OCEAN AND CLIMATE CHANGE DIGITAL SCHOOL SCIENCE KIT

People · Ocean · Planet

MARINE ALLIANCE FOR SCIENCE AND TECHNOLOGY FOR SCOTLAND

Recommended age: 11-14 years

This science pack has been created by the Marine Alliance for Science and Technology (MASTS). MASTS is an organisation that enhances the excellence of marine research in Scotland across 17 institutes and 700+ members. With such a large number of scientists working at the forefront of marine science, MASTS recognise the importance of communicating what we learn to the public.

People Ocean Planet

People Ocean Planet (POP) is an initiative within MASTS, helping to drive positive changes across society for the ocean by making best use of our scientific knowledge.

Meet the MASTS Scientists

In this digital science kit you will hear from 4 scientists, each of which have expertise across 4 different areas of marine science - Fisheries, Marine Renewable Energy, Sea Level Rise and Ocean Acidification. Each scientist has also included a science profile to help get to know them better!

Explore the Ocean with your Pupils

After an introductory video on the ocean and climate change, and each of the topics, the students will get to choose which area they want to learn about first. These packs are designed to have a mix of learning new information through videos and information sheets, as well as encouraging students to conduct their own further research. The activities within this pack then encourage and ask the students to choose their own scientific path to pick how they would best navigate the science around climate change.

From choosing where they would place a marine energy park, conducting ocean acidification experiments, learning how to manage fish stocks and drawing, dancing or writing about protecting habitats, this science kit covers a range of curriculum for children aged 11-14. This science kit can be incorporated into a single or multiple lessons and would also be ideal as a science club activity.

Within the teacher kit for this pack, there are also extra questions and answers from scientist to help you answer any additional questions during the activities. As well as example lesson plans, and additional information. By participating in this pack and filling out the short feedback form at the end, you will also be contributing to helping People Ocean Planet group learn and improve how educational resources like this are made in the future. We also have an active social media, which you can share the science you learn with us!

POP

MASTS

BREAKDOWN OF THE SCIENCE KIT

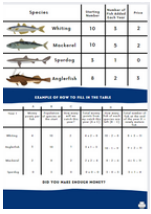
Introduction Video (4.5 mins) - This video is an introduction to the overall topic of oceans and climate change.

Topic Introduction Videos (4.5mins) - Each of the 4 parts of this science kit also come with an introduction to each of the more specific topics.

Meet the Scientists (3 mins): These videos and an introduction to the 4 scientist who created this pack.

Printables - This is a separate document which just includes pages where this logo is seen and a more 'printer-friendly' version on the page sin the pack can be found.

Fisheries and Climate Change Pack
Estimated time to complete = 20 minutes
Preparation Required = Optional cut outs of fish species
Resources/Materials Needed = Paper, Pens, Pencil



Marine Renewable Energy Pack
Estimated time to complete = 20 minutes
Preparation Required = None
Resources/Materials Needed = Paper, Pens, Pencil

Sea Level Rise Pack
Estimated time to complete = 30 - 45 minutes
Preparation Required = Printing of activity sheets and habitat information cards
Resources/Materials Needed = Paper, Pens, Pencil, Colouring pencils

Ocean Acidification Pack
Estimated time to complete = 30 minutes
Preparation Required = Printing of activity sheets
= Optional - Egg experiment
(conducted over 24 hours).
Resources/Materials Needed = Paper, Pens, Pencil
= Optional for Egg experiment
(Jar with lid, Egg, White Vinegar).

Share your Science Sheets - At the end of each pack there are some sheets included which help the children reflect on the decisions they made and how they found the pack. As everyone may choose different science paths we would love for you to share this via social media so we can all learn together (see social media guidance section). **https://www.greatscienceshare.org/share**

#POPSCIKIT
#GSSFS2022
@OceanBehaviours
@mastscot
@GreatSciShare

How did your pupils find this resource?
MASTS and People Ocean Planet Group have created this resource and feedback to help us monitor the impact and improve on this activity will be key to helping us evaluate this activity. Therefore we ask if you could **please fill in a very short 10 question multiple choice survey after running this activity** (https://standrews.eu.qualtrics.com/jfe/form/SV_0jtNvQesa00pFnU).

PROPOSED LESSON PLAN - SCIENCE KIT OVER ONE LESSON (1 HOUR)

0 to 15 minutes - Introduce the activity, play introduction video, each of the 4 topic videos and the meet the scientist video.

15 - 20 minutes - Children split into 4 groups and choose the activity they want to try first.

