Our Blue Planet

A toolkit for

Exploring The Oceans Through Science and Faith

Wembury Bay. South Devon. © David Curry 2021

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Executive summary

The Church of England is made up of 42 dioceses, 24 of these have a coastal boundary. totalling 2,663 miles. No one is more than 70 miles from the ocean.

Without the ocean we wouldn't be here! Not only does the ocean provide us with food, water, medicines and other resources, but it also makes sure that our climate is neither too hot nor too cold, it manages some forms of human waste and it provides inspiration for art, music and poetry.

But humans are putting too much pressure on the ocean. Climate change and pollution are starving the ocean of oxygen, changing its temperature and levels of acidity, and threatening its precious biodiversity. Overfishing has put many species of fish on the endangered list and human activity along our coast is changing coastal habitats. If we carry on mistreating the ocean, we will lose its vital services.

This toolkit offers ways our church communities can address these 'blue' issues and help.

The purpose of the toolbox is to;

- encourage churches to think and talk about our ocean and its inhabitants, their coastal boundaries and enable them to be as cognisant of the importance of 'blue' (ie marine) issues as well as green issues.
- explore the challenges and opportunities in finding ways that churches can deepen and enrich their congregations' understanding of the relationship between ocean science and faith.
- be a helpful resource primarily for churches, but also to provide useful information for schools and colleges.
- provide basic but important information about marine science and our oceans.
- act as a pointer to existing sources of information and support, equipping users of the guide with the tools needed to develop an effective marine science project.

Who is the toolkit for?

CofE Dioceses with coastal boundaries

Diocese Environmental Officers

Church communities

Christians in Science

Green Christians movement

Schools and colleges

Watch: YouTube: Caring for Creation through Science & Faith by Dr Anthony Hereward

What is the ocean?

From outer space the Earth appears blue and so is known as the 'blue planet'. The Earth is covered by 350 million square kilometres of salt water, covering nearly 72% of it's surface. It also supports most of the life on Earth,
The global ocean is made up of five interconnecting ocean areas, which are referred to as individual oceans:

- Atlantic ocean
- Pacific ocean
- Arctic ocean
- Indian ocean
- Southern ocean

These oceans may be further split into smaller discrete seas.

The scientific principles and fundamental concepts covered by this toolkit are the seven contained in the ***Ocean Literacy Framework*** which was developed by scientists and educators from the ocean sciences education community.
It provides a framework to help people to understand the importance of the ocean for humankind, to be able to communicate about the ocean in a meaningfully way, and has a more responsible and informed behaviour towards the ocean and its resources.

1. Earth has one big ocean with many features.
2. The ocean and life in the ocean shape the features of the Earth.
3. The ocean is a major influence on weather and climate.
4. The ocean makes the Earth habitable.
5. The ocean supports a great diversity of life and ecosystems.
6. The ocean and humans are inextricably linked.
7. The ocean is largely unexplored.

See Appendix for fact sheets on each of the seven principles.

Ten fascinating Facts

1) 72% of the Earth is covered by the seas
2) 97% of the Earth's water is in the seas
3) Life on earth began in the seas 3.1 to 3.4 billion years ago
4) 80% of Earth's living organisms are in the sea
5) 50% of the oxygen we breath is produced by ocean plankton
6) 40% of the world's population lives within 100kms of the sea
7) 90% of world trade is carried across the oceans
8) 80% of Earth's mineral resources are estimated to be in the sea
9) 50% of our pharmaceutical anti-cancer arsenal is from marine organisms
10) Over 1 billion people rely on fish and other seafood as their primary energy source of animal protein.

1. What does the ocean do for us?

The open oceans are the world's largest providers of essential 'ecosystems services'.

- There is no life without water, there is no water without the ocean
- *generate 50% of the oxygen we breathe,*
- *absorb 25% of the carbon dioxide emissions,*
- *provide food, jobs, and energy.*
- *It provides inspiration for art, music and poetry.*

So we can see that without the ocean, we wouldn't be here!

