635-1915 (60-255) Volumeter Respirometer Kit

Introduction: All plants and animals must breathe. Complex life can only be supported by gas exchange, which provides the necessary catalysts for biochemical reactions and removes waste products. In general, animals take in oxygen and expel carbon dioxide. Plants perform the opposite role, which tends to balance out rather conveniently. Note, however, that oxygen is a byproduct of *photosynthesis*, not plant respiration. In order to break down stored sugars into useful energy, a plant must consume oxygen.

Using the respirometer, it is possible to measure the volume of air used by an organism, and from there calculate the rough metabolic rate of the organism. To conduct the experiment, you will need:

- Two test tubes: these will hold the reactants and living material. (Included)
- Metal or plastic cage: this should fit into one of the test tubes. It will hold the living materials. (Included).
- Cotton balls soaked in potassium hydroxide: This will absorb carbon dioxide. Alternatively, soda lime can be used. **Take care, as potassium hydroxide is corrosive**.
- Living material: mung beans, isopods (woodlice), or a locust are all good choices. Be sure to obtain an accurate mass of the material.
- Two stoppers to create an airtight seal on the test tubes. (Included)
- Tubing to connect the stoppers to the capillary tubing on the front of the unit. (Included).
- Colored fluid, such as dyed oil.

Operation: The apparatus can either be placed on a lab bench or mounted to a ring stand. To properly set up the apparatus, follow the steps below:

- Place the test tubes in the holders on the back of the unit.
- Draw the syringe to the most extended position. Draw the rear syringes to the maximum level.
- Fill the capillary tubes on the front of the unit with oil. It should come roughly to the '3' mark.
- Place your carbon dioxide absorbent into both tubes. Place an equal amount in each.
- Put your living material in a cage and slide it down one of the tubes. Take care not to expose living things to potassium hydroxide, as it is toxic to them.
- You must compensate for the volume of the living material. Place water or another inert substance into the other test tube to balance out the volume of air in each.

- Stopper each test tube and connect them to the capillary tubing. Your experiment is now taking place in a closed system.
- Note carefully the position of the oil, the position of the syringe, the ambient temperature, and the time.
- As the material respires, it will expel carbon dioxide. This will be absorbed by the potassium hydroxide or soda lime. This leaves a very slight vacuum in the chamber holding the living material.
- Nature abhors a vacuum as they say, and the system must compensate. Air will be drawn in from the other test tube to fill the vacuum. This will cause the oil to move upwards towards the test tube containing the living material.
- Every five minutes, check the location of the oil, and note how far it has moved.
- Slowly inject air into the system with the syringes until the oil is back at equilibrium. Carefully note the new position of the syringe. It is best to use the front syringe for coarse adjustments, and the rear ones for fine tuning.
- The volume of air you must inject into the system to rebalance the oil level is exactly equal to the amount of air used by the living material during that time period!

Now that you know how much air was used by the living material, you can calculate its metabolic rate. First, you will need to calculate the amount of air, in cubic centimeters, consumed by the organisms per minute. Then, you will need to convert this value into cubic millimeters per hour.

Since you know the rate or air use by the organisms and the mass, you can easily compute the mm^3 of air used per mg of material per hour. Since oxygen is 20.8% of air by volume, computing this amount of the air used by the organisms will yield the total oxygen consumption. This is the metabolic rate of the organism.

The values for this amount change drastically with the development of the organism and the temperature. Generally, organisms use higher amounts of oxygen at higher temperatures. To raise the temperature of your apparatus, a water bath is recommended. This will allow you to adjust the temperature precisely.

Repeat the experiment at intervals of 10°C. Calculate the consumption of the living material. It should rise as temperature rises.

Warranty and Parts:
We replace all defective or missing parts free of charge. Additional replacement parts may be ordered toll-free. We accept MasterCard, Visa, checks and School P.O.s. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse or normal wear and tear. Intended for children 13 years of age and up. This item is not a toy. It may contain small parts that can be choking hazards. Adult supervision is required.