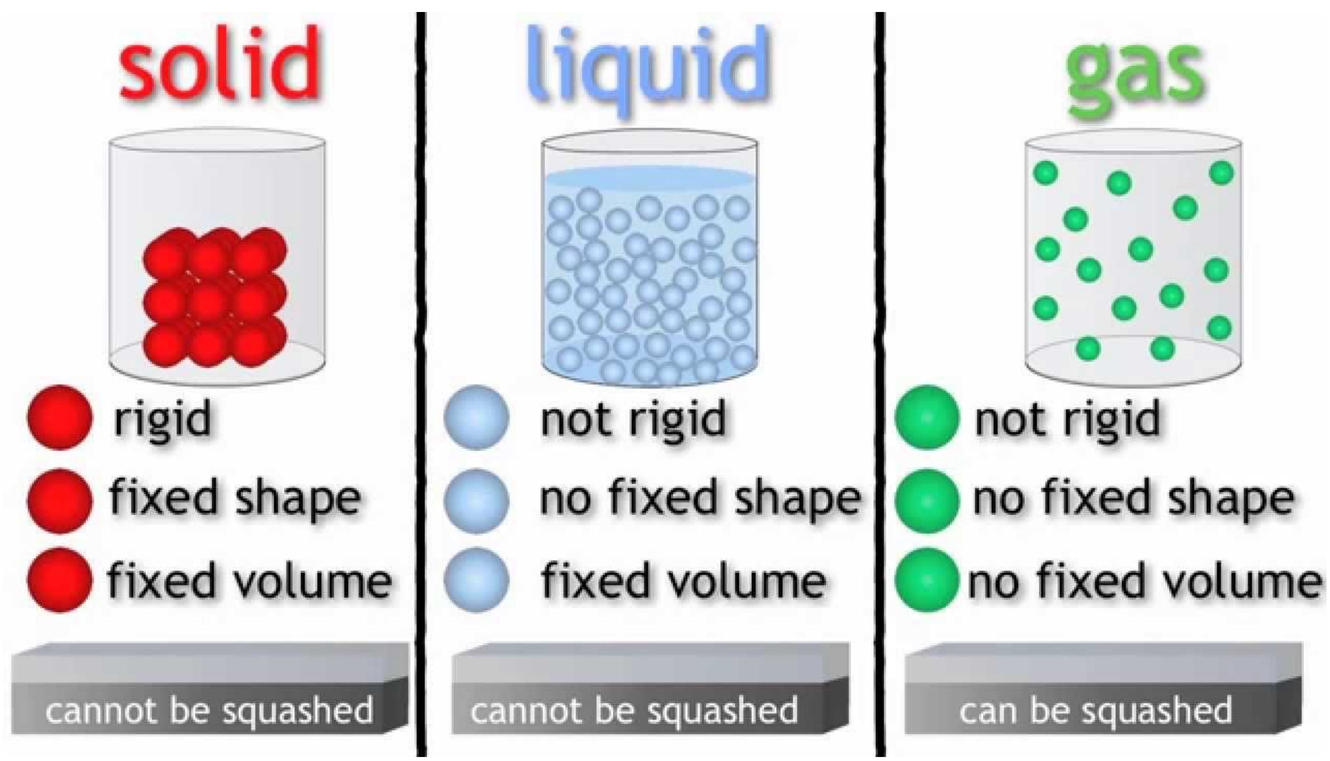
Change Detective

Study of Physics & Chemistry &
Measurement Mathematics

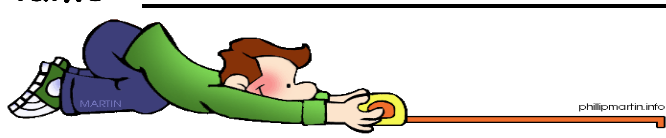
Grades 3,4, & 5

LEARNING LOG



https://i.ytimg.com/vi/21CR01rlmv4/maxresdefault.jpg

Name: ______________________________



Junior Change Detective Learning Log

Copyright: Barbara J. Smith

First Edition, December 2016
3600 Yonge St.
Toronto, Ontario, Canada M4N3R8

Author: Barbara J. Smith and Barbara Black

For other access and permission to use this resource and revise/customize it, please contact:
zpdschoolandcurriculumdesign@gmail.com

This document edition will be used as a pilot resource to support innovative schools. The intent of sharing this first version with students, staff and families, is so we can gather further input for future revisions of this living curriculum.

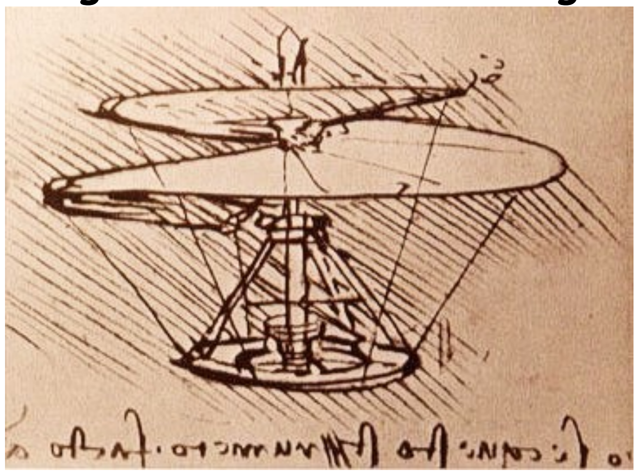
All we ask is that if you use these materials that you give credit to the author(s) of this initial work, in your introduction.

Acknowledgement: Many thanks to Barbara Black for collaborating on this curriculum writing project.

PURPOSE of LEARNING LOG RESOURCE:

1. To support the Ontario Mathematics and Science Curriculum
2. To support independent and paired study during station work or during home study (holiday or at-home interest/ extended homework activities.
3. To add support as an enrichment or remedial resource (students can work at their own pace)
4. To provide a learning log (evidence of learning) built in to student resources

Making Something that Matters Challenge!



https://swh-schoolworkhelper.netdna-ssl.com/wp-content/uploads/2011/07/Leonardo-Da-Vinci-5.jpg?x37075

Trailblazer (Expert)	360 - 400 points
Pathfinder (Apprentice)	320-359 points
Rookie (Novice)	< than 320 points

Challenge	Maximum Points
Experiments	120 (12)
Draw linear measures	10
Conversions (metrics and Imperial)	30
Measurement Quiz A	30
Measurement Quiz B	30
Matter Quiz	60
Patent Proposal	20
Kickstarter entry	40
Tiger Tank Presentation	40
Learning Log Challenge (complete tasks in this booklet)	10
Classroom Work	10
TOTAL	400

Table of Contents

S = Ontario Science Standards; M = Ontario Math Standards

NGSS- Next Generation Science Standards http://ngss.nsta.org/AccessStandardsByTopic.aspx

Starter Check

What do scientists do?

What is an innovation?

What is an experiment?

What is an observation?

Bonus ☺

What is a source?

1. Scientists Design Safely

- Sign the following School Safety Contract:

School Safety Contract

1. Follow the teacher's instructions carefully. Ask questions if you do not understand what to do.
2. Do not taste, eat, drink, or inhale anything used in science activities unless the teacher tells you to do so.
3. Keep your hands away from your face, eyes, and mouth during science activities. Wash your hands after science activities.
4. Always wear goggles when chemicals, glass, or heat are being used and when there is a risk of eye injury from flying objects.
5. Tell the teacher if you see something/someone being unsafe.
6. Notify the teacher immediately if you have an accident or an injury.

I have reviewed these safety rules with my teacher.

________________________________ __________
Student's Signature Date

________________________________ __________
Teacher's Signature Date

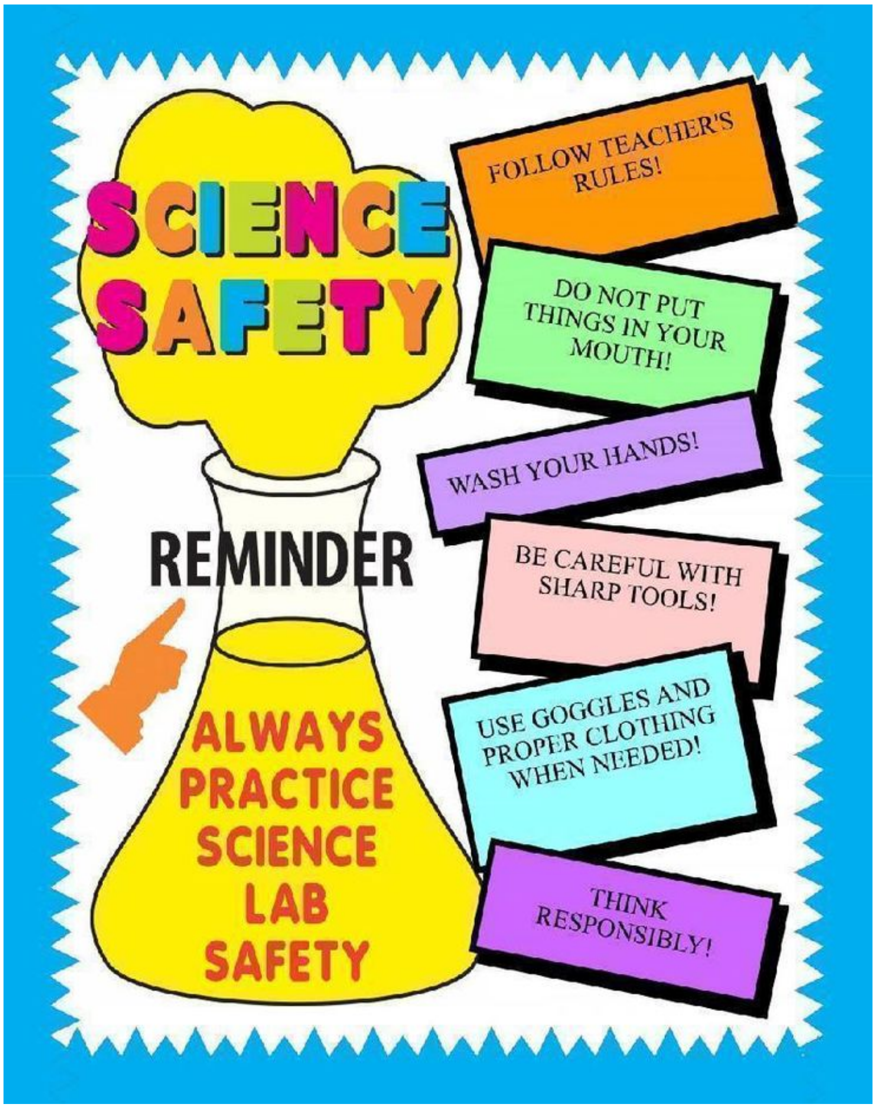
How well did I do this task?	Trailblazer	Pathfinder	Rookie (Not Yet)

SAFETY TIPS WE FOLLOW:

When twisting, bending, compressing, or stretching materials, you need to wear protective _________________________ wear.

_________________ hands when working with soil and dangerous materials.

- Make sure you have permission and use space safely when working with tools.



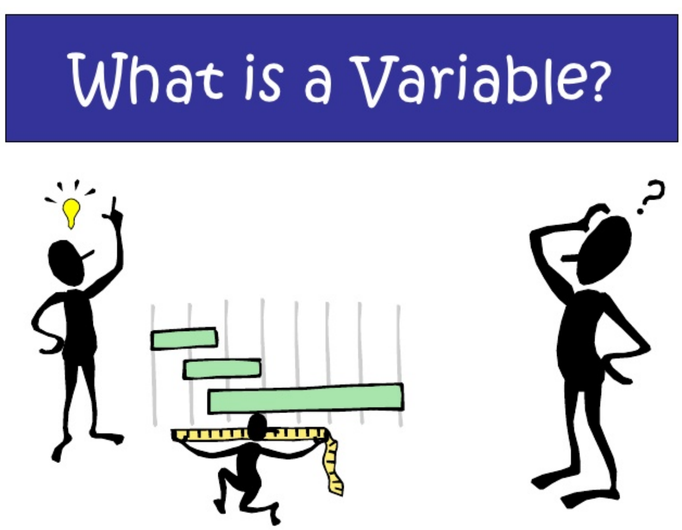
https://s-media-cache-ak0.pinimg.com/736x/19/a9/a8/19a9a8c29c7a7842f97b536ed2de4bf1.jpg

2. Scientists are Change Detectives

Scientists use the Scientific Method to make sure their experiments have been done well. The Scientific Method involves 5 parts:

1. Prediction.
2. Procedure
3. Observations
4. Findings - Confirm or change first ideas.
5. Recommendations - Telling how an experiment could have been better.

Engineers and entrepreneurs work in Research and Development to make things work and make new things that people need.
Scientists observe changes in things.
They change things to see the impact of changing a 'variable' on something else.



https://image.slidesharecdn.com/basicvariablesppt-110925195023-phpapp02/95/basic-variables-ppt-1-728.jpg?cb=1316980332

- Look at the following experiment to find the variable the scientist changed.

Kool-Aid Rock Candy Science Experiment

Prediction:

We think we will be able to make rock candy on the stick. We are not sure how long it will take to make it.

Procedure:

1. Dip sticks in water and roll them in sugar.
2. Place them on parchment paper to dry.
3. Combine 1 cup water and 1 cup sugar over medium heat until sugar is fully dissolved.
4. Add 2 more cups sugar and continue cooking and stirring until it is dissolved.
5. Empty 1 package Kool Aid in a large jar.
6. Put your sugar dipped *(and dried*) sticks in the Kool Aid sugar water. We used a clothespin to keep the stick upright.
7. Make sure your stick does not touch the bottom of the jar.
8. Put a stick in plain water to see if anything happens
9. Watch the sticks for one week and record observations.

Observations:

- Crystals took about a week to grow.
- Rock crystals begin to form on sticks about day 2.
- The stick in jar with the plain water did not have any crystals.

Findings:

We discovered that crystals grew on the sticks and made rock candy in a week's time. We think the stick provided the surface for the crystals to grow on. These *seed crystals* were starting points for larger crystals to grow. We think there was extra sugar in the water when it began to evaporate. When that could not be dissolved, it formed on the stick to make rock candy.

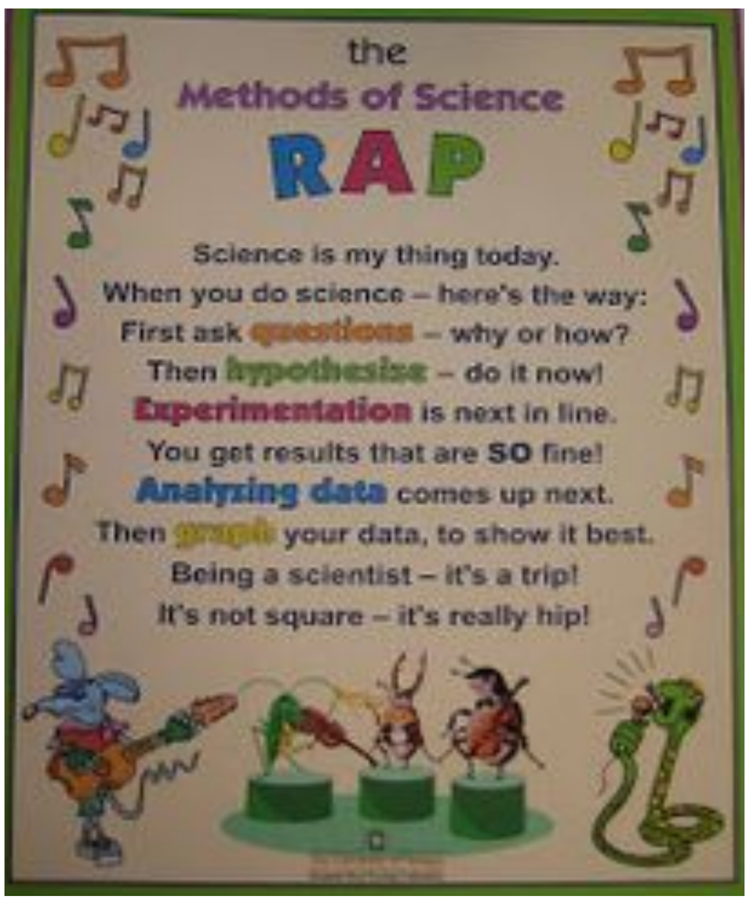
Recommendations:
It would be a good idea to videotape the formation of crystals so we could observe them grow in slow motion.

________________ being added to the water was the variable that changed in this experiment.

Extension:

- Try making rock candy at home – and see if it takes a longer time to grow, or if some colours of Kool-aid grow crystals faster.

- Practise the following rap and put the words, "questions", "hypothesis", "analyzing data", "graph" in the section of the Scientific Method Chart where you think these words fit best.



https://www.pinterest.com/pin/389842911478070696/

Scientific Method Actions	**Words that describe actions**
Prediction	
Procedure	
Observations	
Findings	
Recommendations	

STEP OUTSIDE: Look for things outside that you can:

- Create a question about: ___________________________________
- Form a hypothesis by making a prediction about:

*I predict….*____

*because….*____

The reason for your prediction is a hypothesis.