20 - 50 minutes - Children work through the various activities, if they finish one pack they can start another. It should be possible, depending on the amount of independent research time they are given to complete two of the four sections of the pack in a single lesson.

50 minutes - 1 hour - fill in the feedback sheets, share and discuss what they chose/learnt with peers.

PROPOSED LESSON SCHEDULE - SCIENCE KIT OVER MULTIPLE LESSONS

Each of the Science kits, with independent research time could be conducted over an individual lesson. Giving children the chance to complete each of the 4 activity packs. This is a suggested order to conduct the packs in, but they can be completed in any order.

Lesson 1 - Introduce the activity, play introduction video and sea level rise introduction video.
- Complete the sea level rise pack.
- Homework = complete the task to communicate ways to protect a habitat.

Lesson 2 - Start with presentations of protecting habitat from Sea Level Rise pack.
- Play fisheries introduction video and work through Fisheries Science Pack
- Play Ocean acidification introduction video and start the Egg dissolving experiment for Ocean acidification pack.

Lesson 3 - Work through ocean acidification pack.

Lesson 4 - Play marine renewable energy introduction video.
- Complete the marine renewable introduction pack.
- End with a group discussion and filling in of feedback sheets of how they found the activity, what they learn and want to research in the future.
- (Teacher to fill out survey).

SHARING OVER SOCIAL MEDIA

The Great Science Share for Schools have a fantastic online presences where people can share the exciting science investigations and findings!

We would love for you to join in with this too and share how your students are using this pack!

For ideas and further guidance on what to share please check out the Great Science Share for Schools website.

We would love to see whatever you are willing to share, in whatever creative ways you come up with.

But we have also included some forms that help the students share and reflect on their activities - which can be easily photographed and shared!

Please share with the hashtags:

#POPSCIKIT

AND

#GSSFS2022

You can also tag us on twitter:

@mastsscot
@OceanBehaviours
@GreatSciShare

It is the responsibility of the teacher/adult to ensure all the correct permissions are gained to share any information of photos online and with MASTS/People Ocean Planet. Only adults can share and email about the activities.

By posting to social media you are agreeing that MASTS and People Ocean Planet can use print screens and quotes from the tweets on social media for promotion, a measurement of impact and sharing information about the project with others.

If higher quality images or images/information are emailed to us - we will gain relevant permissions before using them.

RISK ASSESSMENTS

It is the responsibility of the adults/teachers to ensure the activities have been risk assessed and ensure children are supervised during the activity.

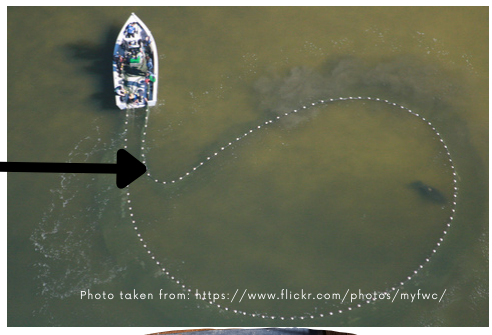
The University of Manchester's Science & Engineering Education Research and Innovation Hub assume no liability with regard to injuries or damage to property that may occur as a result of engaging in the Great Science Share for Schools. This campaign is designed to be carried out by children working with an adult. The adult is fully responsible for ensuring the activities are carried out safely. You can access the CLEAPSS website or SSERC website for up to date health and safety information when planning practical activities for children.

http://primary.cleapss.org.uk/
https://www.sserc.org.uk/

FISHERIES AND CLIMATE CHANGE PACK - ANSWERS AND ADDITIONAL INFORMATION

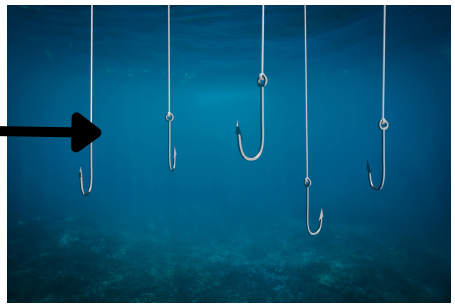
Fish can be caught using traps called creels (often these are used for shellfish like crabs and lobsters).

Some fish are caught be placing nets around them, called Seine-netting.



Some shellfish are caught using gear that is towed by boats, similar to a plough on a farm, and this is called dredging.

Some fish are caught using lines of hooks which are set with bait and then picked up.



Some fish are caught using nets which are towed behind boats, either on their own or in pairs, which is called trawling.

Some shellfish, like scallops, are caught by divers picking them by hand

HOW MANY INDIVIDUALS OF EACH SPECIES OF FISH CAN BE TAKEN FROM THE SEA AND THERE STILL BE MORE INDIVIDUALS AFTER YEAR 6 THAN YEAR 1?

