PROJECT SEAGRASS

SEAGRASS & ME!

ACTIVITY PACK FOR AGES 11-14

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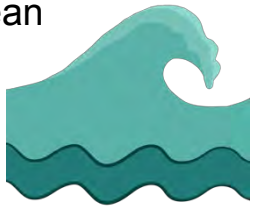
INTRODUCTION

The marine world is so often overlooked and seen as something a million miles away. **Project Seagrass** wants to change this and bring the ocean to the classroom, inspiring a new generation of ocean lovers that are aware of the effects of their actions and how to make positive, sustainable choices.



The activities have been designed for KS3 students between 11 - 14 years old. The activities complement various aspects of the Welsh, English, and Scottish curriculums.

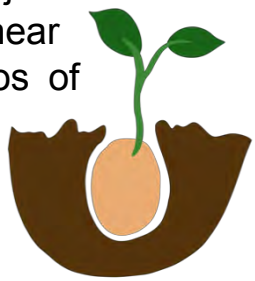
The resources have been written as part of a five-day residential course but are accessible as standalone activities or themed activity packages to enable wider accessibility. The proposed residential site is **Porthdinllaen**, North Wales. Porthdinllaen is a special area of conservation known for its large seagrass meadow, making it the ideal place to highlight the wonders of this little-known ecosystem. However, all activities can be adapted to other UK coastal sites and many to non-marine or classroom settings.

Some activities require specialised equipment, however wherever possible easily accessible household items have been suggested and resources have been kept to a minimum.

Project Seagrass is not responsible for mitigating risk or injury to participants or leaders whilst undergoing an activity. Risk assessments and precautions are your responsibility. Please see our coastal tips for baseline advice for working on the beach and in the shallows.

If you find yourself in an emergency or spot someone else in trouble, you should call **999** or **112** and ask for the coastguard.

We hope these activities inspire curiosity and care for the natural world. Please get in touch with Project Seagrass via social media - we'd love to hear your stories and questions and see photos of your seagrass adventures!



Content:

Activities:

The original design was for the **site comparison** activities to happen over the first two days, giving the participants a baseline knowledge to build on for the **green future** activities over the second two days.

- Site comparison activities were designed to highlight the differences between a bare sand sea scape and a complex seagrass environment. It is advised to spend a day conducting activities at one habitat and the second day at the other. If following this set up, the intent was for the species hunt and samples for the water filtration and microplastic activity for a site to be collected in one go and then repeated at the second site the following day.
- The litter activity involves a daily mini beach clean through the residential but can equally be done as one large session.
- Most beach activities are recommended to be done at a low tide, which may mean a flexi hours approach to timetabling is needed (early starts and late finishes!).

Site comparison activities	Green future activities
• Species hunt (minimum 30 mins) • Water filtration (2-3 hours) • Microplastics (3-4 hours) • Coastal defence (20 mins) • Hide & Seek (10 mins) • Geology intro (2 hours)	• Habit breaker (5 mins) • Climate change introduction (5 mins) • Underwater gardener (2 lots of 3 hours sessions) • Stakeholder meeting (1.5 hours) • Litter and the environment (1-2 hours) • Resource rampage (30 mins) • Home audit (20 mins) • Making changes (1-2 hours)

Suggested timetable/activity combinations, with a day for travel. Morning activities are at the beach, afternoon activities can be classroom or outdoors depending on the weather.

	Day 1	Day 2	Day 3	Day 4
Morning	Species hunt, Water filtration, and Microplastic Sample collection from site 1	Species hunt, Water filtration, and Microplastic Sample collection from site 2	Seed collection	Planting and Litter collection analysis
Afternoon	Hide & seek, Coastal protection, and an Introduction to geology	Follow up indoor activities for Species hunt, Water filtration, and Microplastics	Climate change, Resource rampage, and the Stakeholder meeting	Habit breaker, Home audit, and Making changes

Extra resources:

- Nature photography guide
- Persuasive writing guide

Activity structure:

You will find a teacher's guide and a matching workbook for each activity. The teacher's guide provides extra tips on leading the activities and answers to the workbook.

Teachers guides begin with an overview of learning objectives and curriculum links, followed by a key information box with 4 bullet points:

KEY INFORMATION

- Location of activity – indoor, outdoor or both
- Individual, partner or group activity
- Length of activity
- Activity type- teacher presentation/practical/workbook

Each then works through the following structure:

- **Learning tips.** Some activities complement each other, these are highlighted here! There may also be alternative ways to run the activity. Links to recommended external activities and resources are also provided. Still, Project Seagrass does not take responsibility for the content provided and can only recommend the available content at the time of creation.
- **Key words.** Check the glossary for extras!
- **What's it about?** A broad introductory topic explanation.
- **What to do.** Followed by a list of **necessary and optional resources** to complete the task and **Health and safety points** - any major hazards involved with the activity. Always do a thorough risk assessment for your individual circumstance prior to an activity.
- **Workbook questions and answers.** Some activities have follow-up questions and activities in the student workbook. When appropriate, answers for these have been added here.
- **A fun fact!**

If you're inspired, check out and get involved with these citizen science projects!

- Seagrass spotter**!** https://seagrassspotter.org/
- Great egg case hunt- resources from the Shark Trust- https://www.sharktrust.org/great-eggcase-hunt
- Surfers against sewage have initiatives such as plastic-free schools and ocean school, organise mass unwraps, and beach cleans https://www.sas.org.uk/our-work/education/
- Wildlife trusts have lots of citizen science projects to get involved with from shore searches, hedgehog hunts to river searches https://www.wildlifetrusts.org/citizen-science
- Marine conservation society has lots of initiatives, including beach cleans and seaweed hunts. https://www.mcsuk.org/get-active/
- Capturing our coast records everything on our beaches and provides lots of gear to get your id skills trained up https://www.capturingourcoast.co.uk/Specific-investigations
- Garden BirdWatch https://www.bto.org/our-science/projects/gbw
- Natural history museum has a list of lots of different nature-based citizen science projects https://www.nhm.ac.uk/take-part/citizen-science.html
- CJS has a whole collection of different projects in different areas https://www.countryside-jobs.com/volunteers/citizen-science

COASTAL TIPS

Top tips on safe intertidal and snorkelling work with kids!

This guide offers advice for safe working on the beach and in the shallows. It is not an extensive risk assessment. Project Seagrass is not responsible for risk management or an injury incurred to participants or leaders during an activity. Risk assessments and precautions are your responsibility.

Whilst at the seaside, please only take photos and only leave footprints (or bubbles!).

General:

- Always take an appropriate first aid kit and a trained first aider into the field.
- Have an emergency action plan, including a hospital evacuation strategy.
- Know where the nearest point of phone signal or landline is. Using a VHF radio or a walkie-talkie may be considered at sites with poor phone signals. Brief everyone on a clear recall signal in case you need to clear the beach quickly. For example, three short whistle blows.
- Consider what facilities are at the site such as toilets and cafés.

If you find yourself in an emergency or spot someone else in trouble, you should call **999** or **112** and ask for the coastguard!

Weather:

- Always check the weather forecast before fieldwork and do not go if you are unsure about the conditions.
- Remember that the weather can change quickly on the coast, keep an eye on it and prepare for all conditions.
- The sun reflects off the sea, making it easy to burn even if it is not a hot day. Always wear reef safe sunblock, a hat, and sunglasses.
- Drink plenty of water.
- Pack lots of warm and wet weather gear. Keeping your head warm is key especially after a cold dip in the sea! Waterproofs are good for keeping the wind off as well as the rain. If anyone is cold, try to get them moving and have a hot drink. Move them to a warmer spot sheltered from the wind, such as the minibus, whilst the rest of the group finishes up.
- Ensure a survival blanket is in the first aid kit.

Tides:

- Check the tide times before fieldwork.
- Research whether there is anything unusual about the site, such as rip currents or strong tides. Follow the local safety guidelines and advice.
- Most intertidal and snorkelling work is best done on a spring low tide (full moon).
- Keep an eye on the tide so that no one gets cut off from land as it comes back in.

Marine life:

- Do not disturb or touch marine life! If you leave it be, it will not harm you!
- Some animals can bite, sting or pinch. Seek appropriate medical attention if needed.
- Wear shoes or wetsuit booties and avoid standing on marine life. Find out whether there are any species to be wary of and what to do if an incident occurs. For example, weever fish bury themselves in the sand with venomous spines sticking out, standing on them without booties is extremely painful! If this occurs, soak the wound in hot water for at least 30 minutes and then leave the puncture wound open to allow it to drain.
- Shuffling through the water rather than stepping can alert animals to your presence, allowing them time to get out of your way.
- Do not pick or damage plants.

Rock pooling and beach work:

- Rockpools can be slippery and sharp environments. Move slowly so as not to fall and cut yourself.
- Seaweed and seagrass can be really slippery!
- Watch out for hidden rocks, ropes or snags.
- Keep an eye on the tide so that no one gets cut off from land as it comes back in.
- Watch out for any sharp objects in the sand.
- Be mindful of rock fall if standing near cliffs, and do not climb them as sediment may be unstable.
- Do not hammer or dislodge the rock face unless asked to do so. If hammering is required, ensure safety goggles are worn and students work away from each other to avoid injury.
- Avoid recent landslide and rockfall sites, especially after heavy rain and storms.

- Stay to defined footpaths and away from cliff edges.
- Wear closed-toe shoes.

Snorkelling:

- Consider the weather and tides! You need calm, relatively flat conditions for snorkelling.
- After heavy rain or storms, the water might be murky, making it challenging to see anything. Try and plan around the weather!
- Aim to be in the water for the slack water. Slack water lasts 30-60 minutes before and after low tide. At his time, there is the least water movement, reducing physical effort, the need to duck dive, and the best visibility.
- Whilst snorkelling, designate someone to stay on land. The land person keeps track of who is in the water and watches that no one is moving towards a potentially dangerous situation. They should be first aid trained and have a phone ready to call for help in the case of an emergency. It is useful to record the times of each buddy pair going in and coming out of the water.
- Before getting in brief the group on communication signals. Touching your head calmy above the water is an ok sign- this is a question and should be answered by doing the signal in return to say ok! If something isn't ok, then wave lots. Remind the kids not to wave their arms around if they are fine as you might think they are drowning! A whistle may be useful to get people's attention.
- Set area boundaries before entering the water.
- Get the kids to snorkel in buddy pairs, reminding them they are responsible for their buddies' safety. Group 2 to 4 buddy pairs per staff member, or as appropriate by the group's competency levels. Set a maximum distance that the buddy pairs can go from their staff member.

- You may consider a surface marker buoy (SMB) per buddy pair or group. This makes it much easier to spot where the snorkellers are, especially if they are duck diving. Be wary that unconfident swimmers might find holding on to the SMB challenging and can get tangled in the string. Bright swimming caps/ hoods may offer an easier alternative.
- Always get out of the water as soon as you feel tired, cold or are shivering.
- Attach the snorkel to the side of the mask to stop it from falling off.
- Remind kids to try not to breathe through their nose as the mask will fog. If it becomes foggy, then give it a swill in the sea. A small blob of baby shampoo wiped around the inside of the mask and then rinsed out will help to stop the mask from fogging up.
- Practice breathing through the snorkel above the water, and then try with their mouths under but eyes still out. Finally, try breathing through it with their face fully submerged.
- Remind new snorkellers that if they put their head too deep or there is a big wave, their snorkel might fill with water. If this happens, they just need to do a big blast of breath out to clear it, or they can let it drain above the water.
- Fins are optional. If using, put fins on once in the water.
- A surf or paddle board can be used as a floatation device to hold on to whilst gaining confidence.
- Watch out for other water users, such as boats and jet skis. Try to avoid areas that they are using. Ensure you are visible to them - using an SMB helps if possible.
- Move slowly whilst in the sea - there may be hidden rocks or ropes to trip you!
- Free dive only in areas of clear water, with no risk of entanglement whilst underwater.
- Plenty of water and eating ginger-based products can reduce the effects of sea sickness.

Wildlife spotting tips!

- Move slowly and be still and an animal is more likely to show itself to you.
- Look for shapes rather than colours.
- The strandline is a great place to search, this is the line of seaweed and other bits left behind as the tide heads back down the beach.
- The more you have your feet on the floor whilst snorkelling, the more you will scare the animals and make the water murky.
- Check on the sea floor, between seagrass, seaweed and rocks, and straight out to sea.
- Look closely at leaves and rocks for tiny critters.
- Patience and constant scanning are key!

PROJECT SEAGRASS

SPECIES HUNT
ACTIVITY GUIDE
AGES 11-14

OVERVIEW

This activity guide introduces the topic of species hunt. The activity in this guide allows you to explore the importance of identifying species in order to protect them.

KEY INFORMATION

- Outdoor activity
- Partner activity
- Time – 1 hour
- Practical

- **Lesson Objective:** to identify marine life and their preferred habitats
- **Curriculum links:** Geography/Biology/Creative arts

LEARNING TIPS

Check out our nature photography guide – no fancy equipment needed! Please share any favourite snaps with Project Seagrass! Any pictures with seagrass in can be uploaded to the Seagrass Spotter app to help scientists learn about seagrass.

This 'Species hunt' guide can be used with other habitat comparison Project Seagrass activities, such as '**Water filtration**', '**Microplastics**', '**Hide & seek**' and '**Geology**' guides, as well as sustainability activities such as '**Climate change**', '**Resource rampage**', '**Making changes**' and the '**Stakeholder meeting**' guides.

KEY WORDS

Dichotomous key – Series of questions with only two answers that help to identify an organism

Scientific name – This is a two-part formal name given to a species following a worldwide set of rules. For example, humans are '*Homo sapiens'.* The first word always has a capital and the whole name is always in italics

FUN FACT!

Seagrass meadows in the UK have 35 times more animals than bare sand!

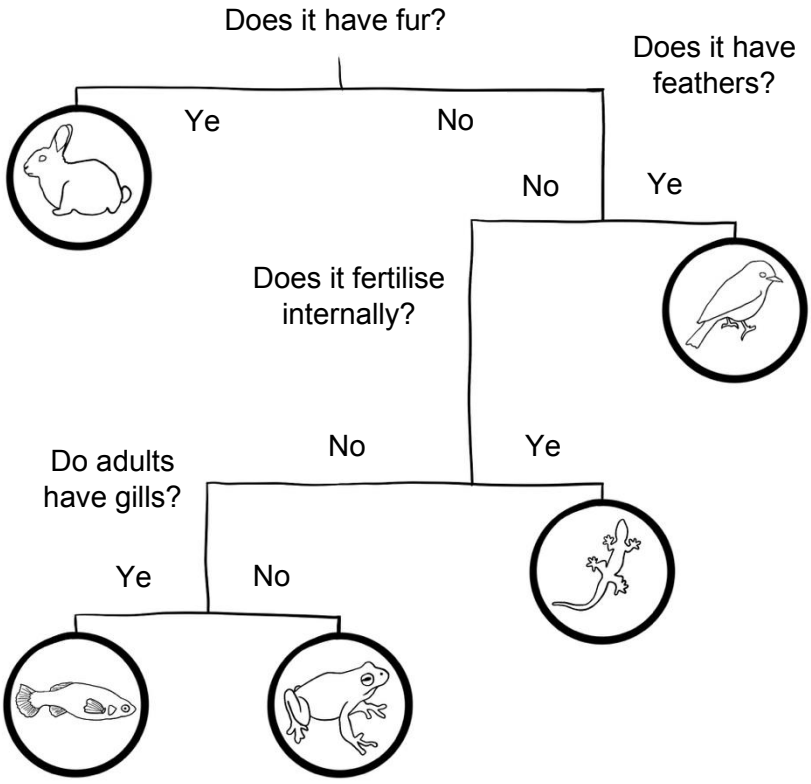
INTRODUCTION

FUN FACT!

The common cuttlefish has three hearts!

There are huge amounts of incredible and diverse creatures in and around UK waves! These vary from tiny shrimp to basking sharks, whose mouths are a metre wide. Just like on land, each of these animals has a key role to play in keeping our seas healthy. This activity is all about getting a taste for life in and around the edge of our seas.

One of the ways we identify different species is through using a **dichotomous key**, where a series of questions are asked about the animal with a yes or no answer, narrowing it to one species. A question might be something like 'does it have feathers?', if 'no' then the animal probably isn't a bird.



Why?

Scientists need to know where different animals **live**, their **habits** and **population size** to be able to **protect** them. Think about how tricky it is to spot the animals, identify them and understand what they're up to whilst you're searching on the shore or snorkelling. Are you sure it's a shore crab and not an edible crab? How do you know you're not repeatedly spotting the same animal or simply not spotting it?

New techniques to look at marine wildlife are being developed all the time. Scientists now use techniques such as baited underwater video cameras, scuba diving, nets, traps, drones, animal tagging and even recording the noise of the ocean - they can translate dolphins chatting in clicks and whistles!

ACTIVITY:

1) On land, talk the class through some basic ID features such as type of animal (fish/bird/snail etc), colour, size, number of legs or fins etc. Use a couple of the species on the list as examples - such as pointing out how cod is a dull green with three fins on its back.

2) Encourage the class to think about how they will find the animals. Firstly, they'll need to consider where the animal lives. The species id card offers tips.

a. If the animal is best spotted from the shore, get them to think about whether they should look to the cliffs, the air, out to sea or in rock pools. If it's on the beach, then the strandline will be the best place to look. This is the line of seaweed and other bits left behind as the tide heads back down the beach.

b. If the animal is in the sea, then remember these top tips!

YOU WILL NEED:

Species hunt id cards and a pencil

A clip board (preferably waterproof, such as a dive slate)

For snorkelling:

Laminated species hunt id cards and white board marker

Wetsuits and swim wear

Snorkel and mask

Fins (optional)

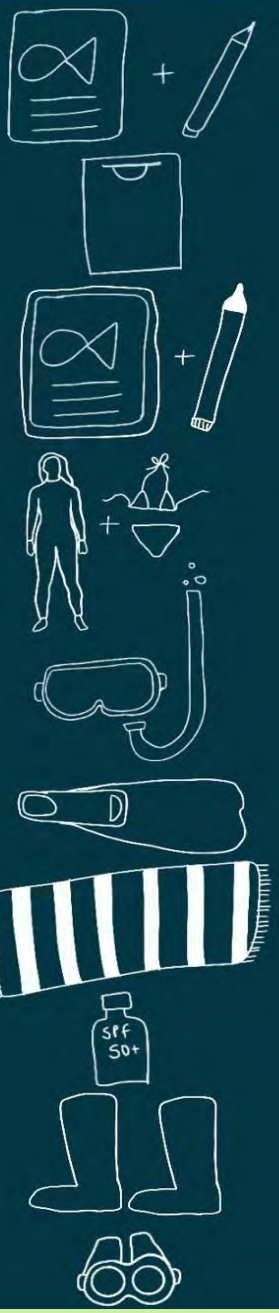
Towels

Reef safe sun cream

For shore searches:

Wellies and appropriate weather gear

Binoculars (optional)



HEALTH AND SAFETY

Do not disturb or touch wildlife!

Refer to our coast tips for advice on health and safety whilst searching for marine wildlife

i) The more you have your feet on the floor, the more you'll scare the animals away and the murkier you'll make the water.

ii) Move slowly in the water to avoid disturbing the animals.

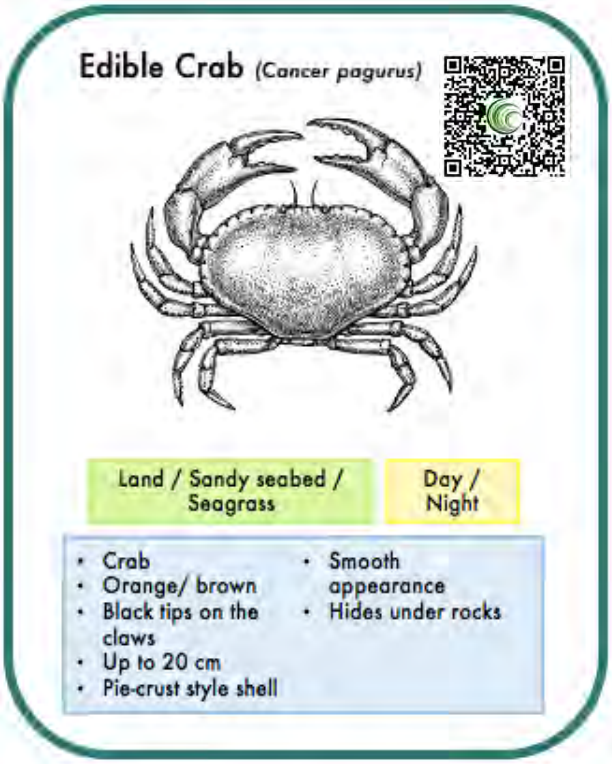
iii) Look for the shape of the animal rather than colour. Most animals try to match their colour to their surroundings to avoid being spotted.

iv) Check on the sea floor, as well as in between and on seagrass, seaweed and rocks, and straight out to sea.

v) Look closely at leaves and rocks for tiny critters!

vi) Patience and constant scanning are key!

3) Encourage the students to follow the QR codes to see some footage of the animals. Movement is a useful way to ID animals and will help them to know what they are looking for before getting to the beach.



Example of a species ID card, with the common name, scientific name, QR link to JD Scuba's species clip, line drawing and key identifying features and finding tip. Circle where and when found - multiple can be circled!

4) Check out the photography guide for anyone planning to bring a camera.

5) Snorkelling is best done on the low tide.

6) Give a full brief including safety rules, search area, risks, and communication signals. Check the coastal tips for more advice.

7) Begin the snorkelling session with a basic introduction on how to snorkel.

a. Attach the snorkel to the side of the mask so it doesn't keep falling off.

b. The mask goes over their eyes and nose so they can see!

c. Try not to breathe through their nose as it fogs up the mask. If it becomes foggy then give it a swill in the sea. If possible, offer baby shampoo - a small blob can be wiped around the mask and then rinsed out to stop the mask fogging up.

d. Practice breathing through the snorkel above the water, and then try with their mouths under but faces still out. Finally, try breathing through it with their face fully submerged.

e. Remind them that if they put their head too deep or there is a big wave that their snorkel might fill with water! If this happens, they just need to do a big blast of breath out to clear it, or they can let it drain above the water.

f. Remind them that there are lots of staff ready to help them and that they must keep close to their member of staff.

g. A surf or paddle board can be used as a flotation device to hold on to whilst they gain confidence.

h. For anyone completely unconfident in the water then many of the species can be found on shore, without getting wet.

i. Get out of the water if chilly or tired.

8) When they spot an animal, they can tick it off. Make a note of which habitat and when they found it!

9) Whilst in the water, the member of staff for each group should have a laminated or waterproof version of the species hunt list. The students can

come back to the staff member to check off what they have found. This is a good way of keeping them close too.

10) Ideally, conduct your hunt at two different habitat types so you can compare what you find. We recommend starting with the least complex habitat first so that everyone can get their eye in. For example, snorkel over a bare sandy seabed on the first day and over a seagrass meadow on the second day.

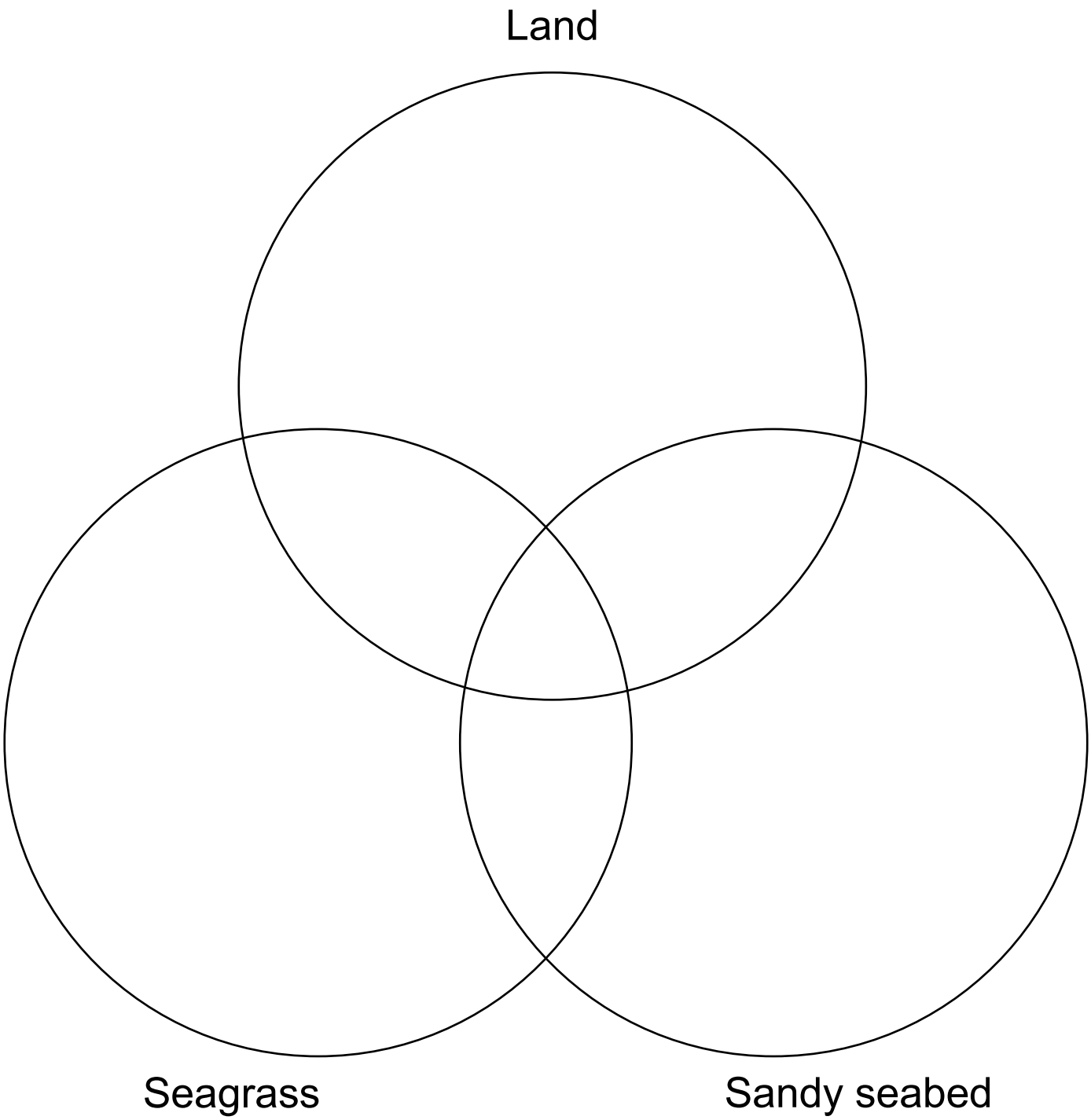
11) After a spotting session have a group discussion about who found which animals, which animals were the easiest and the hardest to spot and which habitats had the most life.

12) After an initial spotting session this could be continued into an ongoing competition as to who can tick the most species off by the end of the week- no cheating!

13) Discuss how tricky it is to gather accurate data about the behaviour and dynamics of marine life. Can the class add to our spotting tips?

WORK SHEET FOLLOW UP:

Below is a Venn diagram. Write the animals you spotted in the habitat where you found them in the Venn diagram. Some might overlap in lots of habitats whilst others you might have only found in one habitat. For example, if you only found a shore crab on the beach, then pop it in the land section only, but if you found it on the beach, in the seagrass meadow and on the sandy seabed then it goes in the middle for everywhere.



Where did you find the most animals and why do you think that might be?

Likely to be on shore, where the animals are easier to spot. In reality seagrass meadows support the most life given its provision of plentiful food and protection, however it's so good at hiding cryptic animals within that it may appear as though there's not much life.

Make a species ID card for your own made-up creature. Give it a common name, a scientific name, draw it, note key identification features and a tip on how to find it.

Sand Martin
(Riparia riparia)

Cliffs / Wading Through Seagrass | Day / Night

- Bird
- Usually 12-14cm
- Wingspan up to 13 inches
- Brown and white upperparts
- Under feathers are white with brown breast band extending to stomach
- Triangle shaped tail

Common Bottlenose Dolphin
(Tursiops truncatus)

Coastal / Deeper Water | Day / Night

- Marine mammal
- Around 2m in length
- Light, silver underbelly
- Darker dorsal side
- Triangular shaped dorsal fin
- Elongated, narrow snout – like a bottle
- Usually swim in pods

Bobtail Squid
(Sepiola atlantica)

Bottom Of The Seabed | Day / Night

- Cephalopod
- Usually 3cm
- Have 8 suckered arms and 2 smaller tentacles
- Reddish/ yellow/ orange in colour but can adapt slightly to camouflage
- 2 fins on their mantle which look like wings

Moon Jellyfish
(Aurelia aurita)

Shallows / Deeper Water | Day / Night

- Invertebrate
- Range from 1-40cm
- Round, dome-shaped jelly
- Usually floating just below the surface
- Often are washed up on beaches
- Four purple circles visible through the bell

Sea Hare *(Aplysia punctata)*

Shallows/ Rockpools / Seagrass | Day / Night

- Marine snail
- Usually 7-20cm
- Reddish-maroon colour (can be green or brown)
- Pair of tentacles on their head, like a hare, which gives them their name!
- Have large 'wings' on both sides of body

Whiting
(Merlangius merlangus)

Shallows | Day / Night

- Fish
- Usually 30-40cm
- Brown/green colour with silver underside
- 3 dorsal fins
- Long body, narrowing toward s the fan-like tail
- Large eyes and mouth
- Line high on body, which runs from head to mid-body

Atlantic Cod *(Gadus morhua)*

Shallows / Sandy Seabed | Day / Night

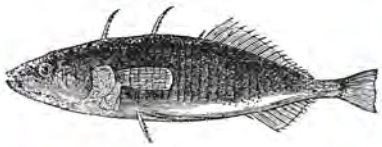
- Fish
- Usually 70-80cm
- Brown/green colour
- Tapered body with distinct tiger-like markings
- Line running from head to mid-body
- Has a chin barbel
- Tail is squared
- 3 dark dorsal fins
- 2 dark anal fins

Tombot Blenny
(Parablennius gattorugine)

Bottom Of The Seabed | Day / Night

- Fish
- Usually 20-30cm
- Orange/brown colour
- Mottled markings and dark bands running down body
- Two large tentacles on the head, which look like antlers!
- Long dorsal fin, which extends along the back

15 Spine Stickleback *(Spinachia spinachia)*



Shallows / Sandy Seabed | Day / Night

- Fish
- Usually 15-20cm
- Brown/olive colour
- Elongated, slender body
- Dorsal and anal fins are opposite each other
- Rounded tail
- Has 14-17 separate spines in front of the dorsal fin

Short-Snouted Seahorse
(Hippocampus hippocampus)

Bottom Of The Seabed/ Shallows | Day / Night

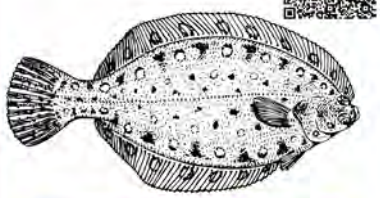
- Fish
- Usually 15cm
- Brown to yellow in colour, with distinctive bands and black markings along body
- Brush-like dorsal fin
- Has a short, upturned snout
- Curved body with curled tail

Greater Pipefish *(Sygnathus acus)*

Shallows / Sandy Seabed | Day / Night

- Fish
- Usually 10-30cm
- Pale brown to greenish brown with darker bands along the body
- Has a long snout
- Long body (often called a straightened seahorse)
- Distinctive hump on top of head behind eyes

Plaice
(Pleuronectes platessa)



Bottom of the seabed | Day / Night

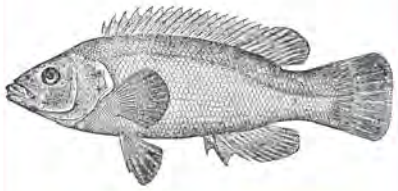
- Fish
- Usually 20-30cm
- Diamond-shaped
- Two eyes on one side
- Brown colouration with red or orange spots
- Fan-like rounded tail
- Dorsal and anal fins extended along both sides of the body

Ballan Wrasse *(Labrus bergylta)*

Shallows / Sandy Seabed | Day / Night

- Fish
- Usually 18-25cm
- Has a broad body
- Reddish brown to dark green colouration
- Has light spots over body
- Single, long dorsal fin extending all away along the back
- Rounded tail

Cuckoo Wrasse
(Labrus mixtus)



Rocky Shores / Shallows | Day / Night

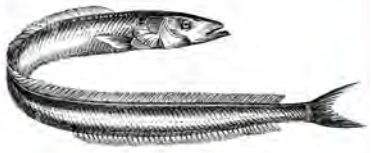
- Fish
- Usually 20-30cm
- Large and slender
- Very colourful markings (most colourful fish in the UK)
- Females are orange with black spots
- Males have electric blue stripes

Fanworm *(Bispira volutacornis)*

Shallows / Sandy Seabed | Day / Night

- Worm
- Up to 40cm long
- Lots of tentacles coming from the head, called a fan (compared to a feather duster)
- Fan can be white, yellow or brown
- Long, brown flexible body

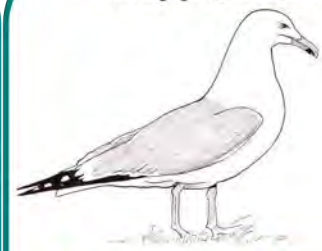
Lesser Sand Eel
(Ammodytes tobianus)



Rocky Shores / Shallows | Day / Night

- Fish
- Usually 10-20cm
- Silver colouration
- Are found buried in the sand
- Very slim, elongated body
- Have a pointy jaw
- Small tail, which looks like a fork

Herring gull *(Larus argentatus)*



Rocky Shores / Muddy Shores/ Estuaries | Day / Night

- Bird
- White head with large yellow beak and pink legs
- Have white feathers, grey wings with black wingtips
- Can have a wingspan up to 1.6m
- Can dive to 6 ft to catch prey

Lesser-spotted dogfish
(Scyliorhinus canicula)

Rocky Shores / Shallows | Day / Night

- Fish (shark!)
- Usually 50-60cm
- Has large, cat-like-eyes and creamy skin that is covered in brown spots
- Baby dogfish develop in mermaid's purses and wash up on beaches when the dogfish have hatched!

Hermit crab *(Pagurus bernhardus)*

Rocky Shores / Shallows | Day / Night

- Crab
- Live inside empty sea snail shells
- Right-hand pincer is larger than the left
- Reddish-brown body
- Have round eyes

Two-spot goby *(Gobiusculus flavescens)*

Rocky Shores / Shallows | Day / Night

- Fish
- Usually 10cm
- Long, slender bodies
- Brown markings
- Two dorsal fins
- Fan-like tail
- Large mouth and eyes

Seagrass *(Zostera marina)*

Shallows / Deeper Water | Day / Night

- Plant
- Usually around 30-50cm
- Dull green in colour
- Grow in meadows
- Each individual leaf has rounded tips
- Can be floating or completely underwater

Shore crab *(Carcinus maenas)*

Rocky Shores / Shallows | Day / Night

- Crab
- Usually between 4-9cm
- Normally green, but can be brown to red/orange
- Has a clam shaped shell
- Hides under rocks

Barnacle *(Pollicipes pollicipes)*

Rocky Shores / Attached to rocks | Day / Night

- Invertebrate
- White-grey in colour
- Smaller than an inch
- Are seen in groups, attached to hard surfaces

Snakelocks anemone *(Anemonia viridisrubens)*

Rocky Shores / Seabeds / Shallows | Day / Night

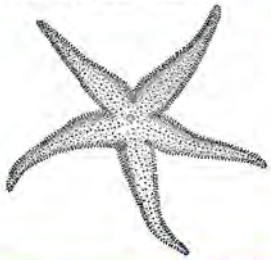
- Anemone
- Usually around 8cm wide
- Normally attached to hard surfaces
- Have long, wavy, bright green tentacles
- Tentacles have purple tips

Shrimp *(Palaemon serratus)*

Rocky Shores / Seabeds | Day / Night

- Invertebrate
- Usually 4-10cm
- Transparent body
- Has dark brown stripes along body
- Yellow and blue banded legs
- Has a fanned tail
- Two pairs of long antennae

Starfish *(Asterias rubens)*



Rocky Shores / Seabeds | Day / Night

- Invertebrate
- Usually 10-30cm
- Orange colour
- They have 5 symmetrical arms
- Have many pale spines along body
- Are mostly found under rocks in groups

Oystercatcher *(Haematopus ostralegus)*

Rocky Shores / Muddy Shores | Day / Night

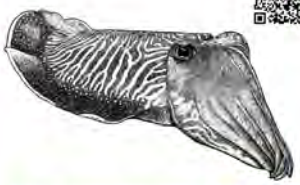
- Bird
- Large, stocky
- Can have a wingspan up to around 80cm
- Black and white feathers
- Long red beak and pink legs
- Orange / red beak
- Can be seen wading in shallow waters

Cormorant *(Phalacrocorax carbo)*

Rocky Shores / Coastal Lagoons / Estuaries | Day / Night

- Bird
- Can have a wingspan up to 160cm
- Have brown and black feathers
- Have white patches on their thighs and under their chins
- Big, triangular head with large beak

Cuttlefish *(Sepia officinalis)*



Sandy seabed / Seagrass / Rocky shallow water | Day / Night

- Cephalopods
- Can grow up to 45cm
- Normally a brown / orange colour but can alter their colour
- Have 8 arms with suckers
- Have two tentacles around the mouth
- Beak like jaws and very large eyes

Octopus *(Octopus vulgaris)*

Sandy seabed / Seagrass / Rocky shallow water | Day / Night

- Cephalopods
- Orange brown colouration but can alter colour slightly to blend in
- Have 8 tentacles covered in two rows of suckers
- Can squeeze through tight space and hide in small crevices

Pollock *(Pollachius pollachius)*

Shallow waters / Seagrass | Day / Night

- Fish
- Can grow up to 4ft
- Grey in colour with a silver underbelly
- Has three dorsal fins
- Has a small barbell coming out of their chin

Thornback Ray *(Raja clavata)*

Sandy seabed / Seagrass bottom | Dusk / Night

- Ray
- Can grow up to 1M
- Have blotchy brown patterns that acts as camouflage on the seabed
- Has a collection of thorns on back and tail
- Light orange / brown pattern

Dog Whelk *(Nucella lapillus)*

Lower Shore / Gaps in the rocks | Day / Night

- Shellfish
- White / Yellow
- 3-6 cm
- Hard exterior shell
- Spiral shell similar to a snails
- Has a groove on the underside of the shell

Common Mussel *(Mytilus edulis)*

Shore / Shallows attached to rocks | Day / Night

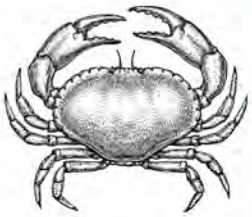
- Shellfish
- Blue / Black / Purple
- Up to 10 cm
- Hard exterior, triangular shell
- Attaches to rocks in large 'beds' of mussels

Spider Crab *(Maja squinado)*

Sandy seabed / Seagrass | Day / Night

- Crab
- Red/ brown
- White tips on the claws
- The body can grow up to 20 cm
- Spines and bumps found all over the shell
- Largest species of crab in Europe

Edible Crab *(Cancer pagurus)*

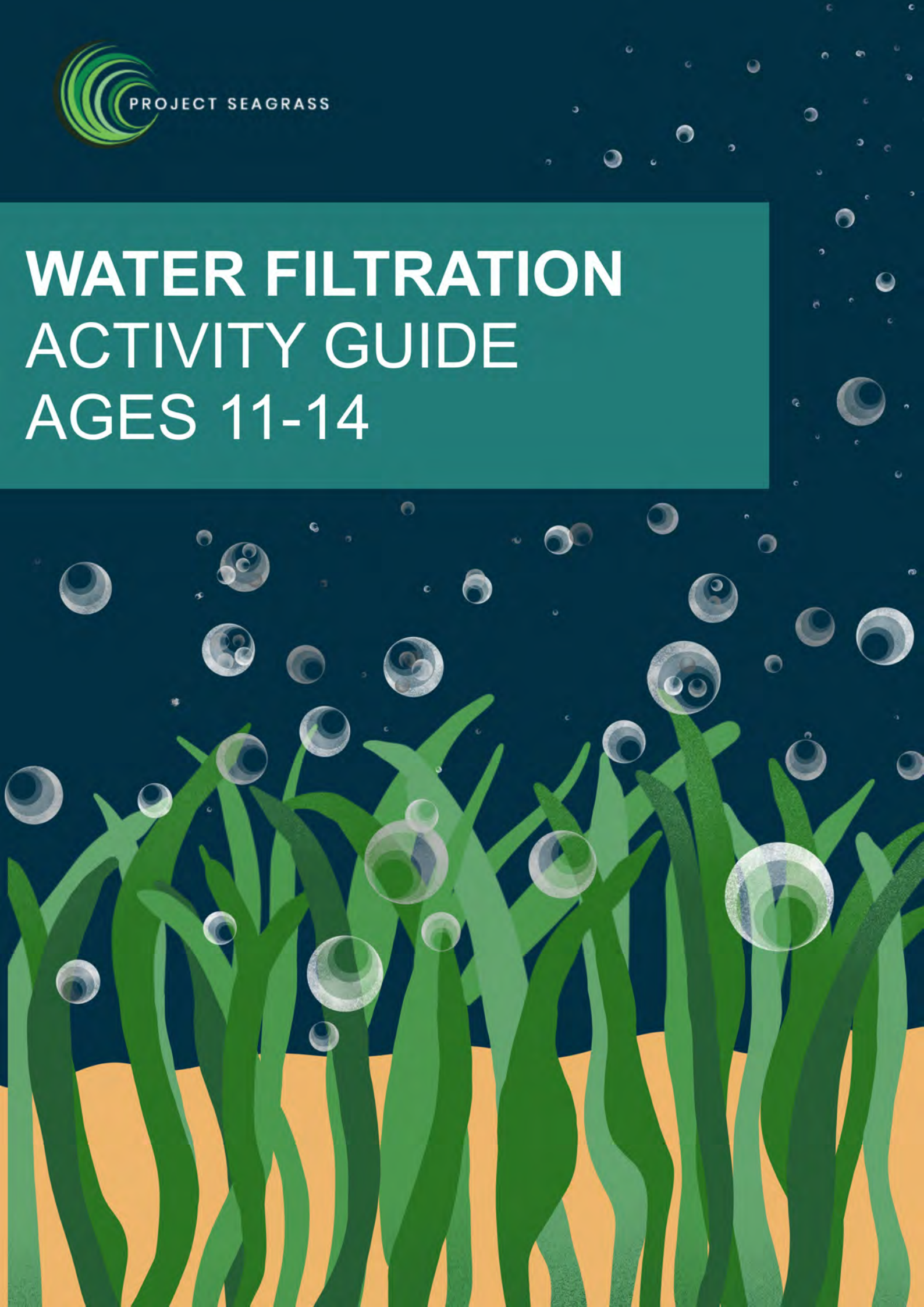


Land / Sandy seabed / Seagrass | Day / Night

- Crab
- Orange/ brown
- Black tips on the claws
- Up to 20 cm
- Pie-crust style
- Smooth shell appearance
- Hides under rocks

PROJECT SEAGRASS

WATER FILTRATION
ACTIVITY GUIDE
AGES 11-14



OVERVIEW

This activity guide introduces the topic of water filtration. Within this guide are two activities which demonstrates and explores the importance of seagrass filtering the ocean. There is also a work sheet follow up with answers.