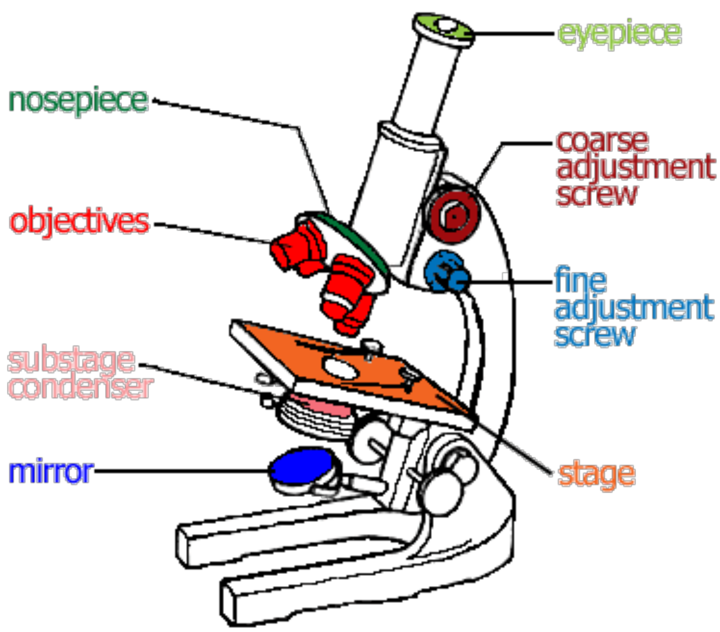
3. Scientists Use Magnifying Glasses and Microscopes

Closer Look

Many researchers use microscopes or magnifying glasses to take a close look at an item.

A microscope is a key tool in the scientist's toolkit!

- Look at the diagram of the microscope.
- Work with a partner to locate each part on a microscope.
- Make up your own definitions for each part.



http://www.clipartbest.com/cliparts/bcy/6ge/bcy6geqKi.gif

nosepiece	eyepiece
objectives	adjustment screws
stage	mirror
substage condenser - cone of light that lights up the specimen	

Why do scientists use microscopes?
A MICROSCOPE IS A USEFUL INSTRUMENT FOR OBSERVING SMALL OBJECTS. BY PRODUCING A MAGNIFIED IMAGE, THE MICROSCOPE REVEALS DETAILS THAT ARE UNDETECTABLE TO THE NAKED EYE.

Proper Care and Use of a Microscope
CAUTION: Microscopes are both delicate and expensive and must be handled with care.

1. Always carry the microscope with two hands— one supporting the base and the other on the arm.
2. Avoid stretching the power cable of the lamp across a walkway.
3. Keep the stage clean and always use a glass slide for specimens.
4. To avoid crushing the glass slide when focusing, begin with the lens close to the specimen and gradually back off to focus.
5. Keep the microscope covered to prevent the buildup of dust while it is being stored.

- Read the following details about using a microscope:
  1. Plug in the lamp.
  2. Place a sample of what you wish to observe on a slide.
  3. Adjust the mirror so it reflects light from the room up into the objective lens.
  4. When the mirror is correctly adjusted, a complete circle of light will appear when you look through the eyepiece.
  5. Place your slide with the specimen directly over the center of the glass circle on the stage. If it is a wet slide, be sure the bottom of the slide is dry.
  6. With the **LOW POWER** objective lens placed over the slide, use the coarse focus knob to lower the lens to the lowest point.
  7. Look through the eyepiece with one eye while closing the other eye. Slowly raise the lens until the focus is relatively clear.
  8. Use the fine focus knob to fine-tune the focus.
  9. Without changing the focus knobs, switch to the **HIGH POWER** objective lens. Once you have switched to **HIGH POWER**, use only the fine focus knob to make the image sharper.

- Work with a younger learning buddy to help them build their collection box.

http://3.bp.blogspot.com/_dq8dd2_NDUg/SX8kutEHgCI/AAAAAAAACQk/x-LxkLmqO28/s400/IMG_1153crop.jpg

- Check out Collection Items with your magnifying glass and microscope.
- Select two different items in the box and look at them through:
    - A magnifying glass and,
    - a microscope
- Discuss; how were they different?
- Draw the items as you see them – and then how you see it using a

… microscope.

Extension:

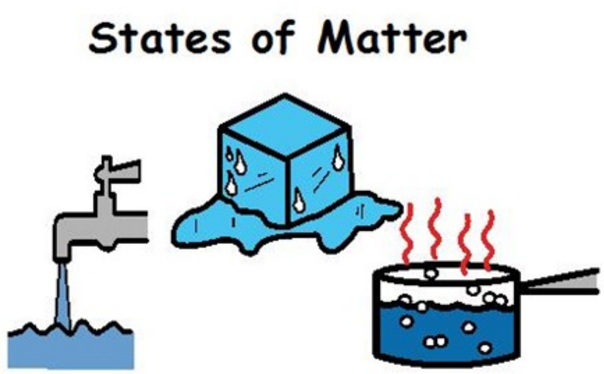
- Make your own Microscope http://www.scienceinschool.org/2012/issue22/microscope

4. Scientists Understand Different States of Matter

- Read the lyrics to the song about solids, liquids & gasses:

https://s-media-cache-ak0.pinimg.com/736x/04/93/a7/0493a7d69dc251bc63e77eae1c656f6e.jpg

- When you observed the items in the Collection Boxes, did you observe .. solids, liquids or gasses with the microscope and magnifying glass?

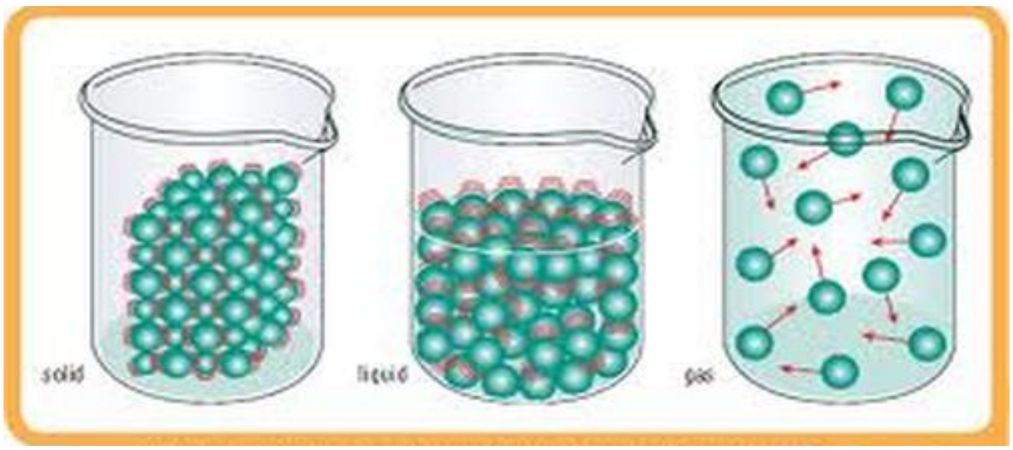


http://images.clipartpanda.com/matter-clipart-cliparti1_matter-clipart_09.jpg

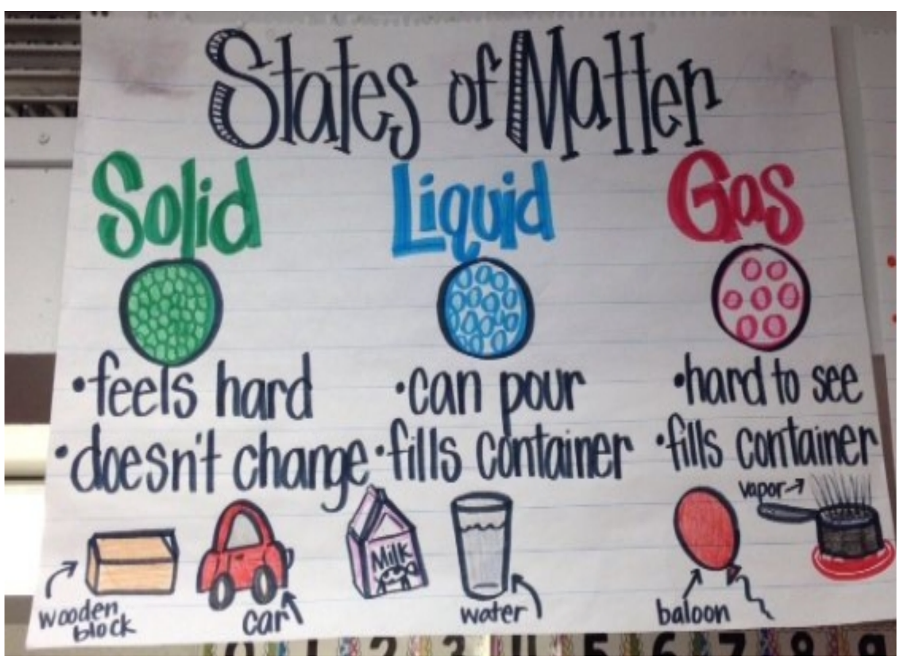
H2O is a great example as it is easy to see as a solid, liquid and gas. The balls inside each beaker represent a theory that shows us that what makes up a:

- solid (ice) are tightly packed molecules
- liquid (water) are less packed molecules
- gas – (steam) are far less packed molecules

Molecules are hidden from the naked eye, a magnifying glass or most microscopes.



https://www.google.ca/search?q=states+of+matter+experiments&espv=2&tbm=isch&tbo=u&source=univ&sa=X&ved=0ahUKEwimlvDclovTAhVs5YMKHVdTBNkQsAQISw&biw=1280&bih=639#imgdii=XHktt9e6seYWkM:&imgrc=3KjlDLWHg2AjQM



- Mix and match the language of matter ☺.

Description	Print correct term here	Term
Reversible		matter
forms in shape of container		solid
size, mass, temperature		liquid
not reversible		gas
tightly packed molecules		physical change
has mass and occupies space		chemical change
molecules can leave container		properties

- Place these words beside the examples that fit: evaporation, condensation, solidification or freezing, fusion or melting, sublimation

a moth ball sublimates in the closet	
water from wet clothes evaporates	
a frozen treat melts on a warm summer day	
steam from a boiling kettle condenses on a cold window	
water in ponds and lakes solidifies or freezes in winter	

How well did you explore states of matter?	Trailblazer (Expert)	Pathfinder (Apprentice)	Rookie (Not Yet)

ET - Make predictions.
ET - Record detailed observations.
ET - Draw conclusions.

5.Scientists know how to experiment with solids.

Experiment Challenge: Mud bricks or cement? Which solids are stronger?

Prediction:

Read through the procedure and make a prediction about how well your recycled paper will turn out. Also, take note of what parts of the procedure might be tricky.

I predict: ____

*I think it might be tricky when*______________________________

STEP OUTSIDE: It's time to get messy!

Part A. Making Mud Bricks (adapted from https://www.education.com/activity/article/brick-making/)

1. In pairs gather 1 ice cube tray, measuring cup, 1 cup of dirt or sand, 2/3 cup water, bowl.
2. Measure 1 cup of dirt and pour it into the bowl.
3. Measure 2/3 of a cup of water and pour that into the same bowl.
4. Use fingers to mix the dirt and the water.
5. Place the mud in the ice cube tray and pack each mud brick down.
6. Let bricks dry a bit.
7. Empty out mini bricks by gently turning over tray.
8. Let each brick dry carefully.
9. Find the mass of one brick.

Observation A:

- Measure the length in millimeters of each side of one mud cube using a measuring tape.

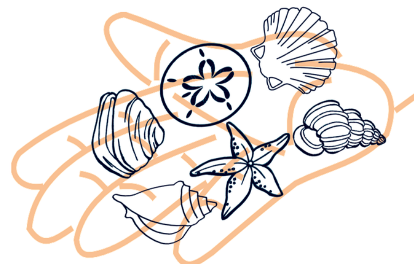
Side 1	
Side 2	
Side 3	
Side 4	
Side 5	
Side 6	

- Draw one mud brick below.
- Use arrows to label it with:
    - The length of each side.
    - The colour it was when it dried (darker or lighter)
    - The mass of the brick.
    - the time it took to harden.

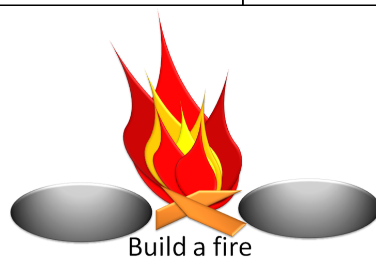
Part B. Making Cement (Adapted fromhttp://www.wikihow.com/Make-Cement-in-the-Wild)

1. Find cement source.
    a. soft rock (limestone)
    b. sea shells
    c. bones of animals, fish, birds…
    d. chalk

Find limestone, shells, bones or chalk

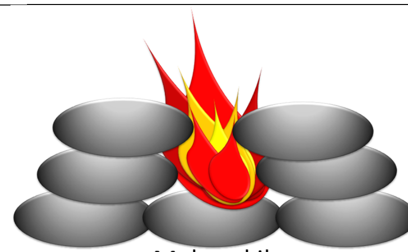


2. Build a fire.



Build a fire

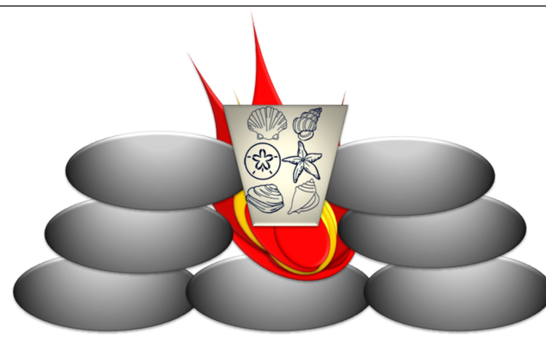
3. Make a kiln.
    a. Stack rocks on top of each other around the fire
    b. opening on the front and top (make it look like a fireplace)



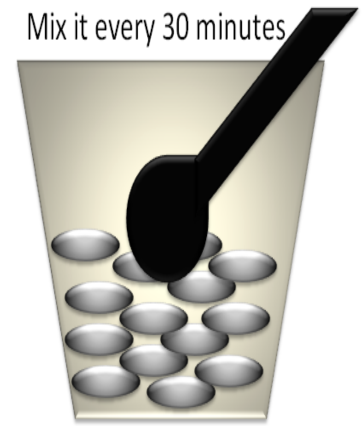
Make a kiln

4. **Fill and heat until items crumble.**
    a. Fill a metal container such as a bucket with your shells or other cement items.
    b. Be sure that the metal container is not your food container.
    c. You can't reuse this container for anything else. It will only serve as a trash bin after.

If you don't have any metal containers, place your items on a large flat rock.



Fill and heat until the items crumble

5. Mix it every 30 minutes. a. Heat your shells or other cement items for 4-7 hours, or until they start to become brittle and start to crumble in to sand like dust. b. To help make your shells or other cement into a more consistent sand, stir it every 30 minutes by mixing the shells (just like cooking). c. If some of your shells or other raw materials do not break down to the size of sand or smaller, remove them before sealing the cement inside an airtight container. d. You can reheat them in the next batch.	
6. Pour into ice cube tray.	
7. Wait for the cement to cool before using. a. Hide the cement in a dry airtight bucket with a lid. b. Store at room temperature in a dry location.	

Observation B:

- Measure the length in millimeters of each side of one cement cube using a measuring tape.

Side 1	
Side 2	
Side 3	
Side 4	
Side 5	
Side 6	

- Draw one cement brick below.
- Use arrows to label it with:
    - The length of each side.
    - The colour it was when it dried (darker or lighter)
    - The mass of the brick.
    - the time it took to harden.

Findings:

When we compared the mud and the cement cube we discovered

____

____

Recommendations:

Next time we make a mud brick, we should ______________________

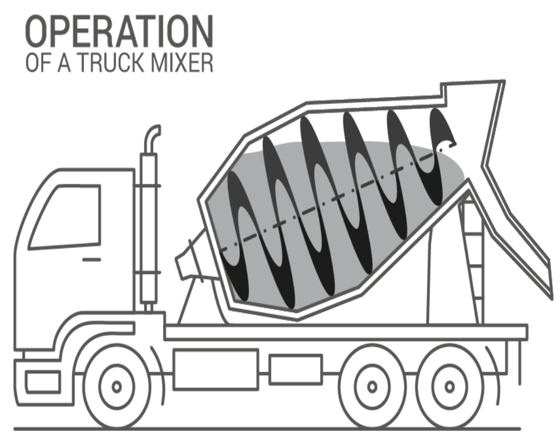
____

Next time we make a cement brick, we should ___________________

____

Think About… how cement is transported for large construction projects. Cement trucks have concrete drums that move so the cement will not harden. Steel rods are added to concrete for extra strength in many structures. The largest concrete structure is the Grand Coulee Dam in Washington state (21 million tonnes of concrete).

https://readtiger.com/img/wkp/en/Operation_of_a_truck_mixer.gif



How well did you explore states of matter?	Trailblazer (Expert)	Pathfinder (Apprentice)	Rookie (Not Yet)

6. Scientists know how to measure solids.

The metric system was first used in France and has spread throughout the world. This system is noted as an elegant and more precise way to measure 2D measures, 3D solids, liquids and gases. Scientists and engineers around the world use metric measures to compare results.

