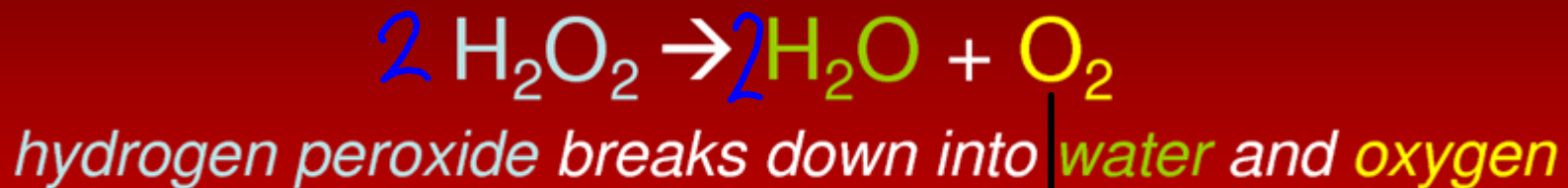
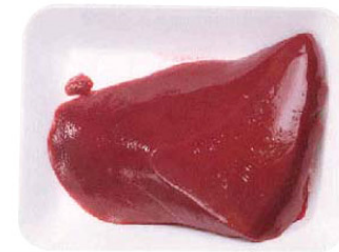


Biology Project

Investigate and compare the effects of pH on the catalytic effect of the enzyme catalase, found in (a) celery and (b) animal liver, on the rate of breakdown of hydrogen peroxide.



Catalase causes this



Oxygen will make **bubbles** in washing-up liquid. So we can measure the amount of bubbles to see how well the enzyme catalase worked.

Part 1 (Introduction)

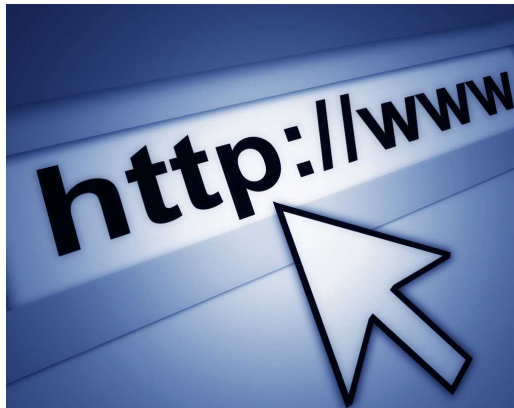
(i) Statement or problem to be investigated - What you are going to do but **in your own words**

(ii) Background research undertaken - You will have to look up a few websites and books to find information for your investigation.

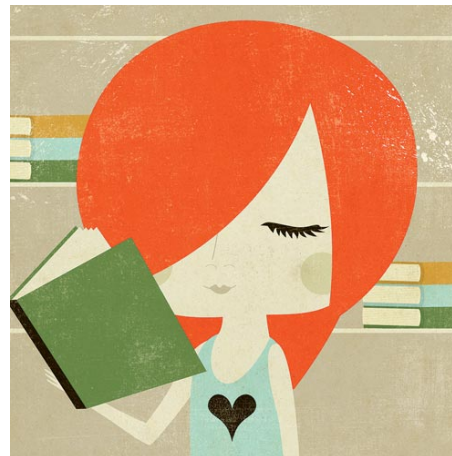
You may even have to ask your teacher or someone at home for information. This is your background research you will need to give **at least 3 pieces** of background research.

Make sure for all three you mention where you got the piece of information and what you used it for.

Internet



Books



Teacher



Part 2 (Preparation and Planning)

(i) Variables

1. The **Independent** Variable (what I will change - **pH**)
2. The **Dependent** Variable (what I will measure - **Amount of Foam**)
3. **Controls** (what I will keep the same -
 - **amount of chemicals (washing-up liquid, pH buffer, H₂O₂) used**
 - **temperature of chemicals**
 - **amount of celery/liver (by weight) used**

(ii) Equipment: List every piece of equipment you use, leave nothing out!

e.g. Safety glasses, gloves, celery, liver, blender, water, scaple, funnel, filter paper, beaker, 4 test tubes, test tube holder, dropper, H₂O₂, washing-up liquid, pH buffers 4, 7, 10 and 13, stopwatch, ruler, notebook and pencil.

(iii) Tasks: This is the list of jobs that need to be done in order.

e.g. Make a mixture of celery\water.

Add the various chemicals to the 3 test tubes and

Observe\note the results and then repeat 2 times more.

Repeat the same procedure with the liver instead of celery.



Part 3 (Procedures, apparatus etc.)

(i) Safety - don't just say 'I wore safety glasses', say why!

For example I wore safety glasses and gloves because acids are corrosive.