2. Why do we need to protect the ocean?

Different human activities are putting too much pressure on the oceans;

- Sea water rising temperatures - The oceans have warmed by an average of 1^{o}C in the last century.
- Rising sea levels are a result of human-caused global warming. Sea level rise is caused primarily by two factors related to global warming: the added water from melting ice sheets and glaciers, and the expansion of seawater as it warms. Pollution and accidents - 75% of total oceanic pollution comes from human land-based activities.
- Ocean acidification - 50% of the carbon dioxide produced by humans burning fossil fuels has been absorbed by the oceans – Moving the oceans along the scale to acidity.
- Habitat loss - Over half the world's coastal wetlands have been lost through human activity.
- Climate change is starving the ocean of oxygen, leading to dead zones
- The world's largest 'dead zone' occupies 70,000 sq kms of the Black Sea.
- Overfishing has put many species on the endangered list
- Tourism - over- crowding, poor sewage disposal, boat-generated waste, beach erosion, over- fishing, and destruction of wildlife habitats have been reported as some of the negative consequences of excessive tourism development in the coastal areas.
- Unless they have a lifespan exceeding 50 years, all of the large fish will have died through industrial fishing.

3. What future for our oceans?

The new High Seas Treaty March 2023 includes an agreement to protect 30% of the oceans from pollution and exploitation by 2030. The high seas account for almost two-thirds of the oceans and lie outside the jurisdiction of specific nation-states. The plan is to have a vast series of ***Marine Protection Areas*** (MPAs) where fish stocks are protected and genetic resources are shared equitably amongst the global community. Signatory States to the treaty will vote on which MPAs go ahead, and a series of ocean-based Conferences of the Parties (COP) will parallel those on climate and biodiversity. The ocean COP will meet every few years to set targets, vote on new MPAs and monitor progress.

The UK's focus will be on enhancing and enforcing the protection of its existing Marine Conservation Zones – there are over 90. The UK will also designate three Highly Protected Marine Areas (HPMA's): Allonby Bay (Irish Sea), Dolphin Head (Eastern Channel) and North-East of Farnes Deep (Northern North Sea), where the focus will be safeguarding habitats from climate change.

The critical issue, however, is how to monitor progress – and the lack of capacity of government agencies and charities to do that. On paper, up to 30% of our territorial waters will be protected, it will be difficult to know if this is making a difference.

4. What can we do?

Having read the facts about our ocean you now know how essential the ocean is to life on Earth, so now it's time to take action to help protect the ocean.. A key aspect of this is to convince other people in your church to join in your efforts to protect the oceans.

Suggested activities;

1. **Ocean themed service** There are many resources to help you plan a service that focuses on creation care. These can be found on the A Rocha website: http://atyourservice.arocha.org/en/
   Why not make the emphasis on the ocean? There are many hymns and choruses that have a sea theme and plenty of Scripture to look at.
2. **Celebrate World Ocean Day** (around June 8th). A day when people everywhere can unite to celebrate and take action for our shared blue planet, with one ocean and one climate, which connect us all. Get together with your family, church community, and join with millions of others around our blue planet to create a better future. The World Oceans Day web site has a number of ideas of the things you can do. https://worldoceanday.org/about/mission-and-history/
3. **Reusable plastic only in church** - Church meals and coffee times don't need to be plastic-filled. It is more hassle and possibly even expense to do it without plastic – but stewardship and discipleship issues don't only apply to money! Encourage people to bring their own refillable coffee and water containers. Make sure drinking

fountains can be used to fill water bottles. And get everyone in on the wash-up – will be great for community building. There are a number of 'Plastic Free….' Projects in Devon e.g. Plastic Free Plymouth, Plastic Free Exeter, Plastic Free North Devon, Plastic Free Newton Abbot. Why not support one of these? Alternatively set up your own plastic-free church.

4. **Organise/Support Beach clean-ups** - The heavens (and the ocean) declare the glory of God. Do you see His glory when surrounded by plastic waste? Organise a clean-up nearby – if you are far from the sea, remember that all rivers eventually run there, so a riverbank clean-up really helps.

