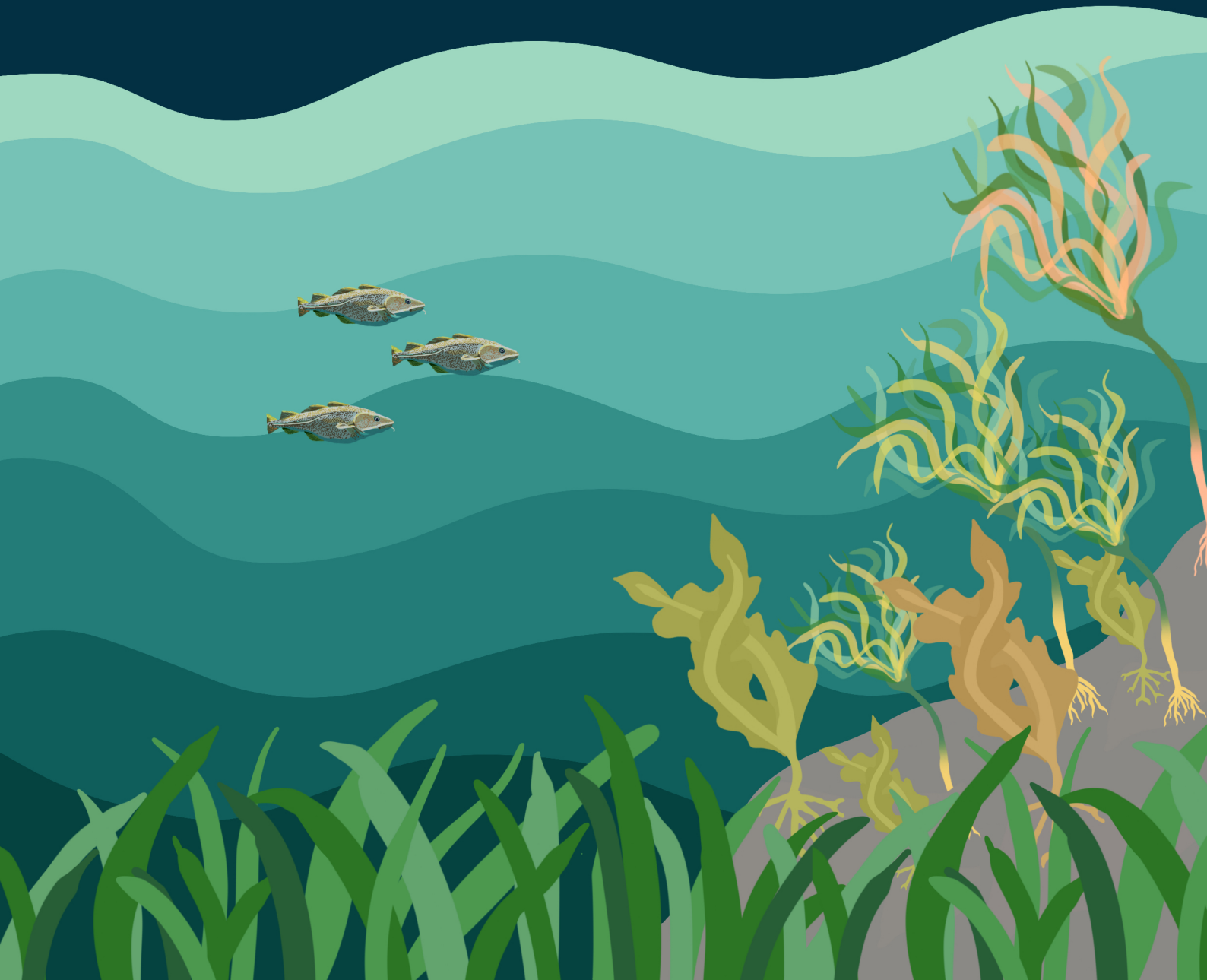
PROJECT SEAGRASS

PHOTOSYNTHESIS
ACTIVITY GUIDE
AGES 11-14



OVERVIEW

This activity guide introduces the topic of photosynthesis. Within this guide are four activities which will help your students understand photosynthesis and the structure of the plant cells.

- **Learning objective:** Plant structure and how they obtain their energy
- **Curriculum links:** Science

LEARNING TIPS

Many of these activities can be easily adapted for the outdoors, especially in beach settings. Student can, for example, draw plant structures or plant cell structures in the sand and use different sized pebbles or other natural debris for the cell components.

INTRODUCTION

Photosynthesis is when plants absorb sunlight to make nutrients from carbon dioxide and water. This allows the plants to grow big and strong, even without a mouth to eat with!

But… how does photosynthesis work? It happens through a long series of chemical reactions. Carbon dioxide, water and light go in and glucose (sugar) and oxygen

KEY INFORMATION

- Indoor and outdoor activity
- Individual and group activity
- Time – 2 hours
- Teacher presentation, practical, workbook

KEY WORDS

Absorb – to take in or suck up, like a sponge.

Cell membrane – this separates the interior of all cells from the outside environment. Cell membranes are semi-permeable, meaning they allow only certain substances in and out of the cell.