(You need at least two safety precautions)

(ii + iii) Procedure with diagram - The best advice I can give is to write it like a recipe. If people cannot copy the experiment using your steps then you need to do them again.

e.g.

Take 2 stalks of celery and add to 100 ml of water.

Use a blender to mix the water and celery until no large lumps remain.

Filter the mixture through filter paper in a funnel and keep the liquid part (filtrate) in a beaker.

Into a test tube add 1 drop of washing-up liquid, and using a dropper add 2ml of pH 4 buffer and 2 ml of H₂O₂.

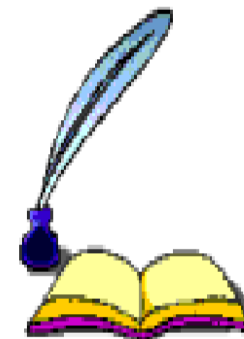
Repeat these steps for 3 more test tubes using pH buffer 7,10 and 13.

Finally add 2 ml of the celery filtrate (catalase) into each of the test tubes.

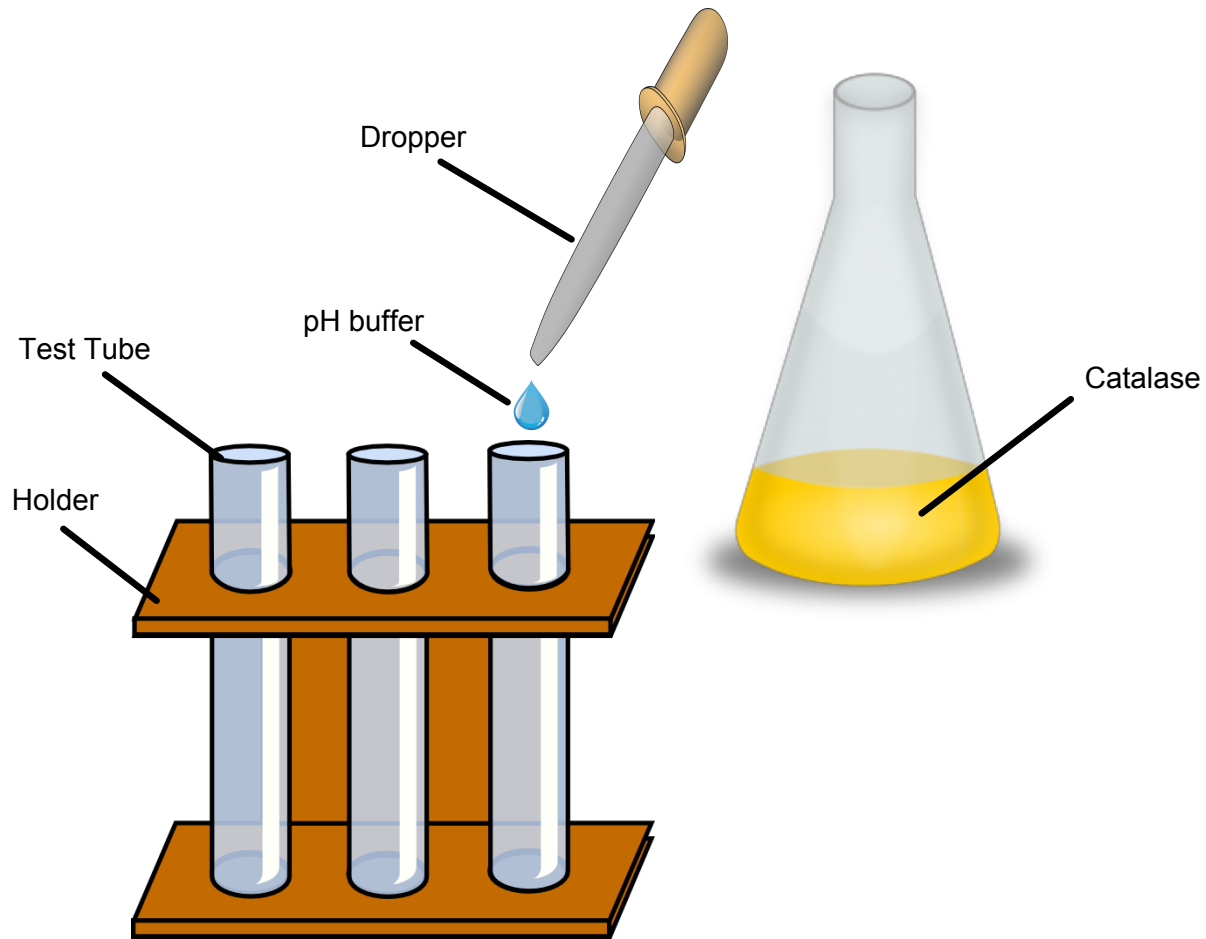
Leave the test tubes for 4 minutes and then measure the height of foam produced (if any) using a ruler. **shake catalase before each use.**

Repeat this experiment twice more to ensure accurate results.