Whiting - 2 each year
Mackerel - 4 each year
Spurdog - 0 each year
Anglerfish - 1 each year
However, you may not take the same number each year so this answer is not exact. Each student may take different numbers.

ADDITIONAL QUESTIONS

How do you age a fish?
We can tell a fishes age by a little ear bone fish have, called an otolith. Otoliths have age lines, much like a tree, which we can count and tell us how old the fish was.

How old can fish live?
Fish can live to many different ages depending on what species they are. One of the longest living species in the world are Greenland sharks which can live as long as 400 years! This means there might be some Greenland sharks still swimming around that were alive in the 1600s!

How many species of fish are there in the UK?
It's difficult to know exactly how many species of fish we have in the UK because of how many different habitats there are but it is over 300. There are even some species that many people don't know about. Some cute (small-spotted catshark), some colourful (cuckoo wrasse) and some very strange (ocean sunfish, John Dory).

How many fishing boats are there in the UK?
There were 5911 registered fishing vessels in the UK in 2019. The majority of these boats are small, day boats under 10 metres in length.

Does the UK have a boat for surveying fish?
Yes, the UK has some boats which are used by scientists to survey fish. Two of these boats are known as the MRV Scotia which is based in Scotland, and the RV Cefas Endeavour, which is based in England.

Where is the biggest fishing port in the UK?
Peterhead, in Scotland, North of Aberdeen is the biggest UK port for landing fish.

What is the most caught species of fish in the UK?
In the UK, Mackerel is the most caught species by value in the UK.

OCEAN ACIDIFICATION CHANGE PACK - ANSWERS AND ADDITIONAL INFORMATION

PH SCALE:
1 – STOMACH ACID
2 – LEMON JUICE
3 – VINEGAR
4 – TOMATO
5 – BLACK COFFEE
6 – MILK
7 – PURE WATER
8 – SEA WATER
9 – BAKING SODA
10
11 – AMMONIA SOLUTION
12 – SOAP
13 – BLEACH
14 – DRAIN CLEANER

EMISSIONS:
39% - COAL COMBUSTION
31% - OIL COMBUSTION
19% - NATURAL GAS COMBUSTION
3% - OTHER INDUSTRY AND FUEL USE
4% - NON-ENERGY USE OF FUELS
4% - CEMENT PRODUCTION

ADDITIONAL QUESTIONS

What would happen if the ocean got too acidic?
The simple answer is that calcifying organisms' shells will dissolve faster than they are able to repair them, this will cause them to become more vulnerable to other environmental stressors and to predation. A loss of these animals will ripple up the food chain and affect other animals. The more complex answer is that we don't fully know if and how animals will adapt to increasing acidification. There are possibilities that some animals will be able to cope with the new conditions. When some animals can cope and others can't cope there could be a shift in the types of animals we see in different environments, and changes to many food webs.

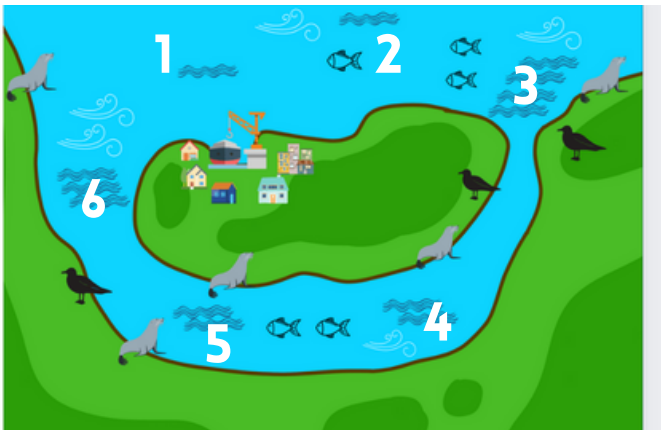
Can Whales be affected by ocean acidification?
Whales are marine mammals, and as such will not be affected the same way as either the other animals we have spoken about. Unlike calcifying animals, they do not have shells or skeletons that are in contact with the acidic water. They also do not balance their chemistry with the surrounding water in the way fish do.
They could still be affected however by changes in their food source brought about by increased acidification.

What would happen if the ocean got much less acidic?
Increasing the alkalinity of the oceans is a proposed solution to help reduce the affects of ocean acidification we have already seen by reducing the amount of carbon dioxide in the oceans. There is very little known about what would happen If the alkalinity was to increase too much (higher pH), and this is an area that needs more research if increasing alkalinity is to be used to reduce acidification.

