OCEAN CHALLENGE BADGE

We live on the blue planet. 70% of the Earth's surface is covered by ocean, which provides at least 97% of the planet's living space.

Find out more about this fascinating and precious resource by taking the plunge and doing the Ocean challenge badge!

Introduction to the Ocean challenge badge

The Ocean challenge badge is aimed at all guiding sections and consists of four themes:

1. Ocean geography
2. Food from the sea
3. Sounds of the sea
4. Looking after the ocean

Each theme includes a selection of activities to choose from for all age groups with creative and hands-on activities, crafts and games. There is a mixture of indoor and shore-based activities too. All background material and resources are provided in this pack.

The badge

To complete the challenge and earn the badge, participants must undertake one activity from each area.

The badge is based on a design by Asha Neilson from 1st Tobermory Guide Unit who won the Festival of the Sea 2012 Ocean challenge badge competition.

The badge can be purchased for £1 from the Girlguiding Scotland shops or online at shop.girlguidingscotland.org.uk.

Age range

At the end of each activity the symbols of the different sections indicate which age group the activity may be suitable for. Leaders are of course free to use activities they believe will be of benefit to their group.

Background

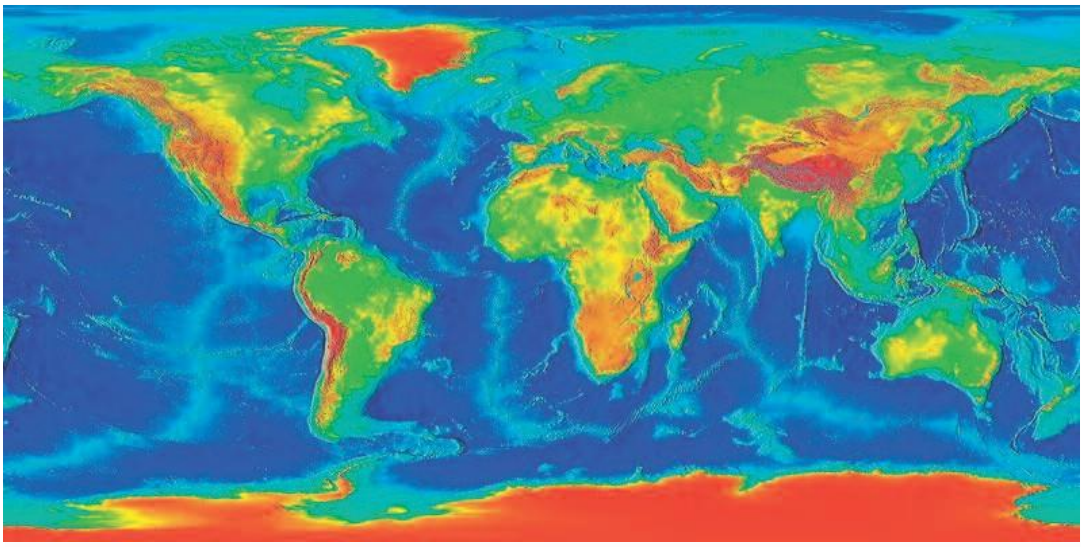
This badge was an idea developed by students and scientists from the Scottish Association for Marine Science (SAMS) in Oban to share their enthusiasm for our oceans with Girlguiding Scotland's 50,000 young members.

It was originally developed as part of the Oban, Lorn and the Isles Festival of the Sea in 2012 – funded by SAMS, the Scottish Government and Argyll and Bute Council - in collaboration with Girlguiding Argyll.

It has since been adopted by the Ocean Explorer Centre, a SAMS visitor centre near Oban, and has been adapted for use by all Girlguiding Scotland members.

www.sams.ac.uk
www.oceanexplorercentre.org
www.girlguidingscotland.org.uk

THEME 1: OCEAN GEOGRAPHY



This section has four activities to choose from:

1.1 Polar seas: the animals of the Arctic and Antarctic - creative
1.2 Ocean bingo - game
1.3 Ocean conveyor belt – science demonstration
1.4 Illustrating the oceans – creative

Activity 1.1: Polar seas: the animals of the Arctic and Antarctic

CREATIVE

30 minutes

Background information – see Resources Section, pages 25 – 33

Equipment needed

- Poster cardboard or paper
- Paper
- Pencils
- Colouring pens or pencils
- Scissors
- Glue

Activity instructions

Draw and create a poster board with two columns - ‘Arctic’ and ‘Antarctic’.

Cut out the different animals with their description and, as a group, decide which side of the poster board each animal belongs to. Once you’ve decided, move animals if necessary and then glue them on.

Once the poster has been made, stand back and ask everyone why they think the Arctic and Antarctic are similar, and why they are different. Why might it be important that we keep these ecosystems?

Try it another way! Why not designate opposite walls of your hall as Arctic and Antarctic and get the girls running to the correct side as you show them the different animals?

Activity 1.2: Ocean bingo

GAME

20 minutes

Background information and activity materials – see Resources Section, pages 34 - 36

Equipment needed

- Cut-outs of descriptions of seas on page 34 of Resources Section
- Pens/papers
- Globe or world map – an inflatable globe is best

Instructions

There are 3 resource sheets on pages 34 – 36 of the Resources Section:

1. Descriptions of the seas
2. Corresponding names for the seas
3. Answer sheet

Cut out the name of the seas as well as the descriptions and, using the globe or map, get the girls to try to match the descriptions to the names.

After the game, topics for further discussion could include a recap of the differences between all of the oceans and seas, or a discussion of some of the human pressures on the marine environment and the locations that the girls think might be most affected.

Activity 1.3: Ocean conveyor belt

SCIENCE DEMONSTRATION

30 minutes

Background information – see Resources Section, pages 37 - 38

Equipment needed

- Large glass dish (casserole dish) to be your 'ocean'
- Ice cube tray and access to freezer
- Kettle or hot tap water
- Two glasses (one with handle if possible)
- 3 food colours (eg red, blue, green)
- Table salt

Preparation (24 hours before meeting)

In advance of doing this activity, mix a large amount of blue food colouring into some water and pour it into an ice cube tray. Put it in the freezer overnight until frozen solid. Keep the blue ice cubes frozen until the time of the activity.

Setting up

1. Fill the glass dish/fish tank with clear, room temperature water. Use this container to represent the global ocean.
2. Dissolve several spoonfuls of table salt in a glass of water, adding enough green food colouring to create a dark green colour. This is your salt water.
3. Boil the kettle, and in a second glass carefully mix some hot water with red food colouring. This is your warm water.

Demonstration

Q1: Effect of extra salt on sea water

Carefully pour a small amount of the green-coloured salty water down one inside edge of the 'ocean' in your dish/fish tank without disturbing the rest of the water. What happens to the salty water? (Answer: This dense water should sink to the bottom).

Q2: Effect of icy conditions on sea water

Carefully place a few blue ice cubes into one side of the 'ocean' and let them melt. Where does the melting water go? Why? Where on the map/globe do you think a similar thing might happen? (Answer: Again, the dense water should sink).

Q3: Effect of warm conditions on sea water

Carefully pour some of the red, warm water down one inside edge of the 'ocean'. What happens to the hot water? Where do you think this would happen in the ocean? (Answer: This less dense water should spread across the surface).

Along with the wind, these differences in temperature and salinity drive the ocean conveyor belt. While cold, salty water is denser and sinks in the ocean, glaciers and icebergs are made of fresh water - so what happens when this ice melts?

Activity 1.4: Illustrating the oceans

CREATIVE

1 hour + research time

Background information – see Resources Section, page 39

Equipment needed

- Large sheets of paper
- Pencils
- Paints and brushes (or colouring pens, pencils or crayons)
- Information about oceans (books and access to internet)

Activity instructions

For this activity the girls should work in groups. Give each group the name of an ocean. Ask them to use books and the internet to research the different life forms which live at different depths in their ocean. They can look at what lives in the deep-ocean seabed, through to the different plankton, invertebrates, fish and mammals that swim in the water. They could also look at seaweeds, corals, sea grasses etc that may grow in the coastal areas, and then the people and seabirds that affect the sea from the surface.

Then give each group of girls a large sheet of poster paper and paints. Ask each groups to make a poster showing a cross-section of their allocated part of the ocean, painting the different life forms that occur at different depth levels. Then ask them to make a short presentation to the rest of the group on what they learnt about their part of the ocean, using their poster!