Repeat the whole experiment but use 0.1g of liver instead of celery.



Sample Diagram



(iv) Data and observations - Decide what results you are going to take and when you are going to take them before the experiment.

e.g.

Measure the level of foam from the top of the liquid in each test tube after 4 mins.

Make a data table before you start your experiment so you can record your measurements as soon as you observe them. This will ensure that you are consistent in the way that you record your results and it will also make it easier to analyse.

Make sure to give your tables and graphs a name or number.

e.g.

Table No. 1 - Celery

	Test 1	Test 2	Test 3	Average
pH 4				
pH 7				
pH 10				
pH 13				

(iv) Data and observations - Decide what results you are going to take and when you are going to take them before the experiment.

e.g.

Measure the level of foam from the top of the liquid in each test tube after 4 mins.

Make a data table before you start your experiment so you can record your measurements as soon as you observe them. This will ensure that you are consistent in the way that you record your results and it will also make it easier to analyse.

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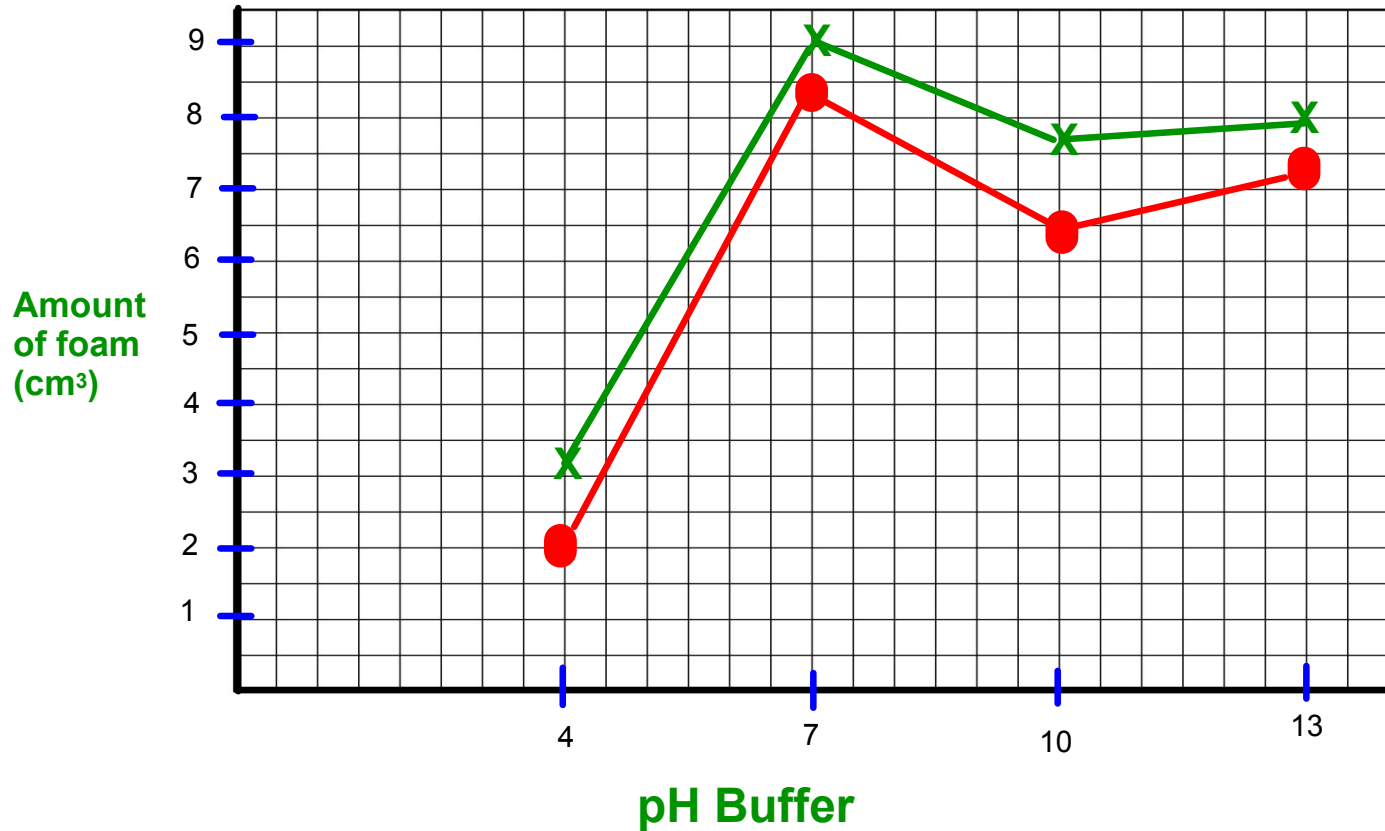
e.g. Observation - the liver worked much quicker than the celery.

Table No. 1 - Liver

	Test 1	Test 2	Test 3	Average
pH 4				
pH 7				
pH 10				
pH 13				

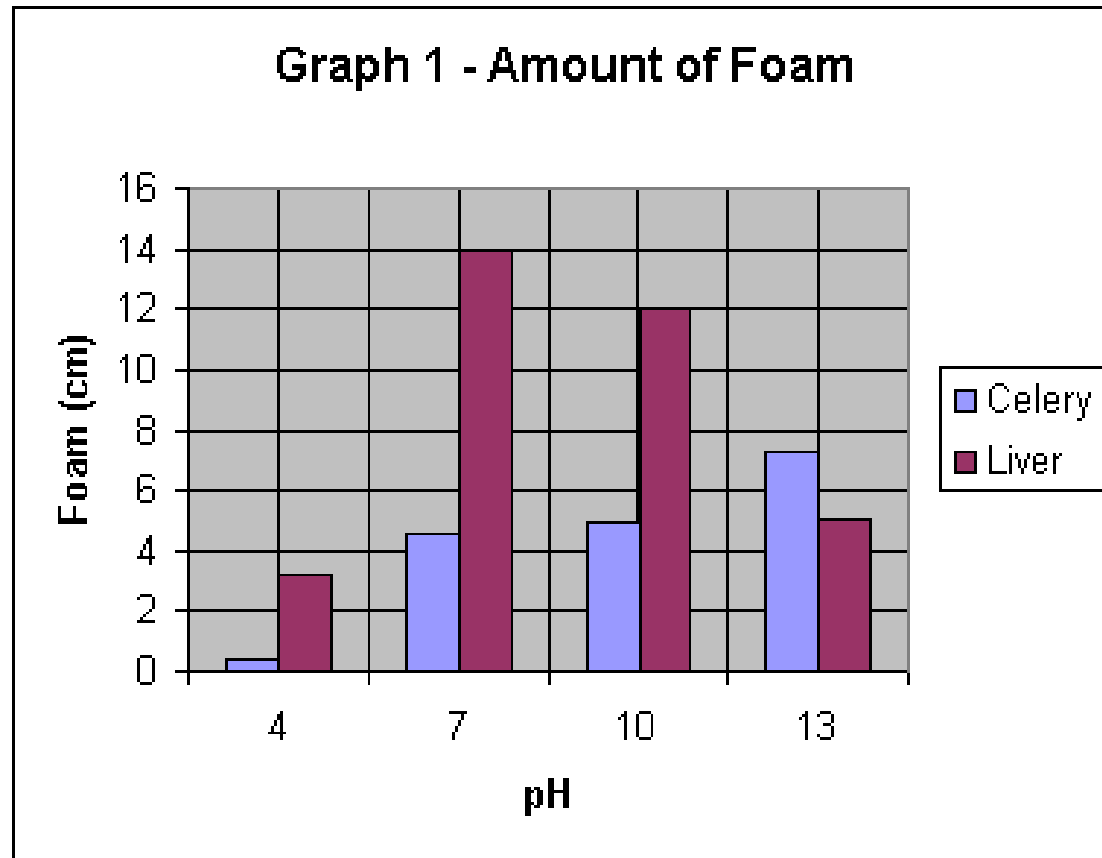


Graph No. 1 - Foam amounts



Was there anything else you noticed when doing the experiment?
 Did you encounter any problems with the experimental method?
 Did you notice any interesting patterns happening?

Example Histogram



Part 4 (Analysis)

(i) Calculations and Data Analysis -

Make sure you outline any calculations (e.g. finding averages)



(ii) Conclusion and Evaluation of result

Some useful sentence starters in this section are:

- I can see from my results that
- When I changed, changed by.....
- From the graph I can see that

Answer some of the following questions in your written report.

- Do your results answer the question you were asking at the start?
- Were the results what you were expecting?
- Is there a trend in your results or did anything unusual happen?
- If you got an unusual result why do you think this happened?
- If you drew a graph did you get a straight line or a curve – what does this show?



Part 5 (Comments)

(i) Refinements, extensions and sources of error

- Do your results answer the what you were trying to find out
- Were you surprised by these results?
- Was there anything that might have affected your results.
Celery not swirled? Liver has more Catalase?
- Are there any changes you would make if you did the experiment again?
Use larger amounts as hard to measure and liver has a lot of catalase in it.
- Is there any way of making it more accurate.
- Does your investigation have any real life applications.
- Could you develop your experiment further, how?

Errors? - Test tube size, amount of liquids and washing up liquid. Larger amounts more consistent? Shake catalase before use? Fresh Celery?