- **Lesson Objective:** to understand how seagrass naturally filters the sea, helping to clean it.
- **Curriculum links:** Science

KEY INFORMATION

- Outdoor and indoor activities
- Group activities
- Time – up to 30 minutes
- Practical

LEARNING TIPS

This 'water filtration' compliments Project Seagrass activities in the '**Coastal protection**' and '**Microplastics**' guides.

Why not add multiple sites, such as a close by river, pond or kelp forest.

If you don't have a funnel, you can cut the top off a plastic bottle and remove the lid (just make sure there aren't any sharp bits).

Try exploring other natural filters of the sea. You could watch this 25 second video of mussels filtering water https://www.sciencelearn.org.nz/videos/732-mussels-filtering-water, discover oysters, mangroves or saltmarshes filtering ability or search out other marine organisms which do the same!

KEY WORDS

Average – The central/typical number for the data. Add all the samples and divide the total by the number of samples you have.

Coastal erosion – The breakdown of our coasts (cliffs, rocks or beaches) often by repeat wave action and storms.

Ecosystem service – A benefit that humans receive from healthy ecosystems.

Insoluble – Something that will not dissolve into a solution, in this case the sand in the sea!

Organism - a living thing, such as animals, plants or bacteria.

Plankton – microscopic organism that drifts with water currents.

Range - This is how varied your results were. Take the largest number and minus it by the smallest number.

Suspended solids – Particles or muck that floats in the water and is insoluble.

INTRODUCTION

FUN FACT!
Seagrass also removes microbes (viruses and bacteria) from the water so we're less likely to get ill whilst swimming!

Seagrass meadows naturally filter our oceans. The seagrass leaves act as traps for **insoluble** particles (like sand and mud) in the water. The particles bump into the leaves and are then pulled down and trapped between the seagrass roots in the sand. By filtering the ocean in this way, seagrass keeps the seas cleaner and clearer, making it much nicer and safer for us to go for a dip!

A thick and healthy meadow has more leaves to catch and trap dirt, whereas sparse or small patches of seagrass are much less likely to be bumped into. The filtering ability of seagrass acts as a positive feedback loop - the more seagrass there is, the more it removes particles from the surrounding water, meaning the less particles there are to block sun light from reaching the seagrass, so the seagrass has more light for photosynthesis and can put more energy into growing into a bigger meadow and, hence, be better at cleaning the water!

Another benefit we receive from meadows is trapping particles between its roots, is that less sand gets washed away by the sea, slowing **coastal erosion**.

ACTIVITY 1:

YOU WILL NEED:

Chairs or students (that are willing to be bumped into)!

Blindfolds (scarves or jumpers make good blind folds)!

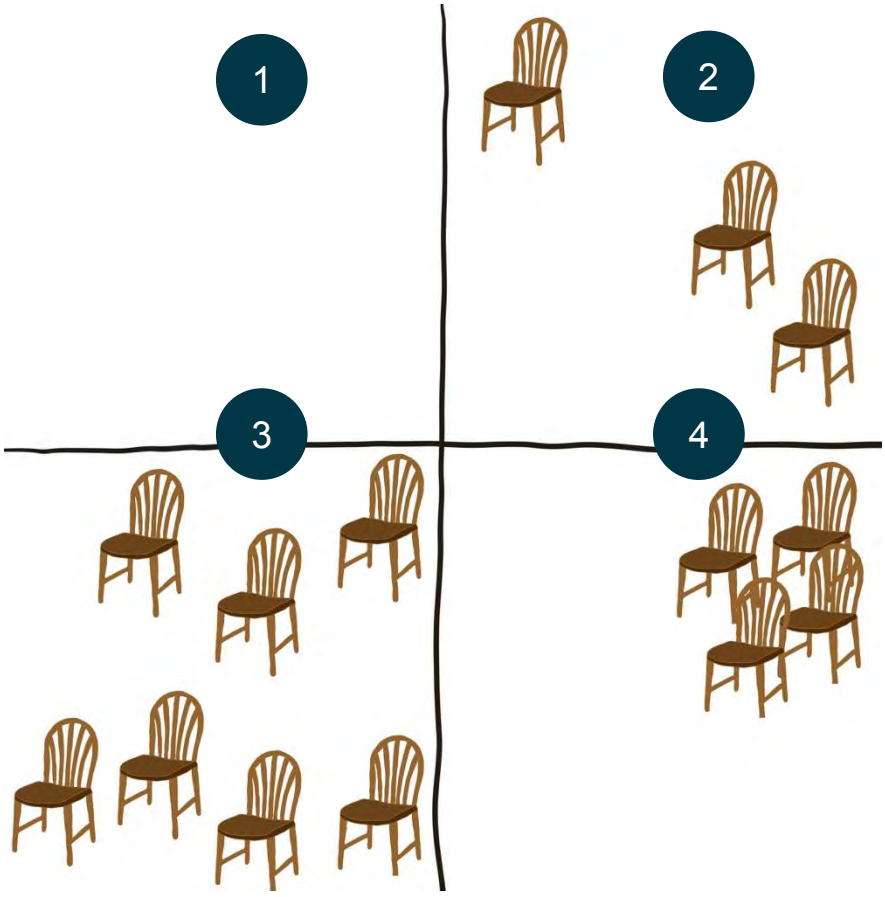
HEALTH AND SAFETY
Walk slowly whilst blindfolded.

1) Clear a large space and get 5 students (depending on space) to stand blindfolded in a line on one side of the space.

2) These students are the particles suspended in the water. They need to walk slowly across the space (the seabed) going with the current to reach the other side.

3) Before the next 5 students start walking across, add a few chairs or other students across the space - these are the seagrass plants! If the particles bump into them then they must sit on the floor next to the 'seagrass', they are now trapped in the sediment rather than continuing to float in the water.

4) Add more seagrass (chairs or students), altering the spread of them for each group of particles. Try these layouts and create your own to see which meadow distribution traps the most particles and leaves the water clear! You should find that an evenly spaced and more dense meadow (a healthier one) cleans the water of the most particles.



ACTIVITY 2:

Down at Porthdinllaen (Llyn Pennisula, North Wales) we have a thick seagrass meadow in the corner of the bay, whilst the rest is bare sand. Try to find a similar site where you are, perhaps even a sandy and a vegetated patch of the same river. The aim of this practical is to see if there's any difference in how clear the water is in the seagrass and the sandy areas. We know that seagrass helps to filter the water by the leaves catching suspended particles and pulling them out of the water to be trapped between the roots, so we expect seagrass areas to have less gunk!

YOU WILL NEED:

Collection jar - jam jars with lids will do.

Filter paper such as coffee

Funnel - top of a plastic bottle.

Electric scales.

Magnifying glass (optional!).

Wading gear.

HEALTH AND SAFETY

- No need to swim.
- Follow our coastal tips.
- Wash your hands.

1) Working in pairs, collect 250 ml sea water samples from just beyond the breaking waves at the seagrass bed and the same from the sandy area. You shouldn't need to swim to collect them but might have to wade! Clearly label each sample with who collected it and from what site, (e.g., 1A for sample 1 by group A). Try to collect samples from each area at the same point of the tide if possible.

2) Look and see if there's an obvious colour difference between the sites. If you have a magnifying glass can you see any plankton or life floating in the samples?!

3) Back inside, draw a table ready for your results.

4) Cut your filter paper into a circle and folding it into a cone shape that fits inside your funnel (or bottle), with one for each sample and labelled with its sample name. Weigh each sample's filter paper before in grams and make a note.

5) Pop the filter paper inside the funnel and balance the funnel above a collection pot.

6) Slowly pour the sample through the filter paper and leave it for 24 hours.

7) Once dry, reweigh the filter paper. Minus the original filter paper weight from this new weight to give you the number of suspended solids in each sample.

8) Bring all the sample suspended solid weights together into one class data set.

9) In pairs or as a class, work out the classes **range** and **average** weight for suspended solids in the seagrass area and the sandy area.

10) Draw a bar graph or a box plot of the data.

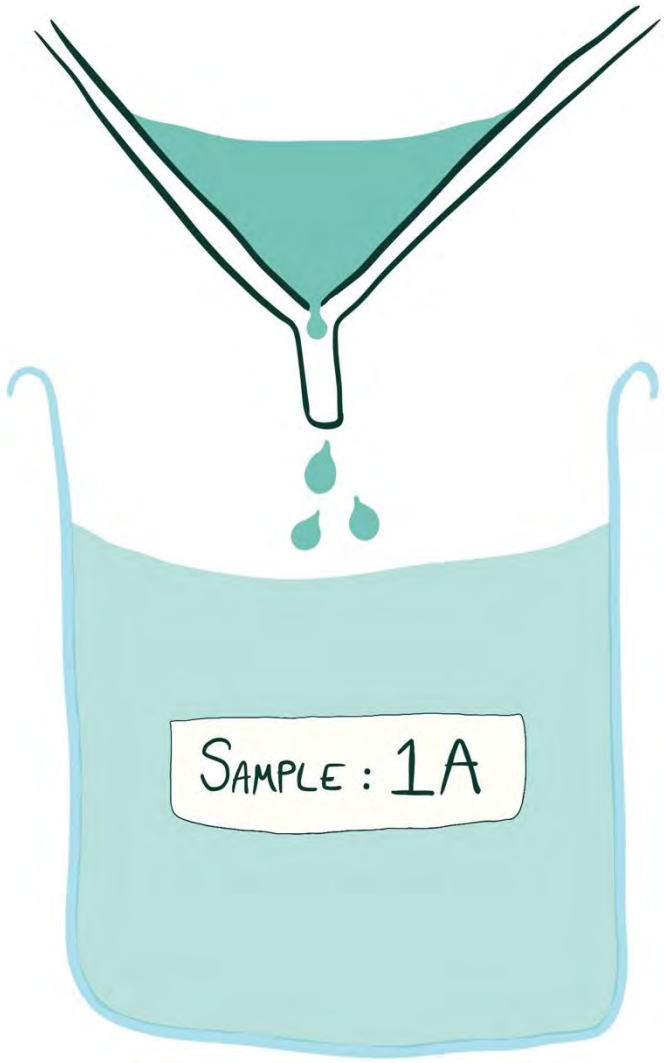
11) Answer the workbook questions or have a class discussion about what you've seen!

a. The seagrass water samples should have been clearer and have less suspended solids because of its filtering ability.

b. There might be little difference if there has recently been a storm or lots of rain. These stir the up seabed and cause lots of dirt to run off the land into the sea, both of which increase the number of suspended solids in the water.

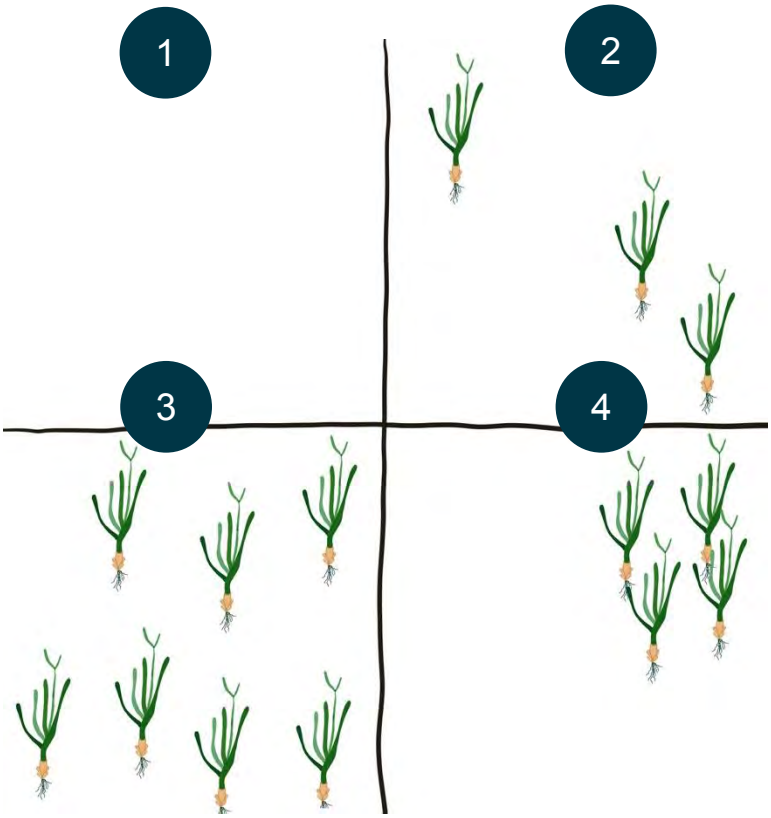
c. If samples had to be taken on different days, then maybe there was different weather events in the lead up.

d. If the samples had to be taken on different points of the tide, one area might have been subject to more water movement resulting in more suspended solids. The high and low tides are called 'slack water' as there's the least tidal water movement at these points.



FOLLOW UP WORKSHEET:

1) Which seagrass meadow do you think will be best at filtering suspended solids from the water?



2) Draw the positive feedback loop for seagrass water filtration, thinking about how light availability helps the plants.

3) Draw a table for your results. You will need to include
(1) sample name
(2) collection site
(3) filter paper weight
(4) dry sample weight
(5) suspended solids weight.

For example:

Sample name	Collection site	Filter paper weight (g)	Dry sample weight (g)	Suspended solids weight (g)
1A	Seagrass	9	17	8

4) Using the class data set for each site calculate:

a. The range - This is how varied your results were. Looking at one site, take the heaviest sample and minus it by the lightest sample.

.....

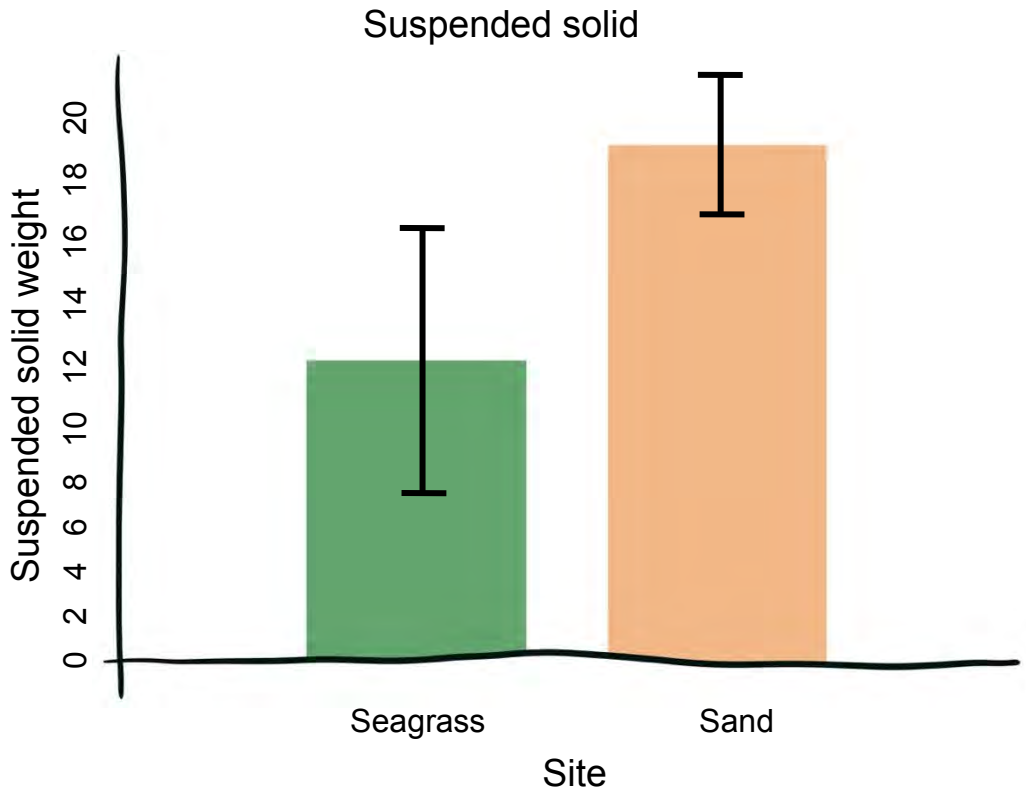
b. The average - This represents normal for the data. Add all the samples up from one site and divide it by the number of samples you have.

.....

5) Now use some graph paper to plot a bar chart of your average weights and your range. You'll need:

(1) do it in pencil with a ruler
(2) title for the graph
(3) axis titles
(4) a suitable scale
(5) all most of the page (no tiny dots of graphs!).

Your bar chart should look like:



6) Which site had a higher weight of suspended solids?

.....

.....

7) Why do you think that might be?

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8) What are the benefits of seagrass acting as a filter for the sea? Try to think of at least one for humans and one for wildlife.

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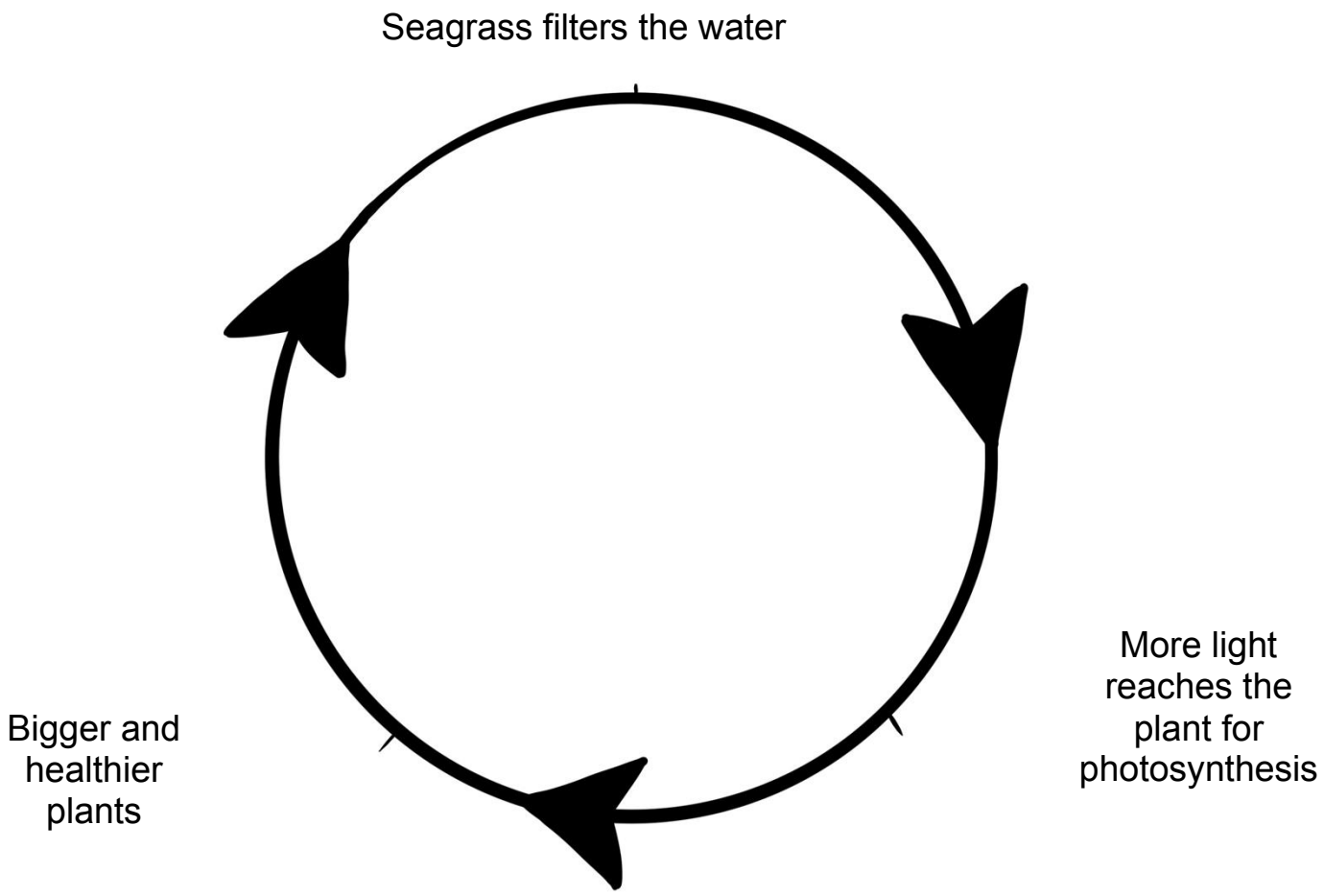
WORKSHEET FOLLOW UP ANSWERS:

1) Bottom left (number 3) as it's evenly spaced across the sea floor, making it more likely that suspended solids will bump into the leaves and become trapped.

2)



3) N/A

4) N/A

5) N/A

6) N/A

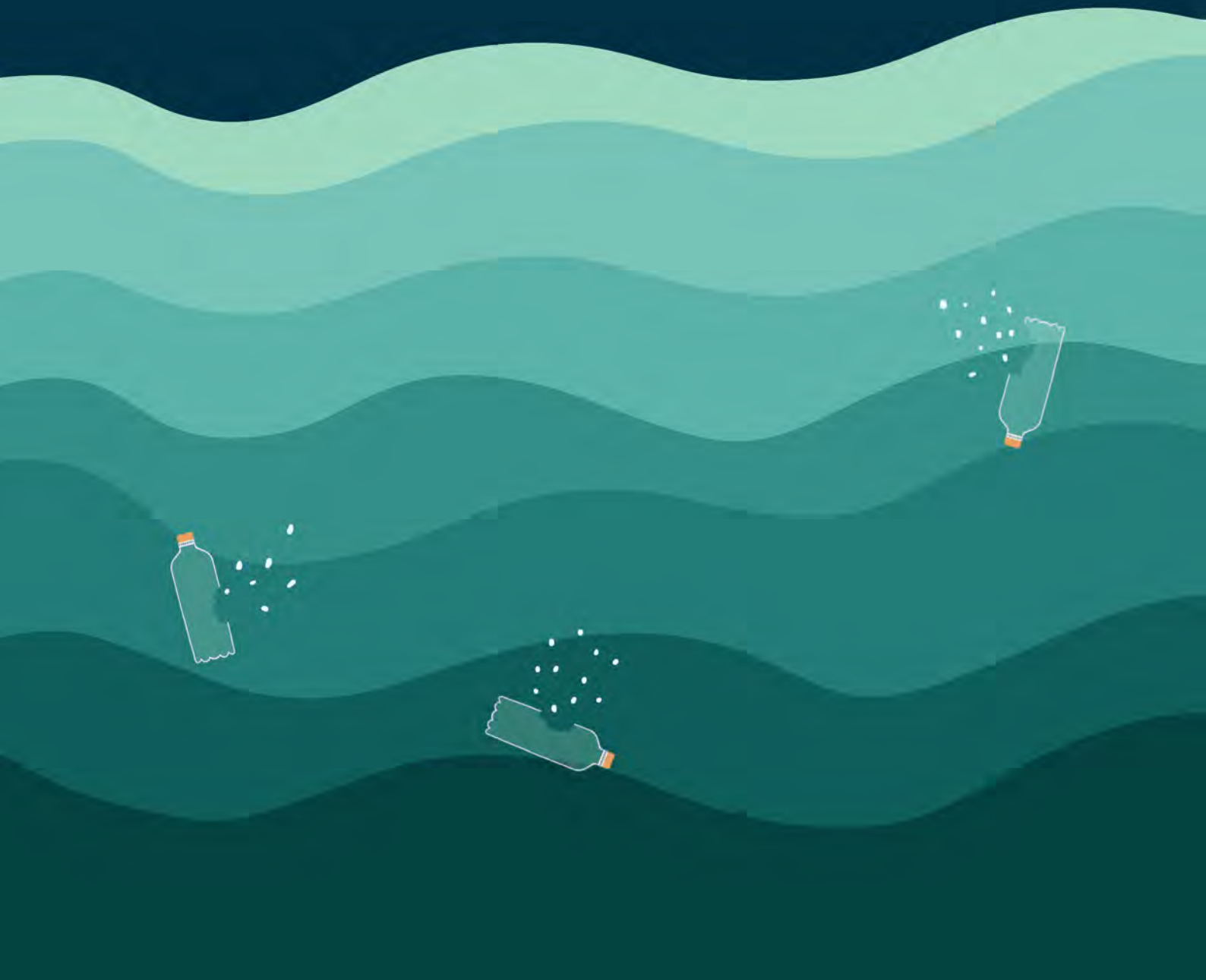
7) N/A

8) **Humans:** clearer water to swim in, fewer microbes and bugs to make us sick, removes some of the pollution we put in, increased biodiversity, increased seagrass health!

Animals: clearer water makes it easier to spot prey/ predators, less pollution.

PROJECT SEAGRASS

MICROPLASTICS ACTIVITY GUIDE AGES 11-14



OVERVIEW

This activity guide introduces the topic of Microplastics. Within this guide is an activity and work sheet follow up with answers.

KEY INFORMATION

- Indoor or outdoor activity
- Partner or group activities
- Time – 1/2 hours
- Practical

- **Lesson Objective:** to understand what microplastics are, where they come from and how we can try to reduce them. To see how seagrass naturally filters the water, trapping microplastics.
- **Curriculum links:** Geography/Science/Numeracy

LEARNING TIPS

This 'Microplastics' guide can be used with Project Seagrass activities in the '**Water filtration**' and '**Food chains**' guides to explain better how seagrass traps microplastics in the same way as suspended solids and how plastic accumulates as it works its way up the food chain. Also link to the '**Making changes**' guide where a sustainability audit is conducted.

Try to encourage open discussion about changes to our own lives we could make to reduce plastic pollution, emphasising how the pollution is directly from our homes. Discuss whether plastic is sustainable.

KEY WORDS

Bioaccumulate – The build-up of something (e.g., plastics) in an organism

Finite resource – A resource that will run out (earth only has a limited amount)

Microplastic – Plastic which is smaller than 0.5cm

Microfiber – A manmade (synthetic) fiber that's smaller than human hair

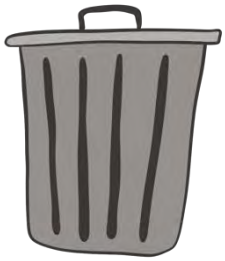
Primary microplastics – Plastics that are originally designed to be tiny!

Secondary microplastics – Fragments broken down from larger plastic items

Salinity - The amount of salt dissolved in a liquid

INTRODUCTION

What are microplastics?



Everything we use or pop in the bin ends up somewhere. Hopefully that's a recycling station, but sadly a lot of our **waste escapes** and ends up in the **sea**. It can get there via **littering**, down our **drains** or swept to sea by **storms**. **Water samples** from the most **remote** and untouched parts of the world show how we have inundated our seas with rubbish, namely **microplastics**.

FUN FACT!

The river Thames going through London has the most microplastic pollution of all rivers in Europe, with an estimated 94,000 microplastics per second flowing down it!

Plastics are made from **finite** sources of **petroleum (oil)** and **gas** in such a way that they can take thousands of years to completely breakdown. As plastics take so long to degrade, we just keep filling the seas with more and more generations of plastic litter.

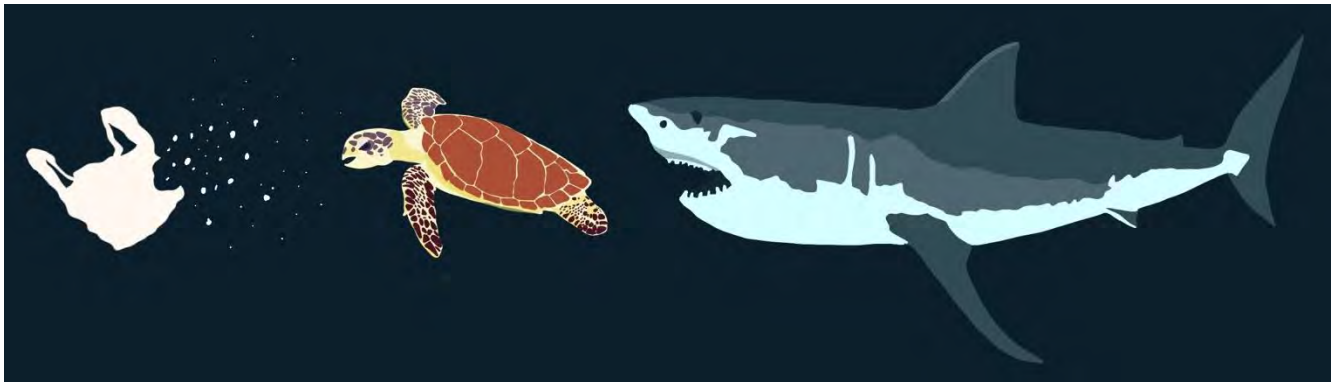
So how about microplastics? These are tiny bits of plastic which are less than **0.5 cm** in size. Check on a ruler just how small that is! We have two main types of microplastics: **primary** and **secondary**. **Primary** microplastics have been **designed** to be so small that they can pass through most water filtration systems, such as the plastics found in **cosmetics** and beauty products. **Secondary** microplastics are the result of larger plastic items slowly **breaking down** into little bits as a result of **weather** and **wave** action.

Another form of microplastics is **microfibers**. These are man-made fibers that are smaller than human hair. Every time we pop a clothes wash on, millions (potentially 17 million!) of tiny plastic microfibers are released into our drains and are small enough to escape out to sea.

What's the problem?

Microplastics are in the **air** we breathe but also have now been found in every corner of our **oceans**, as well as in many different animal's **stomachs**, from whales to crabs, seabirds to humans. The animals may stop eating as their stomachs are filled with plastic. Many also get ill from the harmful **chemicals** and **pollutants** that are attached to the plastic that they have mistakenly eaten.

The amount of plastics and pollutants in the animal increases as we look further up the food chain in a process called **bioaccumulation**. For example, if 5 small fish have each eaten 3 pieces of plastic, and then 1 dolphin eats all 5 fish, the dolphin now has 15 pieces of plastic in its stomach.



Extra microplastic info:

- https://www.nationalgeographic.org/encyclopedia/microplastics/ National Geographic give a quick overview of microplastics.
- https://plantbasednews.org/news/environment/microplastics-what-are-they-how-do-they-end-up-in-our-ocean/ Explains the main sources of microplastic.
- https://friendsoftheearth.uk/plastics/microfibres-plastic-in-our-clothes Friends of the earth looking at microfibers.

Salt water and density explanation:

- https://www.youtube.com/watch?v=vCw1guhZzrQ&ab_channel=Questacon Easy density experiment!

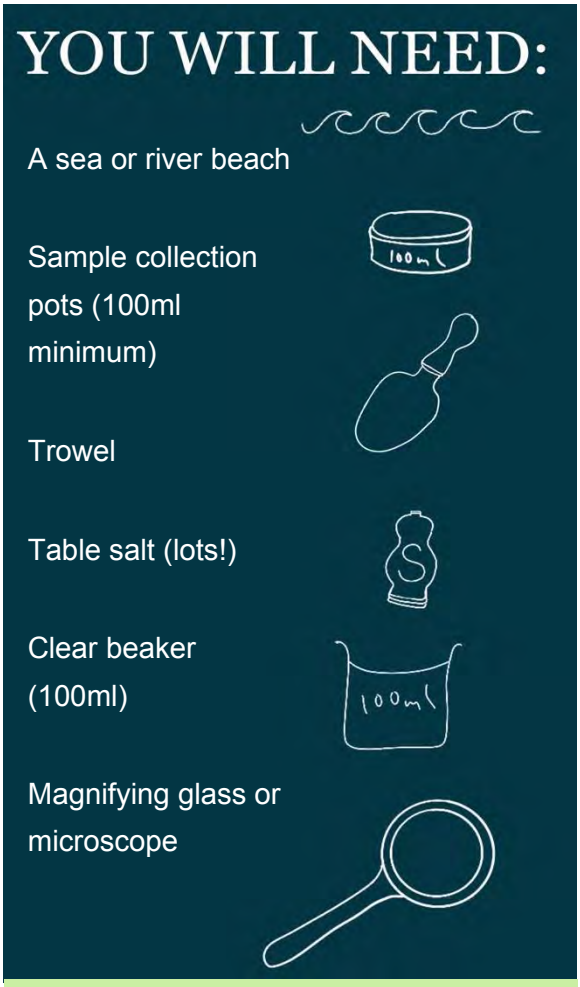
Investigation time!

We're going to look at the microplastics at your local beach (this can be a river beach too!). Scientists have found that seagrass is good at trapping microplastics by locking them away into the seabed and removing them from our seas. Let us see if this is true for your beach!

When we swim in the sea we feel 'floaty' in comparison to being in a swimming pool. This is because the salt in the sea makes the water thicker (like soup) and better at lifting us up. Using this same idea, we can use really salty water to separate out microplastics from sediment as the salty (denser) water helps the microplastics to float.

ACTIVITY:

1) Decide how many sediment samples your class will aim to collect from two different areas. Aim for a minimum of five samples for each!
2) Choose your sample collection point. Try to choose an area with vegetation such as seagrass or a weedy riverbank and an area with a bare bottom, such as sand. Avoid areas where you may harm animals or their homes or that are dangerous to get to.
3) Collect the samples at low tide as far out as possible without getting wet.
4) To collect the sample, use the trowel to scoop sediment from the seabed into the sample collection pots.
5) Carefully label the collection pot (e.g., SG.KS.1 would be seagrass sample by Kate Smith, sample number 1, agree with the whole class your labelling system before heading to the beach!).



HEALTH AND SAFETY

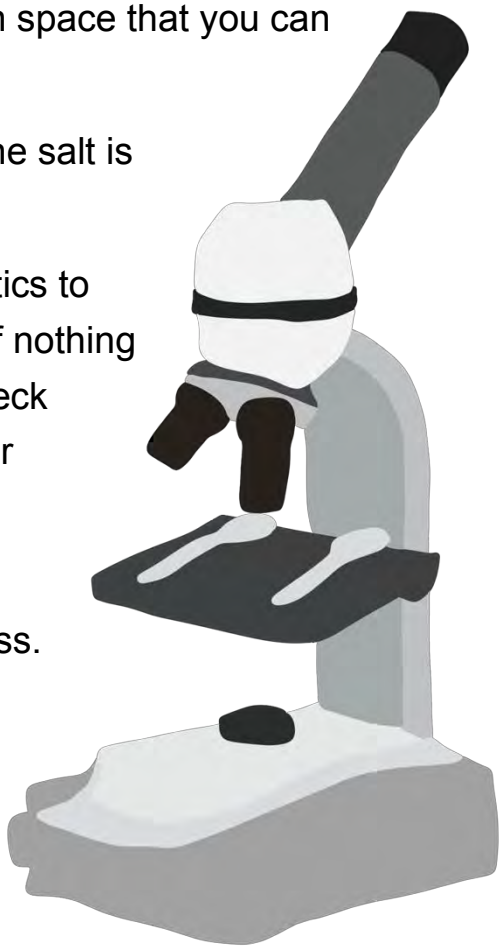
Standard shore health and safety - all work done whilst tide is out, with no one entering the water. See tips for tidal work

Do not consume salt water

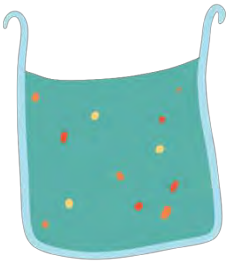
6) Back in the classroom put 50 ml of the sand from one sample into the clear beaker. Fill the beaker with water, leaving enough space that you can easily stir.