THEME 2: FOOD FROM THE SEA

This section has four activities to choose from:

2.1 What use is seaweed? - game
2.2 Seaweed art - creative
2.3 Marine food webs - craft and game
2.4 Food from the sea – experiential learning

Activity 2.1: What use is seaweed?

GAME

45 minutes + travel

Background information and activity/answer sheets – see Resources Section, pages 40 - 42

Equipment needed per group:

- Supermarket sweep worksheet
- Clipboard with pen or pencil

The purpose of the game is to conduct a 'seaweed supermarket sweep' to learn to look at product labels and to discover which everyday foods and products contain seaweed or anything that comes from seaweed.

Provide each group with a copy of the supermarket sweep worksheet. Only the Leader has the answer sheet.

The groups can visit the supermarket together or separately and should try to find each listed product. Look at the list of ingredients to identify which kind of seaweed is in each item. The words to look for (or the E numbers) are: beta-carotene (E160a), carrageenan (E407), agar (E406) and alginate (E400-404).

Note the seaweed derivative next to each product and what seaweed group it comes from. (Some beta-carotene in foods comes from other sources, but it may be extracted from green seaweed, so include). Look for products which contain actual seaweed – to be noted as 'natural'. You may find these extracts in food not on our list, for example, packs of cake mix. If you do, add them to the list for bonus points. Seaweeds are valuable sources of essential nutrients like vitamins and iodine. You may find a surprise with one product which is actually labelled 'seaweed'!

The winning team will have the list with most seaweed-containing products.
(Reward with what you think is appropriate – chocolate bar etc.)

Alternative to visiting the supermarket

The Leader can gather the packaging from the items so they can be examined in the meeting place.

This could also be given out to individuals to do over the course of the week between meetings, to be discussed at next meeting.

Notes

1. Consider informing local supermarkets of the planned visit
2. Encourage good behaviour during your shop visit.

Activity 2.2: Seaweed art

CREATIVE

30 minutes + optional trip to beach

If you live near the sea, visit a beach and collect small amounts of seaweed of each colour (red, brown or green). Make sure you minimise the number of attached small animals you bring home. Make sure you go when the tide is quite low or there will be little to collect. Leaders may collect seaweed ahead of a meeting and only do the art activity.

Equipment needed

- Gloves
- Bucket of seawater to keep seaweed in
- A seaweed identification book
- Cartridge paper
- Shallow trays with water
- Tweezers

Once you have collected your seaweed, put it in the bucket of seawater to keep it fresh.
See if you can identify the seaweeds you have found using the identification guide.

If the weather is fine you can carry on and do the next part of the activity outside, otherwise return indoors.

Make a picture using seaweed: to do this put some seawater in a shallow tray. You might need several trays depending on the size of your unit.

Put a piece of cartridge paper in the tray of water. Pick up a piece of seaweed with your tweezers. Place it carefully on the paper. You can move the fronds of the seaweed around gently to make a nice shape. Lift the piece of paper with the seaweed out of the tray and leave to dry. Your seaweed will stick to the paper and produce a beautiful picture.

If you remain on the shore you could also make a seaweed ‘picture gallery’ in the sand.

Take pieces of seaweed of different colours and types and arrange them to make your own seaweed ‘paintings’. Add shells, driftwood or stones.

Activity 2.3: Marine food webs

CRAFT

Two hours (can be split across two or three Unit meetings depending on section)

Background information – see Resources Section, pages 43 - 45

This activity provides a fun and active way of finding out about different creatures living in the sea and who eats who in the marine food chain!

Equipment needed

- Poster card and paper
- Dye, crayons (white is most effective with dye)
- Scissors and glue
- Dried pasta, cotton, assorted craft material
- Picture resources

1. Using the poster card create a 'blank canvas' for your 'Under the Ocean' scene using crayons and dye to paint the blue/green ocean.

2. The girls can draw some plants and the ocean floor but ensure you keep room to put their 3D 'seafood' creations on later.

3. (For Rainbows do these two stages yourself so the girls can simply concentrate on creating their 'seafood' to go on it later).

4. Assign each child one of the 'seafoods' below (you can do more than one of the same thing depending on numbers and Rainbows maybe pair up):

   The sun
   Phytoplankton (plant plankton)
   Zooplankton (animal plankton)
   Jellyfish
   Sandeel/blenny/sea horse
   Atlantic cod/salmon (larger fish)
   Common skate (shark family)
   Seal
   Blue whale
   Puffin
   Fisherman

5. Using picture resources for Rainbows and simply the description for the other sections, ask the girls to create their own 'seafood'. They can draw it on card and use dried pasta, buttons, cotton, or bunched material to flesh it out to make it more 3D. Paint or dye over it.

6. Once all the 'seafoods' are complete, ask the girls to put them on the canvas in order of the food chain. Example, zooplankton might go very near the bottom then a jellyfish would be somewhere in the middle, a whale higher up etc. Questions to ask about this are found in the resource section.

GAME

5 - 10 minutes

Once all the ‘seafood’ has been put on the ‘Under the Ocean’ canvas scene you can ask the girls to remember which ‘seafood’ they had created and to get into a circle. Using a ball of string, a girl shouts out what kind of creature she is and what she wants to eat, e.g. “I am a seal and I eat cod”.

The cod would then shout out “I am a cod” and, holding on to the end of the string the ‘seal’ would throw the ball of string to her. This goes on throughout the food chain, eventually ending with a phytoplankton girl and the sun.

Then reverse the dynamic and go up the food chain, preferably another path. All girls should hold at least on to the string in one place. Eventually a food web is created. See what happens if one component disappears.

Activity 2.4: Food from the sea

EXPERIENTIAL LEARNING

1 hour

Seafood health benefits

Seafood is a healthy food choice for people of all ages. The government and global health organisations recommend we all eat two seafood meals each week as seafood is an excellent source of low-calorie protein and is low in saturated fats. Seafood is also the main source of the essential omega-3 fatty acids DHA and EPA that promote healthy brain and eye development in children and reduce the risk of heart disease in adults. In addition it is rich in minerals such as selenium (an antioxidant), zinc (for immune system health and cell growth), iodine (for thyroid gland function) and iron (for red blood cells) and in vitamins (especially B-complex, A and D).

Purpose of activity

The purpose of this activity is to support the girls in developing healthy eating habits by:

1. exploring the health benefits of seafood
2. encouraging them to broaden the variety of seafood they eat (This will help both the girls' personal health and the health of the marine ecosystem that suffers from too many of us wanting to eat the same types of fish.)

Explore the health benefits of seafood with the girls. You could do this yourself or invite a nutritionist or dietician to talk to the girls about seafood. At the end, establish what seafood they have tried and like. Make sure all girls contribute - you could get a census going!

Tasting

It is important to have a positive message. Don't be tempted to follow a 'I'm a celebrity, get me out of here' approach that confirms prejudices about food and turns tasting into dares. Instead take a gentler approach, especially if you have a more squeamish group. Here are some suggestions - but we leave it to the Leaders to choose what is best for their group.

- Prawn cocktail: do the crisps taste like the real thing?
- Calamari or onion ring: can you taste the difference?
- Visit an oyster farm, learn how oysters are farmed and try one on the beach...
- Learn to cook fishcakes / seaweed lasagna.
- Explore how preparation changes the taste of salmon (or another popular fish): compare grilled, cooked and fried salmon or hot and cold smoked salmon. If you live near a smoke house, you could combine this with a visit.
- If your group is up for it, why not have a seafood foraging trip (there are a number of guide books to help you - or invite someone with appropriate knowledge to guide you!)
- Have a summer BBQ with a seafood theme.Invite the parents to come along - and contribute too. This could be when you present the girls with their Ocean challenge badge.

THEME 3: SOUNDS OF THE SEA

This section has four activities to choose from:

3.1 Meet humpback whales, the pop stars of the sea – experiential learning
3.2 Marine mammals and sounds - demo
3.3 Sound orienteering and echolocation – experiential learning
3.4 Making wind chimes from sea shells – creative

Activity 3.1: Meet humpback whales, the pop stars of the sea

EXPERIENTIAL LEARNING

15 minutes

Background information – see Resources Section, page 46

Equipment needed

- Music player (CD player, iPod or similar)
- Whale song music (can be downloaded)
- Blue fabric / large dark parachute

Part 1: Just listen

Some whales and dolphins travel in groups called pods. Sort the girls into pods and ask them to close their eyes. Then turn on the music so that the girls experience the underwater sounds made by whales.

