling. These senses are linked to particular parts of the body. **Key vocabulary** Parts of the body including those linked to PSHE teaching (see joint document produced by the ASE and PSHE association) Senses, touch, see, smell, taste, hear, fingers (skin), eyes, nose, ear and tongue NB. Although we often use our fingers and hands to feel objects the children should understand that we can feel with many parts of our body	Can play and lead 'Simon says'. During PE lessons, can follow instructions involving parts of the body Can label parts of the body on pictures and diagrams Can explore objects using different senses
	Applying knowledge in familiar related contexts, including a range of enquiries	Make first hand close observations of parts of the body e.g. hands, eyes Compare two people Take measurements of parts of their body Compare parts of their own body Look for patterns between people e.g. Do people with big hands have big feet? Classify people according to their features Investigate human senses e.g. Which part of my body is good for feeling, which is not? Which food/flavours can I identify by taste? Which smells can I match?	Can use first-hand close observations to make detailed drawings Can name body parts correctly when talking about measurements and comparisons 'My arm is x straws long.' 'My arm is x straws long and my leg is y straws long. My leg is longer than my arm.' 'We both have hands, but his are bigger than mine.' 'These people have brown eyes and these have blue.' Can talk about their findings from investigations using appropriate vocabulary 'My fingers are much better at feeling than my toes' 'We found that the crisps all taste the same.'

Y1 Everyday materials

1. distinguish between an object and the material from which it is made
2. identify and name a variety of everyday materials, including wood, plastic, glass, metal, water, and rock
3. describe the simple physical properties of a variety of everyday materials
4. compare and group together a variety of everyday materials on the basis of their simple physical properties

	Assessment guidance	Key learning	Possible Evidence
SECURE	Shows understanding of a concept using scientific vocabulary correctly	All objects are made of one or more materials. Some objects can be made from different materials e.g. plastic, metal or wooden spoons. Materials can be described by their properties e.g. shiny, stretchy, rough etc. Some materials e.g. plastic can be in different forms with very different properties. **Key vocabulary** Object, material, wood, plastic, glass, metal, water, rock, brick, paper, fabric, elastic, foil, card/cardboard, rubber, wool, clay, hard, soft, stretchy, stiff, bendy, floppy, waterproof, absorbent, breaks/tears, rough, smooth, shiny, dull, see through, not see through	Can label a picture or diagram of an object made from different materials Can describe the properties of different materials
	Applying knowledge in familiar related contexts, including a range of enquiries	Classify objects made of one material in different ways e.g. a group of object made of metal Classify in different ways one type of object made from a range of materials e.g. a collection of spoons made of different materials Classify materials based on their properties Test the properties of objects e.g. absorbency of cloths, strength of party hats made of different papers, stiffness of paper plates, waterproofness of shelters	Can sort objects and materials using a range of properties Can choose an appropriate method for testing an object for a particular property Can use their test evidence to answer the questions about properties e.g. Which cloth is the most absorbent?

Y1 Seasonal Change

1. observe changes across the four seasons
2. observe and describe weather associated with the seasons and how day length varies

	Assessment guidance	Key learning	Possible Evidence
SECURE	Shows understanding of a concept using scientific vocabulary correctly	In the UK, the day length is longest at mid-summer (about 16 hours) and gets shorter each day until mid-winter (about 8 hours) before getting longer again. The weather also changes with the seasons. In the UK, it is usually colder and rainier in Winter and hotter and dryer in the Summer. The change in weather causes many other changes; some examples are numbers of minibeasts found outside, seed and plant growth, leaves on trees and type of clothes worn by people. **Key vocabulary** Weather (sunny, rainy, windy, snowy etc.), seasons (Winter, Summer, Spring, Autumn), sun, sunrise, sunset, day length	Can name the four seasons and identify when in the year they occur. Can describe weather in different seasons over a year. Can describe days as being longer (in time) in the summer and shorter in the winter. Can describe other features that change through the year
	Applying knowledge in familiar related contexts, including a range of enquiries	Collect information about the weather regularly throughout the year Present this information in table and charts to compare the weather across the seasons Collect information, regularly throughout the year, of features that change with the seasons e.g. plants, animals, humans Present this information in different ways to compare the seasons Gather data about day length regularly throughout the year and present this to compare the seasons	Use their evidence gathered to describe the general types of weather and changes in day length over the seasons. Use their evidence to describe some other features of their surroundings, themselves, animals, plants that change over the seasons Demonstrate their knowledge in different ways e.g. making a weather forecast video, writing seasonal poetry, creating seasonal artwork

Y2 Living things and their habitat

1. explore and compare the differences between things that are living, dead, and things that have never been alive
2. identify that most living things live in habitats to which they are suited and describe how different habitats provide for the basic needs of different kinds of animals and plants, and how they depend on each other
3. identify and name a variety of plants and animals in their habitats, including micro-habitats
4. describe how animals obtain their food from plants and other animals, using the idea of a simple food chain, and identify and name different sources of food

	Assessment guidance	Key learning	Possible Evidence
SECURE	Shows understanding of a concept using scientific vocabulary correctly	All objects are either living, dead or have never been alive. Living things are plants (including seeds) and animals. Dead things include dead animals and plants and parts of plants and animals that are no longer attached e.g. leaves and twigs, shells, fur, hair and feathers (this is a simplification but appropriate for year 2 children). An object made of wood is classed as dead. Objects made of rock, metal and plastic have never been alive (again ignoring that plastics are made of fossil fuels). Animals and plants live in a habitat to which they are suited which means that animals have suitable features that help them move and find food and plants have suitable features that help them to grow well. The habitat provides the basic needs of the animals and plants – shelter, food and water. Within a habitat there are different micro-habitats e.g. in a woodland – in the leaf litter, on the bark of trees, on the leaves. These micro-habitats have different conditions e.g. light or dark, damp or dry. These conditions affect what plants and animals live there. The plants and animals in a habitat depend on each other for food and shelter etc. The way that animals obtain their food from plants and other animals can be shown in a food chain. **Key vocabulary:** Living, dead, never been alive, suited, suitable, basic needs, food, food chain, shelter, move, feed, names of local habitats e.g. pond, woodland etc., names of micro-habitats e.g. under logs, in bushes etc.	Can find a range of items outside that are living, dead and never lived Can name a range of animals and plants that live in a habitat and micro-habitats that they have studied Can talk about how the features of these animals and plants make them suitable to the habitat Can talk about what the animals eat in a habitat and how the plants provide shelter for them Can construct a food chain that starts with a plant and has the arrows pointing in the correct direction
	Applying knowledge in familiar related contexts, including a range of enquiries	Explore the outside environment regularly to find objects that are living, dead and have never lived Classify objects found in the local environment Observe animals and plants carefully, drawing and labelling diagrams Create simple food chains for a familiar local habitat from first hand observation and research Create simple food chains from information given e.g. in picture books (Gruffalo etc.)	Can sort into living, dead and never lived Can give key features that mean the animal or plant is suited to its micro-habitat Using a food chain can explain what animals eat Can explain in simple terms why an animal or plant is suited to a habitat e.g. the caterpillar cannot live under the soil like a worm as it needs fresh leaves to eat; the seaweed we found on the beach cannot live in our pond because it is not salty

Y2 Plants

1. observe and describe how seeds and bulbs grow into mature plants
2. find out and describe how plants need water, light and a suitable temperature to grow and stay healthy

	Assessment guidance	Key learning	Possible Evidence
SECURE	Shows understanding of a concept using scientific vocabulary correctly	Plants may grow from either seeds or bulbs. These then germinate and grow into seedlings which then continue to grow into mature plants. These mature plants may have flowers which then develop into seeds, berries, fruits etc. Seeds and bulbs need to be planted outside at particular times of the year and they will germinate and grow at different rates. Some plants are better suited to growing in full sun and some grow better in partial or full shade. Plants also need different amounts of water and space to grow well and stay healthy. **Key vocabulary** As for year 1 plus - light, shade, sun, warm, cool, water, grow, healthy	Can describe how plants that they have grown from seeds and bulbs have developed over time Can identify plants that grew well in different conditions
	Applying knowledge in familiar related contexts, including a range of enquiries	Make close observations of seeds and bulbs Classify seeds and bulbs Research and plan when and how to plant a range of seeds and bulbs Look after the plants as they grow – weeding, thinning, watering etc. Make close observations and measurements of their plants growing from seeds and bulbs Make comparisons between plants as they grow	Can spot similarities and difference between bulbs and seeds Can nurture seeds and bulbs into mature plants identifying the different requirements of different plants

Y2 Animals including humans

1. notice that animals, including humans, have offspring which grow into adults
2. find out about and describe the basic needs of animals, including humans, for survival (water, food and air)
3. describe the importance for humans of exercise, eating the right amounts of different types of food, and hygiene

	Assessment guidance	Key learning	Possible Evidence
SECURE	Shows understanding of a concept using scientific vocabulary correctly	Animals including humans have offspring which grow into adults. In humans and some animals these offspring will be young, such as babies or kittens, that grow into adults. In other animals, such as chickens or insects, there may be eggs laid that hatch to young or other stages which then grow to adults. The young of some animals do not look like their parents e.g. tadpoles. All animals including humans have basic needs of feeding, drinking and breathing that must be satisfied in order to survive, and to grow into healthy adults they also need the right amounts and types of food and exercise. Good hygiene is also important in preventing infections and illnesses. **Key vocabulary:** Offspring, reproduction, growth, child, young/old stages (examples - chick/hen, baby/child/adult, caterpillar/butterfly), exercise, heartbeat, breathing, hygiene, germs, disease, food types (examples – meat, fish, vegetables, bread, rice, pasta)	Can describe how animals including humans have offspring which grow into adults, using the appropriate names for the stages Can state the basic needs of animals, including humans, for survival. Can state the importance for humans of exercise, eating the right amounts of different types of food and hygiene. Can name foods in each section of the Eatwell guide
	Applying knowledge in familiar related contexts, including a range of enquiries	Ask people questions and use secondary sources to find out about the life cycles of some animals Observe animals growing over a period of time e.g. chicks, caterpillars, a baby Ask questions of a parent about how they look after their baby Ask pet owners questions about how they look after their pet Explore the effect of exercise on their bodies Classify food in a range of ways, including using the Eatwell guide Investigate washing hands, using glitter gel	Can describe, including using diagrams, the life cycle of some animals, including humans, and their growth to adults e.g. by creating a life cycle book for a younger child Can measure/observe how animals, including humans, grow. Show what they know about looking after a baby/animal by creating a parenting/pet owners' guide Explain how development and health might be affected by differing conditions and needs being met/not met.

Y2 Uses of everyday materials

1. identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses
2. find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching

	Assessment guidance	**Key learning**	**Possible Evidence**
SECURE	Shows understanding of a concept using scientific vocabulary correctly	All objects are made of one or more materials that are chosen specifically because they have suitable properties for the task. For example, a water bottle is made of plastic because it is transparent allowing you to see the drink inside and waterproof so that it holds the water. When choosing what to make an object from, the properties needed are compared with the properties of the possible materials, identified through simple tests and classifying activities. A material can be suitable for different purposes and an object can be made of different materials. Objects made of some materials can be changed in shape by bending, stretching, squashing and twisting. For example, clay can be shaped by squashing, stretching, rolling, pressing etc. This can be a property of the material or depend on how the material has been processed e.g. thickness. **Key vocabulary** Names of materials – increased range from year 1 Properties of materials - as for year 1 plus opaque, transparent and translucent, reflective, non-reflective, flexible, rigid Shape, push/pushing, pull/puling, twist/twisting, squash/squashing. Bend/bending, stretch/stretching	Can name an object, say what material it is made from, identify its properties and make a link between the properties and a particular use Can label a picture or diagram of an object made from different materials For a given object can identify what properties a suitable material needs to have Whilst changing the shape of an object can describe the action used Can use the words flexible and/or stretchy to describe materials that can be changed in shape and stiff and/or rigid for those that cannot Can recognise that a material may come in different forms which have different properties
	Applying knowledge in familiar related contexts, including a range of enquiries	Classify materials Make suggestions about alternative materials for a purpose that are both suitable and unsuitable Test the properties of materials for particular uses e.g. compare the stretchiness of fabrics to select the most appropriate for Elastigirl's costume, test materials for waterproofness to select the most appropriate for a rain hat	Can sort materials using a range of properties Can explain using the key properties why a material is suitable or not suitable for a purpose Can begin to choose an appropriate method for testing a material for a particular property Can use their test evidence to select appropriate material for a purpose e.g. Which material is the best for a rain hat?

Y3 Plants

1. identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers
2. explore the requirements of plants for life and growth (air, light, water, nutrients from soil, and room to grow) and how they vary from plant to plant
3. investigate the way in which water is transported within plants
4. explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal

	Assessment guidance	Key learning	Possible Evidence
SECURE	Shows understanding of a concept using scientific vocabulary correctly	Many plants, but not all, have roots, stems/trunks, leaves and flowers/blossom. The roots absorb water and nutrients from the soil and anchor the plant in place. The stem transports water and nutrients/minerals around the plant and holds the leaves and flowers up in the air to enhance photosynthesis, pollination and seed dispersal. The leaves use sunlight and water to produce the plant's food. Some plants produce flowers which enable the plant to reproduce. Pollen, which is produced by the male part of the flower, is transferred to the female part of other flowers (pollination). This forms seeds, sometimes contained in berries or fruits which are then dispersed in different ways. Different plants require different conditions for germination and growth **Key vocabulary** Photosynthesis, pollen, insect/wind pollination, seed formation, seed dispersal – wind dispersal, animal dispersal, water dispersal	Can explain the function of the parts of a flowering plant Can describe the life cycle of flowering plants, including pollination, seed formation, seed dispersal, and germination Can give different methods of pollination and seed dispersal, including examples
	Applying knowledge in familiar related contexts, including a range of enquiries	Observe what happens to plants over time when the leaves or roots are removed Observe the effect of putting cut white carnations or celery in coloured water Investigate what happens to plants when they are put in different conditions e.g. in darkness, in the cold, deprived of air, different types of soil, different fertilisers, varying amount of space Spot flowers, seeds, berries and fruits outside throughout the year Observe flowers carefully to identify the pollen Observe flowers being visited by pollinators e.g. bees and butterflies in the summer Observe seeds being blown from the trees e.g. sycamore seeds Research different types of seed dispersal Classify seeds in a range of ways including by how they are dispersed Create a new species of flowering plant	Can explain observations made during investigations Can look at the features of seeds to decide on their method of dispersal Can draw and label a diagram of their created flowering plant to show its parts, their role and the method of pollination and seed dispersal

Y3 Animals including humans

1. identify that animals, including humans, need the right types and amount of nutrition, and that they cannot make their own food; they get nutrition from what they eat
2. identify that humans and some other animals have skeletons and muscles for support, protection and movement

	Assessment guidance	Key learning	Possible Evidence
SECURE	Shows understanding of a concept using scientific vocabulary correctly	Animals, unlike plants which can make their own food, need to eat in order to get the nutrients they need. Food contains a range of different nutrients that are needed by the body to stay healthy – carbohydrates including sugars, protein, vitamins, minerals, fibre, fat, sugars, water. A piece of food will often provide a range of nutrients. Humans and some other animals have skeletons and muscles which help them move and provide protection and support **Key vocabulary:** Nutrition, nutrients, carbohydrates, sugars, protein, vitamins, minerals, fibre, fat, water, skeleton, bones, muscles, support, protect, move, skull, ribs, spine, muscles, joints	Can name the nutrients found in food Can state that to be healthy we need to eat the right types of food to give us the correct amount of these nutrients Can name some bones that make up their skeleton giving examples that support, help them move or provide protection Can describe how muscles and joints help them to move
	Applying knowledge in familiar related contexts, including a range of enquiries	Classify food in a range of ways Use food labels to explore the nutritional content of a range of food items Use secondary sources to find out they types of food that contain the different nutrients Use food labels to answer enquiry questions e.g. How much fat do different types of pizza contain? How much sugar is in soft drinks? Plan a daily diet contain a good balance of nutrients Explore the nutrients contained in fast food Use secondary sources to research the parts and functions of the skeleton Investigate pattern seeking questions such as • Can people with longer legs run faster? • Can people with bigger hands catch a ball better? Compare, contrast and classify skeletons of different animals	Can classify food into those that are high or low in particular nutrients Can answer their questions about nutrients in food based on their gathered evidence Can talk about the nutrient content of their daily plan Use their data to look for patterns (or lack of) when answering their enquiry question Can give similarities e.g. they all have joints to help the animal move, and differences between skeletons

Y3 Rocks

1. compare and group together different kinds of rocks on the basis of their appearance and simple physical properties
2. describe in simple terms how fossils are formed when things that have lived are trapped within rock
3. recognise that soils are made from rocks and organic matter

	Assessment guidance	Key learning	Possible Evidence
SECURE	Shows understanding of a concept using scientific vocabulary correctly	Rock is a naturally occurring material. There are different types of rock e.g. sandstone, limestone, slate etc. which have different properties. Rocks can be hard or soft. They have different sizes of grain or crystal. They may absorb water. Rocks can be different shapes and sizes (stones, pebbles, boulders). Soils are made up of pieces of ground down rock which may be mixed with plant and animal material (organic matter). The type of rock, size of rock piece and the amount of organic matter affect the property of the soil. Some rocks contain fossils. Fossils were formed millions of years ago. When plants and animals died, they fell to the seabed. They became covered and squashed by other material. Over time the dissolving animal and plant matter is replaced by minerals from the water. **Key vocabulary:** Rock, stone, pebble, boulder, grain, crystals, layers, hard, soft, texture, absorb water, soil, fossil, marble, chalk, granite, sandstone, slate, soil, peat, sandy/chalk/clay soil	Can name some types of rock and give physical features of each Can explain how a fossil is formed Can explain that soils are made from rocks and also contain living/dead matter
	Applying knowledge in familiar related contexts, including a range of enquiries	Observe rocks closely Classify rocks in a range of ways based on their appearance Devise a test to investigate the hardness of a range of rocks Devise a test to investigate how much water different rocks absorb Observe how rocks change over time e.g. gravestones or old building Research using secondary sources how fossils are formed Observe soils closely Classify soils in a range of ways based on their appearance Devise a test to investigate the water retention of soils Observe how soil can be separated through sedimentation Research the work of Mary Anning	Can classify rocks in a range of different ways using appropriate vocabulary Can devise tests to explore the properties of rocks and use data to rank the rocks Can link rocks changing over time with their properties e.g. soft rocks get worn away more easily Can present in different ways their understanding of how fossils are formed e.g. in role play, comic strip, chronological report, stop-go animation etc. Can identify plant/animal matter and rocks in samples of soil Can devise a test to explore the water retention of soils

Y3 Light

1. recognise that they need light in order to see things and that dark is the absence of light
2. notice that light is reflected from surfaces
3. recognise that light from the sun can be dangerous and that there are ways to protect their eyes
4. recognise that shadows are formed when the light from a light source is blocked by an opaque object

find patterns in the way that the size of shadows change

	Assessment guidance	**Key learning**	**Possible Evidence**
SECURE	Shows understanding of a concept using scientific vocabulary correctly	We see objects because our eyes can sense light. Dark is the absence of light. We cannot see anything in complete darkness. Some objects, for example the sun, light bulbs and candles are sources of light. Objects are easier to see if there is more light. Some surfaces reflect light. Objects are easier to see when there is less light if they are reflective. The light from the sun can damage our eyes and therefore we should not look directly at the Sun and can protect our eyes by wearing sunglasses or sunhats in bright light. Shadows are formed on a surface when an opaque or translucent object is between a light source and the surface and blocks some of the light. The size of the shadow depends on the position of the source, object and surface. **Key vocabulary:** Light, light source, dark, absence of light, transparent, translucent, opaque, shiny, matt, surface, shadow, reflect, mirror, sunlight, dangerous	Can describe how we see objects in light and can describe dark as the absence of light Can state that it is dangerous to view the sun directly and state precautions used to view the sun, for example in eclipses Can define transparent, translucent and opaque Can describe how shadows are formed by objects blocking light.
	Applying knowledge in familiar related contexts, including a range of enquiries	Explore how different objects are more or less visible in different levels of lighting Explore how objects with different surfaces e.g. shiny vs matt are more or less visible Explore how shadows vary as the distance between a light source, an object or surface is changed Explore shadows which are connected to and disconnected from the object e.g. shadows of clouds and children in the playground Choose suitable materials to make shadow puppets Create artwork using shadows	Can describe patterns in visibility of different objects in different lighting conditions and predict which will be more or less visible as conditions change Can clearly explain, giving examples, that objects are not visible in complete darkness Can describe and demonstrate how shadows are formed by blocking light Can describe, demonstrate and make predictions about patterns in how shadows vary

Y3 Forces and magnets

1. compare how things move on different surfaces
2. notice that some forces need contact between two objects, but magnetic forces can act at a distance
3. observe how magnets attract or repel each other and attract some materials and not others
4. compare and group together a variety of everyday materials on the basis of whether they are attracted to a magnet, and identify some magnetic materials
5. describe magnets as having two poles
6. predict whether two magnets will attract or repel each other, depending on which poles are facing

	Assessment guidance	**Key learning**	**Possible Evidence**
SECURE	Shows understanding of a concept using scientific vocabulary correctly	A force is a push or a pull. When an object moves on a surface, the texture of the surface and the object affect how it moves. It may help the object to move better or it may hinder its movement e.g. ice skater compared to walking on ice in normal shoes. A magnet attracts magnetic material. Iron and nickel and other materials containing these e.g. stainless steel, are magnetic. The strongest parts of a magnet are the poles. Magnets have two poles – a north pole and a south pole. If two like poles e.g. two north poles, are brought together they will push away from each other – repel. If two unlike poles e.g. a north and south, are brought together they will pull together – attract. For some forces to act there must be contact e.g. a hand opening a door, the wind pushing the trees. Some forces can act at a distance e.g. magnetism. The magnet does not need to touch the object that it attracts. **Key vocabulary:** Force, push, pull, twist, contact force, non-contact force, magnetic force, magnet, strength, bar magnet, ring magnet, button magnet, horseshoe magnet, attract, repel, magnetic material, metal, iron, steel, poles, north pole, south pole	Can give examples of forces in everyday life Can give examples of objects moving differently on different surfaces Can name a range of types of magnets and show how the poles attract and repel Can draw diagrams using arrows to show the attraction and repulsion between the poles of magnets
	Applying knowledge in familiar related contexts, including a range of enquiries	Carry out investigations to explore how objects move on different surfaces e.g. spinning tops/coins, rolling balls/cars, clockwork toys, soles of shoes etc. Explore what materials are attracted to a magnet Classify materials according to whether they are magnetic Explore the way that magnets behave in relation to each other Use a marked magnet to find the unmarked poles on other types of magnets Explore how magnets work at a distance e.g. through the table, in water, jumping paper clip up off the table Devise an investigation to test the strength of magnets	Can use their results to describe how objects move on different surfaces Can use their results to make predictions for further tests e.g. it will spin for longer on this surface than that, but not as long as it spun on that surface Can use classification evidence to identify that some metals but not all are magnetic Through their exploration they can show how like poles repel and unlike poles attract and name unmarked poles Can use test data to rank magnets

Y4 Living things and their habitats

1. recognise that living things can be grouped in a variety of ways
2. explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment
3. recognise that environments can change and that this can sometimes pose dangers to living things

