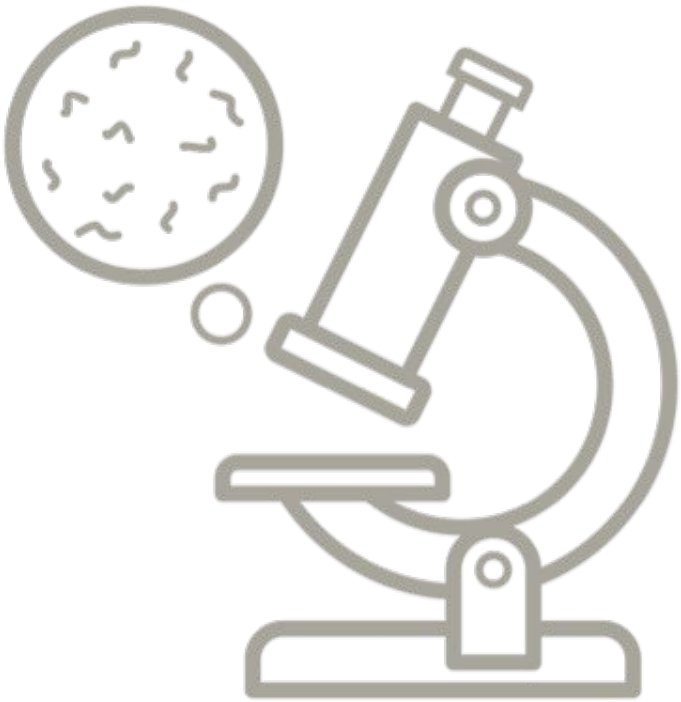
Biology



Required Practicals

Paper One

Required Practicals

Microscopy

Key terms

Microscopy - the study of very small objects using an instrument called a microscope

Light microscope - microscopes that use light and lenses to form an image of a specimen

Electron microscope - microscopes that use electrons to form an image of a specimen. (Higher magnification and resolution than light microscopes).

Resolution - the ability to distinguish between two parts. A higher resolution gives a sharper image.

Practice exam question

State one advantage and one disadvantage of using:
a) light microscope
b) an electron microscope

A micrograph of a plant cell in a book is 160 mm long. The plant cell measures 120 µm long. Calculate the magnification.

Link to video of practical

Equations

Image size = magnification x size of real object

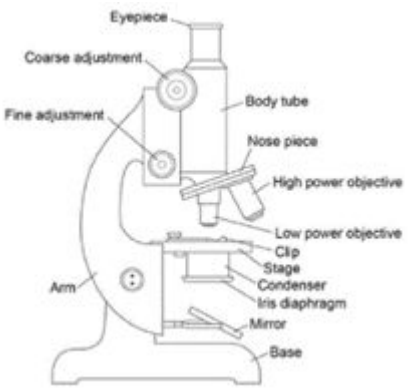
Total magnification = magnification of eyepiece x magnification of objective lens

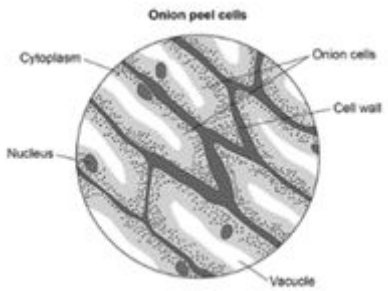
Size of one cell = diameter of field view ÷ number of cells that cross this diameter

Method and notes

1. Use a dropping pipette to put a drop of water on the microscope slide
2. Peel off a thin layer of epidermal tissue
3. Use forceps to place thin layer on the microscope slide
4. Put 2 drops of iodine solution onto the tissue
Iodine is a stain. Stains highlight objects in a cell by adding colour to them.
5. Carefully lower the coverslip
6. Use paper to soak any excess liquid
7. Put the slide on the stage
8. Use the lowest power objective lens
This is because the field of view with high power would be too small making it difficult to locate the cells
9. Turn the coarse adjustment knob to move the objective lens
This changes the distance between the objective lens and the slide
10. Turn the fine adjustment knob to bring the cells into focus
If you need to see the slide with greater magnification, change to a higher-power objective lens and refocus
11. Make a clear, labelled drawing of some cells
Components of the cell should be labelled and the magnification used written next to your diagram