Part 2: Living under the sea surface

Use a parachute or large piece of fabric get the unit to make waves and get them to think about what it would be like to be a whale and live underwater in the sea.

Part 3: Compare with other sounds

Listen again to the whale songs and ask the children to describe what the noises sound like and compare them to other animal noises or musical instruments.

Part 4: Do you need words to talk?

Sitting in a circle on the floor under the blanket, ask the girls if they can imagine how humpbacks might communicate about things without the use of words. Get them to make sounds that tell the others:

1. To be their friend (e.g. sounds of kisses or love song melodies)
2. To hunt with them for prey (e.g. Jaws music theme)
3. To warn them of dangers (e.g. siren)

Activity 3.2: Marine mammals and sounds

SOUND EXPERIMENTS

30 minutes

Equipment needed

- Drinking Straw
- Pair of scissors
- Cup or glass of water
- Drum
- Rice
- Wire hangers
- String

Sound travels differently through water than air and solids. The activities in this session show different ways sound travels, ending with an experiment in water- Water Whistle

Activity 1

Understanding sound as vibrations
Put rice on a drum, when you strike the drum the rice will dance because of the vibrations.

Sound travels through solids

Tie the hook of a wire hanger to the centre of a piece of string about 3 feet long. Wrap the ends of the string around your index fingers. Now put your hands over the openings of your ears while holding the string. Lean over and swing the hanger so that it taps against a table or door. What do you hear?

Activity 2 - Water whistle experiment

Instructions

1. Using your scissors, cut partially through the straw 1/3 of the way down the straw. The cut should be ALMOST all the way through the straw but leave a small piece uncut to keep the two straw sections attached.

2. Bend the straw into a right angle at the cut being careful not to break the straw segments clean of each other.

3. Fill a cup or glass 3/4 full with water.

4. Slide the longer section of straw into the water.

5. Keeping the straw at a 90 degree angle, place your lips on the shorter end of the straw and blow with a light, constant breath. What do you hear?

6. If you are having trouble producing a whistling sound, try pinching the top of the long end of the straw

7. Once you've got your water whistle making a constant, steady sound, trying raising or lowering the straw within the water. What happens to the pitch of your whistle when you do this?

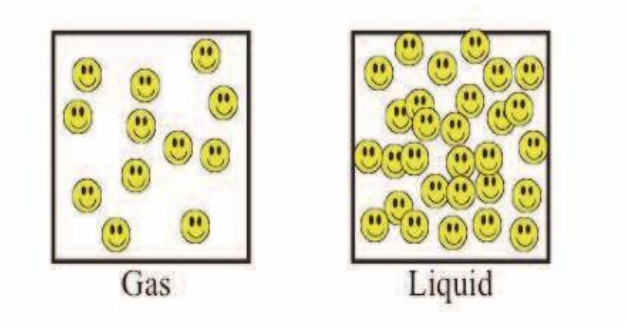
What is happening and why?

The water whistle is fun and makes a cool noise, but what is the science behind it? Well, all sounds originate from vibration. Noises, whether from your car stereo, a saxophone or a car driving by, are actually sound waves. These sound waves are vibrations travelling through the air that reach your ears.

Vibrations are caused by molecules bumping into each other. As one molecule touches another, the vibration is passed to that molecule. Once this energy has been transferred, the original molecule will then return to a normal state, eventually becoming still until more energy is passed through it from another source.

The speed of sound in air is 340 metres per second. In the much denser seawater sound can travel at 1,600 metres per second – almost five times faster! (Calculation: 1,600 / 340 = 4.7).

The image below explains why sound travels faster in seawater than in air:



The image shows that in air (which is a gas) the molecules are more spread out than in liquid water. Water is therefore 'denser' than air.

In air, molecules don't bump into each other as frequently, which means the vibrations don't spread so fast either. In liquid water, being closer together means that the molecules collide more often to pass on their energy to each other.

In solid materials, which have even more densely packed molecules, sounds can travel even faster. This brings us to how whales and dolphins use and process sound underwater.

Activity 3.3: Sound orienteering and echolocation

EXPERIENTIAL LEARNING

30 minutes

Equipment needed

- A blindfold
- An item to make noise with (i.e. keys)
- Music player (CD player, radio, iPod)

Marine mammals rely heavily on sound for many aspects of life. Part 1 and 2 encourage the girls explore using sound to find their way around, just like a toothed whale or dolphin.

Part 3 may be more suitable for Guides than younger girls. It offers an introduction to echolocation, used by land animals like bats and in the sea by dolphins to manoeuver and communicate. The animal calls and then listens out for echoes that reflect from objects. Depending on the distance, size and material of objects, the echo changes, telling the animal what is out there. Some blind people have learned to find their way using clicks and thus use a similar technique to get around.

Part 1: Blind orienteering

Place a blindfold over the participant's eyes whilst she is sitting on the floor in a quiet room. Ensure that her ears are not covered. A partner should produce different noises using a range of objects in different parts of the room. Can the blindfolded girl identify what makes the noises?

She should then get up and try to get to her partner, only putting her hands out to touch them when she thinks they are very near. Make sure nothing is in her way she could trip over. Now switch over the roles and make sure all girls get to try orienteering by sound.

Repeat the exercise but this time put some music on in the background and ask the rest of the unit to talk amongst themselves whilst the pair are doing the same exercise.

Part 2: Discuss the results

How easy was it for the girls to move around by sound? Was it as easy as by using vision? Are there advantages to using sound over using vision? (E.g. you can hear from all directions but you can't see behind yourself!) How easy is it to listen in a noisy environment? What do the girls think could make the sea a noisy environment? (Noise pollution is a really big problem for many marine mammals!)

Part 3: Echolocation

Ask everyone in the room to close their eyes. The Leader should clap, bang on a table or make any other noise in a variety of situations – for example moving from the middle of the room to close to a wall, or going from a small to a bigger room. Go outside and repeat the process, using open areas and enclosed areas. Afterwards, talk about the difference in the echoes in the different spaces and situations.

Activity 3.4: Making wind chimes from sea shells

CREATIVE ACTIVITY

1 hour preparation and 30 – 60 mins activity

Equipment needed

- 5 bits of drift wood of equal size
- A variety of shells drilled with holes for twine
- Twine
- Scissors

https://www.youtube.com/watch?v=-N9NU6UqSN8

For Rainbows, Brownies and Guides please ensure that the shells and wood have been pre-drilled with holes. Members of The Senior Section may drill the holes in the shells themselves.

1. Watch the video for step-by-step instructions.

2. Give a selection of shells, wood and twine to pairs in the unit and get them to plan how it will come together.

3. Use the largest piece of driftwood as a cross-piece and hang all the other bits from it.

4. Hollow pieces of worn driftwood work best as 'chimes'.

5. Use fishing wire or twine to tie alternate strands of driftwood pieces and seashells to your main cross-piece.

6. Make sure you hang the chimes where they will catch the wind and tinkle.

THEME 4: LOOKING AFTER THE OCEAN

This section has four activities to choose from:

4.1 Effects of pollution - game and discussion
4.2 Beach clean - outdoor learning
4.3 Beach litter art – art and craft
4.4 Diary entry or poem about a sea user - creative writing

Activity 4.1: Effects of pollution

ACTIVITY AND DISCUSSION

30 minutes + discussion time

Background information – see Resources Section, pages 47 - 50

Mini oceans

Equipment needed

- Water and large clear jars/vase
- Pebbles, sand and/or shells from the beach
- String and scissors
- Plastic fish – these can be created with card and then laminated and cut out, or you can use coloured plastic film or actual plastic/wooden fish (which can be bought online) - anything that will go into water and be heavy enough not to float on top
- Laminator and laminating pockets
- Felt pens/colouring pencils
- Cooking oil (representing chemical pollutant)
- Moss or any type of greenery (representing biological pollutant)
- Wrappers (representing physical pollutant)

1. Give each pair of girls a large glass jar and get them to create their own "mini ocean" with the sand/shells and fish

2. Tie the string around the fish and dangle them in the water

3. Once the mini ocean has been created then talk about the 3 main types of pollution:

   Biological: microbes, fungi, plants, animals
   Chemical: fertilisers, pesticides etc.
   Physical: sound, litter, heat

4. Using the oil, greenery and wrappers, 'pollute' your mini oceans as you go through the 3 types of pollution and the examples.