Cell wall – this surrounds some cells, outside the membrane, giving the cell support and protection.

Chlorophyll – this absorbs light energy from the sun, needed to make photosynthesis happen.

Chloroplast – these contain chlorophyll and are the site of photosynthesis.

CO_2 – carbon dioxide, a type of gas in the air, the gas we breathe out.

Cytoplasm – this is a jelly-like substance in a plant cell where chemical reactions happen.

DNA – the genetic information that cells need to grow and reproduce.

Nucleus – this is like the cell's brain, controlling what happens in the cell, as well as containing DNA.

come out. The organelles responsible for converting light energy into chemical energy are chloroplasts.

We owe a lot (breathing and eating) to plants being able to turn the sunlight into food. Animals (including humans) eat plants to gain their energy to grow and move, and need the oxygen released by plants during photosynthesis to breathe. It is such an important process!

It is not just the land plants that can photosynthesise, but aquatic plants such as seagrass can also use sunlight to make their own food!

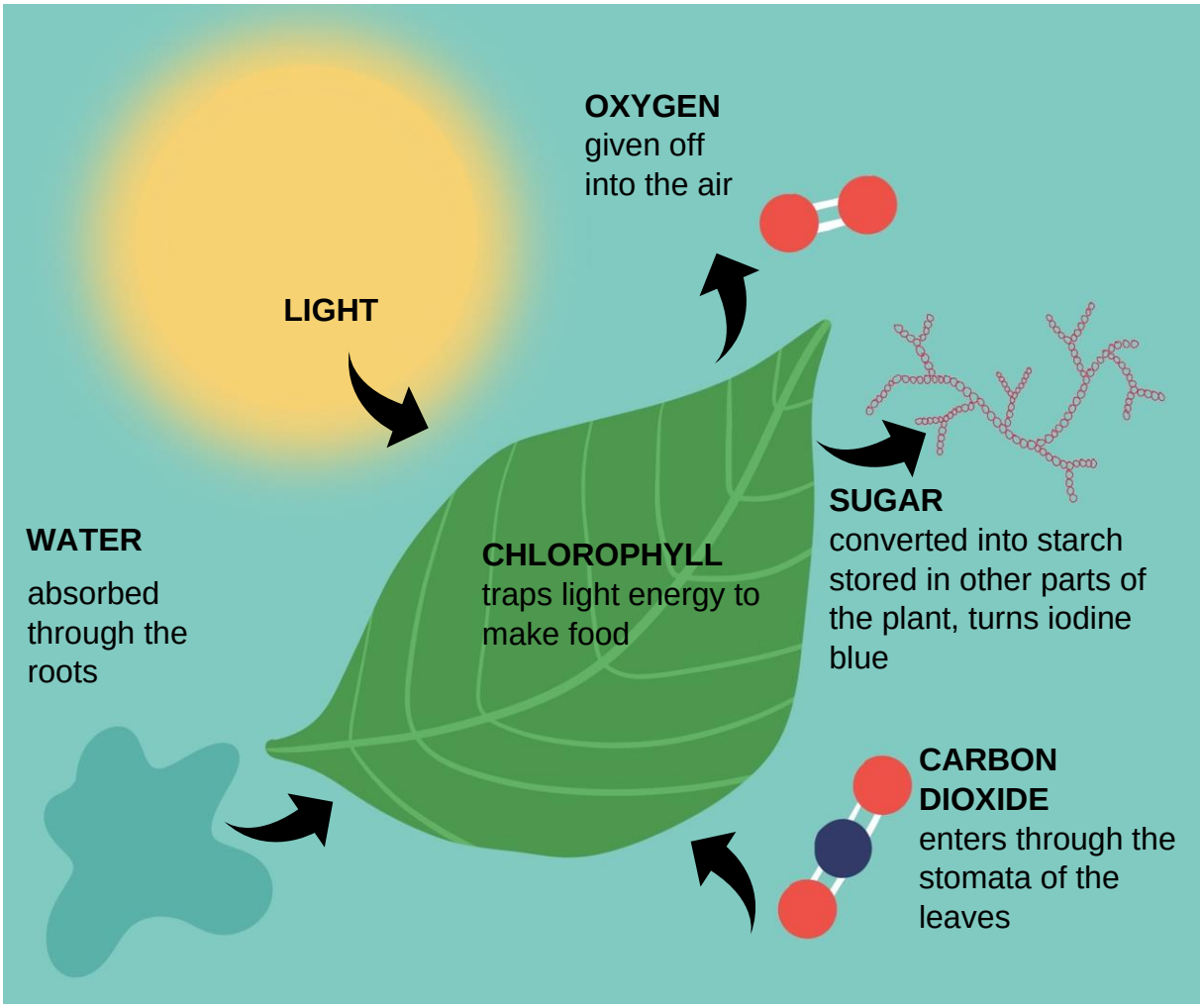
Nutrients – a substance that is essential to help plants grow big and strong.

O_2 – Oxygen, a type of gas in the air, the gas we breathe in!