Visual aids:





Microbiology

Key terms

Antiseptic - substances used to kill microorganisms on the body

Antibiotic - a group of medicines, first discovered by Sir Alexander Fleming, that kill bacteria and fungi

Culture medium - liquid or gel (agar) containing nutrients

Zone of inhibition - area where no bacteria is growing

Practice exam question

A student is given containing a liquid nutrient medium. The medium contains one type of bacterium. The student is told to grow some bacteria on agar jelly in a Petri dish. Describe how the student should prepare an uncontaminated culture of the bacterium in the Petri dish. Explain the reasons for each of the steps you describe.

Link to video of practical

Method and notes

1. Spray the workbench with disinfectant spray
2. Light a Bunsen on a yellow flame
3. Mark the underneath of a nutrient agar plate with wax pencil divide the plate into sections
4. Place a dot in the middle of each section
5. Wash hands
6. Turn Bunsen to a blue flame
7. Remove the lid of the culture of bacteria (keep lid in your hand)
8. Flame the neck of the bottle

All of the equipment must be sterilised to make sure cultures and samples are kept uncontaminated by other microorganisms

9. Using a pipette collect 1ml of the bacterial culture. Flame the neck of the bottle again. Replace lid.
10. Lift the lid of the agar plate on an angle
11. Pipette the bacteria onto the agar plate and replace the lid
12. Dip the glass spreader into disinfectant. Pass the spreader through the flame. Allow to cool for a count of 20 seconds
13. Lift the agar plate. Spread the bacteria around using the glass spreader. Close the lid.
14. Open the lid of the agar plate. Using forceps place filter discs that have been soaked in antiseptic onto the plate.

This is known as the disc-diffusion technique. It is used to test the effectiveness of a disinfectant or an antiseptic or antibiotic

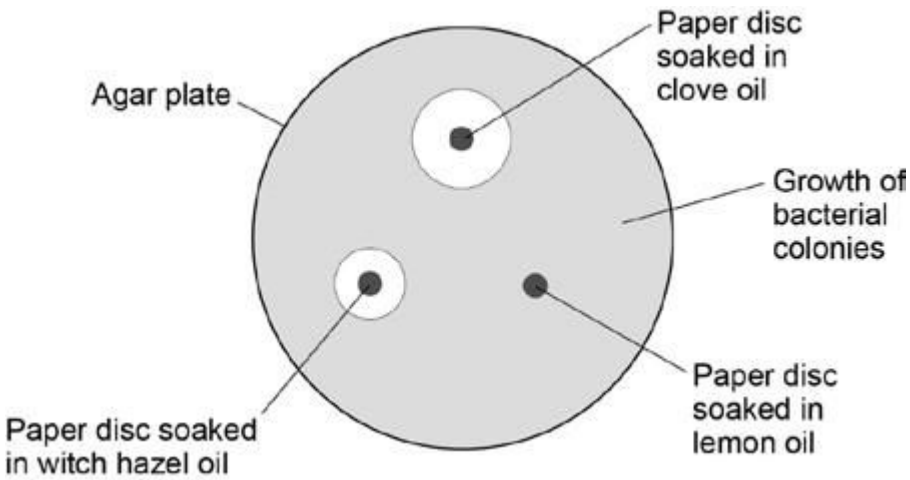
15. Secure with two pieces of tape.

Do not seal all the way around the edge – oxygen needs to get into the dish to avoid harmful anaerobic bacteria growing

16. Incubate the plate for 25°C for 48 hours

A temperature of 25°C must be used in schools to avoid the risk of growing dangerous pathogens

Visual aids:



Osmosis

Key terms

Flaccid - lacking turgor. Lacking in stiffness or strength. Soft and floppy

Osmosis - the net diffusion of water from an area of high concentration of water to an area of lower concentration across a partially permeable membrane

Partially permeable membrane - a membrane that only allows some types of particles through

Plasmolysed - description of a plant cell in which the vacuole has shrunk and the membrane has pulled away from the wall due to water loss

Turgid - having turgor; enlarged and swollen with water

Turgor - the pressure inside a plant cell exerted by the cell contents pressing on the cell wall

Practice exam question

1. What is a hypertonic solution?
2. What word is used to describe plant cells that placed in:
   a) a hypotonic solution
   b) a hypertonic solution
3. What is osmosis?
4. A root hair cell is adapted for absorbing water from the soil.