5. We encourage churches to find a beach clean-up near them using the International Coastal Clean-up website and join their neighbours in this God-honouring and community-serving activity.
   See also Marine Conservation Society U.K. Beach Cleans; Beach cleans | What you can do | Marine Conservation Society (mcsuk.org)

6. **Sustainable Seafood -** Visit a local fish market/supermarket fish counter. List the fish and shellfish. List the different species. Find out about overfishing and fishing methods.
   Meals together are an important part of the Christian life – let's honour God by what we serve. If you want to serve seafood, find out if the species you are eating has been caught in a way that is sustainable and that cares for ocean habitats. In the UK and Europe you can use www.goodfishguide.org

   Organise a ***'Loaves and Fishes'*** meal/event in your church/Mission Community.

   Loaves and Fishes Celebration. Morecombe Bay - In June 2014 the ***Loaves and Fishes Celebration*** was launched all around Morecambe Bay. It was an ecumenical initiative both in its organisation and realisation. organised by the Environment Groups of the Blackburn Anglican Diocese and Churches Together in Cumbria, the Lancaster Roman Catholic Diocese Faith & Justice Commission and CAFOD Lancaster. More information from:

   https://www.blackburn.anglican.org/storage/general-files/shares/Resources/Environmental%20matters/BDEG_Loaves_and_Fishes_Project.pdf

7. **Day out to the seaside** - Take a trip to the seaside. Enjoy the ocean. We protect what we love. Tidepools are great places to explore what God has made. Feel His power in the waves. Head out in a boat. See His beauty reflected in the ocean.
   Join one of the many rockpool exploration sessions in Devon; **See Appendix 2**

8. **Stay informed and pray about marine conservation**.
   Why not organise a series of talks led by guest speakers. For example;

   A Day in the Life of a Trawlerman; Fisheries Protection Officer; Marine Scientist; Marine Conservation worker; Meteorologist

   Useful links:-

   1. **National Marine Aquarium Plymouth and Ocean Conservation Trust**
      National Marine Aquarium Rope Walk Coxside
      Plymouth, Devon PL4 0LF
      http://www.national-aquarium.co.uk/ /

      https://oceanconservationtrust.org/

   2. **Marine Biological Association**
      The Laboratory, Citadel Hill, Plymouth PL1 2PB

      https://www.mba.ac.uk/

   3. **University of Plymouth Marine Institute**
      https://www.plymouth.ac.uk/research/institutes/marine-institute

   4. **Plymouth Marine Laboratory**
      Prospect Pl, Plymouth PL1 3DH https://pml.ac.uk/

   We all love prayer guides that give us specific information to pray about. Find a website that has local ocean information that you can use for prayer.

   Get involved in the ***World Day of Prayer for the Care of Creation*** (around September 1st) Established by Pope Francis in 2015 it is an opportunity to pray, reflect and act to care for God's creation. All of us, both those who most contribute to climate change and those whom it most affects, can pray for better stewardship of the Earth. https://cafod.org.uk/News/UK-news/Celebrate-World-Day-of-Prayer

9. **Books in bookshop, resources available to congregation**
   Does your church have a library? Stock some books on creation care and highlight them from the front. People who already care about the ocean may be afraid to say so for fear of being labelled unorthodox. We recommend:

   Planetwise by Dave Bookless as a good place to start.

   Rewilding the Sea: How to Save our Oceans by Charles Clover. June 2022

Bob Sluka *A Rocha* Lead Scientist, Marine Conservation Programme *has written Grove booklets, 'Hope for the Ocean' and 'Marine Plastics', available to buy and download.*

10. **Don't purchase dried marine life and be discerning buying tropical fish -** We all like to admire beautiful animals. However, we need to make sure that what we are buying has been harvested sustainably. Often those shells you buy at the beach are not from a local source, but have been flown in from afar and often are not sustainably harvested. The Chinese medicine trade often uses threatened species. Choose your aquarium fish wisely – many will not last or are not sustainably fished. Having an aquarium or shells around the house can be a great way to remember the ocean and stimulate prayer – but let's do that in a way that obeys God's commands to be good stewards of His ocean.

