Algae and plants are like humans as they need food, nutrients and a good environment to grow and survive. Algae make their own energy or food from the sun but they also need water, correct temperature and nutrients to grow. Algae live in water or damp environments.

You have discovered that in Lesson 1 macroalgae have lots of cells within their body while microalgae only contain one cell. Inside each cell there is chloroplast and inside the chloroplast there is chlorophyll.

Chlorophyll is very important for making energy from the sun as it give algae their green colour. All algae contain chlorophyll even though they may not appear green. Some algae are red or brown in colour this is because they contain more red or brown pigments (colour). Chlorophyll is like a factory within algae and is used to make its own sugars. These sugars are called glucose. All algae cells contain chlorophyll.

Algae also need carbon dioxide to make sugars. Carbon dioxide is made from pollution such as smoke, fumes from cars and a little carbon dioxide is made when plants breathe at night when there is no sunlight. Algae are good for the environment as they absorb carbon dioxide from the atmosphere and use it to make energy. Algae also need nutrients to grow and they find the nutrients in water. Algae absorb the nutrients through their entire body. While algae is making energy for themselves they are also producing oxygen for humans.

The process of how algae make energy from the sun is called "Photosynthesis". It is like cooking, the main ingredients that algae need to make their energy and give us oxygen are:

Sunlight + Chlorophyll (in their cells) + Carbon Dioxide + Water = Glucose + Oxygen
Oxygen is released into the environment and both humans and animals can use it. Macroalgae contain air-bladders and some other types of macroalgae contain flexible stipes which bring the macroalgae to the surface of the water to catch the sunlight. In the case of microalgae, the tiny floating organisms are brought to the surface of the water by the movement of the currents and waves. This will help the microalgae to capture more sunlight.

Both macroalgae and microalgae absorb water, nutrients and gases from the water through their cell walls. Important nutrients for the growth of macroalgae are carbon, nitrogen, phosphorus and oxygen. The microalgae must be near the nutrients to absorb them. This is helped if the water is mixed by the action of the currents, waves or wind. An important nutrient for diatoms is silica. Dinoflagellates will use their flagella to move allowing access to nutrients. The diatoms will use the oil within their cells to sink and rise to ensure they are near the nutrients.

Algae must compete with other algae and marine life for space and nutrients. They also must avoid predators who would like to eat them.

Carbon is important for all living things. From the diagram we can see that carbon goes around in a cycle. That is why we call it a “Carbon Cycle”. Carbon is needed by the plants, rocks, animals and the soil. We return carbon to the atmosphere by burning, pollution from industry or when we use fuel in our cars. Other examples of putting carbon back into the atmosphere are humans and animals breathing out carbon dioxide into the air. This is called respiration. Carbon enters the rivers, lakes and oceans from the atmosphere.

Algae and plants use sunlight and carbon to make energy and release oxygen. Carbon is recycled when carbon enters the atmosphere and is used by algae and plants.

How can algae grow when there is no sun?

We know that throughout the world people live in different climates. This is the same for algae. Algae are found growing where there are suitable conditions for growth such as temperature, light and nutrients. Some algae grow in warm waters and others prefer cold waters. Some macroalgae like to grow in very cold waters. These macroalgae are located in the Arctic and Antarctic.

The waters of the Antarctic are covered by ice for the majority of the year. There are a few varieties of macroalgae found only in these cold waters. They do not grow anywhere else in the world. A tiny number grow in the Arctic but much more grow in the Antarctic. At certain times of the year they live in complete darkness. They are unable to use the sunlight to make their energy but survive on the energy stored in their cells.

The macroalgae that grow in both the Antarctic and Arctic can make their energy from sunlight where the sun appears again. These particular macroalgae have adapted to their environment and are called “polar seaweeds”.

Microalgae grow in all bodies of water. They prefer warm water as growth rates can be seen to increase when the temperature becomes warmer.
Activity Section - Lesson 2 - How do Algae grow?

Brief summary

Aim: The overall aim of this lesson is to show how algae grow and the conditions in which growth occurs.