   (See Resources section for information and examples)

Further discussion: How can we reduce the damage caused by pollution?

- Policy: better laws on pollution.
- Changing industry: we must change our energy sources (to renewable energy) and manage our land more efficiently.
- Scientific investigations: scientists can help produce oil degrading products to help clean up oil spills. Scientific observations can help monitor pollution levels.
- Each of us: we can put our rubbish in the bin, help with beach clean-ups and travel together, by public transport or by bicycle.

Activity 4.2: Beach clean

OUTDOOR LEARNING

1 hour

Equipment needed

- Bin liners
- Rubber gloves
- Suitable footwear

The whole unit can undertake this activity together. It can be combined with the 4.3 beach litter art activity. You might get some additional people involved, e.g. parents especially to help with getting the collected litter to the appropriate collection site or dump.

Preparation

Ensure you visit a beach at low water: check this out using http://easytide.ukho.gov.uk/

Introduction to marine litter

Make the girls think about why people worry about litter in the sea and on the beach.

Introduction on how to clean a beach

- If possible go to the beach during low tide.
- Avoid bird breeding season if the beach is used by ground-breeding birds.
- Don't disturb the beach environment: If you turn over stones, turn them back.
- Remember to be respectful to marine life.
- You might want to invite a local group with a beach cleaning remit to help you, e.g. by providing bags, gloves and litter-picking devices. (local council – leader to check)
- Split into groups, each with a bin bag.
- All girls should wear rubber gloves.
- Collect all rubbish and afterwards segregate what is rubbish and what is recyclable goods (and recycle afterwards!)
- Ensure not to accidentally include any living animals that may be attached to some of the rubbish.

Reflection time afterwards

Discuss

1. What types of rubbish did you find?
2. Where might the rubbish have originated?
3. What effects may rubbish have on different types of marine life?
4. How could we reduce beach litter?

Activity 4.3: Beach litter art

ART AND CRAFT

1 hour + litter gathering time

Equipment needed

- Boxes for collected beach items
- Rubber gloves
- Suitable footwear for weather
- Plywood (roughly A4 sized) or card
- Play sand (buy it so it's clean)
- Bucket for preparing cement
- Pens / poster paints etc.
- PVA glue
- Scissors

The whole group can join together for this activity. This activity can be done in combination with activity 4.2: Beach clean.

If you don't live close to a beach, you could go straight to step 2 and use paper cutouts and other art materials that are related to beach life that the Leader prepares or buys.

Preparation

Ensure you visit a beach at low tide – check this out at www.ukho.gov.uk/easytide.

Step 1: Collecting

Visit a safe beach and collect interesting items from the shoreline including shells, stones, weathered coloured glass, crab claws, dried seaweed, mermaid's purses and beach litter artifacts such as dry fisherman's string that are washed up on the beach. Put them in a box to take back to base unless the weather is so fantastic that you want to stay outside for the creative activity.

Step 2: Preparing artwork

Prepare sections of plywood roughly the size of A4 paper. Then prepare a bucket of PVA glue and mix it with the play sand to make cement. Give each child a piece of plywood and enough PVA sand mix to cover the whole area of the plywood around 1 cm thick.

Step 3: Making a seashore flotsam collage

Now the girls help themselves to the shells and other collected items to make a collage by sticking the items gently into the cement. Leave to dry overnight.

Make sure the girls wash their hands after touching items from the beach.

Step 4: Group discussion

- What types of litter items did we collect from the beach?
- How and from where did these items reach our beach?
- What do you think about or feel when you see beach art or beach litter art?

Activity 4.4: Diary entry or poem about a sea user

CREATIVE WRITING

30 mins + research time

Equipment needed

- Pen
- Paper
- Computer with internet connection
- Reference books

This activity encourages the girls to think about how people use the sea and to reflect on the cultural heritage of coastal communities and responsible behaviour towards the natural environment.

Instructions

Start by bringing the girls together and leading a discussion on the kinds of people who use the sea around the world. Get the girls to name these people, e.g. a fisherman (different in rural India from Aberdeen), diver, fish farmer, sailor, merchant seaman, ferryman, harbour master, oil worker, beach-comber, tourist (swimmer), life guard on popular city beach, coastguard, lifeboat crew, kayaker, explorer, marine scientist or seaside artist.

Ask the girls how these different people use the seas and what their lives and experiences might be like.

Now ask them to select one sea user each and write a day-in-the-life piece about this chosen person, a poem about their life or their perception of the sea, or even a play.

The girls can use the computer to research their person or just use their imaginations and the information from the discussion.

At the end, the girls should each read out their entry or poem to the group. You could even get them to perform these at a marine fundraising evening - where you could also exhibit other products from doing this badge. This could be in aid of the RNLI or the Marine Conservation Society - or your own group of course!

OCEAN CHALLENGE BADGE

RESOURCE SECTION

Background information, activity and answer sheets.

Activity 1.1: Polar seas: the animals of the Arctic and the Antarctic

Background information

The remoteness and unusual wildlife of the Earth's Polar Regions have fascinated scientists and explorers for hundreds of years. While the Arctic in the north and the Antarctic in the south might seem very similar, there are huge differences between the two. These differences affect the marine environment and the animals that live there

The Arctic Ocean
The Arctic Ocean is an ocean surrounded by land and it is bordered by the land masses of Canada, Alaska, Russia, Norway and Greenland. 2-3 metres of sea ice floats on top of the Arctic Ocean, which can be up to 4,000 metres deep in some places.

Because the ocean here is landlocked, the sea ice cannot move about freely, so Arctic waters tend to stay colder and not all of the sea ice melts in the summer. Some of the sea ice remains until the ocean freezes again the following winter. However, because of the changing climate, scientists predict that all of the ice in the Arctic Ocean might melt during summer in the coming decades, which could have serious consequences for the animals that live there and further south.

It will also change the way people will use the Arctic and could alter major shipping lanes.

Antarctica - a continent
In the Antarctic, an ocean known as the Southern Ocean surrounds a continent called Antarctica. This means that the sea ice forms around the land, and is not land locked. Most of the sea ice that forms in the Antarctic in the winter melts in the summer. The strongest winds on Earth are found in the Southern Ocean, and Antarctica is one of the stormiest places on Earth. The Southern Ocean is very rich in marine life because the water is very rich in nutrients, which feed tiny marine plants called phytoplankton, which in turn are food for tiny animals called zooplankton including krill. Krill is a key species in the Antarctic food chain as it is eaten for example by penguins and whales (for more on food chains see Theme 2: Food from the sea, activity 2.3).

Activity 1.1: Polar seas: the animals of the Arctic and the Antarctic

Activity sheet

Polar Bear

Polar bears are among the most powerful of four- legged animals. They spend most of their lives alone hunting prey on frozen sea ice. Polar bear numbers are currently declining, which may be because of climate change destroying their habitat. Dangerous to people.

Beluga whale

Beluga whales are easily identified by their white colour and the distinctive shape of their heads. Belugas are slow swimmers and spend most of their time close to the edge of pack ice. They feed mainly on fish, but also eat squid, octopus, crab, and shrimp.

Walrus

Walruses are the only pinnipeds (true seals, sea lions & fur seals) with tusks, which can grow to 1m in length and weigh up to 5.4 kg. They use their tusks for fighting, and to help them climb from water onto ice. Their 'whiskers' are sense organs.

Narwhal

The tusk of a narwhal is its left front tooth, which can be up to 9 feet long! In rare cases, male narwhals have been found with two tusks, though the exact purpose of these tusks is not known. They 'suck up' their prey largely in the Arctic deep sea. Being air-breathers they can dive to 1500 m depth but must return to the surface regularly.

Atlantic Cod

Cod is one of the most widely eaten fish in the UK and easily recognised by their chin barbel. Cod live in both shallow and deep waters, where they hunt other fish, worms, crabs, and lobsters. They are endangered and it would be better to eat less vulnerable fish species.

