General Certificate of Education
Advanced Level Examination
June 2010

Human Biology HBI6T/P10/TN

Unit 6T A2 Investigative Skills Assignment

Teachers' Notes Confidential

A copy should be given immediately to the teacher(s) responsible for GCE Human Biology

Teachers' Notes

CONFIDENTIAL

These notes must be read in conjunction with *Instructions for the Administration of the Investigative Skills Assignment* on the ISA disk and published on the AQA Website.

The effect of temperature on the rate of photosynthesis

Candidates are required to find out how two temperatures affect the rate of photosynthesis by algae immobilised in alginate beads. They will do this by timing a colour change in hydrogencarbonate indicator.

Materials

In addition to access to general laboratory equipment, each candidate needs

- 200 cm^3 yellow hydrogencarbonate indicator solution
- 5 cm^3 red hydrogencarbonate indicator to use when determining the end point for each experiment
- 100 gel beads of similar size containing algae. These should be at room temperature, i.e., not taken straight out of the fridge if they have been stored there
- large beakers that could be used as waterbaths or access to electric waterbaths
- thermometer (to measure temperatures in a range of 0ºC to 100ºC)
- 5 small specimen tubes, or test tubes, which can be capped or covered with clingfilm (they need to be made airtight)
- 5 test tubes
- timer
- 10 cm^3 measuring cylinders or syringes
- marker pen or Chinagraph pencil or labels
- 4 graduated pipettes or syringes capable of measuring up to 5 cm^3
- lamp
- distilled water

Candidates should also have access to more specimen tubes and test tubes for repeats.

These preparations will need to be trialled before use.

Managing the Investigation

Data from two different temperatures are required to carry out the statistical test. In this investigation, candidates must individually collect data at two different temperatures. Every candidate must record the time for the indicator to change colour at 30 ºC and at 40 °C. Enough data should be collected to enable a statistical test to be used. For this investigation, 5 repeats would be enough.

Technical Support

The beads of immobilised algae should be made up in advance, stored in the fridge, and given out to the candidates in suitable containers.

The investigation was successfully trialled using the unicellular alga *Scenedesmus quadricauda* and a 60 watt bench lamp.

You can get 2 to 3 dm^3 of dark green 'soup' in about 4 weeks by starting with a 50 cm^3 culture standing in a clear container on a window-sill. Algal enrichment medium can be purchased from Sciento. Sciento are at

61, Bury Old Road, Whitefield, Manchester M45 6TB
Tel: 0161 773 6338

To make up the alginate beads, you need to obtain a concentrated suspension of algae. Do this by removing some of the liquid in which they have been growing. This can be done by leaving 50 cm^3 of algal suspension to stand, then gently pouring off the supernatant to leave approximately 5 cm^3 at the bottom. Alternatively, spin 50 cm^3 algal suspension in a centrifuge gently for 5 minutes. Pour off the supernatant leaving approximately 5 cm^3. This is your concentrated algal suspension.

To make up the sodium alginate solution dissolve 2 g of sodium alginate in 100 cm^3 of warm, distilled water stirring all the time, or use cold water and leave it for 24 hours to dissolve fully. Allow warm solutions to cool.

To make up the calcium chloride solution, dissolve 3 g of calcium chloride in 200 cm^3 of distilled water in a 250 cm^3 beaker.

Pour about 2.5 cm^3 of sodium alginate solution into a very small beaker. Add approximately 5 cm^3 of concentrated algal suspension. Stir the mixture with a clean rod or cocktail stick until the algae are evenly distributed.

Alternatively, suck up 5 cm^3 of algae and 2.5 cm^3 of alginate then suck in a little air and mix by shaking in the syringe.

Push the green mixture slowly through an open-ended syringe (at least 10 cm^3 in size) into the solution of calcium chloride. Swirl the calcium chloride solution as the drops fall through the syringe. This will form small beads of gel containing algae.

Leave the beads for 10 to 15 minutes in the calcium chloride solution. Then wash the beads with distilled water. This can easily be done in a plastic sieve.

These beads should be stored in the light and not allowed to dry out. The beads will remain viable for several weeks.

Hydrogencarbonate indicator is normally supplied ready to dilute 1 part to 9 parts water. This should produce a red solution. To make the solution yellow, blow gently into some of the red solution through a straw. Stop blowing at the first sign of yellow colour. Mix the solution. Add a little more carbon dioxide as necessary by blowing, but do not overdo it. If too much carbon dioxide is added, the algal beads will take a long time to turn it red.

This indicator is very sensitive. It is vital to use really clean glassware. Fresh distilled water should be used. This should be stored in very clean glassware.

Additional information is available on the SAPS website www-saps.plantsci.cam.ac.uk.

Turn over ▶

Do not use a lamp of higher wattage than 60 W.

If candidates are using large beakers as waterbaths, they will need access to kettles of hot water.

If you use different apparatus, please change the Task Sheet to reflect the equipment available.

The tasks will need to be trialled before use.

One week before sitting Stage 1 of the ISA, teachers may give their candidates the following information.

You will investigate the effect of temperature on the rate of photosynthesis.

There should be no further discussion of this topic.

In this investigation, teachers must not give candidates the following information

- how to tell when the colour change of the hydrogencarbonate indicator is complete
- how many repeats to carry out
- which statistical test to use.

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