	Assessment guidance	Key learning	Possible Evidence
SECURE	Shows understanding of a concept using scientific vocabulary correctly	Living things can be grouped (classified) in different ways according to their features. Classification keys can be used to identify and name living things. Living things live in a habitat which provides an environment to which they are suited (year 2 learning). These environments may change naturally e.g. through flooding, fire, earthquakes etc. Humans also cause the environment to change. This can be in a good way i.e. positive human impact, such as setting up nature reserves or in a bad way i.e. negative human impact, such as littering. These environments also change with the seasons; different living things can be found in a habitat at different times of the year **Key vocabulary** Classification, classification keys, environment, habitat, human impact, positive, negative, migrate, hibernate	Can name living things living in a range of habitats, giving the key features that helped them to identify them Can give examples of how an environment may change both naturally and due to human impact
	Applying knowledge in familiar related contexts, including a range of enquiries	Observe plants and animals in different habitats throughout the year Compare and contrast the living things observed Use classification keys to name unknown living things Classify living things found in different habitats based on their features Create a simple identification key based on observable features Use fieldwork to explore human impact on the local environment e.g. litter, tree planting Use secondary sources to find out about how environments may naturally change Use secondary sources to find out about human impact, both positive and negative, on environments	Can keep a careful record of living things found in different habitats throughout the year (diagrams, tally charts etc.) Can use classification keys to identify unknown plants and animals Can present their learning about changes to the environment in different ways e.g. campaign video, persuasive letter

Y4 Animals including humans

1. describe the simple functions of the basic parts of the digestive system in humans
2. identify the different types of teeth in humans and their simple functions
3. construct and interpret a variety of food chains, identifying producers, predators and prey

	Assessment guidance	**Key learning**	**Possible Evidence**
SECURE	Shows understanding of a concept using scientific vocabulary correctly	Food enters the body through the mouth. Digestion starts when the teeth start to break the food down. Saliva is added and the tongue rolls the food into a ball. The food is swallowed and passes down the oesophagus to the stomach. Here the food is broken down further by being churned around and other chemicals are added. The food passes into the small intestine. Here nutrients are removed from the food and leave the digestive system to be used elsewhere in the body. The rest of the food then passes into the large intestine. Here the water is removed for use elsewhere in the body. What is left is then stored in the rectum until it leaves the body through the anus when you go to the toilet. Humans have four types of teeth - incisors for cutting, canines for tearing, molars and premolars for grinding (chewing). Living things can be classified as producers, predators and prey according to their place in the food chain. **Key vocabulary** Digestive system, digestion, mouth, teeth, saliva, oesophagus, stomach, small intestine, nutrients, large intestine, rectum, anus, teeth, incisor, canine, molar, premolars, herbivore, carnivore, omnivore, producer, predator, prey, food chain	Can sequence the main parts of the digestive system Can draw the main parts of the digestive system onto a human outline Can describe what happens in each part of the digestive system Can point to the three different types of teeth in their mouth and talk about their shape and what they are used for Can name producers, predators and prey within a habitat Can construct food chains
	Applying knowledge in familiar related contexts, including a range of enquiries	Research the function of the parts of the digestive system Create a model of the digestive system using household objects Explore eating different types of food, to identify which teeth are being used for cutting, tearing and grinding (chewing) Classify animals as herbivores, carnivores or omnivores according to the type of teeth they have in their skulls Use food chains to identify producers, predators and prey within a habitat Use secondary sources to identify animals in a habitat and find out what they eat	Can use diagrams or a model to describe the journey of food through the body explaining what happens in each part. Can record the teeth in their mouth (make a dental record) Can explain the role of the different types of teeth Can explain how the teeth in animal skulls show they are carnivores, herbivores or omnivores. Can create food chains based on research

Y4 States of matter

1. compare and group materials together, according to whether they are solids, liquids or gases
2. observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C)
3. identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature

	Assessment guidance	Key learning	Possible Evidence
SECURE	Shows understanding of a concept using scientific vocabulary correctly	A solid keeps its shape and has a fixed volume. A liquid has a fixed volume but changes in shape to fit the container. A liquid can be poured and keeps a level, horizontal surface. A gas fills all available space; it has no fixed shape or volume. Granular and powdery solids like sand can be confused with liquids because they can be poured, but when poured they form a heap and they do not keep a level surface when tipped. Each individual grain demonstrates the properties of a solid. Melting is a state change from solid to liquid. Freezing is a state change from liquid to solid. The freezing point of water is 0°C. Boiling is a change of state from liquid to gas that happens when a liquid is heated to a specific temperature and bubbles of the gas can be seen in the liquid. Water boils when it is heated to 100°C. Evaporation is the same state change as boiling (liquid to gas) but it happens slowly at lower temperatures and only at the surface of the liquid. Evaporation happens more quickly if the temperature is higher, the liquid is spread out or it is windy. Condensation is the change back from a gas to a liquid caused by cooling. Water at the surface of seas, rivers etc. evaporates into water vapour (a gas). This rises, cools and condenses back into a liquid forming clouds. When too much water has condensed the water droplets in the cloud get too heavy and fall back down as rain, snow, sleet etc. and drain back into rivers etc. This is known as precipitation. This is the water cycle. **Key vocabulary** Solid, liquid, gas, state change, melting, freezing, melting point, boiling point, evaporation, temperature, water cycle	Can create a concept map, including arrows linking the key vocabulary Can name properties of solids, liquids and gases Can give everyday examples of melting and freezing Can give everyday examples of evaporation and condensation Can describe the water cycle
	Applying knowledge in familiar related contexts, including a range of enquiries	Observe closely and classify a range of solids Observe closely and classify a range of liquids Explore making gases visible e.g. squeezing sponges under water to see bubbles, and showing their effect e.g. using straws to blow objects, trees moving in the wind Classify materials according to whether they are solids, liquids and gases Observe a range of materials melting e.g. ice, chocolate, butter Investigate how to melt ice more quickly Observe the changes when making rocky road cakes or ice-cream Investigating melting point of different materials e.g. ice, margarine, butter and chocolate Explore freezing different liquids e.g. tomato ketchup, oil, shampoo Use a thermometer to measure temperatures e.g. icy water (melting), tap water, hot water, boiling water (demonstration) Observe water evaporating and condensing e.g. on cups of icy water and hot water Set up investigations to explore changing the rate of evaporation e.g. washing, puddles, handprints on paper towels, liquids in containers Use secondary sources to find out about the water cycle	Can give reasons to justify why something is a solid liquid or gas Can give examples of things that melt/freeze and how their melting points vary From their observations, can give the melting points of some materials Using their data, can explain what affects how quickly a solid melts Can measure temperatures using a thermometer Can explain why there is condensation on the inside the hot water cup but on the outside of the icy water cup From their data, can explain how to speed up or slow down evaporation Can present their learning about the water cycle in a range of ways e.g. diagrams, explanation text, story of a water droplet

Y4 Sound

1. identify how sounds are made, associating some of them with something vibrating
2. recognise that vibrations from sounds travel through a medium to the ear
3. find patterns between the pitch of a sound and features of the object that produced it
4. find patterns between the volume of a sound and the strength of the vibrations that produced it
5. recognise that sounds get fainter as the distance from the sound source increases

	Assessment guidance	Key learning	Possible evidence
SECURE	Shows understanding of a concept using scientific vocabulary correctly	A sound source produces vibrations which travel through a medium from the source to our ears. Different mediums such as solids, liquids and gases can carry sound but sound cannot travel through a vacuum (an area empty of matter). The vibrations cause parts of our body inside our ears to vibrate, allowing us to hear (sense) the sound. The loudness (volume) of the sound depends on the strength (size) of vibrations which decreases as they travel through the medium. Therefore, sounds decrease in volume as you move away from the source. A sound insulator is a material which blocks sound effectively. Pitch is the highness or lowness of a sound and is affected by features of objects producing the sounds. For example, smaller objects usually produce higher pitched sounds. **Key Vocabulary** Sound, source, vibrate, vibration, travel, pitch (high, low), volume, faint, loud, insulation	Can name sound sources and state that sounds are produced by the vibration of the object. Can state that sounds travel through different mediums such as air, water, metal Can give examples to demonstrate how the pitch of a sound are linked to the features of the object that produced it Can give examples of how to change the volume of a sound e.g. increase the size of vibrations by hitting or blowing harder Can give examples to demonstrate that sounds get fainter as the distance from the sound source increases
	Applying knowledge in familiar related contexts, including a range of enquiries	Classify sound sources Explore making sounds with a range of objects such as musical instruments and other household objects Explore how string telephones or ear gongs work Explore using objects that change in feature to change pitch and volume such as length of guitar string, bottles of water or tuning forks Measure sounds over different distances Measure sounds through different insulation materials	Can explain what happens when you strike a drum or pluck a string and use a diagram to show how sounds travel from an object to the ear Can demonstrate how to increase or decrease pitch and volume using musical instruments or other objects Can use data to identify patterns in pitch and volume Can explain how loudness can be reduced by moving further from the sound source or by using a sound insulating medium

Y4 Electricity

1. identify common appliances that run on electricity
2. construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers
3. identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery
4. recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit
5. recognise some common conductors and insulators, and associate metals with being good conductors

	Assessment guidance	Key learning	Possible Evidence
SECURE	Shows understanding of a concept using scientific vocabulary correctly	Many household devices and appliances run on electricity. Some plug in to the mains and others run on batteries. An electrical circuit consists of a cell or battery connected to a component using wires. If there is a break in the circuit, a loose connection or a short circuit the component will not work. A switch can be added to the circuit to turn the component on and off. Metals are good conductors so they can be used as wires in a circuit. Non-metallic solids are insulators except for graphite (pencil lead). Water, if not completely pure, also conducts electricity **Key Vocabulary** Electricity, electrical appliance/device, mains, plug, electrical circuit, complete circuit, component, cell, battery, positive, negative, connect/connections, loose connection, short circuit, crocodile clip, bulb, switch, buzzer, motor, conductor, insulator, metal, non-metal, symbol N.B. Children in year 4 do not ned to use standard symbols as this is taught in year 6	Can name the components in a circuit Can make electric circuits Can control a circuit using a switch Can name some metals that are conductors Can name materials that are insulators
	Applying knowledge in familiar related contexts, including a range of enquiries	Construct a range of circuits Explore which materials can be used instead of wires to make a circuit Classify the materials that were suitable/not suitable for wires Explore how to connect a range of different switches and investigate how they function in different ways Choose switches to add to circuits to solve particular problems such as a pressure switch for a burglar alarm Apply their knowledge of conductors and insulators to design and make different types of switch Make circuits that can be controlled as part of a D&T project N.B. Children should be given one component at a time to add to circuits.	Can communicate structures of circuits using drawings which show how the components are connected Use classification evidence to identify that metals are good conductors and non-metals are insulators Can incorporate a switch into a circuit to turn it on and off Can connect a range of different switches identifying the parts that are insulators and conductors Can add a circuit with a switch to a DT project and can demonstrate how it works Can give reasons for choice of materials for making different parts of a switch Can describe how their switch works

Y5 Living things and their habitats

1. describe the differences in the life cycles of a mammal, an amphibian, an insect and a bird
2. describe the life process of reproduction in some plants and animals

	Assessment guidance	Key learning	Possible evidence
SECURE	Shows understanding of a concept using scientific vocabulary correctly	As part of their life cycle plants and animals reproduce. Most animals reproduce sexually. This involves two parents where the sperm from the male fertilises the female egg. Animals including humans have offspring which grow into adults. In humans and some animals these offspring will be born live, such as babies or kittens, and then grow into adults. In other animals, such as chickens or snakes, there may be eggs laid that hatch to young which then grow to adults. Some young undergo a further change before becoming adults e.g. caterpillars to butterflies. This is called a metamorphosis. Plants reproduce both sexually and asexually. Bulbs, tubers, runners and plantlets are examples of asexual plant reproduction which involves only one parent. Gardeners may force plants to reproduce asexually by taking cuttings. Sexual reproduction occurs through pollination, usually involving wind or insects. **Key vocabulary** Life cycle, reproduce, sexual, sperm, fertilises, egg, live young, metamorphosis, asexual, plantlets, runners, bulbs, cuttings	Can draw the life cycle of a range of animals identifying similarities and differences between the life cycles Can explain the difference between sexual and asexual reproduction and give examples of how plants reproduce in both ways
	Applying knowledge in familiar related contexts, including a range of enquiries	Use secondary sources and, where possible, first hand observations to find out about the life cycle of a range of animals Compare the gestation times for mammals and look for patterns e.g. in relation to size of animal or length of dependency after birth Look for patterns between the size of an animal and its expected life span Grow and observe plants that reproduce asexually e.g. strawberries, spider plant, potatoes Take cuttings from a range of plants e.g. African violet, mint Plant bulbs and then harvest to see how they multiply Use secondary sources to find out about pollination	Can present their understanding of the life cycle of a range of animals in different ways e.g. drama, pictorially, chronological reports, creating a game Can identify patterns in life cycles Can compare two or more animal life cycles studied Can explain how a range of plants reproduce asexually

Y5 Animals, including humans (this builds on the learning in Living things and their habitat)

1. describe the changes as humans develop to old age

	Assessment guidance	Key learning	Possible evidence
SECURE	Shows understanding of a concept using scientific vocabulary correctly	When babies are young they grow rapidly. They are very dependent on their parents. As they develop they learn many skills. At puberty, a child's body changes and develops primary and secondary sexual characteristics. This enables the adult to reproduce. This needs to be taught alongside PSHE Useful guidance can be obtained at: http://www.ase.org.uk/news/aseviews/teaching-about-puberty/ http://www.ase.org.uk/documents/2016-joint-statement-on-reproduction/ **Key vocabulary** Puberty: the vocabulary to describe sexual characteristics	Can explain the changes that takes place in boys and girls during puberty Can explain how a baby changes physically as it grows and also what it is able to do
	Applying knowledge in familiar related contexts, including a range of enquiries	This unit is likely to be taught through direct instruction due to its sensitive nature	

Y5 Properties and changes of materials

1. compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets
2. know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution
3. use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating
4. give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic
5. demonstrate that dissolving, mixing and changes of state are reversible changes
6. explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda

	Assessment guidance	Key learning	Possible evidence
SECURE	Shows understanding of a concept using scientific vocabulary correctly	Materials have different uses depending on their properties and state (liquid, solid, gas). Properties include hardness, transparency, electrical and thermal conductivity and attraction to magnets. Some materials will dissolve in a liquid and form a solution while others are insoluble and form sediment. Mixtures can be separated by filtering, sieving and evaporation. Some changes to materials such as dissolving, mixing and changes of state are reversible, but some changes such as burning wood, rusting and mixing vinegar with bicarbonate of soda result in the formation of new materials and these are not reversible. **Key vocabulary** Thermal/electrical insulator/conductor, change of state, mixture, dissolve, solution, soluble, insoluble, filter, sieve reversible/non-reversible change, burning, rusting, new material	Can use understanding of properties to explain everyday uses of materials. For example, how bricks, wood, glass and metals are used in buildings Can explain what dissolving means, giving examples Can name equipment used for filtering and sieving Can use knowledge of liquids, gases and solids to suggest how materials can be recovered from solutions or mixtures by evaporation, filtering or sieving Can describe some simple reversible and non-reversible changes to materials, giving examples
	Applying knowledge in familiar related contexts, including a range of enquiries	Investigate the properties of different materials in order to recommend materials for particular functions depending on these properties e.g. test waterproofness and thermal insulation to identify a suitable fabric for a coat Explore adding a range of solids to water and other liquids e.g. cooking oil, as appropriate Investigate rates of dissolving by carrying out comparative and fair test Separate mixtures by sieving, filtering and evaporation, choosing the most suitable method and equipment for each mixture Explore a range of non-reversible changes e.g. rusting, adding fizzy tablets to water, burning Carry out comparative and fair tests involving non-reversible changes e.g. What affects the rate of rusting? What affects the amount of gas produced? Research new materials produced by chemists e.g. Spencer Silver (glue of sticky notes) and Ruth Benerito (wrinkle free cotton)	Can create a chart or table grouping/comparing everyday materials by different properties Can use test evidence gathered about different properties to suggest an appropriate material for a particular purpose Can group solids based on their observations when mixing them with water Can give reasons for choice of equipment and methods to separate a given solution or mixture such as salt or sand in water Can explain the results from their investigations involving dissolving and non-reversible change

Y5 Earth and space

1. describe the movement of the Earth, and other planets, relative to the Sun in the solar system
2. describe the movement of the Moon relative to the Earth
3. describe the Sun, Earth and Moon as approximately spherical bodies
4. use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky

	Assessment guidance	Key learning	Possible evidence
SECURE	Shows understanding of a concept using scientific vocabulary correctly	The Sun is a star. It is at the centre of our solar system. There are 8 planets (can choose to name them, but not essential). These travel around the Sun in fixed orbits. Earth takes 365¼ days to complete its orbit around the Sun. The Earth rotates (spins) on its axis every 24 hours. As Earth rotates half faces the Sun (here it is day) and half is facing away from the Sun (night). As the Earth rotates the Sun appears to move across the sky. The Moon orbits the Earth. It takes about 28 days to complete its orbit. The Sun, Earth and Moon are approximately spherical. **Key vocabulary** Earth, Sun, Moon, (Mercury, Jupiter, Saturn, Venus, Mars, Uranus, Neptune) spherical, solar system, rotates, star, orbit, planets	Can create a voice over for a video clip or animation Can show using diagrams the movement of the Earth and Moon Can explain the movement of the Earth and Moon Can show using diagrams the rotation of the Earth and how this causes day and night Can explain what causes day and night
	Applying knowledge in familiar related contexts, including a range of enquiries	Use secondary sources to help create a model e.g. role play or using balls, to show the movement of the Earth around the Sun and the Moon around the Earth. Use secondary sources to help make a model to show why day and night occur Make first-hand observations of how shadows caused by the Sun change through the day Make a sundial Research time zones Consider the views of scientists in the past and evidence used to deduce shapes and movements of the Earth, Moon and planets before space travel	Can use the model to explain how the Earth moves in relation to the Sun and the moon moves in relation to the Earth Can demonstrate and explain verbally how day and night occur Can explain evidence gathered about the position of shadows in term of the movement of the Earth. Can show this using a model Can explain how a sundial works Can explain verbally using a model why we have time zones Can describe the arguments and evidence used by scientists in the past

Y5 Forces

1. explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object
2. identify the effects of air resistance, water resistance and friction, that act between moving surfaces
3. recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect

	Assessment guidance	**Key learning**	**Possible evidence**
SECURE	Shows understanding of a concept using scientific vocabulary correctly	A force causes an object to start moving, stop moving, speed up, slow down or change direction. Gravity is a force that acts at a distance. Everything is pulled to the Earth by gravity. This causes unsupported objects to fall. Air resistance, water resistance and friction are contact forces that act between moving surfaces. The object may be moving through the air or water or the air and water may be moving over a stationary object. A mechanism is a device that allows a small force to be increased to a larger force. The pay back is that it requires a greater movement. The small force moves a long distance and the resulting large force moves a small distance, e.g. a crowbar or bottle top remover. Pulleys, levers and gears are all mechanisms, also known as simple machines. **Key vocabulary** Force, gravity, Earth, air resistance, water resistance, friction, mechanisms, simple machines, levers, pulleys, gears	Can demonstrate the effect of gravity acting on an unsupported object Can give examples of friction, water resistance and air resistance Can give examples of when it is beneficial to have high or low friction, water resistance and air resistance Can demonstrate how pulleys, levers and gears work
	Applying knowledge in familiar related contexts, including a range of enquiries	Investigate the effect of friction in a range of contexts e.g. trainers, bath mats, mats for a helter-skelter Investigate the effects of water resistance in a range of contexts e.g. dropping shapes through water, pulling shapes e.g. boats along the surface of water Investigate the effects of air resistance in a range of contexts e.g. parachutes, spinners, sails on boats Explore how levers, pulleys and gears work Make a product that involves a lever, pulley or gear Create a timer that uses gravity to move a ball Research how the work of scientists such as Galileo Galilei and Isaac Newton helped to develop the theory of gravitation	Can explain the results of their investigations in terms of the force, showing a good understanding that as the object tries to move through the water or air or across the surface, the particles in the water, air or on the surface slow it down Can demonstrate clearly the effects of using levers, pulleys and gears

Y6 Living things and their habitats

1. describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including micro-organisms, plants and animals
2. give reasons for classifying plants and animals based on specific characteristics

	Assessment guidance	Key learning	Possible Evidence
SECURE	Shows understanding of a concept using scientific vocabulary correctly	Living things can be formally grouped according to characteristics. Plants and animals are two main groups but there are other livings things that do not fit into these groups e.g. micro-organisms such as bacteria and yeast, and toadstools and mushrooms. Plants can make their own food whereas animals cannot. Animals can be divided into two main groups – those that have backbones (vertebrates) and those that do not (invertebrates). Vertebrates can be divided into five small groups – fish, amphibians, reptiles, birds and mammals. Each group has common characteristics. Invertebrates can be divided into a number of groups including insects, spiders, snails and worms. Plants can be divided broadly into two main groups – flowering plants and non-flowering plants. **Key vocabulary:** Vertebrates, fish, amphibians, reptiles, birds, mammals, invertebrates, insects, spiders, snails, worms, flowering and non-flowering	Can give examples of animals in the five vertebrate groups and some of the invertebrate groups Can give the key characteristics of the five vertebrate groups and some invertebrate groups Can compare the characteristics of animals in different groups Can give examples of flowering and non-flowering plants
	Applying knowledge in familiar related contexts, including a range of enquiries	Use secondary sources to learn about the formal classification system devised by Carl Linnaeus and why it is important Use first hand observation to identify characteristics shared by the animals in a group Use secondary sources to research the characteristics of animals that belong to a group Use information about the characteristics of an unknown animal or plant to assign it to a group Classify plants and animals presenting this in a range of ways – Venn diagrams, Carroll diagrams and keys Create an imaginary animal which has features from one or more groups	Can use classification materials to identify unknown plants and animals Can create classification keys for plants and animals Can give a number of characteristics that explain why an animal belongs to a particular group

Y6 Animals including humans

1. identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood
2. recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function
3. describe the ways in which nutrients and water are transported within animals, including humans

	Assessment guidance	**Key learning**	**Possible Evidence**
SECURE	Shows understanding of a concept using scientific vocabulary correctly	The heart pumps blood in the blood vessels around to the lungs. Oxygen goes into the blood and carbon dioxide is removed. The blood goes back to the heart and is then pumped around the body. Nutrients, water and oxygen are transported in the blood to the muscles and other parts of the body where they are needed. As they are used they produce carbon dioxide and other waste products. Carbon dioxide is carried by the blood back to the heart and then the cycle starts again as it is transported back to the lungs to be removed from the body. This is the human circulatory system. Diet, exercise, drugs and lifestyle have an impact on the way our bodies function. They can affect how well out heart and lungs work, how likely we are to suffer from conditions such as diabetes, how clearly we think, and generally how fit and well we feel. Some conditions are caused by deficiencies in our diet e.g. lack of vitamins. **Key vocabulary** Heart, pulse, rate, pumps, blood, blood vessels, transported, lungs, oxygen, carbon dioxide, nutrients, water, muscles, cycle, circulatory system, diet, exercise, drugs and lifestyle	Can draw a diagram of the circulatory system and label the parts and annotate it to show what the parts do Produces a piece of writing that demonstrates the key knowledge e.g. explanation text, job description of the heart
	Applying knowledge in familiar related contexts, including a range of enquiries	Create a role play model for the circulatory system Carry out a range of pulse rate investigations • Fair test – effect of different activities on my pulse rate • Pattern seeking – exploring which groups of people may have higher or lower resting pulse rates • Observation over time - how long does it take my pulse rate to return to my resting pulse rate (recovery rate) • Pattern seeking – exploring recovery rate for different groups of people Learn about the impact of exercise, diet, drugs and lifestyle on the body. This is likely to be taught through direct instruction due to its sensitive nature	Use the role play model to explain the main parts of the circulatory system and their role Can use subject knowledge about the heart whilst writing conclusions for investigations Can explain both the positive and negative effects of diet, exercise, drugs and lifestyle on the body Present information e.g. in a health leaflet describing impact of drugs and lifestyle on the body