MARINE RENEWABLE ENERGY PACK - ANSWERS AND ADDITIONAL INFORMATION

The **RENEWABLE ENERGY SOURCE** causes the blades of the **DEVICE** to move/rotate. From this movement we can capture energy using a **GENERATOR** with the **TURBINE**. The energy is transported by **CABLES** back to land where is can be stored, transported and used in places like our homes.

PLACEMENT OF THE MARINE ENERGY PARK



There are no right or wrong answers, but there are things to consider for each locations which are discussed in these points.

1) This is close to Port Town and away from any sites known to be important sites for animals. But there is low current speed and wind in this area.

2) This is close to Port Town and away from any sites known to be important sites for mammals or birds. There is low current speed but is a windy area. It is also an area important for fish.

3) This area has the highest current speed of any area on this map, and is also a windy area. It is also not too far from Port Town. However, this is an important site for lots of fishing grounds, mammals and bird activity, which we do not want to disturb.

4) This area is far away from Port Town, but has somewhat high current speed and is windy. It is not too close to important areas for mammals or seabirds, but may be important for fishing.

5) This area is not windy, but has somewhat high current speed. It is, however, very close to areas important for marine mammals.

6) This area is close to Port Town has high current speed and is the windiest place on this map. Sea birds and mammals do have areas important to them somewhat close to this site, but not as close as other sites. This is also not an important area for fishing.

ADDITIONAL QUESTIONS

How much offshore energy is available in the UK?

It is estimated that offshore renewable energy capacity in Scottish waters total 25% of the tidal, 10% of the wave, and 25% of the offshore wind resources in Europe. So, despite its relatively small size as a country, Scotland has a large proportion of Europe's potential for marine and offshore renewable energy

Can offshore renewable energy devices and structures be beneficial to sea life?

Yes, by providing somewhere for creatures to settle on and grow, devices and structures can increase biodiversity. Structures in the sea may form 'artificial reefs' which tend to attract fish and other commercially-valuable sealife like crabs and lobsters. There may be some benefits of this, but we must remember that these are not natural structures and we must find the right balance between making best use of renewable energy resources and protecting natural environments.

SEA LEVEL RISE PACK
- ANSWERS AND ADDITIONAL INFORMATION

The words in the wordsearch include: CLIFFS, MUDFLATS, ROCKYSHORES, SALTMARSHES, SAND BEACHES, SAND DUNES, SEAGRASS MEADOWS, SHINGLE BEACHES

The two secret words are not habitats, but there is a picture of a SEAHORSE on the page of the wordsearch and the students have been introduced to CLIMATE CHANGE on the first page of their booklets.

Primary production – critical role as food	Plant and rock structure – environment for habitat, refuge and nursery for lots of species	Rock pooling
Pollution filtering	Water-skiing	Sediment stability
Oxygen production	soil formation from soils and rocks deposited into habitats	Wave and current dampening
Seed production and dispersal	Carbon accumulation	Nutrient cycling
Plant material can be used to make baskets	Snorkeling	Plant material being used for fuel

Final activity: This task requires the flash cards. The students will focus on ONE habitat. The students can complete this task independently or as a group. It is an open-ended task where there are no wrong answers as long as the students can understand their habitat a little better from reading the flashcards and are able to decide how they are going to try and make a positive impact on the environment. Some of the ideas that they may choose to help protect their habitat may be things you as a class can do together, other things are wider scale measures required to make an impact. Hopefully this will lead to healthy discussion amongst groups, to pick their favourite approached.

If you have decided to use this pack across your whole class, you may want to use this exercise for the students to all practice their public speaking by asking the students to share their poems, articles and chosen ideas of how to protect their habitat.

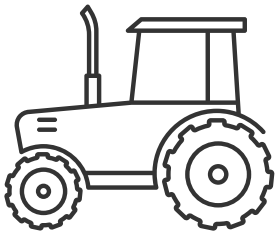
ADDITIONAL QUESTIONS

We don't live in the sea so why does it matter if the sea level rises?
Coastal areas have seen particularly intense change caused by human activity. Population density is also higher in coastal areas than non-coastal areas (Small and Nicholls, 2003). In Europe alone over 70 million people live on the coastline and globally the UN estimates 40% of the world's population live within 1 km of the coast (Martínez et al., 2007; Ondiviela et al., 2014). The combination of population and economic growth has created a strain on the provision of these ecological services. For example overexploitation of fisheries, including physical disturbances due to dredging and trawling, are widespread (Cullen-Unsworth and Unsworth, 2013; McLeod et al., 2011). In 2018, an estimated 179 million tonnes of seafood was extracted from the marine environment for aquaculture production, human consumption as well as non-food uses (FAO, 2020). The average annual rise in seafood consumption is 3.1% (compared with annual world population growth of 1.6% between 1961-2017; FAO, 2020) and there are major concerns about the direct and indirect (such as extraction of feed for aquaculture) impacts this is having.