Photosynthesis – the process where plants use sunlight to create food (nutrients) from carbon dioxide and water, it creates oxygen as a by-product!

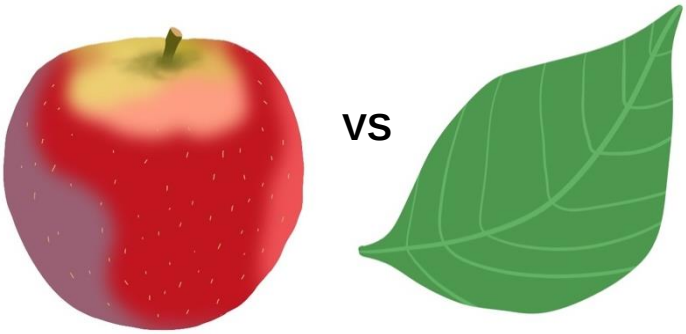
Root – the part of a plant which buries underground, holding the plant in place. They take up water and nutrients to the rest of the plant.

Vacuole – this is a space within the cytoplasm of plant cells that contains sap/ fluids and nutrients.



ACTIVITY 1:

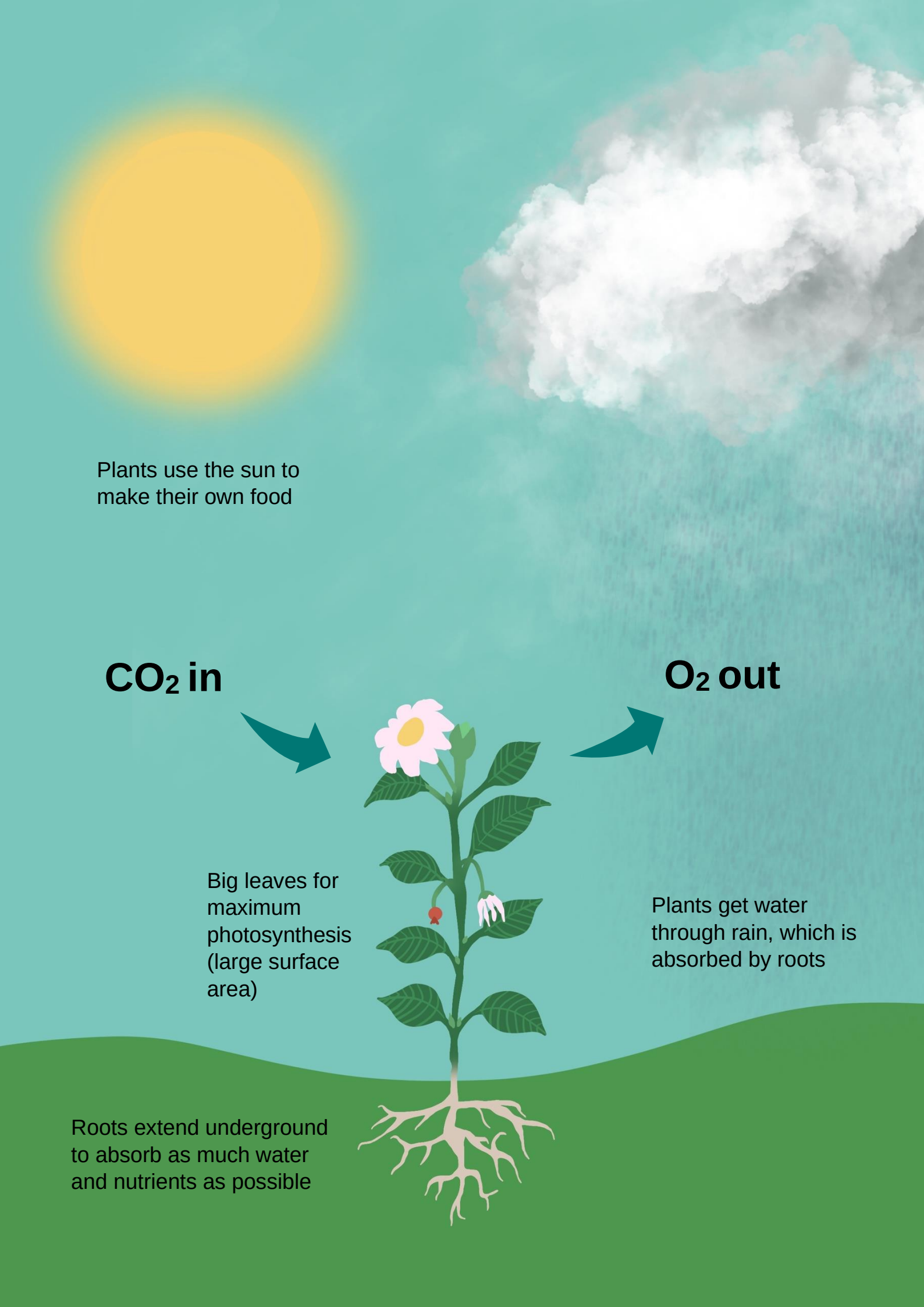
Explain how animals get their energy (from food via metabolism, this can be a simple explanation like – when we eat an apple, we get energy!) and how that is different to how plants get their energy (plants do not have mouths to eat, so instead use the light from the sun to make their own food!)