Y6 Evolution and inheritance

1. recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago
2. recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents
3. identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution

	Assessment guidance	Key learning	Possible Evidence
SECURE	Shows understanding of a concept using scientific vocabulary correctly	All living things have offspring of the same kind, as features in the offspring are inherited from the parents. Due to sexual reproduction, the offspring are not identical to their parents and vary from each other. Plants and animals have characteristics that make them suited (adapted) to their environment. If the environment changes rapidly some variations of a species may not suit the new environment and will die. If the environment changes slowly, animals and plants with variations that are best suited survive in greater numbers to reproduce and pass their characteristics on to their young. Over time these inherited characteristics become more dominant within the population. Over a very long period of time these characteristics may be so different to how they were originally that a new species is created. This is evolution. Fossils give us evidence of what lived on the Earth millions of year ago and provide evidence to support the theory of evolution. More recently scientists such as Darwin and Wallace observed how living things adapt to different environments to become distinct varieties with their own characteristics. **Key vocabulary** Offspring, sexual reproduction, vary, characteristics, suited, adapted, environment, inherited, species, fossils	Can explain the process of evolution Can give examples of how plants and animals are suited to an environment Can give examples of how an animal or plant has evolved over time e.g. penguin, peppered moth Give examples of living things that lived millions of years ago and the fossil evidence we have to support this Can give examples of fossil evidence that can be used to support the theory of evolution
	Applying knowledge in familiar related contexts, including a range of enquiries	Design a new plant or animal to live in a particular habitat Use models to demonstrate evolution e.g. Darwin's finches bird beak activity Use secondary sources to find out about how the population of peppered moths changed during the industrial revolution Make observations of fossils to identify living things that lived on Earth millions of years ago Identify features in animals and plants that are passed on to offspring Explore this process by considering the artificial breeding of animals or plants e.g. dogs Compare the ideas of Charles Darwin and Alfred Wallace on evolution Research the work of Mary Anning and how this provided evidence of evolution	Can identify characteristics that will make a plant or animal suited or not suited to a particular habitat Can link the patterns seen in the model to the real examples Can explain why the dominant colour of the peppered moth changed over a very short period of time

Y6 Light

1. recognise that light appears to travel in straight lines
2. use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye
3. explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes
4. use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them

	Assessment guidance	Key learning	Possible Evidence
SECURE	Shows understanding of a concept using scientific vocabulary correctly	Light appears to travel in straight lines and we see objects when light from them goes into our eyes. The light may come directly from light sources but for other objects some light must be reflected from the object into our eyes for the object to be seen. Objects that block light (are not fully transparent) will cause shadows. Because light travels in straight lines the shape of the shadow will be the same as the outline shape of the object. **Key vocabulary:** As for year 3 plus straight lines, light rays.	Can describe with diagrams or models as appropriate how light travels in straight lines either from sources or reflected from other objects into our eyes. Can describe with diagrams or models as appropriate how light travels in straight lines past translucent or opaque objects to form a shadow of the same shape.
	Applying knowledge in familiar related contexts, including a range of enquiries	Explore different ways to demonstrate that light travels in straight lines e.g. shining a torch down a bent and straight hose pipe, shining a torch through different shaped holes in card Explore the uses of the behaviour of light, reflection and shadows such as in periscope design, rear view mirrors and shadow puppets.	Can explain how evidence from enquiries shows that light travels in straight lines Can predict and explain with diagrams or models as appropriate how the path of light rays can be directed by reflection to be seen, for example reflection in car rear view mirrors or in a periscope. Can predict and explain with diagrams or models as appropriate how the shape of shadows can be varied.

Y6 Electricity

1. associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit
2. compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off position of switches
3. use recognised symbols when representing a simple circuit in a diagram

<table>
<tr><th></th><th>Assessment guidance</th><th>Key learning</th><th>Possible Evidence</th></tr>
<tr><td rowspan="2">SECURE</td><td>Shows understanding of a concept using scientific vocabulary correctly</td><td>Adding more cells to a complete circuit will make a bulb brighter, a motor spin faster or a buzzer make a louder sound. If you use a battery with a higher voltage, the same thing happens. Adding more bulbs to a circuit will make each bulb less bright. Using more motors or buzzers, each motor will spin more slowly and each buzzer will be quieter. Turning a switch off (open) breaks a circuit so the circuit is not complete and electricity cannot flow. Any bulbs, motors or buzzers will then turn off as well.
You can use recognised circuit symbols to draw simple circuit diagrams.
Key Vocabulary
Circuit, complete circuit, circuit diagram, circuit symbol, cell, battery, bulb, buzzer, motor, switch, voltage
NB Children do not need to understand what voltage is but will use volts and voltage to describe different batteries. The words cells and batteries are now used interchangeably</td><td>Can make electric circuits and demonstrate how variation in the working of particular components, such as the brightness of bulbs can be changed by increasing or decreasing the number of cells or using cells of different voltages

Can draw circuit diagrams of a range of simple series circuits using recognised symbols</td></tr>
<tr><td>Applying knowledge in familiar related contexts, including a range of enquiries</td><td>Explain how a circuit operates to achieve particular operations, such as control the light for a torch with different brightnesses or make a motor go faster or slower
Make circuits to solve particular problems such as a quiet and a loud burglar alarm
Carry out fair tests exploring changes in circuits
Make circuits that can be controlled as part of a D&T project</td><td>Can incorporate a switch into a circuit to turn it on and off
Can change cells and components in a circuit to achieve a specific effect
Can communicate structures of circuits using circuit diagrams with recognised symbols
Can devise ways to measure brightness of bulbs, speed of motors, volume of a buzzer during a fair test
Can predict results and answer questions by drawing on evidence gathered</td></tr>
</table>

Year 1 Individual Pupil Science Assessment Record

Name	Teacher	Class

Working Scientifically	Working towards	Achieved	Exceeded
Can ask simple questions and recognising that they can be answered in different ways.			
Can observe closely, using simple equipment.			
Can perform simple tests.			
Can identify and classify phenomena.			
Can use their observations and ideas to suggest answers to questions			
Can gather and recording data to help in answering questions.			
Plants			
Can identify and name a variety of common plants, including garden plants, wild plants and trees, and those classified as deciduous and evergreen.			
Can describe the basic structure of a variety of common plants including roots, stem, leaves and flowers.			
Animals including humans			
Can identify and name a variety of common animals including fish, amphibians, reptiles, birds and mammals.			
Can identify and name a variety of common animals that are carnivores, herbivores and omnivores.			
Can describe and compare the structure of a variety of common animals (fish, amphibians, reptiles, birds and mammals, including pets)			
Can identify, name, draw and label the basic parts of the human body and say which part of the body is associated with each sense.			
Everyday Materials			
Can distinguish between an object and the material from which it is made.			
Can identify and name a variety of everyday materials, including wood, plastic, glass, metal, water, and rock.			
Can describe the simple physical properties of a variety of everyday materials.			
Can compare and group together a variety of everyday materials on the basis of their simple physical properties.			
Seasonal Changes			
Can observe changes across the four seasons.			
Can observe and describe weather associated with the seasons and how day length varies.			

Overall comment:

Year 2 Individual Pupil Science Assessment Record

Name	Teacher	Class

Working Scientifically (continued from Year 1)	Working towards	Achieved	Exceeded
Can ask simple questions and recognising that they can be answered in different ways.			
Can observe closely, using simple equipment.			
Can perform simple tests.			
Can identify and classify phenomena.			
Can use their observations and ideas to suggest answers to questions			
Can gather and recording data to help in answering questions.			
Living things and their habitats			
Can explore and compare the differences between things that are living, dead, and things that have never been alive.			
Can identify that most living things live in habitats to which they are suited and describe how different habitats provide for the basic needs of different kinds of animals and plants, and how they depend on each other.			
Can identify and name a variety of plants and animals in their habitats, including micro-habitats.			
Can describe how animals obtain their food from plants and other animals, using the idea of a simple food chain, and identify and name different sources of food.			
Plants			
Can observe and describe how seeds and bulbs grow into mature plants.			
Can find out and describe how plants need water, light and a suitable temperature to grow and stay healthy.			
Animals including humans			
Understands that animals, including humans, have offspring which grow into adults.			
Can find out about and describe the basic needs of animals, including humans, for survival (water, food and air).			
Can describe the importance for humans of exercise, eating the right amounts of different types of food, and hygiene.			
Uses of everyday materials			
Can identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses.			
Can find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching.			
Overall comment:			

Year 3 Individual Pupil Science Assessment Record

Name	Teacher	Class

Working Scientifically	Working towards	Achieved	Exceeded
Can ask relevant questions and using different types of scientific enquiries to answer them.			
Can set up simple practical enquiries, comparative and fair tests.			
Can make systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers.			
Can gather, record, classify and present data in a variety of ways to help in answering questions.			
Can record findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables.			
Can report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.			
Can use results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions.			
Can identify differences, similarities or changes related to simple scientific ideas and processes.			
Can use straightforward scientific evidence to answer questions or to support their findings.			
Plants			
Can identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers.			
Can explore the requirements of plants for life and growth (air, light, water, nutrients from soil, and room to grow) and how they vary from plant to plant.			
Can investigate the way in which water is transported within plants.			
Can explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal.			
Animals including humans			
Can identify that animals, including humans, need the right types and amount of nutrition, and that they cannot make their own food; they get nutrition from what they eat.			
Can identify that humans and some other animals have skeletons and muscles for support, protection and movement.			
Rocks			
Can compare and group together different kinds of rocks on the basis of their appearance and simple physical properties.			
Can describe in simple terms how fossils are formed when things that have lived are trapped within rock.			
Recognises that soils are made from rocks and organic matter.			
Light			
Recognises that they need light in order to see things and that dark is the absence of light.			
Understands that light is reflected from surfaces.			
Recognises that light from the sun can be dangerous and that there are ways to protect their eyes.			

Recognises that shadows are formed when the light from a light source is blocked by a solid object.			
Can find patterns in the way that the size of shadows change.			
Forces and Magnets			
Can compare how things move on different surfaces.			
Understands that some forces need contact between two objects, but magnetic forces can act at a distance.			
Can observe how magnets attract or repel each other and attract some materials and not others.			
Can compare and group together a variety of everyday materials on the basis of whether they are attracted to a magnet, and identify some magnetic materials.			
Can describe magnets as having two poles.			
Can predict whether two magnets will attract or repel each other, depending on which poles are facing.			
Overall comment:			

Year 4 Individual Pupil Science Assessment Record

Name	Teacher	Class

Working Scientifically (continued from Year 3)	Working towards	Achieved	Exceeded
Can ask relevant questions and using different types of scientific enquiries to answer them.			
Can set up simple practical enquiries, comparative and fair tests.			
Can make systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers.			
Can gather, record, classify and present data in a variety of ways to help in answering questions.			
Can record findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables.			
Can report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.			
Can use results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions.			
Can identify differences, similarities or changes related to simple scientific ideas and processes.			
Can use straightforward scientific evidence to answer questions or to support their findings.			
Living things and their habitats			
Recognises that living things can be grouped in a variety of ways.			
Can explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment.			
Recognises that environments can change and that this can sometimes pose dangers to living things.			
Animals including humans			
Can describe the simple functions of the basic parts of the digestive system in humans.			
Can identify the different types of teeth in humans and their simple functions.			
Can construct and interpret a variety of food chains, identifying producers, predators and prey.			
States of Matter			
Can compare and group materials together, according to whether they are solids, liquids or gases.			
Can observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C).			
Can identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.			
Sound			
Can identify how sounds are made, associating some of them with something vibrating.			
Recognises that vibrations from sounds travel through a medium to the ear.			
Can find patterns between the pitch of a sound and features of the object that produced it.			

Can find patterns between the volume of a sound and the strength of the vibrations that produced it.			
Recognises that sounds get fainter as the distance from the sound source increases.			
Electricity			
Can identify common appliances that run on electricity.			
Can construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers.			
Can identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery.			
Recognises that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit.			
Can recognise some common conductors and insulators, and associate metals with being good conductors.			
Overall comment:			

Year 5 Individual Pupil Science Assessment Record

Name	Teacher	Class

Working Scientifically	Working towards	Achieved	Exceeded
Can plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.			
Can take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.			
Can record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.			
Can use test results to make predictions to set up further comparative and fair tests.			
Can report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.			
Can identify scientific evidence that has been used to support or refute ideas or arguments.			
Living things and their habitats			
Can describe the differences in the life cycles of a mammal, an amphibian, an insect and a bird.			
Can describe the life process of reproduction in some plants and animals.			
Animals including humans			
Can describe the changes as humans develop to old age.			
Properties and change of materials			
Can compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets.			
Knows that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution.			
Can use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating.			
Can give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic.			
Can demonstrate that dissolving, mixing and changes of state are reversible changes.			
Can explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda.			
Earth and space			
Can describe the movement of the Earth, and other planets, relative to the Sun in the solar system.			
Can describe the movement of the Moon relative to the Earth.			
Can describe the Sun, Earth and Moon as approximately spherical bodies.			
Can use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky.			

Forces			
Can explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object.			
Can identify the effects of air resistance, water resistance and friction that act between moving surfaces.			
Recognises that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect.			
Overall comment:			

Year 6 Individual Pupil Science Assessment Record

Name	Teacher	Class

Working Scientifically (continued from Year 5)	Working towards	Achieved	Exceeded
Can plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.			
Can take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.			
Can record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.			
Can use test results to make predictions to set up further comparative and fair tests.			
Can report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.			
Can identify scientific evidence that has been used to support or refute ideas or arguments.			
Living things and their habitats			
Can describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including micro-organisms, plants and animals.			
Can give reasons for classifying plants and animals based on specific characteristics.			
Animals including humans			
Can identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood.			
Recognises the impact of diet, exercise, drugs and lifestyle on the way their bodies function.			
Can describe the ways in which nutrients and water are transported within animals, including humans.			
Evolution and inheritance			
Recognises that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago.			
Recognises that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents.			
Can identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution.			

Light			
Recognises that light appears to travel in straight lines.			
Can use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye.			
Can explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes.			
Can use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.			
Electricity			
Can associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit.			
Can compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off position of switches.			
Can use recognised symbols when representing a simple circuit in a diagram.			
Overall comment:			

The Teacher Assessment in Primary Science (TAPS) school self-evaluation tool

TAPS project team: Sarah Earle, Kendra McMahon, Chris Collier
and Alan Howe from Bath Spa Institute of Education,
with Dan Davies from Cardiff Metropolitan University

why & how?
PRIMARY SCIENCE TEACHING TRUST

BATH SPA UNIVERSITY
INSTITUTE FOR EDUCATION

January 2017

INTRODUCING THE TAPS PYRAMID MODEL

The Teacher Assessment in Primary Science (TAPS) project is based at Bath Spa University and funded by the Primary Science Teaching Trust (PSTT). TAPS aims to develop support for valid, reliable and manageable assessment, which will have a positive impact on children's learning.

Background

Wynne Harlen and colleagues (Harlen et al., 2012: funded by the Nuffield Foundation) recommended that the rich formative assessment data collected by teachers in the course of ongoing classroom work in science should also be made to serve summative reporting purposes. They developed a pyramid model where assessment information flowed from classroom practice to whole school reporting. This flow of information is represented by the **ORANGE ARROW** on the TAPS pyramid.

The TAPS team examined submissions to the Primary Science Quality Mark (Earle, 2014) and practice in 12 project schools to understand current approaches to assessment in primary science (Davies et al., 2014).

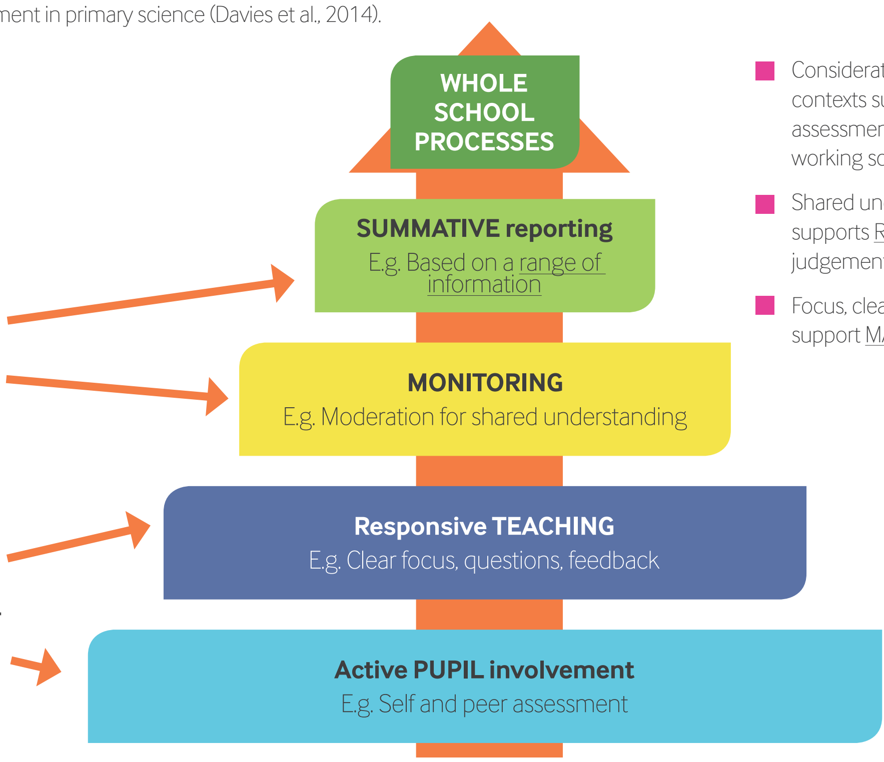
The TAPS pyramid

The TAPS team worked with local project schools, the Primary Science Quality Mark and PSTT College Fellows to create the model of teacher assessment and populate it with examples.

The TAPS pyramid provides a framework to support science subject leaders in identifying strengths and areas for development in school assessment systems. The suggestions in each box aim to strengthen the validity, reliability and manageability of assessment in primary science.

THE ONGOING FORMATIVE ASSESSMENT CAN BE SUMMARISED FOR DIFFERENT REPORTING PURPOSES.

THE BASE OF THE PYRAMID ENCAPSULATES THE PRINCIPLES OF ASSESSMENT FOR LEARNING.



- Consideration of science in range of contexts supports VALIDITY (so that assessments consider all areas e.g. working scientifically).
- Shared understanding and moderation supports RELIABILITY (consistency of judgements).
- Focus, clear purpose and examples support MANAGEABILITY.

Recommendations for where to start

The blue 'Pupil layer' and 'Teacher layer' at the base of the pyramid encapsulate the principles of Assessment for Learning. They include boxes which focus on: clear learning objectives or success criteria; use of questioning, feedback and next steps; peer and self assessment. Schools should begin by focusing on these layers since this is not only the foundation of the whole system, it is also where changes will have the most impact on pupil progress in primary science.

Using the school self-evaluation tool

The downloadable TAPS pyramid pdf is available at: **www.pstt.org.uk/resources/curriculum-materials/assessment**

It provides a supportive bank of examples, which can be found by clicking on each box. The pyramid can also provide a structure to support school self evaluation. The interactive functions allow you to traffic light your assessment systems (on your own saved copy) and make notes on the approaches in your school. If you prefer to do this on paper then a black and white pyramid for printing is also available on the PSTT website.

USING THE SCHOOL SELF-EVALUATION TOOL
http://tinyurl.com/pyramidintro

References

Davies, D., Collier, C., Earle, S., Howe, A. and McMahon, K. (2014) Approaches to Science Assessment in English Primary Schools (full report, teachers' summary and executive summary). Bristol: Primary Science Teaching Trust.

Earle, S., (2014) Formative and summative assessment of science in English primary schools: evidence from the Primary Science Quality Mark, *Research in Science and Technological Education*, 32(2): 216-228. http://www.tandfonline.com/doi/full/10.1080/02635143.2014.913129#.VPgkTfmsX_E

Harlen et al., (2012) Developing policy, principles and practice in primary school science assessment. Nuffield Foundation. http://www.nuffieldfoundation.org/sites/default/files/files/Developing_policy_principles_and_practice_in_primary_school_science_assessment_Nuffield_Foundation_v_FINAL.pdf

Science assessment: school self-evaluation tool

SCHOOL:

DATE:

- NO EVIDENCE
- SOME EVIDENCE
- STRONG EVIDENCE

DIRECTION OF INFORMATION FLOW THROUGH SCHOOL

FEEDBACK FROM DIALOGUE WITH SCHOOL LEADERSHIP, GOVERNORS AND PARENTS INFORMS CHANGES TO SCIENCE ASSESSMENT

TEACHER-PUPIL/PARENT CONFERENCES INCLUDE DIALOGUE ON ATTAINMENT IN SCIENCE

4. WHOLE-SCHOOL REPORTING

Science assessment processes provide a **valid and reliable summary** of pupil achievement at the end of Key Stages

3. SUMMATIVE REPORTING

Teachers **summarise** achievements in terms of **what pupils can do**, not only in terms of levels, grades or %

E.g. progress in skills is passed onto the next teacher.

Parents/carers receive **oral and written reports** that identify the next steps for their children

E.g. at parents' evening, comments on homework.

Summaries of pupil progress across the cohort draw on a range of information

E.g. learning across a range of contexts is used to decide support or extension needs

2. MONITORING OF PUPIL PROGRESS

Teachers base their summative judgements of pupils' learning on a **range of types of activity**

E.g. not reliant on one snapshot to make overall judgement.

Teachers take part in **moderation/ discussion** with each other of pupils' work in order to align judgements

E.g. staff meeting discussions of science work.

There is a **shared understanding of progression** in science

E.g. staff map progression of skills, TAs are involved in assessments.

Pupils are **aware of the criteria** by which their work over a period of time is judged

E.g. examples of what good science looks like are displayed.

A **manageable system for record-keeping** is in operation to track and report on pupils' learning in science

E.g. expectations on planning which annotate, end of topic grids, I cans.

1. ONGOING FORMATIVE ASSESSMENT

Teachers plan opportunities to elicit pupils' science knowledge and skills

E.g. plans show range of elicitation strategies at variety of times E.g. beg/mid/end lesson.

Teachers involve pupils in discussing **learning objectives** and **criteria for success**

E.g. discuss what good observation or conclusions look like.

Teachers gather evidence of their pupils' learning through **questioning/ discussion** and **observation**

E.g. Open Qs, class mindmap/ concept cartoon, TA postit quotes, floorbook, annotated photos

Teachers gather **evidence of their pupils' learning** through study of the products of activities and tasks

E.g. any recording, models, sorting.

Teachers use assessment to advance pupils' learning by **adapting the pace, challenge and content** of activities

E.g. support or challenge in response to pupils.