A further pressure, land-use change has resulted in large losses and degradation of intertidal habitats worldwide (Lovelock and Reef, 2020; Waycott et al., 2009). Saltmarsh loss has been largely attributed to land reclamation for agricultural practices (Almeida et al., 2014; Hobbs and Shennan, 1986). It is unclear how these coastal ecosystems will continue to provide essential services that are critical for climate adaption and resilience, when they are also vulnerable to climate change.

DEFINITIONS

Agriculture activity = Farming activities that have a connection with producing items for commercial purposes (grazing farm animals, planting crops).

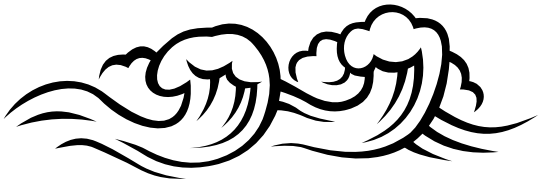


Atmosphere = The gases that surround a planet in layers, these strongly influence the conditions of earth. Without the atmosphere life would not exist on earth.

Carbon footprint = The amount of carbon dioxide released into the air because of a single persons energy needs.

Climate = The weather conditions prevailing in an area in general or over a long period.

Climate change =The long term change in weather patterns. This is influenced by lots of different variables, but carbon dioxide and other green house gases for energy and resource use have been released at at a significant rate into the atmosphere which is changing the earths climate.



Coast/coastal = The part of land connected or near the sea.

Colonise = The process by which a plant or animal settles and becomes established.

DEFINITIONS

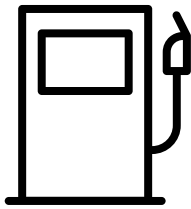
Deforestation = The process of cutting down forests and then changing the use of the area, typically forests are cut down for agricultural activities and urbanisation. This has a very negative impact on ecosystems, the animals and plants within them and the climate.

direct impact = Something immediately leading to or resulting in something else.

Dune = A mound or ridge of sand or other loose sediment formed by wind and waves.

Ecosystem = A system of interacting plants and animals with their physical (non living) environmental materials including water, rocks and soil.

Erosion = The process where typically wind or water wear away sediment, soil or rocks.



Flooding = The temporary inundation of dry land. It typically occurs during storm events.

Fossil fuels = a natural fuel such as coal or gas, formed in the geological past from the remains of living organisms. These fuels take thousands to millions of years to form.

Glacier = A mass of land ice, usually created from the accumulation of snow on mountains.

Global warming = An increase in the average temperature of the earth's atmosphere. This has been caused by human activity and has long-term effects on environmental conditions including sea level rise, flooding, drought and forest fires.

Green house gases = Gases which are in the earth's atmosphere are both natural and manmade. These have increased in the atmosphere since the industrial revolution. The three main greenhouse gases include carbon dioxide, methane, and nitrous oxide.

Habitat = The natural home or environment of an animal or plant.

indirect = Something not directly caused by or resulting from something.

DEFINITIONS

industrial activity = Activities which include all stages of finding materials, creating products and distributing products.

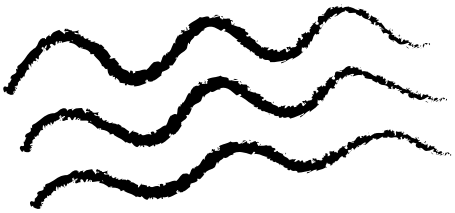
invasive animals and plants = An invasive species is one that, previously not existing in an area, can outcompete species that would normally inhabit that area, becoming dominant and changing the local ecology. They are often introduced by humans (accidentally or deliberately), but may also be forced to move into new areas as they adapt to the conditions of a changing climate.

Restoration = the act of returning a habitat to its former natural condition.

Rewilding = The planned return of an area of land or sea to a more natural state, by restoring habitats or removing human activities that damage habitats.

Risk = The probability of harmful consequences or expected losses (to habitats, animals and plants, properties and livelihood) resulting from interactions between natural and human made hazards.

Sea level rise = The change in the volume of the world's oceans, this occurs due to temperatures increasing and ice melting (including glaciers). This can change due to climate change.



Sea wall = A wall or structure built along a section of coast to prevent the sea causing further erosion to land by wave action.