- Choose 2 of the following to draw using a ruler. (10 points)
    - Draw a 60 millimeter (mm) caterpillar.
    - Draw a 5 centimeter (cm) blade of grass.
    - Draw a 25mm rock
    - Draw an 8cm stick
    - Draw a 4mm nail

(a) Measuring Distances and Edges of Solids

- Using a ruler, measure the length of a solid in the Collection Box.

I measured a _______________ and it was _____cm long.

- Draw the item and label its length below.

- Look at your classmates' measurements to determine who measured the smallest item:

_____________________ measured the smallest solid. (It was a ___________________.)

STEP OUTSIDE:

- Using stones, guess how far 10mm, 10 cm and 10m would be.
- Using a ruler, and tape measure, check to see how close your guesses were to the actual measures.

You can also measure the distance around objects (perimeter).

http://www.ryde.nsw.gov.au/files/content/public/environment-and-waste/trees/tree-protection-zone-calculator/measuring-the-circumference-of-a-tree-trunk.jpg

- Select and justify the unit that should be used to measure the perimeter of the school.

    (a) Millimeter
    (b) Centimeter
    (c) Meter
    (d) Decameter
    (e) Hectometer
    (f) Kilometer

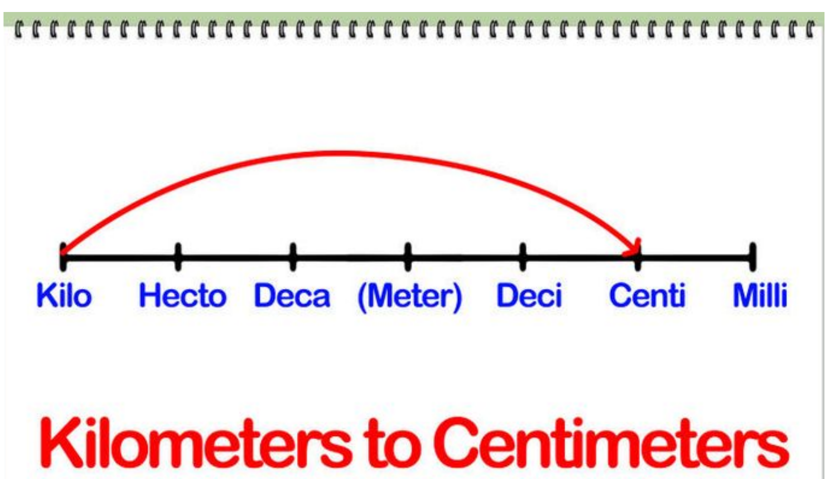
I think it is best to measure the school in ______'s.

STEP OUTSIDE:

- Using string and a meter stick, to measure the distance around a bird feeder or other round object on school property.

  We measured around a _________________________ and found the distance to be close to: ___________ meters.

- Look at this chart to see the smallest to largest metric units of measurement.



https://s-media-cache-ak0.pinimg.com/736x/e8/0e/68/e80e685c077e4f2e46bf98731c1ea8e3.jpg

- What metric measure (mm, cm, m, km) would you use to measure?

A tree ______________________

Distance to the nearest city: ______________________

A butterfly ______________________

A flower ______________________

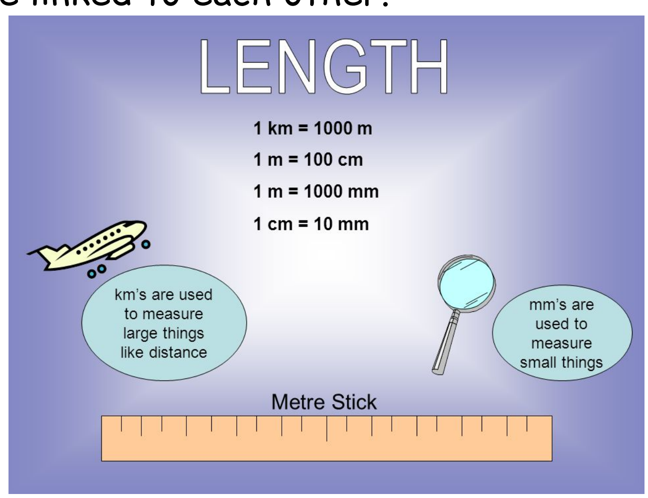
A spec of dirt ______________________

Converting Measures Inside the Metric System

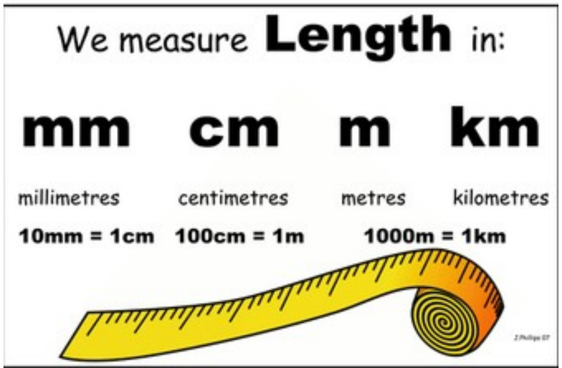
You can convert inside systems (i.e. meters to centimeters) and convert between systems (i.e. meters to yards).

Rule: You need a common unit to add, subtract, multiply or divide distance/lengths units. You need to know that there are 10mm in a cm, 100 cm in a meter and 1000m in a kilometer.

- Look at 4 posters and put a check beside the one that helps you understand the most how millimeters (mm), centimeters (cm), meters (m) and kilometers (km) are linked to each other.



http://slideplayer.com/slide/8949114/27/images/2/LENGTH+Metre+Stick+1+km+=+1000+m+1+m+=+100+cm+1+m+=+1000+mm.jpg

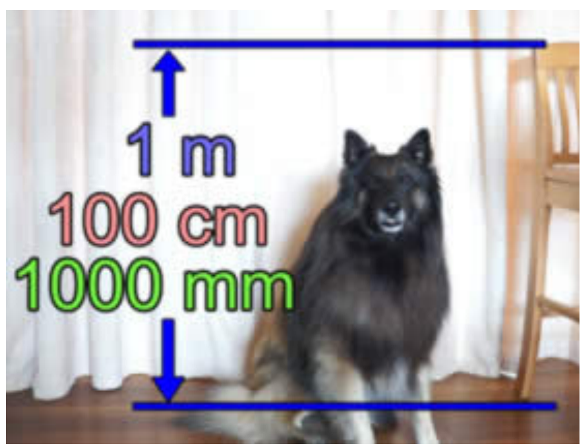


https://l.imgt.es/resource-imgs/6310029%2Furl%3Fwidth%3D500%26height%3D500%26version%3D1417514048000?profile=res-img-med-legacy-v2

Which group of measurement units is correctly arranged in order of increasing size?

1. mm, cm, m, km
2. mm, km, cm, m
3. m, km, cm, mm
4. km, cm, mm, m

http://images.slideplayer.com/27/8974618/slides/slide_30.jpg



https://www.mathsisfun.com/measure/images/arrow-chair.jpg

- Convert the following: 2km = ______m 13cm =_____mm

Operations with Metric Measures

Addition	Subtraction
7m + 3cm + 2km = 700cm + 3cm + 200000cm = 200703cm	1 suitcase (60cm in length) – 1 cell phone (60mm in length) = 60cm – 6cm = 54cm *The suitcase has plenty of room to fit the cell phone. The difference in length is 54cm.*
Multiplication	**Division**
2 km x 3 meters = 2000m x 3m = 6000m = 6km	500 meters divided by 50cm = 50000cm/ 50cm = 1000cm = 10m

GOT IT! Calculate and SHOW YOUR WORK!

(a) 32 cm + 2 m + 8 mm

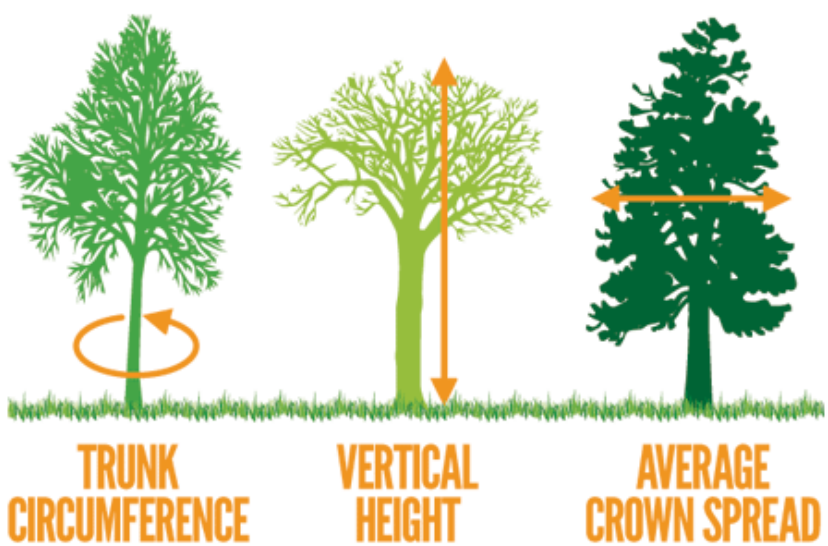
	Rough Work ☺

(b) 25cm x 14m (when ready to do 2-digit multiplication)

	Rough Work ☺

(c) 576cm divide by 8m (when ready to divide into 3-digit numbers)

	Rough Work ☺



http://www.wvcommerce.org/App_Media/Assets/images/naturalresources/Forestry/big_tree_program/big-tree-measurements.gif

STEP OUTSIDE:

• Work with a partner to choose a tree to try and measure its circumference, vertical height and crown spread.

circumference	
height	
crown spread (width of crown)	

Distance Units in the US

Rule: You need to know that there was 12 inches in one foot, 36 inches in one yard and 1760 yards in miles (or 5280 feet).

EXAMPLE:

Addition	Subtraction
7 yards + 3 feet + 2 miles = 21 ft + 3 ft + 5280 ft = 5304 ft	1 suitcase (1.5 feet in length) – 1 cell phone (3.5 inches) = 18 in – 3.5 in = 14.5 in. *The suitcase has plenty of room to fit the cell phone. The difference in length is 14.5 inches.*
Multiplication	**Division**
2 miles x 3 yards = (1760 x 2) x 3 yards = 3520 yards x 3 yards = 10560 yards	525 feet divided by 5 yards = 525 feet÷ 15 feet = 35 feet

GOT IT! Calculate and SHOW YOUR WORK!

(a) 32 inches + 2 feet + 8 yards

	Rough Work ☺

(b) 25 inches x 14 feet (when ready to do 2-digit multiplication)

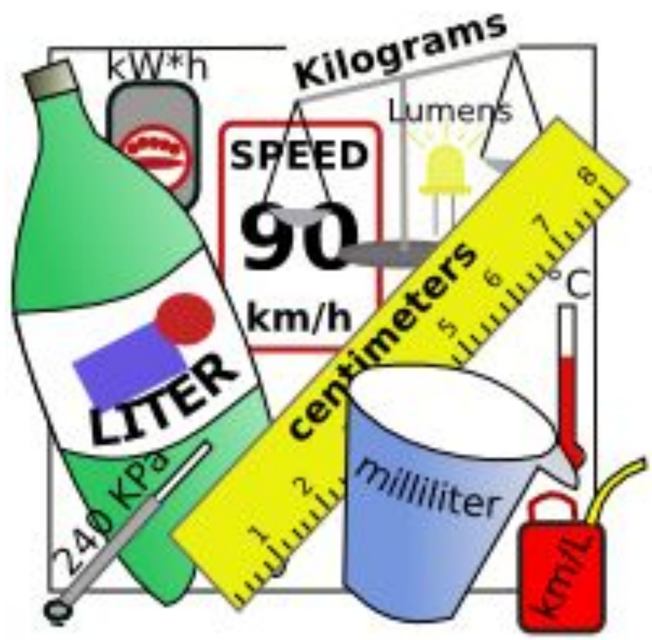
	Rough Work ☺

(c) 576 feet divide by 8 yards (when ready to divide into 3 digit numbers)

	Rough Work ☺

TECH CHECK!

- http://www.superteacherworksheets.com/measurement/feet-inches.pdf
- http://www.superteacherworksheets.com/measurement/comparing-feet-inches.pdf
- http://www.murrieta.k12.ca.us/156220225232237547/lib/156220225232237547/Math/Lesson8-2.pdf
- http://www.asknumbers.com/YardsToInchesConversion.aspx



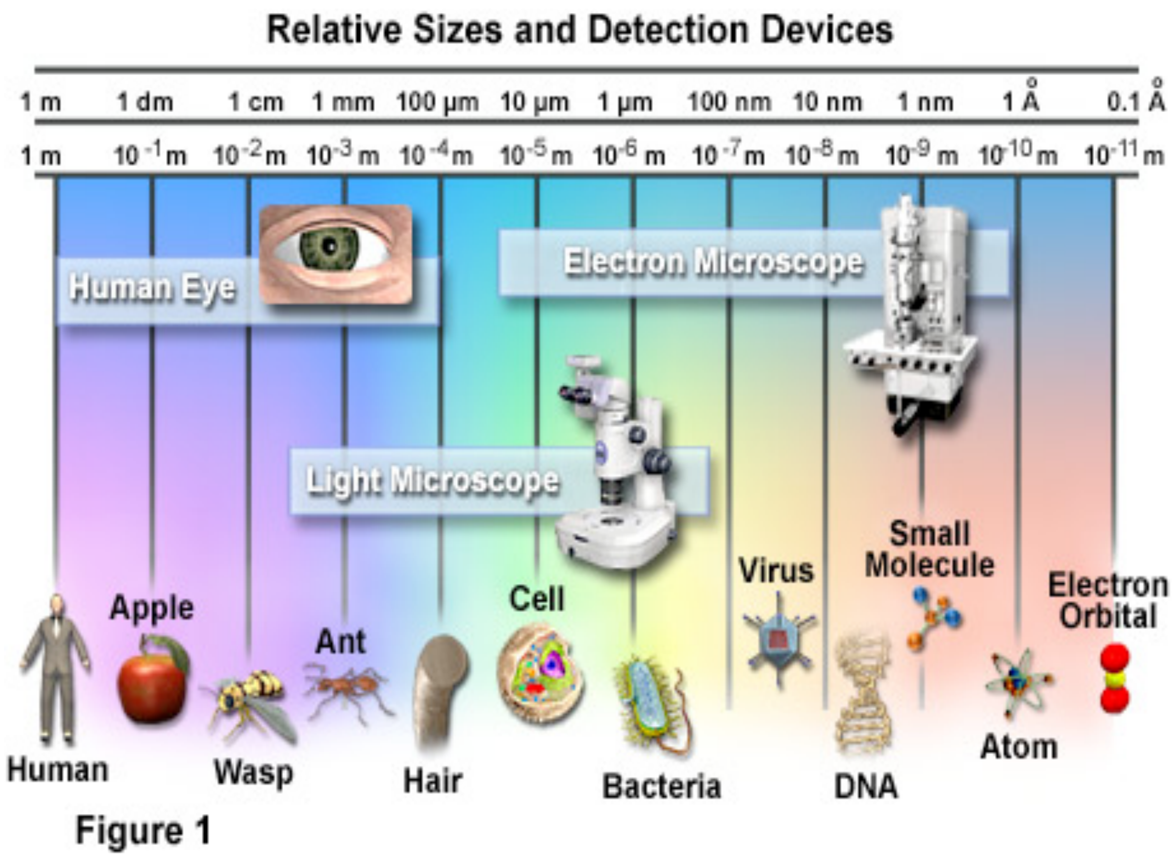
https://cdn.instructables.com/FFY/JBWX/GDTLSSK5/FFYJBWXGDTLSSK5.MEDIUM.jpg

Metric and Imperial Conversions
The Imperial system of measurement is also used mainly in the United States and in Britain. It is important to know how to covert between systems, so you can compare data.

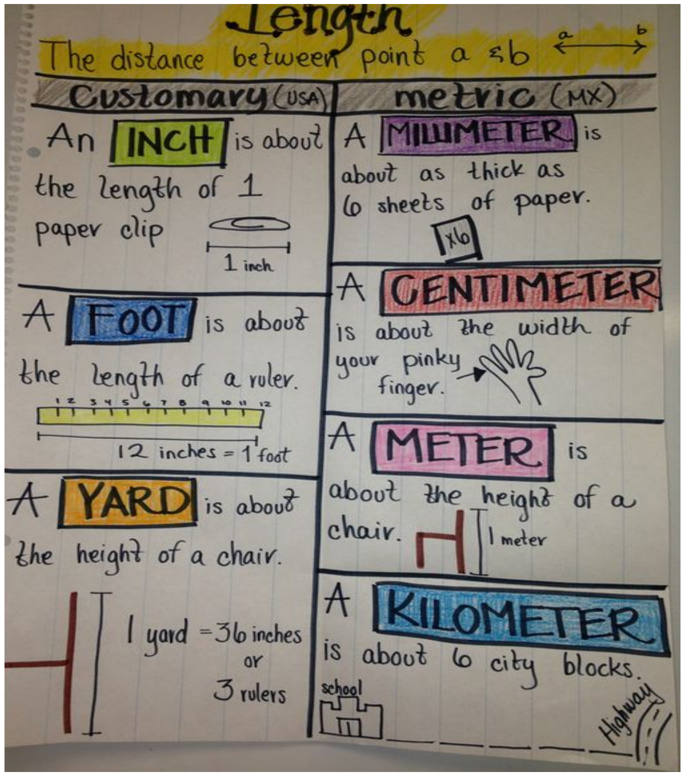
RULE: You might think of Britain when you hear the world "Imperial", but inches, feet, yards and miles are part of the US system for measuring. Many other countries including Britain (and scientists everywhere) use the metric system. It is important to know how to convert between the two systems. The metric system is also easier to remember because everything is based on 10.