Teachers use assessment to advance pupils' learning by **giving feedback** to students about how to improve

E.g. marking, oral feedback, next steps, extension Qs.

Teachers use assessment to advance pupils' learning by providing **time for students to reflect** on and assess their own work

E.g. read and respond time.

Pupils identify their **existing ideas**, learning needs and interests, and consider those of peers.

E.g. mindmaps, annotated drawings, KWL grids, mini whiteboards, post its, talk partners.

Pupils **focus on science** knowledge, understanding, skills and attitudes in **learning objectives** and **success criteria**

E.g. be clear about science focus rather than presentation etc.

Pupils **assess their own** ideas and work against known criteria

E.g. traffic lighting or highlighting objective, commenting on whether predictions are supported.

Pupils **assess peers'** ideas and work against known criteria

E.g. comment on another group's presentation, give 2 stars and a wish for piece of work.

Pupils use assessment to advance their learning by **acting on feedback**

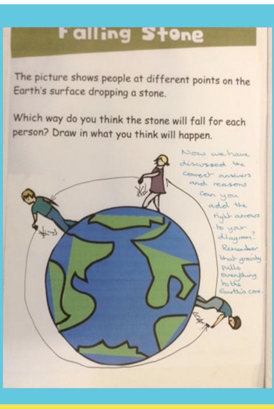
E.g. respond to mini plenary advice in second half of lesson, make improvements in next investigation.

Pupils collaboratively (with peers/ teachers) **identify next steps** in learning

E.g. identify which part of the success criteria is missing, consider how to make the measurement more accurate.

Produced by the Teacher Assessment in Primary Science Project, Bath Spa University, developed from from Harlen et al., (2012).

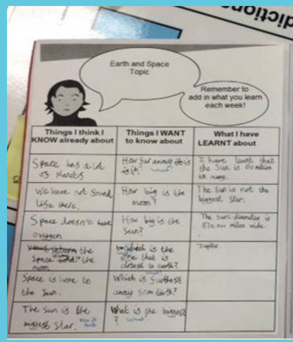
Examples of good practice



RETURNING TO A TASK

In a KWL grid pupils are asked to consider what they already Know about a topic and what they Want to find out. At a later date, return to the grid to consider what they have Learnt.

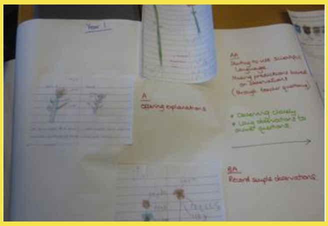
Returning to a task can happen with any activity: a pupil completes an activity, the teacher gives feedback and the pupil has another go. For example, at St Paul's Primary, when labelling falling objects, a pupil had first drawn arrows around the world. After discussion with the teacher, the pupil then drew new arrows towards the centre of the Earth. These particular examples come from Active Assessment: www.millgatehouse.co.uk/product/active-assessment-science

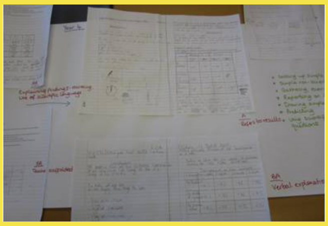


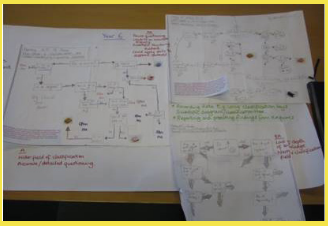
MODERATION GRAFFITI WALL

MODERATION GRAFFITI WALL
http://tinyurl.com/TAPSWorlebury

Moderation discussions, in year groups, schools and clusters, support consistency of expectations and judgements. At Worlebury St Paul's Primary, a staff meeting addressed concerns about explicit teaching of Working Scientifically. The staff were asked to bring examples of enquiry work from each year group and lay these along a roll of paper. This enabled teachers to discuss skills progression and development of independence in investigations. Judgements regarding attainment were discussed in relation to statements in the National Curriculum. Staff created a moderation graffiti wall to consider progression from Y1 to Y6.







RECORDING DISCUSSION IN FLOOR BOOKS

A floor book is a homemade book which provides a record of a discussion. Older children may write on post-its or in different coloured pens, whilst for younger children an adult would scribe the children's comments. The discussion could be in response to a stimulus, for example, at Oaktree Primary, how can we make jelly change? The group or class book creates a record of how the children's ideas have developed. For further information on how to use floor books go to: www.pstt.org.uk/resources/continuing-professional-development/floorbooks.aspx

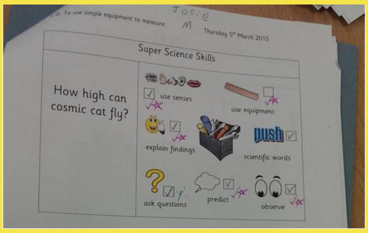
PRE AND POST ASSESSMENTS

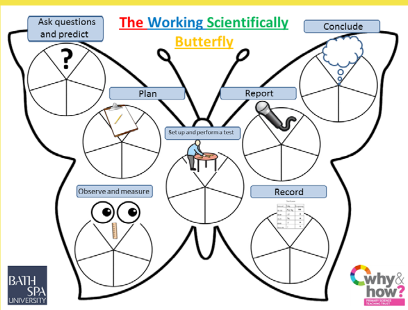
Eliciting the children's ideas at the beginning and end of a topic helps teachers to pitch the lessons , and also clearly demonstrates progress. For example, at the beginning of a unit on plants, a year 3 child's thought shower described factors which affect plant growth; by the end of the unit the same child described photosynthesis and reproduction. In a year 1 group discussion about animals, at the beginning of the topic the children knew little about amphibians or invertebrates. By the end of the unit, the children could name animals in these groups and describe some of their features.

SHARED UNDERSTANDING

Holt Primary have developed a science skills toolkit. This is a picture based success criteria for KS1 Working Scientifically which can be used by both pupils and teachers.

HOLT PRIMARY
http://tinyurl.com/HoltTAPS





At Shaw Primary, science 'stars' are displayed in the classroom showing key features of progression in enquiry. The science stars are also embedded in the planning which details success criteria for the sequence of lessons.

SHAW PRIMARY
http://tinyurl.com/ShawTAPS

Victoria Park Primary have developed a Working Scientifically butterfly to help focus and coverage of skills.

VICTORIA PARK PRIMARY
http://tinyurl.com/VPTAPS

The new focused assessment database of plans and examples is now available:

www.pstt.org.uk/resources/curriculum-materials/assessment

SUPPORT FROM TAPS
http://tinyurl.com/TAPSsupport

If you would like to offer further examples or provide the TAPS team with feedback, please email: **primary.science@bathspa.ac.uk**

Primary Science Teaching Trust, 12 Whiteladies Road, Bristol, BS8 1PD
www.pstt.org.uk

Plan for Focused Assessment of Science

Topic: Animals including humans	Year 1 Age 5-6	Title: Body Parts

Working Scientifically **Review:** Use observations and ideas to suggest answers to questions	**Conceptual Knowledge** Identify basic parts of the human body and say which part of the body is associated with each sense.

Assessment Focus

- Can the children label basic parts of the human body?
- Can the children say which part of the body is associated with each sense?

Activity *Today you are an anatomist.*

What parts of the body do you know?
Children to individually create a model (e.g. play dough or clay) of the human body and label the parts (head, neck, arms, elbows, legs, knees, face, ears, eyes, hair, mouth, teeth). Describe which part is associated with each sense and explain what we use each sense for, could label with different coloured paper or on a class/group model.
Present models to the class – video or photo based.
Look closely at body parts using magnifying glasses / mirrors (mouth, eyes, ears, noses) – are they all the same?
Choose a part of body to make a model of.
Question children to check understanding. Record comments & photo.

Adapting the activity
Support: Adult to ask the names for parts of the model and scribe.
Extension: To name other parts of the body including internal organs

Key Questions

- What different parts of the body have you made?
- What does that part of the body do?
- What are our senses?
- Where would you label your senses?
- What do you think happens inside?

Assessment Indicators

Not yet met: When prompted can name some body parts.

Meeting: Can explain features of their body part and link to senses, *e.g. I can feel things with my legs.*

Exceeding: Can talk about differences and similarities of body parts, including some internal organs, *e.g. heart, brain, lungs, stomach.*

Plan for Focused Assessment of Science

Topic: Animals including humans	Year 1 Age 5-6	Title: Animal classification
Working Scientifically **Review:** Identify and classify	**Conceptual Knowledge** Identify and name common animals including fish, amphibians, reptiles, birds and mammals. Identify and name common animals that are carnivores, herbivores and omnivores	

Assessment Focus

- Can the children name a variety of animals including fish/amphibians / reptiles/ birds/ mammals?
- Can the children classify animals according to different animal groups and/or what they eat?

Activity *(small group – adult to scribe children's comments)*

Give children a small selection of pictures or plastic toys of different creatures from all of the different animal groups. Children to identify and classify into fish, amphibian, reptile, bird and mammal and explain why they belong to that group. Prompt children to name animals and discuss their choices. Using a prepared chart, children sort under the headings fish, amphibian, reptile, bird and mammal. Using mammals only, identify one example that is a carnivore, a herbivore and an omnivore.
Either take photo of classifying or stick pictures onto template.

Adapting the activity
Support: Sort according to 3 animal groups – mammal, fish and bird.
Extension: How else could you sort them? What other ways?

Key Questions

- What is the same about the animals in that group?
- How are they different to this group?
- Why is the …….. in that group?
- Where would you put….?
- How could you sort differently?
- Which other animal could be in that group?

Assessment Indicators

Not yet met: Names some common animals and needs support to sort or limited to common mammals, birds and fish.

Meeting: Name a variety of common animals including fish /amphibians /reptiles / birds/mammals. Uses observations to classify into given scientific groupings including animal groups or omnivore/herbivore/carnivore and can explain how they are similar, *e.g. birds have feathers, frogs go in the water and out of water, they are all mammals because they are hairy.*

Exceeding: Can classify according to a range of features and give reasons for their choices, *e.g. some mammals live underwater, include other insect groups*

TAPS Plan for Focused Assessment of Science

Topic: Materials/light	Year 1 Age 5-6	Title: Ways to test transparency

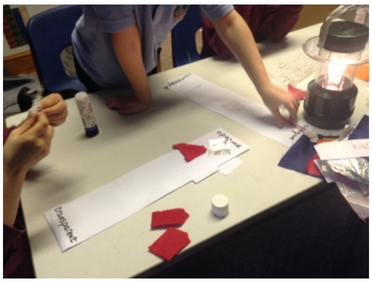
Working Scientifically
Recognise that sorting questions can be answered in different ways

Concept context
Describe properties of materials

Assessment Focus
- Can children test whether materials are opaque or transparent?
- Can children compare materials on the basis of their transparency?
- Can children discuss different ways to test transparency?

Activity
Explore a range of materials e.g. foil, shiny fabric, glossy acetate, shiny paper, brightly coloured paper, netting… list words to describe their properties on a whiteboard (e.g. shiny/dull, transparent/opaque & translucent). Explain that a material is transparent if we can see details through it and opaque if we cannot see anything at all. Ask children to look through a translucent material (e.g. bubble wrap) and explain that this is translucent because we can see light but not details.
Discuss how to test which are the most transparent, e.g. look through the material at a window or at a lamp, or shine torchlight through or take a photo through it. What can you see?
Groups test and sort a range of materials (could be for a purpose, e.g. to find the best material for making a windscreen for a car). Children return to sit in a circle and consider one group's sorting / ordering – do you agree? Would you move any? Why? Adult collect children's ideas or ask target children or those who have not worked with an adult. P4

Adapting the activity
Support: Provide sorting hoops or strips of paper labelled transparent / opaque. Adult to prompt children to describe and explain what they are doing.
Extension: Can you test in a different way? Where would you put this tricky one? e.g. coloured acetate (shiny and translucent).
Other: Could test whether shiny, magnetic, bendy.



Questions to support discussion
- How could you test it?
- Which is the most / least transparent? How do you know?
- What other words could you use to describe the materials?
- Does everyone in your group agree? Can you explain to the others why you have put that material there?
- Can you tell me another way to test this object?

Assessment Indicators

Not yet met: Can sort materials into two groups but not clear or gives a reason for the sorting that doesn't link to transparency. May not use a single criterion to sort: "these are colourful, these are shiny". May confuse transparency with other properties e.g. reflection or bright colours.

Meeting: Describe how they sorted the materials according to how transparent they are, and how other groups used different ways to sort the materials.

Possible ways of going further: Able to order the materials from most to least transparent and explain how the test helped them decide on this sequence. Can comment on effectiveness of different ways to test or compare the objects.

P4 Pupil box 4 - assess peers. See TAPS pyramid for more examples.

Plan for Focused Assessment of Science

Topic: Describing and Sorting Materials	Year 1 Age 5-6	Title: Floating & Sinking

Working Scientifically **Do:** Perform simple tests to compare and group	**Conceptual Knowledge** Compare and group together a variety of everyday materials on the basis of their simple physical properties

Assessment Focus

- Can children carry out a simple test?
- Can children use test results to group materials into those which float or sink?

Activity

Floating and sinking investigation in groups
Ask the children how could we find out which materials float? Discuss.
Provide a group of children with a large container filled with water and discuss ideas for answering the question, 'Which materials will float?'
Children could use a prepared template to record findings or make up one of their own. Children to choose an object and describe its properties, then make a prediction about whether it will float or sink. Children to test the object and record findings.
Adult to take photographs and make observations of children's scientific vocabulary and findings.

Adapting the activity

Support: Peer discussion and provide a recording sheet.
Extension: Explain their findings and begin to give reasons.

Key Questions

- What have you found out?
- Which things would you group together?
- What do you notice about each group? What have these things got in common?
- What else would you like to test? Why?

Assessment Indicators

Not yet met: With support, they can say which objects float or sink during the test.

Meeting: Children can carry out a simple test and describe what they find out through grouping the materials according to whether they float or sink.

Exceeding: Children show a systematic approach to carrying out an investigation and record their findings independently.

Plan for Focused Assessment of Science

Topic: Materials/light	Year 1 Age 5-6	Title: Ways to test reflectiveness

Working Scientifically	**Conceptual Knowledge**
Plan: Recognise that sorting questions can be answered in different ways	Describe properties of materials

Assessment Focus

- Can children test the reflectiveness of materials?
- Can children compare materials on the basis of their reflectiveness?
- Can children discuss different ways to test reflectiveness?

Activity

Explore a range of materials e.g. foil, shiny fabric, glossy acetate, shiny paper, brightly coloured paper, netting… list words to describe their properties on a whiteboard (e.g. shiny/dull, glossy, translucent/opaque).
Discuss how to test which are the most reflective, e.g. put in sunlight / torchlight / use a lamp, does it bounce off onto the wall/table? Can you see yourself in it?
Groups test and sort a range of materials (could be for a purpose, e.g. to find the most reflective materials for making our rockets in DT).
Children sit in a circle and consider one group's sorting / ordering – do you agree? Would you move any? Why? Adult collect children's ideas or ask target children or those who have not worked with an adult.

Adapting the activity

Support: Provide sorting hoops (reflect / not reflect). Adult to prompt children to describe and explain.
Extension: Can you test in a different way? Where would you put this tricky one? e.g. black plastic, coloured acetate (shiny and translucent).
Other: Could test transparency or whether magnetic.

Key Questions

- How could you test it?
- Which is the most or least reflective? How do you know?
- What other words could you use to describe the materials?
- Does everyone in your group agree? Can you explain to the others why you have put that material there?
- Can you tell me another way to test this object?

Assessment Indicators

Not yet met: Can sort materials into two groups but not clear or gives a reason for the sorting that doesn't link to very reflective/less reflective. Or may not use a single criterion to sort: "these are colourful, these are shiny". May confuse reflection with other properties e.g. transparency or bright colours.

Meeting: Describe how they sorted the materials according to how reflective they are, and how other groups used different ways to sort the materials.

Exceeding: Able to order the materials from most to least reflective and explain how the test helped them decide on this sequence. Can comment on effectiveness of different ways to test or compare the objects. May suggest what property of the material causes the reflectiveness.

Plan for Focused Assessment of Science

Topic: Plants *(and Seasonal change)*	Year 1 Age 5-6	Title: Plant structure

Working Scientifically	**Conceptual Knowledge**
Do: Observe closely using simple equipment *(Observation over time if seasonal)*	Identify and describe the basic structure of a plant and a tree. *(Could repeat seasonally)*

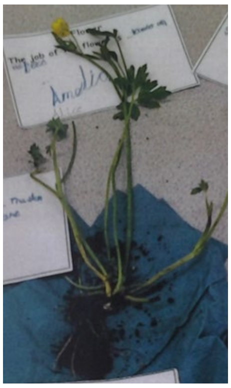
Assessment Focus

- Can children make careful observations of similarities and differences between plants?
- Can children label the basic parts of a plant?

Activity *Today we are botanists.*

Children could go on a 'Weedy Welly Walk' to dig up weeds (including roots).
Provide a selection of different types of plants e.g. flower/vegetable/weed/wild flower/sapling or picture of a tree. Children to explore the plants using magnifying glasses, rulers. Using post-it notes ask the children to write labels to identify the basic structure of a plant.
Question the children (this could be a small group activity) to explain what they know about each part of the plant (see questions below). Record comments that the children make. Photograph the labelled plant as evidence.

Adapting the activity
Support: Provide pre-made labels to prompt knowledge, e.g. stem, roots, etc.
Extension: What are these parts for? e.g. sepal/anther/stigma. Make comparisons between plants.
Other ideas: How is this similar or different to trees?



Key Questions

- What do you notice about these plants?
- Can you tell me the name of this part?
- What does each part of the plant do?
- Where does it grow?
- What happens to it during different seasons?
- What differences can you see between these plants?
- Why might the plants look different?

Assessment Indicators

Not yet met: Describe what they can see using everyday language. With support, label the basic structure of a plant.

Meeting: Can describe and point to the basic structure of a plant and a tree using scientific language, *e.g. leaves, flowers, petals, fruit, roots, bulb, seed, trunk, branch, stem.* May begin to explain what the parts of the plant are for.

Exceeding: Can use their observations to make comparisons between different plants or between different plant parts, *e.g. that plant has a thicker/taller stem than that one, the petals are smaller than the leaves.*

TAPS Plan for Focused Assessment of Science

Topic: Plants	Year 1 Age 5-6	Title: Leaf looking

Working Scientifically Observing closely	**Concept context** identify and describe the basic structure of a variety of common flowering plants, including trees

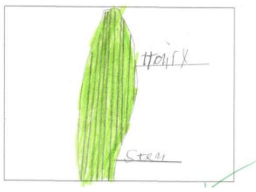
Assessment Focus
- Can children observe closely and make an accurate representation of a leaf that they have found?
- Can children describe features on their leaf?

Activity *Today we will be botanists.*

Go on a 'welly walk' in school grounds to collect leaves *(with clear instructions about where they are allowed to go and what they are allowed to collect/pick e.g. try to collect fallen leaves, do not over-pick from one plant, warn to look for prickles and stinging nettles etc – check with an adult if unsure).*
Use magnifiers to look closely at the leaves and ask pairs to discuss what is the same/what is different. Draw a leaf, labelling with support.
At an appropriate point, you could include a mini-plenary in which you show a drawing by the class teddy/puppet. Ask the children to give advice on how to improve the drawing e.g. *what colour is the leaf stalk? Where do the veins really go?*
Children could then improve their own or do another drawing. P5
Wash hands.

Adapting the activity

Support: Adult prompts to look carefully at veins, hairs, colour etc.
Extension: Label parts of the leaf, e.g. veins, hairs. Compare two leaves.
Other ideas: Provide some unusual leaves (or pictures), e.g. composite leaf, cactus, grass. Collect a nature paint pallet: stick small bits onto a card strip (with double sided tape on.)



Key Questions
- What does a leaf look like?
- How are these leaves different/similar?
- What shape/colour is your leaf?
- Where did you find your leaf? How do you think it got there?
- Does you leaf have hairs/veins? Why do you think they are there?
- Does your leaf look the same on both sides?

Assessment Indicators

Not yet met: Children draw a leaf but shape may not be accurate or features are missing

Meeting: Children can draw a leaf outline accurately and show hairs/veins when present.

Possible ways of going further: Children compare the features of different leaves.

P5 Pupil box 5 - act on feedback. See TAPS pyramid for more examples.

TAPS Cymru Plan for Focused Assessment

Science and DT topic: Materials or Forces	Year 1 Age 5-6	Title: Bridge testers

Enquiry Focus Collect data to compare bridges	**Concept context** Properties of materials: strength of bridge shapes

Assessment Focus

- Can children collect data to measure bridge strength using pennies (or equivalent)?
- Can children use their data to compare bridge shapes?

Activity *Today we will be engineers.*

Show pictures of different types of bridges (local if possible). Discuss similarities and differences between e.g. Flat or beam bridge, Arch bridge, Beam bridge and Concertina bridge.
How do we find out which bridge shape is the strongest? Discuss and select: paper or card, A4 or other, test objects to place on model bridge.
Discuss success criteria for a fair comparison which groups will need to decide upon: same number of books on each side, same gap, same test objects (pennies/blocks etc).
Could allocate group roles e.g. Resource manager, Fair comparison checker, Test object counter, Group reporter.
What should we record? E.g. number of pennies before the bridge falls. Children to record results in a table. After testing ask children to identify the strongest and weakest bridge shape.
Could compare results from different groups and discuss reasons for differences.

Adapting the activity

Support: Provide support to make the paper/card bridges. Test one bridge together.
Extension: Try different bridge spans. Convert pennies into grams to measure the strength of the bridges.
Other ideas: Bridge for particular purpose e.g. insect crossing. Explore bridges using natural materials outside.

Questions to support discussion

- Which bridge shapes are we testing?
- How will we know which bridge shape is the strongest?
- How can we make it a fair comparison?
- How many pennies do you predict this bridge will hold?
- How will you know when to stop counting the pennies? Where will you write that down?
- Which bridge shape did you find to be the strongest? The weakest?
- What do you think makes a good bridge?

Assessment Indicators

Not yet met: Counts pennies, but does not link this to bridge strength without support.

Meeting: Collects data in a table. Uses their data to explain which bridge shape is the strongest and the weakest.

Possible ways of going further: Begin to compare and evaluate the data they have collected, or the data of others, for example, noticing the importance of keeping the bridge span the same.

Plan for Focused Assessment of Science

Topic: Seasons throughout the year	**Year 1** Age 5-6	**Title:** Seasonal change

Working Scientifically	**Conceptual Knowledge**
Do: Observe over time and record data to help in answering questions	Observe changes across the four seasons

Assessment Focus
- Can children observe and record changes across the seasons?
- Can children observe and describe the weather associated with each season and how the day length varies?

Elicitation (September)
What do you know about the seasons? Children to complete a drawing about the four season. Adult to scribe comments.
Activity (each season)
Go on a 'welly walk' to the same place, observe some trees - ensure that on your walk you observe a deciduous and an evergreen tree. Look at the signs of the season and make collections and take photos. Identify and take photos of each tree and the signs of the season. Record the temperature on your walk. Adult scribe comments from children.
Back in class (each season)
Plot the changes using the photographs of a deciduous tree and an evergreen tree throughout the seasons.
Complete daily weather charts for a week each season.
Explore and discuss collections.
Seasonal display – use photos of the walk, collections and data.
Autumn - falling leaves, seeds, fruits, changing colours, dew on grass, temperature, mini beasts, temperature, clothing
Spring – buds on trees, new growth, blossom, bird song, grass, warmth, temperature, clothing
Summer –full trees, colours, mini beasts, wild flowers, temperature, clothing
Winter – bare trees, hard ground, lack of plants, temperature, clothing

Assessment of knowledge (July)
Children to use a photocopy of the elicitation to add new knowledge, include comparisons and descriptions. Share with a partner.
Compare the weekly weather charts and discuss the changes and how it made you feel and how it affects the seasons.