11. **Begin or join a local coastal project**
    Is there a local place that you can help to transform? Perhaps there is a species that is endangered or needs some help. After inviting that marine biologist to speak to the church and getting informed, join in with or start a local ocean volunteer group in your church and affiliate yourself to an ocean-related organisation. It will be a great way to make a difference and build community both inside and outside of the church walls.

12. **Citizen Science**
    'Citizen science' is a term used for projects in which individual volunteers (or networks of volunteers), many of whom may have no specific scientific training, perform or manage research-related tasks such as observation, measurement or computation. There are many opportunities to take part in Citizen Science

    https://www.exploredevon.info/news-items/citizen-science/

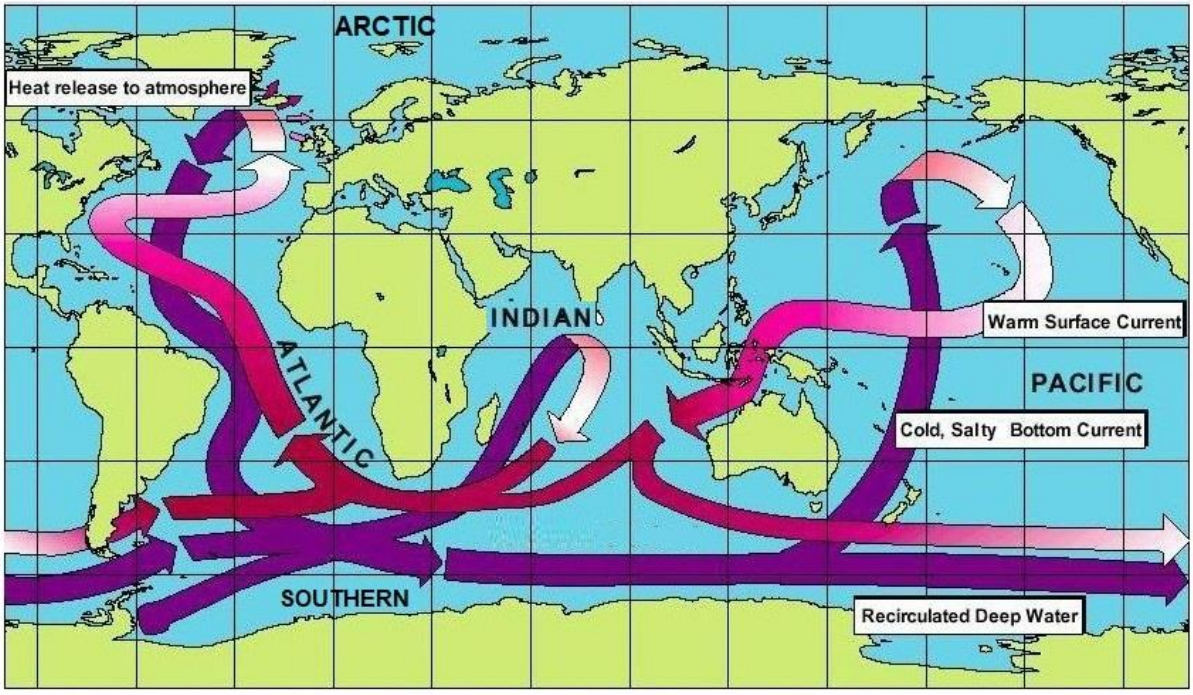
    OR contact Devon Wildlife Trust, or Marine Conservation Society

APPENDIX 1

The seven scientific principles contained in the *Ocean Literacy Framework*. Prof John Spicer, University of Plymouth

1. Earth has one big ocean with many features

- Our planet has one ocean. It is large, but finite. Its resources are vast, but not limitless. The ocean provides 98% of the living space on earth.
- That ocean is divided into five, interconnected ocean basins (marked Arctic, Atlantic, Indian, Pacific and Southern in the map below).