EXAMPLES:

- Take a look at how big or small items are that the metric system can measure.



http://micro.magnet.fsu.edu/cells/images/cellsfigure1.jpg



- Take a look at the poster and make your own poster with other examples to help remember the size of each metric and imperial measure.

- Now view how the Imperial (US System) is like the Metric System:

Length Conversion

kilometer (km)	→	miles (mi)
kilometer (km)	→	feet (ft)
meter (m)	→	feet (ft)
centimeter (cm)	→	inches (in)
millimeter (mm)	→	inches (in)
inches (in)	→	centimeter (cm)
inches (in)	→	millimeter (mm)
feet (ft)	→	meters (m)
yards (yd)	→	meters (m)
yards (yd)	→	kilometers (km)
miles (mi)	→	kilometers (km)

http://www.learner.org/interactives/metric/images/length1.gif

- Look at the following chart that compares runners and swimmers race lengths.

	Runner's Time for the 440 yard dash	Swimmer's time for a short course race
Imperial Time	440 yards	50 yards
Metric Time	402.236 meters	45.72 meters

http://www.bx3.com/phil/tri/tricalc.asp

I think….

*meters are*____________________ *than yards*. (longer, shorter)

centimeters must be __________________ than inches. (longer, shorter)

kilometers must be ____________________ *than miles.* (longer, shorter)

Kilometer Walk

- Predict how long it might take to walk a mile as a group. __________minutes

STEP OUTSIDE:

- How long did it actually take? ______________ minutes

www.onlyadayaway.com/wp-content/uploads/2014/08/25-inca-trail-trek-day-1-km-82-to-wayllabamba.jpg

The quick and easy way to figure out a conversion is to browse the web for a "conversion table" – but these can make mistakes. It's good to know how the conversion table does the math!

For example, to convert 440 yards to meters, you need to know that 1 in = 2.54 cm and 36 in = 1 yd. http://oakroadsystems.com/math/convert.htm#Chaining	Multiply: $440 \text{ yd.} \times \frac{36 \text{ in}}{1 \text{ yd.}} \times \frac{2.54 \text{ cm}}{1 \text{ in}} \times \frac{1 \text{ m}}{100 \text{ cm}}$ $= \frac{440 \times 36 \times 2.54 \text{ yd in cm m}}{100 \text{ yd. in cm}}$ = 440 yd = 402 m

GOT IT!

- Complete and SHOW YOUR WORK!

(a) Convert 1km to meters.

	Rough Work ☺

(b) Convert 25 cm to inches.

	Rough Work ☺

(c) Convert 800 meters to yards.

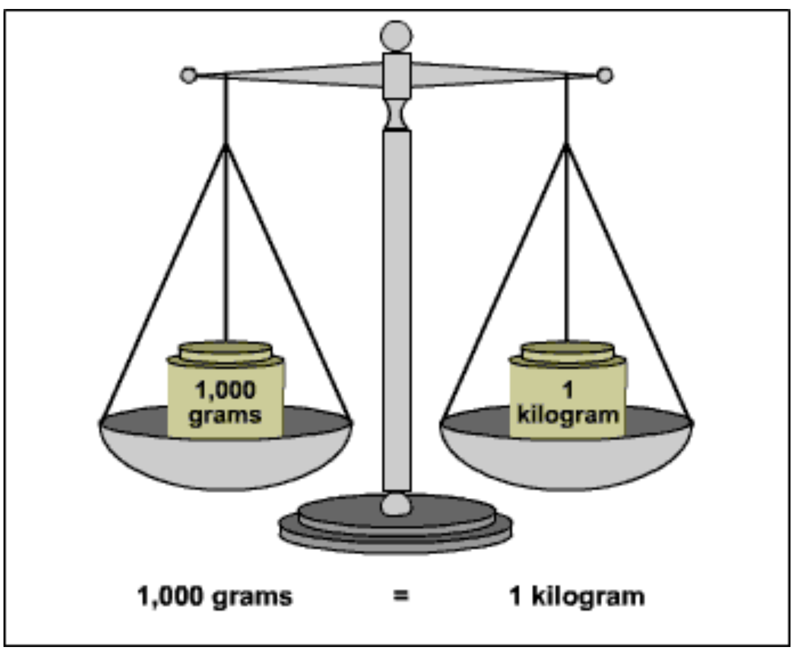
	Rough Work ☺

TECH CHECK:

- http://www.abcteach.com/free/a/abbreviations_measurements.pdf
- http://www.essortment.com/measuring-tape-use-common-conversion-math-60929.html
- http://www.murrieta.k12.ca.us/156220225232237547/lib/156220225232237547/Math/Lesson8-2.pdf
- http://www.swimmingworldmagazine.com/results/conversions.asp
- http://www.easysurf.cc/cnvert.htm
- http://www.metric-conversions.org/length/yards-to-inches.htm

(b) Measuring Mass Components of Solids

Rule: There are 1000 grams in a kilogram.

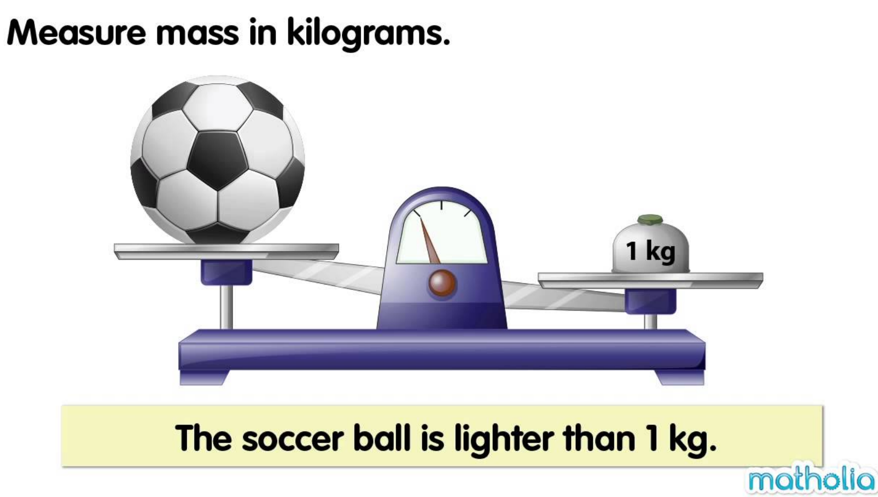


http://www.inchcalculator.com/wp-content/plugins/uber-calc/assets/img/conversion/gram-kilogram.gif

EXAMPLES:

6000 grams (g) = 6 kilograms (kg)

- Convert 45 kilograms to grams.



https://i.ytimg.com/vi/jPnUA1Z8FTg/maxresdefault.jpg

STEP OUTSIDE:

- Find items outside that are lighter than 50 grams.
- Weigh them and then draw and label them below.

Extension (if you have mastered decimals)
5,560 kilograms (5.56 tonnes)
3,055 grams (3.055 kilograms).

THOUSANDS OF KILOGRAMS (TONNES)	HUNDREDS OF KILOGRAMS	TENS	ONES (KILOGRAMS)	TENTHS OF A KILOGRAM	HUNDREDTHS OF A KILOGRAM	THOUSANDTHS OF A KILOGRAM (GRAMS)
			1	• 4		
			0	• 6		
5	5	6	0	•		
			3	• 0	5	5

http://literacyandnumeracyforadults.com/Learning-progressions/Numeracy/Measure-and-Interpret-Shape-and-Space/Activities-table/Connecting-tonnes,-kilograms-and-grams

RULE: There are 16 ounces in a pound. To find out how many ounces you weigh, you simply multiply your weight in pounds by 16 and that will give you your weight in ounces.

Conversions	
The chart below shows the relationships between ounces and pounds. You can use the chart to change a measurement from ounces to pounds or from pounds to ounces.	
Bob's cat weighs 3 pounds. How many ounces is this?	To change from a larger unit of length to a smaller unit of length, multiply.
3 lbs. = ounces	Since, 1 lb. = 16 oz.
3 x 16 = 48	So, 3 lbs. = 48 oz.
Ben's hamster weighs 32 oz. How many pounds is this?	To change from a smaller unit of length to a larger unit of length, divide.
32 oz. = lbs.	Since, 16 oz. = 1 lb.
32 ÷ 16 = 2	So, 32 oz. = 2 lbs.

http://www.studyzone.org/testprep/math4/e/ouncespounds3l.cfm

GOT IT! (SHOW YOUR WORK!)

(a) Convert 48 ounces to pounds.

	Rough Work ☺

(b) Convert 32 pounds to ounces.

	Rough Work ☺

(c) Convert 640 ounces to pounds.

	Rough Work ☺

TECH CHECK:

- http://www.asknumbers.com/OuncesToPoundsConversion.aspx
- http://www.unitconversion.org/weight/pounds-to-ounces-conversion.html
- http://www.brainpopjr.com/math/measurement/ouncespoundsandtons/preview.weml
- http://www.youtube.com/watch?v=IrvEHVn-fks&feature=player_embedded

How well did you round, estimate, & apply units from metric & US customary, both whole & part measures?	Trailblazer (Expert)	Pathfinder (Apprentice)	Rookie (Not Yet)

Extension:

- Find a way to build a scale and measure a series of small items to find out which items are heavier and lighter.

Converting between Grams, Kilograms and Metric Tons & Pounds & Ounces

RULE: There are 16 ounces in a pound. To find out how many ounces you weigh, you simply multiply your weight in pounds by 16 and that will give you your weight in ounces.

- You will need to use this formula to convert between pounds and kilograms:

Conversion factor #1:

1 kilogram (kg) = 2.2046 pounds (lb)

Conversion factor #2:

1 pound (lb) = 16 ounces (oz)

http://www.learner.org/interactives/metric/images/volume7.gif

GOT IT! Complete – and SHOW YOUR WORK!

(a) Convert 45 kilograms to pounds.

	Rough Work ☺

(b) Convert 170 pounds to kilograms.

	Rough Work ☺

- Compare the mass of garbage at the end of the school day for a week.
- Using different weigh scales, weigh the garbage can first.

The garbage can weighs: ______grams.

Day of Week	**Mass (with garbage can)**
Monday	
Tuesday	
Wednesday	
Thursday	
Friday	

- Talk about why some garbage is heavier than others.
- Talk about ways to reduce garbage at school.
- Think about all the food items that use wrapping, or containers that are difficult to recycle.
- Listen to this article about TerraCycle:

TerraCycle is Eliminating the Idea of Waste® by recycling the "non-recyclable." Whether it's coffee capsules from your home, pens from a school, or plastic gloves from a manufacturing facility, TerraCycle can collect and recycle almost any form of waste. We partner with individual collectors such as yourself, as well as major consumer product companies, retailers, manufacturers, municipalities, and small businesses across 20 different countries. With your help, we are able to divert millions of pounds of waste from landfills and incinerators each month. (https://www.terracycle.ca/en-CA/)

Recycling solids can reduce waste. On the TerraCycle website it indicates that:

People signed up to recycle	Waste recycled	Money for charities
63,758,073	3,783,212,164 pounds	$15,623,411

How much does sporty stuff weigh?

- Estimate and order the following items by weight from lightest (1) to heaviest (5).

soccer ball	
hockey stick	
whistle	
baseball bat	
baseball glove	

- Now weigh them to see.

- kg or g – What measure would you use to measure a:

turtle tank	
book	
fly	
table	
bird's nest	
twig	

Now things like airplanes, elephants and buildings are usually measured in metric tonnes. A **metric tonne** is 1000 kg.
You can also measure things smaller than a gram. There are 1000 **milligrams** in one gram.

Which is heavier, a ton of feathers or a ton of bricks?

http://cdn.doriddles.com/doriddles-fb-70.png

- Now complete the following to show you know what is the best way to measure the following:

Fill in the blank with the most reasonable unit (kg, g, mg, or metric ton).

- Elevators in the college have a load limit of 2200 _______
- My new truck can haul a load of 3 _____
- I take 1 _____ of vitamin C each day
- A jar of peanut butter contains 1200 _____
- One common size aspirin tablet is 325 __

TECH CHECK:

- http://www.softschools.com/measurement/games/weight.jsp
- http://www.metric-conversion.net/convert_grams_tonnes%20(metric).htm
- http://www.metric-conversions.org/weight/grams-to-tonnes.htm
- http://www.wonderhowto.com/how-to-convert-american-pounds-kilograms-347114/
- http://www.wonderhowto.com/how-to-convert-kilograms-us-pounds-347111/

Extension:

- How many grams are in one serving if 1.5 kg will serve six people?

7. Scientists know how to experiment with liquids.

- Time how long it takes an ice cube to melt completely.

The ice cube we watched took approximately _____ minutes to melt!

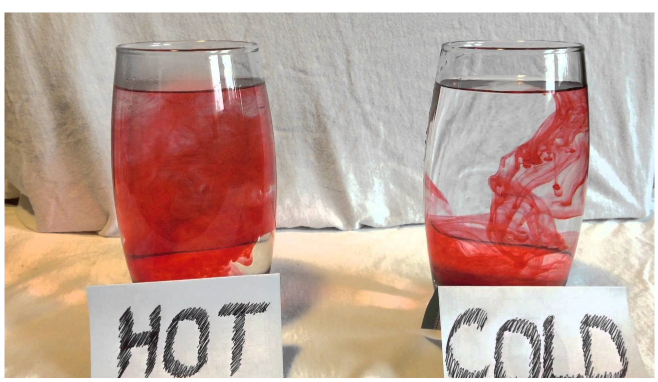
The molecules in liquids (i.e. water) are not as tightly packed as solids (i.e. ice). This means they have more room to move around.

- Read (adapted from http://www.sciencekids.co.nz/experiments/movingmolecules.html) to find out if molecules move more in warmer or cooler liquids.

Prediction:
I think the molecules in the warmer water will move faster than the molecules in the colder water. When water boils, it can bubble and these bubbles seem to be moving faster than water that is cold.

Procedure:
1. Fill one glass with hot water and one glass with cold water.
2. Put one drop of food colouring into both glasses.
3. Draw a picture of what happens.

Observation:



Findings:
The food colouring in the hot water spread out through the liquid. The food colouring in the cold water went to the bottom of the glass. I think faster moving molecules can move throughout the container. I think food colouring might be heavier than water as it did go to the bottom of the glass of cold water.

Recommendations:
When transporting some liquids on trucks, trains or pipelines, it might be helpful to warm up the liquids so that the materials inside the liquid do not separate and leave waste on the bottom of the containers. Keeping it moving, like a cement truck, can help keep the liquid intact.

In the winter when roads heat up, the snow can turn to ice. To prevent accidents communities put salt or sand on the roads.

- Which is the best solution?

	Advantages	**Disadvantages**
Salt	Melts snow and ice; keeps hard packs of snow from forming; inexpensive chemical solution	Corrodes vehicles, pavement, bridges; can harm vegetation
Sand	Provides grit for tire traction; does not harm vegetation; inexpensive	Does not melt snow or ice; need three times as much sand; more work

Many places use a combination of sand and salt.
- Talk about what you think is the best solution.

- Now it's your turn to work with a partner to find out more about ice (solid) and water (liquid).
- What do you think? **Will a glass of water with an ice cube filled to the brim overflow when the ice cube melts?** (adapted from http://www.sciencekids.co.nz/experiments/iceoverflow.html)

Overflow – or not Experiment

Prediction:

I predict that ____

____

Procedure:

1. Fill the glass to the top with warm water.
2. Gently lower the ice cube in the glass so water and ice cube is full to the brim (without spilling)
3. Draw and label an image of the glass as ice cube melts.

Observations: (draw and label image in space below):

Findings:

____

____

____

Hint: When scientists do this experiment, they were surprised that the water level did not change – even when the ice melted. When water freezes it expands to make ice. This takes up more space than water. The water in the ice takes up less space than the ice. When the ice cube melts, the level of the water stays about the same.

When you make a recommendation for improving an experiment, the scientist will look for the 'source of error' or bias. Experiments are not perfect, so when they are conducted, usually by people, they will have errors. Finding the source of error can help you explain how to make the experiment better the next time around.

- In the ice cube experiment, what are the possible sources of error?