Adapting the activity
Support: Adult to support observations on the walk and scribe comments.
Extension: To begin to make connections between the seasons, ask children what has changed since last time.
Other: Measure rainfall in different seasons

Key Questions
- What have you observed?
- How have things changed?
- How has the weather changed?
- What are the differences between the seasons?
- Why have things changed?

Assessment Indicators

Not yet met: With support, children can observe and record what they see at the time.

Meeting: Observe, record and describe changes in plants, temperature and the weather across the four seasons.

Exceeding: Use records of data from previous sessions to begin to make links between their observations and to offer explanations for seasonal change, *e.g. I saw more flowers in spring because it is getting warmer, it is colder in the winter and I need more clothes because we are further from the sun.*

Plan for Focused Assessment of Science

Topic: Animals, including humans	Year 2 Age 6-7	Title: Comparing hand spans
Working Scientifically **Review:** Using their observations and ideas to suggest answers to questions		**Conceptual Knowledge** Recognise growth in humans.

Assessment Focus
- Can children compare different hand spans?
- Can children suggest answers to their questions about hand spans?

Activity *Today we are an anatomists.*
Ask the children to compare the size of their hand with that of another child. As a class create a list of questions e.g. Do older children have bigger hands? Do taller children have bigger hands? Can bigger hands pick up more cubes? *('Handspan grab' can create a graph of cubes).*
Discuss how hand spans could be measured and agree as a class (e.g. draw around hands, spread/closed fingers, start and end place of measurement, to nearest centimetre). With a partner to help, ask each child to measure their own hand. Record results together as a class.
Ask the children to compare hand spans and suggest reasons answers to the class questions.

Adapting the activity
Support: Compare hand cut outs rather than measurements
Extension: What size hands would year 6 have? Why?
Other ideas: Compare feet – do taller people have the biggest feet?

Key Questions
- How can we accurately measure hand span
- Who do you think will have the smallest/ biggest hand span in the class? Why?
- What size hands did most children have?
- What do you notice about people with the biggest hand span?

Assessment Indicators

Not yet met: Can make comparisons, saying which hand is smaller or larger.

Meeting: Can make comparisons saying which hands are bigger and smaller and suggest reasons for this, *e.g. his hand is bigger / he holds more cubes because he has had longer to grow.*

Exceeding: Can make predictions relating hand span to height, *e.g. a year 6 boy will have bigger hands / will hold more cubes because....*
Can raise further questions related to height that could be tested, *e.g. when do your hands stop growing?*

Plan for Focused Assessment of Science

Topic: Living things and their habitats	Year 2 Age 6-7	Title: Nature spotters

Working Scientifically **Review:** Identifying and classifying	**Conceptual Knowledge** Identify and name a variety of plants and animals in their habitats, including micro-habitats

Assessment Focus

- Can children use spotter sheets to identify plants/animals?
- Can children identify the types of plants/animals they are looking for?

Activity *Today we are a conservation officers.*

Explore simple classification keys/spotter sheets – select appropriate for your local habitat (in or out of school grounds) and season, for example:
http://www.woodlandtrust.org.uk/naturedetectives/activities
Take the children on a nature hunt to explore the habitat. Groups could explore: leaves/blossom/trees, flowers, invertebrates (mini beasts), pond life... as appropriate. Remind children about careful handling of animals, returning any creatures to their habitat, not picking wild flowers, not eating, washing hands on return.

Adapting the activity

Support: Provide a spotter sheet containing very common/easy to distinguish plants/animals.
Extension: Provide a more challenging spotter sheet where close observation is needed to spot the differences between the species.
Other ideas: Visit a different habitat and compare findings.

Key Questions

- What do you think we will see on our walk? What will your group be looking for?
- What kinds of plants/animals are you looking for? How do you know?
- How will you know if you find this one?
- How will you know the difference between that one and this one?

Assessment Indicators

Not yet met: Children may name animals already known to them e.g. ants and spiders with little reference to the spotter sheets. Children will not yet be linking the specific animal to its type e.g. *I know it's an ant because we have them in my garden*.

Meeting: Children use spotter sheets to identify plants or animals e.g. *I think that is an earwig because it has a funny tail like on the sheet.* Children begin to classify e.g. *That woodlouse can't be an insect because it doesn't have 6 legs. The squirrel in the tree is all furry so it must be a mammal.*

Exceeding: Children can discuss the limitations of the spotter sheets e.g. *I think it is a kind of ladybird because it has the same kind of back and legs, but it is not the same as on the sheet, but the sheet can't have pictures of all the ladybirds.*

Plan for Focused Assessment of Science

Topic: Living things and their habitats	Year 2 Age 6-7	Title: Woodlice Habitat

Working Scientifically **Do:** Gather and record data to help in answering questions.	**Conceptual Knowledge** Identify that most living things live in habitats to which they are suited and describe how different habitats provide for the basic needs of different kinds of animals and plants

Assessment Focus

- Can children identify where plants and animals live?
- Can children make a record of where plants and animals live?
- Can children discuss why they might live in chosen habitat?

Activity *Today we are a zoologists.*

Present the children with a question – where do these living things live? Give them pictures of the animals/ plants.
Remind children what a habitat is and then discuss different habitats.
Explain that they are going to look in different habitats for woodlice.
Discuss with the children how they are going to record their evidence using a tally chart.

Adapting the activity

Support: Provide a table / map of the environment for recording evidence. Prompt them to look at their evidence when comparing findings.
Extension: Encourage the children to record their data in a way that highlights whether living things share habitats / whether the same living thing is found in more than one habitat

Key Questions

- How are you going to answer the question?
- Where are you going to gather the information from?
- How could you record which animal lives in which habitat?
- Do any animals/ plants share their habitats? Why might this be? What are the characteristics of these habitats?
- Are there any animals/ plants that could live in more than one habitat? Why?

Assessment Indicators

Not yet met: Says how many woodlice were found, *e.g. I found 3 woodlice.* Needs support to produce tally chart at the point it is being drawn.

Meeting: Can draw a tally chart (after it's been modelled to them) and explain why woodlice are found in a particular habitat, *e.g. I found 3 here and 3 there because it is dark.*

Exceeding: Can independently explain their tally chart / pictogram, *e.g. I think there would be more spiders here and more woodlice there…* Explaining why the woodlice might live there e.g. because of predators.

Plan for Focused Assessment of Science

Topic: Materials (or Forces)	Year 2 Age 6-7	Rocket mice

Working Scientifically	**Conceptual Knowledge Link**
Do: Perform simple tests to answer questions	Links to changing shape of materials or pushing forces

Assessment Focus

- Can the children begin to be systematic in their testing?
- Can the children use their tests to suggest answers to questions?

Activity

Demonstrate rocket mouse: put pre-made mouse on top of plastic bottle and whack bottle with both hands. Template at:
http://www.sciencemuseum.org.uk/educators/teaching_resources/activities/rocket_mice.aspx
Children make rocket mice and explore in 3s with different sized bottles. Consider whose mouse went the furthest. Prompt children to explain how they knew it went further. Collect children's ideas for measuring eg hold next to a metre ruler, put a post it on the wall to show how high it got, shoot them across the floor (45° bottle) – this can create a 'floor graph'.
Children could make predictions e.g. I think x will go the furthest because…
Select a method of comparing/measuring then try comparing different sized bottles again e.g. try measuring in 3s or have class competition by shooting mice across the floor.

Adapting the activity

Support: provide very different sized bottles, shoot across floor
Extension: provide equipment for measuring independently
Other ideas: What if - we add ears, a tail, a cape…which would/did go further?

Key Questions

- Whose mouse went the furthest?
- How do you know it went further?
- Can you measure how far/high it goes?
- Does it go that far every time?
- What if we try a different bottle/mouse?
- How could we make it go even further?

Assessment Indicators

Not yet met: Say which mouse went the furthest e.g. *it was Abi's.*

Meeting: Able to explain how they know which one went furthest e.g. *it went up to there on the wall/floor, it went higher than the metre stick.*

Exceeding: Systematic in testing - may record measurements independently or note accuracy e.g. *we struggled to measure it because we didn't have time to measure before they came down.*

This investigation can be for any age and can have a different Working Scientifically focus e.g. do across the school and look for progression.

Plan for Focused Assessment of Science

Topic: Materials	Year 2 Age 6-7	Title: Waterproof materials

Working Scientifically **Plan:** Ask simple questions and recognising that they can be answered in different ways	**Conceptual Knowledge** Use knowledge and understanding of properties of materials to compare suitability for different uses

Assessment Focus

- Can children discuss/use different ways to test how waterproof materials are?
- Can children compare materials on the basis of waterproofness?

Activity *Today we are materials engineers.*

Provide a collection of different types of materials. Discuss which could be the 'best' material – draw out that need to know best for what. Today we want to know the 'best' for waterproof coat/umbrella/cover for summer fair cakes etc – choose appropriate context. Pupils discuss how to compare how waterproof the different materials are, for example:

- Drip water onto the material
- Pour water onto the material
- Wrap up a cotton ball in the material & put into water

Children will plan and carry out a simple test to measure the waterproofness of different materials – groups try difference ways to answer the question.
Children sit in a circle and consider one group's investigation – was this a good test? Why? Do you agree with their results?
Adult collect utterances or ask target children or those who have not worked with an adult.

Adapting the activity

Support: Support children to decide which test to carry out.
Extension: Children independently identify several ways to test. If time, they try more than one method of testing.

Key Questions

- How will you know if it is waterproof?
- How much water will you use? How long will you put it in the water for?
- Can you order the materials: most to least waterproof?
- Do you think everyone else will find the same result?
- How else could you test the material?

Assessment Indicators

Not yet met: Describes their idea/test but it may not help to answer the question and does not consider alternative methods.

Meeting: Explains different tests, *e.g. you can find out which is waterproof by --- or ---*

Exceeding: Comments on the best way to find out and understands that a comparison has to be fair, *e.g. I need to add the same amount of water.*

Plan for Focused Assessment of Science

Topic: Plants	Year 2 Age 6-7	Title: Comparing plant growth in different conditions

Working Scientifically **Do:** Observe closely, using simple equipment	**Conceptual Knowledge** Describe how plants needs water, light and a suitable temperature to grow and stay healthy

Assessment Focus

- Can children observe closely, noticing differences and similarities?
- Can children measure and compare the height of plants?

Activity *Today we are botanists.*

Show children pre-grown plants, discuss what children think these plants could need to keep healthy. Raise questions they would like to investigate e.g. How long can plants last without water / light? Does it matter if the plant is inside or outside? How will less light affect the plant?
Use pre-grown plants to explore conditions for growth, e.g.
NORMAL CONDITIONS (on window sill, + water + light + warm),
No/less/more WATER **or** No/less/more LIGHT **or** No/less/more WARMTH.
Discuss what they think will happen to plants without water/sun etc.
Children need to measure and observe the plants (using simple equipment – magnifiers, cameras and rulers) and they have to decide what a plant needs to grow and to stay healthy.

Adapting the activity
Support: Compare just one of the requirements (e.g. water/no water) and give support confirming whether their results have answered their question.
Extension: To ensure they are measuring accurately and precisely. Children to design a different experiment which would answer the same question?
Other ideas: Investigate different plants.

Key Questions

- What do you notice about the plants? Can you see any differences?
- Why might the plants look different?
- Have our results answered our question? Why?
- What does a plant need to grow?

Assessment Indicators

Not yet met: Children to physically compare which plant is the tallest and shortest (between normal conditions and one other condition) and to think why this is.

Meeting: Observe and record the appearance of the plants (drawing or annotated photo) and compare the heights of the plants. Use findings to suggest how healthy plants are and suggest reasons.

Exceeding: Make a range of comparisons between the plants in different conditions, e.g. colour, droopiness.

Plan for Focused Assessment of Science

Topic: Animals including humans	Year 3 Age 7-8	Title: Investigating the Human Skeleton
Working Scientifically **Plan:** Ask relevant questions and use different types of scientific enquiries to answer them		**Conceptual Knowledge Context** Identify that humans have skeletons and muscles for support, protection and movement

Assessment Focus

- Can children ask questions about the diversity of human skeletons?
- Can children turn questions into a form that can be investigated?
- Can children use their findings to make further predictions?

Activity

Ask children to suggest ideas about differences between human skeletons and help them to turn them into a form that can be investigated, e.g.
Am I/Are you a square? (look at arm span versus height)
Who has the longest arms? (Y3 or Y6?)
Are adult heads bigger than children's heads?
Do older children have bigger feet?
Make predictions and develop enquiries to answer a range questions.

Adapting the activity

Support: model how to ask a relevant question, support directly with turning them into an investigable form. Ask later if outcome was what they expected or if it surprised them.
Extension: ask children to choose questions and independently turn them into an investigable form. Use their results to identify trends and make further predictions.
Other ideas: ask questions about animal skeletons.

Key Questions

- What other questions could we ask that are a bit like this one?
- How could you investigate your question?
- Do you think we will find a difference between…?
- What do you predict you will find out?
- What changes do you think there might be to our skeletons between the age of 7 and 10?
- What do you think will be the general trend in your results?

Assessment Indicators

Not yet met: Can ask questions about the human body, e.g. *How big are people's heads? I wonder who has got the biggest feet?*

Meeting: Can ask questions, and turn them into a form that can be investigated.
Can say whether the outcome of the survey is what they expected, e.g. *I thought that Y6 children have bigger heads than Y4 children and they do.*

Exceeding: As 'meeting'. Use their findings to make a prediction and suggests further questions and investigations, e.g. *I found that taller people have wider arm spans so will they have wider hand spans?*

This investigation can be for any age and can have a different Working Scientifically focus e.g. do across the school and look for progression.

Plan for Focused Assessment of Science

Topic: Forces	Year 3 Age 7-8	Title: Balloon Rockets

Working Scientifically

Review: Using results to draw simple conclusions, suggest improvements and raise further questions.

Conceptual Knowledge Context

Compare how things move on different surfaces.

Assessment Focus

- Can children use results to predict and explain what may happen on the next attempt?
- Can children suggest improvements?

Activity

Set up a balloon rocket with the children (inflated balloon taped to straw, string through the straw, let go of balloon to shoot along string). Ask them to discuss what they think will happen if different tracks of different materials are used e.g. wool, garden string, plastic coated wire, etc.

In groups or as a class, test out different tracks. Each time predict the distance the rocket will go, applying knowledge of friction and previous runs.

Children could record predictions and results OR suggestions of improvements to the method after the investigation.

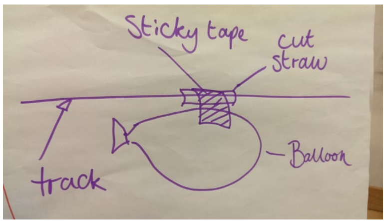
Adapting the activity

Support: Pre-prepared chart for recording predictions and measurements

Extension: Extra column to note explanations for results

Key Questions

- What do you think will happen when we let go of the balloon?
- Do you think it will be different if we use different tracks? Why?
- How far do you think it will go on this track? Why?
- Which balloon went furthest?
- Why did that balloon go further/not as far?
- Which track do you think was the best?
- How accurate/fair do you think our results are?
- What could we do to be more accurate/fair?



Assessment Indicators

Not yet met: Describes differences between different balloon tracks.

Meeting: Explanations of results use comparisons to previous results to make further predictions and suggest improvements for investigation set up, *e.g. need a longer track, we didn't use the same balloon.*

Exceeding: Suggests improvements with reasons, *e.g. it's not fair because we used different balloons, the balloon could have gone further if the track was longer so we need to do it again.*

Plan for Focused Assessment of Science

Topic: Forces	Year 3 Age 7-8	Title: Cars down ramps

Working Scientifically	**Conceptual Knowledge**
Do: Gather, record and present data (in a table or bar chart) to help in answering questions	Compare how things move on different surfaces

- Can children make an accurate record of their measurements?
- Can children use their results to explain how the car moves on different surfaces?

Activity

Discuss the purpose of an escape lane and the kind of surfaces which could be used to slow down vehicles. Explore how far cars go after a hill (down a ramp) which is sitting on the carpet. In small groups discuss how they will measure how far the car goes on different surfaces and how they can record this. Emphasise that we are testing the surface, so everything else must stay the same to be fair – as a class list the control variables.
Groups investigate with each drawing their own 'results table'. Ask children to explain how the surface makes a difference.

Adapting the activity

Support: Ask questions to prompt groups to think about the accuracy of their measurements and the clarity of their recording.
Extension: Ask groups to discuss how their results compared to their predictions and report their findings to the class.

Key Questions

- How do you think it will be different if we move the ramp to the table?
- What if we put a cloth/books/foil/blanket/wood at the end of the ramp?
- How will we know if it makes a difference? How will we measure?
- What do we need to do to keep it fair?
- What will you write down? Could you draw a table ready to collect the distances?
- Where on your table is the result for the carpet etc?
- What have you found? How does this compare to your prediction?
- Can you put your findings on a bar chart?
- Why do you think the surfaces are different? What is slowing the car down?

Assessment Indicators

Not yet met: Measures distance with the equipment provided, recording with support. Predictions/explanations describe how things move (in isolation) e.g. *the car goes faster on plastic*.

Meeting: Takes and records accurate measurements using standard units and presents findings in a table (or bar chart). Can compare how things move, e.g. *it goes quicker on wood and slower on grass.*

Exceeding: Systematically takes repeat readings and records all measurements in a table or bar chart. Can explain findings in terms of friction or describe general patterns e.g. *it will go further on a smoother surface because bumps slow it down.*

Plan for Focused Assessment of Science

<table>
<tr><td>Topic: Forces</td><td>Year 3
Age 7-8</td><td>Title: Shoe grip</td></tr>
<tr><td colspan="2">Working Scientifically Focus
Plan: Set up simple practical enquiries</td><td>Conceptual Knowledge
Some forces need contact between two objects</td></tr>
</table>

Assessment focus

- Can children plan and set up a fair test?

Activity

Invite children to examine a collection of shoes and to look at the shoe's grip. Ask children to plan (in small groups) their own way of testing the shoe's grip but give teacher support where needed. Have useful equipment visible, e.g. ramps (for lifting until the shoe slips), Newton meters (for pulling). A further option could be for runs across the hall to be timed wearing shoes, trainers, socks and bare feet. Record the plans in words and/or diagrams.

Adapting the activity

Support: Ask children to explain what they are changing and what they are keeping the same each time. Could focus on comparing just two shoes & explaining why one slides more easily than the other.
Extension: Ask the children to explain how their plan will be a fair test. Ask for explanations about why the different shoes are giving different results.
Other ideas: Children could explore how shoes perform on different surfaces.

Key Questions

- How can we find out which shoe has the best grip?
- What could we measure?
- What would you need to keep the same to make your test fair?
- Which shoes had more grip? How do you know?
- Which shoe needed the most force/tilt of the ramp? Why could that be?
- What do you think it is about that shoe that gave it such a good grip?

Assessment Indicators

Not yet met: Can make suggestions about how to answer the question, and with support, can devise a simple test. Needs support to explain what has to be kept the same.

Meeting: Can devise a way of answering the question. Can say what was changed and what was kept the same.

Exceeding: Can give examples of other variables which might affect the test and suggest a comparative test to investigate these, *e.g. different surfaces, different angles of the ramp.*

Plan for Focused Assessment of Science

Topic: Forces and magnets	Year 3 Age 7-8	Title: What is the strongest magnet?
Working Scientifically **Plan:** Set up simple practical enquiries, comparative and fair tests		**Conceptual Knowledge** Notice that some forces need contact between two objects, but magnetic objects can act at a distance.

Assessment Focus

- Can children decide on an approach to compare magnet strength?
- Can children recognise and control variables where necessary?

Activity

Provide the children with a collection of magnets and other materials (e.g. card, fabric, tissue, thin wood, aluminium foil, paperclips) to explore. Ask them to find out whether the magnets are all equally strong (see below for differentiated approach).
As a class, discuss the different ways of testing the same thing, and talk about the advantages and disadvantages of each approach. Discuss why it is a good idea to try different ways of answering a question (-to get a more reliable answer).
Carry out the investigations and ask the children to report their findings verbally.

Adapting the activity

Support: Ask which magnet is the strongest. Ask, 'How do you know?' and use the response to help the children plan to systematically test each magnet.
Extension: Challenge children to order the magnets from strongest to weakest. Challenge the children to find several different ways of comparing the strength of magnets and see if these result with the magnets in the same order of strength.

Key Questions

- How can we find out which magnet is the strongest?
- Did the magnets need to be touching to find out?
- Can you now put the magnets in order from strongest to weakest?
- Can you think of any other ways to test which is the strongest?
- Which magnet was the strongest? Did you get the same results with every way you tested it?

Assessment Indicators

Not yet met: With support, can make suggestions about how to find which magnet is the strongest, *e.g. see how many paperclips the magnet will pick up.*

Meeting: Can decide on an approach to answer the question, and what observations/measurements need to be made, *e.g. hold each magnet above the paperclips and measure the distance the paperclips jump.*

Exceeding: Can compare different ways of answering the question and whether they lead to the same sequence of strength of magnets, e.g. *The order was different with when you measure the distance the paperclips jump because it is not very easy to know when this happened.*

Plan for Focused Assessment of Science

Topic: Light	Year 3 Age 7-8	Title: Can everything make a shadow?
Working Scientifically **Do:** Gather and record data to answer questions.		**Conceptual Knowledge** Recognise that shadows are formed when the light from a light source is blocked by an opaque subject.

Assessment Focus

- Can children make a series of careful observations?
- Can children record their observations in a systematic way that relates to the question?

Activity

Provide the children with a collection of materials to explore (some transparent, some translucent and some opaque).
Ask the children to investigate which materials form shadows when a torch is shone on them (colour, darkness, no shadow?) Ask them to record observations (draw, write, sort, photo). Challenge the children to characterise the differences they observe between the shadows – e.g. pale / dark,

Adapting the activity

Support: Prompt children to describe shadow & scribe their comments.
Extension: Can they order the materials and/or shadows in some way?

Key Questions

- Where will you write down the materials you are testing?
- How will you record what you have seen?
- What would be a good heading for this column?
- Does this material form a good shadow?
- What do you notice about this material/shadow?
- Where have you recorded what happened with this material?

Assessment Indicators

Not yet met: Can use their observations to decide whether or not a shadow has been formed by the material, *e.g. has sorted materials into two piles or recorded tick/cross.*

Meeting: Can make observations and decide how to record them to answer question, *e.g. independently records best to worst shadow.*

Exceeding: Recording communicates clearly how it answers the question, using appropriate vocabulary such as opaque and transparent.

BATH SPA UNIVERSITY

Plan for Focused Assessment of Science

why& how? PRIMARY SCIENCE TEACHING TRUST

Topic: Plant Growth	Year 3 Age 7-8	Title: How much water do plants need?
Working Scientifically **Do:** Making systematic and careful observations and measurements using standard units		**Conceptual Knowledge** Explore the requirement of plants for life and growth, and how they vary from plant to plant.

Assessment Focus

- Can children use simple apparatus to measure water/height?
- Can children record their measurements?