Use information from the diagram to explain how this plant root is adapted for absorbing water.

Link to video of practical

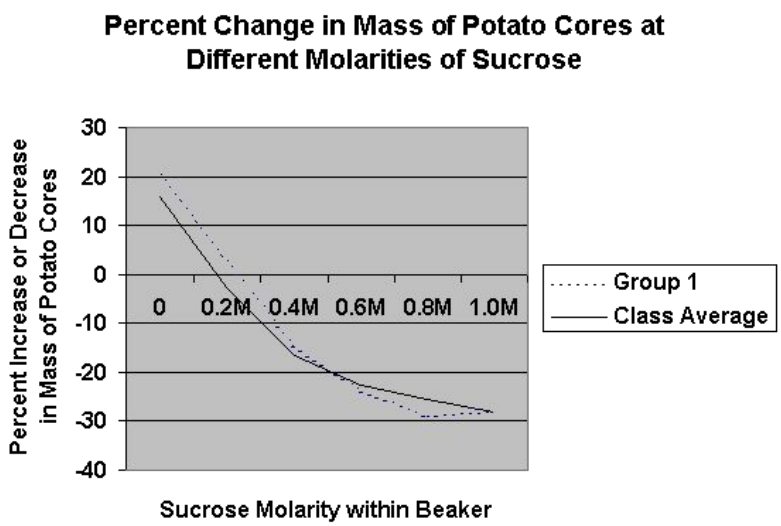
Equations

% change in mass = change in mass ÷ starting mass

Method and notes

1. Use a cork borer to cut three potato cylinders of the same diameter
2. Trim the cylinders so that they are all the same length (about 3cm)
Make sure there is no skin on the potato as this could affect the results
Be careful when using a sharp knife to cut the potato
3. Dry the potato carefully by blotting it with a paper towel
This will help to remove any liquid left on the outside of the plant tissue which would affect the results
4. Accurately measure and record the length and mass of each potato
5. Measure 10cm^3 of 1.0 M, 0.75 M, 0.5 M and 0.25 M sugar/salt solution into boiling tubes. Label each to show the concentration
6. Measure 10cm^3 of distilled water into a fifth boiling tube
This acts as a control
7. Add 1 potato cylinder into each boiling tube
8. Leave overnight
9. Remove the cylinders, carefully blotting dry with paper towel
10. Re-measure the length and mass of each cylinder
If the cylinders have drawn in water by osmosis they'll have increased in mass. If water has been drawn out, they" have decreased in mass
11. Calculate the percentage change in mass for each cylinder.
Calculating the percentage change means you can compare the effect of the sugar concentration on cylinders that didn't have the same initial mass

Visual aids:



Enzymes

Key terms

Amylase - Enzyme that controls the breakdown of starch in the digestive system

Denaturation - When an enzyme's active site loses its shape meaning it can work no longer

Enzymes - Molecules that act as catalysts in biological systems

Practice exam question

a. Explain how amylase breaks down starch

b. Plan an investigation to investigate the effect of temperature on the action of an enzyme

Link to video of practical

Equations

Rate of reaction = change ÷ time

Method and notes

1. Place 1 drop of iodine into a well on the spotting tile
2. Place labelled test tubes containing the buffered pH solutions, amylase solution and starch solutions in to the water bath. Allow them to reach 35°C