____

____

- Based on these sources of error, what would you recommend the next time you do the experiment?

Recommendation:____

____

____

http://i2.wp.com/ncnatts.org/wp-content/uploads/2017/06/Letter-Of-Recommendation-For-A-Student.jpeg?resize=275%2C183

How well did you identify sources of error?	Trailblazer (Expert)	Pathfinder (Apprentice)	Rookie (Not Yet)

Scientists read about what other scientists have discovered.

- Read the following paragraphs about the continent covered in ice.

What is Antarctica?
Antarctica is a continent. It is Earth's fifth largest continent. Antarctica is covered in ice. Antarctica covers Earth's South Pole…

Antarctica is the coldest place on Earth. The temperature in the winter is cold enough to freeze water all the time. The temperature in the middle of Antarctica is much colder than the temperature on the coasts. Antarctica has two seasons: summer and winter. Earth is tilted in space and the direction of tilt never changes. During summer, Antarctica is on the side of Earth tilted toward the sun. It is always sunny. In winter, Antarctica is on the side of the Earth tilted away from the sun. Then, the continent is always dark. Antarctica is a desert. It does not rain or snow a lot there. When it snows, the snow does not melt and builds up over many years to make large, thick sheets of ice, called ice sheets. Antarctica is made up of lots of ice in the form of glaciers, ice shelves and icebergs. Antarctica has no trees or bushes. The only plants that can live in a place that cold are moss and algae.

Who Lives in Antarctica?
Antarctica is too cold for people to live there for a long time. Scientists take turns going there to study the ice. Tourists visit Antarctica in the summers. The oceans around Antarctica are home to many types of whales. Antarctica is also home to seals and penguins.

What Can NASA Learn About Earth From Studying Antarctica?
NASA uses satellites to study Antarctica. NASA wants to know how Antarctica is changing. Scientists want to know what the changes in Earth's climate are doing to Antarctica's ice sheets. They also want to know what changes in Antarctica's ice might do to Earth's climate. One tool that NASA uses is ICESat. That stands for the Ice, Cloud and land Elevation Satellite. Using ICESat, NASA can measure changes in the size of Antarctica's ice sheets. ICESat also helps NASA understand how changing polar ice may affect the rest of the planet. Melting ice sheets in Antarctica may change sea levels all over the world. NASA instruments have also helped scientists create detailed maps of Antarctica. These maps help researchers when planning trips to Antarctica. They also give people a clearer view of the continent.

What Can NASA Learn About Space From Studying Antarctica?
Antarctica is a good place to find meteorites that are easier to see on the white ice. Also, meteorites that fall to Antarctica are protected by the ice for a long time. NASA sends teams to Antarctica to learn more about the planet Mars. Antarctica and Mars have a lot in common. Both places are cold. Both places are dry like a desert. NASA tested robots in Antarctica that later landed on Mars. NASA also goes to Antarctica to study astronaut nutrition. Like people who are in Antarctica in the winter, astronauts in space are not in the sunlight. The sun helps the human body make vitamins. Scientists study people who visit Antarctica to learn how to help astronauts in space get enough vitamins.

1) According to the article, NASA studies Antarctica for all of the following reasons EXCEPT:

A. Antarctica helps us understand ice.
B. Antarctica helps us understand important rare plants.
C. Antarctica is a good place to find meteorites.
D. Antarctica is a good place to test robots. Key: B

2) What can NASA learn from studying people living in Antarctica that would help astronauts?

A. the nutritional effects of a long-term lack of sunlight
B. the extra vitamins the body has to make during the winter
C. the seasons when astronauts would have the best nutrition in space
D. the types of vitamins the body needs when it is exposed to the sun Key: A

3) According to the passage, the changing size of Antarctica's ice sheets has an effect on:

A. living conditions on the continent
B. the temperature of the air and clouds
C. the amount of wildlife that can survive there
D. sea levels all around the world Key: D

4) According to the article, NASA studies Antarctica for all of the following reasons EXCEPT repeat of question 1.

A Antarctica helps us understand ice.
B Antarctica helps us understand important rare plants.
C Antarctica is a good place to find meteorites.
D Antarctica is a good place to test robots. Key: B

5) Read these two sentences from paragraph 3:

"In winter, Antarctica is on the side of the Earth tilted away from the sun. Then, the continent is always dark."

Which of the following describes the relationship between these two sentences?

A. The sentences contrast two events.
B. The sentences describe two steps in the same process.
C. The first sentence explains the reason for the second.
D. The second sentence gives the cause of the first. Key: C

6) According to the passage, the changing size of Antarctica's ice sheets has an effect on:

A. living conditions on the continent
B. the temperature of the air and clouds
C. the amount of wildlife that can survive there
D. sea levels all around the world Key: D

7) Which heading in the article would you look under to find out about the weather in Antarctica?

A What is Antarctica Like?
B Who Lives in Antarctica?
C What Can NASA Learn About Earth From Studying Antarctica?
D What Can NASA Learn About Space From Studying Antarctica? Key: A

So what is snow? A liquid or a solid?

Snow is formed from ice crystals high above the earth. Snow forms from ice in temperatures that are 20 to 50 degrees below zero. Even though you might think that is a frozen raindrop, it is NOT. It forms in its own snow clouds. Hail and sleet are frozen rain – but snow is not.

- Read the short paragraph about The Snowman's Gift and then talk about your answers to the questions.

The Snowman's Gift

So that's the snowman's year-round gift—it's water! Without water, we wouldn't have colorful flowers to look at in the spring. Without water, we wouldn't have soft, green grass to run barefoot on in the summer. Without water, we wouldn't have strong, tall trees to climb in the fall. Water helps all of these things grow. The snowman's gift lasts all year.

1) What do you think causes a snowman to begin to melt?

A. The air becomes warm.
B. The water turns into ice.
C. The ground soaks up water.
D. The ice crystals stick together.

2) What do you think happens when ice crystals get warm?

A. They make heat.
B. They soak up snow.
C. They turn into water.
D. They stick together.

3) Why do you think the paragraph is titled: "The Snowman's Gift"?

A. When the sun shines, it makes heat.
B. The water helps many different things grow.
C. As the snowman melts, it gets smaller.
D. The ground soaks up water like a sponge.

- Now read “Let it Snow” about snowy conditions in the United States.
- Find three words (and circle them) that you want to talk about with the class.

Let It Snow!

1 Many people greet winter snow with a smile. They love skiing, sledding, or just throwing snowballs. They know that the snow will provide needed moisture when it melts. For these and other reasons, people often celebrate when the weather forecast calls for snow. Sometimes, though, snow fails to appear even when meteorologists predict it on the evening news. What conditions are needed to produce this frosty, white wonder?

2 When warm, moist air rises and then begins to cool, clouds will form. If the inside of a cloud is cold enough, water will come into contact with bits of dirt and other materials to form snow crystals. Snow crystals also form when water vapor, which is the gas phase of water, turns to ice. Eventually a collection of these snow crystals may join together to form a snowflake. The many sides of these crystals reflect the sun’s visible white light. As a result, the crystals appear to have a white color. As snowflakes grow heavy, they begin to fall toward the ground. Much can happen to a snowflake as it drifts earthward. Pieces of the crystals may become damaged or even melt as the crystals fall.

3 Conditions must be right for snow to reach the ground without melting. First, the air must be at or near freezing. Meteorologists use special instruments to determine whether the air is cold enough for snow. Other factors besides temperature are important too. For one thing, the air must contain moisture. If the air is dry, there is no water to freeze and make snow. Also, the air must be moving in order to allow the rising and cooling action to take place.

4 If conditions are right, snow can fall in some surprising places. Even deserts may sometimes experience a light dusting of snow across the land. Ordinarily, though, snow falls at higher altitudes because of the colder temperatures there. This fact explains why ski resorts are built high in the mountains. In the towns below, less snow falls. For example, when the temperature is in the low forties in a city like Seattle, Washington, the temperature is in the low thirties in the nearby mountains, making it cold enough for snow.

5 The chart gives information about locations in the United States with the greatest amount of snowfall. Imagine how many snowflakes must exist in that much snow!

Locations in the United States With the Greatest Snowfall	**United States Locations Average Yearly Snowfall in Inches**
Valdez, Alaska	326.0
Mt. Washington, New Hampshire	260.6
Blue Canyon, California	240.3
Yakutat, Alaska	195.3
Marquette, Michigan	141.0

1) How does the author gain the reader's attention in the first paragraph?

A. By asking for an opinion about snow
B. By mentioning reasons people enjoy snow
C. By explaining how snow is predicted
D. By listing some surprising facts about snow

2) Read this sentence from paragraph 2.

Which word uses the suffix -ward as it is used in earthward?
A. awkward
B. award
C. reward
D. backward
Much can happen to a snowflake as it drifts earthward.

3) Read this dictionary entry.
ma•te•ri•al (m n. 1. Cloth or other fabric. 2. Ideas or notes that can be worked up. 3. What an object is made of. 4. Something that is studied. e -tîr'e- el) Which meaning of materials is used in paragraph 2?

A. 1
B. 2
C. 3
D. 4

4) Which of these answers best represents the main idea of the article?

A. Many people like to have fun in the snow.
B. Several conditions must occur for snow to appear.
C. Snow falls in cities around the world.
D. Thousands of snowflakes exist in a ball of snow.

5) In paragraph 4, why does the author use the phrase "dusting of snow"?

A. To explain that the snow looks dirty
B. To show that the snow falls quietly
C. To illustrate the color of the snow
D. To describe the small amount of snow

6) Which would be the best heading for paragraph 4?

A. Where Snow Falls
B. Skiing in the Mountains
C. Snowing in the Deserts
D. How Snowflakes Form

7) Why did the author most likely write this article?

A. To explain why ski resorts are gaining popularity
B. To list reasons why snow falls during certain months
C. To describe the formation of snow
D. To define words used by meteorologists

- Find some data about snowfall in different parts of Canada and share with your classmates.

- Look at the beginning of an experiment below:
- What do you predict might happen in the next few days?

https://ind5.ccio.co/1C/19/o6/e1c07f7061b445b08233b212f3b0bf8f.jpg

Prediction:

I predict ____

____

Procedure:

1. Choose a plant or flower to place in at least three test tubes filled with three different food colourings.
2. Draw and label what takes place in 2-3 days below.

Observation:

Findings: *We found*

____

Osmosis happens when plants, like carnations, absorb water through their roots. What happens? Water travels up the stems to each part of the flower. When food coloring is added to water, it moves up the stem and into the flower. The food coloring shows us how important food is to all parts of a plant.

Recommendation:

When we plant our gardens with flowers and vegetables, we should make sure the soil is well watered so the plants can have healthy drinks from the soil through their roots.

https://www.rodalesorganiclife.com/sites/rodalesorganiclife.com/files/growingcelery-main.jpg

Extension:

- Read about reverse osmosis and explain how different it is from osmosis.
- https://sites.google.com/site/mattatuckmadnessmaplesyrup/home/homemade-reverse-osmosis-system

Sports Drinks (adapted from http://www.sciencekids.co.nz/experiments/dissolvingsugar.html)

According to Alex Swerdloff (Nov. 30, 2015), the best sports drink is plain old sugar water.

"Researchers at England's University of Bath have found that a spoonful of sugar mixed into a bottle of water is actually a better aide for athletic endurance than the energy drinks that were created to do the trick." (https://munchies.vice.com/en_us/article/the-best-sports-drink-is-plain-old-sugar-water)

Sugar dissolves in water up to a point of **saturation.** Have your clothes ever been saturated from the rain? Saturation, in this case, means that your clothes have absorbed the maximum amount of water they can. After this point, you are drenched and dripping water. See how the dog coat is saturated:

https://hidmyf.files.wordpress.com/2012/06/soaking_wet_dog.jpg

- Let's do a saturation experiment to see how many sugar cubes can dissolve in cold and hot water.

Prediction:

I believe that more cubes will dissolve in _______________ water because…

____

Procedure:

1. Fill two glasses with water: one with cold water and one with hot water.
2. Put 1 sugar cube in the hot water.
3. Stir until the sugar disappears.
4. Add in 1 more cube at a time and keep track of the total number of cubes being added to the hot water.
5. Stop when the sugar stops dissolving (you can see sugar start to gather on the bottom of glass).
6. Then do the same with the glass of cold water.

Observation (Fill in chart with data.)

Cubes Dissolved in Hot Water	Cubes Dissolved in Cold Water

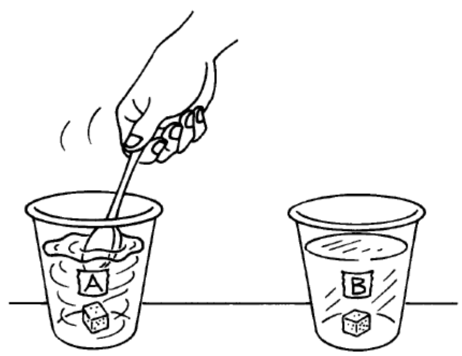
Findings:

We discovered that ____

____

Recommendations:
It is important to make sure that each amount of water was exactly the same. If one glass had more water in it, it might mean that it could dissolve more cubes. Knowing how to measure the amount of liquid is important for removing variables that might change the results.

Hint: The cold water should not be able to dissolve as much sugar as the hot water. When this solution (liquid) can no longer dissolve sugar, it is called a 'saturated solution'; this happens when sugar starts forming on the bottom of the glass. Hot water should dissolve more sugar cubes because the molecules are spread apart more which allows them to move faster. More sugar can fit in between the larger spaces (gaps) between the molecules in the hot water.



http://needchemistry247.weebly.com/uploads/1/0/4/6/10462380/732496831_orig.gif

TECH CHECK:

- www.sciencekids.co.nz/experiments/icecubemagic.html
- http://science.howstuffworks.com/zamboni.htm
- http://www.sciencekids.co.nz/experiments/snowflake.html
- https://www.youtube.com/watch?v=nUu5R0jEIKg
- http://www.sciencekids.co.nz/experiments/eggboiledraw.html
- https://www.youtube.com/watch?v=vmT3wcu8Ed0&ebc=ANyPxKo5rAKd5BxFU7f4CC_DalUqxgbtwOjZPAMYiAvtFGtzEyMnZlrN2ZkfMerBQG3hqHFcu1ggc-Du3uo4caNnaTJ2tomd_A (extension)

8. Scientists know how to experiment with gases.

We breath in just over 470mL (a pint) of air with each breath. When adults stand, they take in about 16 -20 breaths per minute, about 22,000 breaths per day (just over 136,000,000 Liters in a lifetime). Children can take up to about 35 breaths per minute. The air we breathe is an important gas. We need:

_____ X _____ _____ _____ ______ and we exhale:

carbon ____________________________________.

We can see gases easily in carbonated drinks. Natural mineral water has gases that comes from springs. They contain salts or gases (carbon dioxide bubbles) that form when water reacts with limestone to form gas. Underground pressure keeps the gases from escaping.

When you open soda water or carbonated pop, the carbon dioxide gas rises to the surface and escapes that makes a distinct noise.

Read the procedure in the experiment about raisins and find out what happens when you put raisins in regular and carbonated water:

Prediction:

I predict…

Procedure

1. Fill 1 glass with water & another glass with a clear, carbonated beverage.
2. Pour 1/3 cup of raisins into the water glass.
3. Pour 1/3 cup raisins into the glass with a carbonated beverage.

Observation:

- Draw what happens inside each glass.

Findings:

Carbon dioxide is dissolved into carbonated beverages at their bottling factory. When the bottle is opened, gas begins to come out of spaces between the molecules of the liquid in the form of bubbles. These bubbles are attracted to the raisons and help make a "bubble elevator." As raisins reach the surface, the bubbles pop. Then they sink back down again.

(adapted from http://www.giftofcuriosity.com/states-matter-dancing-raisins-experiment/)

Recommendations:

- What could you do differently in your experiment?
- What does this help us understand about beverages?

Making Soda Eruptions! (adapted from http://www.sciencekids.co.nz/experiments/dietcokementos.html)

Prediction:

- Read through the instructions and make a prediction about what you think might happen. (The title is a HUGE hint).

Procedure:

1. Unscrew a ginger ale, Coke, diet coke, soda water and regular water bottle.
2. Place a funnel in each bottle and a geyser tube (if available)
3. Drop a Mento in each bottle.
4. Observe what happens; draw and label them:

Observations:

Findings:

What makes soda drinks bubbly is the carbon dioxide that is pumped in when they are bottled at the factory. The gas is released when you pour your drink. Dropping something into the carbonated beverages speeds up this process by releasing the pressure at the same time bubbles form on the surface of the Mentos candy. Mentos, like golf balls, are covered in tiny dimples. It is the indentations, which increase the surface space, that makes more bubbles form.

Recommendations:

- What could you do differently in your experiment?
- What does this help us understand about beverages?

____

____

____

Heating Up a Balloon Experiment (adapted from http://www.sciencekids.co.nz/experiments/heavyair.html)

Prediction:
Read the procedure and predict what you think might happen.

____

____

Procedure:

1. Stretch the balloon over the mouth of the empty bottle.
2. Put the bottle in the pot of hot water, let it stand for a few minutes and watch what happens.