Activity *Today we are botanists.*

Ask, how much water do these plants need to grow? Discuss how to set up an investigation as a whole class. Either draw on previous maths work or teach the children how to measure volume of water and measure the height of the plant. As they carry out the investigation, the children will need to make their own measurements of water and of the height of the plant and record the height of the plant. Provide beakers/measuring cylinders, but amount of water should easy to measure, e.g. 200ml, expect measurement of length to the nearest centimetre.
Over the course of the investigation, plan to observe groups measuring the water to give to their plant and their measurement of the height of the plant and observe their accuracy. Children to also peer check measures. A record sheet would help with the organisation of this. Teaching assistant support here would also be helpful.
Ask the children to explain why accurate measurements are important.

Adapting the activity

Support: Provide water containers with a single level marked. Provide rulers/card strips with cm coloured stripes that can be counted.
Extension: Provide beakers/measuring cylinders, but amount of water to measure involves understanding of the scale, e.g. 130ml. Independent choice of measuring equipment for length, but expect to nearest mm.

Key Questions

- How much water shall we give the plants?
- How shall we measure how much the plant has grown?
- How can we make sure that we know how much water we have given them?
- Can you show me how you measure the water?
- Can you show me how you measure the plant?
- Why do we need to be accurate when we measure the water/plant?
- Ext: What is the importance of being accurate when taking measurements?

Assessment Indicators

Not yet met: With support, can measure a volume of water and height of the plant (to nearest cm).

Meeting: Can measure accurately the volume of water (to nearest 10 ml) and height of a plant (to nearest cm).

Exceeding: Measures accurately volume of water given to plants, and heights (mm). Explain importance of and suggests ways to improve accuracy (repeat readings).

Plan for Focused Assessment of Science

Topic: Plants	Year 3 Age 7-8	Title: Function of a plant stem

Working Scientifically **Review:** Use straightforward scientific evidence to answer questions or to support their findings	**Conceptual Knowledge** Investigate the way in which water is transported within plants

Assessment Focus
- Can children make careful observations?
- Can children use observations to suggest how water is transported?

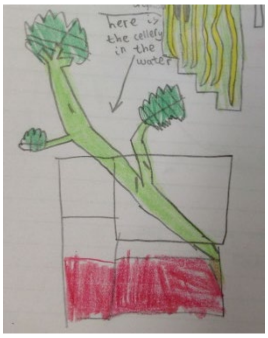
Activity *Today we are botanists.*

Show children a complete head of celery and ask them to name the parts (noting the stem). Explain to the children that they are going to put the celery stem upright in a shallow container of water coloured with food colouring. (Remind to be careful with colouring). What could happen? Make careful observation before placing in water e.g. draw and label. Return to celery later (e.g. 1hr) carefully observe what has happened e.g. labelled drawings of whole and cut celery.

Adapting the activity

Support: Draw a group explanation
Extension: Predict what will happen when the stem is split in two and each end placed in a different coloured food dye.
Other idea: Take accurate measurements of the height of coloured water at time intervals and record findings in a table or line graph.

Key Questions
- What can you see inside the celery?
- What is happening to the coloured water?
- What do you think will happen if the stem is split in 2 and placed in different coloured waters?
- Do you think the leaves will change colour? If so, why?
- What has happened to the inside of the celery?



Assessment Indicators

Not yet met: Can draw/say what has happened simply, e.g. *the colour went up.*

Meeting: Observes what has happened and can make suggestions, e.g. *I know there are tubes in the stem, the water goes up the stem and it might go up to the leaves if I leave it for longer.*

Exceeding: Identify and explain results using scientific vocabulary, e.g. *water travels upwards in the stem and over a longer time it would reach the top of the plant, this shows there are tubes in the stem and water stays in its tube.*

Plan for Focused Assessment of Science

Topic: Rocks	Year 3 Age 7-8	Title: Reporting on rocks
Working Scientifically **Review:** Reporting on findings from enquiries		**Conceptual Knowledge** Compare and group together different kinds of rocks on the basis of their properties

Assessment Focus

- Can children group rocks based on properties?
- Can children talk about / draw a diagram / write about their findings?
- Can children draw conclusions about the least / most wearing rock?

Activity *Today we are geologists.*

Provide a purpose for the investigation – e.g. to find the best material for a new paved area in school. Suggest that you would like to find out which rock would last the longest/be the least wearing/the strongest and that a rub test is one way to do this.

Children to rub rocks on sandpaper and collect scrapings onto white paper.

Ask children to order the rocks and justify their selection of strongest rock.

How will you report your findings (to persuade), e.g. draw, write, power point?

Adapting the activity

Support: Provide a smaller number of rocks.

Extension: What kind of report would you do for children / head teacher / government? Why?

Key Questions

- Why can't I choose the prettiest one?
- What did you find out doing the rub test?
- Which rock would you recommend? Why?
- Which is the least/most wearing rock? How do you know?

Assessment Indicators

Not yet met: Says which rock is 'best'.

Meeting: Uses the 'rub' test to order the rocks and can say (orally or with diagrams/writing) which rock is strongest/harder wearing.

Exceeding: Recommendations are clearly drawn from results and are presented appropriately for the audience. The report contains an explanation of how trustworthy the data is and explains that other factors may need to be tested, *e.g. marble is strong but may be slippery if it gets wet.*

Plan for Focused Assessment of Science

Topic: Animals including humans	Year 4 Age 8-9	Title: Teeth (eggs) in liquids

Working Scientifically	Conceptual Knowledge
Review: Use results to draw simple conclusions, suggest improvements and raise further questions.	Function of teeth – to find out about what damages teeth and how to look after them.

Assessment Focus

- Can children use results to draw conclusions?
- Can children suggest explanations for their findings?

Activity *Today we are dental scientists.*

Discuss how children look after their teeth.
Could use video http://www.youtube.com/watch?v=-nBSQQHYdkE
Explain that we will be using hard boiled eggs to investigate tooth decay.
As a class set up a fair test to investigate the affects that different liquids have on teeth e.g. cola, water, vinegar, milk, sports drink and orange juice.
Discuss how they can make the comparison fair, i.e. as to quantity of liquid, types of containers, time and location (if using milk do they all need to be in the fridge?) Leave for one week, although children can check on the experiment daily to see if they can notice and changes. After one week, unveil the eggs by tipping into a white bowl and photograph. Children to record their observations (look, feel, smell, etc.) and rate the eggs in order of damage to shell observed.
Children to consider how they could improve the test and what further questions arise that they would like answered. Children to suggest ways to answer their additional questions.

Adapting the activity

Support: Focus on comparing just two liquids. Ask questions to prompt suggesting reasons for findings.
Extension: Could link with persuasive writing/advertising. Children could predict what would happen if the eggs were placed in hot drinks – tea (with increasing levels of sugar) or hot chocolate.

Key Questions

- What do you think will happen? Why?
- Why have some 'decayed' more than others?
- What do you think is in the liquid that is making this happen?
- Were there any surprises?
- How is this this similar to your teeth? How is this different?
- What would happen if the eggs were cleaned daily with toothpaste?
- How would a diet drink compare with a regular drink?

Assessment Indicators

Not yet met: Describes differences, e.g. *the egg is OK in milk/water but not in coke.*

Meeting: Can order liquids according to damage done to eggs and suggest reasons why. Able to raise further questions, *e.g. I thought sports drink/orange juice was a 'healthy' drink but it was not, I wonder whether these drinks contain a lot of sugar?*

Exceeding: Would be able to think about other liquids or factors including acid and carbonated drinks and suggest causal relationships, *e.g. the more acid/sugar in the drink, the worse the damage.* Can recognise problems with the test, e.g. *use of eggs not teeth, eggs were in liquid for 1 week but I do not keep coke in my mouth for 1 week!*

Plan for Focused Assessment of Science

Topic: Electricity	Year 4 Age 8-9	Title: Does it conduct electricity?
Working Scientifically **Review:** Report on findings from enquires, including oral and written explanations, displays or presentations of results and conclusions.		**Conceptual Knowledge Context** Recognise some common conductors and insulators, and associate metals with being good conductors. Construct a simple series electrical circuit, identifying and naming the basic parts.

Assessment Focus

- Can children explain results and their conclusions?
- Can children recognise common conductors and insulators, and associate metals with being good conductors?

Activity *Today we are electrical engineers.*

Display and discuss a news story about soldiers wearing 'smart' clothing which conducts electricity: http://www.bbc.co.uk/news/technology-17580666
Introduce the terms conductors and insulators. Example context: Why would a soldier need to be able to conduct electricity? Give the scenario of a soldier in the desert that has ripped part of his 'smart' clothing and therefore lost part of the circuit in his GPS system. As he has no other navigation guides he is unable to provide his location for rescue. Ask the children which materials are used to make electric circuits. Ask why they think these materials are used. Explain that the soldier has a pack containing a variety of objects. Which could be used to complete a circuit to activate his GPS to save him?

Provide a collection of objects/ materials (including different metals and plastics). Ask them how they could find out whether electricity can pass through the materials and help them plan how to put the materials into a gap in a circuit with a bulb or buzzer to test them. Ask the children to focus on recording their results and explaining what the results show.
They then need to produce a radio or video message to send to the soldier explaining what he needs to do to produce a working circuit therefore enabling his GPS and why they are confident that this will work providing scientific evidence to reassure him! The children need to provide a list of all possible conductors in case some are damaged when he comes to use them. At the end of the activity, recap on the terms insulators and conductors.

Adapting the activity

Support: Provide a table template & support children recording their results
Extension: Challenge with extra items to see if they fit the pattern (e.g. lemon, pencil lead, rusty nail.) Challenge children to apply their findings to explain safety rules.

Key Questions

- Which objects completed the circuit? Why?
- Which things conducted electricity? What materials were they made from?
- Which did not conduct electricity? What materials were they made from?
- Can you think of anything else that might/might not conduct electricity? Explain your choices.

Assessment Indicators

Not yet met: Can refer to results in order to identify some objects that allow electricity to pass through them and others that do not

Meeting: Can describe the circuit and explain how their results (orally/written form) show that (in general) metals conduct electricity and other materials don't.

Exceeding: As above, but can also suggest other items to fit into the pattern and explore exceptions to the rule. Can apply the terms conduct/insulate to explain safety rules, e.g. not putting knife in toaster.

Plan for Focused Assessment of Science

Topic: Living things and their habitats	Year 4 Age 8-9	Title: Local Environment Survey
Working Scientifically **Do:** Gather, record and classify data		**Conceptual Knowledge** Recognise that living things can be grouped in a variety of ways

Assessment Focus

- Can children group living things in different ways?

Activity *Today we are environmental scientists.*

Recap previous work on classifying and habitats. Consider school grounds/local area as a habitat and go on a search living things (incl. plants) in the grounds. Take a camera/draw/make lists of larger things and collect smaller things. Classify the living things and create a report to draw conclusions about the local environment and its suitability for supporting life.

Adapting the activity

Support: Support children in identifying animals and plants. Provide sorting hoops or use pre-made sheet with boxes for plants / birds / larger animals / invertebrates etc.

Extension: How else could you sort? What connections are there between the groups?

Key Questions

- Where are you going to look?
- What living thing have you found?
- Did you *not* find anything you might have expected?
- How can you classify these living things?
- What do these plants/animals have in common?

Assessment Indicators

Not yet met: Children can identify various living creatures by obvious differences and begin to suggest methods of grouping them.

Meeting: Children identify that animals and plants can be classified in a number of possible ways including vertebrates and invertebrates, flowering and non-flowering plants.

Exceeding: All groups are sorted by the same characteristic and some groups may be sub-divided. Connections are made between types of living creatures and plants found in each group, e.g. *most insects live in a dark place under rocks or logs*.

Plan for Focused Assessment of Science

Topic: Materials: States of matter	Year 4 Age 8-9	Title: Drying materials

Working Scientifically Focus **Plan:** Set up a fair test	**Conceptual Knowledge Context** Rate of evaporation

Assessment Focus

- Can children identify what is to be changed and what is to be kept the same?
- Can children identify what to observe/measure to see if there is a difference?

Activity

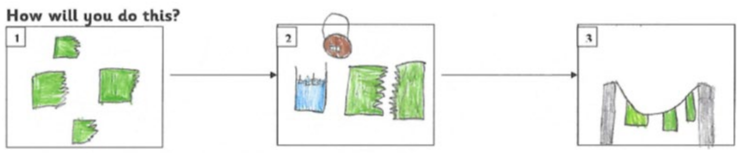
Plan an investigation to reach a conclusion within a real life context, e.g. Where is the best place to dry your washing?
Ask children, which conditions are the best to dry materials by evaporation?
Make a list (warm, dry, windy). Discuss different places to investigate.
In mixed groups, children to decide on the type of material (cloth/paper towels), quantity of water, locations to test evaporation (e.g. could arrange washing lines in different locations around the school) and how often to observe/check. Provide measuring equipment including thermometers, jugs, rulers.
N.B. Paper towels can dry in an afternoon, heavy fabric will take longer.

Adapting the activity

Support: Questioning to support setting up fair test.
Extension: Ask further investigation questions e.g. what is temperature / humidity of your locations?
Other ideas: Data logger could be used to measure temperature of room over a 24 period and children could discuss which would be optimum time to dry washing.

Key Questions

- What factors do you think will affect evaporation (drying)?
- What will you do?
- What will you change?
- What will you keep the same? Why?
- What are you measuring?
- How will you record you observations?



Assessment Indicators

Not yet met: Can make suggestions about how to answer the question but needs support to explain which variables must be kept the same.

Meeting: Can carry out a fair test and is able to say what is changed and that other factors which could affect evaporations are kept the same, e.g. *I will keep the same…amount of water, size of material.*

Exceeding: Recognises additional variables and could suggest some controls, e.g. *have a dry towel outside to check it doesn't rain, put under gazebo so if it rains it doesn't get more wet.*

Plan for Focused Assessment of Science

Topic: Materials: States of matter	Year 4 Age 8-9	Title: Measuring temperature
Working Scientifically **Do:** Take accurate measurements using standard units, using a range of equipment including thermometers and data loggers		**Conceptual Knowledge Context** Understand temperature of materials can be measured in °C

Assessment Focus

- Can children use a thermometer to measure temperature accurately?

Activity

Ask children to put one hand in cold and one hand in warm water, then put both in tap water. What do you think the temperature of the water is for this hand, for that hand? How accurate is your hand? Need a thermometer. Demonstrate accurate reading – keeping thermometer in the water, head down to the level, explain how to use the scale, how to estimate numbers between lines and what accuracy to aim for (e.g to nearest 1 or 5 degrees C.) Carousel of measuring temperature - explore different ways to measure temperature e.g. thermometer in water, digital thermometer, forehead thermometer, data logger. Observe children's measurement using thermometers in water.

Adapting the activity

Support: Ask to measure to the nearest number on the scale.
Extension: Ask to repeat measures and suggest reasons for any similarities or differences.

Key Questions

- Where are you holding the thermometer?
- What happens when you put the thermometer in colder/hotter water?
- Which thermometer do you think is the most accurate?
- Has the temperature changed? How?

Assessment Indicators

Not yet met: Recognise there are different ways to measure temperature. Begin to make measurements, e.g. may need support to read numbers or may need to be reminded to keep thermometer in water. Not consistent in their readings, e.g. may be touching the forehead thermometers or glass end.

Meeting: Make reasonably accurate measurements of temperature independently using units of measurement.

Exceeding: Can explain advantages and disadvantages of different measuring equipment, e.g. inaccuracy of forehead thermometer. Suggests other factors affecting readings (where held) and ways to improve measurements (repeat readings).

Plan for Focused Assessment of Science

Topic: Sound	Year 4 Age 8-9	Title: Investigating Pitch
Working Scientifically **Plan:** Ask relevant questions and use different types of scientific enquiries to answer them		**Conceptual Knowledge** Find patterns between the pitch of a sound and features of the object that produced it

Learning Objectives

- Can children suggest how to alter the pitch?
- Can children carry out simple tests of these ideas?

Activity *Today we are acoustic scientists.*

Show children some homemade 'musical instruments': elastic bands over shoe box, 'straw flute', 'sound sandwich' (lolly stick and straw harmonica), stretched balloon 'drum skin' over tube, glass bottle containing water to blow or tap. Explore how to play them to make a sound and ask the children to suggest which parts are vibrating. Invite children to brainstorm and record questions that they could investigate, focusing on changing pitch. Give one example e.g. How does size of the elastic band affect pitch? Children then work in small groups investigating different ways of altering pitch.

Adapting the activity

Support: Provide question stems/scaffolded question cards, e.g. How does the ----------affect the ------etc.
Extension: Experiment with different instruments.
Other ideas: Oscilloscope (borrow from local Secondary School / You Tube videos).

Key Questions

- What are the differences between these sounds?
- Which sound is the highest/lowest?
- How could we alter the pitch?
- Does your question include what you want to change and what you are going to notice?
- How will you investigate your question?

Assessment Indicators

Not yet met: Can ask questions, e.g. *which makes the highest sound?* Makes some suggestions about what to do, but needs help in phrasing the question.

Meeting: Can ask questions and turn them into a form that can be investigated. E.g. *How does the size of the drum affect the pitch?* Can say whether outcome was what they expected.

Exceeding: Can use their results to make a prediction to set up further comparative fair tests, e.g. *I know that a small drum make a high pitch so will a small recorder make a higher pitch than a long one?*

Plan for Focused Assessment of Science

Topic: Sound	Year 4 Age 8-9	Title: String Telephones

Working Scientifically	**Conceptual Knowledge**
Review: Identify differences, similarities or changes related to simple scientific ideas and processes	recognise that vibrations from sounds travel through a medium to the ear

Assessment Focus

- Can the children explain how to make the best possible string telephone and suggest reasons for the improvements?

Activity *Today we are acoustic engineers.*

Ask a child to help you demonstrate how to use a string telephone.
Discuss how this works; vibrations in air, vibrations in string, the cup amplifies the vibrations, vibrations travel to ear.
Provide a range of plastic pots (yoghurt pots) and different types of string/wool.
In groups, ask children to investigate what makes the best string telephone.
After the investigation, children demonstrate their telephones to the class and explain why their telephone is/is not good.

Adapting the activity

Support: During investigation ask questions to support evaluation, e.g. What have you changed? Which is better? Why is it better?
Extension: Can you eavesdrop on another phone call? (Connect another string).
Other ideas: use a data logger to measure sound (decibels)

Key Questions

- How does the sound travel through your telephone?
- What have you changed on your telephone?
- Which was the best telephone? Why?
- How can you make your telephone better?
- How will you know if your telephone is better?
- Does your telephone always work? What stops your telephone working?

Assessment Indicators

Not yet met: Can select the best string telephone but not explain why in terms of properties.

Meeting: Can talk about features which make a good telephone, *e.g. all work when the string is tight, the bigger cup is better.*

Exceeding: Can relate observations to vibrations, *e.g. it doesn't work when you hold the string because you stop it vibrating.*

BATH SPA UNIVERSITY

Plan for Focused Assessment of Science

why& how? PRIMARY SCIENCE TEACHING TRUST

Topic: Animals including humans	Year 5 Age 9-10	Title: Growth survey

Working Scientifically **Do:** Take measurements using a range of equipment	**Conceptual Knowledge Context** Describe the changes as humans develop to old age.

Assessment Focus
- Can children record and present results clearly?

Activity

What could we measure to show how humans develop?
Groups decide e.g. forearm length, arm span, foot length, etc. Discuss how we could measure this and the number of children/adults we would need to measure. How accurate do our measurements need to be? Decide on how many decimal places or unit.
Children go to different year groups to measure specified number of children. Bring data together to create class table.
N.B. Decide if you are going to average the data or use single data points (have mean averages or medians been taught in maths yet?)
Ask groups to create scatter graphs to present the data, can use ICT to do this.

Adapting the activity

Support: Check children understand how to measure accurately. Provide axes for graph. Prompt pattern description by providing sentence structure e.g. *The older the child, the longer their …*
Extension: Children to average their data. Children to measure to different decimal places. Measuring head size, arm span, forearm etc.
Other ideas: Measure adults or family and explore growth across lifespan.

Key Questions
- How many children will you measure? Why?
- What does your graph show?
- What could this tell us about human development?
- Are there any anomalies? What reasons could there be for the anomalies?
- Why would we repeat or take an average?

Assessment Indicators

Not yet met: Can measure accurately in cm. Can record data in pre-made structure. Can identify highest and lowest results, describes pattern with support.

Meeting: Can measure accurately in cm and mm. Can record data in their own structure. Can identify a pattern, suggest reasons for this pattern, and identify any anomalies.

Exceeding: As above and comments on accuracy of measurements, *e.g. if different people are measuring you must agree where to start.*

Plan for Focused Assessment of Science

Topic: Forces	Year 5 Age 9-10	Aqua dynamics

Working Scientifically **Review:** Explain the degree of trust in the results	**Conceptual Knowledge** Identify the effect of water resistance

Assessment Focus

- Can children use test results to make predictions relating water resistance to surface area?
- Can children identify variables which may affect the results?

Activity

Challenge pairs to make a ball of plasticine or blue-tack fall as slowly as possible through water (size will depend on how big your container is – a large transparent plastic box or measuring cylinder or transparent tube in a bucket).
Ask children to explain why they think it will fall more slowly e.g. draw and label design or hold up and explain. Test designs e.g. repeating in groups or as a whole class with a number of the children timing. Support children to identify the control variables: depth of water, mass of plasticine, position of drop.
Challenge pairs to change the shape so that it falls quickly through the water. Encourage them to use the test results to predict which shapes will fall fastest.

Adapting the activity

Support: Provide drawings of designs to try e.g. flat, boat-shaped, parachute-shaped. Select middle time if repeating readings.
Extension: Average times if repeating readings. Explore different depths or amounts of plasticine.

Key Questions

- Whose design do you think will fall the slowest/fastest? Why?
- What do we need to keep constant so that it is a fair comparison?
- Will it make a difference which way up we drop it?
- Will the shape of the object make a difference to the speed at which it falls?
- Does stability make a difference?
- How can we make our measurements as accurate as possible?

Assessment Indicators

Not yet met: Suggests which shape falls fastest but little recognition of issues with fairness or accuracy.

Meeting: Evaluates how effectively variables were controlled, e.g. *We couldn't get the position the same because some shapes turned over at the surface slowly, so we didn't know whether to time from when it went in the water, or when it had turned over.*

Exceeding: Is able to repeat readings independently and explains how this increases accuracy, e.g. *it was difficult to know when to start timing so we took the middle value/mean average of three readings.*

Plan for Focused Assessment of Science

Topic: Forces	Year 5 Age 9-10	Title: Spinners

Working Scientifically	**Conceptual Knowledge Context**
Do: Measure, taking repeat readings	Identify the effect of air resistance that acts between moving surfaces.

Assessment Focus

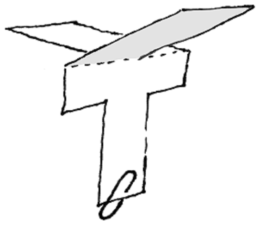
- Can children improve accuracy by repeating measurements?
- Can children identify patterns in results?

Activity

Explore: make and drop a spinner. In groups consider variables and formulate a question *e.g. How does the length of wing/number of paper clips/size of paper affect the time it takes to fall?* Group roles may be useful e.g. dropper, timer, recorder, fair test checker.
Groups or individuals to draw graphs then consider patterns in results.