7) Add 3 tablespoons of table salt and stir until all the salt is dissolved.

8) The high salinity will cause most of the microplastics to float and be poured into a second glass beaker. If nothing is floating, you might need to add more salt or check under a microscope. Sadly, microplastics are near enough everywhere, so are likely in your sample!



9) Now count the number of microplastics and microfibers using a microscope or magnifying glass. Some maybe big enough to see with the naked eye.



10) Form a class data set of the number of microplastics and microfibers in each sample.

11) Work out the average and range for samples from the seagrass meadow and the bare sand site

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WORK SHEET FOLLOW UP:

1) Which site had the most microplastics and microfibers?

2) Does this match where you've been finding the most litter on the daily beach cleans?

3) Which animals are likely affected by microplastics at each site?

4) Circle all the potential plastic sources in the comic strip of our day to day lives below. Try to add alternatives for as many as you can!

5) List 5 sources of marine microplastics

6) Think of three ways you could reduce the amount of microplastics and microfibers that you add to the ocean:


FRESH
FRESH
FRUIT
FRUIT
TOILET ROLL X12
NEWS
HOME

WORK SHEET FOLLOW UP ANSWERS:

1) This should be the seagrass meadow (vegetated area) as the seagrass works as natural filter, trapping particles including microplastics and microfibers in the sediment.

2) N/A

3) All of them! Look to the species tick list and consider the animals found in the BRUV experiment and whilst snorkeling. Microplastics have been found at all levels of the food chain, accumulating as further up the food chain.

4) Plastic bags, cigarette filters, face masks, car tyres, plastic posters, plastic games and toys, wrappers and bottles, small plastic beads in face wash, plastic shower curtain, toilet roll wrappers, clothes pegs, microfibers from clothes wash, plastic news in letter box, plastic doormat.

5) All acceptable answers: **Fishing gear, Clothing, Tyres** (the biggest source of plastic pollution in the UK as small shreds come off the tyres whilst we drive.), **Nurdles** (small plastic pellets that manufactures use to transport plastic - They're bright and colourful making them look tasty for animals.), **Cigarette filters** (the largest man-made contaminant of our seas), **Single use** items such as **plastic bottles, wrappers, bags and food ware, Cosmetics and body/ face washes.**

6) a. Try to avoid buying plastic products all together, bring your own water bottle, buy food with no wrapper or paper, card, tin, glass packaging.

b. Buy second hand and upcycle old items to reduce the overall plastic production.

c. Try to buy products made of natural materials such as cotton, wool or hemp. This is particularly key when buying clothes.

d. Wash clothes as infrequently as possible on a low heat and try to air dry them. This will reduce how many microfibers are released with each wash. Mind you don't get smelly though!

e. Once you've reused an item as much as possible recycle it. The item will still release microplastics but much less than if a new brand-new plastic item is manufactured.

f. There are loads of great tips online to change our day-to-day habits- including home prepping food, simple bathroom routine switches and shopping habits.

g. Avoid eating fish. Abandoned fishing nets are a large source of microfibers, as well as entangling and continuing to catch animals.

h. Write to your MP asking for government bans on single use plastics.

PROJECT SEAGRASS

COASTAL PROTECTION
ACTIVITY GUIDE
AGES 11-14

OVERVIEW

This activity guide introduces the topic of coastal protection and the activities allow you to explore the importance of seagrass with your students.

Within this guide are two quick activities which show how having a barrier, such as seagrass, can slow large amounts of energy.

- **Lesson Objective:** how seagrass meadows help to protect our coastlines
- **Curriculum links:** Geography/Science/Numeracy

KEY INFORMATION

- Indoor or outdoor activities
- Partner or group activities
- Time - 30 minutes
- Practical

KEY WORDS

Coastal erosion –
The wearing away of rock at the seaside

Flood defence –
Methods to protect land from flooding

Rhizomes –
Horizontal underground plant stem capable of producing the shoot and root systems of a new plant

LEARNING TIPS

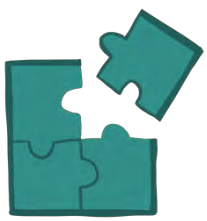
The activities in this coastal protection activity guide can be combined with other Project Seagrass guides: '**seagrass water filtration**', '**climate change**', '**geology**' and '**plant biology**'.

Learn about the importance of urban planning in flood prevention by playing the online game: 'Don't Flood the Fidgets!'. This quick, interactive game uses a combination of natural solutions, such as wetlands, and man-made solutions, such as green roof apartments to soak up the flood water and save your Fidget City from flooding.

Follow this link to play the game:
https://pbskids.org/designsquad/games/dont_flood/

FUN FACT!

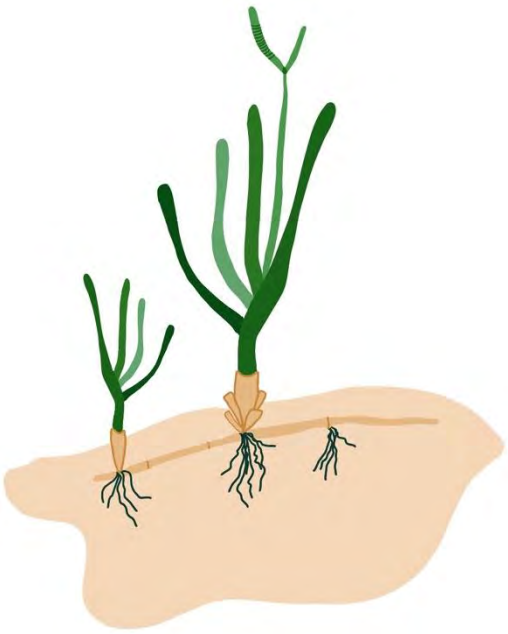
Engineers working on protecting our everchanging coastlines use both natural defences, like seagrass, and man-made ones, such as building sea walls. Sometimes they might have to relocate whole towns!



INTRODUCTION

Our coastlines are constantly being battered by wind and waves, and as a result, the rocks that make up our coast are slowly being worn down. This process is called **coastal erosion** and can cause landslides and cliffs collapsing; not great if your home is at the top of the cliff!

Healthy oceans naturally help to protect our coastlines. When a big wave comes crashing up a sandy beach there is nothing in its way to slow it down or to take some of the force. However, if the wave hits a beach with a **seagrass meadow**, then the thick leaves of the meadow take some of the energy out of the wave, therefore it hits our coastlines with **less force and has less impact** on the coastline.



Seagrass has another trick up its sleeve to help us out! As you walk around the edge of a seagrass meadow, look out for drops in the ground level of around 30 cm. At these points you can see how the seagrass roots and **rhizomes** are keeping the sand and mud stuck in place, stopping it from being washed away like it has been in the bare patch next to the meadow. Next time you're on a seagrass meadow, have a peer at one of these edges and see if you can spot the roots and rhizomes at work!

By locking **sediment** in place and dampening the force of storms seagrass meadows are a natural flood defence. The seagrass helps to protect our homes as **climate change** causes larger and more frequent storms and rising sea levels.

The more seagrass we have, the more we are protected!

ACTIVITY 1:

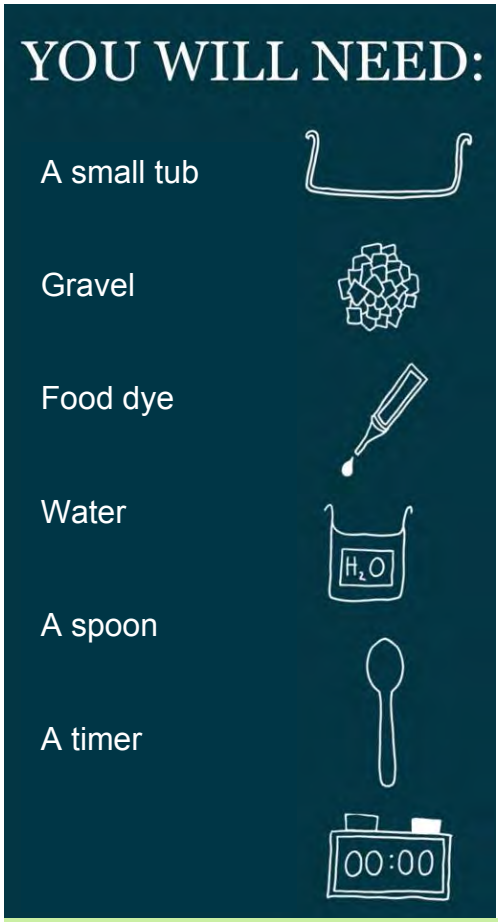
1) Fill the empty tub with water and pour a drop of food dye at one end.

2) Gently stir the food dye with the spoon and time how long it takes for the colour to spread across the whole tub.

3) Empty the tub and add a line of gravel down the middle, then fill once again with water.

4) Add a splash of food dye at one end, gently stir the food dye and again time the spread.

5) The food dye was the large storm with lots of energy, but the stones, just like seagrass, acted as a barrier to slow the energy of the storm as it moved across the tub.



HEALTH AND SAFETY
Food dye may stain clothes

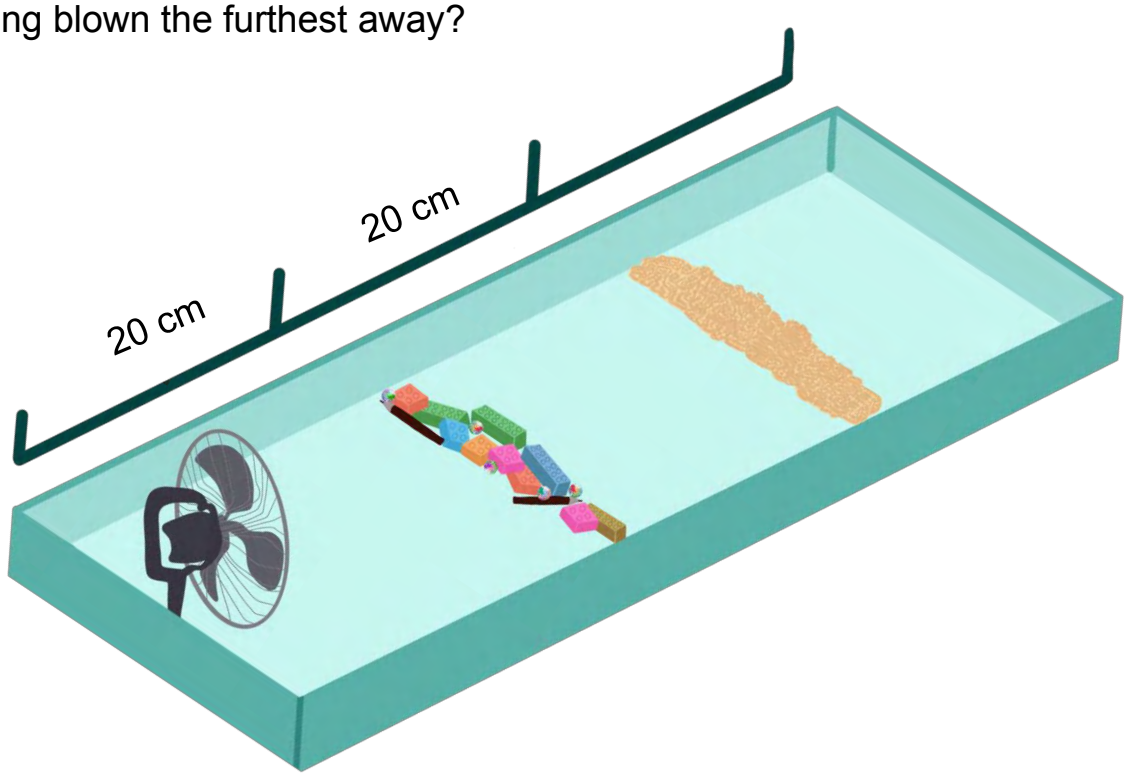
ACTIVITY 2:

YOU WILL NEED:

- A tray/messy space
- An electric fan
- Half cup of sand
- Starting line marker
- Measuring tape
- Small items e.g., marbles, lego

HEALTH AND SAFETY
Don't blow sand towards people's faces!

1) Set up a large clear space that can get sandy. You could also use a tray.
2) At one end, mark where the fan should be placed.
3) Roughly 20 cm from the fan, mark a second point. This is where the 'seagrass' barrier will be built.
4) Mark a third point 20 cm from the seagrass. This is where the half cup of sand will be emptied.
5) Provide each team (optional numbers) with a bag of random items such as a comb, marbles, pens or Lego. They will need to build their 'seagrass' barrier from these materials on the second point. The barrier needs to protect the sandy beach from being blown away.
6) Once a team's barrier is set up then place the fan on its marker and turn it on for 3 seconds. Measure how far the sand has travelled.
7) Re-set up for each time.
8) Who created the best seagrass barrier and stopped their sandy beach from being blown the furthest away?



PROJECT SEAGRASS

HIDE AND SEEK
ACTIVITY GUIDE
AGES 11-14

OVERVIEW

This activity guide introduces the topic of hide and seek and the activities allow you to explore the importance of complex environments for marine life.
Within this guide are two quick activities, activity 1 is best for larger groups, whilst activity 2 is better for smaller or quieter ones.

KEY INFORMATION

- Indoor or outdoor activities
- Group activities
- Time - 5 minutes
- Practical

- **Lesson Objective:** to appreciate how a seagrass meadow provides an important fish nursery habitat
- **Curriculum links:** Geography/Science

LEARNING TIPS

This hide and seek guide compliments Project Seagrass activities in the '**Species hunt**', '**Plant anatomy**' and '**Stakeholder**' guides. Use these activities to help discuss why different animal diversity and abundance may be seen in different habitats.

INTRODUCTION

Three dimensional environments are hotspots for wildlife! The more **complex** the environment, the more spaces an animal has to hide. Bare areas such as sand on the other hand, offer little protection for animals from **predators** or sneaky places to lay their eggs. Seagrass is considered a great **nursery habitat** for juvenile fish because of this – there are plenty of spaces for young fish to hide and avoid being **prey** for larger predators. The same hiding spaces idea can be applied to kelp forests, coral reefs, or even **terrestrial** forests and grass lands!

KEY WORDS

Prey –
An animal that is hunted or eaten by another animal

Predator –
An animal which preys on another animal

Habitat –
The natural home of an animal

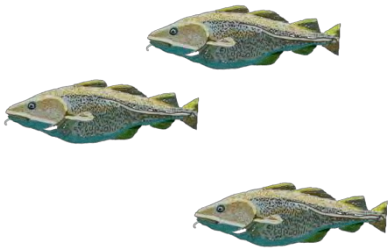
Nursery habitat –
An area where juvenile animals live

Biodiversity –
The different kinds of animal and plant life in one area

Terrestrial –
Something on land

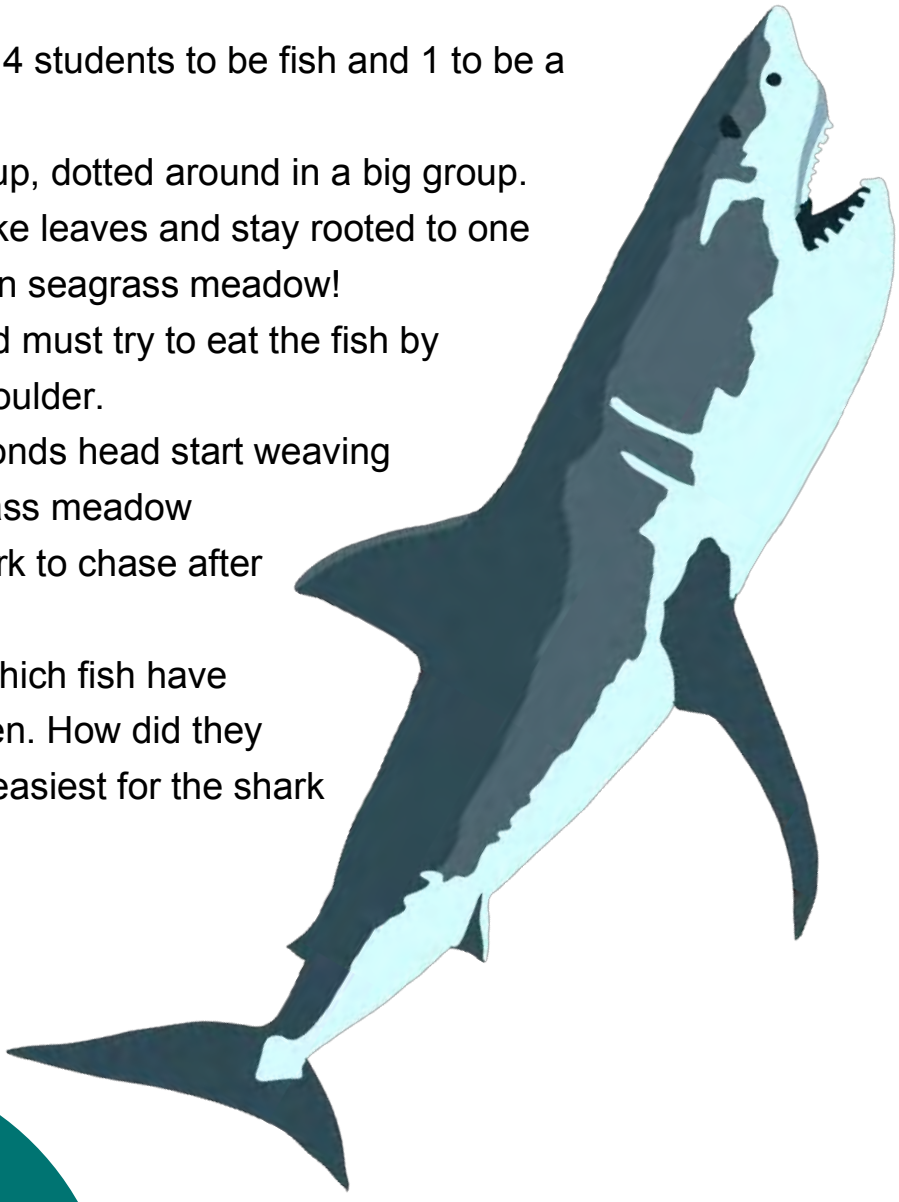
Marine –
Something in the sea

ACTIVITY 1:



HEALTH AND SAFETY -- Run carefully

1) Clear a large space.
2) In a class of 30 choose 4 students to be fish and 1 to be a hungry shark.
3) Get everyone to stand up, dotted around in a big group. Chuck arms in the air like leaves and stay rooted to one spot - this is your human seagrass meadow!
4) The shark is hungry and must try to eat the fish by tapping them on the shoulder.
5) Give the fish a few seconds head start weaving in and out of the seagrass meadow before allowing the shark to chase after them.
6) After 30 seconds see which fish have managed not to be eaten. How did they escape? Where was it easiest for the shark to catch the fish?



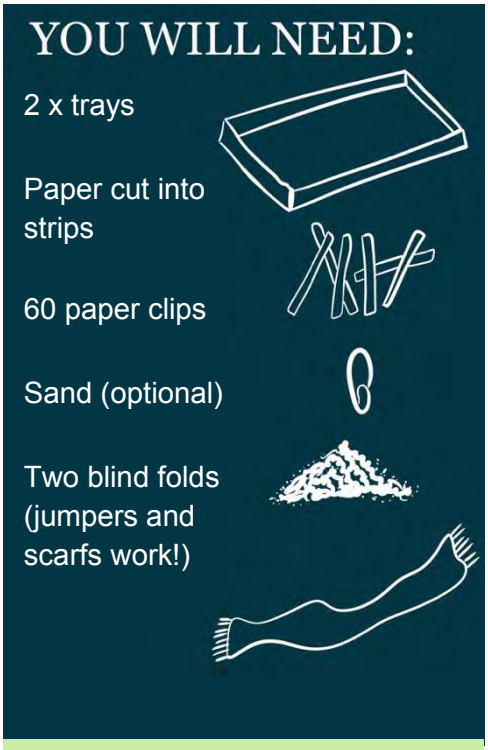
FUN FACT!

Seagrass is a nursery habitat for fish such as cod and plaice - our Friday night fish and chip favourites!

7) Explain how the seagrass meadow makes it a lot easier to swim away and hide, whereas going on to the bare sand outside of the meadow made it easier for the shark to spot and catch them.

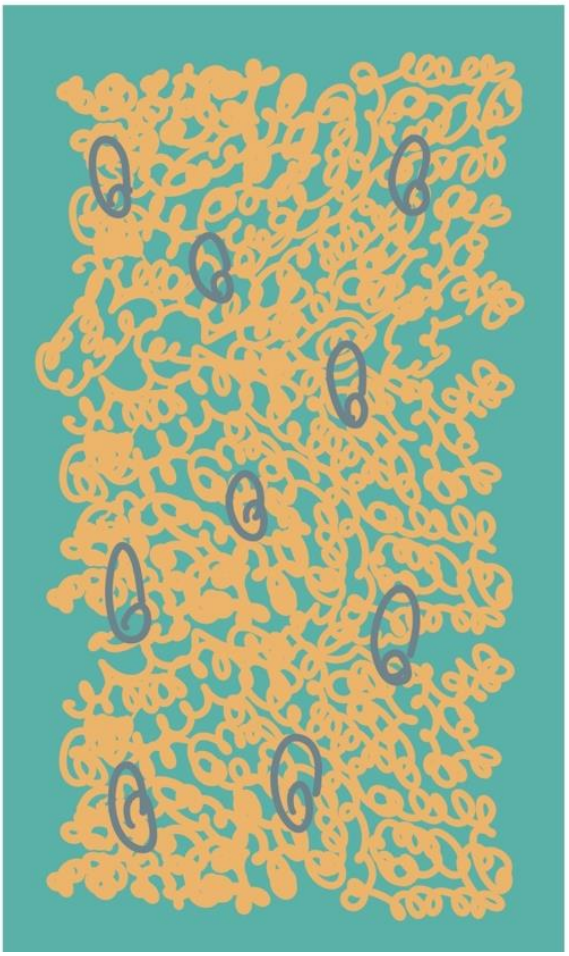
ACTIVITY 2:

1) If using sand, add it to the bottom of each tray. In one of the trays also add the paper strips, this is the ‘seagrass’, the other tray is a bare seabed.
2) Put 30 paperclips in each tray, these are your fish. Remember to attach paperclips on to and all around the seagrass paper.
3) Blindfold two students and give them 10 seconds to find as many paperclips as they can.
4) It should be much easier for the student on the bare sand to find and eat all of the prey!



HEALTH AND SAFETY
Take care whilst blindfolded!

BARE SAND TRAY



SEAGRASS TRAY

WORK SHEET FOLLOW UP:

After completing either or both activities, write a short story in under 500 words about a day living in a seagrass meadow. You can pick any animal you like - you could even tell it from the seagrass' point of view!

PROJECT SEAGRASS

INTRODUCTION TO GEOLOGY
ACTIVITY GUIDE
AGES 11-14

OVERVIEW

This activity guide introduces the topic of geology. Within this guide are two activities which show the basics of geology and explain how the shape and structure of the coastline benefits the growth of seagrass.

- **Lesson Objective:** to gain an understanding of the basics of geology and its application to our broader understanding of the Earth
- **Curriculum links:** Geography/Science/Creative Arts

LEARNING TIPS

The activities in this 'introduction to geology guide' can be combined with '**Restoration**' and '**Plant biology**' activities by considering whether the geology of the area lends itself to be a good habitat for seagrass.

Check out the recommended YouTube videos below or host a movie night to watch Ice Age or Journey to the Center of the Earth.

- A Brief History of Geological Time https://www.youtube.com/watch?v=rWp5ZpJAIAE
- The Whole Saga of the Supercontinent https://www.youtube.com/watch?v=KfYn9KVya-Q
- What if Pangea Never Broke Apart? https://youtu.be/7IeF_6u4ohI
- The Geologists Are Coming https://www.youtube.com/watch?v=1NU51lJIdrg
- Plate Tectonics Theory Lesson https://www.youtube.com/watch?v=zbtAXW-2nz0&list=PLHMOilVKE_NxoKcIVJKwiOCmYq7WZMdiD&index=3

KEY INFORMATION

- Indoor and outdoor activities
- Individual and group activities
- Time - 60 minutes
- Practical and workbook

KEY WORDS

Compaction –
A process where sediment becomes squashed closer together during burial

Core –
Found at the center of the Earth. Separated into the 'inner' and 'outer' cores which are made from nickel and iron

Crust –
The thin and rocky outermost layer of Earth (approx. 20 km thick)

Deposition –
The process of sediment settling from the water or wind as the flow slows down, or from ice as it melts

Erosion –
Breakdown and removal of rock material by flowing water, wind, or moving ice. Not to be confused with weathering!

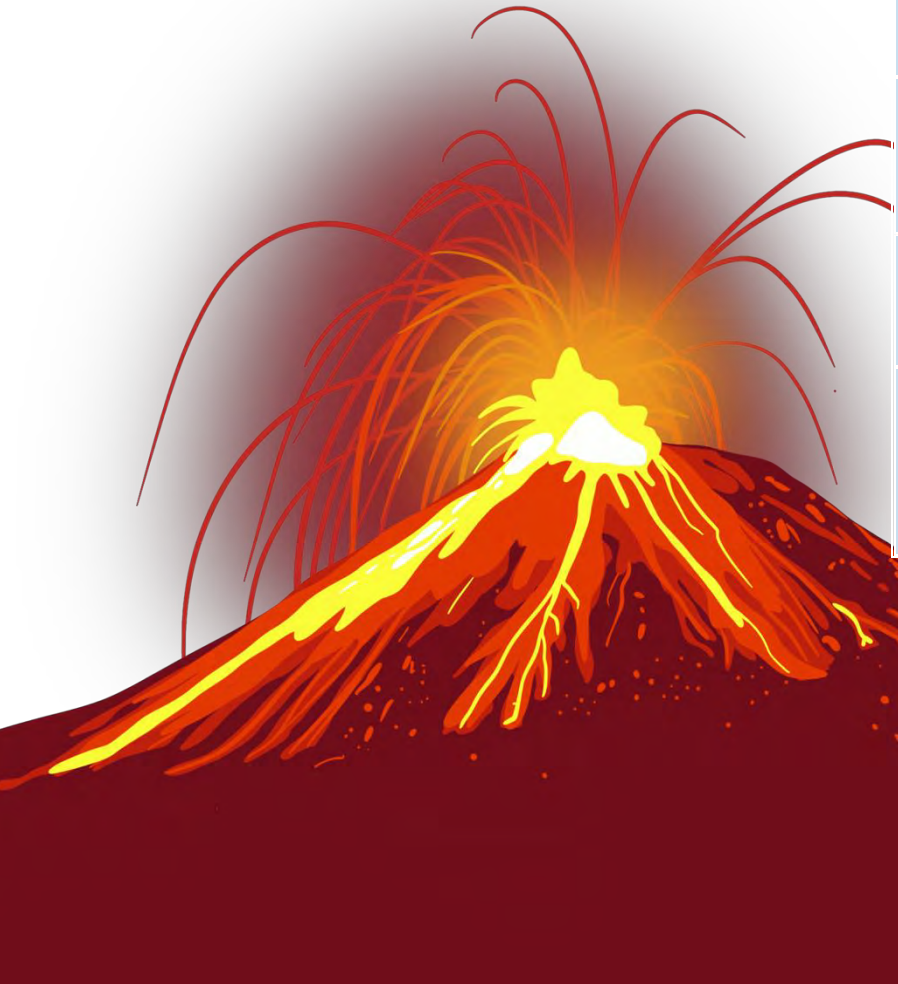
Fossil –
Any trace of past life preserved in a rock (includes animal tracks & burrows as well as shells, skeletons and impressions of soft flesh)

INTRODUCTION

“Do you know what rocks? *Geology*.”

From studying rocks, we have learnt so much about the history of the earth. We’ve learnt what the weather was like thousands of years ago and discovered animals that haven’t changed in millions of years. Rocks have taught us about super volcanos which might destroy entire continents, how earthquakes happen and why sometimes the magnetic north and south poles reverse (the next one is predicted in 1000- 2000 years).

Geologists are like detectives, looking at what’s around us to figure out what has come before and what lies ahead.



Geology –
The area of science concerned with the solid Earth, the rocks of which it is composed, and the processes by which they change over time

Ice age –
A period in Earth's history where the ice sheets cover large areas of land, due to an overall lowering of the Earth's global temperatures

Igneous –
A type of rock formed from magma, either erupted from a volcano or cooled below ground in an intrusion

Lithosphere –
Outer layer of Earth (uppermost mantle and crust) that behaves as a number of rigid, moving "plates"

Mantle –
Layer of hot, dense rock deep beneath the surface (from about 25 to 2500 km down). Hot enough to flow slowly

Metamorphic –
A rock which has re-crystallised due to heat and/or pressure. Examples: marble, slate, schist

Minerals –
Naturally occurring chemical compound (e.g. calcium carbonate), often with a regular crystal structure

Sedimentary –
Any rock made up of sediment grains e.g. mudstone, sandstone, limestone, rock salt, coal

Transportation –
Movement of sediment by water, wind or glacier ice

Weathering –
Slow breakdown of rock at the Earth's surface, due to climatic and biological processes

ACTIVITY 1:

1) Simply run through the Geology PowerPoint carrying out the classroom and independent activities as you go.
2) This activity will introduce students to the basics of geology and its application to our broader understanding of the Earth. Following an overview of key words and theories, students will have an opportunity to explore geographical features of the UK, including any features of special interest.
3) To summarise what they have learnt, students will complete a pop quiz in teams with a chance to win a prize.

YOU WILL NEED:

- Introduction to Geology PowerPoint
- Pencils
- Lined Paper/Workbooks
- Rulers
- Quiz sheets and Quiz prize
- Keyword sheets
- Scissors and glue

ACTIVITY 2:

For activity 2, the **Rock ID & Field Sketch Tasks,** students will have an opportunity to visit a beach (sea, river, or adapt to a local field or park!), explore the environment around them and taught to successfully identify rock types and processes. They should be given the opportunity to hypothesise why sandy seabed is well adapted for seagrass to growth and what they think the landscape will look like in the future. Finally, to summarise what they have learnt, students can create a field sketch and annotate it to highlight geographical features and explain how the shape and structure of the coastline benefits the growth of seagrass.

YOU WILL NEED:

- OS Map
- Pencils + paper
- Clipboards
- Rulers
- Compasses
- Hard hats
- High visibility vests
- Dilute hydrochloric acid

HEALTH AND SAFETY
Geological field work carries some risk, but it can be reduced by knowledge, experience and a careful approach! Look to the beach work section of our coastal tips

TASK – Rock identification:

1) Get students to identify 5 rocks found on the beach, using the **rock ID guide** provided. Only get them to identify to sedimentary/igneous/metamorphic level. If you feel confident with their ID skills, challenge them to narrow it down further! Get them to run over how each rock type is formed, have them look around their environment to see if they can recognise any features that might suggest the rock type for the area (which they should remember from the BGS map in the PowerPoint!) e.g., **stratification.**
2) Get students to suggest possible processes that explain the rock's shape and present location (Keywords: **Deposition**, **Transportation, Erosion** and **Weathering**).

TASK – Field sketch:

1) Students need to sketch their surroundings following the PowerPoint field sketch guide. Get them to annotate and highlight key features and delegate one student to take photographs of the area.
2) Get them thinking about how these features may have formed, for example are there any headlands, caves or bays?
3) If relevant, get students to identify coastal features that might benefit the marine life, for example seagrass meadows need sheltered bay with sandy or muddy sediment.

Guide to a field sketch:

Field sketches are an important tool in the world of fieldwork. They are a form of **qualitative data** and can be used alongside photographs to summarise important geological features. Artistic skills are not required!

1) Identify the landscape that needs to be sketched. Give your sketch a title.

2) Draw an outline of the main features of the landscape e.g., mountains, valleys or roads!

3) Add detail to the sketch to record more information e.g., recognisable trees, meanders in a river or caves at the beach.

4) If it's useful (for scale!) draw people, this can be a helpful trick when trying to estimate heights of features!

5) Annotate or label the sketch, note down the weather, time and date.

6) Take a photograph to support your sketch.

FUN FACT!

Geology tells us the history of earth; from the weather to what dinosaurs liked for breakfast!

WORK SHEET FOLLOW UP:

1) Draw James Hutton:

2) Give your own definition for:

a. Geology

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b. Uniformitarianism

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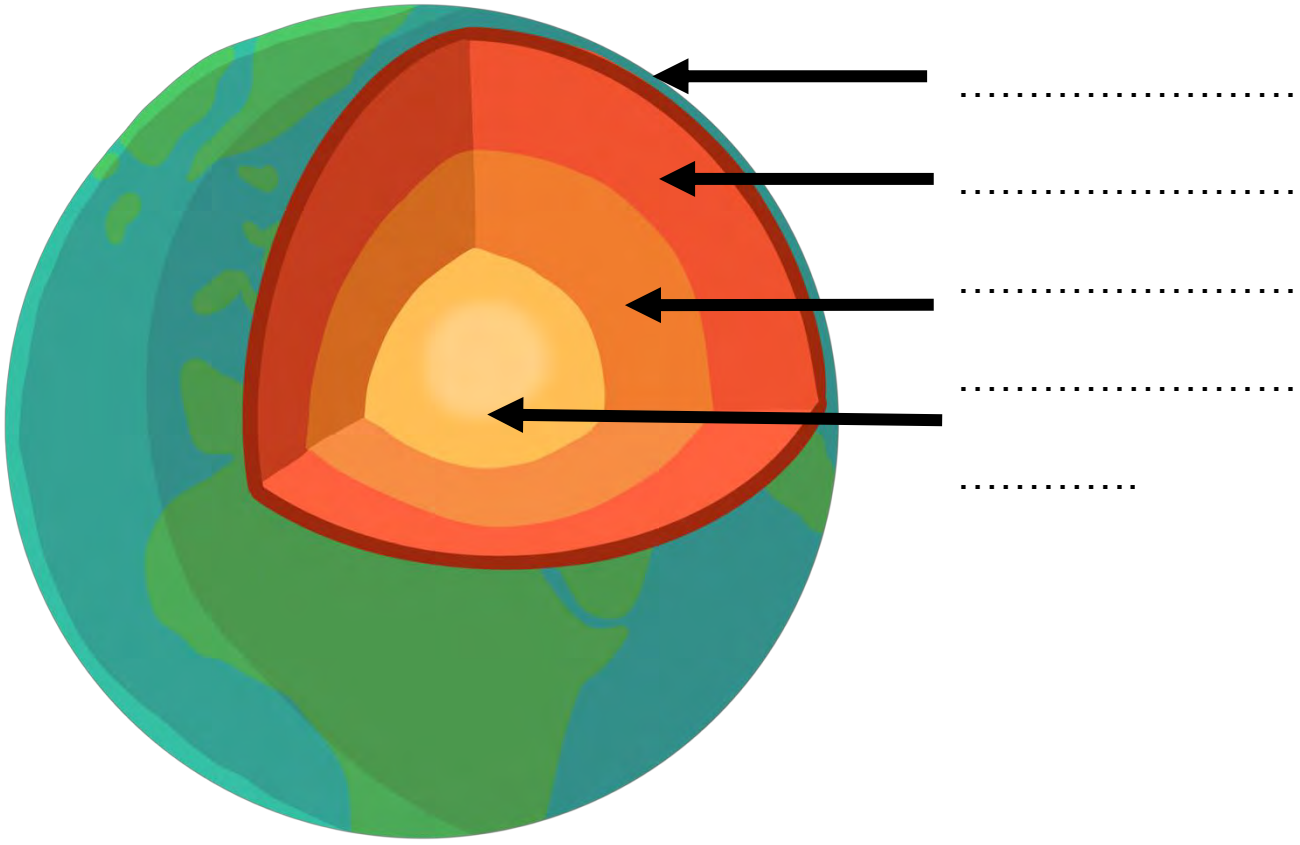
3) Draw the geological timeline:

4) Label the earth's inner core, outer core, mantle and crust!

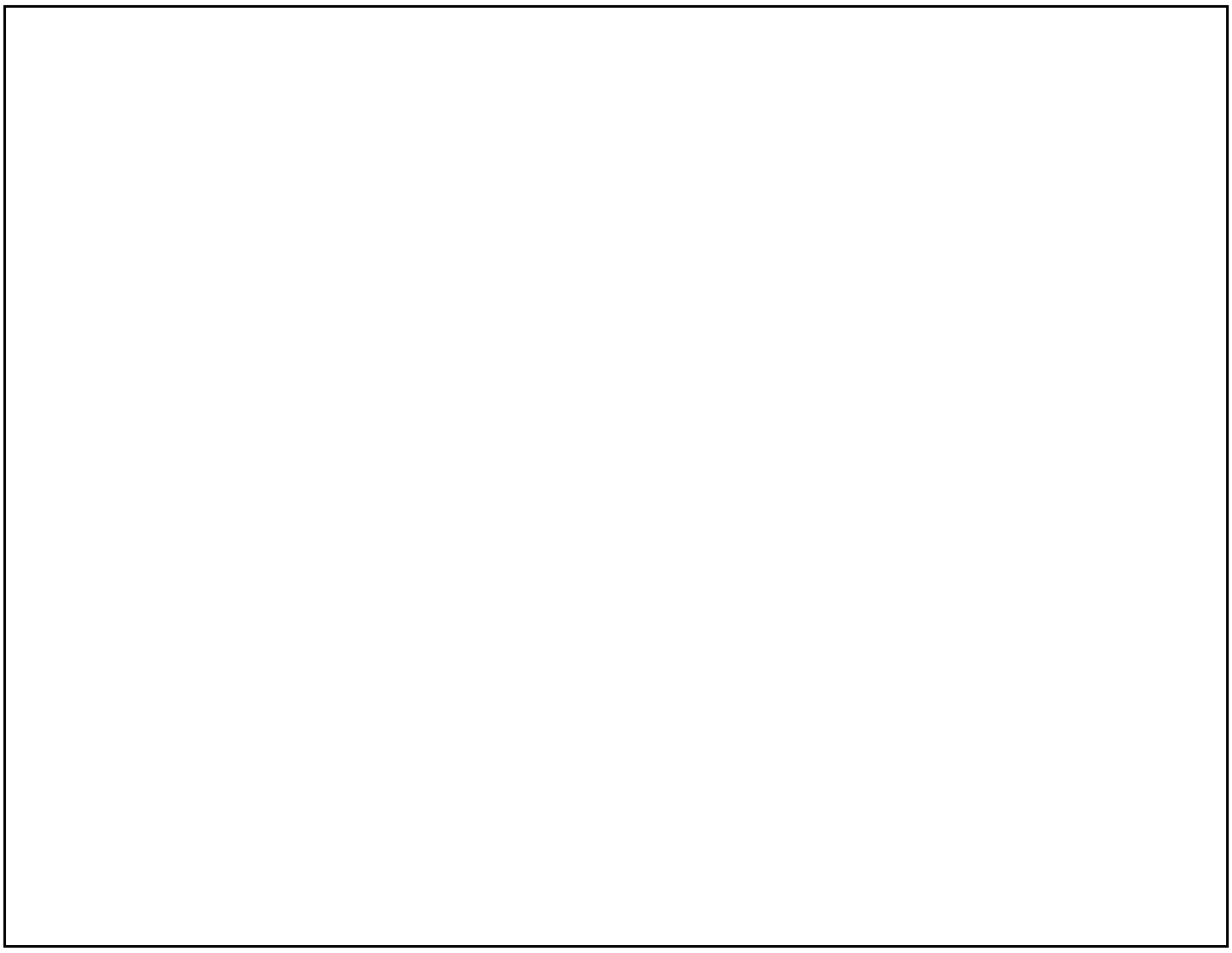


5) Mix and match of keywords:

Compaction	**Core**
Crust	**Deposition**
Erosion	**Fossil**
Geology	**Ice Age**
Igneous	**Lithosphere**
Mantle	**Metamorphic**
Minerals	**Sedimentary**
Transportation	**Weathering**
A process where sediment becomes squashed closer together during burial	Found at the center of the Earth. Separated into the ‘inner’ and ‘outer’ cores which are made from nickel and iron.
The thin and rocky outermost layer of Earth (approx. 20 km thick)	The process of sediment settling from the water or wind as the flow slows down, or ice as it melts
Breakdown and removal of rock material by flowing water, wind, or moving ice. Not to be confused with weathering!	Any trace of past life preserved in a rock (includes animal tracks & burrows as well as shells, skeletons and impressions of soft flesh)
The area of science concerned with the solid Earth, the rocks of which it is composed, and the processes by which they change over time.	A period in Earth's history where the ice sheets cover large areas of land, due to an overall lowering of the Earth's global temperatures.
Formed from magma, either erupted from a volcano or cooled below ground in an intrusion	Outer layer of Earth (uppermost mantle and crust) that behaves as a number of rigid, moving "plates"
Layer of hot, dense rock deep beneath the surface (from about 25 to 2500 km down). Hot enough to flow slowly	A rock which has re-crystallised due to heat and/or pressure. Examples: marble, slate, schist
Naturally-occurring chemical compound (e.g.calcium carbonate), often with a regular crystal structure.	Any rock made up of sediment grains e.g., mudstone, sandstone, limestone, rock salt, coal
Movement of sediment by water, wind or glacier ice	Slow breakdown of rock at the Earth's surface, due to climatic and biological processes

6) Find and ID 5 different rocks, aim for one of each sedimentary, igneous and metamorphic.