Basket Star

Basket stars are a type of brittle star and can be recognised by their many-branching arms. They occur in the deep sea, weigh up to 5 kg, grow to 70 cm in arm length and can live up to 35 years. Their arms capture shrimp and other tiny animals drifting in the currents.

Greenland Shark

These sharks may grow up to 23 feet long and live at icy cold depths down to at least 2,200 m. They grow very slowly. Their flesh is poisonous, but after being boiled, dried, or rotted underground for several months, it is considered a delicacy in Greenland and Iceland. They give birth to ca. 10 live young.

Snow Crab

Snow crabs occur mostly between 70 and 200 m depth in the Bering Sea, Chukchi Sea, Barents Sea and the western Atlantic in areas where the seabed is made of sand or mud. They usually live 5-6 years. Females carry 6,000 - 140,000 eggs for c. 2 years. Snow crabs are commercially fished.

Bowhead whale

Bowhead whales are the second heaviest whales, after blue whales, and each animal can weigh up to 100 tonnes. Bowheads have the largest mouth of any animal, but feed only on tiny zooplankton. These whales may live more than 100 years.

Emperor Penguin

Emperor penguins are the largest of all penguins and spend their entire lives in frozen polar conditions. They have several adaptations to the cold, including densely packed feathers (the most densely packed of any bird!), and a thick layer of fat beneath their skin.

Sperm whale

Sperm whales have the largest brain of any animal on Earth. Because of their size, these huge creatures must eat around a ton of fish and squid per day, diving as deep as 1 km to hunt squid. On these deep dives whales can hold their breath for up to 90 minutes.

Leopard Seal

Leopard seals are formidable hunters, preying on fish, penguins, squid and smaller seals. They have long, streamlined bodies and heads for underwater agility, and a thick layer of fat underneath their skin to insulate them from the cold waters.

Southern Elephant Seal

Elephant seals are named for the large, protruding nose found on the males, which looks like a small elephant's trunk. Male elephant seals can be twice as long, and weigh up to four times as much as females – one of the largest differences in any mammal.

Krill

Krill form the base of the polar food chains, and are the main food for many baleen whales. However, scientists have recently found that krill populations are declining, which may be because of rising temperatures affecting their breeding grounds and nurseries.

Patagonian Toothfish

The Patagonian toothfish is also known as the Chilean sea bass, and is a highly prized fish in Japan and the United States. It is thought to live up to 50 years, and can reach lengths of over 2 m.

Jellyfish

In warmer parts of the ocean, many jellyfish live in deep water, where temperatures are colder. However, in Polar Regions, the water at the surface is cold all year, so these jellyfish can live close to the surface.

Red King Crab

These crabs are ocean giants and can measure more than a meter across. They do not normally tolerate the cold waters of polar seas, but scientists recently found them there, possibly because of warmer temperatures at the bottom of the ocean.

Zooplankton

Zooplankton are microscopic ocean animals which feed on single-celled plant plankton called phytoplankton. Thousands of different species are part of the zooplankton, some their entire lives like krill and jelly- fish, and others only while they are small, e.g. fish.

Ice Fish

The ice fish is the only vertebrate that does not have red pigment (haemoglobin) in its blood. Ice fish blood contains glycerol, which acts like antifreeze and allows it to live in frigid polar conditions.

Colossal Squid

Before 2003, only six specimens of the colossal squid had ever been found, mostly from the stomachs of sperm whales, which appear to be its main predators. While it's rarely seen, alive or dead, scientists estimate that this ocean giant can grow up to 15m in length.

Activity 1.1: Polar seas: the animals of the Arctic and the Antarctic

Answer sheet

Polar Bear – Arctic
Beluga whale – Arctic
Walrus – Arctic
Narwhal – Arctic
Atlantic Cod – Arctic
Greenland Shark – Arctic
Basket Star – Arctic and Antarctic
Snow Crab – Arctic
Bowhead Whale – Arctic
Emperor Penguin – Antarctic
Sperm Whale – Arctic and Antarctic
Leopard Seal – Antarctic
Southern Elephant Seal – Antarctic
Patagonian Toothfish – Antarctic
Krill – Arctic and Antarctic
Ice Fish – Antarctic
Colossal Squid – Antarctic
Red King Crab – Antarctic
Jellyfish – Arctic and Antarctic
Zooplankton – Arctic and Antarctic

Activity 1.2: Ocean bingo

Background

The world's seas and oceans cover 70% of Earth's surface, and represent some of the largest ecosystems on the planet. They are also important for people across the globe, providing food from fish and shellfish, energy from petroleum, wind, waves, and tides, as well as recreation. They are also prime trade routes.

Description of seas - cut these into separate boxes:

This European sea is connected to the Atlantic Ocean by the English Channel in the south and Norwegian Sea in the north.	This large body of water in northeastern Canada is frozen over for much of the year and famous for its polar bears and beluga whales.	This sea is almost completely isolated from the Pacific Ocean by the Japanese island chain. It is rich in fish and other biological products.	This Inlet between Africa and Arabia is one of the most salty seas in the world. The Suez Canal connects it to the Mediterranean. Many people learn diving here.
This ocean surrounds Antarctica & comprises the southernmost waters of the Pacific, Atlantic and Indian Oceans.	This ocean is the third largest in the world, and is bordered by Africa, Asia and Australia.	The second largest ocean covers 20% of the surface of Earth and borders the Americas, Europe and Africa.	This sea is bordering Turkey, Georgia, Russia, Ukraine, Romania and Bulgaria. It is connected to the Mediterranean via the Sea of Marmara.
This warm, tropical sea's name is derived from the Caribs, an American Indian people who inhabited this region.	One third of the world's shipping goes through this region to the east of Vietnam and west of the Philippines.	A salt lake bordering Jordan, Palestine and Israel. It is nearly 10 times as salty as the oceans. Its coastline lies 427m below sea level, the lowest elevation on land.	Earth's largest ocean covers an area that exceeds the total area of all land on the planet.
Located to the south east of the USA, this region is much affected by human activities. The Deepwater Horizon oil spill here in 2010 was the largest ever.	This is the smallest and most confined of the world's five oceans, and is covered year-round by a drifting ice pack. It lies in the very north of the planet.	This northern European sea is less salty than ocean water because many rivers add much freshwater into it.	This sea is connected to the Atlantic Ocean by the Strait of Gibraltar. Its name comes from a Latin root, and means 'middle of the world'.

Activity 1.2: Ocean bingo

Names of seas - cut these into separate boxes and match them with their descriptions using the map or globe provided by Leader:

NORTH SEA	HUDSON BAY	SEA OF JAPAN	RED SEA
SOUTHERN OCEAN	INDIAN OCEAN	ATLANTIC OCEAN	BLACK SEA
CARIBBEAN SEA	SOUTH CHINA SEA	DEAD SEA	PACIFIC OCEAN
GULF OF MEXICO	ARCTIC OCEAN	BALTIC SEA	MEDITERRANEAN SEA

Activity 1.2: Ocean bingo

Answers

NORTH SEA This European sea is connected to the Atlantic Ocean by the English Channel in the south and Norwegian Sea in the north	**HUDSON BAY** This large body of water in northeastern Canada is frozen over for much of the year and famous for its polar bears and beluga whales.	**SEA OF JAPAN** This sea is almost completely isolated from the Pacific Ocean by the Japanese island chain. It is rich in fish and other biological products.	**RED SEA** This Inlet between Africa and Arabia is one of the most saline seas in the world. The Suez Canal connects it to the Mediterranean. Many people learn diving here.
SOUTHERN OCEAN This ocean surrounds Antarctica & comprises the southernmost waters of the Pacific, Atlantic and Indian Oceans.	**INDIAN OCEAN** This ocean is the third largest in the world, and is bordered by Africa, Asia and Australia.	**ATLANTIC OCEAN** The second largest ocean covers 20% of the surface of Earth and borders the Americas, Europe and Africa.	**BLACK SEA** This sea is bordering Turkey, Georgia, Russia, Ukraine, Romania and Bulgaria. It is connected to the Mediterranean via the Sea of Marmara.
CARIBBEAN SEA This warm, tropical sea's name is derived from the Caribs, an American Indian people who inhabited this region.	**SOUTH CHINA SEA** One third of the world's shipping goes through this region to the east of Vietnam and west of the Philippines.	**DEAD SEA** A salt lake bordering Jordan, Palestine and Israel. It is nearly 10 times as salty as the oceans. Its coastline lies 423 metres below sea level, the lowest elevation on land.	**PACIFIC OCEAN** Earth's largest ocean covers an area that exceeds the total area of all land on the planet.
GULF OF MEXICO Located to the south east of the USA, this region is much affected by human activities. The Deepwater Horizon oil spill here 2010 was the largest ever.	**ARCTIC OCEAN** This is the smallest and most confined of the world's five oceans, and is covered year-round by a drifting ice pack. It lies in the very north of the planet.	**BALTIC SEA** This northern European sea is less salty than ocean water because many rivers add much freshwater into it.	**MEDITERRANEAN SEA** This sea is connected to the Atlantic Ocean by the Strait of Gibraltar. Its name comes from a Latin root, and means 'middle of the world'.