Adapting the activity

Support: Provide table to collect readings and axes for graph.
Extension: Draw own table to collect repeat measures. Plot results on a line graph independently.
Other ideas: What if…we dropped it from a higher position, changed the shape of the wings, the material etc. Why do sycamore seeds spin?



Key Questions

- What do you predict will happen?
- What range of lengths/paper clips will you test?
- What kind of graph will you draw? Why did you choose a (line graph)? How did you choose your scales on the graph?
- Why did you repeat your measurements? Are there any measurements which you would repeat again?
- What happened to the time when changed the ….? What happens when you add more paper clips/make the wings longer?
- Is there a pattern in your results? Can you describe it?
- Can you explain why there is this pattern?
- Can you explain any anomalies in your results?

Assessment Indicators

Not yet met: With support, measures and records results in given table / graph. Makes comparisons e.g. *five paper clips fell quickly, but one paper clip was slow.*

Meeting: Takes repeat measurements and either chooses middle value or finds mean average (may need support to find mean) to plot points on a line graph and comment on the general pattern, e.g. *the more paper clips, the longer it took.* Some explanation in terms of air resistance.

Exceeding: Uses repeat readings to construct a line graph independently, is able to explain why repeat readings improve reliability, and spots anomalous results. Can describe pattern and shows evidence of understanding of forces e.g. *the longer the wings the bigger the air resistance so it takes longer to fall, until the wings get too big*.

Plan for Focused Assessment of Science

Topic: Living things and their habitats	Year 5 Age 9-10	Title: Life cycle research

Working Scientifically **Review:** Report and present findings from enquiries, in oral and written forms such as displays and other presentations, using appropriate scientific language.	**Conceptual Knowledge** describe the differences in the life cycles of a mammal, an amphibian, an insect and a bird

Assessment Focus

- Can children present their research clearly?
- Can children present using scientific language?

Activity *Today we are going to be biologists.*

Ask children to research the life cycles of two different species using a range of secondary sources. This could be in small groups or individually. Discuss possibilities for presenting their research (if possible, provide a purpose e.g. presenting to younger children/parents etc.) For example, different children could choose to make a model, a mime/drama, a rap/song or a poster/book. Agree on criteria for successful presentation of research e.g. clear order to life cycle, comparison between two life cycles, use of scientific vocabulary etc. Give children the choice about how they will present their learning. *(Note – the life cycle facts will be from research, the comparison is application and gives you more information about understanding).*

Adapting the activity

Support: Provide a short list of animals and support children to choose two which are quite different. Create a word bank of scientific words to include.

Extension: Consider the implications of the similarities/differences between the life cycles e.g. what does it mean for how/where they can live/reproduce?

Other ideas:

Key Questions

- What are the most important things you have found out about the life cycle?
- How will you make this clear in your presentation?
- How is this different to your other animal?
- What similarities between your animals have you found?
- Which key science words do you need to include in your report?

Assessment Indicators

Not yet met: Children report either with little reference to their research, or using sections verbatim.

Meeting: Children select relevant facts from their research compare the life cycles of different animals.

Exceeding: Children make links to other areas e.g. animal classification, habitats, survival, life processes.

Plan for Focused Assessment of Science

Topic: Properties and changes of materials	Year 5 Age 9-10	Title: Champion tape

Working Scientifically **Review:** Report and present findings from enquiries, including conclusions and explanations of degree of trust in results	**Conceptual Knowledge** Give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials

Assessment Focus

- Can children recommend a champion tape?
- Can children explain how they have come to their conclusion?

Activity *Today we are going to be materials engineers.*

Challenge children to design a test to find the stickiest tape. Provide children with a range of sticky tapes and a range of testing/measuring instruments *(e.g. rulers, weights, timers, newton meters).* Give groups time to discuss how they will do this to get results which they can trust.
Groups/individuals could present their champion material, explaining how the scientific evidence makes it a champion, and what it could be used for.

Adapting the activity

Support: Support with fair test. Have a prompt sheet or results table ready if needed.
Extension: Ask children to consider how much they trust their results. Repeat readings.
Other ideas: Stretchiest fabric or other properties of materials.

Key Questions

- How will you test for stickiness?
- Do you think it needs to be a fair test?
- How will you ensure it is a fair test?
- How will you compare the tapes? How will you know which is better?
- How will you ensure that your test is accurate?
- What could your champion tape be used for?

Assessment Indicators

Not yet met: Can describe which tape is the 'best' but is not able to explain how the results lead to this conclusion.

Meeting: Can explain which tape is best and why their findings are reliable (used repeat readings) and fair (identifies variables which should be kept the same), e.g. *we used the same amount of weight to make sure it was fair, the same person observed*. Suggests uses for their champion material.

Exceeding: Recommendations are based on results and utilise scientific concepts appropriate for a scientific audience. Evaluates their findings, including recognising anomalies.

Plan for Focused Assessment of Science

Topic: Properties and changing materials	Year 5 Age 9-10	Title: Dissolving

Working Scientifically

Plan: Plan scientific enquiry to answer question and recognise and control variables where necessary

Conceptual Knowledge Context

Know that some materials will dissolve in a liquid to form a solution.

Assessment Focus

- Can children plan a fair test to investigate factors affecting the speed at which solids dissolve in water?

Activity

Ask children to think of everyday example of dissolving solids in water (e.g. sugar in tea, salt in cooking water). Ask them to suggest ways of making the sugar dissolve faster (e.g. stirring, temperature of the water, size of sugar grains, volume of water). Ask them to choose a factor to investigate and to plan a fair test.
Carry out tests and discuss outcomes.

Adapting the activity

Support: Within a scaffold, make some suggestions about what could be kept the same/measured. Teacher support to plan a fair test but children explain how the planned test had been made fair.
Extension: identify what to change, measure and keep the same using a planning board provided. Plan a fair test independently, identifying and controlling relevant variables.
Other ideas: Consider continuous variables, e.g. temperature – how to decide on intervals / range.

Key Questions

- What is your question?
- How will you investigate this?
- How will you keep your test fair?
- What will you change?
- What will you measure?
- What will you keep the same?
- Can you explain why you have made these decisions?

Assessment Indicators

Not yet met: Can say what is being changed. May need support to explain what must be kept the same.

Meeting: Can plan a fair test identifying one thing to change, one thing to measure/observe and important factors to keep the same.

Exceeding: Identifies a range of factors to keep the same. Plans an appropriate range of intervals for chosen variable, e.g. 50 ml, 100 ml, 150 ml.

BATH SPA UNIVERSITY

why& how? PRIMARY SCIENCE TEACHING TRUST

Plan for Focused Assessment of Science

Topic: Properties and Changes of Materials	Year 5 Age 9-10	Title: Insulation layers
Working Scientifically **Do:** Use test results to make predictions to set up further comparative and fair tests	**Conceptual Knowledge Context** Compare everyday materials on basis of their thermal conductivity. Give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials.	

Assessment Focus

- Can children carry out an investigation to test a hypothesis?

Pre-activity *Today we are going to be packaging technologists.*
Tell the children you are fed up of having cold cups of tea and you want to see which cup will keep your tea warm for longer. Before the lesson show the children different cups of hot water, e.g. paper cup, stacked paper cups, thermos mug. Measure the temperature of the water and repeat after about one hour (at the beginning and end of lunchtime).

Activity

Use the results of the pre-activity to make predictions about insulations (a good insulator has more layers / traps air / made of….). Provide a collection of different materials and invite the children to discuss their ideas about which might be good for keeping the drink warm. The children could order the materials according to which will be best insulators? How will you test this?

Adapting the activity

Support: support the children with making choices about how to plan and carry out the test, e.g. by exaggerating 'unfairness', suggesting the use of a thermometer/probe. Testing sheet provided to structure the investigation.
Extension: Children to predict/choose which alternative material could insulate their beaker better, thinking about properties of the materials.
Other ideas: Which materials will insulate a hot baked potato?

Key Questions

- Why has the beaker of water been wrapped?
- What will you measure?
- How will you make it a fair test?
- What makes a good insulator? What other materials could be used as thermal insulators? Why has bubble wrap been chosen?
- Where have you seen things insulated?

Assessment Indicators

Not yet met: Suggests which insulators might be best but needs support to carry out fair test

Meeting: Carries out a fair test independently. From own findings identifies which material is the best insulator, *e.g. this one because it took longer to cool*

Exceeding: Compares own data with the original hypothesis & suggests reasons for similarities and differences, including any anomalies, *e.g. this one took longer to cool because....*

Plan for Focused Assessment of Science

Topic: Materials	Year 5 Age 9-10	Title: Testing nappy absorbency

Working Scientifically	Conceptual Knowledge Context
Plan: Plan different types of scientific enquiry, including recognising and controlling variables	Give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials

Assessment Focus

- Can children plan and carry out a fair test to compare the absorbency of different brand nappies?
- Can children explain why the test is/is not fair?

Activity

Discuss the need for soaking up liquids in everyday life. What materials are used? Consider when liquid needs to be soaked up, then contained without leakage. Refer to nappies – what are the key requirements? What do they know about their history? What do they know about their construction? What if we just used a towel or tissues for a baby?
Look at the packaging claims – parents have to decide which brand to choose. What would be their priority?
Task is to set up a comparative investigation to find out which nappy absorbs the most water. Have planning structures available.

Adapting the activity

Support: with support (TA / scaffolding) discuss and decide what will make a good way to test and what needs to be done to keep the comparisons of 2 nappies fair. Record their results as a table
Extension: Independently plan a valid fair test, present the conclusion referring to the interpretation of the data. Evaluate the effectiveness and reliability of the test.

Key Questions

- What are you trying to find out? What are you comparing?
- What will you do? What will you measure?
- What will you keep the same? What will you change?
- How will you record your results?
- How will you verify your results? (make sure they are accurate)
- How will you know if you have conducted a good test/obtained useful results?
- Can you use your data to justify your conclusion?

Assessment Indicators

Not yet met: Say what is being changed. Needs support to explain what variables are kept the same and why.

Meeting: Clearly explains the plan for the test and identifies the variables (what to change, what to measure/observe, what important factors to keep the same). Makes a reasonable attempt to control these.

Exceeding: Works systematically and identifies a range of factors to keep the same. Uses repeat readings and explains how this improves reliability.

Plan for Focused Assessment of Science

Topic: Properties and changing materials	Year 5 Age 9-10	Title: Sugar cube stacks

Working Scientifically **Do:** Gather and record data of increasing complexity using tables	**Conceptual Knowledge Context** Know that some materials will dissolve in a liquid to form a solution.

Assessment Focus

- Can children record data clearly and accurately?
- Can children record repeat readings?

Activity

Ask children to explore what happens when they place a stack of three sugar cubes in a small pool of coloured water (on a plate). Pause and discuss what they notice and what they could investigate e.g. does the number of cubes/amount of water make a difference? What if you place a material between the cubes (paper/foil/cling film)? How will you know if it makes a difference – what should we measure? (e.g. time for water to reach x, time to fall). Ask groups to investigate one of their ideas and record their findings in their own table.

Adapting the activity

Support: Question children to ensure they are clear about what they are changing, what they are measuring, and what they are keeping the same.
Extension: Repeat readings or try a different measure to check results.
Other ideas: investigate different types of sugar, different temperatures of water, different methods of adding water…

Key Questions

- What will you change?
- What will you measure?
- What will you keep the same?
- How confident are you in your results?
- How could you check your results?
- What do you think would happen if you did it again?
- What do you think would happen if you did it differently?

Assessment Indicators

Not yet met: Children note the times for each sugar cube test, but it may not be clear what they are measuring e.g. time to absorb or time to fall/dissolve.

Meeting: Results are recorded clearly in a table. Children may recognise the need to repeat readings but may not have recorded these.

Exceeding: The results table is clear and follows the science format of 'change' in the left-column and 'measure' in the right column(s). Repeat readings can/have been recorded in the table.

Plan for Focused Assessment of Science

<table>
<tr><td>Topic: Space
(or Forces)</td><td>Year 5
Age 9-10</td><td colspan="2">Title: Craters</td></tr>
<tr><td colspan="2">Working Scientifically
Do: Gather and record data using tables and graphs.</td><td colspan="2">Conceptual Knowledge Context
Explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object.</td></tr>
</table>

Assessment Focus

- Can children design simple tables to record results?
- Can children present results as a bar chart or line graph?

Activity Today we are going to be geologists.

This activity invites children to investigate the formation of 'craters' by dropping meteors (e.g. marbles or balls) into a tray of sand and observing the craters produced. Introduce by looking at photos/websites of impact craters. As a class drop a variety of different spherical objects into the sand and measure the diameter of the craters, creating a class graph. As a class, consider what could be changed and measured (could use a sticky note planning board) and allocate different variables to different groups of children (height of drop, size of meteor, type of sand). Ask each group to make measurements and record them in a table/graph of their own design.

Adapting the activity

Support: categorical variable, e.g. tennis ball/Ping-Pong ball/rubber ball, support with making measurements of crater to nearest cm, use pre-prepared table/graph.
Extension: Choose own variables, measure to nearest mm, talk about accuracy of results and repeat readings.

Key Questions

- Where on the table will you write down the things you have changed/measured?
- What would be a good heading for this column?
- Where on the bar chart will you show what you changed?
- Where on the bar chart will you show your measurements?
- Can you explain how you have recorded your results?

Assessment Indicators

Not yet met: Records measurements in a simple table/graph (support provided for scale as necessary).

Meeting: Can make decisions about what to record and where to put information in a simple table/graph. With support, can calculate/plot mean or median if repeat measurements have been taken.

Exceeding: Can design and use a suitable table/graph and aims to collect repeated measurements. Will notice and discuss anomalous results or discount them from the data.

This investigation can be for any age and can have a different Working Scientifically focus e.g. do across the school and look for progression.

Plan for Focused Assessment of Science

Topic: Animals including humans	Year 6 Age 10-11	Title: Heart Rate Headstands

Working Scientifically	**Conceptual Knowledge Context**
Do: Use test result to make predictions to set up further comparative and fair tests	Describe the functions of the heart, blood vessels and blood Recognise the impact of exercise on the way their bodies function

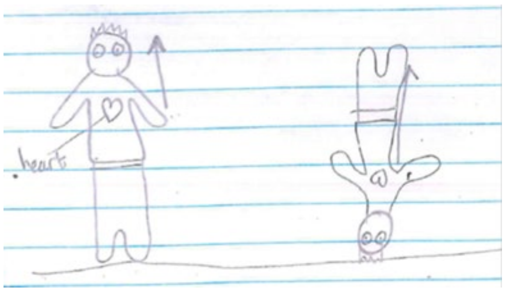
Assessment Focus
- Can children plan a scientific enquiry to answer their question?
- Can children explain their findings and consider the degree of trust in their results?
- Can children make predictions based on their results?

Activity *Today we are going to be biomedical scientists.*

What do you think happens to your heart when you do a headstand?
Ask children to think about other factors that could change their pulse rate. List their ideas and discuss why pulse rate increases during exercise: *emphasise that blood carries oxygen around the body and that when you exercise the muscles in your body need more oxygen so your heart works harder to supply more oxygen.*
Discuss with the children how to plan and carry out a test into headstands or similar. Consider how long the headstand should last, how many measurements should be made, whether one child or several children should be tested, how to carry out the tests safely.
Ask the children to carry out the test and record results as a group (tables or graphs). Focus individual recording on explanation of what their data shows, their explanations, degree of trust in results and further predictions.

Adapting the activity

Support: Offer written prompts to support children's predictions: e.g. your brain will get less/more/too much blood, your feet will get less/more blood, your heart will need to pump harder/less hard, it won't make any difference to how hard your heart pumps.
Provide a table for children to record their findings: Pulse before, Pulse after, Difference in pulse rate.
Extension: What happens to your pulse when you hold your hands above your head? Use your results to make further predictions.
Other ideas: Do you think a giraffe has a smaller or greater pulse than you? Find pulse rates of other animals on websites. Or link to healthy living.



Key Questions
- When was the heart rate the slowest/highest?
- What is the difference in pulse rate between at rest and after the head stand?
- Why did you measure the heart rate of several children not just one?
- Can you see any visible changes caused by blood circulation when a person does a head stand?
- Does your heart pump blood upwards against gravity?
- How far does blood travel from the heart to the head / heart to feet?
- Do you think your results would look the same if you measured the pulse rates of a different group of children?
- Why do you think the heart beats faster when you are upside down?
- Suppose we tested Sam's heart rate before he did a head stand, could you predict what it would be immediately afterwards?

Assessment Indicators

Not yet met: Children can explain that where the pulse rate goes up, this indicates that the heart is beating faster. They are aware that different children may have different resting pulse rates.

Meeting: Children can use their data to make predictions linking how hard the heart has to work with the heart rate, *e.g. When you are upside down the distance that the blood needs to be pumped upwards is greater, so your heart works harder and beats faster.*

Exceeding: Can explain that it is important to measure the changing pulse rates of several children to get a good picture of the overall pattern as individuals might vary. Can use their tables or graphs to make predictions about different situations, e.g. *If Sam did a headstand his pulse would go up and might be between 170 and 190, but we can't say for sure, If Sam held his hands above his head his heart rate would increase because his heart has to work harder to pump the blood upwards a greater distance*

Plan for Focused Assessment of Science

Topic: Electricity.	Year 6 Age 10-11	Title: Bulb brightness

Working Scientifically	**Conceptual Knowledge**
Plan: Plan a scientific enquiry to answer a question, recognising and controlling variables.	Compare variations in how components function.

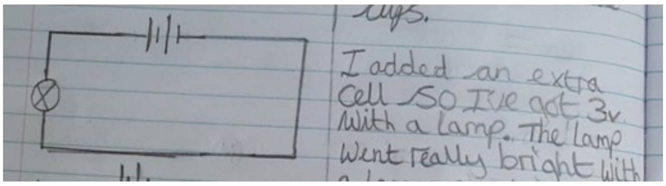
Assessment Focus
- Can children raise a question relating to simple circuits and the brightness of the bulb?
- Can children decide what evidence to collect in order to answer the question?

Activity *Today we are going to be electrical engineers.*
Each group/pair to have basic circuit components to include some variety between them (e.g. different thickness/length of high resistance (fuse) wires, number of bulbs/batteries available.) Set up a context requiring the need for light e.g. working late in winter/car headlights/torch light etc. Challenge each group to make a quick simple circuit to provide this light. There should be a variety of different circuits produced according to the resources, presenting an opportunity to compare and discuss differences in brightness and construction of circuitry (AfL).

Introduce the main task: to investigate how they can change the brightness of the bulb using the full range of equipment available. In pairs/groups, use planning devices (Post-it Planners) to generate a list of variables which could be changed in their circuit. Each group/pair select the variable they wish to change and how they will measure the effect of this change and use this to form a scientific question. Draw the test circuit. Each group report their question and list their variables (what to measure, what to change, what to keep the same) to the class for feedback.

Adapting the activity

Support: as needed in the planning process. Help them to decide how to measure the brightness of the bulb. (Data-loggers/layered paper). Scaffolding frameworks.
Extension: Children have a greater degree of control and independence in their choices. What further investigations could the children suggest to further their understanding?
Other ideas: Bulbs could be substituted for motors or buzzers.



Key Questions
- What factors in the circuit could be changed?
- Which variable will you investigate?
- Predict how changing your chosen variable affects the brightness of the bulb.
- What will you do to find an answer to your question?
- What will you keep the same?
- Are your test results reliable and what improvements could be made?
- Have you found an answer to your question? If yes, what? If not, can you explain why your investigation wasn't able to give you a clear answer?

Assessment Indicators

Not yet met: Can identify what they would like to test (e.g. adding more bulbs) but may need support in identifying and developing a succinct testable question, e*.g. "We will put in more bulbs to see if it gets brighter," should be re-worded to, "How does increasing the number of bulbs affect the brightness of each bulb?"*
Aware of the need for a fair test, but unable to identify the different types of variables (see below

Meeting: Identify a range of circumstances that may affect the brightness of the bulb and define a succinct scientific question to test, *e.g. What will happen to the (brightness of the bulb), if we change the (length of wire), but keep the (number of batteries, voltage of bulbs, type of wire etc) the same.*
Able to plan a fair test unaided, identifying the different types of variables: what to measure, what to change, what to keep the same

Exceeding: Can identify control variables for a range of investigation questions, *e.g. if we look at wire length we need to keep the voltage the same but if we look at voltage we need to keep the wires the same.* Identifies reliability issues within the test.

Plan for Focused Assessment of Science

Topic: Evolution (OR Forces)	Year 6 Age 10-11	Title: Egg strength

Working Scientifically **Review:** Explain degree of trust in results	**Conceptual Knowledge Link** Identify how animals are adapted to suit their environment in different ways

Assessment Focus

- Can the children explain how they are testing the strength of the eggs?
- Can the children consider the trustworthiness of their method/results?

Activity

Prior activity: why does a hen sit on her eggs? Why do they not break? Try 'squashing' eggs horizontally and vertically / standing on a tray of eggs. So we know they can be fragile – and strong. How strong? What would be a scientific way of finding out how strong a chicken egg is?
Children (in groups) set up a suitable test to measure strength and consider accuracy of measurements. Access to a range of weights/books, newton meters, lids, clingfilm (to protect books), card/loo roll (to make egg stand), plasticine, egg per group to test to destruction. Compare the results from different groups.

Adapting the activity

Support: ask children to take on a specific role in the group. Ask them to explain back what they understand about what they are doing and why.
Extension: work independently, support and communicate effectively with others.
Other ideas: Link with Maths lesson on averages and/or graphs.

Key Questions

- Which do you think is the best position to test?
- How will the egg be held in place? (cushioning? – what difference could this make?)
- What 'measure': weights/ newton meters/marbles/books etc.?
- How will the weight be added (increments / position) and recorded?
- How much confidence do you have in your results? Do you think you would get the same results again?
- How does your group's data compare to the class results?

Assessment Indicators

Not yet met: Understands the need to be 'fair' / 'same' across all eggs. When prompted, can look for possible problems with the test (holding egg differently, putting weights on with different force).

Meeting: Can identify a range of factors that need to be consistent, e.g. egg position, how weight applied, how egg held in place, etc. Can consider which variables were hard to control and offers suggestions for improving the test.

Exceeding: Can anticipate potential problems, evaluates throughout the process and makes adjustment – but mindful that changes could affect the consistency of results. Problem solves, e.g. ran out of actual weight so used substitutes and weighed them on scales.

Plan for Focused Assessment of Science

Topic: Evolution and inheritance	Year 6 Age 10-11	Title: Fossil habitats

Working Scientifically	**Conceptual Knowledge**
Review: Identifying scientific evidence that has been used to support or refute ideas or arguments.	Recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago.

Assessment Focus

- Can children use evidence (from fossils or research) to develop ideas?
- Can children discuss whether evidence supports ideas?

Activity *Today we are going to be palaeontologists.*

Provide children with photos (or better still real or resin) fossils (trilobite, ammonite, ichthyosaurus). Discuss what the animals could have looked like- back up with evidence using secondary sources. Discuss what they could have eaten (link to teeth) or where they could have lived (provide details of where fossils found).

Children to design a habitat that the animal could have survived in when it was alive millions of years ago. Draw and label the creature in its habitat.

Make comparisons to modern creatures. e.g. whales- sea living prehistoric creatures, birds to many prehistoric creatures.

Adapting the activity

Support: Provide examples of animals alive today that have similar physical characteristics. Provide list of habitats to prove/disprove.

Extension: Make food webs for the prehistoric creatures using secondary sources, arrange in time order, find examples of creatures alive today that share characteristics supporting evolution

Other ideas: research palaeontologists, top trumps of fossils, models to demonstrate, explanation writing about fossil formation.