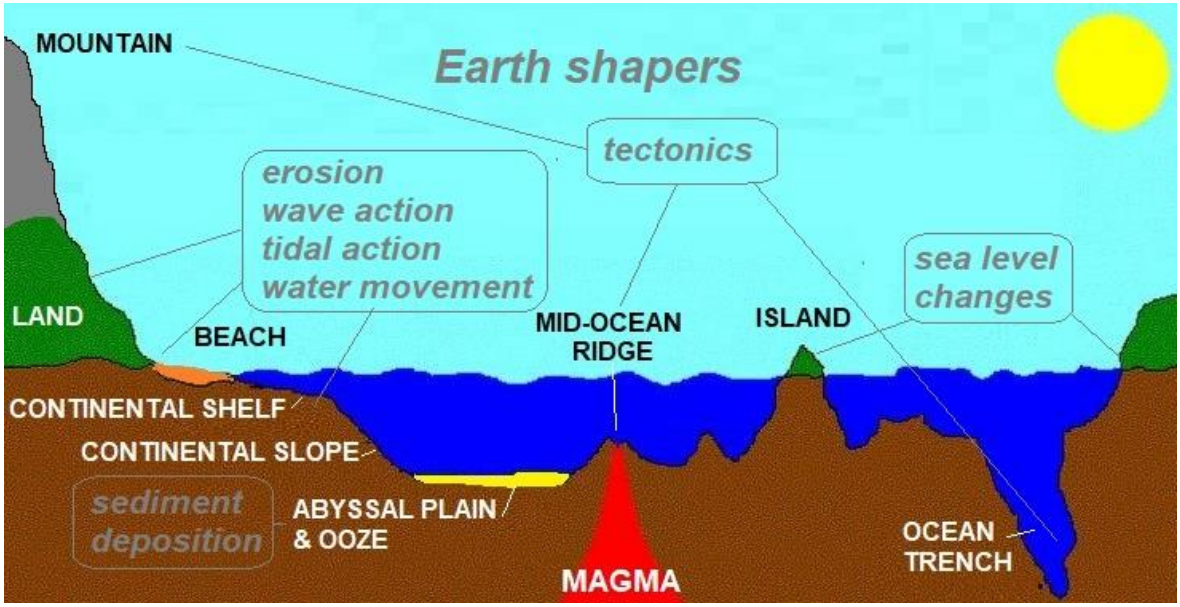
Ocean basins and movement of water and heat (marked by arrows). *Sea water is circulated within the basins, and throughout the ocean, by the power of the wind, the tides, the earth's spin and the sun's influence. How else could 28,904 yellow rubber ducks that in 1992 'fell' overboard mid Pacific, within a few years find themselves more than half way around the planet. Apart from rubber ducks this water also takes heat (the darker the arrows the deeper the currents) and energy around the world, contributing to our climate.*

- The oceans contains 1,338,000,000 km^3 of water, 96.64% of all water on the planet. This is enough to fill 5,352,000,000,000 Olympic swimming pools, 670 pools for every person alive. All life on earth, including marine life is made up from mostly water, about 1,120 km^3 of it. Water is essential for life as we know it. Most water is 4 billion years old.
- Sea water is salty. It has been for hundreds of millions of years. It has dissolved in it every natural element on earth (and some unnatural ones too), but the majority of the salt is contributed by just six ions; sodium, chloride, magnesium, sulphate, calcium and potassium.

- Because of these salts sea water freezes at a lower temperature and conducts electricity better than pure water. It's also more dense than pure water.
- Three quarters of the ocean floor is abyssal, that is it is at a depth of between 4 and 11 km. Here the pressure is between 400 and 1150 atmospheres and the temperature less than 5°C, around the temperature of your refrigerator. The deepest part of the ocean is the Marianas trench which is 11 km deep.

2. The oceans and life in the oceans shape the features of the earth

- A slow but continuous movement of sea water, erosion of land and deposition of sediments, sea level changes, and wave and tidal action, all create and modify landscapes not just in the ocean but also on land.



Key features of the ocean floor and the forces that create and shape our scenery on land and in our ocean.

