Purpose of a control

- Negates the effect of the variable being tested
- To show that the variable being tested caused the change
- Results more comparable

Conversion: mm to μm: $x10^3$

1. **The cells of beetroot contain a coloured pigment, which leaks from the cells if the cell membranes are damaged. Effect of temperature on leakage is being investigated. Suggest why cylinders of beetroot are cut to the same length for the investigation.**
   - To ensure there are same number of cells/ amount of tissue at the start OR
   - To ensure that the same surface area is being exposed to water

2. **How to ensure that the shaking of 2 test tubes (to mix contents) is same**
   - Duration of shaking should be same
   - Intensity of shaking should be same

3. **Source of error for an investigation involving heating:**
   - Error: the temperature could change over time
   - Correction/apparatus: use an insulating lid OR thermostatically controlled water-bath

4. **Anomalous result**
   a result that doesn't fit the pattern / fit with the other results / not concordant with the other results

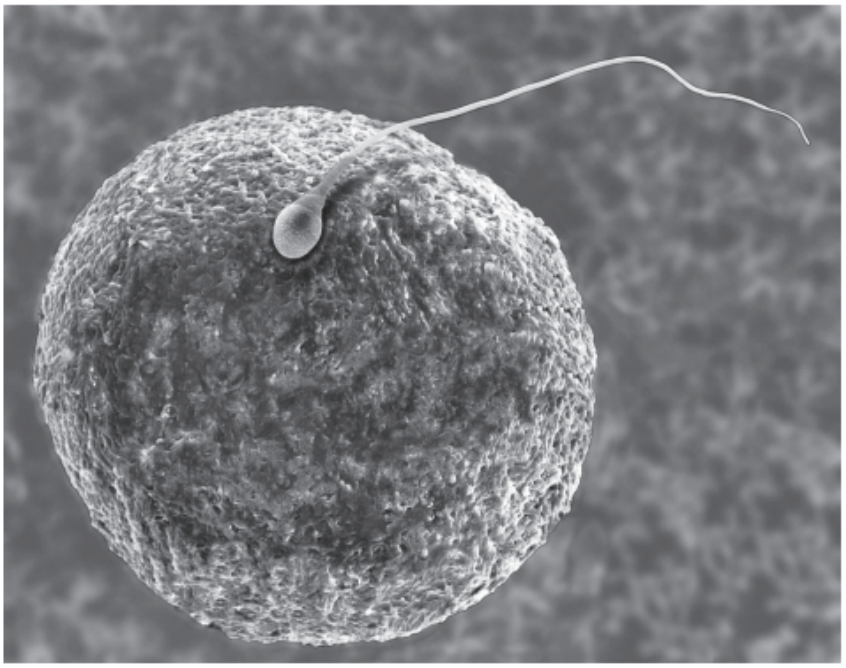
5. **Why a control group is used**
   to show that the (independent variable) causes the effect

NOTE: *control experiment* is different from *control variable*
Eg. control variable refers to variables that should be kept constant; control experiment refers to the method with normal conditions (for example, using drinking water instead of energy drink, when the effect of energy drink is being investigated)

6. **How to test for reducing sugars**
   - add Benedict's solution to the sample
   - heat and observe colour
   - red / orange / green / yellow (if reducing sugars are present)

7. **Why eye protection may need to be worn during an experiment**
   - Use of Benedict's solution/ biuret/ DCPIP, etc.
   - Heating liquid (that might spill out of test-tube)

8. **State visible differences between the ovum and sperm shown**



   - ovum is larger than the sperm ;
   - ovum is round, sperm long and thin ;
   - ovum has rough surface, sperm is smooth ;
   - ovum has a uniform shape, sperm is wider at one end ;

9. **1cm3 of 0.1 mol/dm3 glucose solution is added to 4 cm3 of distilled water. Calculate the concentration of glucose solution.**
   Concentration = 0.1 / (1+4) = 0.02 mol per dm3

NOTE: ensure that graphs drawn cover at least half of the grid.

10. **Yeast suspension in 2 test tubes is first stirred, before adding glucose solution (of different concentrations for investigation) in each. Suggest why.**
    - So that there is the same concentration/ number of yeast cells in both test tubes.