The temperature must be controlled with a water bath

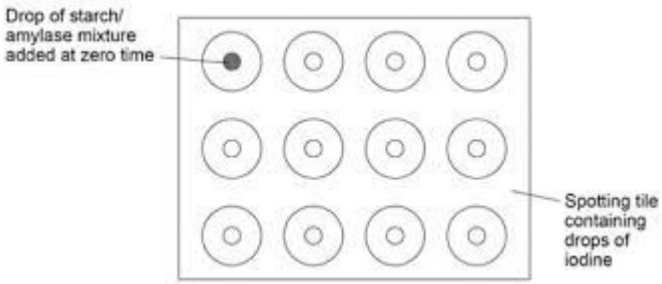
3. Add 2cm^3 of one of the buffered solutions to a test tube
4. Add 2cm^3 of amylase
5. Start the stop clock
6. Mix using a glass rod
7. After 30 seconds, remove a drop of the mixture and add to the first well of the spotting tile.
8. Repeat, adding a drop of the mixture every 30 seconds
9. Continue until the iodine solution and the amylase/buffer/starch mixture stays orange

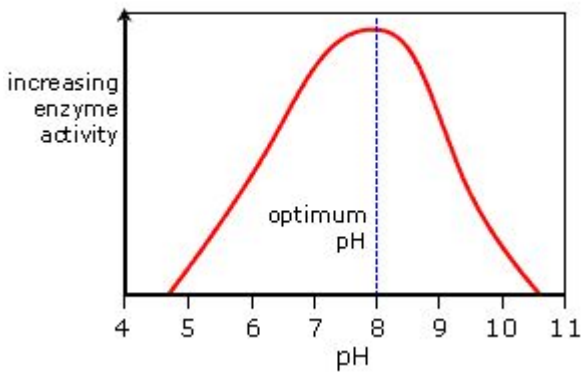
When the iodine no longer changes colour it means that there is no starch present

10. Repeat with solutions of different pH (2,4,6,8)

The optimum pH for amylase is pH6

Visual aids:





Food Tests

Key terms

Carbohydrates: food belonging to the group consisting of sugars, starch and cellulose

Lipid: fats (solids) and oils (liquids). Composed of fatty acids and glycerol

Protein: organic compound made up of amino acid molecules. Needed by the body for growth and repair

Qualitative: data that deals with descriptions

Practice exam question

A student has a piece of food and wants to know if it contains lipids/starch/sugar/proteins. Outline a plan that the student could use.

Include any health and safety considerations that the students must make.

Link to video of practical

Method and notes

1. Use a pestle and mortar to grind up a small sample of food.
2. Transfer the food to a beaker. Add distilled water.
3. Stir the mixture so that some of the food dissolves
4. Filter using a funnel with filter paper to obtain as clear as a solution as possible.
5. Half fill a test tube with some of the solution.
6. Follow procedure for testing

Testing for starch (Iodine)
1. Add a few drops of iodine solution
2. Note any colour change

Starch is present black, blue-black colour appears

Testing for sugar (Benedict's)
1. Add 10 drops of Benedict's solution to the solution in the test tube
2. Place the test tube in a beaker of hot water
3. Note any colour change

If a reducing sugar present solution will turn green, yellow, or brick red.

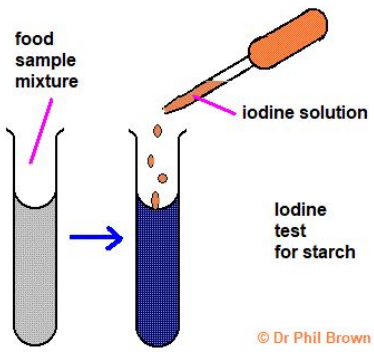
Testing for Lipids (emulsion test)
1. Add 2cm^3 ethanol
2. Add 2cm^3 water

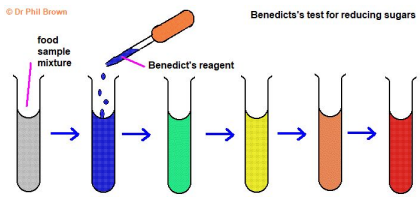
If lipids are present a cloudy white emulsion will appear