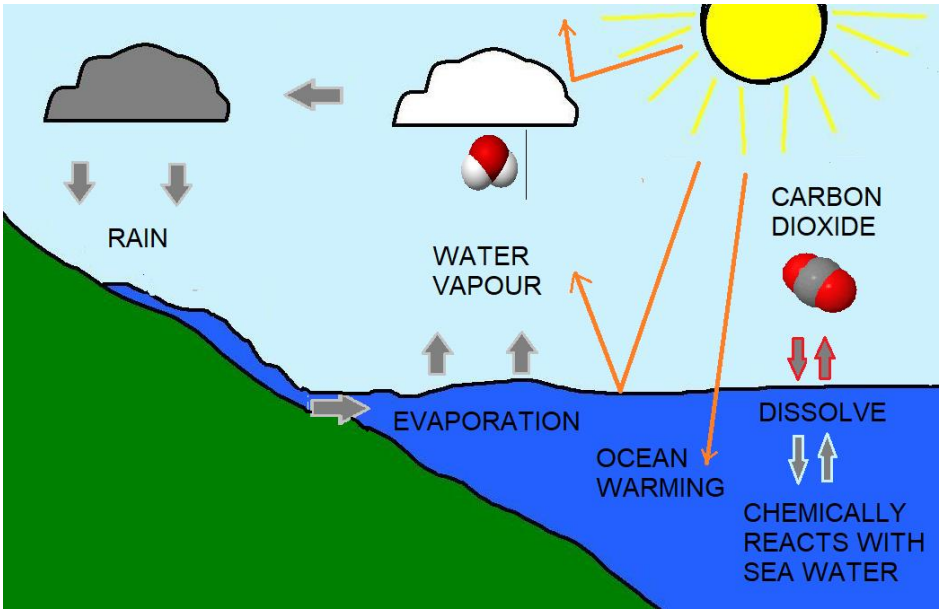
- The earth's solid outer crust is made up of a number of interlocking plates that move around on what is called the asthenosphere, the molten upper portion of the earth's mantle. There are oceanic plates and there are continental plates. These plates spread apart or come together, or scape against one another, reshaping the ocean and the land. This is known as the plate tectonics conveyer belt
- The mid-ocean ridge is the earth's longest mountain range at 65,000 km long and 1,500 kilometres wide. This is where ocean crust is created from molten rock (magma) which spreads out from the mid-ocean ridge as it harden into what we call basalt. The two plates can move grow apart as much as 10 cm a year – we call this sea floor spreading.
- When plates collide one of two things can happen. First mountain ranges can be formed. The Himalayas were formed 55 million years ago when two plates collided. But one plate can also slip below the other, and in such areas active

volcanoes are present, driven by the heat produced by the friction between the plates. There may also form an ocean trench.

- Many of the sediments laid down in the ocean become sedimentary rocks. They often contain the remains of ancient marine life, fossils.
- The white cliffs of Dover are made of chalk, the skeletons of billions of microscopic planktonic algae that lived in the sea off the UK between 66 and 100 million years ago. Suck rocks give the scenery a very distinctive look. The same is true of the Mendips a range of limestone hills located south of Bristol. They are made from the remains of marine life that lived in shallow warm waters 320-350 million years ago. The resultant sediment was then, as a result of tectonics, thrust up above the water and became the hills and scenery we see today.
- Fossil marine life is the basis of many sedimentary rocks across the globe and even in mountainous regions like the Himalayas.

3. The oceans are a major influence on the weather and climate

- Weather is what we call short term conditions in our atmosphere. Climate is the weather of a particular area averaged over a long time period. Our ocean influences both.



Exchange of gases (water vapour and carbon dioxide) and heat between the atmosphere and ocean.

- The more carbon dioxide (CO_2) present in the atmosphere, the warmer the atmosphere becomes. That is why CO_2 is called a greenhouse gas - it keeps our planet from freezing. Our atmosphere is constantly exchanging CO_2 with our ocean. By acting as a 'sink' for CO_2 the ocean keeps the atmosphere cooler than it might otherwise be.

