

# Worksheet 1.1 Van Helmont's experiment



Jan Baptist van Helmont was born in Brussels in 1579. He trained to be a doctor of medicine, but throughout his life he carried out experiments to find out more about the natural world.

At that time, no-one knew about photosynthesis. Of course, people did realise that the mass of a plant increased as it grew. Van Helmont asked the question: **Where does the extra mass come from?**

The very fact that van Helmont asked this question shows that he understood that mass cannot be created from nowhere. He realised that if the plant was gaining mass, then that mass must have been taken from somewhere else.

Van Helmont did an experiment to try to find the answer to his question.

- Van Helmont dried some soil in a furnace. He measured out 200 pounds of the dry soil. (A pound is an old unit of mass; one pound is about 0.45 kg.)
- He put the dry soil into a large pot. Then he added enough water to make it moist.
- He measured the mass of a young willow tree. Its mass was five pounds. He planted the willow tree in the pot.
- He covered the soil in the pot with a piece of metal, so none of the soil could blow away. He made little holes in the metal so that he could water the tree.
- He grew the tree for five years, watering it regularly.
- After five years, he took all of the soil from the pot, dried it again and measured its mass. He found that it was almost exactly 200 pounds.
- He also measured the mass of the tree. He found that its new mass was 169 pounds.

## Questions

1 What was van Helmont trying to find out by his experiment?

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2 Explain why van Helmont dried the soil before he measured its mass.

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# Van Helmont's experiment: Worksheet 1.1



**3** How much mass did the willow tree gain during the five years of the experiment?

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**4** Van Helmont concluded that all of the mass gained by the tree must have come from water. Suggest why he came to this conclusion.

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**5** We now know that van Helmont was only partly right. Only some of the extra mass of the tree came from water. Some of it came from another substance.

Use your knowledge of photosynthesis to suggest what the other substance was.

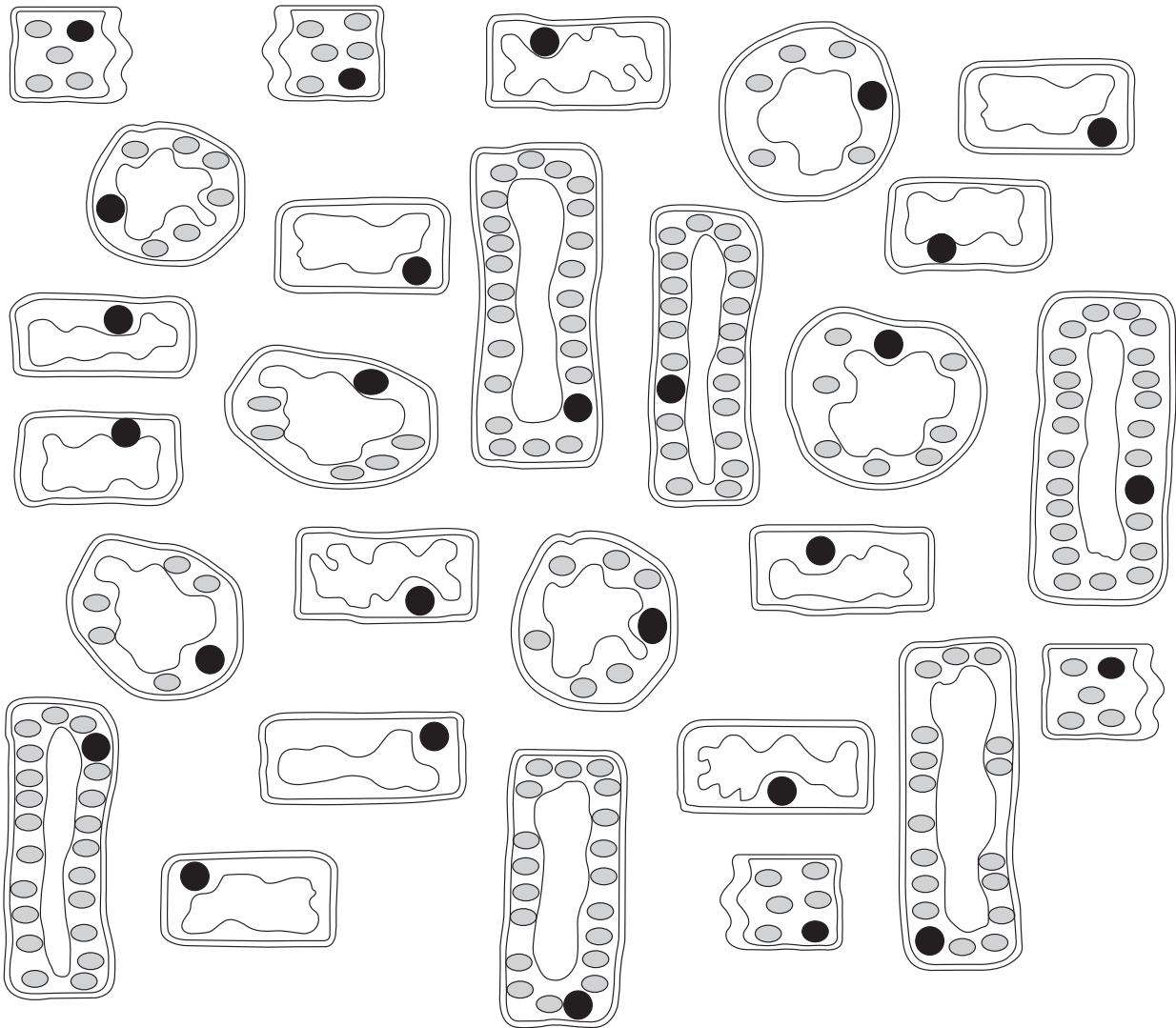
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# Worksheet 1.2A Cells in a leaf



The diagrams show some examples of different kinds of cells in a leaf.