Key Questions

- What is a fossil? How was it made? (The rock has filled the gap where the animal was, so not the remains of an animal).
- What do fossils tell us?
- What do you think it looked like? How can you tell?
- What do you think it ate? How can you tell?
- Where do you think it lived? How can you tell?

Assessment Indicators

Not yet met: Can identify physical characteristics from fossil evidence and can explain what a fossil is in simple terms.

Meeting: Above, plus can suggest where the creature might have lived, and what we can learn from fossils using correct scientific vocabulary

Exceeding: Considers what can be known about appearance, habits and habitats from fossil evidence. Describes potential sources of error.

Plan for Focused Assessment of Science

Topic: Light	Year 6 Age 10-11	Title: Investigating shadows

Working Scientifically **Do:** Take accurate measurements and record data on a graph	**Conceptual Knowledge Context** Use the idea that light appears to travel in straight lines to explain why shadows have the same shape as their objects

Assessment Focus

- Can children make accurate measurements?
- Can children choose the appropriate type of graph to present their results?

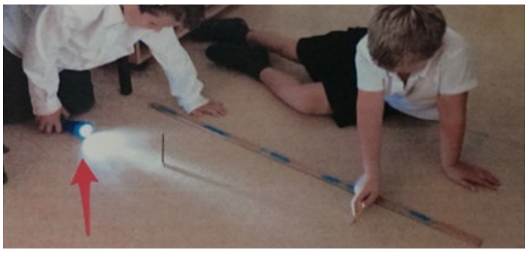
Activity

Introduce the investigation by shining a light on an object and asking how the shadow of the object could be changed. List potential investigation questions. Ask children to select a question and carry out the investigation. Focus on recording of results.

Adapting the activity

Support: Provide support to as needed in the planning process (could use planning framework) to clarify what question should be investigated, what will be measured, changed and kept the same. Support drawing an appropriate graph (line graph).
Extension: Ask children how the angle of the light affects the shadow. Ask children to use their graph to make further predictions and test them.
Other ideas: Research use of and limitations of sundials

Key Questions



- What could we change that might change the shadow?
- What could we measure about the shadow?
- How are you making sure that it is a fair test?
- What kind of a graph can you draw with that data?
- It there a pattern or trend in your results?

Assessment Indicators

Not yet met: Carries out a fair test with some support and may need help to draw a line graph.

Meeting: Uses appropriate equipment to measure, e.g. a protractor for angle of light, a ruler to measure length of shadow to nearest mm. Records data and draws a line graph.

Exceeding: Identifies why a line graph is preferred and uses the graph to make further predictions, *e.g. if the angle of the light is 60°, the shadow will be 5cm.*

Plan for Focused Assessment of Science

Topic: Living things and their habitats	**Year: 6** Age 10-11	Title: Invertebrate research

Working Scientifically **Review:** Report and present findings from enquiries using appropriate scientific language	**Conceptual Knowledge** Give reasons why a particular invertebrate belongs to a certain group

Assessment Focus

- Can children report and present information about an invertebrate classification group

Activity (to be completed after some input of animal classification)

Show children some invertebrate film clips (e.g. David Attenborough).
Explain that their task is to research different invertebrates (show examples).
Brainstorm – how will you share what you have found out? - films, posters, models (playdough), write, drama, hot-seating, etc.
Children to work in small (mixed ability) groups and should be given a different invertebrate group to focus on (annelids, molluscs, insects, arachnids, crustaceans and myriapods). Each group must give an example and describe the features which make it a member of its classification group.

Adapting the activity

Support: Adult support – prompting children to describe features: How do you know it is a mollusc? How is it different to an insect?
Extension: Give the children a fictitious animal that the children have to classify, using branch diagrams that they are familiar with.
Children to design their own species of living thing that would fit in with one of the classification groups.
Other ideas: use a tablet / camera to film their presentation

Key Questions

- Why is your invertebrate a member of the …. group? Why could it not fit within a different group?
- What other invertebrates are also members of this group?
- Which scientific visual aids will you prepare to illustrate how your invertebrates are classified?
- How can you ensure that you clearly present the information about your group in a way that others can understand?

Assessment Indicators

Not yet met: Report and present information about an animal classification group explaining that there are differences between groups of animals

Meeting: Explain all of the key characteristics of that group and how they differ from other groups. Able to justify why their chosen animal belongs to one invertebrate group and not another.

Exceeding: Able to explain how invertebrates from a broad range of habitats are classified with reasons why. Could answer questions about an unfamiliar invertebrate and decide which group it belongs to.

Working Scientifically in the Primary Classroom:

Progression of Enquiry Skills from EYFS to KS3

CENTRE *for* INDUSTRY EDUCATION COLLABORATION

The SALTERS' Institute

"The posters were very well received when I used them in a staff INSET to identify the expected progression in working scientifically! Each class now has a copy on their science display."

"I adapted them slightly, to fit our curriculum planning, and they are laminated and can be found on the children's tables. They are used as targets for learning and year 1 and 2 love them especially. I also used the statements to create Science 'I can' tracking sheets that are consistent with maths and literacy."

"I have tried the poster with my class for one of the activities and it worked really well. It was easy for the Year 1 class to use. Next term I will build it in to my planning. I will be taking the first staff meeting of next term and I'm going to propose that we roll it out throughout the school."

Working Scientifically in the Primary Classroom: Progression of Enquiry Skills

Introduction

This booklet has been produced to help teachers understand how to 'work scientifically' within the primary science curriculum for England [1].
Each page contains a summary of information intended to enable teachers to:

- plan science lessons during which children can show progress in their learning
- ensure continuity and progression of essential enquiry skills
- differentiate activities and add challenge for more able children
- make accurate assessments, and facilitate high quality peer and self-assessments.

The notes below provide guidance for teachers using and sharing the posters and progression grids in their own school and beyond. We do hope that these are useful to as many colleagues as possible in English primary schools, and would appreciate feedback on how they are used to ciec@york.ac.uk.

Encouraging children to work scientifically

There are three aims in the English primary science curriculum, to ensure that all pupils:

- develop **scientific knowledge and conceptual understanding** through the specific disciplines of biology, chemistry and physics
- develop understanding of the **nature, processes and methods of science** through different types of science enquiries that help them to answer scientific questions about the world around them
- are equipped with the scientific knowledge required to understand the **uses and implications** of science, today and for the future.

This guidance provides support particularly for the second of these aims. In order for primary school children to operate as successful scientists, they should be taught a wide range of essential enquiry skills. These skills should build upon earlier opportunities they have had to play, explore, create, engage in active learning, and think critically in the Early Years Foundation Stage.

By carefully examining the statutory requirements for Working Scientifically at Key Stage One, Lower Key Stage Two and Upper Key Stage Two, it is possible to create a list of generic science enquiry skills common to all children across the primary age phase:

Asking questions	Observing and measuring
Planning and setting up different types of enquiries	Identifying and classifying
Performing tests	Gathering and recording data
Using equipment	Reporting, presenting and communicating data/findings

By further 'teasing apart' the statutory requirements and non-statutory notes and guidance for Working Scientifically, it is possible to see subtle differences in the way that each skill is described as children increase in age and ability. It is important that teachers understand the progression route for each skill to enable them to plan high quality science lessons.

1 The National Curriculum in England Key Stages One and Two framework document September 2013, Department for Education

Progression of skills: grids explained

Early Years Foundation Stage to Key Stage One

Progression of Enquiry Skills Early Years Foundation Stage to Key Stage One, is a succinct overview of science enquiry for our youngest scientists. Teachers can use this grid to see how emergent science skills act as precursors to the statutory requirements of Working Scientifically found in the English National Curriculum for Science for Key Stage One. The document has been separated into rows of distinct skills so that teachers can easily understand the expected standards as well as plan for differentiation and progression within each skill. The information in italics shows where each statement comes from; whether it is an Early Learning Goal or a Characteristic of Effective Learning found in the non-statutory guidance 'Development Matters'.

Teachers could also use this document to formulate Working Scientifically learning objectives and ensure that all areas of enquiry have been taught throughout the academic year. It could be used for both formative and summative assessment purposes whereby teachers highlight particular skills that have been achieved by either individuals or groups of children and then use this information to target areas of weakness as well as to indicate 'next steps' in learning. Note: Pupils are not expected to cover each aspect for every area of study.

Key Stage One to Key Stage Two

Progression of Enquiry Skills Key Stage One and Two is an organised summary of the statutory requirements and non-statutory notes and guidance for Working Scientifically from Years 1 to 6. It has the same purpose as the EYFS – KS1 grid and will enable teachers to understand and make quick reference to the expected national standards across the full primary age range.

Key Stage Two to Key Stage Three

Progression of Enquiry Skills Upper Key Stage Two to Key Stage Three has the same purpose as outlined above, with a focus on enabling teachers to see how the skills pupils learn at primary school can be extended beyond Year 6. Upper Key Stage Two teachers can use this information to create activities which challenge their most able children and make purposeful links to the additional mathematics required to carry out higher level science.

Working Scientifically Posters

A poster is provided for each of the following age ranges:

- Early Years Foundation Stage
- Key Stage One
- Lower Key Stage Two
- Upper Key Stage Two

The information from the grids has been converted into child-friendly 'I can' statements and presented in a format that may be used for both peer and self assessment.

Teachers may wish to replace the poster image with photographs of individual children in their class. Each child can use their own poster and personalise their learning by identifying the enquiry skills being taught in weekly science lessons. They could highlight, tick or date a skill when they feel they have achieved the expected standard of attainment. Teachers can use the posters as a quick and easy reference for age appropriate expectations when planning enquiry activities. The statements have been written in hierarchical order around the posters so that it is possible to refer to an earlier or later age group's poster to help with differentiation and challenge. This order is not intended to be explicit to children, and should therefore avoid 'labelling' or levelling themselves or each other.

Progression of Enquiry Skills from Early Years Foundation Stage to Key Stage One

EYFS	Key Stage One
Show curiosity about objects, events and people Playing & Exploring Questions why things happen Speaking: 30-50 months	Explore the world around them and raise their own simple questions
Engage in open-ended activity Playing & Exploring	Experience different types of science enquiries, including practical activities
Take a risk, engage in new experiences and learn by trial and error Playing & Exploring	Begin to recognise different ways in which they might answer scientific questions
Find ways to solve problems / find new ways to do things / test their ideas Creating & Thinking Critically	Carry out simple tests
Develop ideas of grouping, sequences, cause and effect Creating &Thinking Critically Know about similarities and differences in relation to places, objects, materials and living things ELG: The World	Use simple features to compare objects, materials and living things and, with help, decide how to sort and group them (identifying and classifying)
Comments and asks questions about aspects of their familiar world such as the place where they live or the natural world The World: 30-50 months	Ask people questions and use simple secondary sources to find answers
Closely observes what animals, people and vehicles do The World 8-20 months Use senses to explore the world around them Playing & Exploring	Observe closely using simple equipment With help, observe changes over time
Make links and notice patterns in their experience Creating & Thinking Critically	With guidance, they should begin to notice patterns and relationships
Choose the resources they need for their chosen activities ELG: Self Confidence & Self Awareness Handle equipment and tools effectively ELG: Moving & Handling	Use simple measurements and equipment (e.g. hand lenses, egg timers) to gather data
Create simple representations of events, people and objects Being Imaginative: 40-60+ months	Record simple data
Answer how and why questions about their experiences ELG: Understanding Make observations of animals and plants and explain why some things occur, and talk about changes ELG: The World	Use their observations and ideas to suggest answers to questions Talk about what they have found out and how they found it out
Develop their own narratives and explanations by connecting ideas or events ELG: Speaking Builds up vocabulary that reflects the breadth of their experience Understanding: 30-50 months	With help, they should record and communicate their findings in a range of ways and begin to use simple scientific language

Progression of Enquiry Skills from Key Stage One to Key Stage Two

Key Stage 1	Lower Key Stage 2	Upper Key Stage 2
Explore the world around them and raise their own simple questions	Raise their own relevant questions about the world around them	Use their science experiences to explore ideas and raise different kinds of questions
Experience different types of science enquiries, including practical activities	Should be given a range of scientific experiences including different types of science enquiries to answer questions	Talk about how scientific ideas have developed over time
Begin to recognise different ways in which they might answer scientific questions	Start to make their own decisions about the most appropriate type of scientific enquiry they might use to answer questions	Select and plan the most appropriate type of scientific enquiry to use to answer scientific questions
Carry out simple tests	Set up simple practical enquiries, comparative and fair tests Recognise when a simple fair test is necessary and help to decide how to set it up	Recognise when and how to set up comparative and fair tests and explain which variables need to be controlled and why
Use simple features to compare objects, materials and living things and, with help, decide how to sort and group them (identifying and classifying)	Talk about criteria for grouping, sorting and classifying; and use simple keys	Use and develop keys and other information records to identify, classify and describe living things and materials, and identify patterns that might be found in the natural environment
Ask people questions and use simple secondary sources to find answers	Recognise when and how secondary sources might help them to answer questions that cannot be answered through practical investigations	Recognise which secondary sources will be most useful to research their ideas and begin to separate opinion from fact
Observe closely using simple equipment with help, observe changes over time	Make systematic and careful observations Help to make decisions about what observations to make, how long to make them for and the type of simple equipment that might be used	Make their own decisions about what observations to make, what measurements to use and how long to make them for
With guidance, they should begin to notice patterns and relationships	Begin to look for naturally occurring patterns and relationships and decide what data to collect to identify them	Look for different causal relationships in their data and identify evidence that refutes or supports their ideas
Use simple measurements and equipment (e.g. hand lenses, egg timers) to gather data	Take accurate measurements using standard units learn how to use a range of (new) equipment, such as data loggers / thermometers appropriately	Choose the most appropriate equipment to make measurements with increasing precision and explain how to use it accurately. Take repeat measurements where appropriate.
Record simple data	Collect and record data from their own observations and measurements in a variety of ways: notes, bar charts and tables, standard units, drawings, labelled diagrams, keys and help to make decisions about how to analyse this data	Decide how to record data and results of increasing complexity from a choice of familiar approaches: scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs
Use their observations and ideas to suggest answers to questions Talk about what they have found out and how they found it out	With help, pupils should look for changes, patterns, similarities and differences in their data in order to draw simple conclusions and answer questions	Identify scientific evidence that has been used to support or refute ideas or arguments
With help, they should record and communicate their findings in a range of ways and begin to use simple scientific language	Use relevant simple scientific language to discuss their ideas and communicate their findings in ways that are appropriate for different audiences, including oral and written explanations, displays or presentations of results and conclusions	Use relevant scientific language and illustrations to discuss, communicate and justify their scientific ideas, use oral and written forms such as displays and other presentations to report conclusions, causal relationships and explanations of degree of trust in results
	With support, they should identify new questions arising from the data, making predictions for new values within or beyond the data they have collected and finding ways of improving what they have already done.	Use their results to make predictions and identify when further observations, comparative and fair tests might be needed

Progression of Enquiry Skills from Key Stage Two to Key Stage Three

Upper Key Stage 2	Key Stage 3
Use their science experiences to explore ideas and raise different kinds of questions	Ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience
Talk about how scientific ideas have developed over time	Understand that scientific methods and theories develop as earlier explanations are modified to take account of new evidence and ideas, together with the importance of publishing results and peer review
Select and plan the most appropriate type of scientific enquiry to use to answer scientific questions	Select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate
Recognise when and how to set up comparative and fair tests and explain which variables need to be controlled and why	
Use and develop keys and other information records to identify, classify and describe living things and materials, and identify patterns that might be found in the natural environment	
Recognise which secondary sources will be most useful to research their ideas and begin to separate opinion from fact	
	Make predictions using scientific knowledge and understanding
Choose the most appropriate equipment to make measurements with increasing precision and explain how to use it accurately Take repeat measurements where appropriate	Use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety Evaluate the reliability of methods and suggest possible improvements Evaluate risks Pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility.
	Apply sampling techniques Apply mathematical concepts and calculate results Use and derive simple equations and carry out appropriate calculations Undertake basic data analysis including simple statistical techniques
Make their own decisions about what observations to make, what measurements to use and how long to make them for	Understand and use SI units and IUPAC (International Union of Pure and Applied Chemistry) chemical nomenclature Make and record observations and measurements using a range of methods for different investigations Present observations and data using appropriate methods, including tables and graphs
Decide how to record data and results of increasing complexity from a choice of familiar approaches: scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs	
Look for different causal relationships in their data and identify evidence that refutes or supports their ideas	Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions
Identify scientific evidence that has been used to support or refute ideas or arguments	Present reasoned explanations, including explaining data in relation to predictions and hypotheses Evaluate data, showing awareness of potential sources of random and systematic error
Use relevant scientific language and illustrations to discuss, communicate and justify their scientific ideas Use oral and written forms such as displays and other presentations to report conclusions, causal relationships and explanations of degree of trust in results	
Use their results to make predictions and identify when further observations, comparative and fair tests might be needed	Identify further questions arising from their results

Working Scientifically Poster for Early Years Foundation Stage

I question why things happen

I have my own ideas

I test my ideas

I begin to use science words

I notice similarities and differences

I can talk about things like plants, animals, natural and found objects

I can use my senses and look closely

I can create simple representations of people and objects

I use equipment and tools carefully

Working Scientifically Poster for Key Stage One

I perform simple tests

I recognise that questions can be answered in different ways

I can compare things. I sort and group them

I ask simple questions

I use simple scientific language

I observe closely

I talk about what I have found out

I use simple equipment to make measurements

I gather and record simple data in different ways

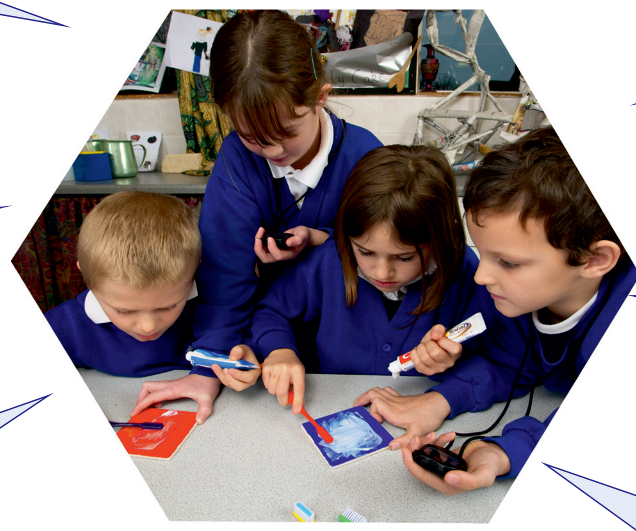
Working Scientifically Poster for Lower Key Stage Two

I ask my own questions
I use different ways to answer them

I set up my own simple tests

I suggest improvements and raise further questions

I make careful observations



I use relevant scientific language

I use different equipment to measure accurately in standard units

I draw simple conclusions and make predictions for new values

I explain what I have found out using speaking and writing

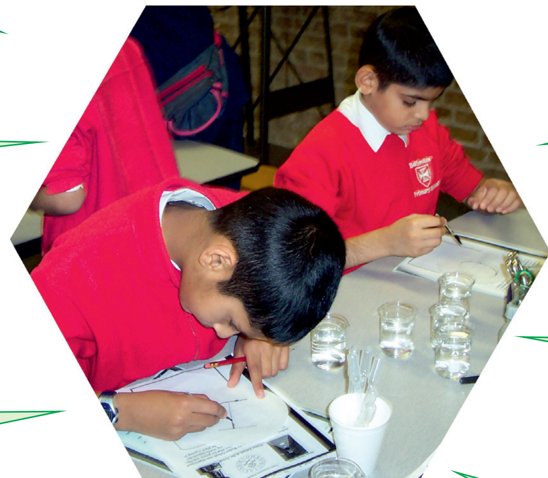
I gather, record, classify and present data in different ways including drawings, labelled diagrams, keys, bar charts, and tables

Working Scientifically Poster for Upper Key Stage Two

I ask different kinds of questions

I use results to make predictions and set up more tests (including fair tests)

I plan different types of scientific enquiries to answer questions



I can set up fair tests when necessary

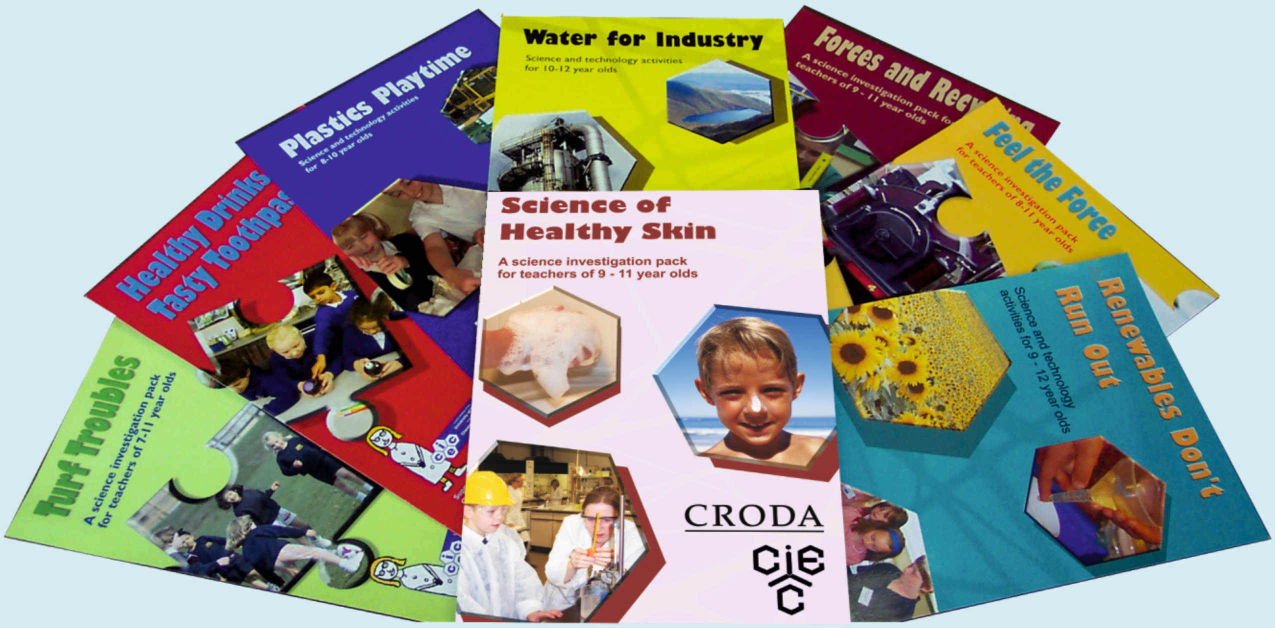
I use relevant scientific language and illustrations

I decide what observations and measurements to make

I report and present findings using speaking and writing including displays and presentations

I use different scientific equipment to measure with precision. I take repeat readings when appropriate

I decide how to record data and results. I can use scientific diagrams, labels, classification ,keys, tables, scatter, bar and line graphs



CIEC offers support for the teaching of science across the primary age range and beyond. This support includes CPD programmes, bespoke in-school CPD, interactive websites for teachers to use with their pupils, and a wide range of downloadable resources which encourage collaborative, practical problem solving. For more information, please visit our website:

www.ciec.org.uk

or contact:

Centre for Industry Education Collaboration, CIEC
Department of Chemistry
University of York
York, YO10 5DD

Telephone: 01904 322523
email: ciec@york.ac.uk