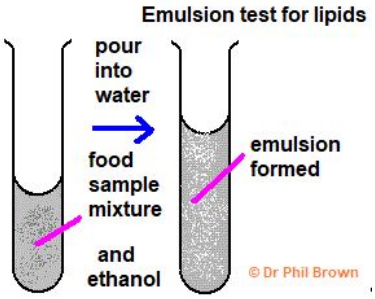
Testing for Protein (Biuret)
1. Add 2cm^3 of the solution to the test tube
2. Add 2cm^3 of Biuret solution
3. Shake gently
4. Note and colour change

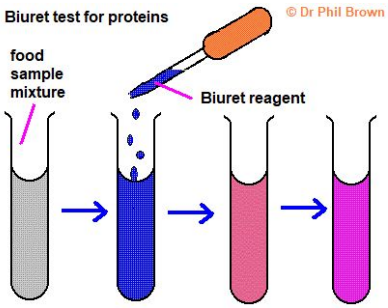
Proteins will turn the solution pink or purple

Visual aids:









Photosynthesis

Key terms

Photosynthesis - A chemical reaction that occurs in the chloroplasts of plants and algae and stores energy in glucose

Limiting factor Anything that reduces or stops the rate of a reaction

Practice exam question

Light intensity, carbon dioxide concentration and temperature are three factors that affect the rate of photosynthesis.

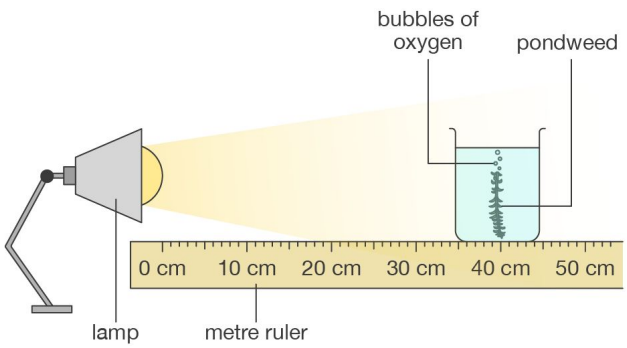
How would you investigate the effect of temperature on the rate of photosynthesis?

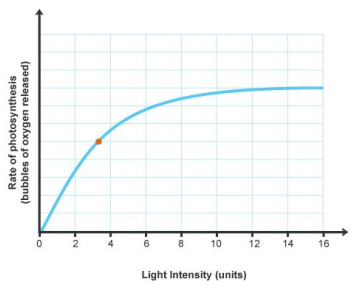
Link to video of practical

Method and notes

1. Set up a test tube rack at a distance of 10cm away from the light source
It is best to use an LED light source as they give off less heat. If a normal lightbulb is used it place a beaker of water in between the boiling tube and the lamp to reduce the temperature affecting the results.
2. Fill the boiling tube with sodium hydrogen carbonate
This increases the concentration of CO_2, stopping CO_2 being a limiting factor
3. Put a piece of pondweed into the boiling tube
4. Leave for a couple of minutes
This is allow the pondweed to adjust to the new light intensity
5. Start the stopwatch and count the number of bubbles produced in 1 minute
6. Repeat (use data to calculate a mean)
7. Repeat at distances of 20cm, 30 cm and 40cm from the light source

Visual aids:





Paper Two

Required Practicals

Reaction Times

Key terms

Caffeine - a drug that can speed up a person's reaction time

Effector - muscles or glands that which respond to nervous impulses

Receptor - cells that detect stimuli

Reaction time - time taken to respond to a stimulus

Stimulus - a change in environment

Practice exam question

A student wants to investigate the effect of caffeine on reaction times. Plan an investigation to test this.

Suggest why measuring reaction time with a computer is more accurate than measuring reaction time with a stopwatch.

