# The effect of temperature on respiration

Science, Biology

Every living thing respires in some way. There are two forms of respiration, aerobic and anaerobic. Areobic respiration only takes place in the presence of oxygen and is a far more efficient way for complexed organisms to convert carbohydrates into energy. There are four stages in aerobic respiration, Glycolysis, the link reaction, Krebs cycle and oxidative phosphorylation. Anaerobic respiration is far less efficient than aerobic, but can produce low yields of energy quickly. T6he overall equation for respiration is;

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{energy}$

A respiratory quotient (RQ) is used to show what substrate is being used in respiration, it can also show if anaerobic respiration is occurring. The following equations can be used to calculate RQ:

RQ = Volume of carbon dioxide given out in unit of time

Volume of oxygen taken in unit of time

Or

RQ = moles or molecules of carbon dioxide given out

Moles or molecules of oxygen taken in

Prediction

I predict that an increase in temperature will increase the respiration rate. The increase will only take place until a certain temperature is reached, the respiration rate will then start to decrease after that temperature. I think that

the respiration rate will start to decrease after 50 C. This is because as the temperature increases, the enzymes and substrate molecules involved in respiration will gain more activation energy. This means that the enzymes and substrate are more likely to collide, and a reaction to take place. I think that respiration will reach its optimum rate at about 40 C, this is because enzymes work best at about this temperature, that is only providing that another factor, such as oxygen available, does not become a limiting factor.

Preliminary work

To test the effects of temperature on respiration a respirometer wil be used. A respirometer consists of two test tubes, an experimental test tube and a control tube, and a capillary U-tube. The experimental tube contains soda-lime solution with a wire gauze platform over it, with non-vertebrates in it. The control tube also contains soda-lime, with a wire gauze above it, with glass beads in it. Both tubes are sealed and attached to the u-tubing containing manometer fluid.

A respirometer is suitable for measuring the rate of oxygen consumption of small terrestrial invertebrates. The Carbon dioxide produced in respiration is absorbed by a suitable chemical such as soda-lime or Potassium Hydroxide solution. The amount of oxygen used can be measured by reading the level of manometer fluid against the scale. Using a water bath alters the temperature.

We did a test run using this equipment; germinating peas were used instead of small invertebrates. Only one test was completed, this was at room

temperature no repeats were made. This was due to time restrictions. This test run taught us how to set up the equipment. We compared our results gained to reference book values and decided that they were reasonably reliable.

Variables:

* The surrounding atmospheric temperature of the water bath must remain constant to prevent anomalous results being obtained.

* The atmospheric pressure must remain constant; this is ok because the experiment will take place in the same room all of the time.

* A control tube is used to compensate in small changes in atmospheric pressure.

* The same volume and concentration of NaOH must be used in every experiment; this is to prevent more or less CO2 being absorbed.

* The mass of the invertebrates and the number of invertebrates must remain constant to prevent differences in respiration rates occurring.

Five different temperature inputs will be used, these temperatures will be 10 C, 20 C,

30 C, 40 C and 50 C. These temperatures provide a good range for which varying respiration rates can occur. The enzymes involved in respiration will be working very slowly at both 10 C and 50 C. The optimal temperature for respiration can also be found using these temperatures. These changes in

temperature will not do any harm to the invertebrates, by over heating them. Each test will be repeated three times to gain an average result and to remove any anomalous results as far as possible.

Apparatus

* Two large test tubes

* Sodium Hydroxide solution

* Two test tube bungs, with two holes in each

* 4 capillary tubes

* 1 capillary u-tube containing manometer fluid

* 1Cm syringe

* 8 maggots

* Glass beads

* 2 small pieces of wire gauze

* 1 screw clip

* 1 three way tap

* Stopwatch

Method

1. Set up the equipment as shown in the diagram above

2. Using the syringe, adjust the level of manometer fluid in the u-tubing to ensure that it is the same level at both sides

3. Seal the screw clip and record the level of manometer fluid every two minutes, over a period of 10 minutes.

4. repeat step 3 for the temperatures of 10 C, 20 C(room temperature), 30 C, 40 C and 50 C. These temperatures can be reached by using either a water bath or crushed ice

5. Each test must be repeated 3 times.

6. Record each result in a table and work out the average. Use the results to calculate the RQ values.

Risk Assessment

* The NaOH is corrosive, so it must be kept away from the invertebrates. Saftey goggles and a lab coat must be worn to protect eyes and clothes from NaOH.

* Living creatures must be treated withrespect

* Any spillages must be mopped up immediately to prevent accidents occurring.