Observation: (Draw and label what happens below.)

Findings: What's happening?
The air inside the balloon expands when heated. The balloon stretches when the fast moving molecules move further apart from each other. Heat does not change the amount of air, just expands it. Warmer air takes up more space than cold air. It also weighs less than cold air. This is how a hot air balloon works!

Recommendation
- What could you have done differently in the experiment?
- Why is this important to know?

Our healthy body temperature is around 98.6 degrees F, but this is not the metric system!

The metric system uses Celsius which means a healthy body temperature would be 37 degrees.

So what is the **boiling and freezing point of water** in Celsius and Fahrenheit?

Freezing	**Boiling**	**Measurement System**
0 degrees	100 degrees	Celsius
32 degrees	212 degrees	Fahrenheit

Did you know Celsius was a Swedish astronomer and Fahrenheit was a Prussian physicist?

Dynamite

Alfred Nobel's family owned an explosives factory in Sweden. His brother died in an explosion when he was young. He became a chemist because he wanted to make explosives safer and easier to handle. At the time, nitroglycerin was used to help make railroads and move large boulders. It has to be handled very carefully, as the movement of the liquid alone could set off the explosion. Nobel added wood chips to the mixture which helped to stabilize the chemical reaction. He patented this invention in 1867, calling it 'dynamite' after the Greek work meaning "power". When he passed away he left his fortune to the Nobel prizes for medicine, physics, chemistry, literature, and peace. A prize for economics was added later in 1969.

The explosive power of gases can be experienced in a variety of ways:

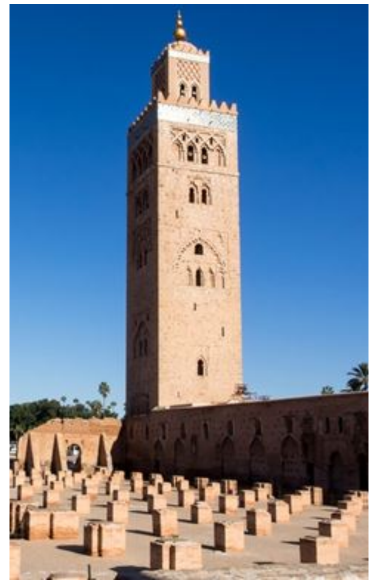
- Heating popcorn kernels so moisture inside each kernel expands until they explode to 30-35 times their size
- Our ears pop on planes. The middle part of the ear is vulnerable to pressure changes.

Condensation

The air conditioner was invented in 1902 by Willis Carrier. He wanted to remove moisture in the air in his New York picture-printing plant. He discovered that paper absorbed the moisture in air – and this changed the colours of his pictures. By thinking about the way fog works, when water is condensed out of the air when the air cools, he designed a machine for cooling air before it entered his plant. He wanted the moisture to collect in the machine – not in the air in his plant.

While his machine was intended to keep the air dry inside the plant, he actually built a machine that cooled the air before entry into the plant. The Ancient Egyptians did not make a machine, but they placed wet mats at their tent doors to cool air blowing in, the first unofficial air conditioning practice.

Smells….



In Marrakesh, Morocco, the Koutoubiya minaret, is famous for its fragrance. The just over 67 meter tower was built in 1195. It used 950 sacks of musk (perfume made from animal secretions). This musk was mixed into cement. And 800 years later, people can still enjoy the aroma coming from the structure.

http://www.infomorocco.net/uploads/9/4/9/2/9492999/4413984_orig.jpg

TECH CHECK: (for more gas experiments)

- http://www.teachertube.com/video/soda-can-pedestal-418805
- http://www.teachertube.com/video/soda-can-shake-up-338961
- http://www.teachertube.com/video/see-through-soda-357649
- http://www.sciencekids.co.nz/experiments/dietcokementos.html
- http://www.sciencekids.co.nz/experiments/lemonade.html
- http://lifestyle.howstuffworks.com/crafts/other-arts-crafts/science-projects-for-kids-states-of-matter4.htm
- http://www.sciencekids.co.nz/experiments/vinegarvolcano.html
- http://www.msichicago.org/experiment/hands-on-science/create-gas/
- http://www.msichicago.org/experiment/hands-on-science/hot-air-balloon/
- http://www.teachertube.com/video/insta-snow-demo-16792
- http://www.sciencekids.co.nz/experiments/dryicebubble.html
- http://lifestyle.howstuffworks.com/crafts/other-arts-crafts/science-projects-for-kids-states-of-matter5.htm
- http://science.howstuffworks.com/question22.htm (fans - circulate air)
- https://www.youtube.com/watch?v=3YxxPKPhgwl
- Make a vacuum chamber http://makezine.com/2017/03/14/build-vacuum-chamber-30/ (extension)

9.Scientists know how to measure liquids and gasses.

Measuring Liquids
Liquids are usually measured in liters and milliliters.

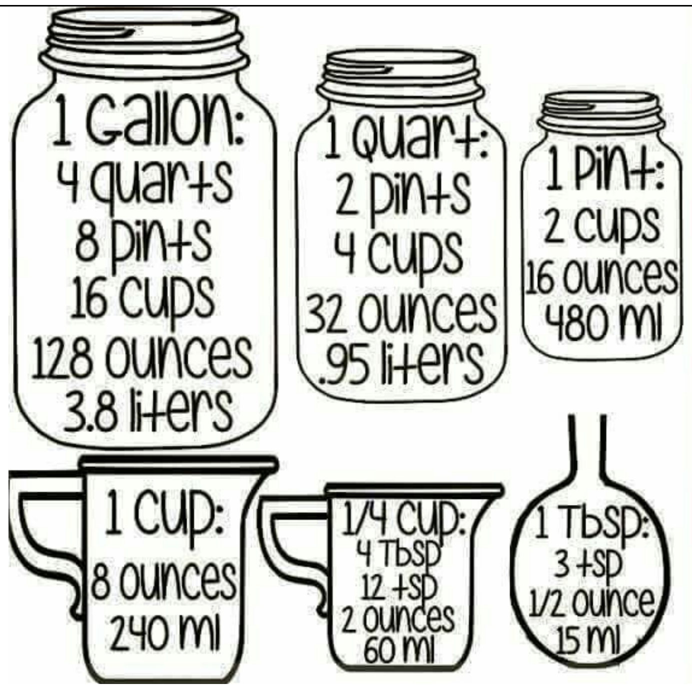
http://baef480c1b9a59094802-bb7fd020772cbf1cd099f3b22c712b0b.r79.cf2.rackcdn.com/6023EC1C-A627-4381-B3EB-2BE47F6C03B3.jpg

- Many recipes use "Imperial" measures (cup, pint, teaspoon, tablespoon, quart), so it is important to know how to convert measures between metric (liters and milliliters).

http://www.telegraph.co.uk/content/dam/food-and-drink/2017/02/24/measuringcup-small_trans_NvBQzQNjv4BqqVzuuqpFlyLIwiB6NTmJwfSVWeZ_vEN7c6bHu2jJnT8.jpg

https://s-media-cache-ak0.pinimg.com/originals/2d/d3/6b/2dd36bf58b24fc194086599823c38395.jpg

- If you are driving in the United States, you will need to know how to convert from liters.
- Look at the information below and determine how much the US gasoline would cost in Canadian dollars.

 https://s-media-cache-ak0.pinimg.com/originals/6a/de/33/6ade33cab437460207bb3c26c2ada300.jpg	 http://media.npr.org/assets/img/2016/01/28/gettyimages-503469534_custom-f56f48482e6511a6a146db7b9c16cb52b6c51394-s900-c85.jpg

It is much easier converting volume to capacity using Canadian/UK standards: i.e. 24 cubic meters = 24 liters

	Standard cup	**Tablespoon**	**Teaspoon**
Canada	250ml	15ml	5ml
UK	250ml	15ml	5ml

http://www.allfoodbusiness.com/liquid_measures.php

(a) Volume of Space

RULE: The volume of a solid is the amount of space it takes up.
Volume = length x width x height so a container with a length of 3feet and a width of 2 feet and a height of 5 feet would be 30 cubic feet.

- Calculate the **volume of a container** that is 3m x 5m X 2m and then determine the capacity that it can hold.

	Rough Work ☺

Capacity of Liquids and Gases
Volume is the space inside a 3D container, but the material that fills it up is called capacity.

The capacity is the amount of liquid a container can hold. The capacity is how much fluid can fill the space (volume) of a container.

https://s-media-cache-ak0.pinimg.com/originals/d8/e8/95/d8e89507292cb9d1b071526133de43db.jpg

Cooking Show Poem

- Create a fun poem to share with your classmates about how you can use different containers to measure different capacities (different size measuring cups, measuring spoons)
- Make sure you use liter, milliliters, half, quarter to help your viewers learn which containers are best for which amounts.
- Make sure your poem talks about how many of the smaller items make up the larger measuring tool.
- Place the measuring tools in order as you present your poem.

http://www.homedepot.com/catalog/productImages/400_compressed/3b/3be2961e-505a-418a-bd24-01a1250c38cc_400_compressed.jpg

- If a liquid detergent has a volume of 3 cubic meters, how many liters would be the container's capacity?

  The liquid laundry detergent would hold a capacity of ____ mL.

http://www.homedepot.com/catalog/productImages/400/24/245e5865-79d5-41c3-a12a-0516f4bcfc2a_400.jpg

- What is the capacity of a box of cereal that has a volume of **240mm3 (cubed)?**

  The cereal box would hold a capacity of _______ mL.

- Think about the capacity and volume of items below and estimate how large they are, by using the some of these words: litre, milliliter half a liter, quarter of a liter:

Liquid	***Capacity***
Juice in juice box	
Can of soup	
Carton of milk	
Oil in pipeline	

Container	***Volume***
Blender	
Large spaghetti pot	
Gasoline container for small boat	
Oil pipeline	

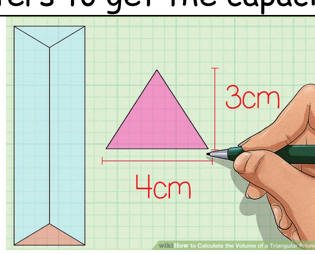
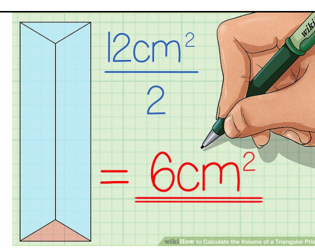
Did you know? Some of the largest objects on earth are fuel pipelines. Canada's longest oil pipeline is approximately 2857km long. Currently, Russia has the longest oil pipeline (3700 km long) in the world, but new pipelines are being planned for North America. 8 million gallons of oil is transported each day through pipelines.

http://globalnews.ca/news/1069624/how-do-crude-spills-compare-by-rail-truck-pipeline-you-may-be-surprised/

- Talk about the advantages and disadvantages of moving fuel through pipelines.
- Talk about the daily uses of petroleum. Many products wind up in landfills.
- What plastics would we still need, and which ones could we do without?

Extension:

- Calculate the area of a triangle & volume of a triangular prism.
- Compare the volume and capacity of a triangular prism by calculating the volume in cubic centimeters to get the capacity in milliliters.

 http://pad2.whstatic.com/images/thumb/2/27/Calculate-the-Volume-of-a-Triangular-Prism-Step-1-Version-2.jpg/aid929068-v4-728px-Calculate-the-Volume-of-a-Triangular-Prism-Step-1-Version-2.jpg	 http://pad1.whstatic.com/images/thumb/f/fc/Calculate-the-Volume-of-a-Triangular-Prism-Step-3-Version-2.jpg/aid929068-v4-728px-Calculate-the-Volume-of-a-Triangular-Prism-Step-3-Version-2.jpg

The volume of the above example is: ____________cubic centimeters.
The capacity, therefore would be ______________ milliliters.

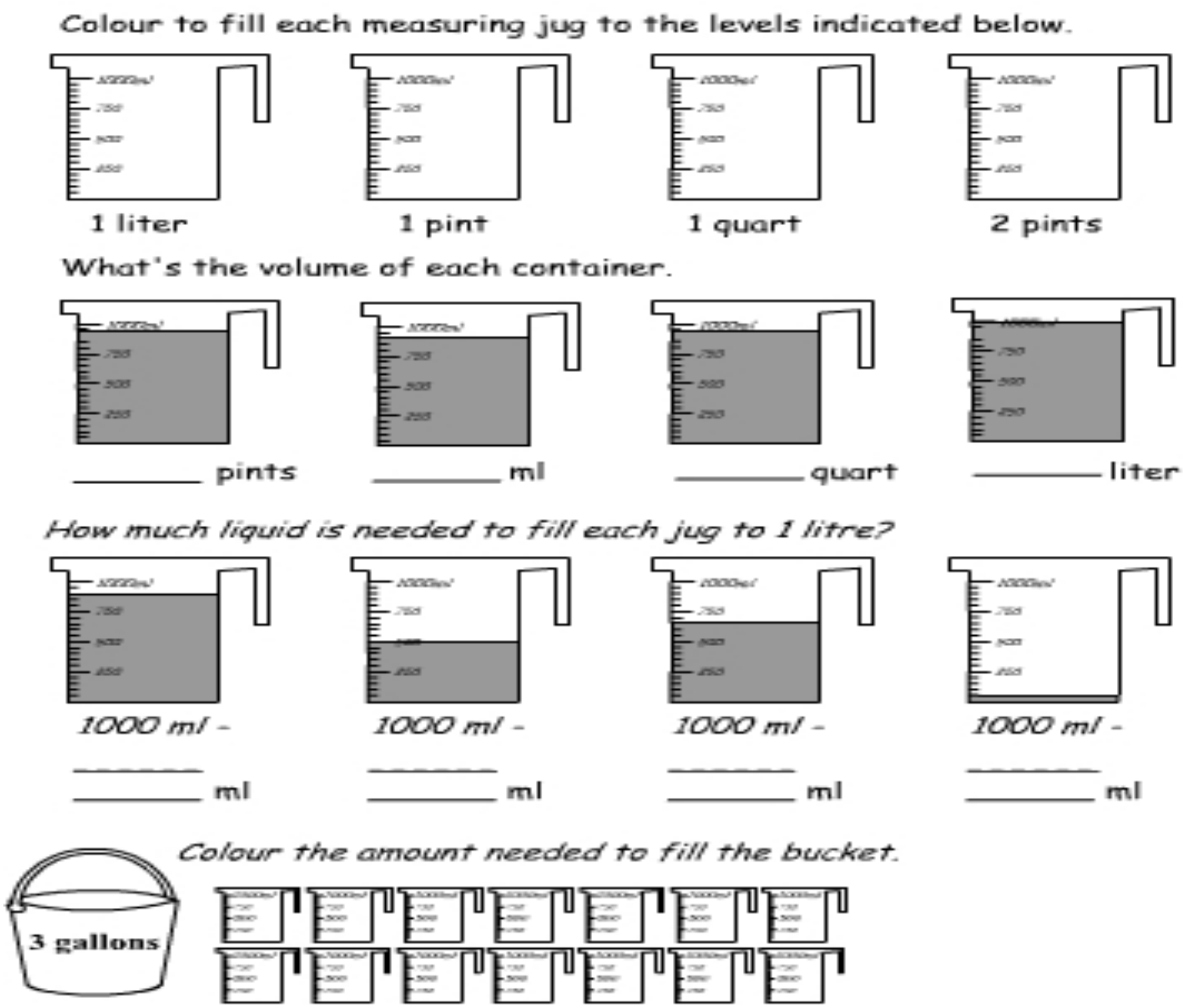
Imperial Units for Volume and Capacity:
1 gallon = 4 quarts which = 16 cups = 128 fluid ounces. Volume can be converted to a liquid unit using a conversion table
(http://www.ookingdom.com/metric/dim-to-capacity)

- Make your liter meter to think about the links between imperial and metric units.

https://s-media-cache-ak0.pinimg.com/originals/14/87/e0/1487e0a586f35de36c753aece6ec4946.jpg

Practice using Imperial units:

- 4 pints = ______ qt + _______ pt.



https://static.studyladder.com/cdn/course/db/6baee47a1f25.jpg

Evaporation Experiment

It's easy to see when ice melts to water, but what happens when water is evaporating into gas?

- Will water evaporate when left outside for a week (on a non-rainy day)?

Prediction:

I predict: ____

Procedure:

1. Put 50 milliliters (mL) in a graduated cylinder.
2. Place outside for a week (when it is not raining).
3. Record the amount of water and the mass each day.