11. **Why it is important to use a clean syringe to add a solution**
    To prevent contamination

12.

Step 6 Use a dropping pipette to add one drop of iodine solution to test-tube **A** and shake the test-tube gently to mix the contents.

Step 7 Repeat step 6, counting the number of drops added, until a blue-black colour appears and stays blue-black after mixing.

Identify sources of error in these steps and suggest an improvement.

- Error: volume (of iodine) not directly measured/ inconsistent drop size / using a (dropping) pipette
- Improvement: use a syringe / use a burette / use a graduated pipette / use a measuring cylinder / measure the (iodine) volume

- Error: judgement of the endpoint / endpoint is subjective / endpoint is qualitative
- Improvement: compare to a colour standard / compare to a colour chart / compare to one that had already changed colour / colorimeter

- Error: different degree of , shaking / mixing / stirring
- Improvement: shake at a fixed speed / use a (mechanical) stirrer

- Error: different time of , mixing / shaking
- Improvement: shake / stir , for a fixed time

13. Describe how method for testing with Benedict's solution differs from method for testing with biuret solution

Benedict's reagent must be heated

14. For an osmosis investigation, the increase in length of 10 raisins placed end to end is measured rather than increase in length of just 1 raisin. Suggest why.

- Smaller percentage of error/ larger measurements are more accurate
- Large group of raisins will give a larger change/ each raisin has only a small change

15.

Step 5 The large test-tube labelled **hot** was half-filled with hot water.

Step 6 The large test-tube labelled **cold** was half-filled with cold water.

Identify sources of error in these steps and suggest an improvement

- Error: volume not measured
- Improvement: use a measuring cylinder/ burette/ syringe/ graduated pipette

- Error: temperature not controlled
- Improvement: use a thermostatically controlled water bath

16. Suggest why repeating a procedure several times would improve an investigation

anomalous results can be identified and excluded

17.

A population of one species of nautilus was studied. The widths of the nautilus shells were measured and recorded.

The results are shown in Table 2.1.

Table 2.1

width of shell / mm	number of shells
101–110	8
111–120	84
121–130	138
131–140	98
141–150	22

(i) Plot a histogram on the grid of the data in Table 2.1.

Using information on the histogram, describe the results of the study

- As the width increases, number of shells at that width increases and decreases
- Shells of width 121-130mm are most common, and those of width 101-110 mm are least common
- All shells measured were between 101-150 mm wide

Suggest why such a large number (350) shells were measured

to give a representative sample / to avoid bias

18.

