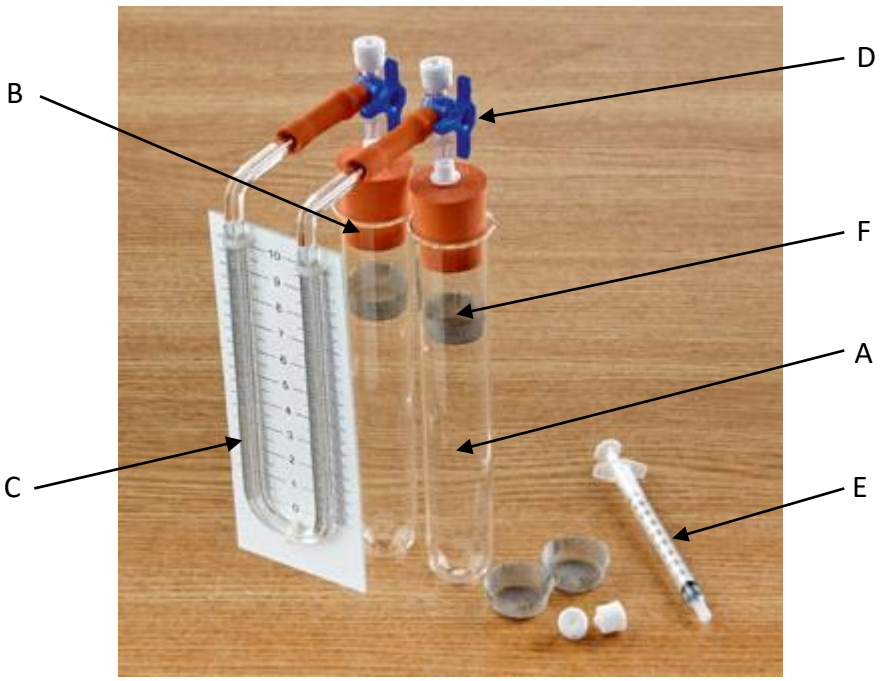
B8H24890 Simple Respirometer NFU 545

Purpose

This apparatus is designed for comparisons of the rate of absorption or evolution of gas by small organisms or micro-organisms, e.g., locust hoppers (early instars) or yeast.

Apparatus detail



The respirometer comprises two test tubes, one to contain the living material (A) and the other to act as control thermobarometer (B), linked by a capillary manometer (C). The manometer contains coloured liquid (Brodie's fluid or paraffin deeply coloured with Sudan 111) and indicates relative volume or pressure changes between the two test tubes.

Small changes on the ambient temperature or atmospheric pressure affect both the experimental test tube (A), and the thermobarometer (B), thus changes in the manometer levels are due only to the activities of the living material.

The experiment and control tubes are connected to the manometer via three-way taps (D).

A 1 cm^3 syringe (E) is connected to the tap of the experimental test tube and acts as a compensator.

The living material may be held in small mesh basket (F), which is a push fit in the experimental tube; however, to ensure that the basket will not slip to the bottom of the tube, a short length of glass rod may be used to support it. As a control an equivalent volume of killed material may be placed inside the other tube.

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Requirements

The apparatus should be set up with the test tubes immersed in a water bath and the manometer tube hanging outside. For experiments at room temperature a deep beaker full of water will be adequate, but for experiments above ambient temperature, a thermostatically controlled water bath will be required.

Experiment 1 - Evolution of carbon dioxide by fermenting yeast

Additional requirements

- *Saccharomyces cerevisiae*
- Glucose
- Filter paper

Procedure

1. Take the manometer and, using a syringe carefully draw in a small volume of coloured liquid paraffin or Brodie's fluid, ensuring that it is free from bubbles. The fluid should come about half-way up each arm of the manometer.
2. Carefully assemble the manometer, taps and stoppers, ensuring good seals throughout.
3. Prepare a suspension of active yeast in glucose solution and dip a small weighed piece of filter paper loosely and place in the wire basket. Insert the basket into the experimental tube. As a control, dip a similar piece of paper into a killed yeast suspension and place into the other tube.
4. Make sure both taps are turned to the atmosphere position, i.e. pointing away from the manometer, and connect both test tubes to the manometer ensuring that the bungs seal the test tube mouths properly.
5. Set up the assembled apparatus with the tubes immersed in a water bath at about 20°C and the manometer suspended outside.
6. Leave the apparatus for about ten minutes so that it can equilibrate with the water temperature in the bath.
7. Set the syringe to about the 0.5 cm^3 mark, turn the taps to the manometer position and adjust the position of the meniscus so that the fluid levels are the same each side.
8. Note the position of each meniscus at the start of the experiment and at subsequent two minute intervals. At the end of the experiment reset the manometer to its original level using the syringe. Note the new syringe volume and hence calculate the total volume of carbon dioxide evolved during the experiment.
9. The dry mass of yeast may be determined by carefully removing the filter paper from the basket and drying it overnight in an oven at 105°C. The evolution of carbon dioxide per minute per gram dry mass of yeast can then be calculated.

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Experiment 2 - Evolution of oxygen during photosynthesis by *Chlorella*

Additional requirements

- *Chlorella* (green algae)
- Sodium hydrogencarbonate
- Filter Paper
- Light Source
- Specimen Tube

Procedure

The basic procedure is as described in experiment 1 with the following modifications:-

1. Pipette about 5 cm^3 of 0.2M sodium hydrogen carbonate solution into each tube to maintain the carbon dioxide concentration, and add a piece of filter paper to increase the surface area of the solution.
2. Prepare a suspension of *Chlorella* in a small specimen tube, and with a short length of glass rod to support it clear of the sodium hydrogen carbonate, place this in the experimental tube.
3. Set up the assembled apparatus with the tubes immersed in a water bath at about 20°C and the manometer suspended outside. Set up the light source close to the beaker but do not switch on.
4. Leave the apparatus for about ten minutes so that it can equilibrate with the temperature in the bath.
5. Switch on the light source and note the level of the manometer at the start of the experiment and at subsequent two minute intervals.
6. Investigations possible are the effect of light intensity or temperature on the rate of evolution of oxygen.

Extensions

Using this apparatus, it is possible to measure the carbon dioxide evolution or oxygen uptake of several small organisms such as locust hoppers, water lice (*Asellus*), blowfly (*Calliphora*) or housefly (*Musca*) larvae.

To measure oxygen uptake, the experimental volume must have 2 or 3cm^3 of strong potassium hydroxide solution in the bottom, and a piece of glass rod will then be required to keep the basket containing the organisms clear of the alkali. A piece of filter paper in the absorbent will increase the surface area for carbon dioxide absorption.

The rate of photosynthesis in terms of the rate of evolution of oxygen may be measured for other photosynthetic organisms, e.g., green leaves detached from larger plants can be used.

Other requirements

Potassium hydroxide
Pipe cleaner

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Acknowledgements

We are indebted to Mr P J Syrett of University College London who devised the apparatus in it original 'Barcroft' form and described it in School Science Review vol. 118 pp 387-389.

Supplier details

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