- 1 Cut out each of the cells.
- 2 Arrange the cells together on a sheet of blank paper as they might be arranged in part of a section through a leaf. If you need more cells, you can copy some extra ones.
- 3 When you think you have arranged them correctly, stick them in place.
- 4 Label the different kinds of cells or tissues in the leaf.

# Worksheet 1.2B Measuring the thickness of a leaf

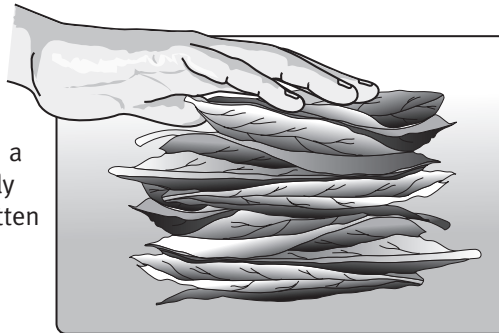


Leaves are so thin that it is impossible to measure the thickness of one using a ruler. However, if you stack lots of them together, you can measure the thickness of the stack. Then you can work out the mean thickness of one leaf.

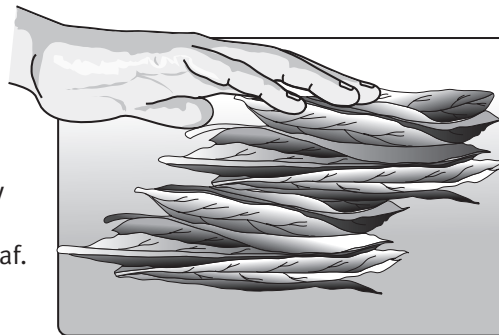


Pick at least 20 leaves from the same tree.

Stack the leaves into a neat pile. Press gently down on them to flatten the leaves.



Measure the thickness of the pile of leaves. Then divide by the number of leaves to find the mean thickness of one leaf.



# Worksheet 1.2D

## Comparing the number of stomata on the two surfaces of a leaf



Plan and carry out an investigation to answer the question:

**Is the number of stomata the same on the upper surface and on the lower surface of a leaf?**

Here are some things to think about.

**1** How will you count the stomata?

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**2** Will you count stomata on the whole leaf, or just part of it?

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**3** What should you keep the same in your investigation?

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**4** How will you record your results? Construct a results table that you could use.

**5** Now carry out your investigation. You can change your method as you go along, if you can think of a way to improve it.

# Worksheet 1.3B

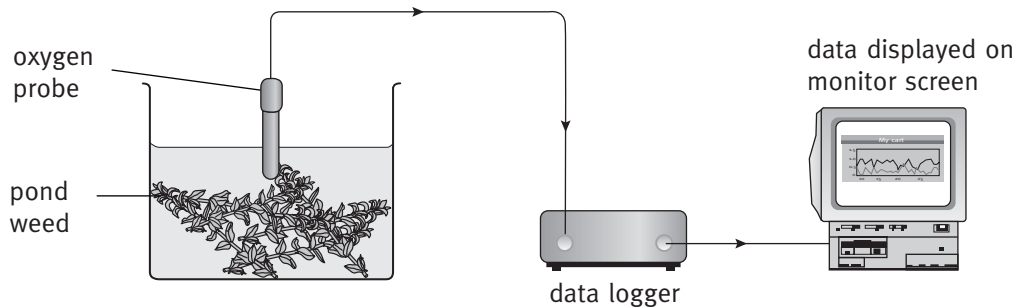
## Investigating how plants affect oxygen concentration



Anyone who keeps fish in a tank knows that it is a good idea to have plants growing in the water as well.

In this experiment, you will use an oxygen probe and a data logger to find out what happens to the oxygen concentration in a tank containing water plants.

- 1 Partly fill a glass container (such as a fish tank or a large beaker) with pond water. Put some pond weed into the tank. (If you live near the sea, you could use seawater and seaweed instead.)
- 2 Put the tank into a place where it gets plenty of light.
- 3 Your teacher will connect up an oxygen probe to a data logger. The oxygen probe measures the concentration of oxygen in the water.



- 4 Leave the apparatus in the same place for at least 24 hours.

### Questions

- 1 Describe the results that you obtained.

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# Investigating how plants affect oxygen concentration: Worksheet 1.3B



2 Using what you know about photosynthesis, suggest an explanation for these results.

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