7) Draw the rocks you found in q6 and label the parts that made you think it was that type of rock.



a. Suggest what processes might have shaped at least 3 of these rocks. Use the keywords!

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b. From your rock ID guide, add where on the Mohs hardness scale you think your rocks are.

8) Draw a field sketch!

9) Write your own ‘Rock Cycle ’song

10) Create a poster showing the geology and features of the area

WORK SHEET ANSWERS:

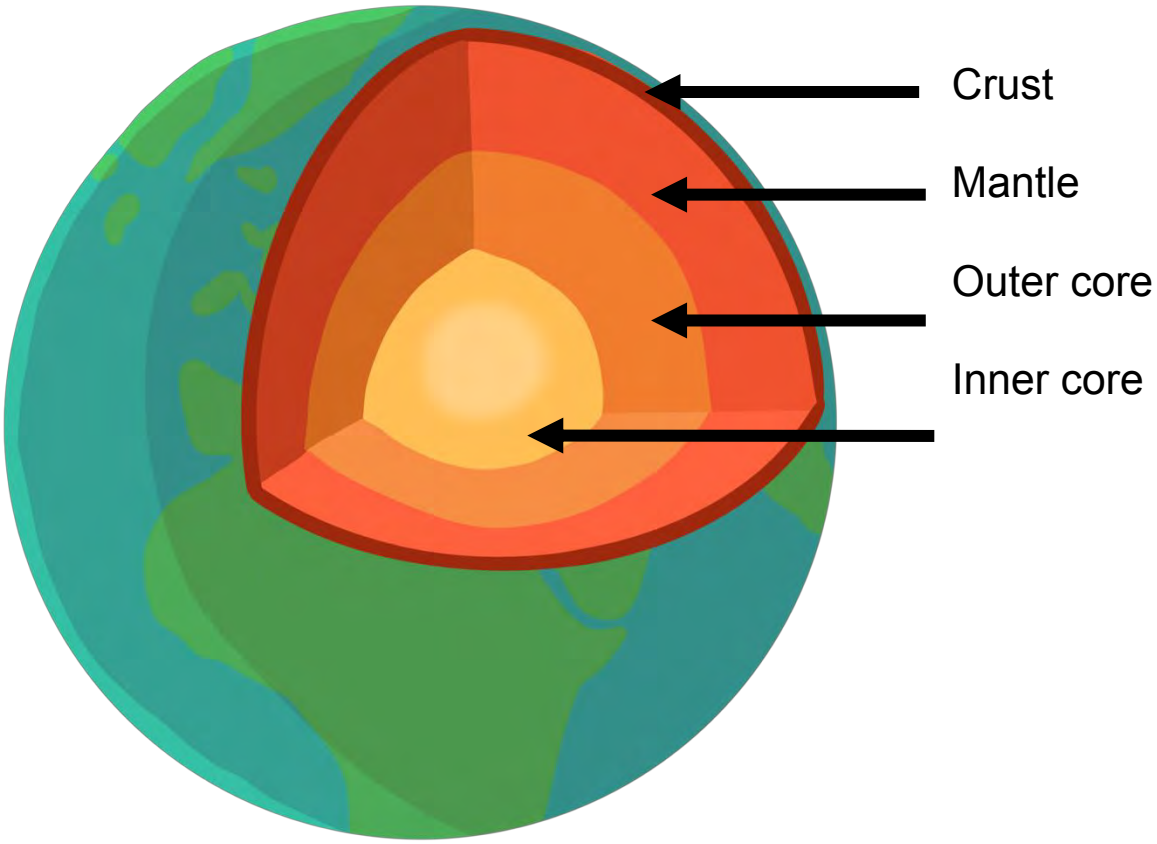
1) N/A

2) a. Geology - *area of science concerned with the structure of the Earth. It includes the study of rocks and the processes that shape our planet.*

b. Uniformitarianism - *the assumption that the natural processes and laws we see today have always operated the same.*

3) Draw the geological timeline: Precambrian (Hadean, Archean, Proterozoic); Paleozoic (Cambrian, Ordovician, Silurian, Devonian, Carboniferous, Permian); Mesozoic (Triassic, Jurassic, Cretaceous); Cenzoic (Tertiary, Quarternary)

4)



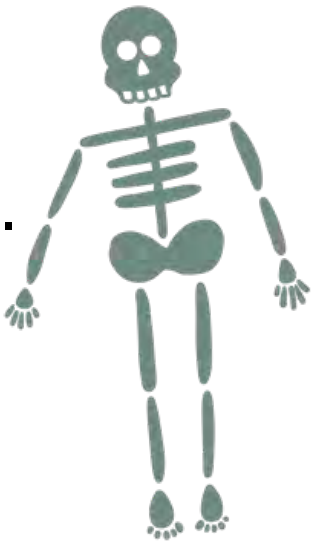
GEOLOGY POP QUIZ

Q1. How old is the planet Earth? (Bonus point: write the number out in full)

a. 4.6 billion years (4600 million years)

b. 450 million years

c. 45,000 years



Q2. How long ago did life evolve on Earth?

a. 64 million years ago

b. 4,280 million years ago

c. 468,000 years ago

Q3. How long ago did seagrass recolonise the sea?

a. 70,000-100,000 years ago

b. 700,000-1 million years ago

c. 70 - 100 million years ago

Q4. Which element is most abundant in the Earth's crust?

a. Iron

b. Oxygen

c. Sodium

Q5. Earthquakes happen on a regular basis in the UK.

True or false?

Q6. What type of rock makes up the London area?

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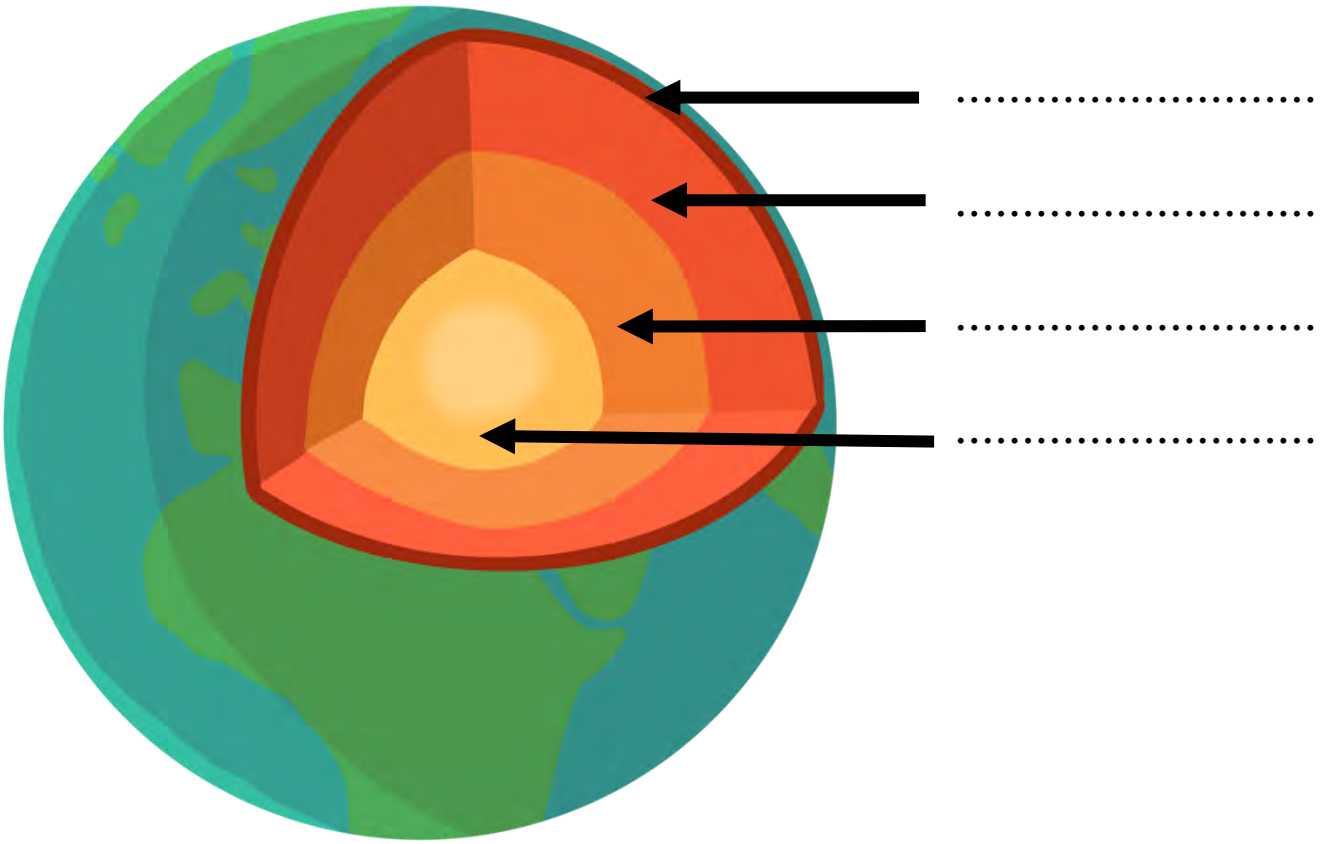
Q7. Label the diagram:



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Q8. Describe how igneous rocks are formed:

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Q9. Fossils can be found in all three rock types.

True or false?

Q10. What was James Hutton's nickname?

a. The Son of Geology

b. The Father of Modern Geology

c. The Modern Geologist

Q11. What name is given to the outermost layer of Earth, comprised of tectonic plates?

a. Atmosphere

b. Lithosphere

c. Stratosphere

d. Biosphere

Q12. What is this fossil?

Q13. What is thought to be the oldest living organism on Earth?

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Q14. Coprolite was mined in the First World War to be turned into fertiliser.
True or false?

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Q15. Parts of the UK were once covered by rainforest and shallow tropical seas.
True or false?

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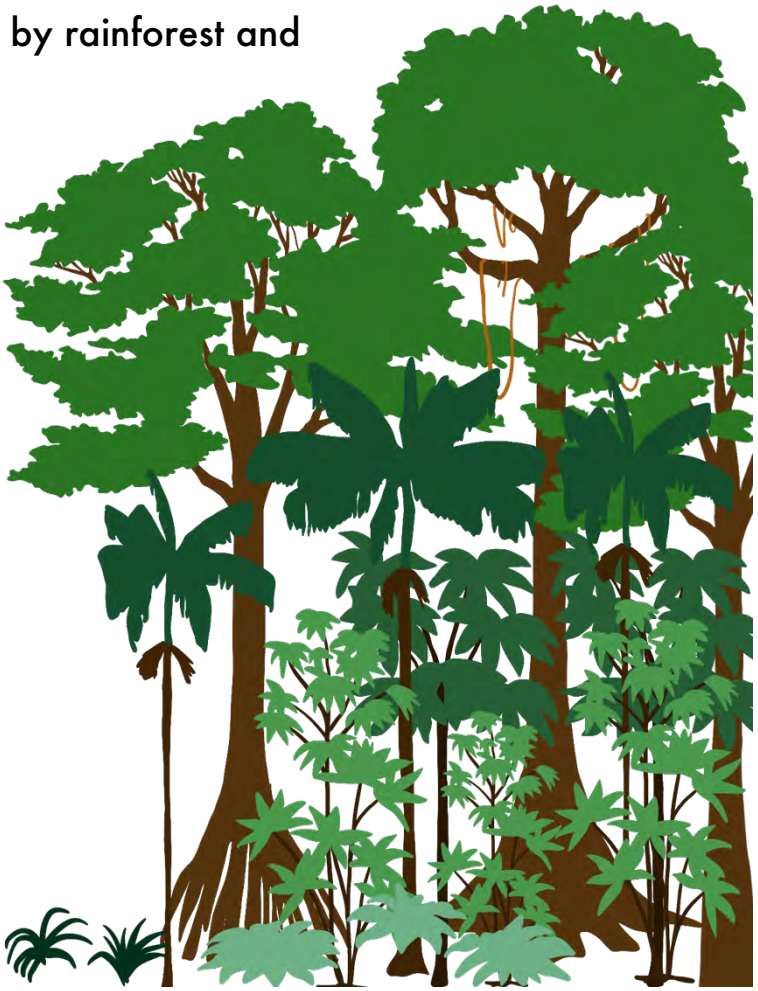


POP QUIZ ANSWERS:

Q1 – a (Bonus point for writing out 4,600,000,000 in full)

Q2 – b

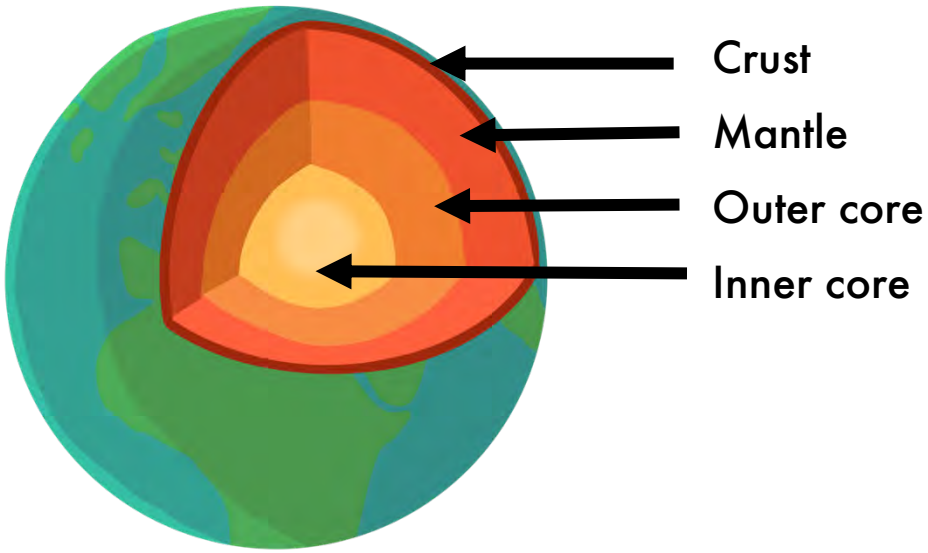
Q3 – c

Q4 – b

Q5 – TRUE (Use the BGS interactive map's Earthquake Timeline to demonstrate)

Q6 – Sedimentary

Q7



Q8 - Magma cools either by erupting from a volcano or beneath the ground in an intrusion

Q9 – False

Q10 – b

Q11 – b

Q12 – Ammonite

Q13 – Giant seagrass

Q14 – True

Q15 – True

ROCK IDENTIFICATION GUIDE

1) Is it igneous, sedimentary or metamorphic?

a. **Igneous** rocks such as granite or lava are tough, have little texture or layering. Rocks like these contain mostly black, white and/or grey minerals.

b. **Sedimentary** rocks such as limestone or shale are hardened sediment with sandy or clay-like layers (strata). They are usually brown to grey in colour and may have fossils and water or wind marks.

c. **Metamorphic** rocks such as marble are tough, with straight or curved layers (foliation) of light and dark minerals. They come in various colours and often contain glittery mica.

2) Check the rock's grain size and hardness.

a. **Grain Size:** Coarse grains are visible to the naked eye, and the minerals can usually be identified without using a magnifier. Fine grains are smaller and usually cannot be identified without using a magnifier.

b. **Hardness:** This is measured with **the Mohs scale** and refers to the minerals contained within a rock. In simple terms, hard rock scratches glass and steel, usually signifying the minerals quartz or feldspar, which has a Mohs hardness of 6 or higher. Soft rock does not scratch steel but will scratch fingernails (Mohs scale of 3 to 5.5), while very soft rock won't even scratch fingernails (Mohs scale of 1 to 2).

The Mohs Hardness Scale

Mineral	Mohs relative hardness scale	Scratch test
Talc	1	Scrapeable with fingernail
Gypsum	2	Scrapeable with fingernail
Calcite	3	Scratch with copper coin
Fluorite	4	Scratch with nail
Apatite	5	Scratch with nail
Feldspar	6	Scratch with steel file
Quartz	7	Scratches window glass
Topaz	8	Scratches glass
Corundum	9	Scratches topaz
Diamond	10	Scratches corundum

Igneous Rock Identification

Grain Size	Usual Colour	Other	Composition	Rock Type
fine	dark	glassy appearance	lava glass	Obsidian
fine	light	many small bubbles	lava froth from sticky lava	Pumice
fine	dark	many large bubbles	lava froth from fluid lava	Scoria
fine or mixed	light	contains quartz	high-silica lava	Felsite
fine or mixed	medium	between felsite and basalt	medium-silica lava	Andesite
fine or mixed	dark	has no quartz	low-silica lava	Basalt

mixed	any color	large grains in fine-grained matrix	large grains of feldspar, quartz, pyroxene or olivine	Porphyry
coarse	light	wide range of color and grain size	feldspar and quartz with minor mica, amphibole or pyroxene	Granite
coarse	light	like granite but without quartz	feldspar with minor mica, amphibole or pyroxene	Syenite
coarse	light to medium	little or no alkali feldspar	plagioclase and quartz with dark minerals	Tonalite
coarse	medium to dark	little or no quartz	low-calcium plagioclase and dark minerals	Diorite
coarse	medium to dark	no quartz; may have olivine	high-calcium plagioclase and dark minerals	Gabbro
coarse	dark	dense; always has olivine	olivine with amphibole and/or pyroxene	Peridotite
coarse	dark	dense	mostly pyroxene with olivine and amphibole	Pyroxenite
coarse	green	dense	at least 90 percent olivine	Dunite
very coarse	any color	usually in small intrusive bodies	typically granitic	Pegmatite

Sedimentary Rock Identification

Hardness	Grain Size	Composition	Other	Rock Type
hard	coarse	clean quartz	white to brown	Sandstone
hard	coarse	quartz and feldspar	usually very coarse	Arkose
hard or soft	mixed	mixed sediment with rock grains and clay	gray or dark and "dirty"	Wacke/ Graywacke
hard or soft	mixed	mixed rocks and sediment	round rocks in finer sediment matrix	Conglomerate
hard or soft	mixed	mixed rocks and sediment	sharp pieces in finer sediment matrix	Breccia
hard	fine	very fine sand; no clay	feels gritty on teeth	Siltstone
hard	fine	chalcedony	no fizzing with acid	Chert
soft	fine	clay minerals	splits in layers	Shale
soft	fine	carbon	black; burns with tarry smoke	Coal
soft	fine	calcite	fizzes with acid	Limestone
soft	coarse or fine	dolomite	no fizzing with acid unless powdered	Dolomite rock
soft	coarse	fossil shells	mostly pieces	Coquina
very soft	coarse	halite	salt taste	Rock Salt
very soft	coarse	gypsum	white, tan or pink	Rock Gypsum

Metamorphic Rock Identification

Foliation	Grain Size	Usual Color	Other	Rock Type
foliated	fine	light	very soft; greasy feel	Soapstone
foliated	fine	dark	soft; strong cleavage	Slate
nonfoliated	fine	dark	soft; massive structure	Argillite
foliated	fine	dark	shiny; crinkly foliation	Phyllite
foliated	coarse	mixed dark and light	crushed and stretched fabric; deformed large crystals	Mylonite
foliated	coarse	mixed dark and light	wrinkled foliation; often has large crystals	Schist
foliated	coarse	mixed	banded	Gneiss
foliated	coarse	mixed	distorted "melted" layers	Migmatite
foliated	coarse	dark	mostly hornblende	Amphibolite
nonfoliated	fine	greenish	soft; shiny, mottled surface	Serpentinite
nonfoliated	fine or coarse	dark	dull and opaque colors, found near intrusions	Hornfels
nonfoliated	coarse	red and green	dense; garnet and pyroxene	Eclogite
nonfoliated	coarse	light	soft; calcite or dolomite by the acid test	Marble
nonfoliated	coarse	light	quartz (no fizzing with acid)	Quartzite

PROJECT SEAGRASS

HABIT BREAKER
ACTIVITY GUIDE
AGES 11-14

OVERVIEW

This activity guide introduces the topic of habit breaking and the activity allows you to explore the importance of changing our behaviour to combat climate change with your students. Within this guide is a quick activity which show how habits are formed.

KEY INFORMATION

- Indoor or outdoor activities
- Group activities
- Time - 5 minutes
- Practical

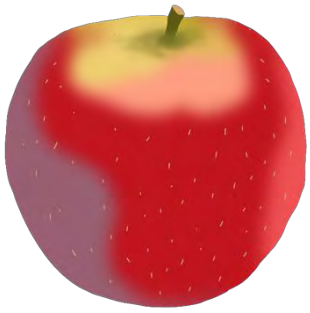
HEALTH AND SAFETY
Follow standard classroom rules!

- **Lesson Objective:** to appreciate the need to change behaviour to combat climate change
- **Curriculum links:** Geography/Science

LEARNING TIPS

This habit breaker guide is a good starter activity for the '**Act Local**, **Think Global**' Project Seagrass activities, as well as when discussing '**Climate change**', '**Resource rampage**', '**Microplastics**' and '**Litter**' activities!

INTRODUCTION



To combat **climate change** we **ALL** need to make changes! By reducing our demand of **fossil fuels** and making green switches, we'll start to slow the amount of **greenhouse gasses** being released. We can make simple changes like **walking** or **cycling** instead of driving, eating **less meat**, turning **electrical** items off when they're not in use and thinking about the things we buy.

Some of the changes necessary may seem hard to do, but we just need to make them into **habits** that we can do without even having to think. This activity highlights how it can be uncomfortable to break habits, it takes a lot of thought and some mistakes, but if we keep thinking about our new habit then we'll quickly be eco-friendly without having to make any effort!

ACTIVITY:

FUN FACT!

Habits take a minimum of three weeks to become engrained in your brain!

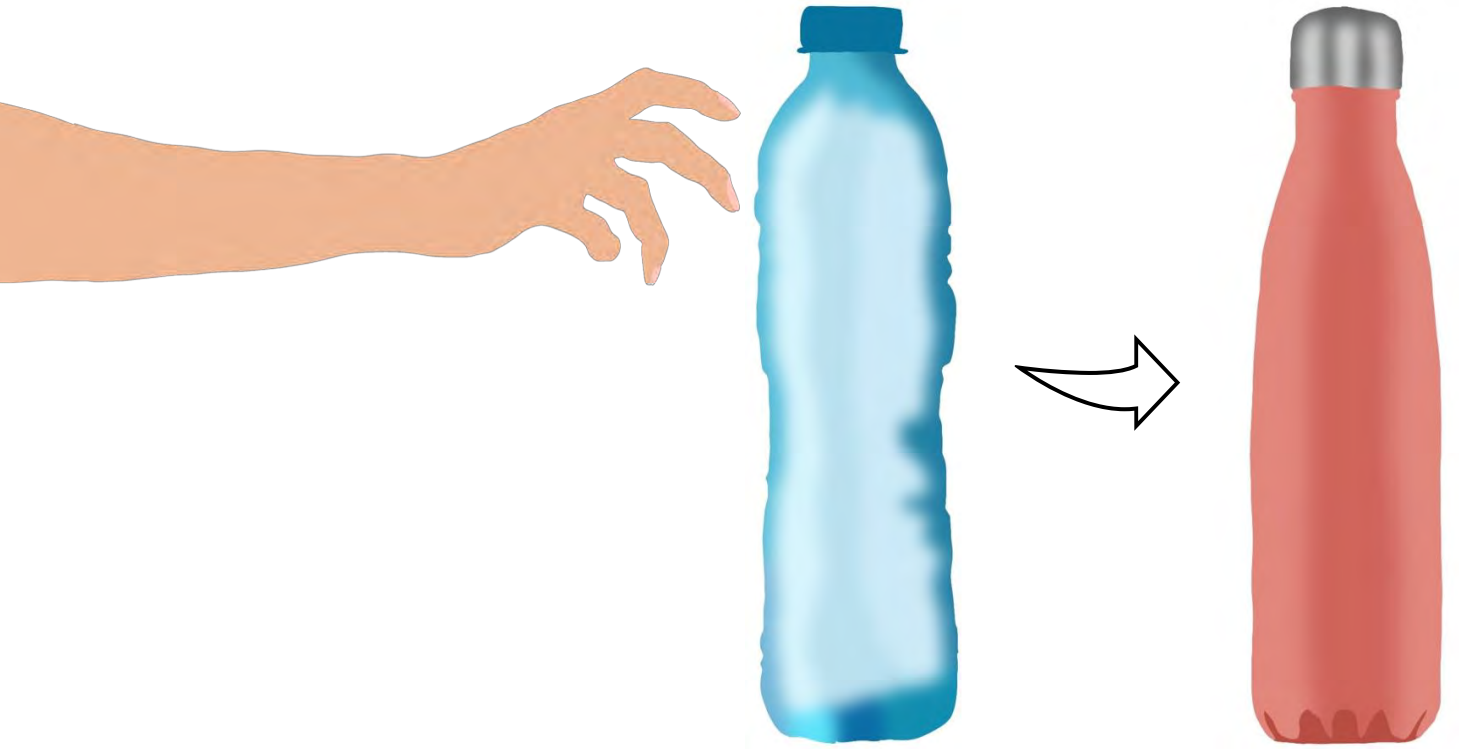
1) Ask everyone to put down anything they're holding and to fold their arms.
2) Now get the group to cross their arms and to remember whether they put their right or left wrist on top.
3) All drop your arms to your sides.
4) Cross your arms and again remember which wrist is on top.
5) Drop your arms back to your sides.
6) Now ask everyone who had the same wrist on top both times to put their hand up and give them a quick count. Normally this will be most of the group. Do the same for those that changed which wrist they had on top.
7) Explain that crossing their arms the same way is a good thing - they have learnt an easy way to tuck their arms out of the way, so why waste energy changing it each time?
8) Now find out how many people had their left wrist on top both times and the same for the right wrist. Normally it'll be about half and half. This shows that neither way is necessarily better.
9) Explain how without realising it they've developed one way of folding their arms and it has become a habit that they repeatedly do without question. Habits are good for us! They stop us having to spend time and energy on things that we already have an easy solution for, such as putting the same wrist on top each time they tuck their arms out of the way.

10) Sometimes conditions change and habits stop being useful - let's try to change this habit! Ask everyone to cross their arms with the *other* wrist on top.

11) A big well done to everyone for managing to change their habit!

12) Point out how breaking their arm folding habit required some thought, perhaps a couple of mistakes and felt a bit uncomfortable to begin with.

13) Humans have spent hundreds of years developing habits that use more energy, increased food production and take more from the earth. These habits have helped humans to grow and develop. However, the condition of the earth has now changed, and we can't continue with these habits. We have to change them in ways that reduce the damage we're doing, such as our contribution to climate change. To make those changes into habits we have to remember that, just like crossing our arms differently, we can do it! But we will have to keep thinking about the new habits and that sometimes we will slip up, but in the end, we will break the damaging habits and find new eco-friendly ones!



PROJECT SEAGRASS

CLIMATE CHANGE
ACTIVITY GUIDE
AGES 11-14

OVERVIEW

This activity guide introduces the topic of climate change. The activity within this guide allow you to explore the greenhouse effect with your students.

KEY INFORMATION

- Indoor or outdoor activity
- Group activity
- Time – 5 minutes
- Practical

- **Lesson Objective:** to learn what climate change is and its effects
- **Curriculum links:** Geography/Science

LEARNING TIPS

This 'Climate change' guide goes well with Project Seagrass activities in the '**Photosynthesis**', '**Seagrass restoration**' and '**Sustainability audit**' guides.

INTRODUCTION

Let's tackle climate change. A daunting topic!

We'll kick off with one of the elements that forms the basis of all living things. This wonder element, key to life if you are a human, a dinosaur or even a mushroom, is **carbon**.

Everyone and everything is built from carbon. When a living thing dies, the carbon from its body gets buried back into the earth, ready for it to be built back into a new living thing. Remains of creatures that first roamed the earth are now buried deep into the ground. Over **millions of years** and huge amounts of **pressure**, the carbon in these creatures remains have changed into oil, coal and gas. These are called **fossil fuels** and there is

KEY WORDS

Carbon - An essential element for all living things

Climate change – A change in the average weather conditions, such as temperature and rainfall, over a long time

Finite resource - Something that there is only a limited amount of

Fossil fuels - The remains of living organisms that have been changed over millions of years into oil, coal and natural gas, which we use as an energy source

Greenhouse effect - Gases such as carbon dioxide stop the suns warmth from escaping earth's atmosphere

only a limited amount of them on earth, meaning they are non-renewable, finite resources. We use fossil fuels to power every part of our lives. To gain power from fossil fuels we burn them, which releases the carbon back into the atmosphere in the form of carbon dioxide.

Earth needs some carbon to keep forming the basis of life, but too much in the atmosphere can be damaging. By releasing all the carbon locked up in fossil fuels we are tipping this delicate balance. Adding more carbon dioxide into the earth's atmosphere is like adding more and more blankets to it. The earth needs a little blanket so that some of the sun's rays are trapped and stop it from freezing over. However, if there's too much carbon dioxide it's like wrapping too many blankets around the earth with no way for the heat of the sun to escape. This is called the **greenhouse effect**.

FUN FACT!

In 2020, 11% of humans were estimated to be vulnerable to climate change impacts.

As the earth becomes warmer our average long term weather patterns such as rainfall and temperature begin to alter, this is called **climate change**. Warmer temperatures lead to melting ice caps causing rising sea levels and changes to our seasons, such as when flowers bloom and animals hatch, upsetting their natural cycles. It also causes more extreme weather events, such as big floods, hurricanes and forest fires. Alongside burning fossil fuels, other human activities such as deforestation, industry and waste management also add to the greenhouse effect, speeding up climate change.

ACTIVITY:

HEALTH AND SAFETY
Remove items if starting to overheat!

1) Choose one student to pretend to be the earth and another pretend to be the sun.
2) The sun keeps zapping its rays at the earth, warming it up. This can be shown by flashing the torch or waving their hands towards the earth.
3) Add the first blanket, check how the earth is feeling. Highlight how one blanket keeps the 'earth' comfortable with everything functioning correctly.
4) Add more and more blankets, hats and gloves and check on the earth. They should now feel too hot and very uncomfortable!
5) Explain how the blankets are represented carbon dioxide and other greenhouse gases. The earth needs a blanket to keep comfortable by trapping some of the sun's rays. However, as we add more greenhouse gases to the environment, we are adding more blankets around the earth, making it uncomfortably hot and unable to function as too many of the sun's rays are trapped inside. This is the greenhouse effect!
6) Unwrap the earth before it melts!

PROJECT SEAGRASS

UNDERWATER GARDENER

ACTIVITY GUIDE AGES 11-14

OVERVIEW

This activity guide introduces the topic of Underwater gardening, allowing you to explore ways to plant seagrass.

- **Lesson Objective:** to actively participate in seagrass conservation.
- **Curriculum links:** Geography/Science

KEY INFORMATION

- Outdoor activity (at a seagrass meadow)
- Group activity
- Time – 2/3 hours for two consecutive days (at low tide)
- Practical

KEY WORDS

Intertidal Zone–
Area on the beach, covered by high tide but exposed at low tide.

Spathe –
The part of the seagrass plant containing seeds, like a seed pod.

LEARNING TIPS

Contact Project Seagrass for any guidance on how and where to plant a seagrass meadow.

Be extra cautious whilst working at sea!

This 'Underwater gardener' guide can be used in partnership with the Project Seagrass activities: '**Marine restoration**', '**Plant biology**' (anatomy, photosynthesis and reproduction), '**Stakeholder roleplay**' for seagrass restoration, '**Coastal protection**', '**Water filtration**' and '**Hide & seek**'.

FUN FACT!

Up to 92% of the UK's seagrass meadows have been lost in just the last century

INTRODUCTION

Seagrass Seed Collection - *Walking & Snorkelling*

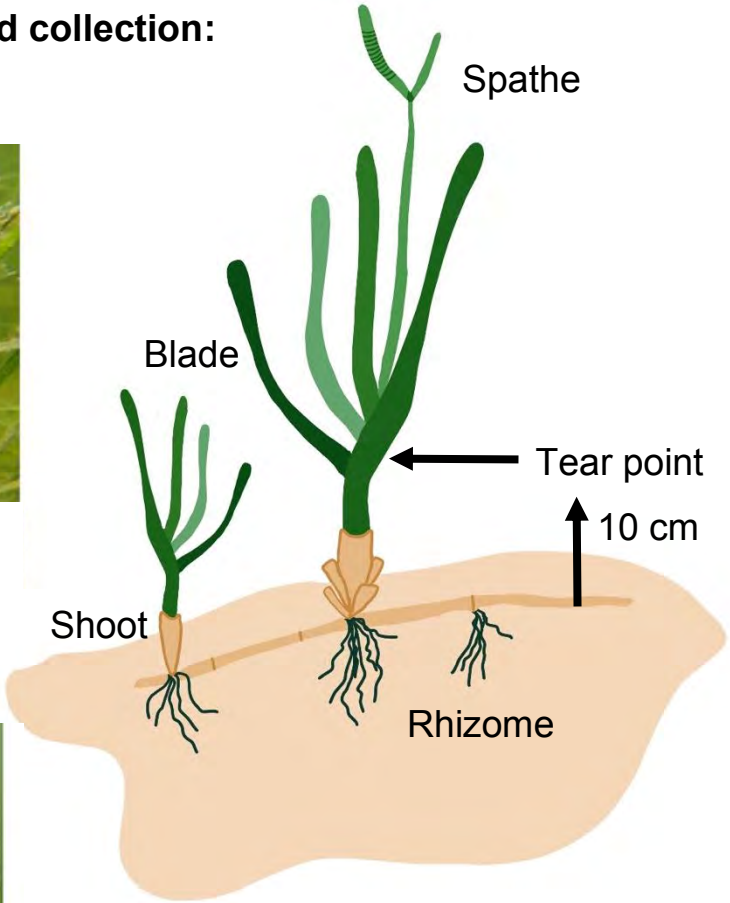
Ever wanted to be an underwater gardener? Well today is your time to shine! Check out this video: https://www.youtube.com/watch?v=fC1QxOBkx-g&ab_channel=RAZORScienceShow, on how Seagrass Ocean Rescue did it, so you know what to expect!

Seagrasses are marine flowering plants, living in shallow and sheltered coastlines. They can grow up to 10 meters deep in the UK but are often found in the **intertidal** (where the beach is exposed when the tide goes out). Seagrasses are very different to seaweeds. Their bright green leaves form underwater meadows, which are key for our **fisheries**, are an important **carbon store** and provide us with **coastal protection**.

Head to Project Seagrass' YouTube channel for some videos in seagrass meadows, so you know what it will look like underwater! It feels just like grass in your garden.

The seeds are at the top of a special leaf called a '**spathe'**; they look like tiny peas in a pod. The easiest way to spot them is looking for strands that are a yellow/green colour, and are skinnier, more like string (cylindrical) and tend to be taller than the flat leaves. The seeds once matured and ready to pick, are small ovals a couple of millimetres in size, squeezed in a line with about 10 others.

Seagrass anatomy and cut point for seed collection:



1

Identify seed spathe

2

Pick gently from 10cm above the shoot

3

Add seeds to mesh bag and repeat!

The seagrass likes to grow in sheltered bays with a soft sediment like sand or mud. The easiest way to find somewhere suitable to plant seeds is to plant next to existing seagrass. When the seeds naturally drop from the plant, most are washed away to sea, where they won't be able to grow. By putting the seeds in biodegradable hessian bags, they stay near the meadow allowing it to expand much quicker, boosting the fantastic habitat. It also stops crabs from eating the seeds!

The hessian bags will need half filling with sand from the beach in which the seeds will be planted. Seeds are then added, and the bags are filled to the top with more sand. Adding the sand gives the seeds something for the roots to grow into (like soil for plants on land). The weight of the sand will also help keep the seeds in place. The sand won't be enough to stop the seeds being carried away with tide, so the bags need to be pinned to the seabed using bamboo stakes or tied to ropes that are weighed down by larger sandbags.

ACTIVITY:

Always ensure calm sea conditions and full knowledge of currents and tides in the area. If you feel uncertain whether conditions are safe, then do not enter the water and keep the class to intertidal picking. Low tide is also recommended for the snorkelling work to reduce the need to duck dive.

- Ensure site appropriate permits are in place including landowner permission.
- Two days will be needed to complete this seagrass planting activity as it relies on low tides (preferably when its light).
- Before going onto the beach, everyone should be provided with a thorough health and safety briefing on the shore, as well as how to identify and pick seeds. A laminated picture of seagrass seeds may be helpful for correct ID.
- Emphasise that the quality rather than quantity of seeds is key! Immature ones will not develop into new plants.

YOU WILL NEED:

Contact Project Seagrass prior to the activity for help with permits, planning and gear.

Snorkelling gear including mask, snorkel, wetsuit as a minimum (Extras surface marker buoys, fins, booties, gloves and hoods).

Wellies, waders or wetsuit booties for intertidal collectors.

Towels and warm clothes to change into.

First aid kit (see snorkelling and intertidal health and safety guide).

Mesh collection bag.

Scissors or dive knife (optional).

Sealable storage box.

Hessian bags.

Buckets.

Bamboo stakes (minimum size of 15 cm) **or** biodegradable twine.

HEALTH AND SAFETY

Follow intertidal and snorkelling guidelines and complete risk assessment.

Do not consume seeds or sand.

Take care with the bamboo stakes not to spike yourself.

Follow the coastal tips guide for planning your intertidal or snorkelling seed collection.

Day 1 – Seed collection

1) If snorkelling, attach your mesh bag to your wet suit or around your wrist to stop it floating away. Likewise, attach your surface marker buoy if you are using one.