Both macroalgae and microalgae need sunlight, water, chlorophyll, carbon dioxide, the correct environment and nutrients to grow and make their own energy. Macroalgae have air-bladders or flexible stipes which help the algae to rise to the surface of the water and catch the sunlight. Algae also need carbon dioxide which they get from pollution or when plants or animals breathe. Humans take in oxygen into their lungs and breathe out carbon dioxide. Algae and plants absorb carbon dioxide and give out oxygen but they also return a little carbon dioxide into the atmosphere. Algae also need water and they find their nutrients in the water. Their nutrients are carbon, oxygen, phosphorus and nitrogen. Certain microalgae use silica as their nutrients. Algae need chlorophyll which are found inside the cell of both macroalgae and microalgae.

Algae make their own energy by using:

\[ \text{Sunlight} + \text{Carbon Dioxide} + \text{Water} + \text{Chlorophyll} \rightarrow \text{Glucose} + \text{Oxygen}. \]

Algae then make glucose and oxygen. They give oxygen to the environment. This is good for the environment and everyone living on earth. Algae give us oxygen and use carbon dioxide. This process is called "photosynthesis".

If you look at the Carbon Cycle diagram you will see that animals, humans, factories and cars produce carbon dioxide. Algae, plants and trees need carbon dioxide to make their energy.

Algae can be found in different environments. There are a small number of macroalgae found growing in the Arctic and Antarctic. These are called "polar seaweed". At certain times of the year these macroalgae do not receive much sunlight however they grow using their food reserves from the previous year and wait until the sun comes out again to start producing energy.
Learning Outcomes:
► Describe what conditions are necessary for algae to grow.
► Illustrate the importance of sunlight for the growth of algae.
► Discuss how algae can be good for the environment.

Introduction:
From previous lesson ask pupils about the structure/features of both macroalgae and microalgae.
Ask pupils what makes people grow.
Explain that the sunlight and carbon dioxide, water, nutrients and chlorophyll that are inside the cells help to make food/energy for the algae and plants.
Use the illustration of photosynthesis to explain the concept.
Discuss briefly the carbon cycle and how algae benefit the environment by consuming carbon dioxide and producing energy and oxygen.
Teacher may use a map of the world to show where the Arctic and Antarctic are located and how macroalgae can grow in these environments.

Activities:
Activity 1 The effect of sunlight on plants.
Activity 2. To show what conditions are needed for growth of Algae
Activity 3. Draw a diagram/picture showing how algae get their energy from the sunlight.
Activity 4. Unscramble the following words that are important for algae growth.
Activity 5. Word Search

Final Activity:
► Teacher will discuss the main learning points from the lesson.
► Teacher will test the knowledge of the pupils by asking them to explain the role of sunlight in the growth of algae. Pupils must also highlight importance of carbon dioxide, water, chlorophyll and nutrients.
► Ask pupils to identify ways in which algae can benefit the environment.
► Ask the pupils to discuss their findings from their group Activity 1 or Activity 2 and what their findings meant in relation to algae and photosynthesis.

Vocabulary: photosynthesis, carbon dioxide, oxygen, chlorophyll, nutrients and sunlight.
<table>
<thead>
<tr>
<th>Curriculum Links</th>
<th>Level 1</th>
<th>Level 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Literacy and English</strong></td>
<td>I can identify and discuss the purpose, key words and main ideas of the text. LIT 1-04a</td>
<td>I can identify and discuss the purpose of the main ideas and supporting detail contained within the text. LIT 2-04a</td>
</tr>
<tr>
<td>Finding and using information</td>
<td>I can understand information, explore ideas and problems and create new texts. LIT 1-15a</td>
<td>I can create new texts using my own words as appropriate. LIT 2-05a</td>
</tr>
<tr>
<td><strong>Reading</strong></td>
<td></td>
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</tr>
<tr>
<td>Finding and using information</td>
<td></td>
<td>I can understand information, develop my thinking, explore problems and create new texts, using my own words as appropriate. LIT 2-15a</td>
</tr>
<tr>
<td><strong>Writing</strong></td>
<td></td>
<td>I consider the impact that layout and presentation will have and can combine lettering, graphics and other features to engage my reader. LIT 2-24a</td>
</tr>
<tr>
<td>Tools for writing</td>
<td></td>
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<tr>
<td><strong>Numeracy and Mathematics</strong></td>
<td>I have explored a variety of ways in which data is presented and can ask and answer questions about the information it contains. MNU 1-20a</td>
<td>I can interpret and draw conclusions from the information displayed, recognising that the presentation may be misleading. MNU 2-20a</td>
</tr>
<tr>
<td>Information handling</td>
<td></td>
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<tr>
<td>Data analysis</td>
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<tr>
<td><strong>Sciences</strong></td>
<td>I can distinguish between living and non living things. I can sort living things into groups and explain my decisions. SCN 1-01a</td>
<td>I can relate physical and behavioural characteristics to their survival or extinction, SCN 2-01a</td>
</tr>
<tr>
<td>Planet Earth</td>
<td>Through carrying out practical activities and investigations, I can show how plants have benefited society. SCN 2-02b</td>
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<tr>
<td>Biodiversity and Interdependence</td>
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</tbody>
</table>

Skills: Observe, record, inquiry and investigate.
### Ireland
**National Council for Curriculum Assessment (NCCA)**

<table>
<thead>
<tr>
<th>English</th>
<th>First Class, Second Class</th>
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</thead>
<tbody>
<tr>
<td>Writing</td>
<td></td>
</tr>
<tr>
<td>Developing cognitive abilities through language</td>
<td>Write a version of a story told by the teacher.</td>
</tr>
</tbody>
</table>

| Mathematics                   |                           |
| Data                          |                           |
| Representing and interpreting  | Sort and classify objects by two and three criteria. |

| Social Environmental and Scientific Education (SESE) Science |                           |
| Living things - Plants and Animal life | Appreciate that living things have essential need for growth. |

| Geography                     |                           |
| Environmental awareness and care - Caring for my locality | Develop an awareness that air and water are essential to the environment. |

<table>
<thead>
<tr>
<th>Third class, Fourth class, Fifth class</th>
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</thead>
<tbody>
<tr>
<td>English</td>
<td></td>
</tr>
<tr>
<td>Reading- Receptiveness to language</td>
<td>Read and interpret different kinds of functional text.</td>
</tr>
</tbody>
</table>

| Mathematics                     |                           |
| Data                            |                           |
| Representing and interpreting data | Read and interpret tables. |

| Social Environmental and Scientific Education (SESE) Science |                           |
| Fifth Class, Living things, Plant and animal life | Become aware of the sun as a source of energy for plants through photosynthesis. |

| Third class, Fourth Class, Living things, Plant and animal life |                           |
| Geography Fifth- Class-Natural environment. The local natural environment | Come to appreciate that animals depend on plant and indirectly on the sun for food. |

| Third Class, Fourth Class Natural environments The local natural environment | Investigate the influence of these features and on the lives of animals and people. |

|                              | Observe and explore ways in which these features have affected the lives of plants animals and humans. |

**Skills:** Re-call facts and definitions, record present findings and conclusions.
<table>
<thead>
<tr>
<th>Northern Ireland</th>
<th>Key Stage 1</th>
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</thead>
<tbody>
<tr>
<td><strong>Language and Literacy</strong></td>
<td><strong>Talking and listening</strong></td>
</tr>
<tr>
<td></td>
<td>Listen to, interpret and retell written texts.</td>
</tr>
<tr>
<td></td>
<td>Re-tell, re-read and act out a range of texts, pictures and diagrams.</td>
</tr>
<tr>
<td></td>
<td>Write making own decision about form and content.</td>
</tr>
<tr>
<td><strong>Reading</strong></td>
<td><strong>Writing</strong></td>
</tr>
<tr>
<td></td>
<td>Discuss and interpret the data extract information from charts.</td>
</tr>
<tr>
<td><strong>Mathematics and Numeracy</strong></td>
<td><strong>Handling Data</strong></td>
</tr>
<tr>
<td></td>
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<tr>
<td><strong>The World Around Us</strong></td>
<td><strong>Interdependence</strong></td>
</tr>
<tr>
<td></td>
<td>How plants rely on each other within the natural world.</td>
</tr>
<tr>
<td></td>
<td>Ways in which living things depend on and adapt to their environment.</td>
</tr>
<tr>
<td><strong>Place</strong></td>
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<tr>
<td><strong>Key Stage 2</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Language and Literacy</strong></td>
<td><strong>Talking and listening</strong></td>
</tr>
<tr>
<td></td>
<td>Prepare and give a short oral presentation to a familiar group.</td>
</tr>
<tr>
<td></td>
<td>Use traditional sources to locate, select and communicate information for a particular task.</td>
</tr>
<tr>
<td><strong>Reading</strong></td>
<td><strong>Writing</strong></td>
</tr>
<tr>
<td></td>
<td>Begin to formulate their own personal style.</td>
</tr>
<tr>
<td><strong>Mathematics and Numeracy</strong></td>
<td><strong>Handling Data</strong></td>
</tr>
<tr>
<td></td>
<td>Classify, record and present data explain their work orally and draw conclusions.</td>
</tr>
<tr>
<td><strong>The World Around Us</strong></td>
<td><strong>Interdependence</strong></td>
</tr>
<tr>
<td></td>
<td>How living things rely on each other within the natural world.</td>
</tr>
<tr>
<td><strong>Place</strong></td>
<td>Ways in which plants and animals depend on features and materials in places.</td>
</tr>
</tbody>
</table>

**Skills:** Thinking, problem solving, working with others and managing information.
Activity 1. Name

The effect of sunlight on plants

Materials:
Plants (living) example potted plant (1 potted plant may be enough to show as a demonstration).
Strong pieces of paper (large enough to cover leaves).
Paper clips or sellotape - to secure the paper over the leaves.

Method:
1. This activity can be demonstrated by the teacher or as a class.
2. Divide the pupils up into groups.
3. Give each group a healthy/living plant.
4. Pupils will be asked to cover some leaves of the plant and to keep the remainder of the leaves uncovered.
5. Ask the pupils to observe and record the colour of the leaves of the plant.
6. Pupils must select some leaves they wish to cover from the plant. Cover with strong paper. Ensure the paper is securely attached.
7. Leave the plant in a sunny location for 2 weeks.
8. Remove the paper from the leaves after 2 weeks.
9. Record the colour and the condition of the leaves that were covered and uncovered.
10. Compare the difference between the covered and uncovered leaves.

What are your conclusions?

<table>
<thead>
<tr>
<th>Table 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
</tr>
<tr>
<td>Before Covering</td>
</tr>
<tr>
<td>After Covering</td>
</tr>
<tr>
<td>Conclusion</td>
</tr>
</tbody>
</table>
Activity 2.

To show what conditions are needed for the growth of algae.

Teacher demonstration only.

Materials:
Water - Try to collect some water from a pond that may contain algae.
Gloves for collecting water.
Glass container with clear lids - 4 containers (for each group).
Aluminium foil or black paper.
Dropper (or measurement jug for collected water).
Nutrients in the form of fish food (you may obtain from pet shop).

Health and Safety: Wash hands after collecting water and handling the fish fertilizer. Throw out all collected water after experiment and wash thoroughly to prevent infection.

Method:
Place four empty bottles or containers on the table.
Label the four containers:
With sun and with nutrients
With sun and without nutrients
Without sun and with nutrients
Without sun and without nutrients

Add 15ml of water by using the dropper or measurement jug to each container.
Add 5 drops of fish feed to the two containers labelled “nutrients”. The fish feed will act as nutrients.
Pick one container that received the nutrients and one that did not receive nutrients.
Cover these two containers with aluminium foil or black paper and label them “without sun”. The cover is to ensure that they do not receive sunlight.
Choose another container that received the nutrients and one that did not receive nutrients. Leave the remaining two with clear lids-uncovered. These containers should be labelled “with sun”.
Place all four containers on a safe sunny window

Complete your science investigation sheet.
Observe and record the appearance of all containers at the start of the experiment.
Observe and record the appearance of all containers at the end of the experiment on day five.
Record growth, colour and how clear the water is.

What conditions did algae grow best? ________________________________________

What conditions did algae not grow? ________________________________________
Activity 3. Name  

Draw a diagram/picture showing how algae get their energy from the sunlight. Label the picture describing what is used and what is made by the algae during this process/photosynthesis.

Write a brief description about what is happening in this process.

Explain the role of sunlight, nutrients, water, chlorophyll inside the cells and carbon dioxide in the picture?

Why is photosynthesis (the way algae or plants use sunlight) good for the algae and the environment?

(This is the photosynthesis picture from the Lesson 2 - Energy from the Sea).
Activity 4  
Name ____________________________

Unscramble the following words that are important for algae growth.

tuirnnet  = 
rrtteeampu = 
erwat = 
gsiltunh = 

From the following list choose 4 items that help algae produce glucose and oxygen.

Sunlight
Plants
Chloroplast
Oxygen
Silica
Carbon Dioxide
Diatoms
Water
Chlorophyll
Phosphorus

_________ + ___________ + _________ + ___________ → Glucose + Oxygen
1. Find three things that algae need for growth.
2. What parts of the algae plant is used to make photosynthesis?
3. Find two places in the world where macroalgae grow in very cold conditions?
4. What is the name of the gas that is made by photosynthesis?
5. Apart from making gas in photosynthesis, what else is made?
6. Find two nutrients that algae like.
7. What nutrients do diatoms need?
8. What do you call macroalgae that live in the Arctic or Antarctica?
9. What do algae use to absorb nutrients as they have no roots?
Answers to Activities

Activity 1
Answer: There should be a difference in appearance and condition of the leaves that were covered and uncovered. Explain to the class that like algae the leaves need sunlight in order to make their own energy and food. This process is called "photosynthesis".

Activity 2
Answer: In conclusion the containers that were left uncovered and obtained nutrients should show growth. This states that algae requires sunlight and nutrients for growth.

Activity 3
Answer: The pupils should write a brief description about what is happening in this process.
Encourage the pupils to briefly explain using their own words the process of algae obtaining sunlight. The pupils should explain that algae is making food and energy for themselves and return oxygen to the atmosphere.

Pupils should explain the role of sunlight, nutrients, water, chlorophyll inside the cells and carbon dioxide in the picture?
Algae make their own energy by using:

\[
\text{Sunlight + Carbon Dioxide + Water + Chlorophyll} \rightarrow \text{Glucose + Oxygen.}
\]

Encourage the pupils to tell how photosynthesis is good for the environment by removing carbon dioxide and produce oxygen and also by making energy/ food for the algae. The pupils should also state that during photosynthesis algae consume carbon dioxide which is good for the environment.

Activity 4

Unscramble the following words that are important for algae growth.

<table>
<thead>
<tr>
<th>tuirnnet</th>
<th>nutrient</th>
</tr>
</thead>
<tbody>
<tr>
<td>rrtteeeampu</td>
<td>temperture</td>
</tr>
<tr>
<td>erwat</td>
<td>water</td>
</tr>
<tr>
<td>gsiltunh</td>
<td>sunlight</td>
</tr>
</tbody>
</table>

Answer:

\[
\text{Sunlight+Carbon Dioxide+Water+Chlorophyll} \rightarrow \text{Glucose + Oxygen}
\]
Activity 5 – Word Search

1. Name three things that algae need for growth?
   Answer: water, light, and carbon dioxide.

2. What parts of the algae plant is used to make photosynthesis?
   Answer: chlorophyll.

3. Name 2 places in the world where macroalgae grow in very cold conditions?
   Answer: the Arctic and Antarctic.

4. What is the name of the gas that is made by photosynthesis?
   Answer: oxygen.

5. Apart from making gas in photosynthesis, what else is made?
   Answer: energy.

6. Name two nutrients that algae like.
   Answers: phosphorus and nitrogen.

7. What nutrients do Diatoms need?
   Answer: silica.

8. What do you call macroalgae that live in the Arctic or Antarctica?
   Answers: polar seaweed

9. What do algae use to absorb nutrients as they have no roots?
   Answer: cells
Energy from the Sun

We make sugar and Oxygen

Chloroplasts

Chlorophyll

Microalgae

Macroalgae

We eat carbon dioxide

We eat Carbon dioxide

We make sugar and Oxygen

Chloroplasts
Carbon Cycle

Emissions

Fossil

Oil

Ocean Uptake

CO₂

O₂

Carbon Cycle diagram illustrating the flow of carbon dioxide (CO₂) and oxygen (O₂) through the environment. The diagram shows emissions from fossil fuels and oil, the uptake by the ocean, and the role of photosynthesis in the carbon cycle.