- This CO_2 is used by tiny marine plants, phytoplankton and algae, in combination with water and sun light to generate energy, a process called photosynthesis. This is the same process that takes place in land plants. All sorts of marine life, not all microscopic, use CO_2 to build skeletons or shells. When they die, these carbonate structures sink to the ocean floor. So the CO_2 they have used is now stored, safe and locked up in ocean sediments..

- However human activities such as burning of fossil fuels has increase the atmospheric CO_2 and so our atmosphere is warming faster than it has in the past. As a result more CO_2 is stored in, than released from, the ocean. While CO_2 is necessary for marine life, when more of the gas enters the ocean, it reacts with the sea water and causes its pH to reduce, termed Ocean Acidification. Ocean acidification is a threat to all marine life that makes shells or skeletons out of carbonates.

- Just as the oceans absorbs CO_2 ocean currents allow sea water to take up, store, and transfer heat -another reason why ocean has such a major effect on climate.

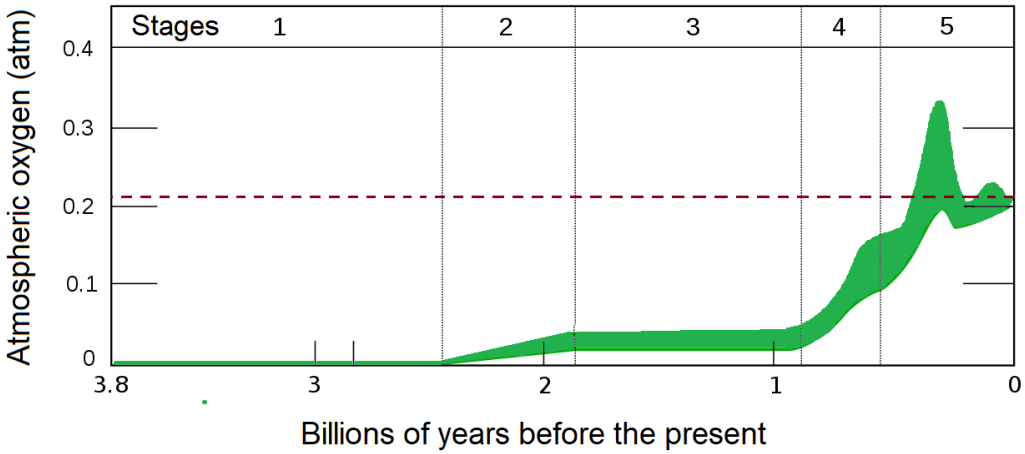
- Most of the rain that falls on the land comes from the ocean. Water evaporates from the oceans and becomes water vapour in the atmosphere. This vapour helps to form clouds which produce rain and so the cycle continues.

4. The oceans makes the earth habitable.

- Our current scientific understanding is that the oceans formed from water vapour released into the atmosphere from a very hot, but cooling, earth. Once the earth's surface was below the boiling point of water (100°C) rain began to fall. Gravity ensured that the water did not escape into space, but instead filled any great depressions in the planet's surface. All this happened about 4 billion years ago. Life is thought to have originated in this new ocean.

- The earliest physical evidence for life is microscopic and found in sedimentary rocks laid down in the ocean. The history of life of earth, (biodiversity) is dominated by microbes, with larger organisms, like animals and plants, appearing fairly late in the story of life,

- The sort of microbes that typified early earth life can be found today on the ocean floor at hydrothermal vents. These vents spout sulphur rich, boiling water into the surrounding waters. The microbes use the sulphur compounds to produce energy. These communities and early earth communities used chemosynthesis (reliant on chemical energy) and not, as is the majority of cases today, photosynthesis (energy from light captured from the sun, producing oxygen (O_2) as a by-product).