2) Try to find a patch of bare sabd, that is in arms reach whilst floating on the surface. Timing your snorkel with the low tide will make this much easier! (Duck diving can be tried if the staff feel confident to supervise this).

3) Pick every third mature seagrass seeding shoots, then add to your mesh bag. This reduces the risk of over picking a site.

4) Mature seeding shoots are those where the seed has become rounded and fully formed rather than green and pointy. Each seed spathe may contain up to 20 seeds. Some shoots will have multiple branches of spathes, meaning multiple spathes can be picked in one go.

5) Pick the shoot of a seeding plant 10 cm above the seabed. To do this, pinch below the picking point to stop any damage to the rest of the plant and tear at the picking point. **Do not pull up,** only gentle tearing! You may find it easier to do this by using scissors.

6) The process is the same whether you are walking on an exposed meadow or snorkelling.

7) Keep the seed shoots in the mesh bag throughout the collection.

8) On the beach it is time to snip the seed pods as short as possible. Cut above and below the spathe so just the seed pod is left.

9) Transfer the trimmed seeds to watertight boxes filled with local sea water. Lunch boxes work well!

10) Keep the boxes in a in a cool place, out of direct sun light.

Day 2 – Planting

1) Head to the beach a couple of hours before low tide.
2) Set up a bag filling station with empty hessian bags, sand scoops (or hands) and a bucket filled with seawater to use as a dunk tank.
3) Fill each of the hessian bags about halfway with dry sand.
4) Add 4-5 of the trimmed spathes, from the previous day, into the bag, then top the bag up with sand and tie the drawstrings firmly shut.
5) Once filled put the bags straight in the dunk tank to keep the seeds wet.
6) Once the tide is at its lowest point it is time to plant the bags! This can be done in one of two ways:

Planting method 1:

1) Wade out on a low tide, to about hip height, where there is a gap of bare sand or mud, in or next to a seagrass meadow.
2) Planting should take place in threes: (these roles can be rotated).
   a. Person one to carry the bags.
   b. Person two to pierces the hessian bag so that the bamboo stake comes through to the other side of the bag. Take care not to stab yourself!
   c. Person three is responsible for planting. Holding the top of the stake, push the bag into the sediment as far as possible. If the water is clear enough, dig a small hole in the sand for the bag to sit in before pushing the stake into the ground.

Planting method 2:

1) After a good soak the bags are ready to be tied onto twine.
2) Get everyone into one big line, spaced roughly a meter apart and then feed the twine out along the line. Leave an extra 2m of twine at either end.
3) Each participant now ties a seed filled bag on to the twine at their meter mark. To do this pinch the twine creating a 3 cm loop. Put the loop through one of the bags drawstrings and tie a double knot.
4) Repeat this until you have around 30 bags on a line (cut the twine with 2m spare from the last bag.

5) Tie a large hessian bag filled with more sand from the beach on to each end of the line. These need to be a minimum of 7kg to hold the line in place whilst the seeds grow!
6) Once it is nearly low tide then it's time to plant! Have someone on either end supporting the large sandbags, and a couple of people to support the small seeded bags. Wade straight out until chest height, get the line taught and drop it to the seabed.
   a. If conditions allow get an adult to take the large sandbag at each end of the line, then have the children support the seed bags. Walk out together in a big line until you reach the planting spot!
   b. If getting the children in the water isn't suitable then the line with the bags can be fed into a large plastic box or tub, taken to the water's edge and fed out slowly by hand whilst walking. Remember to tie a large sandbag on each end!
7) Incredible, you've planted a whole new part of a seagrass meadow and helped create a home for so much wildlife! Please send Project Seagrass pictures so we can shout about your amazing achievement!

- Upload any seagrass snaps to our spotter app! https://seagrassspotter.org/
- How to plant a seagrass meadow. https://www.seawilding.org/how-to-videos
- Information about Seagrass Ocean Rescue. https://www.projectseagrass.org/seagrass-ocean-rescue/
- Seagrass videos. https://www.youtube.com/channel/UCGSHPlN3rgaE04a0bgzCYjw

PROJECT SEAGRASS

STAKEHOLDER MEETING ACTIVITY GUIDE AGES 11-14

OVERVIEW

This activity guide introduces the topic of stakeholder meetings. The activity within this guide allows you to explore the importance of working with stakeholders for better climate change and sustainability outcomes.

- **Lesson Objective:** to recognise that we all have an impact on the marine environment and a voice in what happens to it.
- **Curriculum links:** Geography/Science/Creative Arts

KEY INFORMATION

- Indoor activity
- Group activities
- Time – 45 minutes
- Presentation/Practical

LEARNING TIPS

Encourage students to consider the experiences they have had through the week such as the species they have spotted, plastic pollution, benefits of healthy marine ecosystems, the area's geology, and other restoration work.

If possible, try to encourage students to reach a consensus on one or more of the most supported arguments, and together discuss these in more detail. Conclude with a vote on the best scenario.

KEY WORDS

Climate change – The change in the climate that lasts longer than individual weather events or seasons (e.g. temperature rising all year round).

Compromise – a deal between different people or groups where everyone involved gives up part of their demand to reach an agreement

Habitat – the natural home or environment of an animal, plant, or other organism

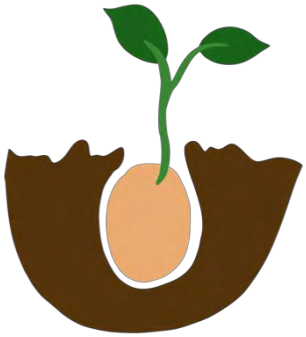
Livelihood – a job or other means to obtain money to pay for food and other necessities of life

Seagrass – seagrasses are the flowering plants which grow in marine environments

Stakeholder – someone with a vested interest in the area or development under consideration

Sustainable future – sustainability is the ability to exist constantly without using up all of the planet's resources

INTRODUCTION



Seagrass habitats are vitally important for supporting marine life and for fighting **climate change**. Much of our seagrass has been lost over the years and there are now plans in place to restore these coastal **habitats**. However, restoration plans can have impacts on the people that live nearby, whose **livelihoods** or **recreational** interests in the area may be affected by these developments. These people are called **stakeholders**. A large part of working towards a **sustainable future** is trying to find **compromises** between various stakeholder groups to ensure that the best solutions for all are put into action. For this, stakeholder meetings are held to enable all the different groups to put their views forward and work together to find the best compromise.

Through this roleplay activity you'll explore the real life environmental, social, political and business impacts of a conservation project such as seagrass restoration. You'll have to use persuasive speaking techniques to convince others of your stakeholders' point of view. Check out our tips on persuasive techniques page for some tips!

ACTIVITY:

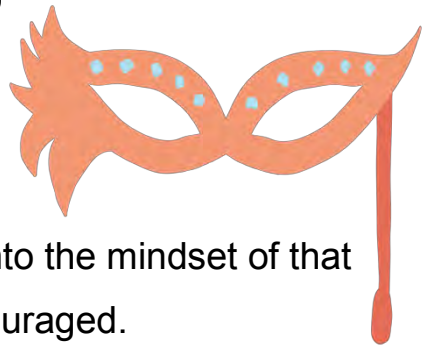
YOU WILL NEED:

- Stakeholder role play cards
- Large paper and pens
- Persuasive writing tips resource
- Room/outdoor space for students to break into groups

HEALTH AND SAFETY

Standard classroom safety rules with appropriate risk assessments for outdoor work

1) Welcome the class to this stakeholder meeting! Explain to the class what stakeholder meetings are for and describe the development that is going to be discussed today. The development proposed here is a seagrass restoration project (see role card resource) and you, as chair of the meeting are also in charge of the proposed development. Provide the students with a quick overview about some of the potential benefits and disruptions that the development may cause both short and long term. However, do not give the students too much information, as it is important for them to also come up with their own ideas.



2) Assign groups of students (or individuals if you have only a small class size) to the stakeholder cards that they will be representing. Encourage students to get into the mindset of that character – dressing up and dramatic role play is encouraged.

3) Allow 10 minutes for the groups to read their stakeholder role card and prepare a 1–2 minutes speech on their view of the new development. Encourage creativity of other positive or negative thoughts the students think their stakeholder might have.

4) Allow each group to present their views. After all speeches have been made, give students 5 minutes to think about whether their stakeholder's opinion might have changed based on these speeches.
5) Chair a whole class discussion/debate to challenge each other's views and try to find a compromise around any issues. This can also involve questions from stakeholders directly to the development proposer. The role play resource has questions to help guide the debate.
6) By the end of the discussion, the stakeholders need to have found compromises around the development which keeps all (or at least the majority) of them happy!

WORK SHEET FOLLOW UP:

Ask students to write up a quick summary of their character and how they feel about the group's compromise on the development:

1) Who was your stakeholder, and did they support the development before the discussion?

.....

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2) What was the main positive your stakeholder thought about the development?

.....

.....

.....

.....

3) What was the main negative your stakeholder thought about the development?

.....

.....

.....

.....

4) How did your stakeholder feel about the final compromise over the development?

.....

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STAKEHOLDER MEETING

TASK:

Discuss and debate, assuming the viewpoint of your stakeholder, the differing opinions around a conservation project.

- **Aim:** Through role play, explore the real life environmental, community, political and business impacts of a local seagrass restoration project.
- **Key learning points:** The potential impact of the new development. Who are the stakeholders? (Emphasis on diversity of individuals/opinions) and the challenge of reaching a resolution/compromise.

KEY INFORMATION

- Indoor activity
- Group activity
- Time – 45 mins
- Presentation and discussion

THE DEVELOPMENT: SEAGRASS SAVIOURS!

Background: New developments in an area can have widespread negative and positive impacts, for example on the environment and economy. Some members of the local community may be in favour of the new development, whereas others may oppose it, and to greater or lesser degrees. The proposer of the development should try to find compromises which are approved by the local community. This is called stakeholder engagement and is what you'll try to achieve today.

The proposed development is to plant a 2-hectare seagrass meadow just off the coast of a coastal town in Wales. This project will restore seagrass habitat that has been lost. In a way, it is very similar to gardening, albeit underwater! Seagrass habitat is excellent for the local environment – it improves water quality, provides a nursey habitat for juvenile fish (supporting fish stocks) and acts as a buffer against storms by dampening wave action on the beach. At a global scale, seagrass is a sink for carbon dioxide, helping to fight climate change. Seagrass habitats attract an abundance of wildlife including lots of fish, crustaceans, and lots of charismatic birds. A thriving seagrass meadow, and

the resulting wildlife that it brings, may encourage a rise in tourism as people want to see the wildlife, leading to increased water users (more swimmers, snorkellers, bird watchers, and recreational fishermen).

The **local marine biology students**, **National Trust volunteers**, and **ecological consultants**, think this will be a great opportunity for the local town to help contribute to restoring an important habitat and fighting climate change. However, the **local fishermen** are concerned that if seagrass habitat is being restored here, then that might mean they are no longer allowed to fish in this area. Similarly, other **local boat users** are worried that they will not be able to put their boat at anchor in the habitat. Some of the **older members of the community** do not like the idea of lots of tourists showing up in the summer.

Structure:

Necessary resources:

- Development description and stakeholder cards
- Paper and pens for presentations (optional)

Small group variant: With small groups (e.g., only 5 students), it is recommended that certain stakeholders be represented to encourage a broad debate. These should include Gareth Llewelyn (**Commercial fisherman**), Mair Tomos (**Mayor**), Dafydd Brewer (**Pub landlord**), Sam Reeds (**Swansea University**), and Thomas Smith (**National Trust**).

1) Begin with this presentation explaining the proposed development. The class should be split into groups of 3–4 and given one of the stakeholder cards.
2) Each group should be allowed 10 minutes to learn about their stakeholder and to add information to the card.
3) Each group now presents their stakeholders view to the class, including the positive and negative impacts they perceive and their relationship with members of the community.
4) After the presentations, break off for 5 minutes in groups and discuss whether their stakeholder's opinion might have changed.
5) Hold a whole class chaired debate about the proposed development for 15–30 mins. Guide the class to suggest a new proposal which suits most of the stakeholders.

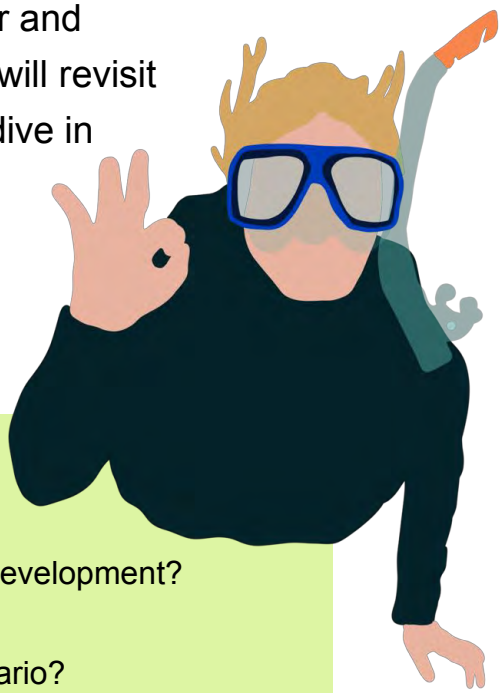
Logistics of the development

Planting seagrass is a laborious process requiring a reasonably large amount of time and many volunteers. Seagrass seeds will have been collected from a different location to the one proposed in this development. These seeds will be brought to the development site and planted on the seabed using lines of hessian rope. Hessian rope is special because it degrades in seawater within approximately 1 year. The rope is 5 mm thick and is weighed down by sandbags at each end (these also degrade in about the same time). The seeds are held inside small hessian bags evenly spaced each metre along the rope. From these seeds, small seagrass plants will sprout within 3–6 months. The lines are 100 m long.

The plan is to plant 200 lines in a 2-hectare area (about the size of two football fields). These lines will be deployed over 2 weeks from a small boat in the bay. The 2-hectare area will be a voluntary off limit zone to other boats and water users– this means that whilst boat users aren't strictly forbidden from this area, they are politely asked to voluntarily choose not to go there to undertake water sports such as sailing or fishing.

The development requires 30 volunteers working on the beach to prepare the seagrass bags. They will stay in nearby accommodation and will purchase all their food and drink from local restaurants and shops. There will likely be some disturbance to the local public during this time, for example with more people on the beach than usual, there may be some difficulty finding parking spaces, and greater use of the main road in and out of the village. Seagrass seeds can sometimes be a little bit smelly too!

There will be plenty of opportunities for locals to volunteer to help with the planting, but no paid work. There will be education opportunities for the locals (including children) such as snorkelling with marine biologists. The team will plant the seagrass sometime between September and November, and a smaller team of up to 8 people will revisit the site once every couple of months to SCUBA dive in the location to monitor the seagrass growth.



Example prompting questions:

- How will the stakeholder be affected?
- What do they think are the pros and cons of the development?
- What is the main motivation for their argument?
- What do they stand to lose or gain from this scenario?
- How will the development affect:
    a. The local area?
    b. Local people's businesses and incomes?
    c. The local wildlife – will it attract new wildlife?
    d. The local environment and landscape?
    e. Tourism?
- Compromises to consider:
    a. Where and how it's planted
    b. Restrictions on use of the planted area
    c. Restriction on the construction disturbance

THE STAKEHOLDERS:

Introduction
Stakeholder's initial thoughts on the proposed development.

Affiliation
Anyone the stakeholder maybe associated with.

Attitudes
Personality and social traits.

General information
Things such as the stakeholders job and hobbies.

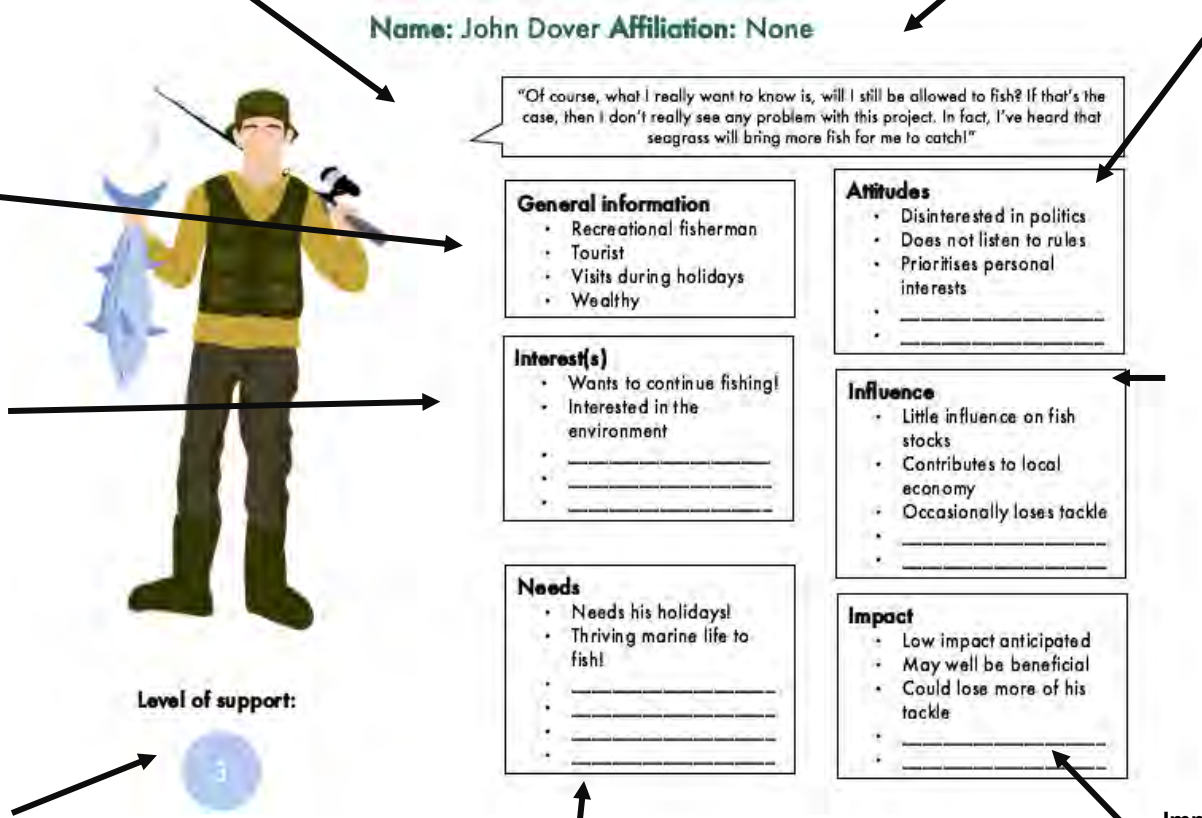
Interests
For example, if they enjoy wildlife or water sports.

Support
Stakeholders original level of support for the development.
1 = strongly against
2 = against
3 = neutral
4 = supportive
5 = strongly supportive
Your stakeholder's level of support may change after the debate!

Influence
How much influence the stakeholder could have on the development *and* how much influence that person has among other stakeholders.

Impact
The potential impacts that the development may have on the stakeholder.

Needs
What they need! For example, the local fishermen need to be allowed to catch fish to earn money.



Each stakeholder card has the same structure, providing lots of useful information that students should familiarise themselves with.

Name: John Dover **Affiliation:** None

Level of support:

3

"Of course, what I really want to know is, will I still be allowed to fish? If that's the case, then I don't really see any problem with this project. In fact, I've heard that seagrass will bring more fish for me to catch!"

General information

- Recreational fisherman
- Tourist
- Visits during holidays
- Wealthy

Attitudes

- Disinterested in politics
- Does not listen to rules
- Prioritises personal interests
- _____
- _____

Interest(s)

- Wants to continue fishing!
- Interested in the environment
- _____
- _____
- _____

Influence

- Little influence on fish stocks
- Contributes to local economy
- Occasionally loses tackle
- _____
- _____

Needs

- Needs his holidays!
- Thriving marine life to fish!
- _____
- _____
- _____
- _____

Impact

- Low impact anticipated
- May well be beneficial
- Could lose more of his tackle
- _____
- _____

Name: Gareth Llewelyn **Affiliation:** Fisheries Local Advisory Group

"Seagrass means seahorses, and seahorses mean Marine Protected Areas! God help these outsiders and the Welsh Government if they think they can just come here and prevent me from fishing. This is my livelihood! I will not stand for it!"

Level of support:

1

General information

- Commercial skipper
- Local
- Very knowledgeable of area
- _____
- _____

Interests

- The environment
- Any changes to local area
- The opinion of his crew
- _____
- _____

Needs

- A sustainable livelihood
- To pay his crew
- _____
- _____
- _____
- _____

Attitudes

- Hates government
- Not a fan of change
- Stubborn
- _____
- _____

Influence

- Great influence on locals
- Contributes to pollution
- Depletes local fish stocks
- _____
- _____
- _____

Impact

- Disruption could make his livelihood non-viable
- May be positives
- _____
- _____
- _____

Name: Henry Swift **Affiliation:** None

Level of support:

3

"Apparently seagrass habitats attract wading birds! If that's the case then I should definitely think I'll be supporting the project. Though I would like to find out a bit more first..."

General information

- Historian
- Bird enthusiast
- Local
- _____
- _____
- _____

Attitudes

- Generally supportive
- A little suspicious
- Wary of outsiders
- _____
- _____

Interest(s)

- Birds and other wildlife
- The environment
- The local history
- _____
- _____
- _____

Influence

- Some influence on the project
- Knows many of the locals
- Friends with Hannah Marsh
- _____
- _____
- _____

Needs

- To know the impact on birds and other wildlife
- Peace and quiet
- _____
- _____
- _____

Impact

- Positive impact to wildlife
- Potentially negative if lots more tourists start arriving!
- _____
- _____

Name: Mair Tomos **Affiliation:** Local Government

Level of support:

4

"I have received letters from local residents who are both supportive and against the proposed development and I am finding it difficult to appease both sides. If truth be known, I really quite like the idea! I just want to make sure it works for everyone.

General information

- Mayor
- Fluent welsh speaker
- Local
- _____
- _____
- _____

Attitudes

- Supports the development
- Concerned about climate
- _____
- _____
- _____
- _____

Interest(s)

- Economy
- People's livelihoods
- _____
- _____
- _____
- _____

Influence

- Large influence
- Knows the locals well
- _____
- _____
- _____
- _____

Needs

- Needs more information
- Need to keep people happy
- _____
- _____
- _____
- _____

Impacts

- May impact her position as Mayor if locals are upset
- Good career prospects if she supports successful project

Name: Layla Marsh **Affiliation:** Local Ecological Consultancy

Level of support:

5

"It sounds like these developers have done their research and have planned a great project. I look forward to seeing how the environment improves over time. I wish them the best of luck in this development!"

General information

- Ecological consultant
- Local
- Non-Welsh speaker
- Keen environmentalist

Interest(s)

- Environmental management
- Snorkelling
- Learning Welsh
- _____
- _____
- _____

Needs

- To know environmental assessment is sufficient
- _____
- _____
- _____
- _____

Attitudes

- Fully supportive of the idea
- Concerned about climate
- Vegan
- _____
- _____

Influence

- Some influence on locals
- Some influence on project
- _____
- _____
- _____

Impact

- Project will impact her work
- Project will make her happy
- _____
- _____

Name: Harriet Wake **Affiliation:** Local Watersports Centre

Level of support:

2

"I don't really know that much about seagrass. What's the point of it? Is it going to damage my Jetski? I really hope these people don't think I'm going to be going elsewhere to have fun. I've been a watersports user here for years!"

General information

- Recreational water user
- Local
- Wealthy
- _____

Interest(s)

- Watersports!
- Fast boats!
- Freedom
- _____
- _____
- _____

Needs

- Needs her weekend blast!
- Her opinion to be heard
- _____
- _____
- _____

Attitudes

- Unaware of environmental issues and climate change
- Prioritises personal interests
- _____

Influence

- Moderate influence on locals
- Good friends with Mayor
- _____
- _____

Impact

- Seagrass unlikely to influence her if she doesn't run over it!
- May have to drive her Jetski elsewhere
- _____
- _____

Name: Dafydd Brewer **Affiliation:** Pub Landlords Association

Level of support:

3

"Of course I like the idea of increasing the attractiveness of our local environment – more tourists means more revenue! But I also care deeply for my loyal local guests and would hate to lose them as both customers and friends."

General information

- Local pub landlord
- Fluent Welsh speaker
- Family has been here years
- _____
- _____

Attitudes

- Supports the idea
- Has concerns
- Understanding of others
- _____
- _____

Interest(s)

- Walking the coastal path
- Local community projects
- Taking his kids to the beach
- _____
- _____
- _____

Influence

- Owns land on proposed development site (beach pub)
- Huge influence on locals
- _____
- _____

Needs

- To maintain his revenue
- A break from tourists in the winter months
- _____
- _____

Impact

- Positive for livelihood
- Positive bathing quality for kids
- _____
- _____
- _____

Name: Ashley Valley **Affiliation:** Local Tourist Board

Level of support:

4

"The watersports industry and recreational fishing industry could thrive if this project were to go ahead, attracting tourists from far and wide – think of the economic boost to the local community! If we don't do it, someone else will!"

General information

- Local tourist adviser
- Non-Welsh speaker
- Not originally from area
- _____
- _____
- _____

Attitudes

- Optimist
- Impatient
- Supports the project
- _____
- _____

Interest(s)

- Technology
- Opportunities for tourists
- Environmental issues
- _____
- _____
- _____

Influence

- Hit and miss with locals
- Large influence on tourism
- Influence on local government
- _____
- _____

Needs

- Key messages for marketing
- To see his area thrive
- _____
- _____
- _____
- _____

Impact

- Positive impact for tourism!
- May involve more work with council to solve parking issues
- _____
- _____

Name: Jane Chalk **Affiliation:** Local School Council

Level of support:

4

"I think this is a wonderful opportunity to get our kids involved in an exciting and positive project. After all, it's their future that will be compromised if we don't do something about the climate. Though I do understand the concerns of others."

General information

- School teacher
- Born and bred local
- Welsh speaker
- Head of school council board

Attitudes

- Thoughtful and thorough
- Concerned about climate
- Concerned for child welfare
- _____
- _____

Interest(s)

- Wildlife documentaries
- Local volunteering projects
- Holidaying at home
- _____
- _____

Influence

- Good influence on locals
- Big influence on children
- Big influence on local council
- _____
- _____

Needs

- To not feel swamped by tourists to the local area
- _____
- _____
- _____
- _____

Impact

- Positive impact on school activities for kids
- May bring too much tourism
- _____
- _____

Name: Thomas Smith **Affiliation:** The National Trust

Level of support:

5

"This is an important project which will restore some of our most important marine habitats. If we do not tackle climate change and water pollution head on then these habitats will continue to degrade, at the cost of fish stocks and ecosystem balance!"

General information

- National Trust Steward
- Not originally from the area, but has been here for years
- Intermediate Welsh speaker

Attitudes

- Fully supportive of the project
- Concerned about climate
- Optimist
- _____
- _____

Interest(s)

- The great outdoors
- Helping others
- Opportunities for all
- _____
- _____

Influence

- Large influence on project
- Positive influence on locals
- Friends with fishermen
- _____
- _____

Needs

- To increase footfall at the National Trust centre
- _____
- _____
- _____
- _____

Impact

- Positive impact to NT
- Positive impact to quality of the environment that he loves
- _____

Name: Sam Reeds **Affiliation:** Swansea University

Level of support:

5

"This restoration project could be a huge boost to both the local economy and the local wildlife. The bathing quality will improve, along with increases in the abundance of fish. We are also fighting climate change at the same time! What's not to love?

General information

- Lead project technician
- Welsh speaker
- Not local
- _____
- _____

Interest(s)

- Fighting climate change
- Restoring marine life
- Supporting local communities
- _____
- _____

Needs

- To make the project a success
- _____
- _____
- _____
- _____

Attitudes

- Concerned about climate
- Wants to help communities
- Realist
- _____
- _____

Influence

- Growing influence with locals
- Large influence on project
- _____
- _____
- _____

Impact

- Potentially significant
- Disruptive
- Pros and cons
- _____
- _____

Name: Claire Bridges **Affiliation:** The Local Council

Level of support:

2

"This does sound like a good project, but I'd be concerned about the potential cost that this might have for the local council. With greater numbers of tourists we'll need to spend more on road infrastructure and we don't have the budget for this."

General information

- Local Council Officer
- Not originally from area
- Has three children
- _____
- _____

Attitudes

- Calm and collected
- Logical and practical
- Doubtful of project support
- _____
- _____

Interest(s)

- Local developments
- Volunteering activities
- Keeping the community safe
- _____
- _____

Influence

- Influence with government
- Influence on the project
- In contact with Sam Reeds
- _____
- _____

Needs

- To control council expenditure
- To appease the majority
- _____
- _____
- _____
- _____

Impact

- Project may raise access issues for the council
- Potential for new opportunities
- _____
- _____

Name: Deryn Llaeth **Affiliation:** Farmer's Union

"I'm not sure how this project will affect me, if at all. I've heard concerns about agricultural run-off and eutrophication, but surely my land is too far away for that. Will this project encourage others like it that try to stop me farming how I want to?"

General information

- Local Dairy Farmer
- Family business
- Fluent Welsh speaker
- _____
- _____

Interest(s)

- Environmental management
- Economic production
- Rewilding
- _____
- _____

Needs

- More information to decide
- To maintain family business
- _____
- _____
- _____

Attitudes

- Caring and considerate
- Tentatively supportive
- Understands others' concerns
- _____
- _____

Influence

- Influence with locals
- Influence with fishermen
- Influence with government
- _____
- _____

Impact

- No direct impact immediately
- If successful, project may encourage others like it
- _____
- _____

Level of support:

3

Name: Emily Butterbean **Affiliation:** Local University

Level of support:

5

"After having just graduated from Marine Biology, what a fantastic opportunity this project could be for me to gain some real-world experience! I really hope they are successful. Maybe I can convince the locals to help them out!"

General information

- Marine Biology Graduate
- Local for 4 years
- Learning to speak Welsh
- _____
- _____

Attitudes

- Enthusiastic
- Supportive of project
- Inquisitive
- _____
- _____

Interest(s)

- Job/volunteering opportunities
- Sustainability/climate change
- Environmental protection
- _____
- _____

Influence

- Some influence with locals
- Knows local fisherman
- Knows Sam Reeds
- _____
- _____

Needs

- To find a fulfilling job
- To put her degree to good use
- _____
- _____
- _____
- _____

Impact

- Volunteer/work opportunities
- Encourages her to stay local
- _____
- _____
- _____
- _____

Name: Pete **Affiliation:** None

Level of support:

1

"What's all this nonsense now! Back in my day there was loads of this seagrass stuff and no one gave a toss then. I moved here to get away from all the hustle and bustle. The outsiders are already too many in number as it is!"

General information

- Retired
- Pub regular
- Has plenty of stories to tell
- _____
- _____

Attitudes

- Set in his ways
- Dislikes tourists and outsiders
- Outspoken
- _____
- _____

Interest(s)

- Peace and quiet
- Reading the newspaper
- Good ale
- _____
- _____

Influence

- Influence with pub landlord
- Influence with Mayor
- In contact with Sam Reeds
- _____
- _____

Needs

- To enjoy his retirement
- To not feel disturbed
- _____
- _____
- _____

Impact

- May feel threatened
- Positive impact may not affect him due to his age
- _____
- _____

PROJECT SEAGRASS

LITTER
ACTIVITY GUIDE
AGES 11-14

OVERVIEW

This activity guide introduces the topic of litter. Within this guide is an activity and a follow up work sheet which allows you to explore the importance of reducing pollution with your students.

KEY INFORMATION

- Outdoor activity
- Group activities
- Time – 30-40 minutes
- Practical/workbook

- **Lesson Objective:** to identify pollution sources and how marine pollution is directly linked to own lives
- **Curriculum links:** Geography/Science/Literacy/Numeracy

LEARNING TIPS

Emphasising the relevance to the children's personal lives is key for this activity to be a success! Encourage students to continue to engage with initiatives promoting clean ups and waste free lives.
The activities in this litter activity guide can be combined with other Project Seagrass guides: '**microplastics**', '**habit breaker**' and '**making changes**' activities. Check out these pages:

- **Two-minute beach clean** https://www.beachclean.net/
- **Surfers against sewage** https://www.sas.org.uk/our-work/education/
- **Global plastic pollution in numbers** https://www.condorferries.co.uk/plastic-in-the-ocean-statistics
- **More plastic pollution lesson plans** https://education.plasticoceans.uk/schools/
- **City to sea** https://www.citytosea.org.uk/take-action/

KEY WORDS

Finite resource –
A resource that will run out (earth only has a limited amount)

Bioaccumulate –
The build-up of something (e.g., plastics) in an organism

Pollution –
Makes the environment unclean or dirty

Linear economy –
Resources are used once then thrown away

Circular economy –
Resources are continuously reused

Raw material –
An unprocessed material, such as a tree

INTRODUCTION

Everything we use or pop in the bin ends up somewhere. Hopefully, that's a **recycling** station, but sadly a lot of our waste escapes and ends up in the **sea**. It can get there via **littering**, down our **drains** or **swept to sea by storms**. Water samples from the most remote and untouched parts of the world show how we have inundated our seas with rubbish. A large proportion of that rubbish is **plastic**.

Plastic is an incredibly **strong** and **useful** material. We use it in all realms of life, from laptops and lunch boxes to cookers and cars.



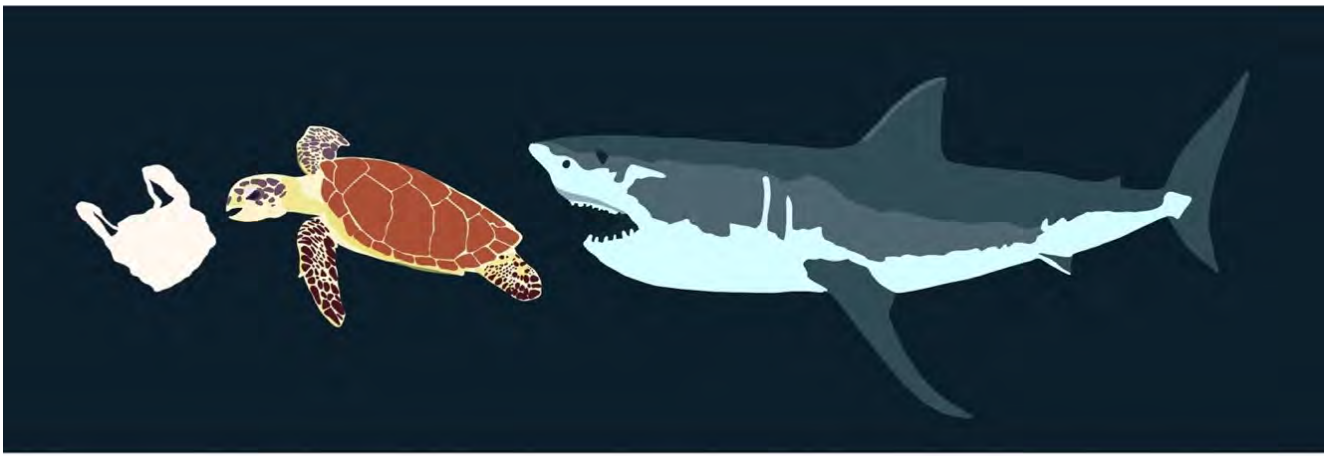

It is so strong that it can take **thousands of years** to completely breakdown. This strength is also natures weakness! As plastics take so long to degrade, we just keep topping up the sea with more and more generations of plastic pollution, consequently never giving the sea a chance to recover from our mess.

Plastics are made from **finite** sources of **petroleum** (oil) and **gas**. Finite resources such as these are **unsustainable** as we only have a limited supply of them. Once we've used them up then there will be none left for our children or grandchildren.

What's the problem?

The flash of silver foil can look just like the flash of a fish to a bird, or the blob like shape of a plastic bag can be mistaken for a tasty jellyfish by a turtle, filling their stomachs with yucky plastic. These harmful things make our

treasured sea animals very unwell due to the harmful chemicals that are attached to the plastic that they've mistakenly eaten. The **number** of **plastics** and **pollutants** in the animal increases as we look further up the food chain in a process called **bioaccumulation**. For example, if 5 small fish have each eaten 3 pieces of plastic, and then 1 dolphin eats all 5 fish, the dolphin now has 15 pieces of plastic in its stomach.

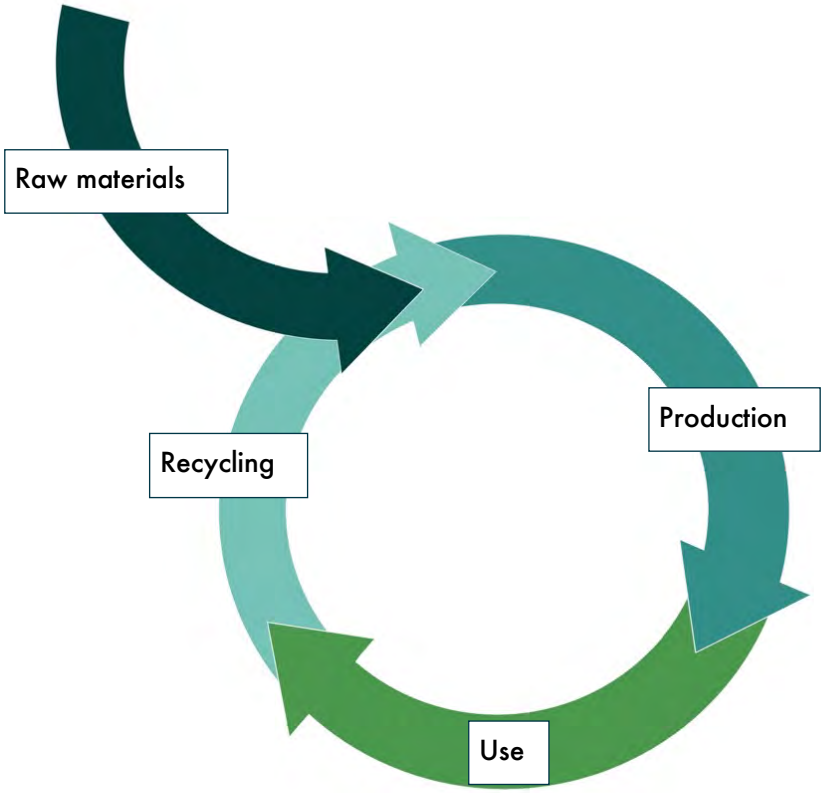


Problem solving...

We hear on repeat '**reduce, reuse, recycle**' and there's good reason behind that!

Once we are finished with an item then that is not the end of the item's life, it still exists once we put it the bin. If we're not careful, some of what we throw away might also end up on our beaches. At the moment we heavily rely on what's called a '**linear economy**'. We take raw materials from the earth, use them once, then put them in landfill. This only works if we could take never ending amounts of everything from the earth!

By sticking to the magic phrase '**reduce, reuse, recycle**' we can try to keep what has to go in the bin to as little as possible! This is called a '**circular economy**'. We take the smallest number of raw materials from the earth as possible, leaving more for **wildlife** and **future generations**. We then keep using these same resources over and over again! We can **repair** and **upcycle** once things get broken, giving them new life, and once the item is finally beyond repair then we can recycle it so that it's broken back down into raw materials and built again as a new item.



If we reduce the number of trees that have to be chopped down or the mines built for precious minerals and metals, then we can give more of this land back to nature. Nature will then help protect us from climate change and increase the number of wild animals.

