**Biology: 12. Photosynthesis and Plant Responses**

In the early 1600's, the Flemish alchemist Jan Baptista van Helmont planted a willow sapling and measured its weight as it grew. After five years the tree weighed 169 pounds.

Where had the solid bulk of wood come from? Not from the soil – it had lost only two ounces in all that time.

***Please remember to photocopy 4 pages onto one sheet by going A3→A4 and using back to back on the photocopier***

**Syllabus**

**OB48** Describe, using a word equation, how plants make their own food through photosynthesis

**OB49** Show that starch is produced by a photosynthesising plant

**OB50** Investigate the growth response of plants to gravity (geotropism) and light (phototropism)

**Student Notes**

**Photosynthesis is the way in which plants make food**

Plants take in carbon dioxide from the air and water from the ground.

Plant cells then combine this with chlorophyll (which is already in the cells) and sunlight to produce food in the form of glucose.

Oxygen is produced as a by-product and is released into the atmosphere.

**Word equation for photosynthesis**

**Carbon dioxide + Water (+ sunlight and chlorophyll) → glucose + oxygen**



**To show that starch is produced by a photosynthesising plant**

Starch is a form of glucose

To test for starch add a drop of iodine and the material should turn blue-black if starch is present.

|  |  |
| --- | --- |
| **Procedure** | **Reason** |
| 1. Place a plant in the dark for a few days | All the starch moves out of the leaves |
| 1. Place aluminium foil over one of the leaves | **All the plant should be making starch except for the part under the foil** |
| 1. Put the plant in strong sunlight for a day |
| 1. Put the leaves in boiling water for a minute | Kills the leaves |
| 1. Soak the leaves in alcohol for a few minutes | To remove the chlorophyll so that the leaf is white so it can be tested (but makes the leaf brittle) |
| 1. Dip the leaves in boiling water again and rinse | To soften the leaves before testing |
| 1. Test for starch |  |

**Result**

The leaves will go blue-black indicating that starch is present, except the leaf which was covered with aluminium foil.

There is no starch in this leaf because photosynthesis couldn’t occur since there was no sunlight.

**Geotropism and phototropism**

**A tropism is the response of a plant to a stimulus**

**Geotropism is the *growth* response of a plant to gravity**

**To investigate geotropism**

Procedure

1. Soak some broad bean seeds in water for a day or two to begin germination.
2. Insert the seeds just inside the glass of a beaker of soil, making sure to turn the seeds in lots of different directions.
3. After a few days the plants will start to grow, but in each case the shoots will grow upwards and the roots will grow downwards.



**Phototropism is the *growth* response of a plant to light**

**To investigate phototropism**

Procedure

1. Place some germinating seeds onto a petri dish of moist cotton wool.
2. Place the petri dish into a covered shoe-box which has a hole at one end and leave it beside a window for a week.
3. Take the cover off of the shoe-box and note that the plant has started to grow towards the hole in the box.

**Did you know?**

Plants pirated the machinery for use in photosynthesis more than a billion years ago from bacteria.

The same machinery is found in every single plant today, from tiny insect-eating sundews to colossal redwood trees – and it has barely changed.

**Exam Questions**

1. [2011]

Give the word equation for photosynthesis

Carbon dioxide + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ + oxygen



1. [2009]

Name two processes that the leaves of green plants carry out.

1. [2012]

Name a gas that moves into and a gas that moves out of a green leaf during active photosynthesis.



1. [2007]

Pondweed is a green plant that lives in water. In the presence of light pondweed undergoes photosynthesis and a gas is produced as one of the products.

Name the gas produced.

1. [2007][2010 OL]

Pondweed and all green plants take in and use another gas, from their environment during photosynthesis.

Name the gas taken in.

1. [2007]

How might the rate of production of bubbles, by the pondweed, be increased?

**Photosynthesis experiment**

1. [2007 OL][2010 OL][2008 OL]

A plant that was left in sunlight for a few days.

A test was carried out in the laboratory on a part of the plant to see if it had made food (starch).