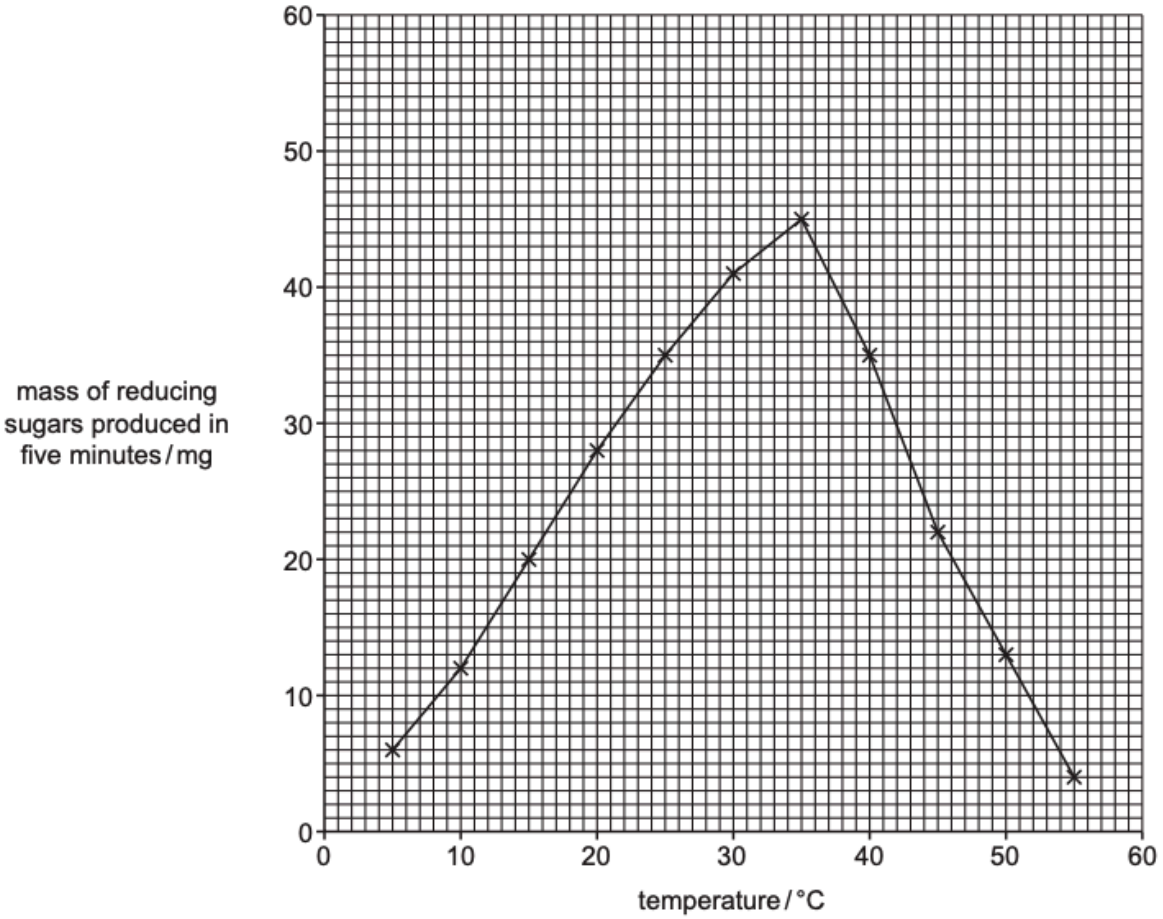
Step 3 A measuring cylinder was used to add 20 cm^3 of distilled water to the rice in beaker **W**.

Step 4 The same measuring cylinder was then used to add 20 cm^3 of a 1% amylase solution to the rice in beaker **A**.

It is important that step 3 is carried out before step 4. Predict effect on the results if step 4 was carried out before step 3

- Beaker W would also show positive result for reducing sugars

19.



Use the graph to estimate the rate of amylase activity in mg per minute, at a temperature of 42°C

30 / 5 = 6 mg per minute

The student wants to obtain a more accurate value for optimum temperature. Suggest further investigative work to be carried out

- test at smaller intervals of temperature ;
- select a narrower range of temperatures around 35°C ;

20. One way of improving the method used in an investigation:

Repeating the investigation

21. Suggest why a yeast suspension was left for two minutes in hot water before starting to count the number of bubbles produced.

to allow the temperature of the yeast to become the same as the water / idea of equilibration

22. Explain why test tubes were kept in water baths for 5 minutes

to equilibrate the water / so that the water is the same temperature as the water-baths

23. Explain why it was important to dry carrot cubes before measuring the final mass.

- extra solution / water / AW, will affect the, mass / AW

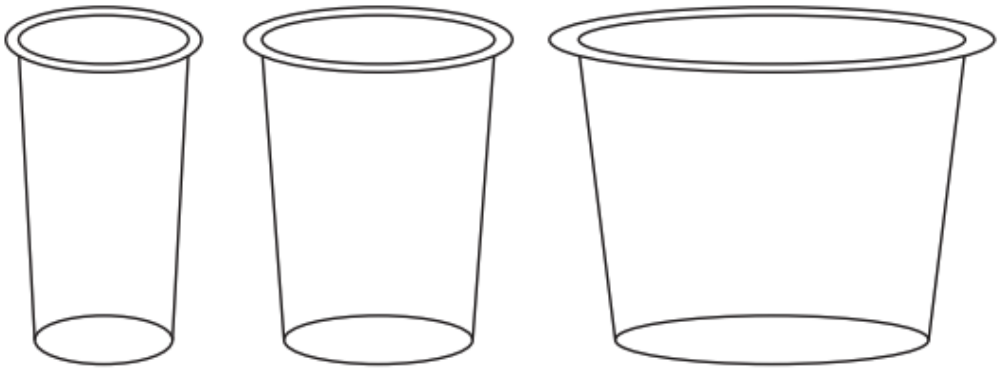
24. Describe the method for the emulsion test for fats.