Use this approach to teach students the key aspects of photosynthesis – how light, CO_2 and water are combined to produce oxygen and carbohydrates like glucose, the same carbohydrate that we as humans get from our food.

Tie in how plants have evolved to be able to maximise CO_2 absorption through various adaptions like through their leaves (e.g., many leaves extended on branches with large surface area which allows the most efficient photosynthesis possible), and maximum water absorption via roots and veins. Explain how plants have chlorophyll in their leaves which is the site of photosynthesis!

1) Start by getting the students to draw a flower on a piece of paper. Ask them to continue their drawing by adding the sun, water, soil and rain.
2) Next, get them to write carbon dioxide and draw an arrow towards the flower.
3) On the opposite side, write the word oxygen and draw another arrow, but away from the flower this time.
4) At the bottom of the plant, draw a sugar cube. Make sure to explain the process of photosynthesis as they are drawing as they go along.
5) Add roots and leaves and label the adaptions that plants have to maximise their photosynthesis efficiency!


Plants use the sun to make their own food
CO_2 in
O_2 out
Big leaves for maximum photosynthesis (large surface area)
Plants get water through rain, which is absorbed by roots
Roots extend underground to absorb as much water and nutrients as possible

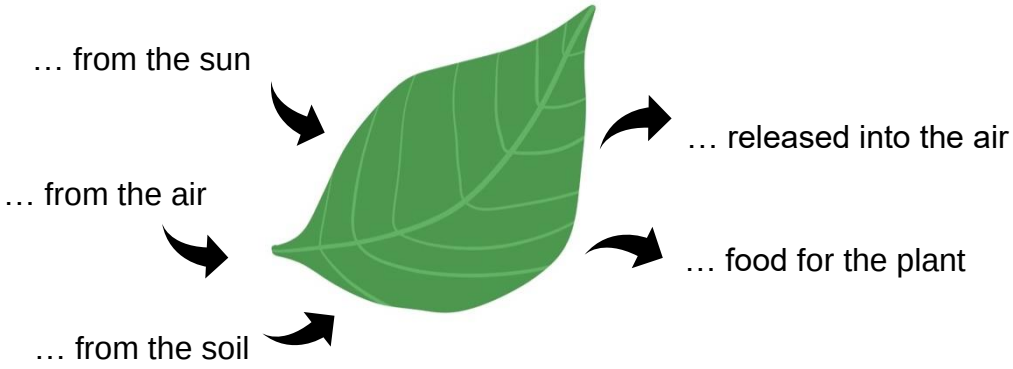
WORKBOOK ACTVITIES

Now that students understand the key concepts of photosynthesis, complete some workbook activities.

1) Complete the word equation for photosynthesis:

.....

2) Complete the gaps:



3) Draw lines to match the sentence beginnings with their correct endings:

Plants need water from the soil for…	…it wilts
The roots of a plant are spread out to…	…absorb lots of light
Leaves have a large surface area to…	…photosynthesis
If a plant does not get enough water…	…through stomata
Photosynthesis reactions happen in…	…plant organs
Carbon dioxide gets into leaves…	…chloroplasts
Roots, stems and leaves are all…	…absorb lots of water

WORKBOOK EXTENSION

1) Fill in the gaps:

The raw materials for photosynthesis are …… and …… . The sugar made by photosynthesis is …….. and ……. gas is also produced. Photosynthesis needs …….. energy to make it happen.

2) True or false?

1. Plants get food from the soil. _____
2. Plants make food in their green leaves. _____
3. Water gives the plant the food it needs. _____
4. It is the green chemical in leaves that helps make the food. _____
5. To make food a plant needs oxygen. _____
6. Chlorophyll is green. _____
7. Photosynthesis makes chlorophyll. _____
8. Photosynthesis is when the plants make food in its leaves. _____
9. A plant needs water to make food. _____
10. The plant gets food from the sun. _____
11. Sunlight is needed for photosynthesis. _____
12. The speed of photosynthesis is always the same in a leaf. _____
13. The speed of photosynthesis depends on the temperature. _____
14. It needs to be warm for photosynthesis to take place quickly. _____

WORKBOOK ACTIVITY ANSWERS:

1) carbon dioxide + water + light energy ⟶ sugar + oxygen

2) **Light** from the sun, **carbon dioxide** from the air, **water** from the soil, **oxygen** released into the air, **sugar** for food for the plant

3)

1. Plants need water from the soil for ……. photosynthesis.
2. The roots of a plant are spread out to …….. absorb lots of water.
3. Leaves have a large surface area to ……. absorb lots of light.
4. If a plant does not get enough water ……. it wilts.
5. Photosynthesis reactions happen in ……. chloroplasts.
6. Carbon dioxide gets into leaves ……. through stomata.
7. Roots, stems and leaves are all ……. plant organs.

Extension answers

1) The raw materials for photosynthesis are **carbon dioxide** and **water**. The sugar made by photosynthesis is **glucose**. **Oxygen** gas is also produced. Photosynthesis needs **light** energy to make it happen.

2) (1) False (2) True (3) False (4) True (5) False (6) True (7) False (8) True (9) True (10) False (11) True (12) False (13) True (14) True

ACTIVITY 2:

YOU WILL NEED:

Real terrestrial or aquatic plants, we recommend cress (as it grows quickly)

Two papers cups

Water

HEALTH AND SAFETY

Risk of slipping with large water supplies!

1) This activity gives students the opportunity to visualise the importance of sunlight to plants!

2) Give each student two paper cups with a quick growing plant potted inside.

3) Ask them to place one cup in a dark room and the other in the sunlight on a windowsill.

4) Each child needs to water both flowers throughout the week.

5) After a week has passed, get the children to bring over both their plants and ask them to evaluate the two.

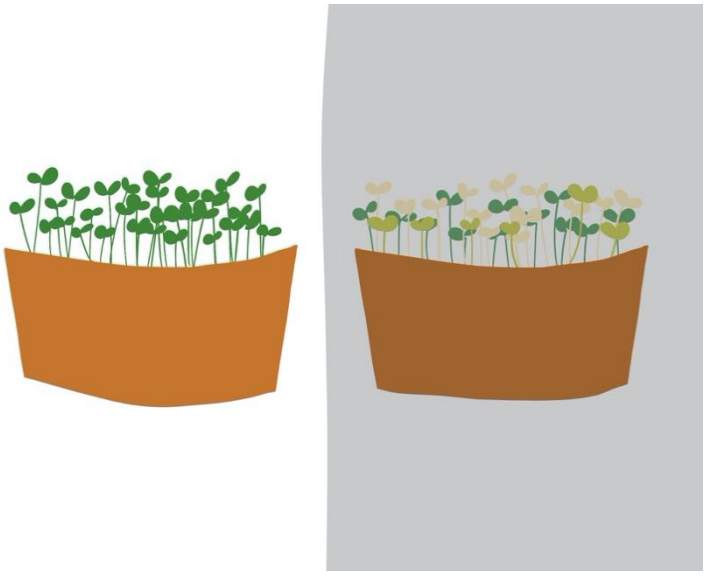
6) Explain that the plant had a sunlight deficiency whilst in the dark room, so therefore photosynthesis wasn't possible and as a result the plant looks limp and is dying. Compare to the plant that was on the windowsill – look how healthy this plant looks.

7) Similarly, have the students place a healthy, growing, leafy plant by the window for several days.

8) Get the students to take construction paper and tape it over some of the leaves.

9) Then after several days, get the students to remove the tape.

10) The leaves covered in tape will be darker. Chlorophyll is what gives leaves their colour and without sunlight, the leaves will lose that colour.



ACTIVITY 3a:

This activity looks at the structure of a plant cell. All living things are made up of cells, both animals AND plants. Most cells are so small that you can only see them with a microscope. Cells have their own special jobs. The cells we will learn about in this activity are those found in plant leaves.

YOU WILL NEED:

- Paper
- Pencils
- Clipboards for drawing

1) Draw a plant cell on a flipchart.
2) Go through each plant cell component labelling these and describing them.
3) To test student knowledge, have each student draw their own plant cell and label it (on paper, a white board, in groups) before describing the function of each part.
4) Have students use different (appropriate) colours to distinguish each component, e.g., green for chloroplasts, brown for nucleus.
5) Once students have given this a go, it's time to build a model plant cell – if there are enough resources (Activity 3b).

KEY WORDS

Absorb – To take in or suck up like a sponge.

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Cell wall – this surrounds some cells, outside the membrane, giving the cell support and protection.

Chloroplast – these contain chlorophyll and are the site of photosynthesis.

Chlorophyll – this absorbs the light energy needed to make photosynthesis happen.

Cytoplasm – this is a jelly-like substance in a plant cell where chemical reactions happen.

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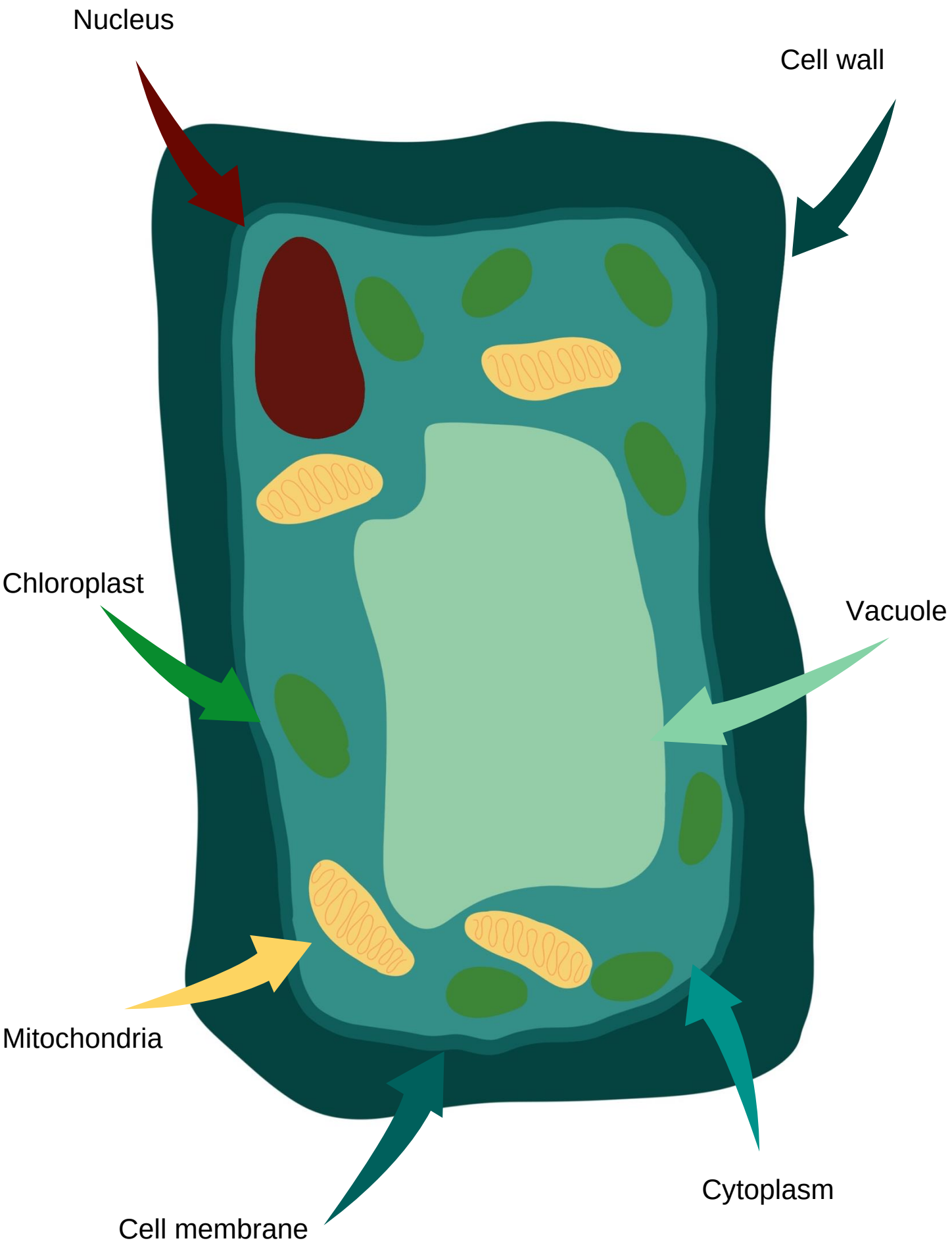
Nucleus – this is like the cells brain, controlling what happens in the cell, as well as containing DNA

Vacuole – this is a space within the cytoplasm of plant cells that contains sap/ fluids and nutrients.

The Structure of the cell



ACTIVITY 3b:

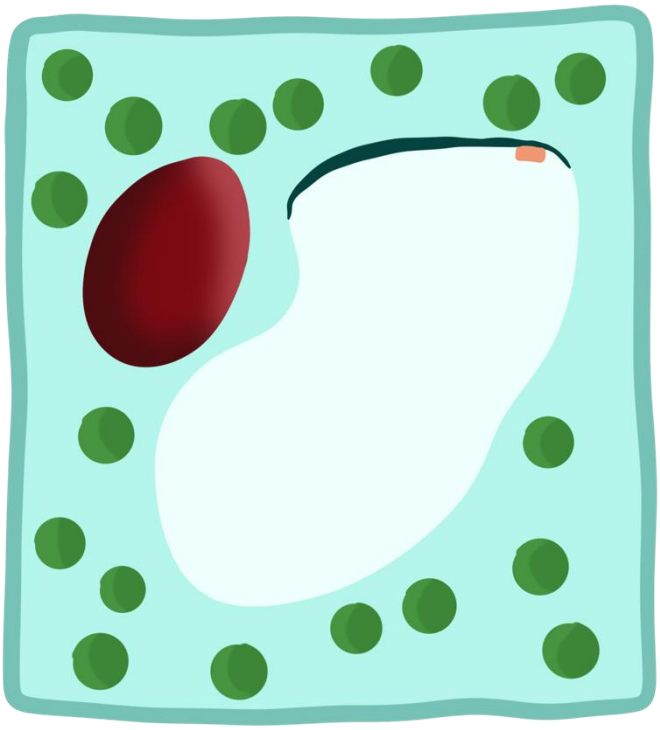
Have students work individually, or in groups. Alternatively, this could be done on the beach with shells, stones, seaweed and seawater or whatever you can find!

1) Take a plastic Tupperware container and line it with clingfilm.
2) The Tupperware acts as the cell wall and the clingfilm as the cell membrane.
3) Fill a small zip-lock plastic bag with water and place it inside the Tupperware – this acts as the vacuole.
4) Fill the rest of the Tupperware up with water – this is the cytoplasm.
5) Add plenty of small green peas, these are the chloroplasts.
6) Finally, add a red grape for the nucleus.
7) After students have done this activity, have them look at it and then repeat the worksheet exercise from Activity 3 (drawing, labelling, and describing the function of each component in a plant cell).
8) This activity could be made more fun by creating a plant cell that is edible!
9) Instead of using water for the cytoplasm and vacuole, you could use clear jelly.
10) Green sweeties could be used for the chloroplasts, and a grape again for the nucleus. Students could then eat their plant cells!

YOU WILL NEED:

- Tupperware
- Clingfilm
- Ziplock bags
- Peas
- Grapes
- Water

HEALTH AND SAFETY
Make sure that all food intolerances and allergies have been checked prior to doing this!



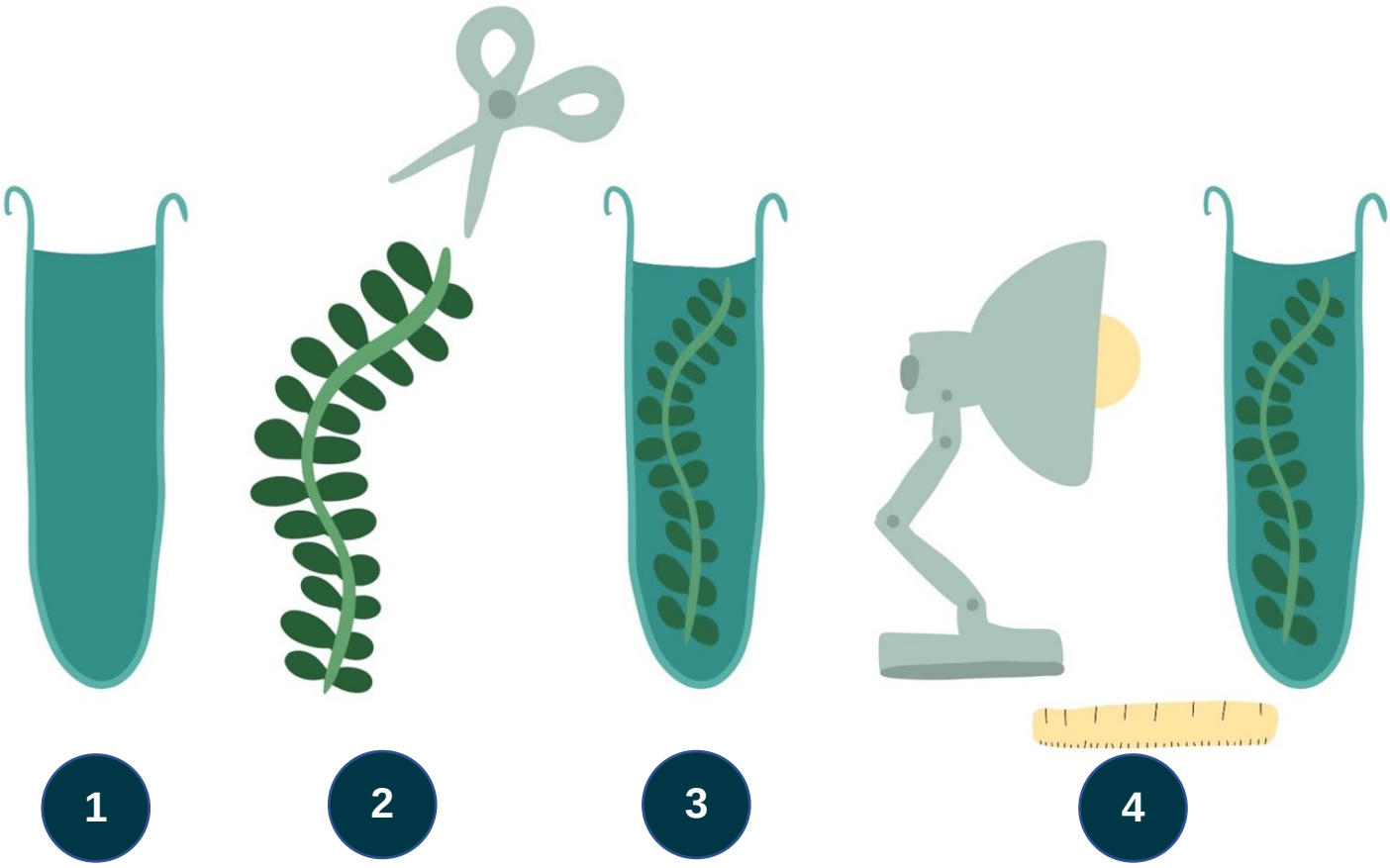
ACTIVITY 4:

The effect of light intensity on photosynthesis can be investigated in water plants. Use *Cabomba* or *Elodea* (sold in aquarium shops). The plants will release bubbles of oxygen which can be counted. Before this experiment, ask students to draw a table preparing to record the bubble rate over one-minute periods. An LED bulb is best for this experiment as it will not raise the temperature of the water. Add sodium hydrogencarbonate ($NaHCO_3$) to the water to supply carbon dioxide (reactant in photosynthesis) to the plant. The light intensity from the lamp is related to distance (it will decrease further away from the bulb) so light intensity can be varied by changing the distance from the lamp to the plant.

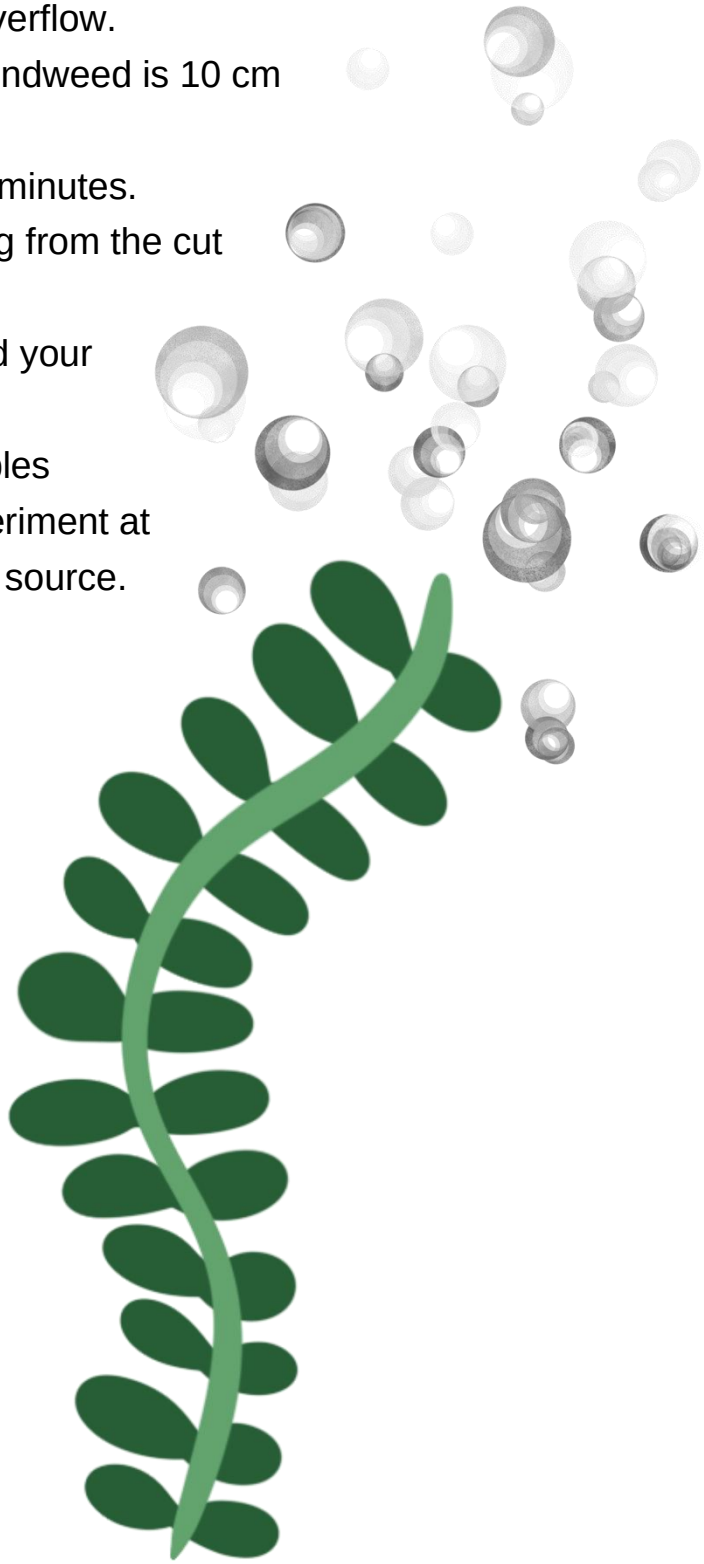
YOU WILL NEED:

- Pondweed (*Cabomba/Elodea* is favoured)
- Lamp with an LED bulb
- Beaker of water
- Ruler

HEALTH AND SAFETY
Care must be taken when using water near electrical equipment. Ensure that your hands are dry when handling the lamp



1) Set up a boiling tube containing 45 cm^3 of sodium hydrogen carbonate solution (at 1% concentration). Allow the tube to stand for a few minutes and shake to disperse any air bubbles that might form.
2) Cut a piece of the pondweed, 8 cm long.
3) Use forceps to place the pondweed in the boiling tube carefully. The pondweed should be cut end at the top. Make sure that you don't damage the pondweed or cause the liquid to overflow.
4) Position the boiling tube so that the pondweed is 10 cm away from the light source.
5) Allow the boiling tube to stand for five minutes.
6) Count the number of bubbles emerging from the cut end of the stems in one minute.
7) Repeat the count five times and record your results.
8) Calculate the average number of bubbles produced per minute. Repeat the experiment at different distances away from the light source.



FUN FACT!

One hectare of seagrass can produce up to 100,000L of oxygen per day and absorbs 35x more CO_2 than the same sized area of pristine tropical rainforest.