Link to video of practical

Equations

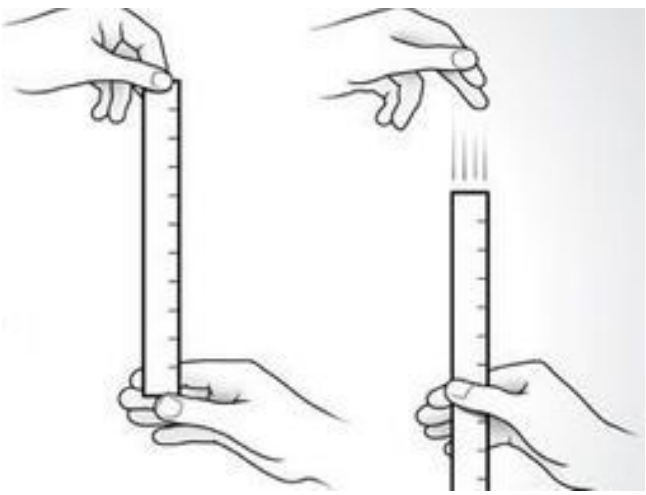
Speed = distance ÷ reaction time

Method and notes

1. Use your weaker hand for this experiment.
2. Sit down on a chair
3. Place the forearm of your weaker arm across the table with your hand overhanging the edge of the table
The arm is placed on the table to stop it moving up and down during the test
4. Your partner will hold a ruler vertically with the bottom end (the end with the 0 cm) in between your thumb and first finger
5. Your partner will hold the ruler so the zero mark is level with the top of your thumb. They will tell you to prepare to catch the ruler
6. Your partner will then drop the ruler without telling you
7. Catch the ruler as quickly as you sense it dropping
8. After catching, look at the number level with your thumb.
9. Record this
10. Have a rest and repeat
11. Continue to repeat the test several times.

The test can be repeated after the person has had caffeinated drink to investigate how reaction time is affected

Visual aids:



Plant Responses

Key terms

Auxin - a type of plant hormone (produced in *tips* of plant shoots and roots)

Gravitropism - growth response of a plant to gravity

Phototropism - growth response of a plant to light

Stimulus - a change in environment

Practice exam question

When a seed starts to grow, the young root grows downwards towards gravity. The young shoot grows upwards. Name this type of response to gravity.

Describe how students could investigate the growth response of maize seedlings to light shining from one side.

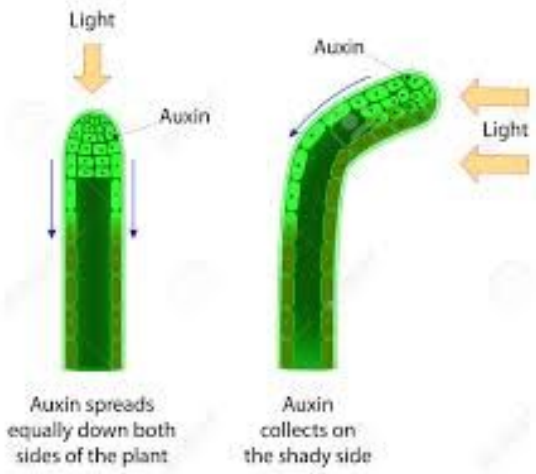
Dandelion stems have a strong gravitropic response. Outline a plan to investigate gravitropism in dandelions.

Link to video of practical

Method and notes

1. When a seed starts to grow, the young root grows downwards towards gravity. The young shoot grows upwards. Name this type of response to gravity.
2. Describe how students could investigate the growth response of maize seedlings to light shining from one side.
3. Dandelion stems have a strong gravitropic response. Outline a plan to investigate gravitropism in dandelions.

Visual aids:



Field Investigations

Key terms

Abundance: the population size of an organism
Distribution: where organisms are found in a particular area
Mean: a measurement of average found by adding all the data and dividing by the number of values there are
Median: the middle value in a set of data when they're in order
Mode: the most common value in a set of numbers
Quadrat: a square frame enclosing a known area, e.g. 1 m^2
Quantitative data: data that deals with numbers
Transect: a line that which can be used to study the distribution of organisms across an area

Practice exam question

Ragwort is a plant that often grows in weed in grassland.
Write a plan that will enable students to estimate the number of ragwort growing in a field.