1. What is the name of the process by which plants make food?
2. What is the name of the part of the plant where most of the food (starch) is made?
3. What is the name of the substance which gives plants their green colour?
4. What is the name of the chemical that produced a blue-black colour when it is used to test for starch?
5. [2010 OL]

Name the green chemical found in leaves that help plants make food.

1. A plant was left in the dark for 24 hours and then it was placed in bright light for 6 hours.

A leaf was taken from the plant and boiled in a liquid to remove the green chemical.

1. Name the liquid in which the leaf was boiled.
2. An iodine solution was then poured onto the ‘white’ leaf and the leaf became blue/black in colour.

What does this result tell us about the green leaf?

1. [2006]

The plant shown in the diagram was left in total darkness overnight and then exposed to strong sunlight for four hours. The leaf with the foil was removed from the plant and tested for starch.

Clearly state the result you would expect from this test.

What conclusion can be drawn?

1. [2010]

****The diagram shows a plant with variegated leaves i.e. the leaves have areas with different colours. The leaves of this plant have a green centre with pale yellow margins. This plant was used in an experiment to investigate the production of starch by photosynthesis.

1. Why was the plant left in darkness for a day at the start of the experiment?
2. The plant was then exposed to bright light for some hours after which a leaf was removed and boiled in water for a few minutes.

Why was the leaf boiled in water?

1. Draw a labelled diagram showing the apparatus and named liquid used to remove the green pigment from the leaf.
2. The leaf was finally covered with a solution that turned the area which was previously green to blue-black while the leaf margins did not turn blue-black.

Name the solution used.

1. Suggest a reason why the leaf margins did not turn blue-black.
2. [2009 OL][2012]

Photosynthesis is a process by which green plants make food (starch).

Describe an investigation to show that starch is produced by a photosynthesising plant.

Use the following headings: Labelled diagram, Equipment, Procedure, Result,

**Phototropism and Geotropism**

1. [2007 OL]

How do plants respond to light?

1. [2007 OL]

Describe, with the help of a labelled diagram, how you could set up an investigation to show how plants respond to light.

Use the following headings: Equipment: Procedure: Result: Labelled diagram

1. [2010]

A plant in an otherwise dark room bends towards the light from a window.

1. What is the growth response of a plant to light called?
2. What benefit does the plant get from this response?
3. [2009 OL]

A plant was left to stand inside a window for a long period.

1. What caused the plant to grow towards the window?
2. Name this growth response of plants.

**Exam Solutions**

1. Water, Glucose
2. Photosynthesis, gaseous exchange, transpiration, food storage, respiration.
3. Gas in: carbon dioxide (CO2)

Gas out: oxygen (O2)/ water vapour (H2O)

1. Oxygen (O2)
2. Carbon dioxide (CO2)
3. Shine a brighter light
4. Photosynthesis
5. Leaf
6. Chlorophyll
7. Iodine
8. Chlorophyll
9. Alcohol
10. The leaf contains starch
11. Covered area: no blue-black/ iodine stays yellow (orange)/no starch produced

Uncovered area: goes blue-black/ starch produced

Light is required for starch (food) production (photosynthesis).

1. In order to destarch the leaves.
2. To kill the leaf.
3. See diagram
4. Iodine
5. There is no chlorophyll in these sections therefore no photosynthesis takes place, therefore there is no starch.
6. De-starch plant (cover part of leaf /place in dark) / Test leaf for starch (before exposure to light)
7. Expose plant to light
8. Leave for a time
9. Boil in water
10. Remove chlorophyll / boil in alcohol
11. Test leaf with iodine
12. Result: Iodine turns blue/black
13. They grow towards light
14. Equipment: Container of seedlings / plant

Procedure: Place container of seedlings (leafy plant) near a window / light source

Leave for a time

Result: seedling (plant) grows towards window (light source)

1. Phototropism
2. Make more food/ more photosynthesis/ absorb more light…
3. Sunlight
4. Phototropism