Activity 1.3: The ocean conveyor belt

Science demonstration

Background information on ocean currents

Did you know that water at the surface of the ocean can be travelling in a different direction to water in the deep ocean, flowing along the seabed? There are a number of different currents moving through the ocean, like great rivers flowing from one place to the next. These currents result from differences in the density of seawater, caused by differences in temperature and salt concentration of sea water. They can also be caused by wind blowing across the sea surface.

In the polar regions of the ocean the water becomes very cold, which makes it more dense. Additionally, when sea water freezes into sea ice, it cannot hold the salt, so the salt mixes with the water under the ice, making it even denser. This cold, salty, dense water is heavier than the rest of the water and thus sinks to the bottom of the sea, where it spreads across the sea floor. The sinking water is replaced by surface water from warmer regions, moving towards the poles. The deep, dense water moves slowly towards warmer latitudes, where it eventually rises to the surface as it warms up, to flow back towards colder regions. This process is sometimes called the ‘ocean conveyor belt’, and one cycle can take 1,000 years to complete

Activity 1.3: The ocean conveyor belt

Background information on global ocean circulation

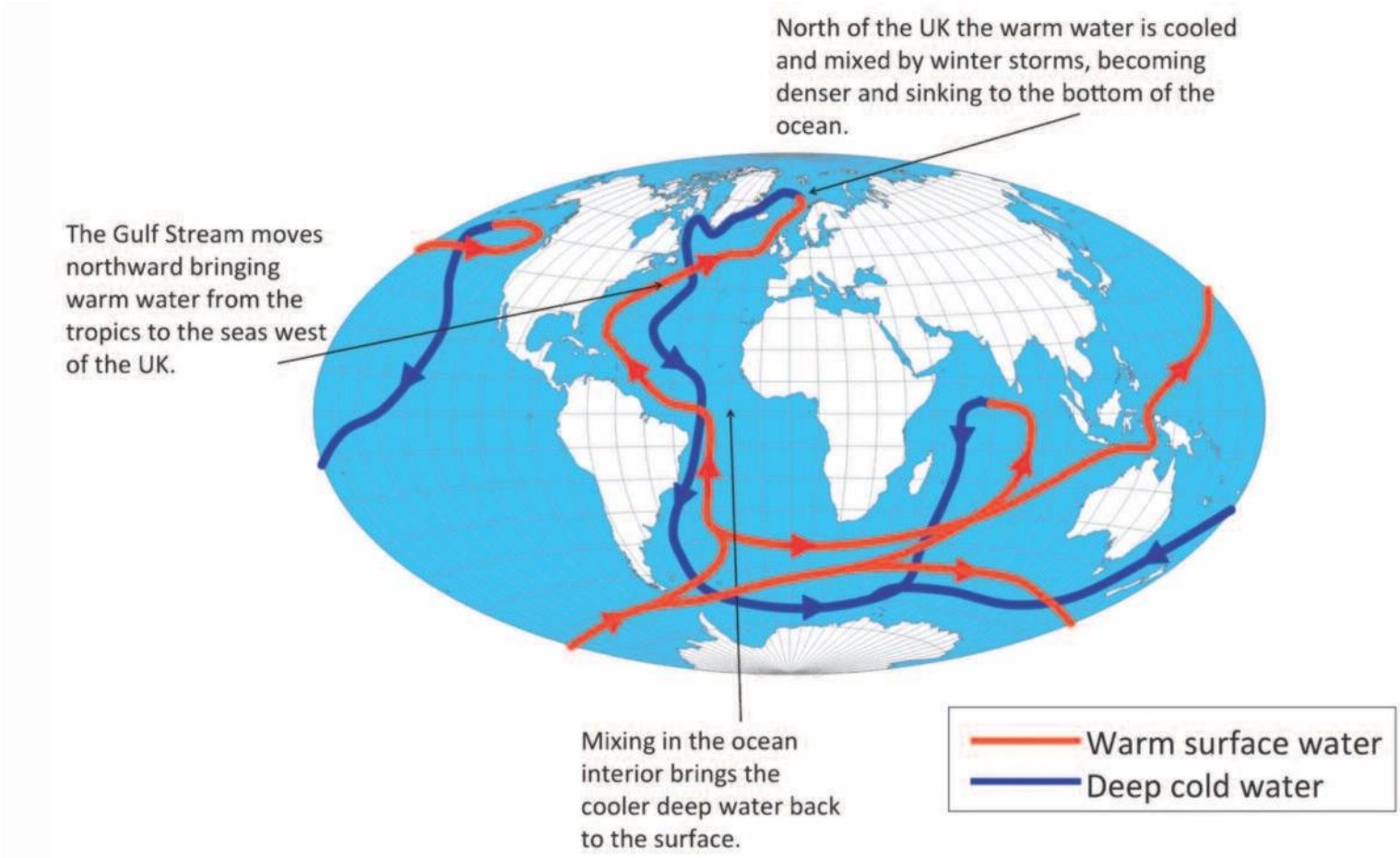


Image created by Dr Clare Johnson of SAMS

Activity 1.4: Illustrating the oceans

Background information

Name

Pacific Ocean	Atlantic Ocean	Indian Ocean
Southern Ocean	Arctic Ocean	Mediterranean Sea
Caribbean Sea	South China Sea	Bering Sea
Gulf of Mexico	Okhotsk Sea	East China Sea
Hudson Bay	Japan Sea	Andaman Sea
North Sea	Red Sea	Baltic Sea
Chilean Sea	Amundsen Sea	Weddell Sea
Ross Sea	Tasman Sea	Coral Sea
Aratura Sea	Timor Sea	Bay of Bengal
Arabian Sea		

Background information

Most people never think about seaweed and that it plays an important role in our world; for example it generates oxygen. Only half the oxygen we breathe is made by land plants, the other half is produced by algae, both floating plant plankton and seaweeds. Without them, life on our planet would be very different.

Seaweed is also an important food source. Many animals live off and on it. People have been eating seaweed since Neolithic times, particularly in Scotland, Ireland and Asia.

There are three kinds of seaweed
- Green seaweeds like sea lettuce
- Red seaweeds such as dulse
- Brown seaweeds include kelp and wracks

Greens contain the yellow-orange pigment **BETA CAROTENE** that is widely used for food colouring. Some land plants also contain it.

Reds contain **CARAGEENAN** which is used to gel foods together, e.g. ice cream. Algae is also an extract from red seaweeds.

Algae are simple plants that can range from being microscopic/tiny to large seaweeds.

Brown seaweeds are a source for **ALGINATES** that help oil and water mix into smooth liquids.

Activity 2.1: What use is seaweed?

Seaweed supermarket sweep activity sheet

Team name: _____

Instructions

Find as many of the listed food and health products as you can.

Look at the ingredients to identify which seaweed derivative is in each item. Search for the words **beta carotene** or **E160a** (from green algae), **carrageenan** or **E407** and **agar or E406** (both red seaweed derivatives) and **alginate** or **E400-404** (from large brown seaweeds). Write the derivative and originating seaweed next to each item where possible.

Two of the listed items are natural seaweed products, to be marked a 'natural' in the list.

Challenge: One of the listed products contains no seaweed. Write 'odd one out' next to it.

