MODULE: Photosynthesis and Respiration

Intervention Session Teaching Guide

This session has been designed to help your students to practice answering PISA questions, both paper and computer based assessments about Photosynthesis and Respiration. The computer based assessment item is the interactive that goes with this module. This intervention also helps your students to practice reading and interpreting text; analysing and interpreting data; evaluating scientific inquiries; and explaining key concepts and applying their understanding.

It must be emphasised that PISA assessment items are not designed to test knowledge in the approach of TIMSS assessment items. PISA assessment items are designed to test students' ability to read and interpret text, analyse and interpret data, evaluate scientific inquiries; explain the outcomes of enquiries using their scientific understanding; and apply their understanding of how the world of science works. These assessment items have been designed to help students practice those skills.

1. (15 minutes)

Carry out the Mars Mission computer based assessment question on the computer. Read the information, instructions and questions carefully before selecting or typing in your answers.

Remember that you can navigate backwards and forwards to check and change your answers.

When you have finished, print your answers by clicking on the print icon.

- Q1 55
- Q2 a. No, because the plants need light to photosynthesise
 - b. The leaves may have just been take out of the light, and they were still photosynthesising
- Q3 Same volume and concentration of Sodium bicarbonate

Vacuum

Same number of discs

Same size of discs

Same length of time exposed to the light

Same temperature

- Q4 a. White
 - b. It is made up of all the colours of light

- Q5 a. White light and highest intensity of light possible
 - b. They would survive because in the red light 50% of the discs floated to the surface showing that the plants will photosynthesise
- Q6 a. Carbon dioxide
 - b. In their cells the astronauts breakdown sugar in the presence of oxygen to produce energy. This process is called cell respiration. Cell respiration also produces carbon dioxide and water as products. The body releases the carbon dioxide when the astronauts breathe out.
- Q7 The plants would provide oxygen and food for the astronauts through the process of photosynthesis. The astronauts would eat the plants and breathe in the oxygen and use the sugars in the food and the oxygen for the process of respiration in their cells. This process will produce energy for the cells of the astronaut. They will breathe out the carbon dioxide which will be used by the plants in the process of photosynthesis. Thus, creating a self-sustaining unit.
- 2. (15 minutes)

Plants produce food by photosynthesis.

- a. Complete and balance the chemical equation for photosynthesis
 - $CO_2 + C_6 H_{12}O_6 +$ Sunlight $6 CO_2 + 6H_2O \longrightarrow 6C_6 H_{12}O_6 + 6O_2$

Some students investigated the effect of temperature on the rate of photosynthesis in pondweed. They set up the apparatus and altered the temperature of the water bath using ice and hot water.

They counted the number of bubbles given off in a minute as different temperatures.



b. Why did the students use a water bath?

To keep the temperature constant.

The graph shows the students' results.



c. Explain the shape of the graph between 22°C and 27°C.

A limiting factor other than temperature, e.g. carbon dioxide

d. A greenhouse owner wants to grow vegetables as quickly and cheaply as possible in winter.

At what temperature should he keep his greenhouse in order to grow the vegetables as quickly and cheaply as possible?

21/22°C

Explain your answer

The rate of photosynthesis is at maximum for the least heating cost.

3. (10 minutes)

A student investigated how much gas was given off under different conditions in the production of gasohol. The diagram shows the apparatus she used.

Test tubes A and B contained the same volume of yeast mixed with glucose solution.

Test tube C contained yeast in water, but no glucose

Test tube D contained glucose, but no yeast.

Test tube A was placed in room temperature at 20°C. The other test tubes were placed in a warm water bath at 35°C. A balloon was put over the opening of each tube.



The table describes the appearance of the balloons after 15 minutes:

Tube	Appearance of balloon after 15 minutes	
А	slightly inflated	
В	very inflated	
С	no change	
D		

a. Explain why the balloons on tubes A and B inflated.

The explanation should link the following points:

- respiration (of the yeast)
- (produces) carbon dioxide (gas)
- b. Explain why tube B being in a higher temperature than tube A caused the balloon on tube B to inflate more than the balloon on tube A.

The explanation should link the following points:

- Increased enzyme/yeast activity
- Increased chemical reactions

Accept: warmer gas takes up a larger volume.

c. Why did the balloon on tube C not show any change?

No glucose, so no gas/ carbon dioxide produced.

d. Describe the appearance you would expect the balloon on tube D to have at the end of the experiment.

No change: no yeast, so no respiration, so no carbon dioxide produced.

4. (10 minutes)

When we make bread, we mix flour, water, salt and yeast. After the ingredients have been mixed, the mixture is left for some time in a warm place for a reaction called fermentation to take place. This involves the yeast transforming the starch in the flour into carbon dioxide and water. It also causes the bread dough to rise.

- a. Why?
 - A. Because alcohol is produced and turns into a gas.
 - B. Because the yeast is reproducing.
 - C. Because a gas, carbon dioxide, is produced. \checkmark
 - D. Because fermentation turns water into a vapour.
- b. After this process, called proving, has happened, if we weighed the dough we would observe that its mass (not weight) has decreased.

Look at the experiments below. The dough weighed the same at the start of all four investigations.



Which two experiments would you compare if it was the yeast that was causing the loss of weight?

- A. You should compare experiments 1 and 2.
- B. You should compare experiments 1 and 3.
- C. You should compare experiments 2 and 4.
- D. You should compare experiments 3 and 4. \checkmark
- c. In the dough, yeast helps to transform starch and sugars in the flour. A chemical reaction occurs during which carbon dioxide and alcohol form.

Where do the carbon atoms that are present in carbon dioxide and alcohol come from? Circle 'yes' or 'no' for each of the following explanations:

Is this a correct explanation of where the carbon atoms come from?		
Some carbon atoms come from the sugars	Yes	
Some carbon atoms come from the salt		
Some carbon atoms come from the water		

5. (10 minutes)

a. The diagram below shows plants growing in a greenhouse. It is noon on a hot, sunny day.



In the sentences below, cross out TWO words which are wrong in each box.

The plant leaves will be taking in

Carbon dioxide	
Nitrogen	
Oxygen	

The plant leaves will be making

Sugar Magnesium Nitrate

The energy needed for this process comes from

Electricity Fossil fuels Light

b. The diagram shows a computer being used as a data logger in a photosynthesis experiment.

The experiment is to find how the oxygen output of the water plant varies over a 24-hour period.



Give TWO advantages of using a data logger in this experiment

Many more readings/ much more data

Records for 24 hours/does not require manual readings during the night.

c. A student investigates the rate of photosynthesis in plants. She has two test groups of plants of the same species in different conditions.

For each group she measures the rate of photosynthesis at different concentrations of carbon dioxide.

The graphs show her results.



Suggest how the conditions for group B have differed from group A, and explain why this has produced the results shown in the graphs.

The rate of photosynthesis can be limited by carbon dioxide, light intensity and temperature.

In group A, light intensity or temperature is limiting the rate of photosynthesis (at high carbon dioxide levels).

In group B there is greater light intensity/higher temperature.

So a faster rate of photosynthesis is possible before light intensity/temperature becomes limiting.