Observation:

	Monday	Tuesday	Wednesday	Thursday	Friday
Volume					
Mass					

Findings:

____

____

____

Recommendation:

____

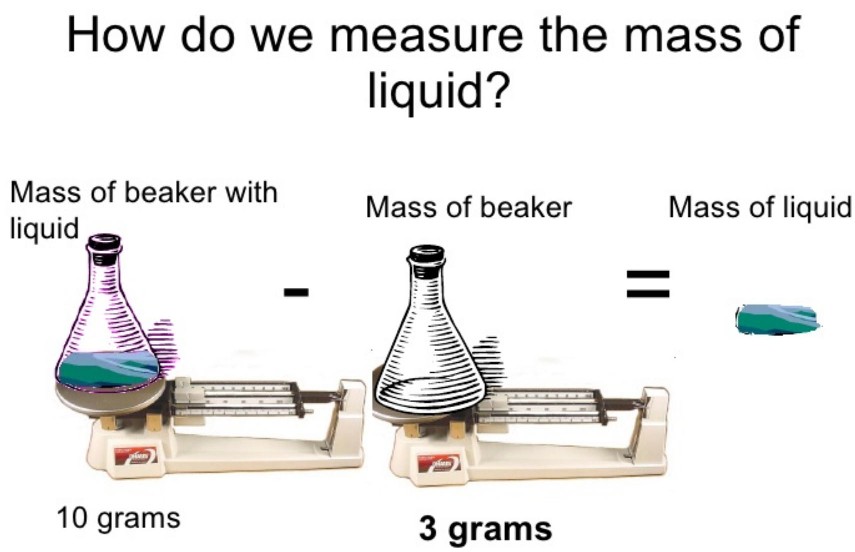
____

____

TECH CHECK:

- http://www.abcteach.com/Math/liqmeas.htm
- http://chalk.richmond.edu/education/projects/webunits/measurement/volume1.html
- http://www.mathsisfun.com/measure/us-standard-units-introduction.html
- http://www.brainpopjr.com/math/measurement/cupspintsquartsgallons/preview.weml
- http://www.ookingdom.com/metric/dim-to-capacity
- http://www.oceanmagic.net/calculating_pool_capacity.htm
- http://atlantis.coe.uh.edu/archive/science/science_lessons/scienceles3/capacity/capacity.html

Because liquid is inside a container, it is important to find the weight of the container – and subtract that from the total in order to record accurate data about the weight of a liquid.



https://image.slidesharecdn.com/measurementlab-090930232344-phpapp01/95/measurement-lab-3-728.jpg?cb=1254353065

- Convert 3 gal, 2 quart and 2 oz = ________ oz

How well did you measure & estimate liquid volume & mass?	Trailblazer (Expert)	Pathfinder (Apprentice)	Rookie (Not Yet)

10. <u>**Changing States of Matter**</u>

- What changes states of matter?
  - (a) heat
  - (b) cold
  - (c) chemical reaction
  - (d) all of the above!

Microwave Science (adapted from http://www.teachertube.com/video/gassy-soap-350057 (s-l-g))
Microwaves can add heat quickly.

- Let's take a bar of soap and place it in the microwave.

Prediction:
I think the bar of soap will ________________________

Observation:

Findings:

____

____

Recommendation:

____

____

Kinetic Science (Shake it up!)

- Read about the business of making ice cream.

July is National Ice Cream Month. To celebrate, I decided to whip up some homemade ice cream. You can try it at home, too. Put milk, sugar, and vanilla into a freezer bag and seal it up tight. Fill a larger freezer bag (3-4 liters) with ice and rock salt. Place the liquid mix bag inside the ice bag and give it a good long shake. Some scientists might call this part "agitating." After five minutes or so, you'll notice the liquid mix in your bag becomes solid. Then you can dig in with a spoon…

After making my own homemade tuna-flavored ice cream, I decided to take a trip to the Washington State University Creamery to see how the professionals make ice cream for Ferdinand's Ice Cream Shoppe.

I met up with our friend John Haugen, the creamery manager. Each year at the WSU creamery, students make more than 18,000 gallons (over 68,000 liters) of ice cream. That's a lot of scoops. Just like our Ice Cream-in-a-Bag recipe, their recipe uses a mix of milk, cream, and sugar that's frozen in a way to prevent crystals from forming and incorporates enough air to make it soft. At the creamery, milk flows through pipes into big stainless steel tanks that have been specially engineered.

The students add a bit of fat to the mix in the form of cream, which gives the ice cream a smooth texture. When the fat mixes with air, it helps create small pockets in the ice cream. It makes the texture smoother. In fact, a scoop of ice cream is about half air. When making ice cream, we need to keep the ingredients blended together. With all the liquids going in the vat, we also add a few solids like dry milk, followed by the sugar. Then, we heat it up to 155 degrees to pasteurize the milk and kill any bad bacteria that might have snuck into the mix. We also don't want the cream to rise to the top or different parts to separate. This is where we add in what's called an emulsifier. One of the original emulsifiers that did the trick was actually egg.

We also want to keep the ice cream from getting too many ice crystals. So, we add in a bit of carrageenan, a kind of seaweed. But it's just a tiny bit. It helps keep the ice cream from forming those tiny ice crystals. The liquid goes through a homogenizer, forcing the mix through a small opening and breaking down milk fats into smaller pieces to make the ice cream even smoother. Finally, the mix goes through a specially engineered machine to bring the temperature down. Then it gets sent through a freezing barrel and packed into boxes until it's ready to eat. The best part of the job is eating the ice cream, Haugen adds. Sometimes there's no better way to find out how something is made than to give it a try.

Sincerely,
Dr. Universe (adapted from https://askdruniverse.wsu.edu/2016/07/07/ice-cream-made/)

We all scream for ice cream! ☺

What we know about ice cream dates back to the time of the Roman emperors.

Their cooks mixed snow with honey and fruit juices. Marco Polo brought back the recipe for iced milk from China

Now Make ice cream as an experiment!

I predict: ____

Procedure:

1. ____
2. ____
3. ____

Observation:

Findings:

____

____

____

Recommendation:

____

____

____

TECH CHECK: (hints)

- http://www.teachertube.com/video/homemade-ice-cream-341391 (ice cream) change
- http://www.teachertube.com/video/snow-ice-cream-372381 (ice cream) change
- https://mail.google.com/mail/u/0/#label/Curriculum/14dc980583b29269 (ice cream, lemonade)
- http://www.teachertube.com/video/homemade-ice-cream-341391
- http://www.teachertube.com/video/snow-ice-cream-372381

A key part of the theory of matter is that matter is made up of molecules. Ice cream and soap are made of very small bits of matter. The smallest bits of matter are called 'atoms'. There are MANY different kinds of atoms that are solid, liquids or gases. They can be combined with one another and called 'compounds'; they can form solutions when they dissolve and they can form mixtures when they do not fully dissolve.

- Research an atom of your choice - and prepare a presentation: "My Life as an Atom".

TECH CHECK:

- http://science.howstuffworks.com/matter-channel.htm (atoms)
- https://www.youtube.com/watch?v=21CR01rlmv4
- https://www.youtube.com/watch?v=sOZyd6ujvv0 (answer questions about science at the mall) atoms
- https://www.youtube.com/watch?v=MBgM73DLK1s (bill nye – atom)
- https://www.youtube.com/watch?v=wyRy8kowyM8 (atom)
- https://www.youtube.com/watch?v=wclY8F-UoTE (atom)
- https://www.youtube.com/watch?v=mVzWB7nNx7w (atom)
- http://www.teachertube.com/video/states-of-matter-225031 (atom)
- http://science.howstuffworks.com/chemistry-channel.htm (extension) atom (extension)
- http://www.msichicago.org/experiment/hands-on-science/fingerprints/ (chemistry) matter (extension)

Extension:

- Create a periodic table and colour code it to show elements that are solids, liquids and gases.
- Make some atoms using tooth picks and marshmallows.
- Create your own atom – that is similar but distinct than other atoms.

Irreversible Change

Some chemical changes in matter cannot be reversed.
Rust on the chrome of a bike is chemical change. Unlike ice that can go back and forth as water – if cooled or heated, rust on a bike can never be returned to chrome (at least with the science we know today).

A chemical change is what happens when you see something change in colour (the flower of a plant from food colouring absorbed through it's stem; gas is formed when vinegar and baking soda mix).

The story of Sourdough bread is a cool example of a chemical reaction that is thought to be influenced by the environment.

Where does sourdough bread taste better? In Paris or San Francisco?
For Fun…first of all, set up a blind taste test to try and taste the difference tastes of breads (whole wheat, rye, white, sourdough…)

- Make a class graph to show which breads are more popular with the range of class taste buds.
- Draw your class graph here:

- Talk about how sourdough bread is made from flour salt water and natural yeast.

Bakers use brick ovens. The bakers use a 'starter' which is fermented dough set aside from former batches, to use for future batches. Some bakers have strains dating back 100 years. This process started in Egypt about 4000 years ago when bakers exposed dough to airborne yeast (a fungus that helps bread rise). There are chemically-made yeasts, but they do not produce the same 'sour' flavor. Carbon dioxide gas is produced by yeast during fermentation. In San Francisco, the bakers say the yeast is effected by mountain air winds and fog, so their famous bread cannot be replicated in Paris.

- If time, let's make bread, and talk about what a Blue Mountain or Beaver Valley brand of yeast might lend to a new local sourdough bread.

Extension:
- Talk about what you think the impact might be on the environment if farmers changed grains such as wheat, corn, and rice?
- How might this effect the flour or production of any kind of bread, pasta, or crackers?

A **physical change** can be reversed [ice to water to ice], whereas a chemical change creates a new substance, or substances. When bread is made or when a log is burned the chemical change makes wood into smoke and ash.

Changes in matter can happen by adding or absorbing heat, but it can also involve the release of heat. When water freezes it releases heat, or when an ice cube melts, it absorbs heat.

Reading a thermometer and recording temperatures, is an important part of what scientists need to know how to do!

In each of the experiments that involved hot and cold water, for instance, that we have done so far, you could have added data about the temperature to be more precise. In some cases, the results might be different if some hot water was hotter than others. We make reference to the temperature outside each day. This helps us know if we need to wear warmer clothes in the winter or cooler fall days.

Read the thermometer outside and record today's temperature:

At ______ (time) the temperature is ______degrees C.

- Now estimate what you think the temperatures of cold, hot and microwaved (1 minute) water might be.

- Then use a thermometer to check out the temperatures of hot and cold water from the tap.

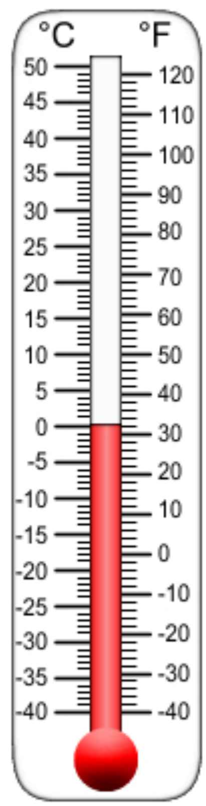
	Cold water	Hot water	Microwaved water
ESTIMATE			
Actual			

- Draw a number line to show the three actual temperatures.

Find out…

At what temperature does water freeze? _______ degrees C.

At what temperature does water boil? _________ degrees C.



http://www.teacherfiles.com/clipart/Thermometers/Thermometer_F_C_freezing.jpg

11. Scientists Consider the Environmental Impact

- Talk about the environmental impact of changing one product into another product through physical or chemical changes.
- What happens when pulp turns into paper and paper products?

Making Recycled Paper

Prediction:

- Read through the procedure and make a prediction

*I predict:*____

I think it might be tricky when ______________________________

Procedure (directions)

1. Cut screen to fit into hoop with 2cm overhang. Cut another screen the same size.
2. Squeeze the two hoops and tightening the screw.
3. Trim the screen so about 2 cm hangs over the edge of the hoop.
4. Tear 3 sheets of white paper and 1 sheet of coloured paper into 2cm pieces
5. Places pieces in blender with warm water to the half way point.
6. Blend to create a pulpy mixture called slurry.
7. Pour slurry into large container. Add extra water so water is about 10cm deep.
8. Place the mold into the slurry.
9. Use your hands to scoop slurry over mold so the entire screen is covered.
10. Gently shake frame back and forth so pulpy paper fibers collect on the screen.
11. Slowly lift mold from tub. Place mold on the tray and cover with extra piece of screen.
12. Gently press sponge on blotting screen to remove excess water from paper
13. Squeeze sponge back into slurry container. Continue blotting until most of water is removed.
14. Place mold on a cookie sheet where it can be left to dry for 24 hours.
15. Once the paper is dry, unscrew hoop and remove new paper.

Adapted from http://www.msichicago.org/experiment/hands-on-science/recycled-paper/.

- Look at this picture of a large-scale recycling paper company.

http://blog.artterro.com/wp-content/uploads/2011/05/Paper-Making.jpg

- Discuss with the class what you think the advantages and disadvantages might be to this business.

Observations:

- Draw and label images of your observations at different stages of creating your recycled paper.

Findings:

- Did your experiment turn out as expected?

Recommendations:

- What would you recommend to someone else who might do this experiment.

Recycling paper, cardboard, plastics, and organics can keep materials out of landfills for a longer period of time, but recycling may have their own impacts.

- What are some advantages and disadvantages of recycling?

Advantages	Disadvantages

Extension:

- Make plans to make a paper canoe. (http://www.instructables.com/id/The-Incredible-Paper-Canoe/)

When plastic containers replaced bottles, it became much more affordable for many companies to ship their products all over the world. The environmental impact was significant.

- Read Jodie Mangor's message: "All Bottled Up" to start the conversation about the impact of the water bottle globally:

All Bottled Up by Jodie Mangor

1 Voss and Imsdal come from Norway, Bisleri is bottled in India, and Vata is an Iranian brand. Around the globe, people are quenching their thirst with bottled water. In the past 10 years, sales in Asia and South America have tripled. In 2007, people in the United States drank more than 8 billion gallons of bottled water. The United States currently consumes the most bottled water in the world, followed by Mexico, China, and Brazil. Compared to sugary, caffeinated soft drinks, this seems a healthy choice. But is it a wise one?

2 A single-serve water bottle offers great convenience. It can be bought almost anywhere, carried around for a while, and then thrown away.

3 The impact of bottled water on the environment, however, is staggering. Approximately 2.7 million tons of plastic are turned into disposable bottles each year. This requires large quantities of crude oil and water. It also produces greenhouse gases. Bottled water is often shipped long distances to reach consumers, sometimes transcontinentally. It may be important to think about more than just getting a drink when you pick up a bottle of water. This article discusses some of the problems that bottled water causes. Read the article and answer the questions that follow. This uses even more fossil fuels and creates more pollution.

4 Although the bottles can be recycled, only a fraction of them are. The United States only recycles about 23 percent. The rest are part of a growing solid waste problem.

Bottled Over Tap?

5 Convenience isn't the only reason for bottled water's rise in popularity. Words like "pristine" and "pure," together with images of mountains or glaciers, are used to market bottled water. Many people believe that it must be cleaner and more healthful than tap water1 from public water systems. But this is a misconception. In developed nations such as the United States and in Europe, regulations that ensure safe water are often stricter for tap than for bottled water. In the United States, tap water is regulated by the Environmental Protection Agency (EPA). Bottled water, which is viewed as a packaged food product, is regulated by individual states if it stays within their borders or by the Food and Drug Administration (FDA) if it crosses state lines.

6 Jermuk water, which is bottled in Armenia, provides an example of how bottled water standards vary from place to place. In 2007, Jermuk water was pulled from American shelves by the FDA because it contained arsenic2 levels as high as 674 micrograms per liter. Armenian standards allow as much as 700 micrograms of arsenic per liter of water, but U.S. standards set the limit at 10 micrograms per liter.

7 It may come as a surprise that as much as 40 percent of the water bottled in the United States starts out as tap water. Before bottling, some companies filter it, and they might add minerals for taste.

8 Despite its sometimes humble origins, bottled water can cost anywhere from 240 to 10,000 times more per gallon than tap water.

Is the Bottle Ever Better?

9 At times, bottled water is the best available option. Hurricanes, other natural disasters, and emergency situations such as the terrorist attacks on the Pentagon and World Trade Center in 2001 can negatively affect the safety of public water. Reliable water systems may not be in place in developing nations and war-torn countries. In these cases, bottled water can provide an important source of clean, safe, drinking water.

Future Solutions

10 "Back to the tap" movements are cropping up around the world. In order to save money, use fewer resources, and create less waste, they advocate using tap water and reusable "sports" bottles rather than bottled water. San Francisco and other cities across the United States no longer allow their governmental departments to buy single-serve water bottles. Cities in Canada, Australia, and the United Kingdom are considering similar bans.

11 Many bottled water companies are trying to do their part, too. They have reduced the amount of plastic in their bottles and bottle caps. Both the Colorado-based BIOTA company and the English company Belu Water use biodegradable plastic bottles derived from corn. Belu takes it a step further by donating some of its profits to clean water projects.

12 Bottled water has become an international phenomenon.3 While it is an important source of safe drinking water, we should not lose sight of a more environmentally friendly source: the water that comes out of our taps.

http://www.proacquaaustralia.com.au/wp-content/uploads/2014/03/Pollution1.jpg

- Now complete the questions in small groups. You do not have to agree. Just listen to each's reasons for their choices, and share your reasons, too.