PRODUCT	SEAWEED DERIVATIVE (ingredient from seaweed)	RED, BROWN OR GREEN
Margarine		
Gaviscon tablets		
Tin of pet food		
Shampoo		
Toothpaste		
Ice cream		
Vitamin C tablets		
Sushi sheets		
Yogurt		
Relish		
Marinade		
Paracetamol		
Cheesy pasta		
Milkshake		
Philadelphia		
Seaweed soap		
Crispy seaweed		
Baby food		
Air freshener		

Activity 2.1: What use is seaweed?

Seaweed supermarket sweep answer sheet

PRODUCT	SEAWEED DERIVATIVE (ingredient from seaweed)	RED, BROWN OR GREEN
Margarine	Beta Carotene	Green
Gaviscon tablets	Carageenan	Red
Tin of pet food	Alginate	Brown
Shampoo	Alginate	Brown
Toothpaste	Alginate	Brown
Ice Cream	Carageenan	Red
Vitamin C tablets	Beta Carotene	Green
Sushi sheets	Natural	N/A
Yogurt	Beta Carotene	Green
Relish	Beta Carotene	Green
Marinade	Alginate	Brown
Paracetamol	Alginate	Brown
Cheesy pasta	Beta Carotene	Green
Milkshake	Carageenan	Red
Philadelphia	Carageenan	Red
Seaweed soap	Natural	
Crispy seaweed	Odd one out	It is actually cabbage!
Baby food	Beta Carotene	Green
Air freshener	Alginate	Brown
PLEASE NOTE: Some products may vary depending on colours or thickening agents	Leaders could check products in advance and adapt the list for the specific products offered in the visited supermarket	

Activity 2.3: Marine food webs

Background information

All living things need energy to live and grow. The order of how this energy is transferred between different organisms is called a food chain. In reality the situation is complex as organisms usually eat many things and change diets as they grow, giving rise to food webs. If one part of the web is removed, it can affect the wider marine life system.

Question: Where does the energy in the ocean food chain come from?
Answer: The sun provides the energy for photosynthesis, the process by which plants turn carbon dioxide and water into plant material and oxygen.

Question: What sea creature 'eats' sunlight?
Answer: Seaweed and phytoplankton (tiny floating algae).

Question: What feeds on phytoplankton?
Answer: Zooplankton, i.e. the smallest free-floating marine animals.

Question: What eats zooplankton?
Answer: Now it becomes variable as many things eat zooplankton, at least during some periods of their life. So you can ask several times 'what else eats zooplankton'.

Question: What eats sand eels?
Answer: Puffins; Atlantic cod; fishermen.

Question: What eats jellyfish?
Answer: Jellyfish! Some larger fish, and turtles too.

Question: What eats blue whales?
Answer: Fishermen. Blue whale calves can be eaten by killer whales and large sharks. The cookiecutter shark may take bites out of small blue whales without killing them.

Question: What eats puffins?
Answer: Whatever can catch them e.g. larger seabirds like large gulls and skuas, and land roamers such as otters, mink and terrestrial predators.

Question: What eats Atlantic cod/salmon?
Answer: Seals; Common Skate; fishermen.

Question: What eats common skate?
Answer: Fishermen (but skate are now protected in the EU) and large sharks.

Question: What eats seals?
Answer: Killer whales, sharks, polar bears and fishermen (especially Inuit hunters).

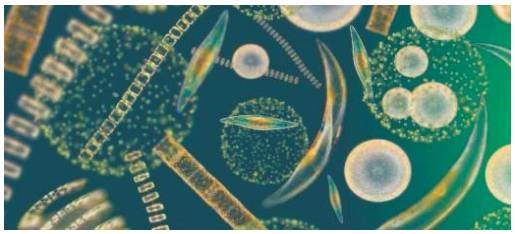
Question: What eats fishermen?
Answer: Sharks? Bacteria? Most fishermen certainly count as top predators.

Activity 2.3: Marine food webs

Further background notes

Plankton
Plankton means wanderer or drifter because the tiny floating creatures, even if they can swim, are at the mercy of currents as to where they move to. Phytoplankton and bacteria form the base of the marine food chain - all higher life depends on them. Some have a tail called a flagellum that they beat like a whip to swim to avoid predators and stay in the light. Some have hard outer shells made of glass or other material for protection. Some have glass spines that reduce the speed with which they sink and thus help them float in the light surface layer.

Zooplankton
Nearly every type of marine animal has a version which goes through a zooplankton stage. Many are part of it during early life stages as eggs or larvae. Zooplankton vary in size from 1 mm to the size of a dinner plate. They live everywhere but only those in the surface layers eat phytoplankton. Those in deeper water must live off tiny particles that often 'rain' down from above.



Below is some information on plankton eaters:

Sand eel
Sand eels live on sandy shores and bury themselves 25-30 cm into the sand to hide from predators and during winter. They swim in large shoals with their heads down to dart into sand when danger arrives. They feed on zooplankton, while the largest ones may also take seabed worms, small crustaceans and very small fish. They are a preferred prey fish of puffins and other auks, kittiwakes, and larger fish. A small sand eel fishery exists off the west coast and in Shetland. People eat them and use them for animal feed and to make into fertiliser.

Jellyfish
Most jellyfish are carnivorous and catch prey passively with their tentacles as drift nets, stunning prey with their poisonous stinging cells that remain fully functional even if the jellyfish itself is dead. Prey include plankton, crustaceans, fish eggs, small fish and also other jellyfish. They are eaten by other jellyfish, larger fish like salmon, sharks and sea turtles. In some countries like Japan people also eat jellyfish, usually after being dried.

In Argyll the moon jellyfish is the most common, recognisable by four pink rings that mark the otherwise transparent gelatinous body. They have only a mild sting for humans. The other, more unpleasant local species is the lion's mane jellyfish. It is deep red, with a bell diameter of up of 2 metres and tentacles up to 37 metres long (actually the largest known species of jellyfish) and a very painful sting. It occurs in a Sherlock Holmes short story!

Blue whale
The largest animal that ever lived, measuring up to 33 metres long (3 buses end to end!) and weighing upwards of 200 tonnes). To grow to this size they filter up to 4 tonnes of krill (small shrimplike creatures) and other plankton and small animals from the water. They gulp seawater into their big mouths and throats, and with their massive tongues force the water out through a curtain of baleen that hangs down from their upper jaws. The krill are trapped by the baleen - made of fingernail-like material - and swallowed. Blue whales often spend their summers feeding in polar waters that are teeming with krill and then migrate to warmer waters where they give birth to their calves.

Fishermen
People have become the top predator not only of land creatures but also of sea life. We have been fishing so many fish out of the sea that many stocks are now critically low and some fisheries have completely crashed. On the west coast we used to land herring and many other fish while now most fishing is for scallops, shrimp and crabs. People don't only hunt for fish, we also used to kill whales - so much so that many whale species are now in danger of going extinct. Many animals we don't mean to kill, because we have no use for them, are accidentally killed when we fish, when our ships collide with them, when our pollution makes them ill or when we change the climate so they can no longer live where they used to.

Puffins
Although puffins do not live in or on the ocean like some other sea birds, they do get their food from the marine food chain. Instead of hinged jaws like ours, puffins can dislocate their jaws like snakes. This means the top and bottom part of their bill remains flat and they can collect many fish or sand eels in one go. Their diet consists of sand eels, herring, hake and capelin. The most ever recorded was 60 sand eels in one beak – not bad for a small bird! Puffins are predated upon by great black-backed gulls and people.

Atlantic cod
This fish can grow to 2 metres long and weigh nearly 100 kg if it reaches the 25 years it can live for. When the fertilised cod eggs hatch into baby cod they first live as part of the zooplankton. As they grow they first feed on krill and other large zooplankton and small fish. As adults they live of a very diverse diet that includes smaller fish and invertebrates like shrimp and crabs. Atlantic cod is a fish much enjoyed by seals and by people.

Seals
These marine mammals feed largely on fish of most types and sizes including cod and salmon. They also like squid and occasionally take shrimps, crabs, molluscs and seaweed! Rarely they can also be seen to kill and eat seabirds. They catch their prey with their mouths and rip it into chunks.

In Argyll there are two types of seal: common seals and the larger grey seals. In many places seals are top predators without natural predators of their own.