We're going to head outdoors to find out who and what is littering our beaches, rivers and parks! Our guidelines are based on the movement by #2MinuteBeachClean; check out their website and campaigns to discover what a big difference just two minutes of litter picking can make to your local area.

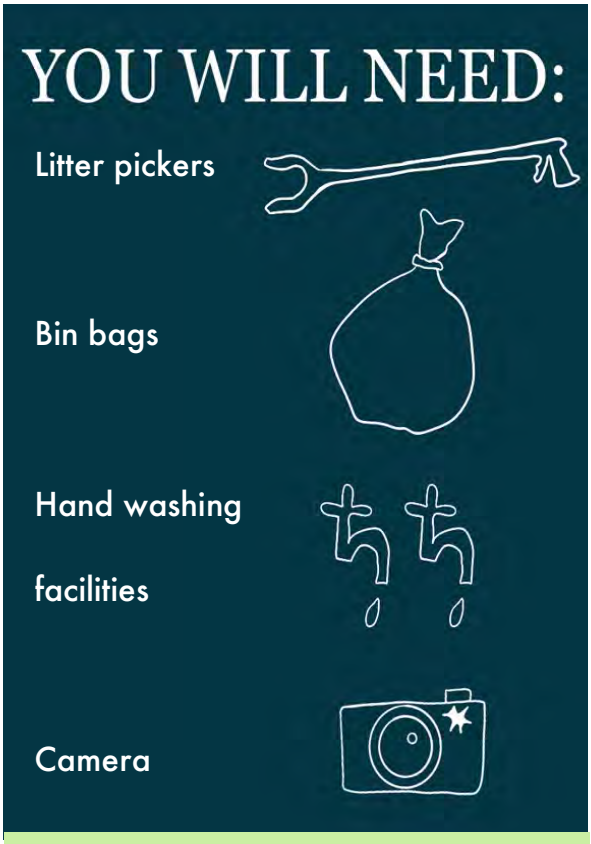
ACTIVITY:

1) On arrival to each beach activity through the residential, take two minutes to do a litter pick.

2) Pair the children up and collect the litter in boxes or old bags, being mindful not to disturb the wildlife or pick in any difficult to reach locations. Do not throw the litter away!

3) At the end of the week analyse the litter collected. First, see how much it weighs and calculate how many minutes it took the class to collect.

4) Sort the litter into source type (for example food wrappers, fishing gear, plastic bags, face masks and gloves, bottles and cups, cigarette butts, cosmetics etc.,) and make a tally of how much is in each category.

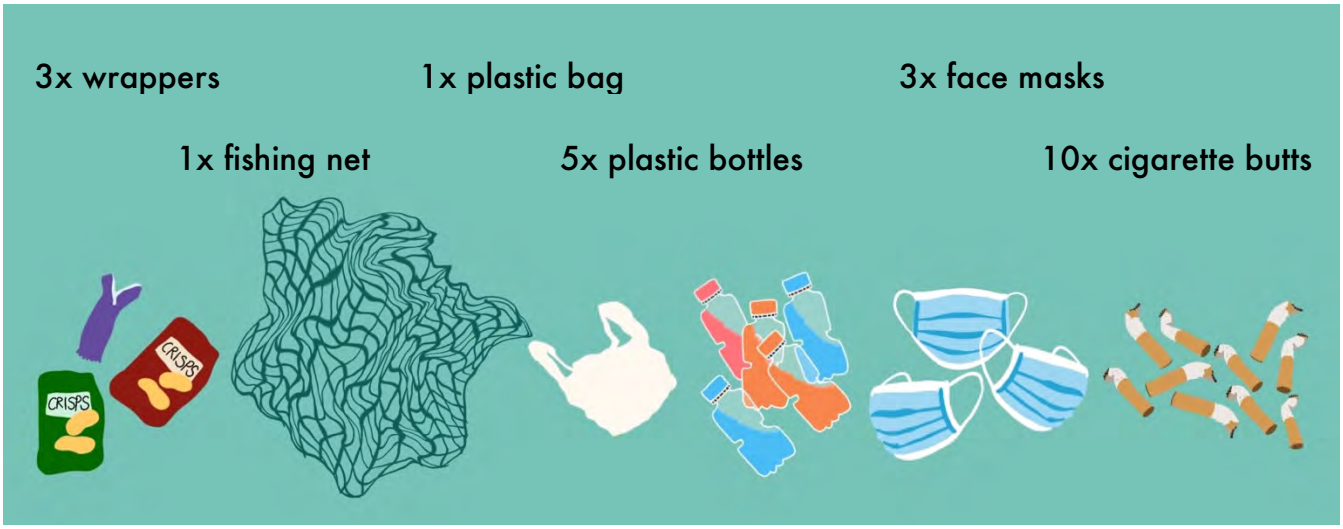


HEALTH AND SAFETY

- Have adult supervision if picking up any sharp or non-sanitary items
- Ensure thorough hand washing after touching anything
- Be polite and mindful of other shore users
- Do not touch or disturb wildlife
- Do not put yourself into danger to collect hard to reach litter
- Define picking location to stay within area of staff supervision

5) If you can, take pictures of the total collection and each category of rubbish.

6) Encourage discussion around the sources of pollution - which ones could be replaced by a non-polluting material, or stopped being used completely? Which are the most damaging to marine life and why?



7) Follow this by encouraging the children to take an action. Assign the children to contact the biggest polluters, e.g., coca cola drinks or walker's crisp or local businesses which are contributing to the litter. This can be done really easily by finding the contact section of a company's website, explaining that they were one of the biggest polluters on the beach and that the company needs to change in order for us to have a sustainable future. If possible, add a picture of their rubbish.

8) If possible, post a class picture of your beach clean using the **#2MinuteBeachClean** to get involved with the movement. **Tag** companies that are the main offenders!

9) Once finished make sure to recycle as much as possible!

10) Complete the workbook activities either as a group discussion or independent work; these strongly link with the microplastics activities.

WORK SHEET FOLLOW UP:

1) What was the total weight (kg) of the rubbish and how many minutes did it take for your class to collect? *If 15 people collected for 2 minutes over 3 days, then the total time would equal 15 x 2 x 3 = 90 minutes.*

.....

2) Which category was the largest source of pollution?

.....

3) Which category was the most harmful? *Consider chemicals released, animal consumption (shiny is more likely to be mistaken for a fish), entanglement, sharp edges. This maybe multiple categories!*

.....

.....

.....

4) What was the strangest item found on the beach cleans?

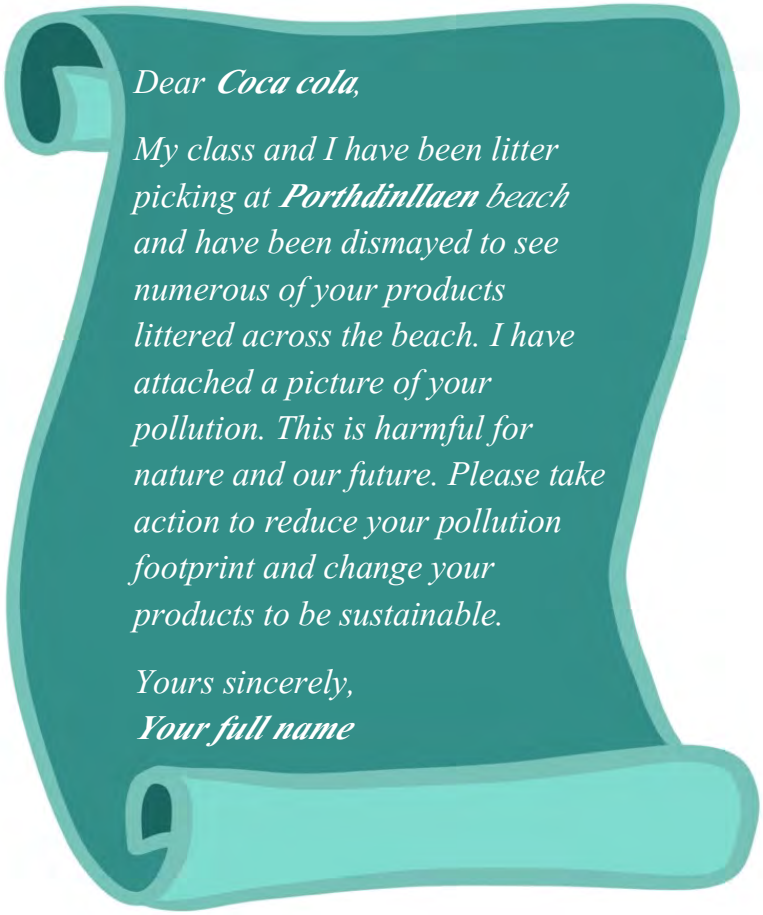
.....

5) What was the most valuable item?

.....

6) Take action! Challenge yourself to complete at least one of the following actions. Add your own ideas on fighting plastic pollution:

a. Contact companies producing unnecessary waste such as excess food packaging and ask them to remove it or find environmentally friendly alternatives. If we take two minutes to let them know it's an issue, then they are more likely to change. Use the template below.



b. Write to your MP asking them to put pressure on the government to implement legislation banning single use plastics and forcing companies to use sustainably sourced packaging.

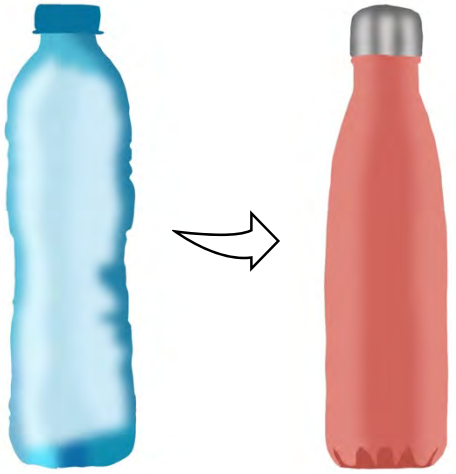
c. Get active on social media! When used in the right way social media can be a powerful tool to raise awareness. Use the hashtag #2MinuteBeachClean with a picture of the litter you've collected and tag companies that were repeat offenders- ask them to change.

d. Push your school to go plastic free. This can start off small such as banning single use bottles within your class.

e. Read a blog with tips on how to go plastic free!

f. Check out pre-loved apps, you'll save money as well as the planet! Apps such as Vinted and Depop are great for clothes, and Facebook marketplace, Gumtree or eBay for everything else.

7) Write down three personal pledges to reduce your plastic consumption of your choice.



a. Do a two-minute litter pick once a week (beach, street, park, river - it all helps!).
b. Swap from shampoo bottles to waste free bars.
c. Reuse the items I already have for as long as possible.

d. Take on an upcycling project.
e. Try and buy second hand wherever possible.
f. Recycle all the rubbish that I can.
g. Avoid buying plastic bottles.
h. Make homemade sandwiches for lunch in a reusable box.
i. Contact a company when they produce unnecessary and wasteful packaging.

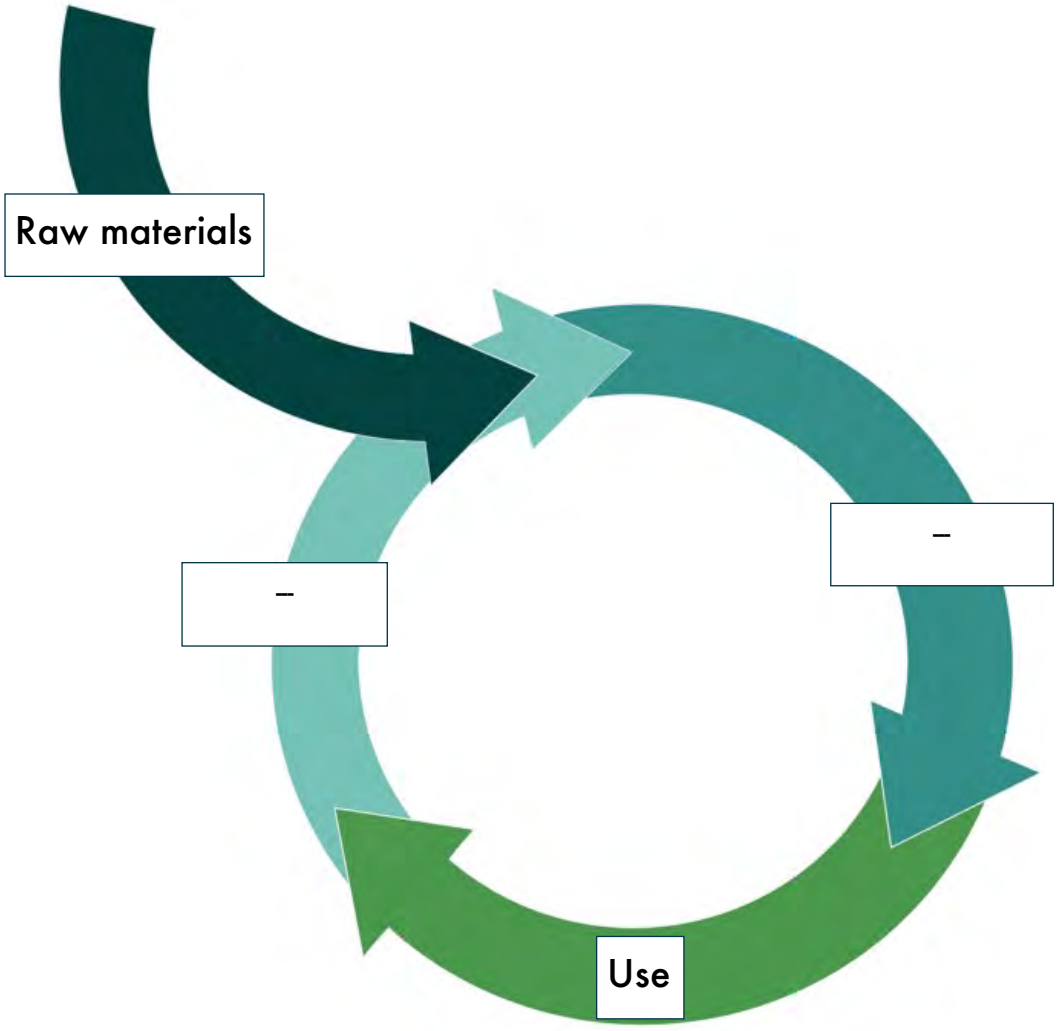
8) Discuss and chose a whole class plastic free pledge:

a. Arrange for more recycling bins at your school.
b. Arrange a teracycle collection point at your school.
c. Push your school to have plastic free catering.
d. No plastic bottles allowed in class (unless they're being reused!).

9) Fill in the gaps:

1

2



PROJECT SEAGRASS

RESOURCE RAMPAGE
ACTIVITY GUIDE
AGES 11-14

OVERVIEW

This is an activity guide that introduces the topic of resource rampage. The activity allows you to explore the importance of 'The tragedy of the commons' with your students.

- **Lesson Objective:** To gain a basic understanding of the tragedy of the commons.
- **Curriculum links:** Geography/Science/Mathematics

LEARNING TIPS

This 'Resource rampage' guide can be used with Project Seagrass activities in the '**Habit breaker**', '**Climate change**', '**Making changes**', '**Species hunt**', '**Microplastics**' and '**Litter**' guides.

This activity could be played on the beach with the ocean jar drawn in the sand and using shells and pebbles as counters. Use shoes as the ships!

FUN FACT!

90% of the world's fisheries are overfished!

KEY INFORMATION

- Indoor activity
- Group activity
- Time – >20 minutes
- Practical

HEALTH AND SAFETY
Standard classroom or outdoor rules!

KEY WORDS

Poseidon –
Greek God of the sea

Tragedy of the commons –
Individuals neglecting what's best for the community for personal gain

INTRODUCTION

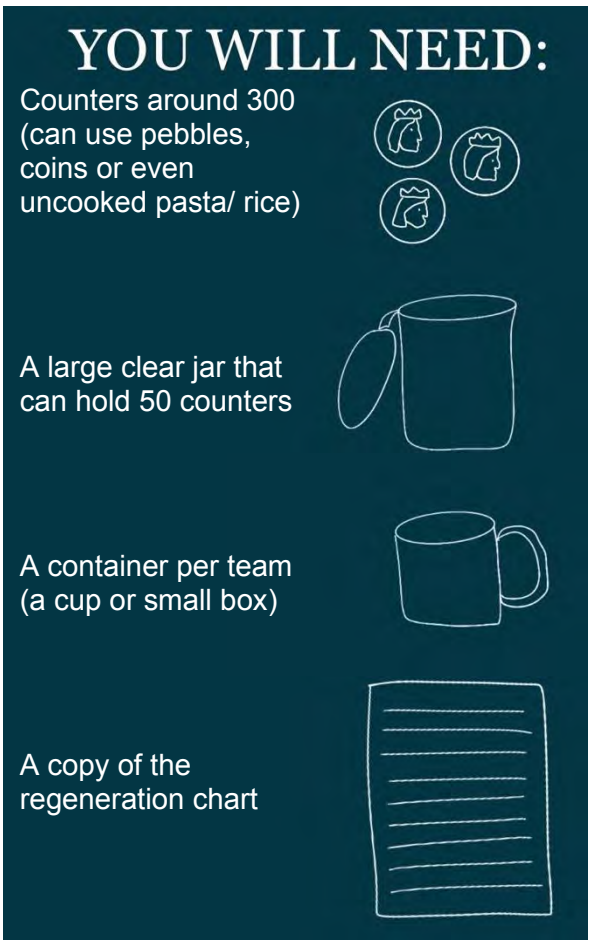
For most resources on Earth, we only have a **limited** amount of them. When lots of people use a **common resource**, it can quickly run out, especially if it doesn't cost the individual anything to gain a bigger reward, so the individual keeps taking more and more. If everyone has this approach, then the **free** or **common resources** quickly deteriorates. This is called the **tragedy of the commons.**

Think about receiving email spam. If one company sends you an email every week to advertise their goods, then you'll likely read what they have to offer. If lots of companies send you an email every week then you'll quickly start to ignore them all, so none of them benefit from you reading their advertising.

The resource rampage activity uses fish in the ocean to show how difficult it can be to manage common resources whilst individual interests are at play. Consider other examples of the tragedy of the commons such as **burning fossil fuels**, **air** and **water pollution** and **deforestation**. We need to find ways that ensure everyone works together so that everyone gains the benefits of a sustainable planet.

Here's a 5-minute TedEd video which explains the tragedy of the commons
https://www.youtube.com/watch?v=CxC161GvMPc&feature=emb_logo&ab_channel=TED-Ed

ACTIVITY:



1) Split each group into teams with at least 2 players. Give each team a container - they're now a proud fishing company with a fancy new ship. Encourage naming their ship!

2) The ocean (clear container) is filled with 50 fish (counters), this is its maximum carrying capacity and it stays with **Poseidon** (the person running the game). Keep the remaining counters with Poseidon.

3) Each company wants to get the most wealth through catching the most fish possible.

4) Each round represents a year, so the companies need to think of strategies that will get them the most fish over many years. Warn them that the number of fish in the ocean the following year depends on how many are left once all the companies have been fishing.

5) To catch fish each company needs to secretly write down how many fish they want to catch and put it in their ship to take over to Poseidon, the king of the sea.

6) Once each company has bought their ship over with their paper slip then Poseidon will **randomly** select a ship and give out the number of fish they've asked for from the ocean. If a company asks for more fish than are left in the ocean, then their ship is returned empty and Poseidon moves on to the next ship. The order the ships are chosen to receive their fish must be random so that it doesn't become a race to get the first fish request in.

7) That's year one completed!

8) At the end of each year Poseidon will top up the fish in the ocean depending on how many are left.

a. If there are more than 25 fish left, then Poseidon will replenish stocks back to the ocean's maximum capacity of 50 fish.

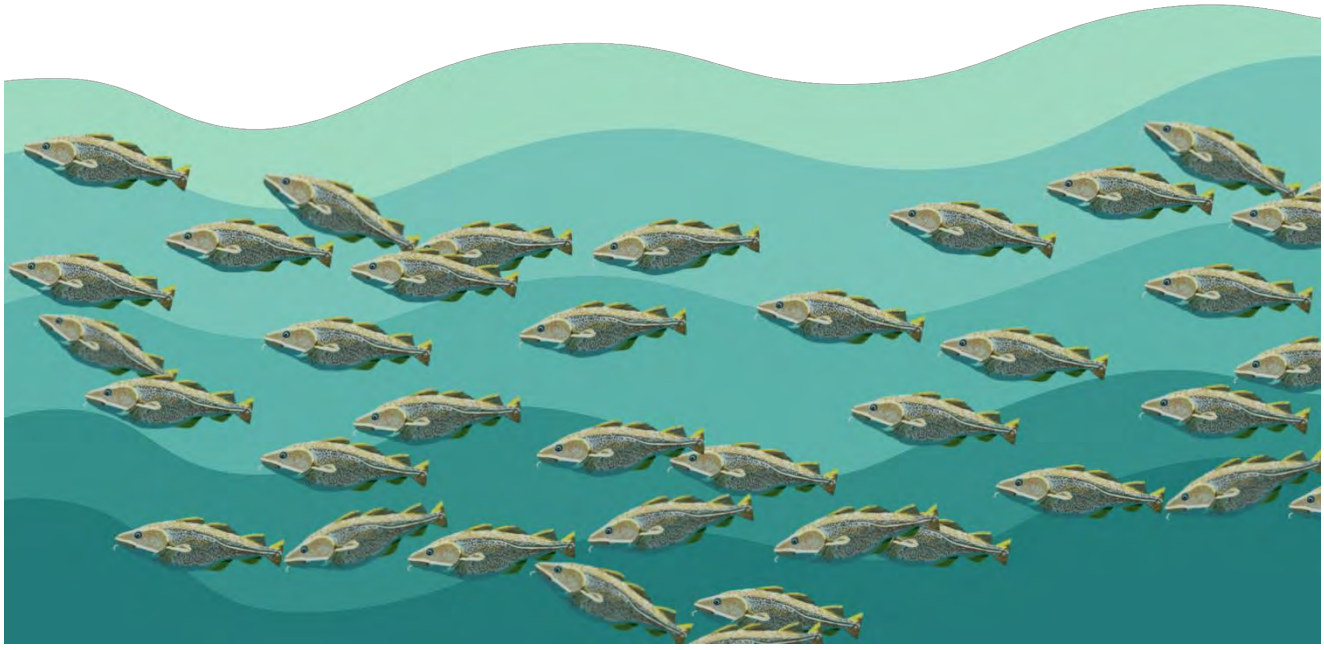
b. If there are less than 25 fish left, then Poseidon will double what is left. So, if 3 fish are left, Poseidon will add 3 more, leaving only 6 fish for the following year.

9) Repeat the process for the following years.

10) If the companies quickly catch all the fish, then continue for a couple more years to emphasise their mistake of taking too much - no catch at all!

11) If all the companies are working together to get the maximum sustained catch you can also stop the game.

12) Ask each company to count up their final wealth and tell the rest of the group.



Depending on the group, random events could be added every other year to see how new circumstances alter the games dynamics:

- **Seagrass restoration success** - add 5 fish to the ocean's max capacity.
- **Sea water warms** - minus 10 fish, ocean capacity never recovers.
- **Oil spill** - minus 5 fish, ocean capacity can slowly rebuild.
- **Marine protected area introduced** - minus 10 fish from capacity in the first year but add 20 the following year (totalling 60 fish capacity at the beginning of the 2nd year if starting with 50).

Follow up discussion points:

1) Was there a winner from the game?

2) Talk about the most sustainable catch number- if the total of all companies catch was 25, then the ocean would be fully replenished the following year, producing the biggest catch over the long term. If they played for 10 years, then 250 fish would have been available.

a. How many would that be for each company? This would have been the maximum available catch for all companies.

b. How does the maximum available catch compare to their total catches?

c. What rules could they have followed so that each company gained the maximum sustainable catch each year?

3) Was there a sudden collapse? Why do they think there was/wasn't?

4) Relate the shared ocean fish to other shared common resources, such as carbon dioxide production and fossil fuel use, forests or land use. Can the group think of any other scenarios where we tend to overtake causing a quick collapse of a shared resource?

5) If playing with the extension discuss how the external events effected their decision making within and between the companies.

PROJECT SEAGRASS

MAKING CHANGES
ACTIVITY GUIDE
AGES 11-14

OVERVIEW

KEY INFORMATION

- Indoor activity
- Group activities
- Time – 2/3 hours
- Discussion/workbook

This activity guide introduces the topic of making changes and the activities allow you to explore the importance of 'Act Local, Think Global' with your students. Within this guide is an activity which demonstrates how to make a sustainability impact.

- **Lesson Objective:** to emphasise how our day-to-day actions impact the environment, and how we can make be more sustainable.
- **Curriculum links:** Geography/Science/Literacy

LEARNING TIPS

Set dates to check up on how your class is managing to implement their changes into their day to day lives. Encourage them to follow their promotion plan!

This 'making changes' guide can be used with Project Seagrass activities in the '**Habit breaker**' guide. It also goes well with '**Resource rampage**', '**Climate change**' intro and the '**Microplastics**' and '**Litter**' activities.

KEY WORDS

Sustainability – meeting our current needs whilst not negatively impacting future generations

Audit – Looking at how well an organisation is doing

Climate change – A change in the average weather conditions, such as temperature and rainfall, over a long time

Upcycle – to make something new out of something old

INTRODUCTION

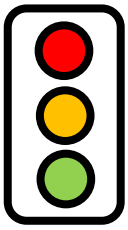
‘Act local, think global’

A simple but powerful idea when it comes to changing the world. If everyone made a **small change** to their day to day lives, then it quickly has a massive effect. If a thousand, a million or even a billion people also make that small change - if all those people say no to one plastic bottle, then it has a much larger effect. It’s not just one plastic bottle saved, it’s a billion.

Wherever we live and whatever we do, we have an impact on nature. Our actions alter the land and sea that nourishes us. With this in mind, it’s time to make some positive changes. From the whackiest inventions to the smallest lifestyle changes, let’s impact our earth in a good way. Time to make some waves in your local community!

ACTIVITY:

1) Split the students into small groups (around 4-6).
2) Allow the students to identify an area that their group wants to make more sustainable. For example, their home life, their school, an area in their local community such as a local park, town centre or local shopping experience.
3) Once the area has been identified, work through the sustainability audit to identify areas that could be more environmentally friendly. The audit can be followed exactly or used as a guideline to create a mind-map of positive and negative practices. There may be other sustainability issues that are relevant to the area but not covered by the audit - adding these is encouraged!
4) After the group has had around 15 minutes to go through the audit, get them to traffic light each area as to how well their site is already doing.



5) Use the audit and traffic lights to decide which issue is the most important for the group. Some examples of broader topics are: Plastic pollution/Water quality/Biodiversity crisis/Food waste/Carbon footprint/Light, noise or other types of pollution.

6) Each group needs to come up with a change, initiative, campaign or invention to combat their chosen issue. They need to develop an action plan on how to implement it and ensure that it has a lasting impact.

7) The action plan should include:
   a. A catchy name.
   b. The issue it is combating and why.
   c. What the change is and easy instructions on how to do it.
   d. Who will be affected by it?
   e. A plan to promote the change.
   f. Future development for the change.
8) The action plans will be presented to the rest of the class and can be in any format the students chose, from posters and social media campaigns through to Attenborough style documentaries. However, it must be:
   a. Engaging and eye catching.
   b. Have a clear message.
   c. Be inspiring.
9) Use our persuasive writing and speaking guide for tips
10) Encourage students to implement this work once back in school. Ask them to set key dates as to when they'll have tasks done by. Once at school check they've been promoting it or at least doing it in their own lives! If the students are willing, then they could enter their idea or invention to the Big Bang Science Fair and potentially win some great prizes!

Another idea might be to target fast fashion and try putting on a catwalk of clothes made from junk or that have been upcycled! Or maybe the group could invent a machine that keeps litter from being washed down drains and out to sea.

Example project:

Name of project: The pollinator project

Why? We're facing a biodiversity crisis and entering the sixth mass extinction. Small actions such as encouraging pollinators into our school will help promote biodiversity in the area. Bees are struggling!

What? Encouraging everyone in our school to make and put up an insect home and to plant some bee friendly flowers.

How? We're going to make a video on how to build an insect home, following the Eden Project's instructions. We're also going to make a guide of the best flowers to plant for bees and how best to collect and plant the seeds or clippings.

Promotion plans? We've made posters to explain the importance of pollinators and how people can help them with bee friendly gardens. We're also going to do a whole school assembly and ask each class to make an insect home.

Future development? The pollinator project will write to our council asking for public space to be left to grow wild so there are more flowers for bees and insects.

Inspiration:

- https://efficiencytips.tumblr.com/tagged/at-school Lots of small tips to use less energy.
- https://www.getwaterfit.co.uk/ Assess your water use and tips on how to change it.
- https://www.thebigbangfair.co.uk/ Big bang science fair- an awesome UK wide competition with some great prizes.
- https://www.farmdrop.com/blog/how-to-fight-fast-fashion/ Sustainable fashion tips.
- https://www.rhs.org.uk/science/conservation-biodiversity/wildlife/encourage-wildlife-to-your-garden Ways to encourage more biodiversity.

SUSTAINABILITY AUDIT

When doing a sustainability audit there are 5 main elements to consider:

- **Air** - think about pollution from cars, chemicals or smoke.

- **Land** - is the land used in a way that works with wildlife?

- **Waste** - how much waste is produced and what happens to the waste?

- **Water** - using clean water takes a lot of energy, is it used sparingly? Do any chemicals go down the drain?

- **Energy** - are there efforts to reduce the amount of energy used? Is the energy from a renewable source such as solar and wind power?

For questions 4 – 8, traffic light how much work is being done to make that element sustainable. Use green for trying hard, orange for needs more work, and red for no effort made. Use this to reflect on what change you want to make.

1) Where are you assessing? (e.g., school, home, local park, local shops)

.....

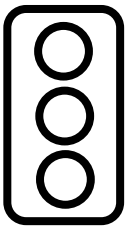
2) Who uses the site?

.....

3) Is there someone leading the sustainable development of the location already? If no, could you lead it?

.....

4) Is the space used in a way that encourages wildlife?

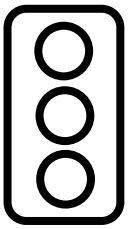


a. Are there lots of plants and green areas?

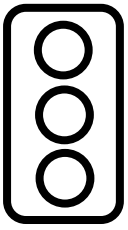
b. Are there bird feeders, insect hotels, hedgehog holes or other ways to encourage wild animals?

c. Would you expect to see litter?

5) Do most people walk, cycle or get public transport to the site?



6) Are materials used in a sustainable way?



a. What are the main items that get thrown away?

b. Are there easy to use recycling bins?

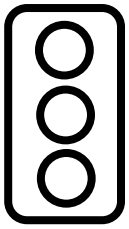
c. Are there extra recycling options for items such as batteries, clothes, TerraCycle products, plastic bags and a compost bin for food waste?

d. Are single use products avoided?

e. Would you expect to see upcycled or second-hand items?

7) Is water used in an efficient and environmentally friendly way?

a. Is rainwater collected and used?

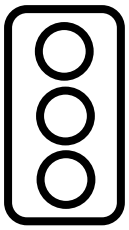


b. Are eco-friendly cleaning products used?

c. Are there efforts to reduce the amount of water used?

8) Is minimal energy use encouraged?

a. Are lights and electrical devices switched off when not in use?



b. Are windows and doors left open when the heating is on?

c. Is the energy from a renewable source such as solar or wind power?

PROJECT SEAGRASS

PLANT ANATOMY
ACTIVITY GUIDE
AGES 11-14

OVERVIEW

This activity guide introduces the topic of plant anatomy. Within are two activities: firstly, a quick plant identification activity and secondly, a guide to using food colouring to understand a plant's vascular system and processes such as transpiration.

KEY INFORMATION

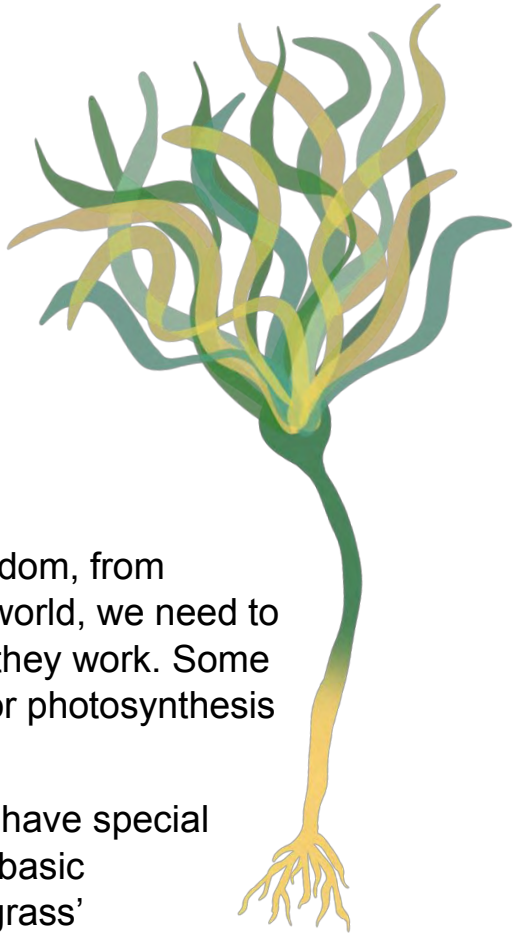
- Indoor and outdoor activity
- Individual and group activity
- Time – 1 hours (return next day for results)
- Teacher presentation, practical, workbook

- **Lesson Objective:** how are water and nutrients moved around the plant?
- **Curriculum Links:** Science

LEARNING TIPS

This 'Plant anatomy' guide can be used alongside Project Seagrass activities in the '**Photosynthesis**' and '**Reproduction**' guides.

UK seagrass flowers between June and August!



INTRODUCTION

There is a huge amount of diversity in the plant kingdom, from cactuses to vines to seagrass. To understand their world, we need to first understand their different 'body parts' and how they work. Some parts of the plant collect water, others take in light for photosynthesis or attract insects for pollination.

Thankfully, plants in the sea are really similar! They have special adaptations to deal with life under the sea, but their basic structure is the same as plants on land. In fact, seagrass' closest relatives are lilies!

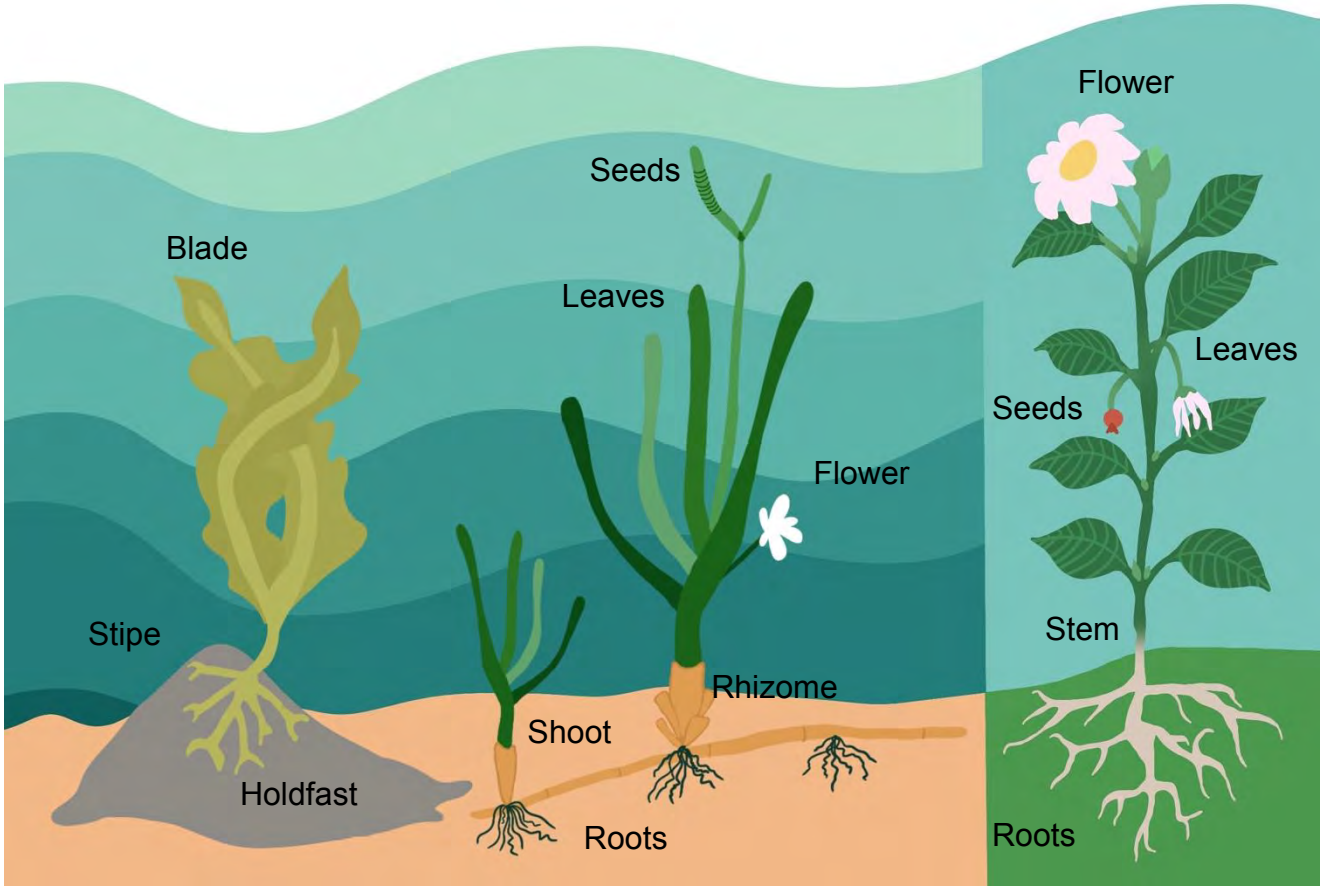
Often there's a bit of confusion when it comes to seagrass - people tend to think it's a type of seaweed. This is not true! Both plants and seaweed have a green pigment called chlorophyll to allow photosynthesis, and have similar structures, but the names and functions of these structures differ.

Here are the main body parts of flowers:	Here are the main parts of seaweed:
Flowers – these are involved in reproduction and produce seeds from which new plants grow. The flower is usually colourful for attracting insects	**Thallus** – the entire body of a seaweed
Roots – take up water and nutrients from the soil which is carried to the rest of the plant through branches and fibres	**Lamina/Blade** – a flattened structure that is the site of photosynthesis
Rhizome – a plant stem that grows underground and stores nutrients like carbohydrates and proteins	**Air bladders** – a hollow, gas-filled structure which helps the seaweed float, found on the blade or stipe
Stem – carries water and nutrients to different parts of the plant	**Stipe** – a stem-like structure of a seaweed (though not all seaweeds have these)
Leaf – site of photosynthesis	**Holdfast** – a specialized structure on the base of a seaweed which acts as an “anchor” allowing it to attach to a surface (e.g., a rock)
Sheath – protects newly formed leaves	**Haptera** – finger-like extensions of holdfast which holds the seaweed upright

A big difference between plants and seaweed is their reproductive organs. Most plants are **monoecious**, meaning that individuals have both female and male structures. Notice how seaweeds don’t have roots, stems, leaves or flowers. However, they do have mini balloons called air bladders to help them float!