1) What is the main purpose of the statistics in paragraph 1?
A. to explain which countries lead in bottled water use
B. to list the international names of bottled water products
C. to show readers that bottled water is popular everywhere
D. to convince readers that bottled water is better than sugary drinks

2) According to the article, what is the main problem with bottled water?
A. the waste associated with the bottles
B. the difficulty of transporting the bottles
C. the amount of water required to fill the bottles
D. the inconsistent quality of the water in the bottles

3) Based on paragraph 5, why are words such as "pristine" and "pure" used to sell bottled water?
A. to meet governments' laws
B. to influence people's choices
C. to present scientific evidence
D. to show the values of a company

4) Read the sentence from paragraph 3 in the box below.
"Bottled water is often shipped long distances to reach consumers, sometimes transcontinentally."
In the word transcontinentally, the prefix trans- means
A. nearly.
B. across.
C. toward.
D. beneath.

5) Read the sentence from paragraph 10 below.

"In order to save money, use fewer resources, and create less waste, they advocate using tap water and reusable "sports" bottles rather than bottled water."

In the sentence, what does the word advocate most likely mean?

A. debate

B. predict

C. research

D. encourage

The Last Water Bottle

Imagine having a bottle called: "The LAST WATER BOTTLE" presented like a museum piece and gentle reminder that students and staff need to bring reusable containers for their drinks at school each day. The 'Last Water Bottle' is a salute to a culture that is NOT contributing to the build-up of plastic waste in our landfills.

12. **Scientists Make Stuff**

Scientists are change detectives.
As change detectives, you will have a chance to work on your own Invention Project. All projects will be presented on line – as well as in the Tiger's Tank, at the end of the semester.

Practice Making a Group Invention

- Let's make an invention together as a class, as an example.
- Let's make something that helps us understand how weather, climate and temperature change over time in different locations near our school.
- Read up about weather measurements
  https://weather.gc.ca/marine/forecast_e.html?mapID=10&siteID=05500
  https://www.theweathernetwork.com/ca/14-day-weather-trend/ontario/georgian-bay

Procedure:

1. Place thermometers in each of the following locations.
   - in the school office
   - near the entrance
   - one foot underground
   - in a windy location outside
   - in a calmer location outside.
   - another location of your choice
2. Assign a student or pair of students to be responsible for that one reading each day.
3. Record the temperatures on a class chart.
4. Talk about how to figure out weekly temperature averages.

Findings:

- Discuss why you think there were differences in temperatures at different locations and at different times.

Recommendations:

What can we do with this information? Why is it important?

Extension (Uber project idea):

Research how our school can be the site of a weather station (what it involves in terms of materials, understanding how to read instruments, cost of assembly, how to become an official data source that fits into the overall weather system)

- https://www.wired.com/2016/04/diy-weather-station/
- http://makezine.com/2015/11/20/build-your-own-arduino-weather-station/
- https://weather.com/news/news/how-make-weather-station-pro-20130731#/1

INVENTION EXAMPLE: The PowerBarr Business Plan

(adapted from https://www.kickstarter.com/projects/powerbarr/power-up-easily-efficiently-and-sustainably-with-p/description)

- Go to: Tiger Tank Crowd Funding.
- Create a 3-minute pitch to demonstrate a prototype in video format. (or words)
- Explain:
    - Who you are as inventors "About Us"
    - the value of the proposal
    - what people will get
    - who is supporting the project (team, talent, skills)
    - how you came up with the idea
    - Note: risks and challenges (What do you think are the big hurdles to overcome that might derail the project?)
    - What are the rewards that investors will gain?
    - the marketing plan for communicating invention
    - how your invention is distinct from other similar inventions
    - What pricing will be used to sell invention? (see Indiegogo manual – add link)

- Prepare a budget with projected costs and revenues
- Prepare a submission for a patent for your invention.

The process of getting a patent in Canada (adapted from http://www.ic.gc.ca/eic/site/cipointernet-internetopic.nsf/eng/wr03716.html)

What is a patent?

Patents apply to newly developed technology as well as to improvements on products or processes. Patents provide a time-limited, legally protected, exclusive right to make, use and sell an invention. In this way, patents serve as a reward for ingenuity.

Why is getting a patent a good idea?

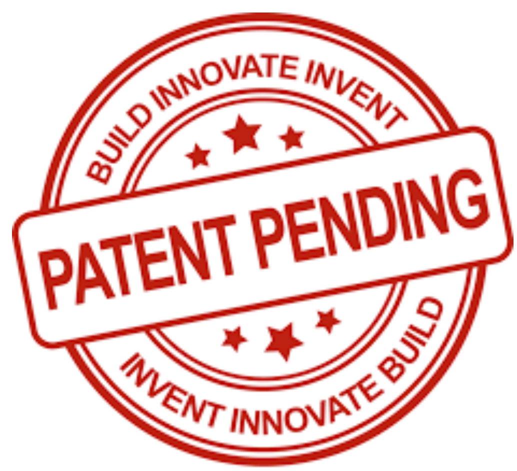
In Canada, a patent lasts for 20 years from the date that you file it. You can sell patents, license them, or use them to attract funding from investors. You must provide a full description of the invention when you file a patent. Details of patent applications filed in Canada are disclosed to the public after an 18-month period of confidentiality.

To be eligible for patent protection, your invention must be:

- new—first in the world
- useful—functional and operative
- inventive—showing ingenuity and not obvious to someone of average skill who works in the field of your invention

The invention can be:

- a product (e.g., door lock)
- a composition (e.g., chemical composition used in lubricants for door locks)
- a machine (e.g., for making door locks)
- a process (e.g., a method for making door locks)
- an improvement on any of these



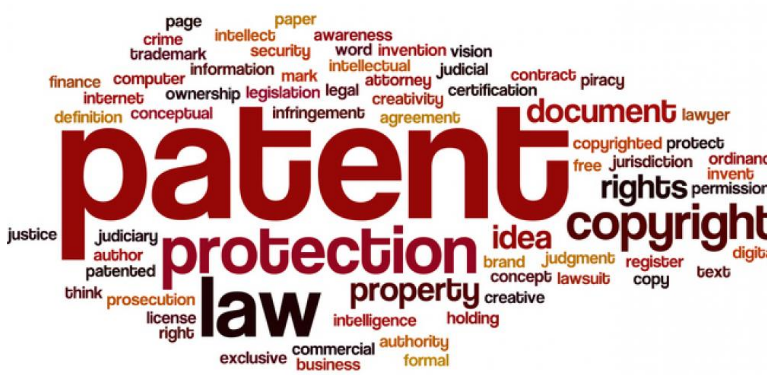
You should file as soon as possible after you complete an invention in case someone else is on a similar track. Many inventors use the services of a registered patent agent.

A patent application consists of:

- an abstract (summary),
- a specification and, in most cases,
- drawings

The **abstract** is a brief summary of the contents of the specification.
The **specification** is made up of:

- a clear and complete description of the invention and its usefulness; and,
- your claims that define the original parts of your product/invention



The description:

- must be clear
- must be accurate
- should be as simple, direct
- must be written so people would be able to use the invention the same way as the inventor
- must be specific enough to identify your invention by making sure it is different from all previous inventions
- drawings illustrated in your application must show all parts of the invention.
- results of laboratory or commercial tests showing your patent's preferred practice and the conditions under which poor or dangerous results could be expected
- includes lists of related patents or articles you have already found in any literature search, with a list of the similarities and differences of practices or products that are relevant to your invention
- must include your name, address and citizenship
- filing fee, and a signed small entity declaration
- pay an examination fee (http://www.ic.gc.ca/eic/site/cipointernet-internetopic.nsf/eng/wr00142.html)

Once CIPO accepts your application for filing, the application is assigned a number and filing date. You will be informed about these. This is no guarantee of a patent; it simply means your application is pending.

The application will be open to public inspection (that is, the public will have access to your application) 18 months after the filing date or priority date. If you wish, you may request to have your application published earlier.

It is not uncommon for the patent examiner to object to a claim. The examiner may find previous patents or publications that show every feature of one or more claims in your application…The examiner's objection will be outlined in a report or letter called a "Patent Office action," which will list the objections, and set a date for you to reply. The action may object to your whole application or only some claims, or it may ask for other changes in your application. Do not feel discouraged if the examiner objects to some of your claims. You may respond to the objections as long as you do so within the period that the examiner specifies in the action. Your response may ask the Commissioner to amend your application by changing or cancelling some claims, or adding new claims. You must deal with each objection raised by the examiner.

TECH CHECK:

- http://www.ic.gc.ca/eic/site/cipointernet-internetopic.nsf/eng/h_wr03652.html
- http://www.ic.gc.ca/eic/site/cipointernet-internetopic.nsf/frm-eng/PDUS-88FMK9

Invention Project

- Now work with a partner to come up with some ideas for your own invention to feature in the *Tiger Tank.*

https://ichef.bbci.co.uk/images/ic/480x270/p0518hgl.jpg

- Make something that will let you:
  - require changes states of matter somehow!
  - uses the scientific method to investigate changes of state and changes in matter.
    - prediction
    - procedure
    - observation
    - findings
    - recommendations
  - answers A-Z questions the 'Tigers' might ask:

Sample Tiger Questions

- How does your invention solve a problem?
- What change of state happens when you use your invention (condensation? solidification?)
- How does your invention use the release of heat or an absorption of heat?
- What physical changes in matter can you see when you use your invention?
- What caused the changes in matter to take place?
- Is it possible to reverse the changes?
- Did you observe chemical changes in matter when you used your invention?
- What caused those changes to take place?
- How will you test your invention to ensure that the materials you use will work the same if others replicate your experiment?
- What properties of the materials make the instrument useful?
- Can the invention have multiple uses?
- What is the environmental impact of using each of the materials needed for your instrument?
- Which part of making the invention is tricky for future inventors?
- How might you improve your invention to make it work better?
- How did your invention help you understand more about changing matter? How can we explain physical and chemical changes (beyond what we can see) using the theory of molecules?
- Can you expand this business by franchising?
- Do you have a patent on your invention – or is it 'patent-pending'?
- How many units have you sold in the past month?
- What value do you place on this company?
- What percentage are you willing to give up in a partnership?
- How much money did clear after paying for all expenses?
- What profit do you forecast over the course of the next 3 months?
- How portable is your product? What are the costs of packaging and shipping your product?
- How well did you use safety procedures? (use of hammer, drills…)
- What will make your 3-minute pitch stand out?
- Add your own question!

https://www.zsl.org/sites/default/files/styles/wysiwyg/public/image/2014-02/tiger-1.jpg?itok=qGFG4Ilj

Your invention will need to solve a problem.

- Will it work better than a similar invention?
- Will it be a time savor?
- Will it cost less?
- Will it do several things at one time?
- Will your invention make your bed?
- Will it make a healthy snack?
- Will it help you get from one spot to another?
- Will it help you improve at music or sports?
- Will it help people who need help?
- Will it use renewable/non-renewable energy?
- Will it include a list of safety rules for use?
- What size is your invention? Will it fit in the lab space?

Starter Materials: journal, pencil, duct tape, boxes (large and small), scissors, magnet strips, material, buttons, safety pins, crayons, newspapers, magazines….

- Use your Learning Journal to make and label diagrams.
- List other things you might need for your invention.
- Your report should include as many data sources as possible. (sizes, mass, temperatures, costs, graphs, dates….)

Starter Ideas: Think about making an invention that might….

- clean up a liquid spill in the kitchen (sponge, paper towel, cloth?)
- be simple (http://likemag.com/de/verwende-diese-tricks-mit-einem-haken-und-es-wird-sich-auszahlen/322817)
- be complex (Rome wasn't built in a day – but this house was: (http://mashable.com/2017/03/03/3d-house-24-hours/#OTkKkUMg5OqH)
- At first you can go back and forth between designing blueprints of your ideas – and building samples.
- You might find some idea from experiments we conducted or ideas from TECH TIME.

TECH CHECK:

- http://www.msichicago.org/experiment/hands-on-science/create-gas/
- http://science.howstuffworks.com/forensic-science-channel.htm
- http://www.msichicago.org/experiment/hands-on-science/candy-chromatography
- http://www.sciencekids.co.nz/experiments/vinegarvolcano.html
- http://www.sciencekids.co.nz/experiments/invisibleink.html
- http://forensics.rice.edu/

Final Check

What do scientists do?

What is an innovation?

What is an experiment?

What is an observation?

Bonus ☺

What is a source?

Appendix A:
Ontario Ministry of Education and Training SCIENCE Expectations

2007 REVISED The Ontario Curriculum Grades 1-8

GRADE 3 SCIENCE
RD3C.2.1 follow established safety procedures during science and technology investigations (e.g., use eye protection when twisting, bending, compressing, or stretching materials)

RD3D.2.1 follow established safety procedures during science and technology investigations

GRADE 4 SCIENCE
RD4C.2.1 follow established safety procedures for protecting eyes and ears

GRADE 5 SCIENCE
RD5B.2.1 follow established safety procedures for working with tools and materials

RD5C.1.1 evaluate the environmental impacts of processes that change one product into another product through physical or chemical changes

RD5C.1.2 assess the social and environmental impact of using processes that rely on chemical changes to produce consumer products, taking different perspectives into account…, and make a case for maintaining the current level of use of the product or for reducing it

RD5C.2.1 follow established safety procedures for working with heating appliances and hot materials

RD5C.2.2 measure temperature and mass, using appropriate instruments

RD5C.2.3 use scientific inquiry/experimentation skills (see page 12) to investigate changes of state and changes in matter

RD5C.2.4 use scientific inquiry/experimentation skills to determine how the physical properties of materials make them useful for particular tasks

RD5C.2.5 use appropriate science and technology vocabulary, including mass, volume, properties, matter, physical/reversible changes, and chemical/irreversible changes, in oral and written communication

RD5C.2.6 use a variety of forms (e.g., oral, written, graphic, multimedia) to communicate with different audiences and for a variety of purposes

RD5C.3.1 identify matter as everything that has mass and occupies space

RD5C.3.2 identify properties of solids, liquids, and gases…and state examples of each

RD5C.3.3 explain changes of state in matter (e.g., evaporation, condensation, solidification or freezing, fusion or melting, sublimation), and give examples of each

RD5C.3.4 describe physical changes in matter as changes that are reversible

RD5C.3.5 describe chemical changes in matter as changes that are irreversible

RD5C.3.6 explain how changes of state involve the release of heat…or the absorption of heat

RD5C.3.7 identify indicators of a chemical change

RD5C.3.8 distinguish between a physical change and a chemical change

RD5D.1.2 evaluate the effects of various technologies on energy consumption

RD5D.2.1 follow established safety procedures for using tools and materials

Appendix B:
Ontario Ministry of Education and Training MATHEMATICS Expectations

GRADE 3 MATH
M3B.1.1 estimate, measure, and record length, height, and distance, using standard units

M3B.1.2 draw items using a ruler, given specific lengths in centimetres

M3B.1.4 estimate, read…, and record positive temperatures to the nearest degree Celsius

M3B.1.5 identify benchmarks for freezing, cold, cool, warm, hot, and boiling temperatures as they relate to water and for cold, cool, warm, and hot temperatures as they relate to air

M3B.1.8 choose benchmarks for a kilogram and a litre to help them perform measurement tasks; – estimate, measure, and record the mass of objects…, using the standard unit of the kilogram or parts of a kilogram; – estimate, measure, and record the capacity of containers…, using the standard unit of the litre or parts of a litre…

M3B.2.1 compare standard units of length…, and select and justify the most appropriate standard unit to measure length

3B.2.2 compare and order objects on the basis of linear measurements in centimetres and/or metres…in problem-solving contexts;

3B.2.5 compare and order a collection of objects, using standard units of mass and/or capacity

GRADE 4 MATH
4B.1.1 estimate, measure, and record length, height, and distance, using standard units; – draw items using a ruler, given specific lengths in millimetres or centimetres

4B.1.5 estimate, measure, and record the mass of objects, using the standard units of the kilogram and the gram

4B.1.6 estimate, measure, and record the capacity of containers, using the standard units of the litre and the millilitre

4B.2.1 describe, through investigation, the relationship between various units of length; – select and justify the most appropriate standard unit to measure the side lengths and perimeters of various polygons

4B.2.4 compare and order a collection of objects, using standard units of mass and/or capacity

4B.2.5 determine, through investigation, the relationship between grams and kilograms

4B.2.6 determine, through investigation, the relationship between millilitres and litres

4B.2.7 select and justify the most appropriate standard unit to measure mass and the most appropriate standard unit to measure the capacity of a container

GRADE 5 MATH
5B.1.3 measure and record temperatures to determine and represent temperature changes over time

5B.2.1 select and justify the most appropriate standard unit to measure length, height, width, and distance, and to measure the perimeter of various polygons

5B.2.2 solve problems requiring conversion from metres to centimetres and from kilometres to metres

5B.2.6 solve problems requiring the estimation and calculation of perimeters and areas of rectangles

5B.2.7 determine, through investigation, the relationship between capacity and volume, by comparing the volume of an object with the amount of liquid it can contain or displace

5B.2.9 select and justify the most appropriate standard unit to measure mass

GRADE 6 MATH
6B.2.1 select and justify the appropriate metric unit to measure length or distance in a given real-life situation

6B.2.2 solve problems requiring conversion from larger to smaller metric units