Activity 3.1: Meet humpback whales, the pop stars of the sea

Background information

If you've ever heard a whale song, it will most likely have been a recording of the sounds of the humpback whale. Although they do not sing with words, they use different sounds to communicate with other humpbacks. Scientists think that the male humpback's song ranges from a frequency of around 30–8,000 Hz, which is the biggest range of any mammal on Earth.

Humpbacks live in a massive space in the sea and need to communicate over vast distances, without the benefit of a mobile phone. So they produce sounds that travel miles and miles throughout the water and they can hear extremely well. Humpbacks have a song for every occasion, be it hunting, playing or courting.

Activity 4.1: Effects of pollution

Background information

Ocean water pollution is one of the biggest environmental issues our planet faces. To understand how ocean pollution is destroying marine life and how it affects us, we must first understand its causes.

There is no single source of ocean pollution – in fact, it's the result of different industries and practices. Land-based activities are responsible for more than 80% of ocean pollution. From plastic bags to pesticides, the majority of the waste we create on land ultimately reaches the oceans, either through purposeful dumping or from run-off through drains and rivers.

There are 3 main types of pollution:

1. BIOLOGICAL POLLUTION

This means the adverse effects of invasive alien species on the quality of the aquatic and terrestrial environment. An invasive species (also known as an introduced species) is a plant or animal that is not native to an area. It has a tendency to spread, in some cases causing damage to the environment, native species and potentially to humans.

Examples include:

Green crab (*Carcinus maenas*)

This European crab has been carried by ships in ballast water and is sold as fish bait in much of the world. It now has established populations on both coasts of North America, in southern South America, Australia, South Africa and Japan. It is a predator of many forms of shore life including worms and molluscs. In some areas, the crab's voracious appetite has affected the commercial shellfish industry.

Killer algae (*Caulerpa taxifolia*)

A strain of this green seaweed, native to the Indian and Pacific Oceans, has escaped public and private aquariums in California, Japan, Australia and Monaco. It has spread widely in the Mediterranean, replacing native plants and depriving marine life of food and habitat. In California, it was eradicated at considerable cost using toxic chemicals.

Sea walnut (*Mnemiopsis leidyi*)

This ctenophore (a stingless jellyfish-like animal) is native to the east coast of North and South America. In 1982 it was discovered in the Black Sea, where it was transported by ballast water. It subsequently spread to the Caspian Sea. In both places it multiplied and formed immense

populations. The sea walnuts contributed to the collapse of local fisheries because they feed on zooplankton that the commercial fish also consume. *Mnemiopsis leidy* has also been discovered in the Mediterranean, Baltic and North Seas.

Veined rapa whelk (*Rapana venosa*)

A large marine snail with a beautiful shell, *Rapana venosa* is native to the northwest Pacific, from Vladivostok, Russia to Hong Kong. In 1946 it was discovered in the Black Sea and later spread to the Mediterranean Sea. In 1998, it was found in the Chesapeake Bay where it was probably transported in the ballast water of ships. It is also established in European coastal waters from Norway to Spain, and in the Rio de la Plata estuary in South America. This animal, a predator on bivalve molluscs, severely reduced shellfish in the Black Sea, but is now fished and sold to Asian countries as food. Its role as a predator in the Chesapeake Bay is being studied, and it is expected to colonize other parts of the east coast.

Zebra mussel (*Dreissena polymorpha*)

This bivalve mollusc is native to the Caspian Sea, lagoons of the Black Sea and their inflowing rivers. It lives in fresh and brackish water and cannot tolerate full seawater. In the 18th and 19th centuries it spread through European canals, reaching the Baltic Sea and many European river estuaries. In 1988, it was discovered in the Great Lakes and has spread to many rivers and lakes in eastern and central North America. The mollusc has fouled power plants, water purification facilities and ships, and littered beaches with decaying mussels and sharp shells. Large populations have devoured plankton and decreased the food available for commercial and game fish. It is abundant in the fresh, tidal parts of the St Lawrence and Hudson Rivers, and has been discovered at the head of Chesapeake Bay.

2. CHEMICAL POLLUTION

This is caused when chemicals are released into our environment and disrupt the balance of our ecosystems, threatening our health, polluting the air we breathe and contaminating our food. Examples include:

Oil

Our demand for fossil fuels is adversely affecting the oceans. As most of the oil reserves are located under the sea floor, prospecting, drilling and transporting oil from the oil wells makes it the worst of all ocean pollution causes. The oil industry is not only to blame for occasional large scale oil spills, which seriously damage sensitive marine areas and disturb marine species, but also for the smaller leaks that occur on a regular basis.

The 2010 BP oil spill is one of the greatest environmental catastrophe's the US has ever faced. For 86 days, oil spewed into the Gulf of Mexico from BP's damaged well, dumping around 200 million gallons of crude oil into our sensitive ecosystems.

In turn, when gasoline is burned, either by vehicles or power stations, toxic gases are released into the air. These gases dissolve in rain, sometimes forming acid rain, and ultimately fall back to the ocean.

Sewage disposal (biological and chemical)

Although it's hard to imagine, in several parts of the world, sewage flows untreated, or under-treated, into the ocean on a regular basis. This sewage also includes grey water which includes water from toilets and water from food preparation and laundry. At times, sludge from sewage treatment is also dumped into the ocean.

Toxic waste from factories and industry

Toxic liquids or the wastes from factories and industries are sometimes dumped directly into the ocean or other water sources that flow into it. These toxic chemicals are a major source of ocean pollution.

Almost all marine organisms, from plankton to whales, are affected by manmade chemicals. These chemicals can accumulate in the fatty tissue of the animals, leading to organ failures as well as failure in mammals' and birds' reproductive systems.

In few cases, the dumped liquids are warm and can raise the ocean water temperature through a process known as thermal pollution. Some ecosystems that cannot survive at higher temperatures may be wiped out completely.

Acid rain

When toxic chemicals released into the atmosphere from industry, vehicles and power stations dissolve in rain, acid rain is formed. Acid rain then falls directly or indirectly onto rivers, seas and oceans. This causes ocean acidification which can dissolve shells.

Agriculture

Agriculture is another major source of ocean pollution causes. Farmlands are usually far inland but, when it rains, toxic pesticides are washed into the rivers and streams and ultimately flow into the ocean.

When fertilisers flow into the ocean, the extra nutrients cause eutrophication - too much plankton grows because of the abundance of nutrients. Sunlight cannot penetrate the water at a certain depth, hindering photosynthesis by the underwater plant. The decay of dying plankton also uses up oxygen in the water. The amount of dissolved oxygen in the water becomes depleted, and other marine life suffocates. Eutrophication has created vast dead zones in several parts of the world, including the Gulf of Mexico and the Baltic Sea.

3. PHYSICAL POLLUTION

This is the introduction of discarded materials into the environment. Physical pollution is what you might refer to as trash, garbage or rubbish, and is the direct result of human actions.

Examples include:

Rubbish dumping

Rubbish is one of the significant causes of ocean pollution. Back in 1975, America's National Academy of Sciences estimated that about 14 billion pounds of rubbish was being dumped into the ocean every year. That's more than 1.5 million pounds per hour, with an estimated one third contributed by the United States.

Plastic bags, balloons, glass bottles, shoes, packaging material and more have found their way into the ocean through being irresponsibly disposed of. The dumping of garbage into the ocean has given birth to oceanic dumps, like the Great Pacific Garbage Patch - the world's largest.

Plastic debris persists in the ocean even after decades of floating about. Plastic is especially dangerous to marine life because it breaks up into tiny pieces which can be mistaken for food and eaten. Plastic materials, mainly plastic bags, have been found choking the breathing passages and stomachs of many marine species.

The dumping of garbage into the ocean can also diminish the oxygen dissolved in water, seriously affecting the health of marine life.

Even when trash is buried in landfill, toxic chemicals may leach from there into ground water, which may eventually flow into the ocean.

What can we do about ocean pollution?

There are many causes of ocean pollution, each of which have a harmful effect on life. Ocean pollution affects not only marine animals and plants, but humans as well.

The widespread ocean pollution we see today is mainly down to humanity's actions. We must now clean up our act and take better care of the oceans and the marine life they support. If our oceans were to fail, this would take away many people's livelihoods – and a key food source for many more of us.

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