Here are a few more differences between plants and seaweed:

- In flowering plants, reproductive structures can appear together in a single bisexual flower (monoecious), or the flowers can be only male (staminate) or only female (pistillate).
- Seagrasses can have separate male and female plants (dioecious) or have both sexes on the same plant (monoecious).
- Overall, about 75% of all seagrass species are dioecious.
- *Zostera marina,* one of the main UK seagrass species, is monoecious, where individual plants have both male and female flowers in separate alternating clusters.



Seaweeds, however, reproduce by releasing spores into the water; if male spores (sperm) and female spores (eggs) coincide they fuse together, developing into a new seaweed. The development happens in the water, normally away from the seaweed, and doesn't go through a seed stage.

Plants, however, produce pollen which needs to develop into a seed on the plant before being released.

ACTIVITY 1:

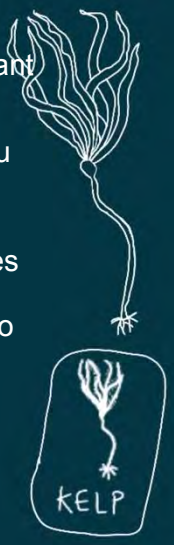
Get down to the beach and have a peer at some real plants and seaweed. Time this trip with low tide so you don't have to pull plants up. If not possible, then collect a terrestrial plant, a marine plant and a seaweed, carefully keeping the whole organism intact, and bring them to the classroom. Ideally, select a terrestrial grass, seagrass and kelp. Use your guides to check what you're looking at!

YOU WILL NEED:

If possible, have a live terrestrial plant, a marine plant and a seaweed (we recommend using kelp if you can)

Plant and seaweed ID guides

Pictures and photos can also be used – (UK seagrasses flower between June and August)



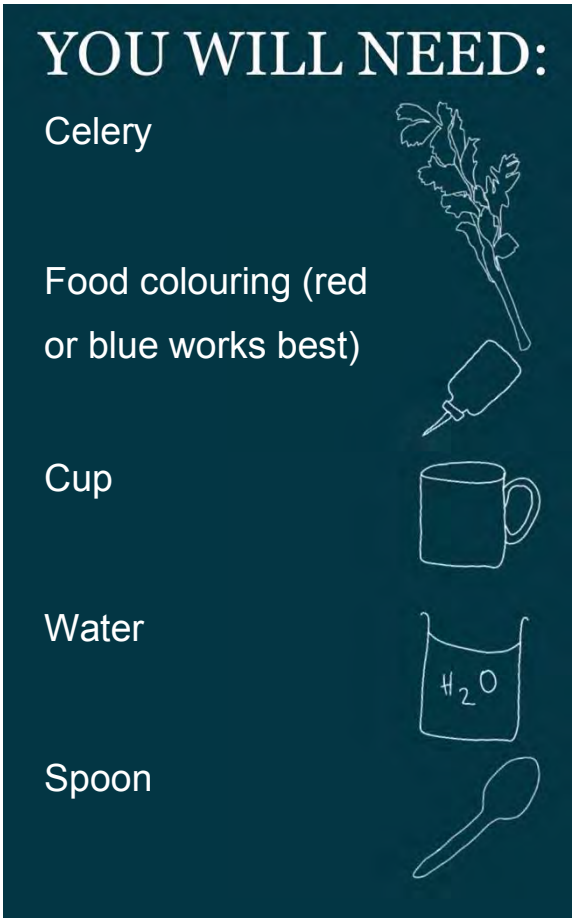
HEALTH AND SAFETY

- Ensure adequate botany skills when selecting live plants. Some should not be picked, and others may be harmful when touched or consumed.
- No need to get wet!

1) Lead the class through the different plant and seaweed parts.
2) Wherever you are, get everyone to try sketching one of each. Note down key identifying features and label the sketches with the different anatomical parts and their functions.
3) Try a second series of sketches but focusing on the flowers of the plants. Select a typical flower and a grass flower, both a terrestrial and marine one. When searching for seagrass flowers, look for lighter yellow/green, cylindrical strands. The flowers, and later the seeds, are held on a spathe – just like a pod of peas – at the top of the light green strand.
4) Label the flowers. A more stereotypical flower might be easier to label than a grass flower.
5) Try the quick true/false activity, hands up for true, hands down for false, or just shout out!

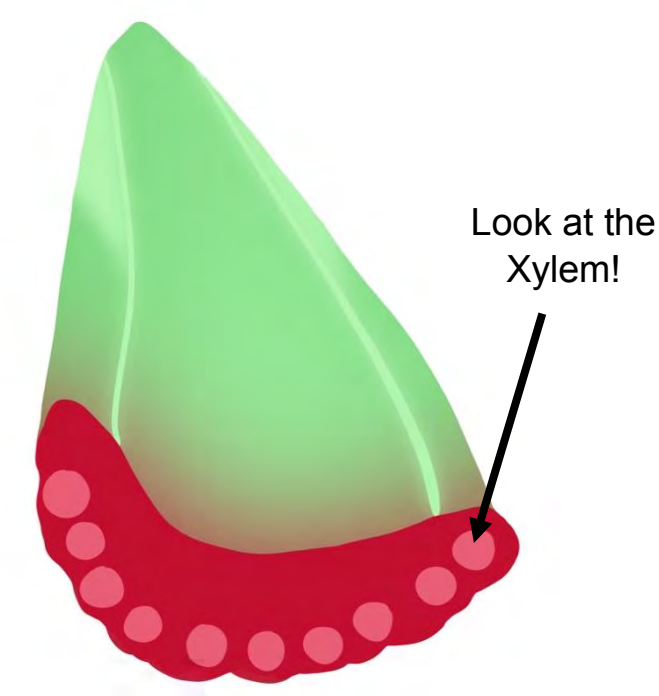
ACTIVITY 2:

A plant has special cells to help move water around the plant – up from the roots, all the way to the leaves of the plant, in a process called **transpiration**. These specialised cells are called the **xylem**, hollow structures which resemble pipes or tubes. A piece of celery is needed for this activity! It's crunchy, good for you… and it can show us how plants move water around inside them.



1) To set this experiment up, fill half the cup with water.
2) Add at least 5 drops of food colouring to the water (the more food colouring that's added, the easier it will be to see later!).
3) Cut the bottom edge of the celery stalk so that the end is nice and fresh.
4) Put the celery in the water and leave it for a whole 24 hours. After 24 hours, look at the leaves of the celery, they should be blue or red (depending on the food colouring used).
5) Pick up the stalk and look at the bottom edge that was standing in the water.
6) Look closely at the bottom of the celery, the colour will help you see the special cells (xylem) which help the plant move water around, from the roots all the way to the leaves!

Have fun with this activity and try other experiments. What would happen if different food colouring was used? What would happen if you split the bottom of the celery stalk in two, and put each half in a different colour of water? Would the same experiment work if you used a different type of plant, or even flower? The experiments are endless!



FUN FACT!

Some plants are adapted to eating flies and insects, for example, the Venus fly trap.

FUN FACT!

Redwoods are the tallest trees in the world and can easily reach heights of 300 feet - the equivalent to 3 blue whales! And just like celery, water is moved around the plant in exact the same way!

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

KEY INFORMATION

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

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 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!

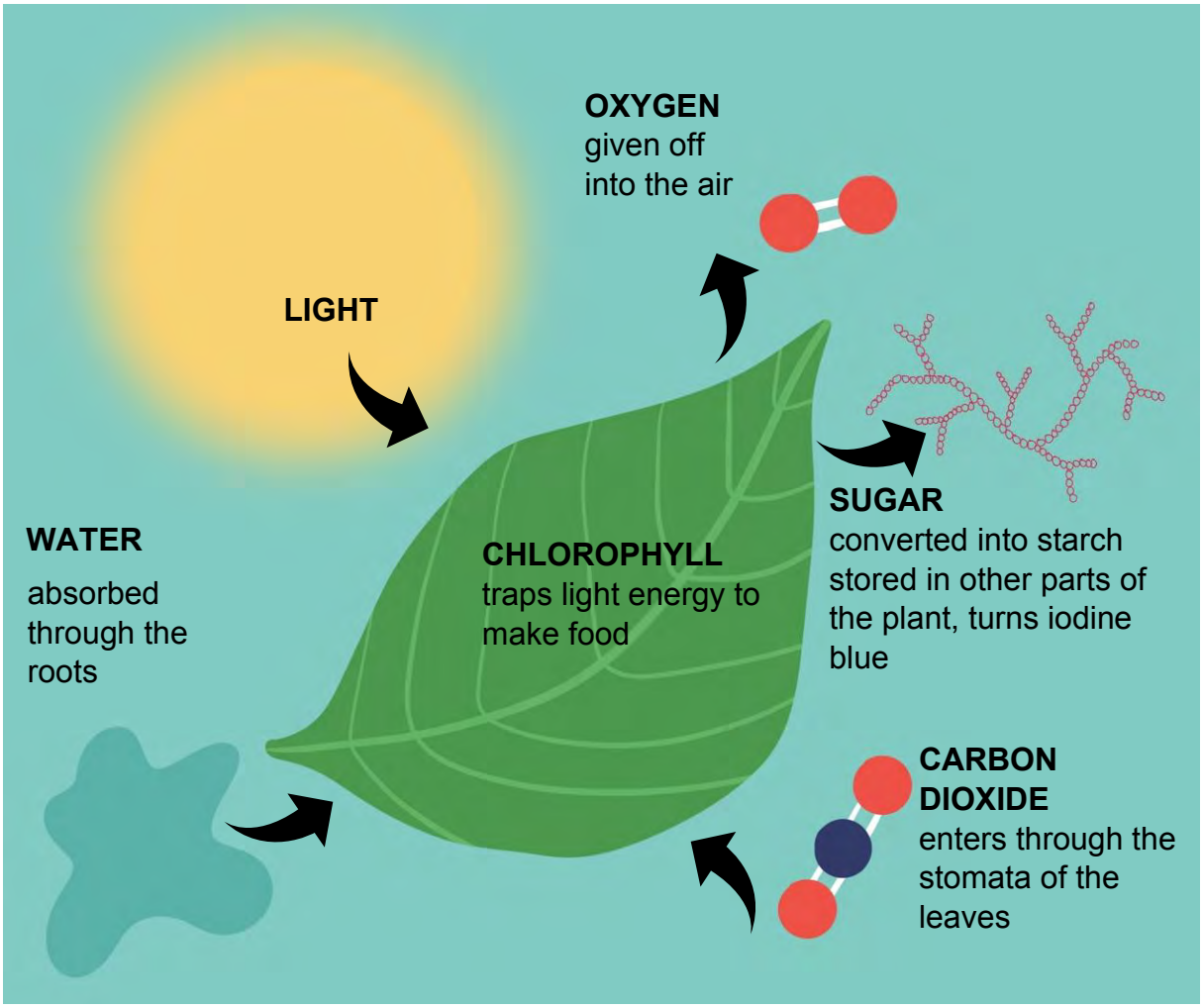
Nutrients – a substance that is essential to help plants grow big and strong.

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!

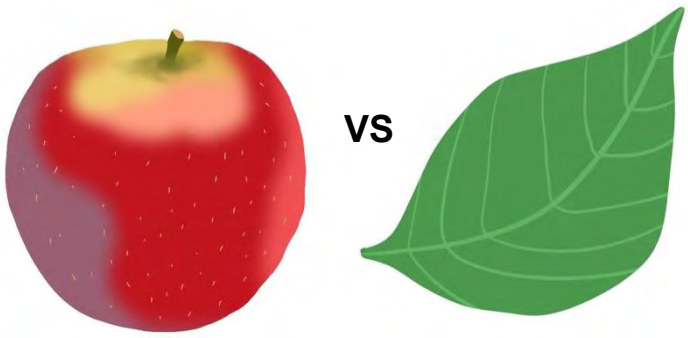
Root – the part of a plant which buries underground, holding the plant in place. They take up water and nutrients to the rest of the plant.

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



ACTIVITY 1:

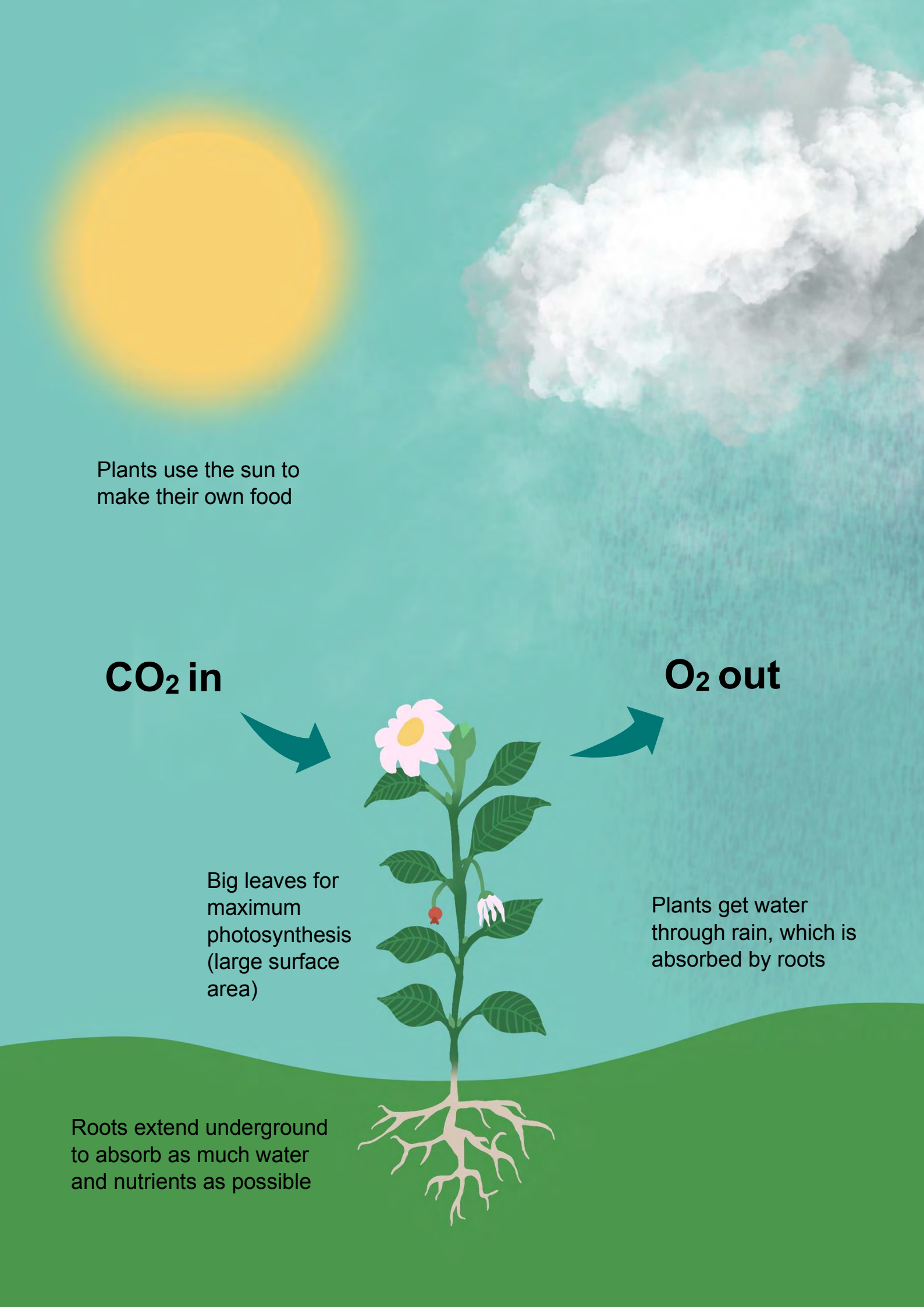
Explain how animals get their energy (from food via metabolism, this can be a simple explanation like – when we eat an apple, we get energy!) and how that is different to how plants get their energy (plants do not have mouths to eat, so instead use the light from the sun to make their own food!)



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

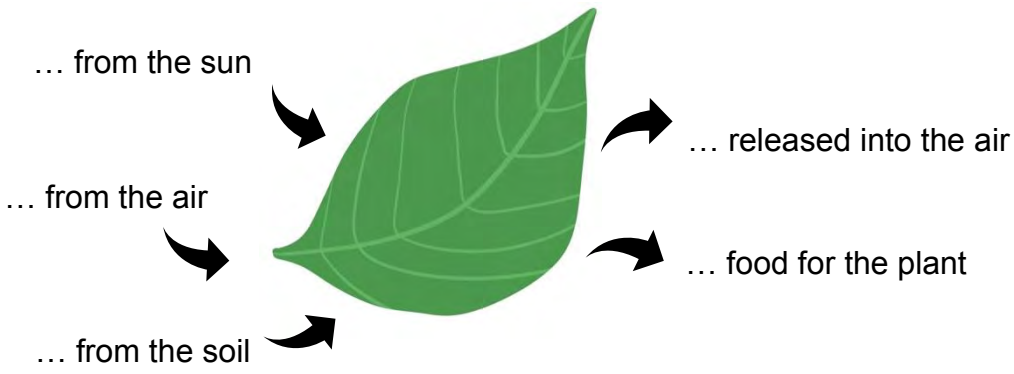
WORKBOOK ACTVITIES

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)

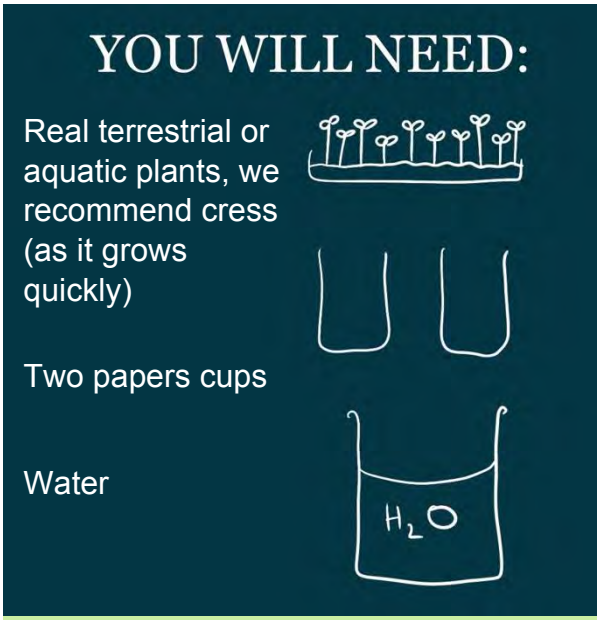
1. Plants need water from the soil for …… photosynthesis.
2. The roots of a plant are spread out to ……... absorb lots of water.
3. Leaves have a large surface area to ……. absorb lots of light.
4. If a plant does not get enough water ……. it wilts.
5. Photosynthesis reactions happen in ……. chloroplasts.
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

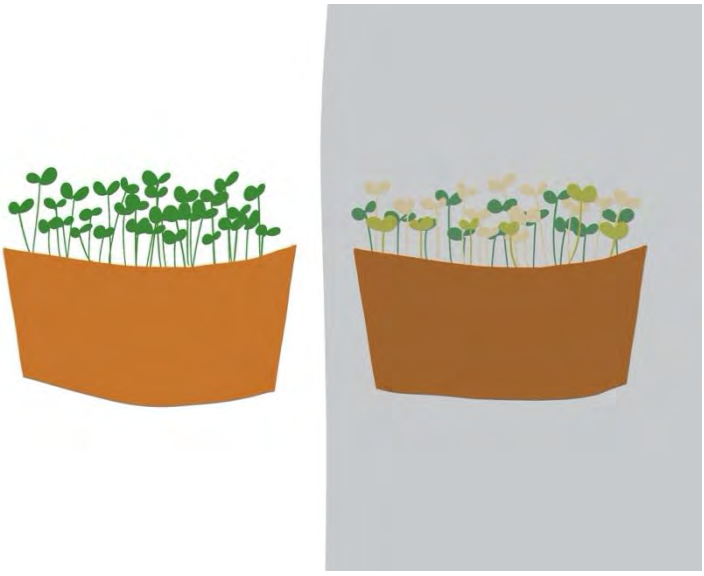
ACTIVITY 2:



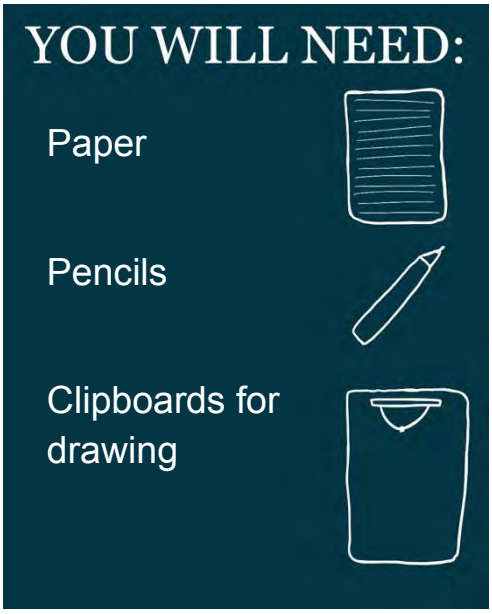
HEALTH AND SAFETY

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.

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.

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.

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

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

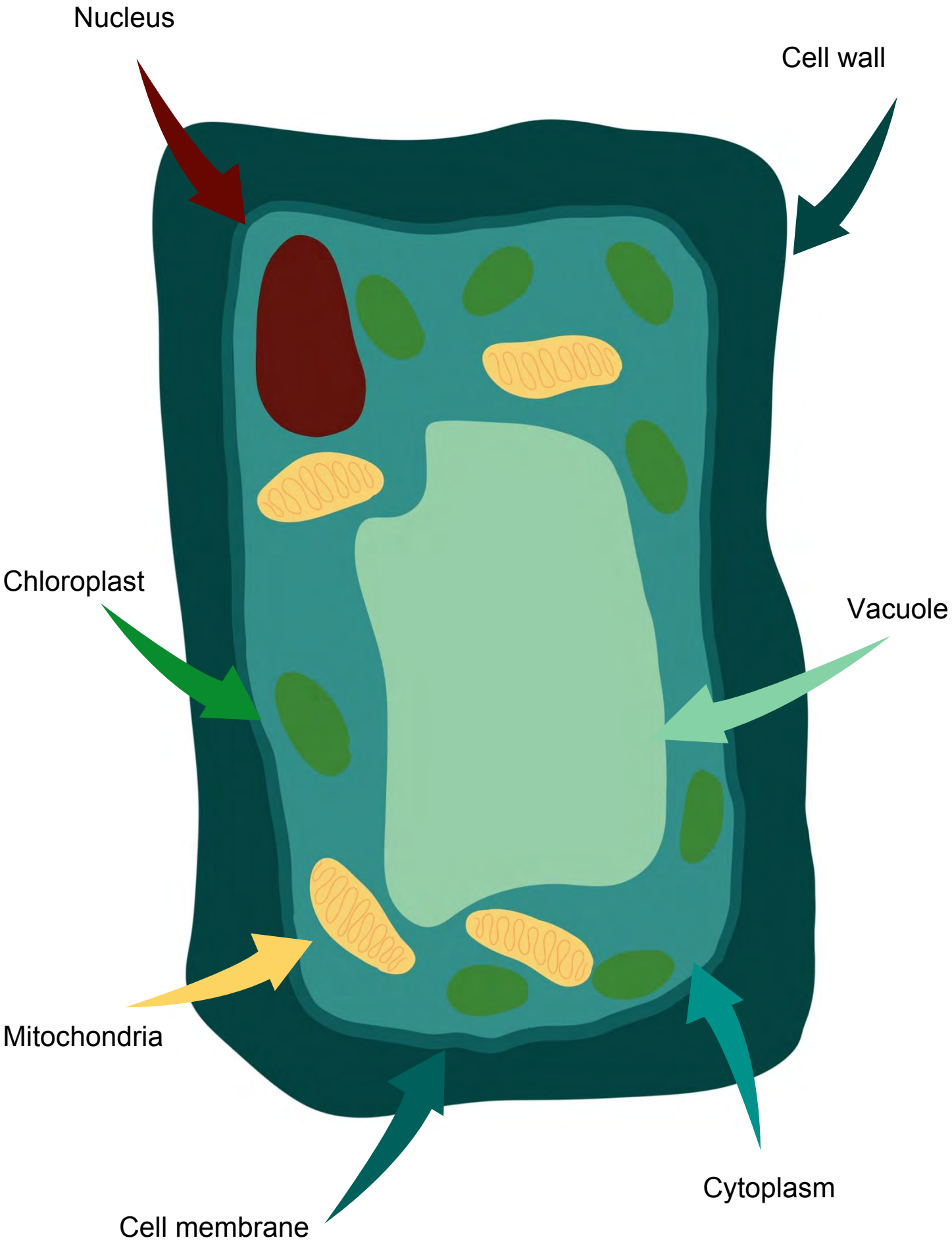
Cytoplasm – this is a jelly-like substance in a plant cell where chemical reactions happen.

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

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

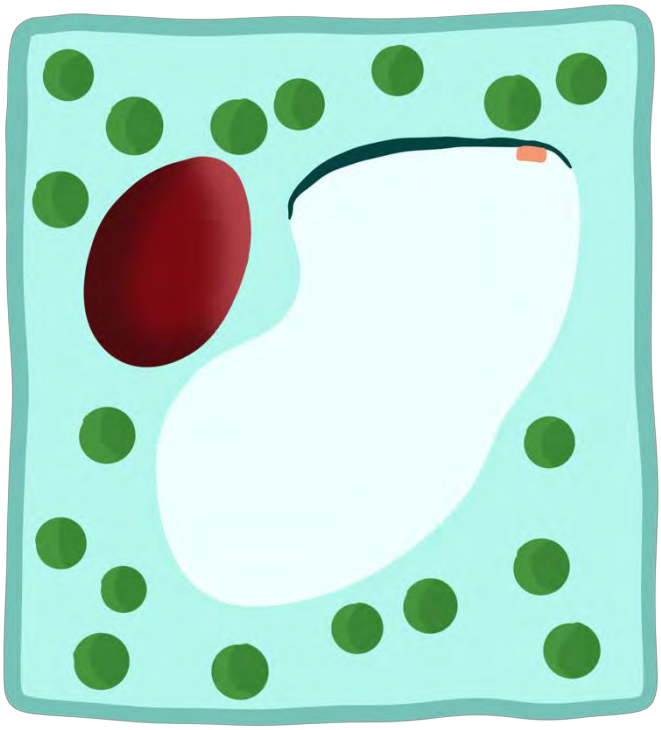


ACTIVITY 3b:

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!

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



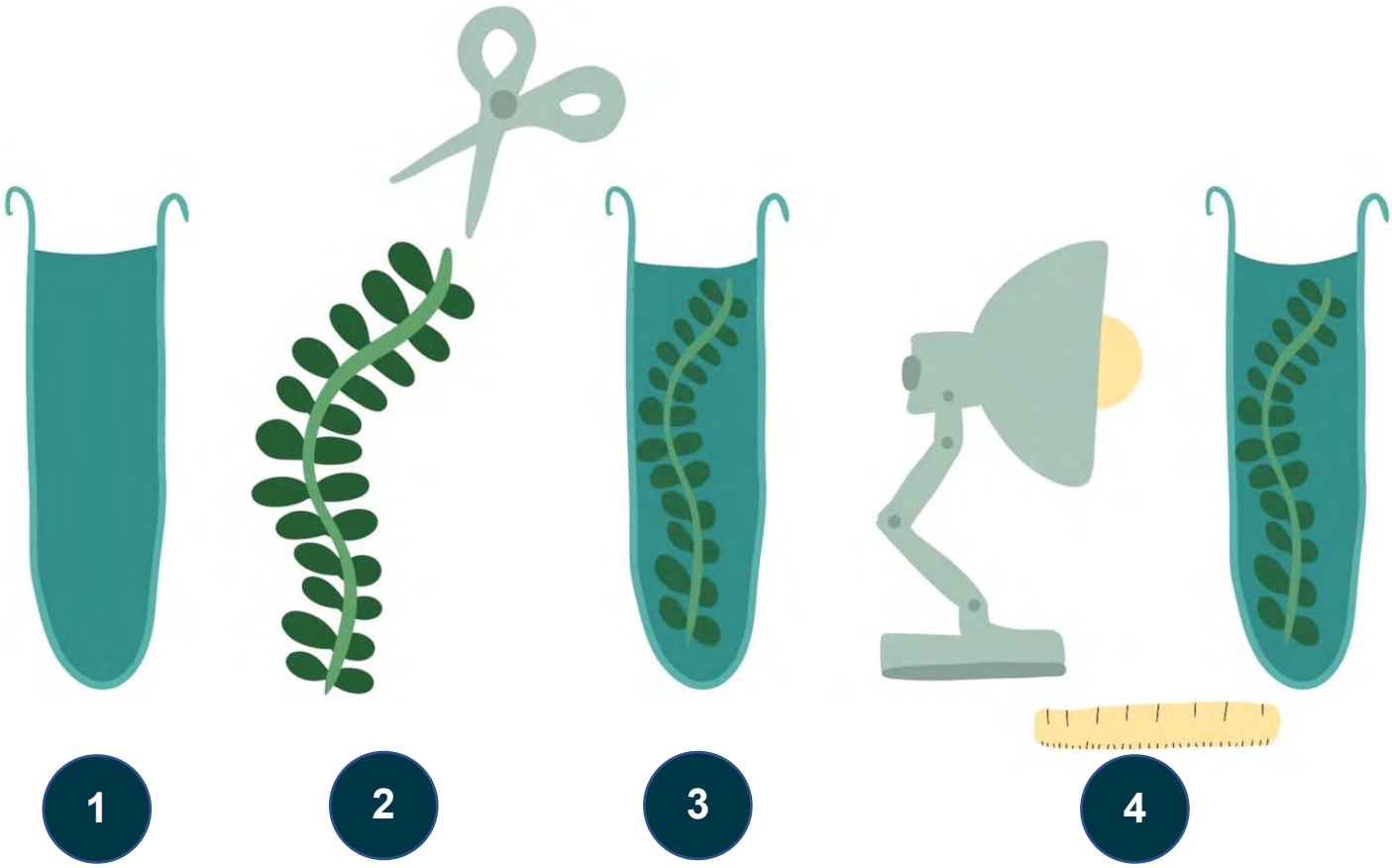
ACTIVITY 4:

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.

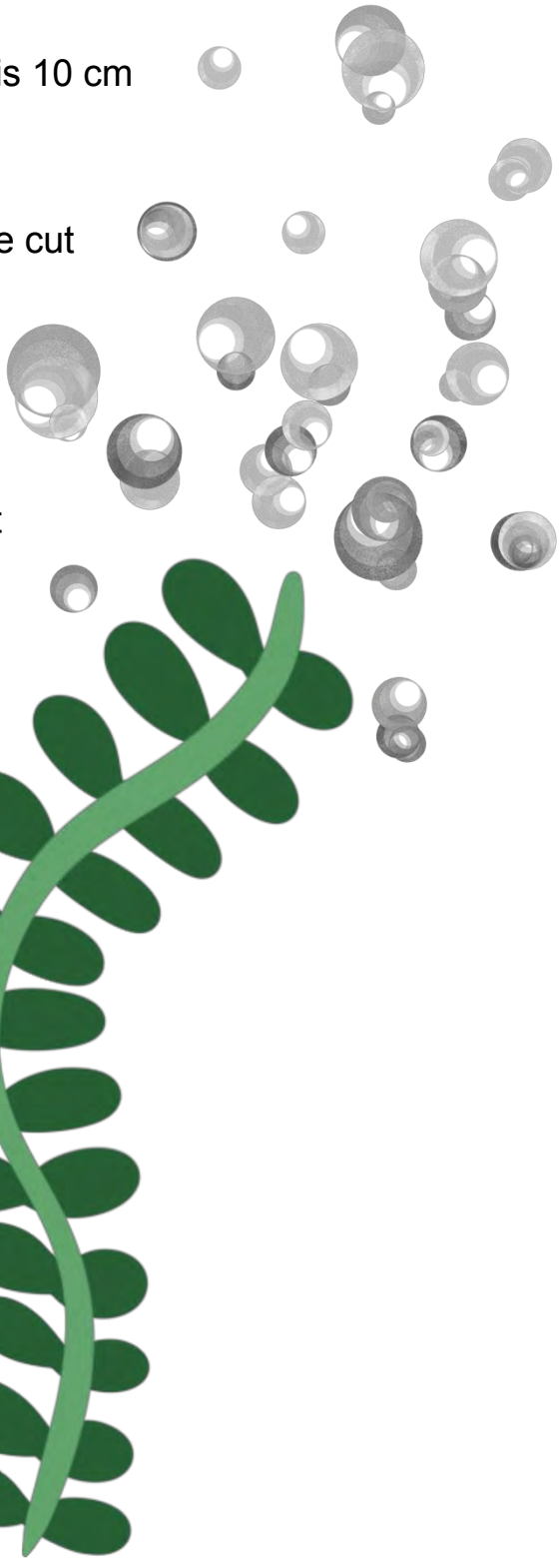
YOU WILL NEED:

- 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.

PROJECT SEAGRASS

REPRODUCTION
ACTIVITY GUIDE
AGES 11-14

OVERVIEW

This activity guide introduces the topic of plant reproduction. Within this guide are five activities: firstly, to help understand plant's reproduction structure, followed by activities to understand processes of sexual and asexual reproduction.

KEY INFORMATION

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

- **Lesson Objective:** Flower structure and reproduction in plants
- **Curriculum links:** Science

LEARNING TIPS

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

INTRODUCTION

Plant reproduction is a very important process because it is how new plants are produced! There are two types of reproduction: sexual and asexual reproduction. Sexual reproduction produces new plants which are genetically very different – like siblings, which have the same parents but their own unique genetics. Asexual reproduction is when a plant produces a

clone of itself, something that humans cannot do – we are not clones of our parents!

KEY WORDS

Reproduction – the process by which plants and animals make new offspring

Sexual – reproduction involving both male and female cells. Offspring are a combination of the male and female

Asexual – reproduction involving clone cells from one plant

Clone – an exact copy

Pollination – when male and female plant cells combine in the process of sexual reproduction

Dispersal – the spreading of seeds or pollen over a wide area

Rhizome – a plant stem that grows underground

Pollination is the process which happens through sexual reproduction, where female and male sex cells meet, pollinate, and create a seed. On land, pollination is aided through animals and through the wind. Bees are a common pollinator, but animals such as birds and even primates are also crucially important pollinators! In the marine environment, pollination is aided through currents and wind but interestingly, also through small critters like crabs, which help spread pollen underwater!

After pollination occurs and the seeds mature, they leave the plant and drift in ocean currents until they settle somewhere new to grow. Similarly, on land a seed falls from a tree and is taken by the wind to a new destination.

However, the challenge does not end there! For plants to grow well, they must outcompete other nearby plants for light, water, space, and nutrients. This means that the seeds must settle in an area that is far enough away from other growing plants to succeed!

In asexual reproduction, no pollen is produced! Instead, plants like seagrass sprout new growth from special structures called rhizomes, which are stems that grow horizontally, along underground before developing stems that grow vertically, upwards. Seagrass can reproduce via both sexual (genetically different plants) and asexual (identical plants) reproduction!

Flower –
produce seeds where new plants will grow. The flower is usually colourful for attracting insects

Root –
the part of a plant which attaches it to the ground or to a support, typically underground, conveying water and nourishment to the rest of the plant via numerous branches and fibres

Stem –
transports nutrients like water and glucose all around the plant

Seeds –
when male and female sex cells meet, they reproduce and mature into seeds

Leaf –
site of photosynthesis

Blade –
a flattened structure that is resembles a leaf

Float –
a hollow, gas-filled structure that helps the seaweed float

Stipe –
a stem-like structure, not all seaweeds have these

Holdfast –
acts as an “anchor” and attaches to a surface (e.g., a rock)

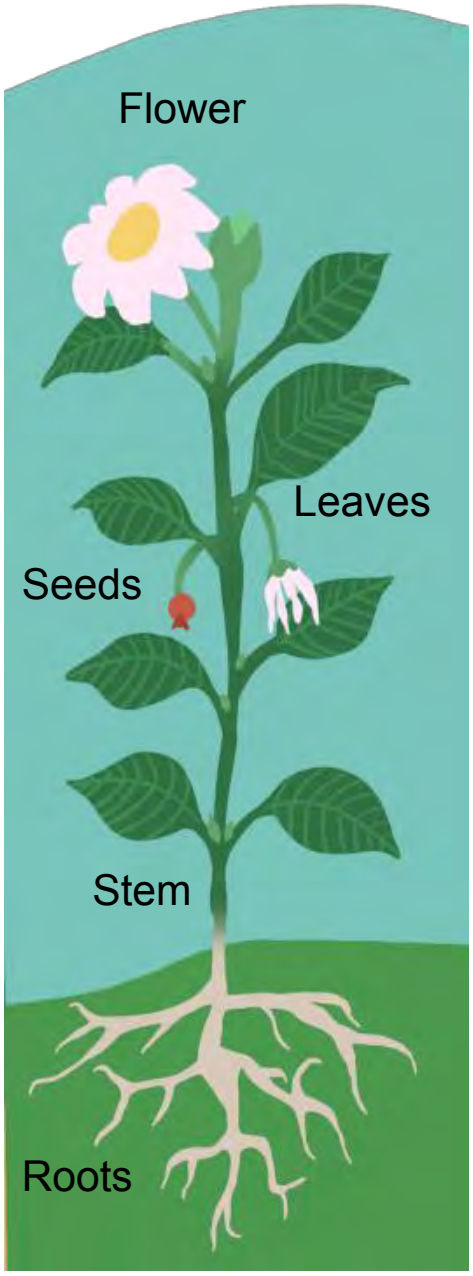
ACTIVITY 1:

1) Discuss with students what a plant/algae structure looks like. First, use a questioning approach to draw out answers and anything students may already know. Discuss key structures and the roles that these structures play.

YOU WILL NEED:

Some cuttings for labelling and drawing:

Key structures of plants
Flower – Make sure to mention that flowers produce male and female sex cells and that insects, like bumblebees, are attracted to flowers because they are very colourful!
Root – Discuss with students why they think that the roots of a plant are underground? This allows these special structures to absorb water and nutrients from the soil to the rest of the plant via numerous branches and fibres.
Stem – Ask students why they think stems are important? This structure is used to transport water and nutrients around the plant and is also the backbone of the plant, meaning that this is how the plant stands up straight!
Leaf – Make sure to ask students why leaves are important beyond reproduction… The leaf of a plant is the site of photosynthesis, which is how a plant is able to make its own food!
Seeds – Seeds are essential to plant reproduction! Discuss how when male and female sex cells meet, they reproduce and mature into seeds. These seeds then have the big responsibility of finding a suitable area for the new plant to grow.