The table below shows the students' results. The area of the field was 80 000 m^2. The quadrat used was 1 metre x 1 metre

Quadrat number	Number of ragwort
1	1
2	0
3	3
4	0
5	0
6	0
7	5
8	0
9	0
10	7

Complete the following calculation to estimate the number of ragwort plants in the field.
Use the information from the table above
Total number of ragwort plants in 10 quadrats =
Mean number of ragwort plants in 1 m^2 =
Therefore estimated number of ragwort plants in a field =

Link to video of practical

Equations

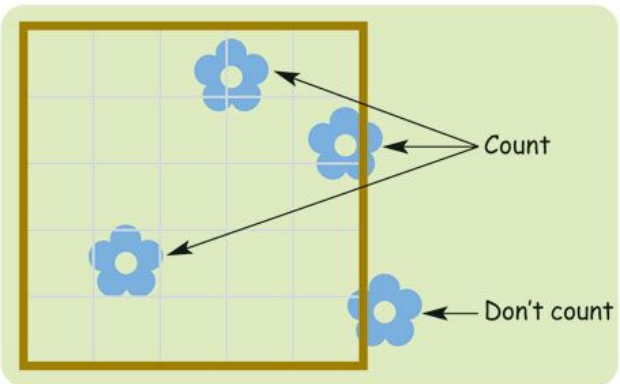
$$\text{Estimated population} = \frac{\text{sampled area}}{\text{total area}} \times \text{number of organisms counted}$$

Method and notes

Method 1
1. Put the 30m tape measure across the field to form a transect line
2. Put the 1 m^2 quadrat against the transect line. One corner of the quadrat should touch the 0 m mark on the tape measure.
3. Count the number of daisy plants within the quadrat
4. Record the number of daisies counted within the quadrat in a table
5. Move the quadrat 5m up the transect line and count the daisy plants again.
6. Continue to place the quadrat at 5m intervals.
7. Calculate the mean number of daisy plants per m^2 for the area

Method 2
1. Put the 30 m tape measure in a line from the base of a tree to an area of open ground
2. Put the quadrat against the transect line. One corner of the quadrat should touch the 0 mark
3. Count the number of plants inside the quadrat
4. Use a light meter to measure the light intensity at this position
Move the quadrat 5m up the transect line and count the number of plants again and measure the light intensity.
Quadrats should be placed randomly so that a representative sample is taken.
The more quadrats that are analysed the more the validity and reproducibility of the results increases.

Visual aids:



Decay

Key terms

Lipase - enzyme that breaks down protein and fat in milk

Practice exam question

A student made the following hypothesis 'The higher the temperature, the faster the growth of mould'

The student planned to measure the amount of mould growing on bread. The student used the following materials and equipment – slices of bread, sealable bags, a knife, a chopping board, and mould spores.

Describe how the materials and equipment could be used to test the hypothesis.

Link to video of practical

Method and notes

1. Half fill a 250 cm^3 beaker with hot water from a kettle. This is the water bath
2. Label two test tubes, one lipase and one milk
3. In the 'lipase' test tube put 5cm^3 of lipase solution
4. In the 'milk' test tube put 5 drops of Cresol red solution

Cresol red is an indicator that is purple in alkaline solutions of about pH 8.8. When pH drops below pH 7.2 Cresol red becomes yellow

5. Use a calibrated dropping pipette to add 5cm^3 of milk to the 'milk' test tube

A calibrated dropping pipette is used to ensure accurate measurement

6. Use another pipette to add 7cm^3 of sodium carbonate solution to the 'milk' test tube. The solution should be purple
7. Put a thermometer into the 'milk' test tube
8. Put both test tubes into a water bath
9. Use another pipette to transfer 1cm^3 of lipase to the 'milk' test tube. Start timing
10. Record the colour change to yellow, in seconds.

Digestion of fat produces fatty acids (and glycerol) that neutralise the alkali, sodium carbonate, lowering the pH and changing the Cresol red to yellow

11. Repeat at different temperatures

Alternative indicators can be used to identify when neutralisation has occurred; phenolphthalein will change from pink to colourless

The natural process of decay in milk is a slow process, which is difficult to monitor in normal class time. The addition of lipase speeds up the process. The fall in pH in natural decay would be due to the production of lactic acid. In the above method, the fall in pH is mainly due to the production of fatty acids as a result enzyme action.

Visual aids: