OCR (A) Biology A-level

Module 1: Development of practical skills in Biology

PAG 11: Investigation Into The Measurement of Plant or Animal Responses

Please note: You only need to do one from each PAG, and you don't need to do the PAGs listed here, as long as you show the same skills that these are testing (see 5f of the specification for more information). However, you need to at least be able to design your own method for most of these experiments in the exam.

Investigating heart rate:

1. **Measure the resting heart rate** by putting your index and middle fingers on the pulse on your forearm. Count the number of beats in 15 seconds and multiply it by 4 to get beats per minute.
2. Record it in the results table.
3. Do some **gentle exercise**, such as stepping on and off a step for 5 minutes. Immediately afterwards, measure the heart rate again.
4. **Return to the resting position**. **Measure the heart rate every minute** until it returns to the resting state.
5. Record the **time taken to return to normal**.
6. The expectation is that heart rate increases after exercise is done.
7. Repeat the experiment for different people (e.g. 8 people).
8. Use the **Student's t-test** to see whether their exercise causes a **significant** increase in heart rate.
9. To measure the heart rate in Daphnia, put one Daphnia on a wet mount slide on a light microscope and count the number of beats per minute. Make sure you cut a pipette at an angle so the Daphnia can fit into it, treating the Daphnia ethically. You could measure the heart rate at different temperatures and produce a graph of heart rate against temperature.

Detecting electrical activity in muscles:

1. Attach **two electrodes to each muscle you are measuring** (e.g. biceps in the arm) and a **third electrode on an inactive point** (such as the bony wrist area) to act as a control.
2. Switch off any other electrical equipment that is not needed as it generates noise which interferes with the electrical signal from the muscle.
3. Connect the electrodes to an amplifier and a computer.
4. **Keep the muscle relaxed**. This should be a **straight line on the electromyogram**.
5. Then **contract the muscle** by bending the arm. There should be **spikes in the graph as motor units are activated to contract the muscles**.
6. Then **lift a weight**. **The amplitude of the trace will increase** as there are more electrical signals because **more motor units are activated to contract the muscle**.
7. **Continue to lift the weight**. The **muscle begins to fatigue** so it can no longer contract as forcefully as previously. The amplitude of the trace will increase further. This is because the brain is trying to activate more motor units to generate the force needed.

Investigating phototropism:

1. Take nine wheat shoots that are roughly equal in height and plant them in individual pots in the same type of soil.

2. Prepare the shoots as follows:
    a. **Cover the tips of three shoots with a foil cap** and label A.
    b. **Leave three shoots without foil** and label B.
    c. **Wrap the bases of the final three shoots with foil, leaving only the tip exposed** and label Shoot C.
3. Set up the shoots in a light source. Make sure that the roots are all the same distance from the light source and experience the same light intensity. Control other variables like moisture, temperature and nutrient concentration (put in same propagator for example).
4. Leave the shoots to grow for 2 days.
5. After they've been left for 2 days, **record the amount of growth and the direction**, giving qualitative and quantitative data.

Investigating geotropism:

1. Line three Petri dishes with moist cotton wool. Use the same volume of water and the same amount of cotton wool in each dish.
2. Space out 10 cress seeds on the surface of the wool. Press them down in the wool slightly.
3. Put a lid on each dish. Wrap the dishes in foil to prevent light reaching the seeds.
4. Choose somewhere to leave the dishes where the temperature is constant and warm like an airing cupboard.
5. Set up the dishes so **they're placed at different angles**:
    a. Prop one dish at a **ninety-degree angle** and label it. Use a wooden block and tape it to it to make it stay upright.
    b. Place another dish on a slope at **forty-five degrees**. Attach it to a wooden block with tape.
    c. Place the third dish on a **flat, horizontal surface**.
6. Leave the seeds for 4 days.
7. After 4 days, unwrap each dish and **note the direction of the shoot and root growth of cress seedlings**. Record in a table.
8. The roots should all have grown **towards gravity.**

Investigating the role of auxins in apical dominance:

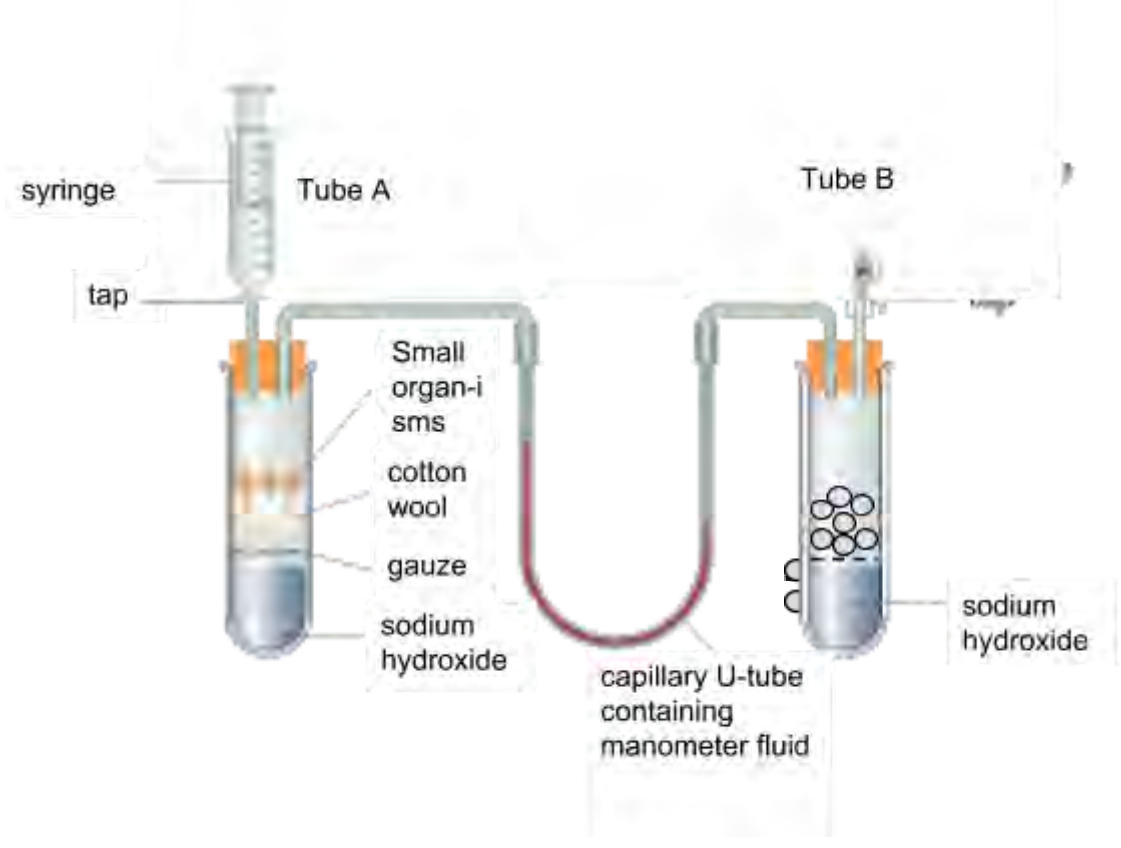
1. Put **30 similar plants** (same height, age and weight) in pots containing the **same soil**.
2. Count and record the **number of side shoots** growing from the main stem of each plant.
3. For **10 plants**, remove the tip of the shoot and **apply a paste containing auxins** to the top of the stem.

4. For another **10 plants**, remove the tip of the shoot and **apply a paste without auxins** to the top of the stem.
5. Leave the final **10 plants** as they are. These are untreated **controls** for comparison to see the effect of the hormone on the plant.
6. Leave the plants to grow for **6 days**. Keep the control variables constant (e.g. same light intensity, water and temperature).
7. After 6 days, count the **number of side shoots** growing from the main stem of each of the plants. Record in a table.
8. The plants with the auxin paste should prevent extra side shoots from growing.

Investigating the role of gibberellins in stem elongation:

1. Plant **40 plants** that are a similar age, height and mass in pots containing the same type of soil.
2. Leave 20 plants to grow, watering them all in the same way and keeping all other conditions the same. These are negative controls.
3. Leave the other 20 plants to grow in the same conditions, except water them with a dilute solution of **gibberellin** (100 mg dm^{-3}).
4. Let all the plants grow for 28 days.
5. Every 7 days, measure the **length of the stem of each plant**.
6. Calculate the **mean stem length** for the plants watered normally and the plants watered with gibberellin. **Plot a graph of stem length against time for both groups**.

Investigating rate of respiration using a respirometer:



Note that the **total volume of the glass beads** should be the same as the **total volume of the organisms**.
The **sodium hydroxide absorbs the carbon dioxide** released by the organisms, so that the **only change in volume will be due to the absorption of oxygen**.

1. Place a coloured liquid with detergent added to it into the manometer tube, as the **manometer fluid.**
2. Connect the apparatus with the **taps open**.
3. The mass of the small organisms to be used should be measured.
4. Place the living organisms in the apparatus. Leave the taps open.
5. Place the whole apparatus in a **water bath** until it is the **same temperature as the water** (about 10 minutes).
6. **Record the starting level of the syringe**. This should be **near the top of the scale**.
7. Mark the **starting levels of the manometer fluid** in the manometer with a marker pen.
8. **Close the taps** and leave the apparatus in the water bath for a set time period (e.g. 10 mins).
9. **Measure the new level of the manometer fluid** and calculate the **change in level** of manometer fluid.
10. Push down the syringe barrel to reset the manometer fluid. **The change in volume in the syringe** (measured by the change in level of the syringe plunger) **is equal to the volume of oxygen absorbed by the organisms**.
11. Calculate the **oxygen absorbed per minute per gram of organism**.