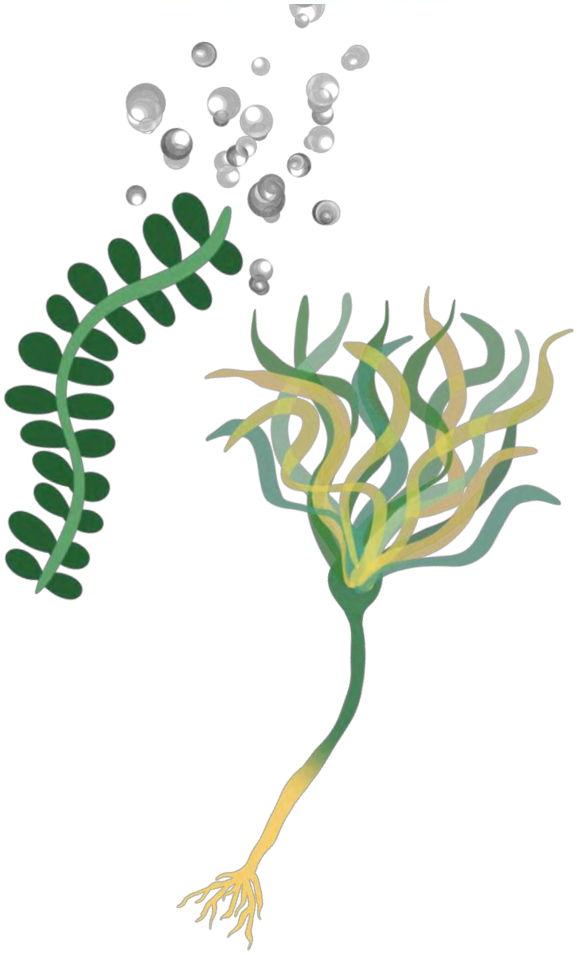
2) Now that students are familiar with the structure of a plant, have them look at real plants/algae and draw them. We recommend a jade tree (*Crassula ovata)* for the terrestrial plant, and seagrass (*Zostera marina*) for the marine plant (remember that seagrass only flowers from around June – early August in the UK).

3) At the end, highlight to the students that the flower is the most important structure for reproduction. Discuss whether marine plants and terrestrial plants differ slightly? If so, how?

ACTIVITY 1 ANSWERS:

- Terrestrial plants get plenty of air, so they usually have stomata on the bottoms of their leaves.

- Plants that float on the surface of the water have their stomata on top of their leaves, where they have access to air.



- Plants that live completely under water gather carbon dioxide from the water.

- When they release oxygen, you can see tiny air bubbles gathering around them.

- Plant roots drink water and nutrients from the environment.

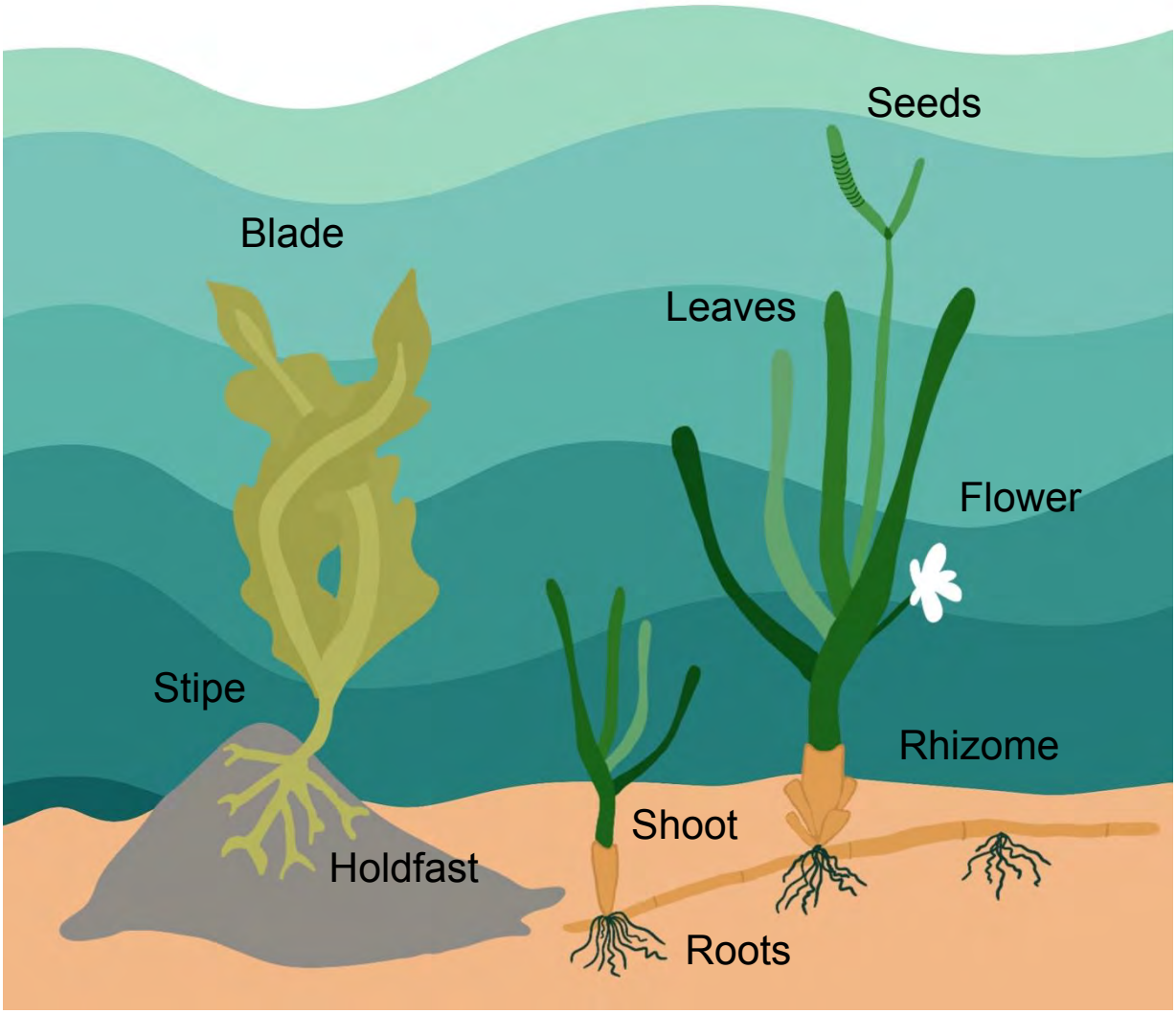
- Aquatic plants have plentiful water to drink, but nutrients may be scarce; the opposite is true for terrestrial plants.

- Terrestrial plants' roots change shape to compensate for what the plant is trying to get from its environment.

ACTIVITY 2:

Students may ask if seagrass is the same as seaweed. They are not the same at all! To start off, **seagrass** is an **angiosperm** (a flowering plant), whereas a **seaweed** is a **marine algae**. Seagrass is more related to the plants that we find in our gardens! Just like these plants, seagrass can photosynthesise and have structures such as roots, stems, leaves and produce flowers and seeds. Seaweed do not have roots, stems, leaves, or flowers. They do however, like plants, use the green pigment chlorophyll to photosynthesise.

Seaweeds, like seagrass, need salty or brackish water to survive, with plenty of sunlight and a surface to attach themselves to (like rocks). Instead of roots, seaweeds have a holdfast and are usually found on rocky shores rather than sandy seabed.



Firstly, discuss the structure of a seaweed with students. Drawing out answers may be more difficult than discussing the anatomy of a plant, so if no answers are drawn out, ask students what job they believe certain structures do.

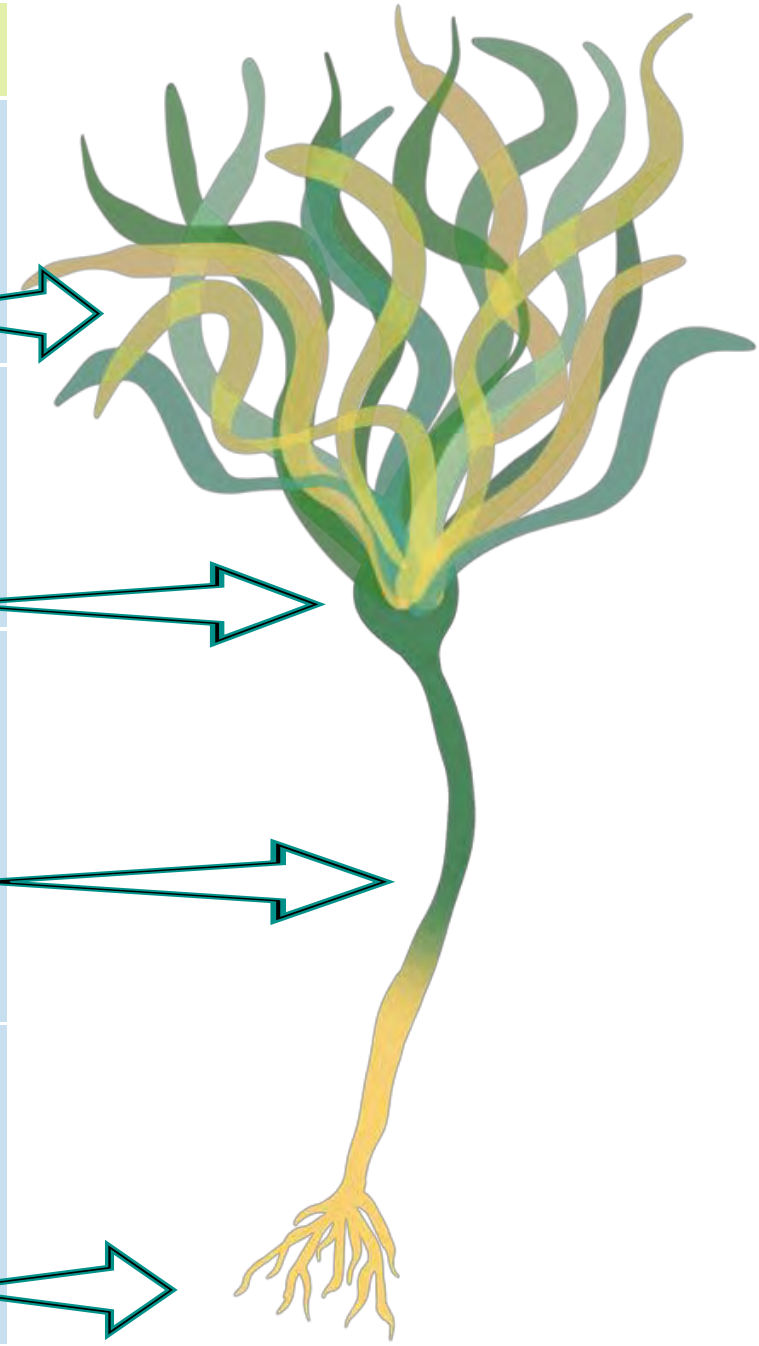
Key structures of a seaweed

Blade – These are flattened structures that resemble leaves. Ask students why they believe these structures are flat? This is in order to maximise photosynthesis efficiency!

Float – This is a hollow, gas-filled structure that helps the seaweed float. Why would the seaweed need to float? To get enough sunlight to photosynthesise!

Stipe – A stem-like structure, not all seaweeds have these. Why might some seaweed not have this structure, ask students what the benefit of this may be… Stipes are only needed in larger seaweed, like kelp, to make sure that they have structure. Smaller seaweeds do not need the same support!

Holdfast – Why are holdfasts important? They act as an "anchor" and attaches to a surface (e.g., a rock). This means that the seaweed is safely secured and will not drift away in the currents.



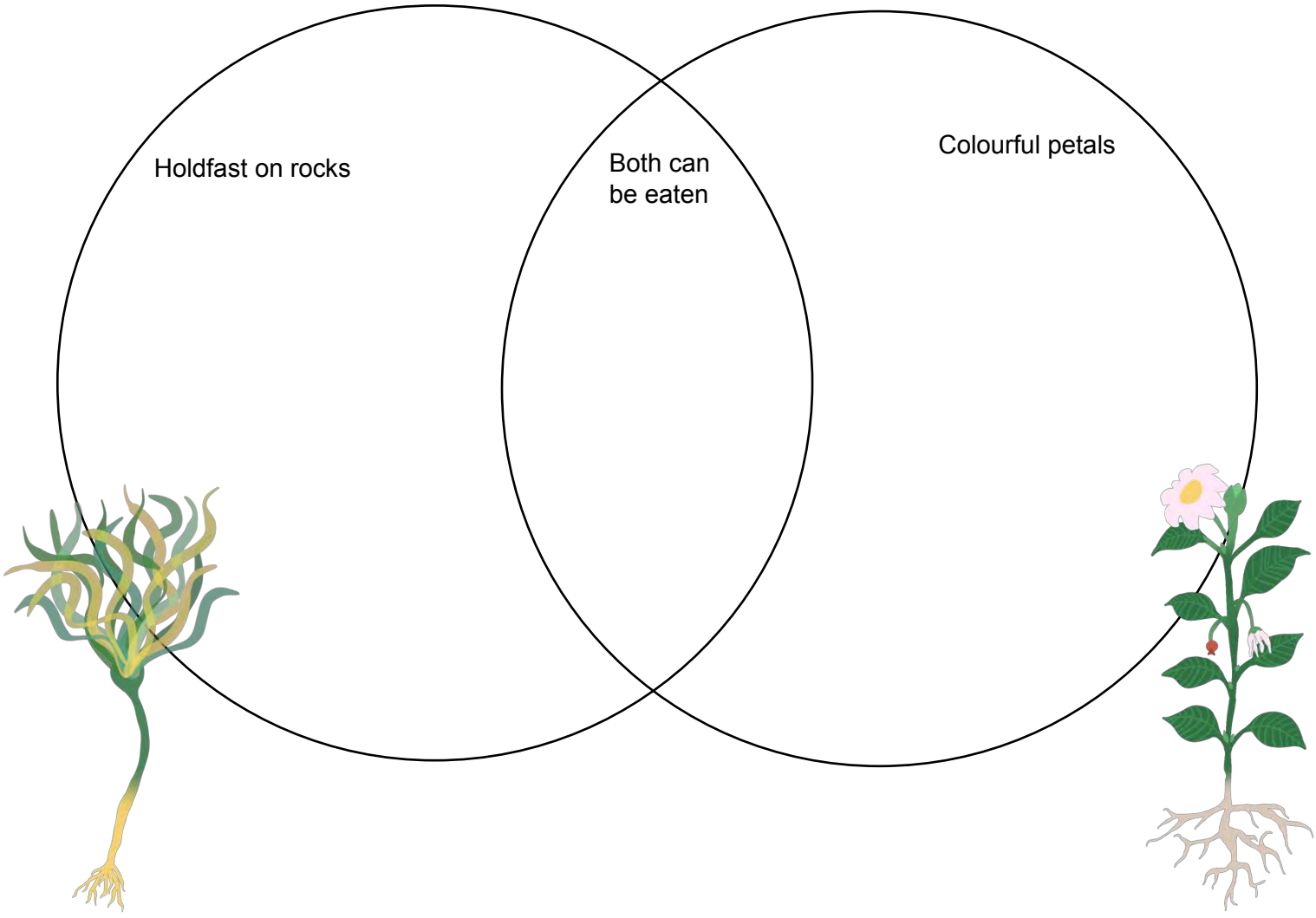
Seaweed Reproduction

Like plants, seaweeds have two types of reproduction – sexual and asexual reproduction! Sexual reproduction is where male and female sex cells meet and create new, genetically different seaweeds. Asexual reproduction happens when a seaweed breaks into little pieces and directly into new algae (that is actually a clone of the parent seaweed)!

1) Give students/groups of students one type of seaweed (we recommend kelp if possible) and one flowering plant. Have students compare the differences and similarities between the seaweed and a flowering plant.

2) Discuss: what structures does a plant have that a seaweed does not? Do they differ in colour? Do they feel different? Can they do the same processes (e.g., photosynthesis – yes, they can).

3) Have students put their knowledge to the test by completing the Venn diagram, which highlights the key differences and similarities of both structures:

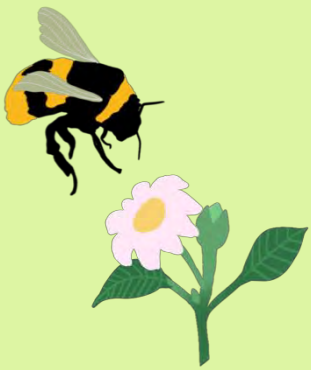


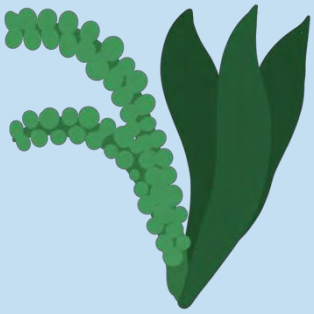
ACTIVITY 3:

During plant reproduction, pollen grains need to move from one flower to another. How do they do this? **Pollination!** Insects can pollinate flowers, and so can the wind or water. Plants are adapted to be pollinated either by animals or by the wind:

YOU WILL NEED:

Real terrestrial and aquatic plants (keep in water tank) or use plant ID books as a backup





Feature	Insect pollinated	Wind pollinated
Petals	Large and brightly coloured to attract insects	Small, often dull green or brown, no need to attract insects
Scent and nectar	Usually scented and with nectar	No scent or nectar
Number of pollen grains	Moderate – insects transfer pollen grains efficiently	Large amounts – most pollen grains are not transferred to another flower
Pollen grains	Sticky or spiky – sticks well to insects	Smooth and light - easily carried by wind without clumping together
Anthers	Inside flower, stiff and firmly attached – to brush against insects	Outside flower, loose on long filaments – to release pollen grains easily
Stigma	Inside flower, sticky – pollen grains stick to it when an insect brushes past	Outside flower, feathery – form a network to catch drifting pollen grains

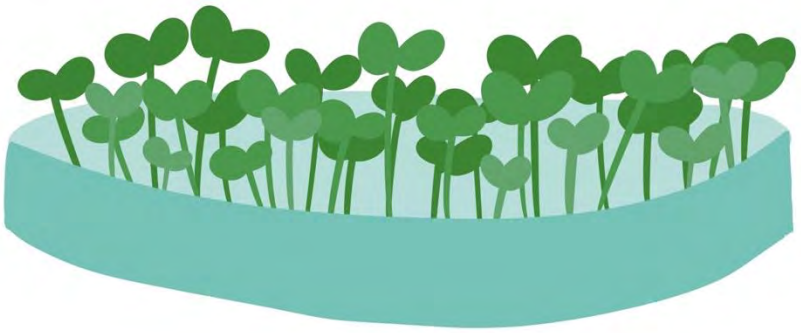
The pollen then germinates. Eventually, this matures into a seed. When this seed is fertilised, flowers develop into a fruit. In seagrass, the fruit remains on the plant and does not surrond the seed like typical fruits that students will be familiar with (e.g., an apple).

Discuss some key pollinators – birds, insects, weather. Discuss why the role of these factors are important. Answers could be that they help our food grow, help our medicine grow, helps with climate change, helps create our oxygen and clean our air…Have students draw a plant and the different ways of dispersal, e.g., wind, bees, animals:

ACTIVITY 4:

1) Cress grows quickly, making it great at showing what conditions plants need to grow – light, water, and air!

2) At the start of the week, set up four petri dishes (or tubs/plates) with a layer of kitchen roll at the bottom and a thin layer of seeds sprinkled on the top. Each of these will be put in different conditions. Half will be exposed to sunlight, such as a window ledge, and half will be kept somewhere dark. Half will have the kitchen roll soaked in tap water, and half will be kept dry. So, the dishes will be set up as follows: light/damp, light/dry, dark/damp, dark/dry.



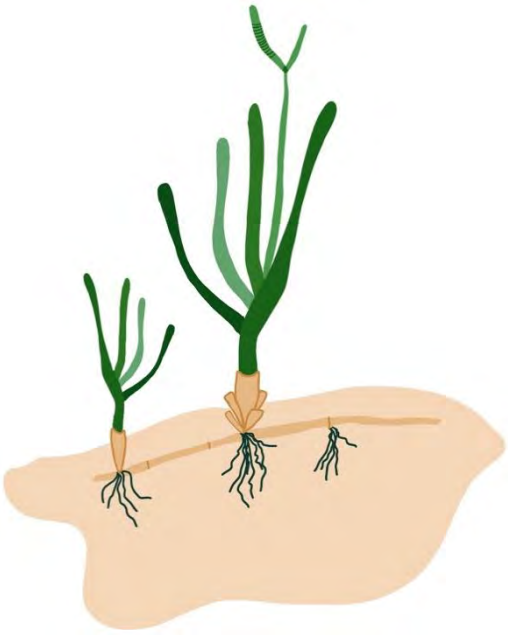
3) Leave these for at least 3 days (the longer the better) and then have the students identify the differences between how the cress has grown. Think how this could affect a plant such as seagrass, which has very specific growing conditions. What conditions do you think seagrass likes best?

- Too dark? There is not enough light for photosynthesis. Why is this a bad thing? The plant cannot make the food that it needs in order to survive!
- Too little water? The plant is not receiving enough nutrients which would affect how the plant grows. This will also affect photosynthesis too!

ACTIVITY 5:

As well as producing seeds, seagrass can also reproduce by extending rhizomes and creating "clones". These are hard to see, but you can demonstrate asexual reproduction by having the students create leaf cuttings. If the teacher has access to a spider plant, this is also a very good way to show rhizomes and can be used instead. This requires a healthy, young, but fully-grown plant (e.g., a jade plant *Crassula ovata*). Avoid damaged, diseased leaves, or those affected by pests. If possible, try and take leaf cuttings in spring to early summer.

1) Cut leaves should be left for 1–2 days to "callus" – where sections of the leaves thicken before potting.
2) Put individual leaves into pots filled with ¾ depth with 2 parts cactus compost to 1-part fine grit (if struggling to find either, sand will also work!).
3) Top with some more fine grit.
4) Try not to cover the cuttings.
5) Place them in a warm position with good light.
6) Keep compost just slightly moist – cutting will be prone to rot if left too wet.
7) Keep cuttings around 20°C in a well-lit room. Protect from direct sunshine (close to a windowsill will be fine!).



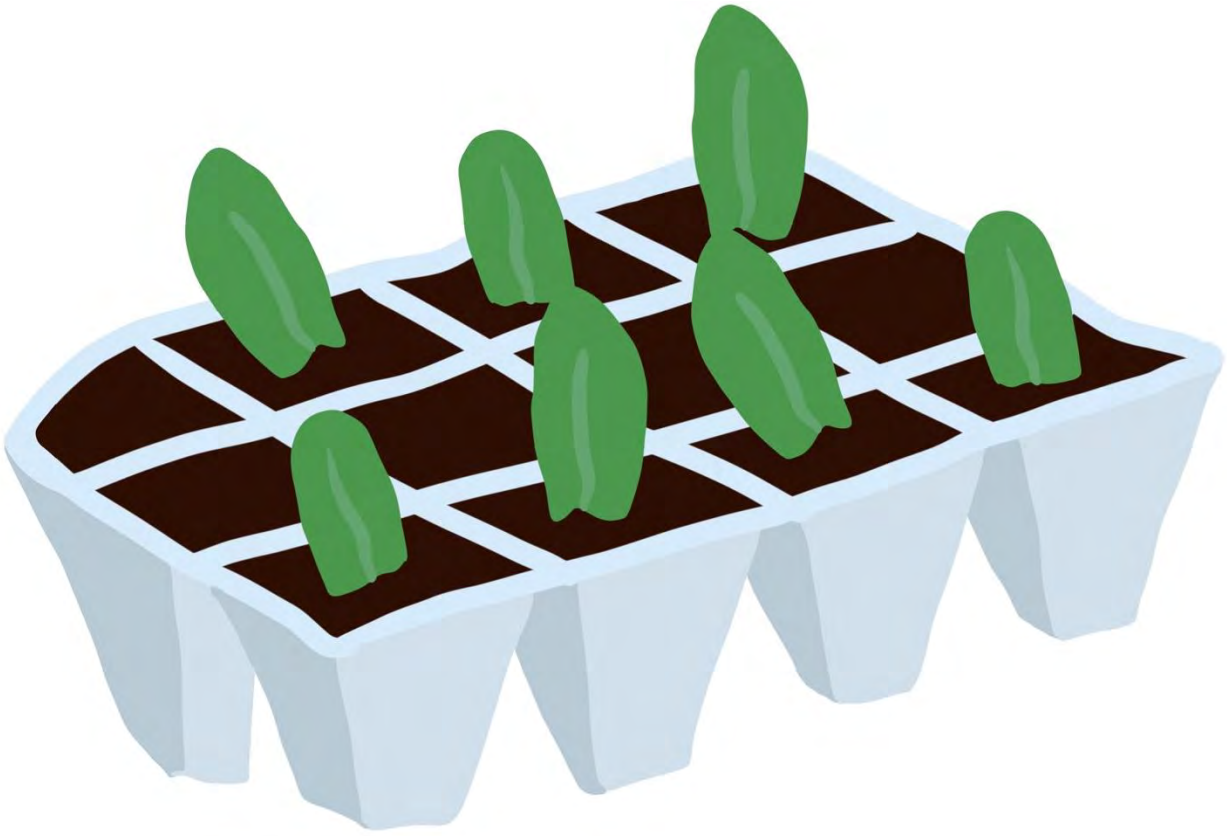
BONUS ACTIVITY:

Instead of using plastic pots, have students get creative and make their own biodegradable plant pots out of toilet/cardboard rolls (e.g., https://www.instructables.com/Biodegradable-toilet-paper-roll-pots/) which will help get the creative juices flowing and reduce our plastic use!

Please note that these plants are not as fast growing and so are unlikely to show significant results instantly. Instead, they can be taken home or to the classroom and checked every few days to see if any progress is being made! If you want to show results during the trip/ lesson, it may be a good idea for the teacher to create a couple of leaf cuttings prior to the trip/ lesson.

FUN FACT!

Did you know that in warmer countries, primates and bats are important pollinators! Very different to your average bumblebee.



PHOTOGRAPHY GUIDE SHEET

Photography can be a great way to explore nature and be creative. Here are some classic techniques and tips to help get the most out of your photos. You can use these on their own, combine them, or even completely ignore them if you wish! Photography is an art form, and, like any other art, you can experiment and find a personal style. Most importantly... HAVE FUN with it and explore your creativity!!!

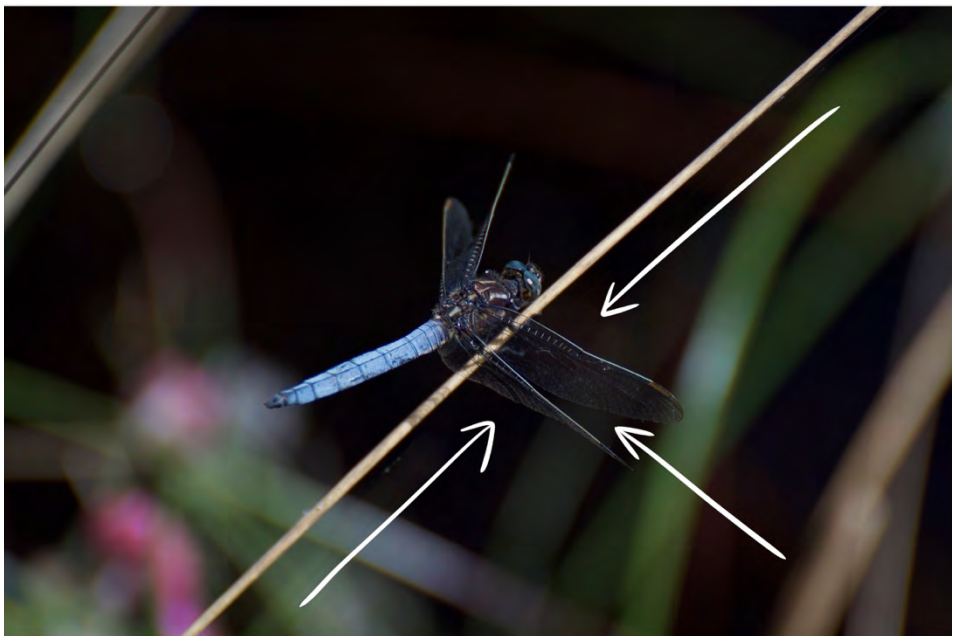
Composition – How all the different elements of the photo are positioned within the frame.

Rule of thirds – Imagine a 3x3 grid, with two lines splitting the frame horizontally, and two lines splitting it vertically. Often it is good to place the main elements of your photo either somewhere on the lines, or particularly where the lines meet (e.g., the shadows and hills in this photo align with the grid lines).

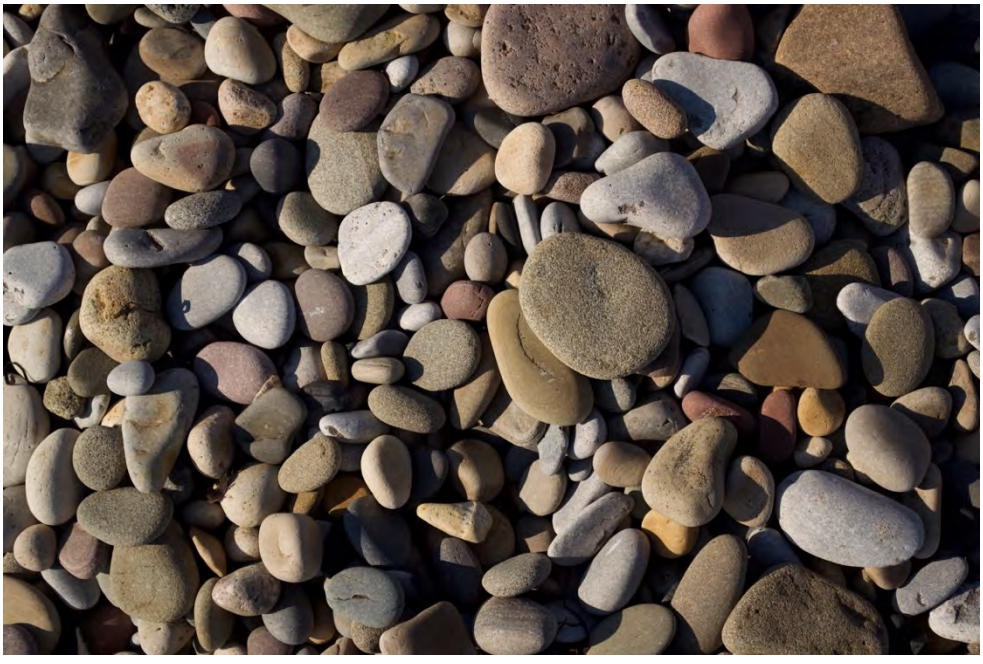
Symmetry and patterns – In photography, symmetry can create a very striking image! Think about how reflections and shapes balance an image. Patterns also appear in many places, making for interesting imagery.

Direction – When photographing animals, the most important part of the being is the eye. Pay attention to which way the animal is looking; you will generally want to have more space in whichever direction that is. This creates a sense of motion. If you are close enough to see the eye clearly, it's often good to try and place the eye on one of the lines created by the "rule of three".

Leading lines - When looking at an image, you'll naturally follow any lines that appear in it. Use this to draw the viewers eye towards a subject, or just create an interesting photo. Lines can appear in many things, for example fences, clouds, branches, paths and rivers.



New perspectives – One thing many photographers aim to do is show people a new way of seeing something. Instead of photographing everything as you initially see it, try finding a new angle. Get close to the ground, look straight down from above, use reflections in water. There are endless possibilities when it comes to finding new angles.

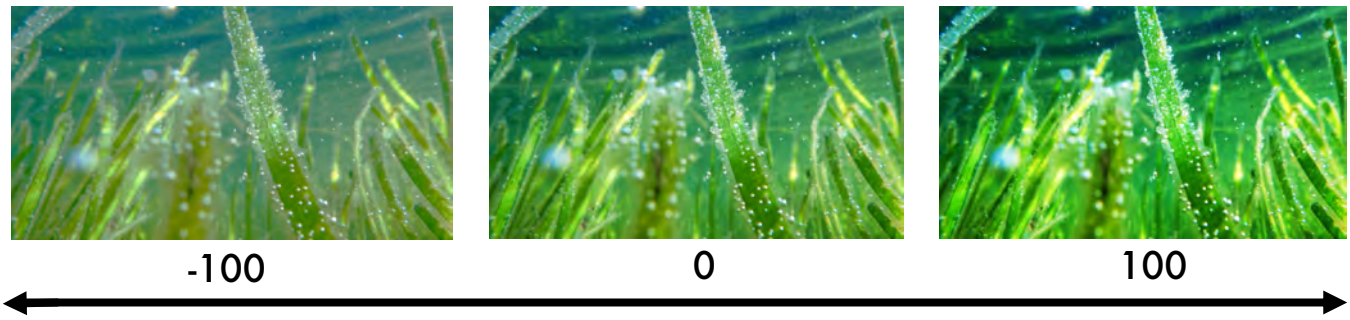


Light

Where is your light source? - Photography is all about light. Therefore, it is important to know where your light is coming from! Outside, this will usually be the sun, though you can use a flash to create a light source. Typically, you want light to be behind you, otherwise it will either make whatever you are focusing on appear very dark or the light will be too bright to see anything else.

FUN FACT!
The most viewed picture in the world is the Windows XP default wallpaper!

Contrast – Have you ever seen an image that is almost all one colour? They often appear boring. That's because the difference between light and dark creates texture and colour that makes photos more interesting. It also makes pictures seem more 3D.



"Golden hour" – This is a particular time in the day when the sunlight turns everything that it touches a beautiful golden colour! It does this right before sunset, because of the low angle of the sun. This light gives everything a warm, glowing feelings which often shows very well in photos.

Editing is perfectly fine! Bring out the best in your photos, however, don't entirely change the image. Doing things such as reducing highlights and shadows, or increasing contrast, can accentuate your photos best features. Go easy when increasing saturation though, as crazy, bright colours can make the image look fake.

PERSUASIVE TIPS

Follow these tips for delivering persuasive speeches and writing letters!

Structure:

1) Start with an **introduction.** Why are you writing this letter or making this speech? What is your motivation? Why should others care?
2) **Evidence** your opinion. Provide facts which support your case.
3) Finish with a strong **conclusion**, which summarises your key points and finishes on a powerful note.

Make a **POINT**	Give **EVIDENCE**
Your opinion:	**Justifying your opinion:**
• I think... • In my opinion... • It seems to me that... • I consider...	• The reason for this is... • Due to the fact that... • This is evidenced by... • This shows...

EXPLAIN it	
Comparing:	**Consider:**
• Similarly… • Equally… • Likewise… • However… • On the other hand… • Instead… • ...whereas... • Although… • While it is true that…	• Strengths • Weaknesses • Good qualities • Advantages • Disadvantages • Drawbacks • Shocking facts • Relevance

Your **conclusion** should summarise your key points and finish on a powerful note:

- In summary…
- On the whole…
- In conclusion…
- Overall…
- To conclude…

Think about persuasion:

- You need to write with confidence! Don't be half-hearted.
- Use rhetorical questions (questions which do not require an answer).
- Back up your statements with evidence.
- Use emotive language to appeal to the reader's feelings.
- Emphasise words using **bold** print or <u>underlining</u>.

SEAGRASS BUZZWORDS:

- Restoration
- Climate change
- *Zostera marina*
- Coastal protection
- Nursey habitat
- Water quality
- Fisheries
- Biodiversity
- Carbon sink
- Tourism
- Volunteering
- Oxygen

It is key to remember to:

Make a **POINT,** give **EVIDENCE, EXPLAIN** it

GLOSSARY

Audit	Looking at how well an organisation is doing
Average	This represents normal for the data. Add all the samples and divide the total by the number of samples you have
Bioaccumulate	The build-up of something (e.g. plastics) in an organism
Biodiversity	The different kinds of animal and plant life in one area
Carbon	An essential element for all living things
Circular economy	Resources are continuously reused
Climate change	A change in the average weather conditions, such as temperature and rainfall, over a long time
Coastal erosion	The wearing away of rock at the seaside
Compaction	A process where sediment becomes squashed closer together during burial
Compromise	A deal between different people or groups where everyone involved gives up part of their demand to reach an agreement
Core	Found at the centre of the Earth. Separated into the 'inner' and 'outer' cores which are made from nickel and iron
Crust	The thin and rocky outermost layer of Earth (approx. 20 km thick)
Deposition	The process of sediment settling from the water or wind as the flow slows down, or from ice as it melts
Dichotomous key	Series of questions with only two answers that help to identify an organism
Ecosystem service	A beneficial provision that humans receive from healthy ecosystems
Erosion	Breakdown and removal of rock material by flowing water, wind or moving ice. Not to be confused with weathering!
Finite resource	A resource that will run out (earth only has a limited amount)
Flood defence	Methods to protect land from flooding
Fossil	Any trace of past life preserved in a rock (includes animal tracks & burrows as well as shells, skeletons and impressions of soft flesh)
Fossil fuels	A fuel (such as gas or coal) formed from the remains of living organisms that have been changed over millions of years

Geology	The area of science concerned with the solid Earth, the rocks of which it is composed and the processes by which they change over time
Greenhouse effect	Gases such as carbon dioxide which stop the suns warmth from escaping earth's atmosphere
Habitat	The natural home of an animal
Ice age	A period in Earth's history where the ice sheets cover large areas of land due to the lowering of the Earth's global temperatures
Igneous	A type of rock formed from magma, either erupted from a volcano or cooled below ground in an intrusion
Insoluble	Something that will not dissolve into a solution - for instance the sand in the sea!
Intertidal	The area where the ocean meets the land between high and low tides
Linear economy	Resources are purchased, used once, then thrown away
Lithosphere	Outer layer of Earth (uppermost mantle and crust) that behaves as a number of rigid, moving "plates"
Livelihood	A job or other means to obtain money to pay for food and other necessities of life
Mantle	A layer of dense rock beneath the Earth's surface (from about 25 to 2500 km down), so hot it slowly flows
Marine	Relating to or something in the sea
Metamorphic	A type of rock which has re-crystallised due to heat and/or pressure. Examples: marble, slate, schist
Microfibre	A manmade (synthetic) fibre that's smaller than human hair
Microplastic	Plastic which is smaller than 0.5cm
Microplastics (Primary)	Plastics that are originally designed to be tiny
Microplastics (Secondary)	Fragments broken down from larger plastic items
Minerals	Naturally-occurring chemical compound (e.g. calcium carbonate), often with a regular crystal structure
Nursery habitat	An area where juvenile animals live
Organism	A living thing, such as animals, plants or bacteria
Plankton	An organism that drifts with water currents
Pollution	Makes the environment unclean or dirty

Poseidon	The Greek God of the sea
Predator	An animal which preys on another animal
Prey	An animal that is hunted or eaten by another animal
Range	This is how varied your results were. Take the largest number and minus it by the smallest number
Raw material	An unprocessed material, such as a tree or iron, from which products are made
Rhizomes	Horizontal underground plant stem capable of producing the shoot and root systems of a new plant
Salinity	The amount of salt dissolved in a liquid
Scientific name	This is a two-part formal name given to a species following a world-wide set of rules. For example, humans are '*Homo sapiens'.* The first word always has a capital and the whole name is always in italics
Seagrass	Seagrasses are the flowering plants which grow in marine environments
Sedimentary	Any rock made up of sediment grains e.g., mudstone, sandstone, limestone, rock salt, coal
Spathe	The part of the seagrass plant containing seeds, like a seed pod
Stakeholder	Someone with a vested interest in the area or development under consideration
Suspended solids	Particles or muck that float in the water and are insoluble
Sustainability	Meeting our current needs whilst not negatively impacting future generations
Terrestrial	Something on land
Tragedy of the commons	Individuals neglecting what's best for the community for personal gain
Transportation	Movement of sediment by water, wind or glacier ice
Upcycle	To make something new out of something old
Weathering	Slow breakdown of rock at the Earth's surface, due to climatic and biological processes