- add ethanol and then water
- shake / mix

25. Variables that should be considered when selecting people for a study.

- Gender/ sex
- Age
- Genetic factors
- Ethnicity
- Health status
- Diet

26. In an investigation measuring the height of dough after a specific time, explain why using different-sized cups causes an error in the results.



The same increase in dough volume (during the investigation) will result in a different increase in height in the cups.

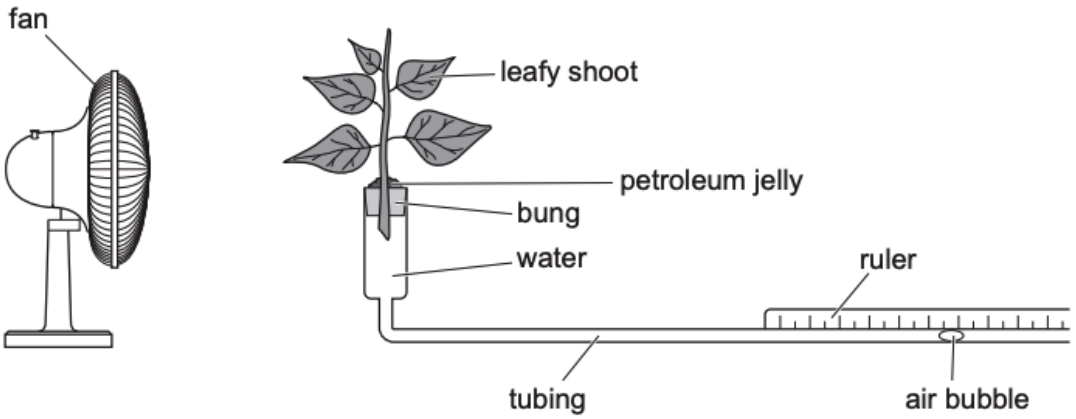
27. Hazard when doing the Benedict's test

Heating the reagent // Benedict's reagent is toxic / harmful / irritant / corrosive

28. Reagent used to test for carbon dioxide

Limewater

29. Purpose of petroleum jelly in potometer



Airtight seal/ prevent water loss

30.

Students investigated the effect of temperature on the activity of amylase.

Amylase is an enzyme that catalyses the breakdown of starch to form reducing sugars.

The students used this method:

Step 1 Use a pen to label a spotting tile as shown in Fig. 1.1.

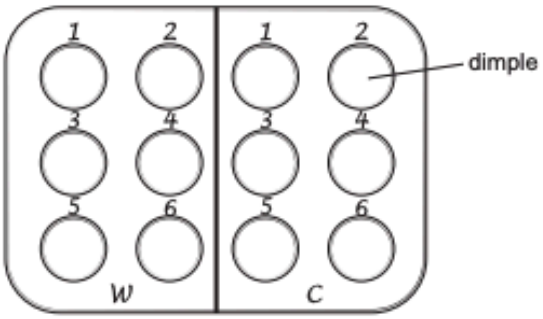


Fig. 1.1

Step 2 Put one drop of iodine solution into each of the dimples on the spotting tile.

Step 3 Put 2 cm^3 of 2% amylase solution into two test-tubes.

Step 4 Label a third test-tube **W** and a fourth test-tube **C**.

Step 5 Put 2 cm^3 of starch suspension into test-tube **W** and into test-tube **C**.

Step 6 Label a beaker **W** and put approximately 200 cm^3 of warm water into beaker **W**.

Step 7 Put test-tube **W** and one of the test-tubes containing 2 cm^3 of 2% amylase solution into beaker **W**. Leave both test-tubes in beaker **W** for three minutes.

Step 8 After three minutes, pour the 2% amylase solution into test-tube **W** and start the stop-clock.

Step 9 Wait for 30 seconds and then use a pipette to remove a sample of the liquid from test-tube **W**. Put two drops of this sample into the dimple labelled **W1** on the spotting tile. Record the colour of the liquid in dimple **W1**.

Step 10 Repeat step 9 using dimple **W2**. Continue taking and testing samples of liquid from test-tube **W** at 30-second intervals, using the remaining dimples **W3**, **W4**, **W5** and **W6**. Record the colour of the liquid in each dimple. Stop the stop-clock and reset it to zero.

Step 11 Label a beaker **C** and put approximately 200 cm^3 of cold water into beaker **C**.

Step 12 Put test-tube **C** and the other test-tube containing 2 cm^3 of 2% amylase solution into beaker **C**. Leave both test-tubes in beaker **C** for three minutes.

Step 13 After three minutes, pour the 2% amylase solution into test-tube **C** and start the stop-clock.

Step 14 Repeat step 9 and step 10 with test-tube **C** and the dimples labelled **C1**, **C2**, **C3**, **C4**, **C5** and **C6**.

State variables that were kept constant in this investigation

- Volume of amylase
- Concentration of amylase
- Same enzyme

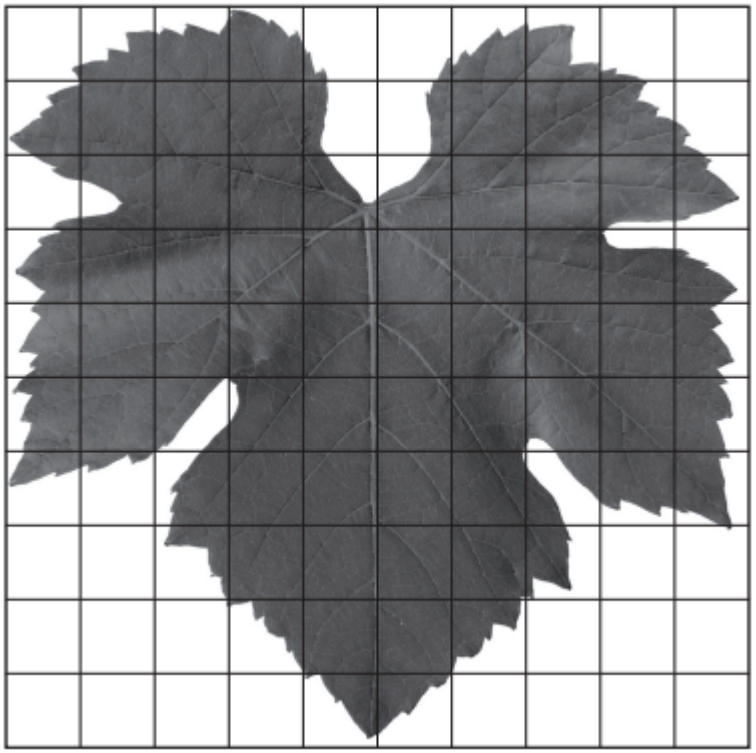
- Volume of starch suspension
- Time for equilibration
- Time intervals/ sample intervals
- Number of drops of simple added to iodine solution
- Number of drops of iodine solution

Explain why the method used in this investigation does not allow students to obtain accurate time for breakdown of starch

- Colour change might take place between sampling times
- Time intervals were too long
- Difficult to judge end point/ colour change is subjective/qualitative

The temperature of the water in the beakers during the investigation was a source of error. Describe how to improve the method to reduce this error.

- Insulate the beakers
- Use thermostatically controlled water bath
- Description: use Bunsen burner and thermometer to control the temperature



Characteristics of the leaf shown

- This leaf is said to have a serrated/rough/ragged edge
- It doesn't have a stalk/ petiole
- It is lobed

31.

Bladder wrack is found on the seashore and is exposed to the air when it is not covered by water at certain times of day.

Students investigated how rapidly bladder wrack lost water. They used this method:

- Three samples of bladder wrack were collected.
- The samples were blotted with tissue to remove any water on the surface of the seaweed.
- The initial mass of each sample was recorded.
- The samples were hung from a piece of string stretched between two stands.
- The mass of each sample was recorded every 30 minutes for the first two hours and then every hour for a further three hours.

Variables to be kept constant in this investigation

- Temperature
- Humidity
- Wind speed
- species/ type of seaweed
- age of seaweed
- size/ length/ surface area
- how long the bladder wrack has been out of the water
- measuring time / interval time (between measuring mass) / sampling times
- spacing while hung up
- amount of blotting / blotting time / blotting method / type of blotting paper

Investigations

1. <u>Exercise</u>

Hypothesis: "Drinking greater volume of beetroot juice would increase the length of time that athletes are able to run"

- <u>Independent variable:</u> at least 2 different volumes of beetroot juice
- <u>Method:</u>
    - details of when juice is consumed / ref to fasting
    - details of method to measure running time
    - many participants in each group // repeat (whole experiment) with same individual(s) for many trials
    - rest breaks between repeat measurements
- <u>Constant variables</u> (max. 2)
    - concentration of beetroot juice
    - correct detail of consistency in running
    - age / sex / fitness / diet of athletes

        - same named environmental conditions e.g. temperature / humidity / gradient
- Safety precaution: e.g. checking participants are healthy / checking for trip hazards / suitable footwear

Intensity of exercise and breathing rate

- Independent variable: at least two different exercise intensities
- Dependent variable: breathing rate (immediately) after /during exercising
- Method:
    - method of changing intensity of one type of exercise
    - measurement of initial / resting breathing rate
    - describing type of exercise / equipment used
- Constant variables (max 2)
    - same age participants
    - same sex participants
    - same fitness of participants
    - same duration of exercise / pace / speed of exercise
    - same person
    - same named environmental conditions e.g. temperature / humidity / gradient
- two or more replicates / repeat investigation two or more times
- Safety precaution: e.g. checking participants are healthy / checking for trip hazards / suitable footwear

2. **Enzymes**

Effect of temperature on activity of amylase

Reducing sugar method

- Independent variable: use at least 2/3 different temperatures
- Dependent variable: time to first change colour / colour of Benedict's solution after a set period of time / mass of reducing sugars produced
- Method:
    - Method of maintaining temperatures: hot water-bath / thermostatically controlled water-bath
    - Equilibration to correct temperature
    - Measure at regular intervals
    - Take fixed volume of samples, heat and test with Benedict's solution
    - Use of colorimeter / colour chart for Benedict's solution colour change // use of balance to measure mass of reducing sugars produced
- Constant variables (max 2)
    - same type, volume, concentration of amylase enzyme
    - same pH
    - same type/source, volume, concentration of starch suspension

    - same volume of Benedict's solution
    - incubating enzymes and starch suspension for same time
- At least two further replications / repeat investigation two more times
- Safety precaution: eg. gloves / goggles / tongs / test-tube holder

Disappearance of starch method

- Independent variable: use at least two different temperatures
- Dependent variable: time for iodine solution to stay yellow-brown / disappearance of starch
- Method (max 2)
    - Method of maintaining temperature:hot water-bath / thermostatically controlled water-bath
    - Equilibration to correct temperature
    - Measure at regular intervals
    - Take fixed volume of samples and test with iodine solution
    - Use of spotting / white tile
- Constant variables (max 2)
    - same type, volume, concentration of amylase enzyme
    - same pH
    - same type/source, volume, concentration of starch suspension
    - incubating enzymes and starch suspension for same time
- At least two further replications / repeat investigation two more times
- Safety precaution: eg. gloves / goggles

Effect of pH on activity of amylase

Reducing sugar method

- Independent variable: at least two pH values tested / two pH values stated
- Dependent variable: time to first change colour / colour of Benedict's solution after a set period of time / mass of reducing sugars produced
- Method:
    - Method of maintaining pH: buffer solution
    - Equilibration to correct pH
    - Measure at regular intervals
    - Take fixed volume of samples, heat and test with Benedict's solution
    - Use of colorimeter / colour chart for Benedict's solution colour change // use of balance to measure mass of reducing sugars produced
- Constant variables (max 2)
    - same type, volume, concentration of amylase enzyme
    - same temperature
    - same type/source, volume, concentration of starch suspension

    - same volume of Benedict's solution
    - incubating enzymes and starch suspension for same time
    - same volume of pH solution
- At least two further replications / repeat investigation two more times
- Safety precaution: eg. gloves / goggles / tongs / test-tube holder

Disappearance of starch method

- Independent variable: at least two pH values tested / two pH values stated
- Dependent variable: time for iodine solution to stay yellow-brown / disappearance of starch
- Method (max 2)
    - Method of maintaining pH: buffer solution
    - Equilibration to correct pH
    - Measure at regular intervals
    - Take fixed volume of samples and test with iodine solution
    - Use of spotting / white tile
- Constant variables (max 2)
    - same type, volume, concentration of amylase enzyme
    - same temperature
    - same type/source, volume, concentration of starch suspension
    - incubating enzymes and starch suspension for same time
    - same volume of pH solution
- At least two further replications / repeat investigation two more times
- Safety precaution: eg. gloves / goggles

Effect of temperature on activity of protease (photographic film consists of a plastic sheet coated in crystals, which are fixed together by gelatin made of protein. If gelatin is digested by protease, crystals fall off and the film will become transparent)

- Independent variable: use at least two different temperatures
- Dependent variable: measuring time for film to become transparent / clear / for crystals to fall off
- Method:
    - Method of maintaining temperature:hot water-bath / thermostatically controlled water-bath
    - Equilibration to correct temperature
    - Shaking
- Constant variables (max 2)
    - same type, volume, concentration of protease enzyme
    - same pH
    - type/ size of film pieces

    - consistent shaking
- At least two further replications / repeat investigation two more times
- Safety precaution: eg. gloves

Effect of lipase concentration on the breakdown of fats in milk (produces fatty acids which decrease pH of milk)

- Independent variable: at least two different enzyme / lipase concentrations
- Dependent variable: measuring pH after a set time OR measuring time to reach a certain pH
- Method:
    - use of pH meter / pH paper / (named) indicator
    - measure / same initial pH / initial colour
    - control and description of the control e.g. using boiled enzyme / water instead of enzyme
- Constant variables (max 2)
    - volume of lipase / enzyme
    - volume of milk
    - type of milk / same milk / fat content of milk
    - temperature
    - volume of indicator
- Two or more repeats / total of three or more trials
- Safety precaution: e.g. use of goggles / gloves

3. **Effect of temperature on vitamin C concentration in fruit juice.**
    - Independent variable: use at least two different temperatures
    - Dependent variable: volume/ number of drops of DCPIP added to a constant volume of fruit juice until colour change /// volume/ number of drops of fruit juice added to a constant volume of DCPIP until colour change
    - Method (max 3)
        - Method of maintaining temperature: hot water-bath / thermostatically controlled water-bath
        - Equilibration to correct temperature
        - method of measuring volume DCPIP/ fruit juice added (use titration)
        - shaking / stirring after each added drop
        - method to check end point
    - Constant variables (max 2)
        - type, volume of fruit juice
        - concentration of DCPIP
    - At least two further replications / repeat investigation two more times
    - Safety precaution: eg. gloves

4. **Germination of seeds**

   How the volume of water added to germinating seeds affects rate of germination

   - Independent variable: at least two different volumes of water added
   - Dependent variable: number of seeds germinated / time taken for seeds to germinate
   - Method (max 3)
     - method of maintaining temperature
     - watering at regular intervals
     - reference to placing seeds in trays / petri dish / testtube / planting in soil
     - check seeds at regular intervals / at a set time period
     - AVP, e.g. calculation of rate described
   - Constant variables (max 2)
     - Temperature
     - type of seeds
     - oxygen concentration
     - pH
     - type / amount of, soil / growing medium
     - light (intensity)
   - repeat at least two times (three trials)

5. **Transpiration**

   Effect of air temperature on movement of dye up celery stalk

   - Independent variable: at least two different air temperatures
   - Dependent variable: time for dye to reach the leaves or a set distance / distance moved by dye (in set time) / counting number of sections cut
   - Method (max 2)
     - method of maintaining (two) air temperatures
     - equilibration time for celery and / or dye before celery is put in the dye
     - cutting sections of stalk to see the distance moved by the dye
     - cut stems under water (if used a potometer)
   - Constant variables (max 3)
     - wind-speed
     - humidity
     - light intensity
     - length of stalk
     - number of leaves / surface area of leaves
     - species / type (celery) / age / health / plant
     - same dye / concentration of dye
     - set period of time (in dye) / time stated (if not the dependent variable)

    - same thickness of cut sections
- two/ more repeats at each temperature / repeat investigation at least 2 more times
- safety precaution: e.g. cutting sections on flat or stable surface / cut away from body

6. **Photosynthesis**

   Effect of temperature on rate of photosynthesis in an aquatic plant
   - Independent variable: at least two different temperatures
   - Dependent variable: counting bubbles / measuring volume of gas given off
   - Method (max 2)
       - use of gas syringe / upturned measuring cylinder or test-tube
       - method of controlling the temperature
       - fixed distance from light source
       - use of heat shield
       - equilibration time
       - use of oxygen probe
   - Constant variables (max 3)
       - set time period (for measurement)
       - species / type of, plant / plant tissue
       - size / mass of plant or number of leaves
       - age of plant
       - carbon dioxide / HCO_3 concentration
       - light intensity / same lamp / same light bulb
       - pH of water
       - nutrient content of water
       - volume of water
   - repeat investigation (at least) twice / at least two replicates

7. **Osmosis in dialysis tubing**

   Effect of concentration of sugar solutions on movement of water into or out of dialysis tubing
   - Independent variable: at least two concentrations of sugar solution
   - Dependent variable: measure mass/volume before and mass/volume after // change in mass/volume of dialysis tubing or test-tube
   - Method (max three)
       - make sugar solution of different concentrations
       - maintain the temperature (during the investigation)
       - make a model cell e.g., knotting dialysis tubing at both ends / other methods of securing dialysis tubing at both ends
       - remove excess liquid from the tubing (if mass measured)
       - measure mass / volume / height of water / sugar solution

    - e.g., use of a balance / measuring cylinder / syringe / ruler
- Constant variables (max three)
    - volume of water (in dialysis tubing / test-tube)
    - volume of sugar solution (in dialysis tubing/ test-tube)
    - temperature
    - (soaking) time
    - type of dialysis tubing / surface area of tubing
    - type of sugar
- repeat the whole investigation at least twice more (three trials)

8. **Diffusion in agar jelly**
    - Independent variable: at least two different temperatures
    - Dependent variable: time taken for cube to become (completely) colourless // after a set period of time how much of the cube has become colourless
    - Method:
        - method of maintaining different temperatures
        - method of cutting agar cubes
        - enough acid to cover cubes / AW ;
    - Constant variables (max 3)
        - same, size agar cubes / shape of agar (cubes)
        - type of agar
        - concentration / pH of acid
        - volume of acid
        - type of acid / named acid
        - same type of indicator / named indicator
    - At least two further replications / repeat investigation two more times
    - Safety precaution: goggles / gloves / cut agar on solid surface / cut away from hands

9. **Dough / bread / yeast**

    Effect of the mass of sodium chloride added on the volume of dough
    - Independent variable: different masses of sodium chloride / salt
    - Method:
        - use a balance / scale to measure mass of salt / ingredients / dough
        - mixing / kneading
        - measuring change in height / volume / circumference / size of dough OR time taken to reach a set height / volume / circumference / size
        - method of measuring height / volume of dough
    - Constant variables (max 3)
        - same initial volume / height / size / mass / amount of dough
        - type of flour / type of dough / batch of dough

        - type, volume/amount/mass/concentration of yeast
        - volume/amount/mass of water
        - type of salt
        - time left to rise / of the reaction
        - temperature
        - diameter of container (for measuring height)
    - two or more repeats

10. **<u>Catalase</u> hydrogen peroxide → water + oxygen.**

    Compare concentration of catalase in three types of food

    - <u>Dependent variable:</u> volume of gas
    - <u>Method:</u>
        - preparation of food samples e.g. cutting / grinding
        - apparatus to measure food e.g. balance / scales
        - mixing / stirring of food and hydrogen peroxide
        - method of collecting gas (gas syringe / displacement / count bubbles)
    - <u>Constant variables</u> (max 3)
        - volume/mass, surface area of food
        - volume, concentration of hydrogen peroxide
        - temperature
        - pH
        - time
    - Repeat at least two times (three trials)
    - <u>Safety precaution:</u> eg. gloves, goggles

    For large diagram questions

    S.O.L.D

    1. Size (at least ⅔ times larger); try to do at least 1.5 times larger
    2. Outline: Unbroken, clear, single + No shading
    3. Labels (if asked - don't use arrow heads for labelling)
    4. Details (specific)