The current theory of how atmospheric O_2 (green shaded area) changed over time

Present day O_2 makes up 21% of our atmosphere (indicated by the red dashed line). Stage 1: Before there was an ability of life to capture energy from the sun, producing O_2 as a by-product, there was O_2 on earth but little in the atmosphere. The ocean turned red as iron chemically combined with O_2 - it rusted. We see evidence of this in very old rocks. Stage 2: The great oxygenation event. An upturn in O_2 production by life exceeds that lost to rusting, but has little effect on atmospheric O_2 as it is absorbed by the ocean, building a huge reservoir of dissolved O_2. Stage 3: O_2 starts to leak from the ocean, but has little effect on the atmosphere as it is absorbed by the lifeless land. Stages 4&5: All O_2 'sinks' are full and there is accumulation of the gas in the atmosphere. This is accompanied by, and may actually have driven, a huge increase in the diversity of life. Stage 5 is characterised by the origin of all main animal groups, invasion of land by plants and animals, and organisms achieving very large body sizes compared to the past. [Figure adapted from Heinrich D. Hollandderivative work: Loudubewe (talk) - Oxygenation-atm.svg, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=12776502]

- Between 50% and 80% of the O_2 we breathe and is essential for life is produced by ocean, mostly microbial plankton (i.e living suspended in the water column not on the sea floor) life. About 20 % comes from just one species of bacteria that can photosynthesise *Prochlorococcus*. Discovered only in 1999 with a diameter of 0.6 µm, it is the most abundant and smallest photosynthetic life form on earth,

- The ocean acts as a sink for atmospheric carbon dioxide, helping to regulate the temperature of the earth.

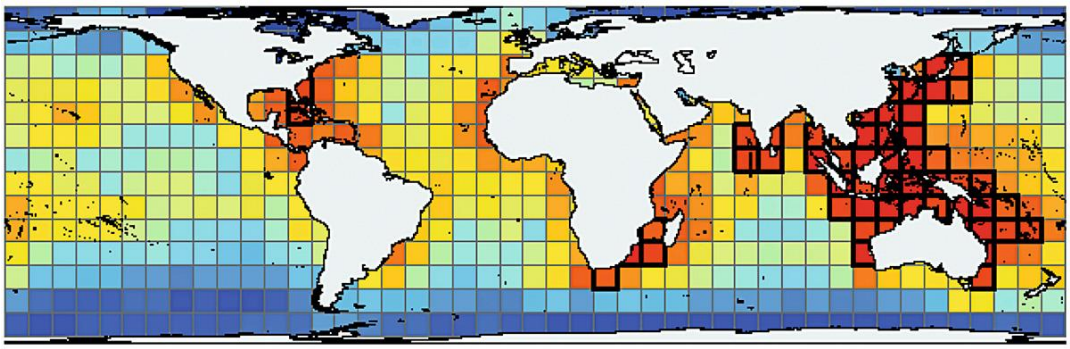
- The ocean provides (for free) water, O_2, and nutrients, and moderates the conditions (the climate), for life to exist on earth. But these 'services' are currently under threat.

5. The oceans supports a great diversity of life and ecosystems

- Every major type of life - viruses, microbes, invertebrates (animals without backbones – largest on earth is the giant squid), vertebrates (bony and

cartilaginous fish, reptiles, birds and mammals – the largest animal on earth is the blue whale) - can be found in our ocean.

- While the land has more described species than the ocean, the oceans contains all but one of the major animal groupings (phyla), and many groups not found on land (sponges, jellyfish, sea anemones, star fish, sea urchins, sea squirts). Some scientists suggest that if we could find and describe all ocean species they could outnumber land species 9 to 1.



A snapshot of global marine life. *The warmer the colour the more marine species present (i.e. greater biodiversity)* © Tittensor et al. (2010)

- Marine life is not evenly spread across or within the oceans – there are hotspots and cold spots and gradients. For example, the Indo-western Pacific has greatest concentration of marine biodiversity, as well as greatest diversity of coral reefs and species associated with them. Mirroring what happens on land, there appears to be a latitudinal gradient in marine species richness (a measure of biodiversity), from low at the poles to high in the tropics.

- The number of marine species initially increases with increasing water depth (1-3 km deep) but thereafter diversity decreases sharply with depth. The deep sea (abyssal) is comparatively poor in terms of biodiversity. Echinoderms (group that contains brittlestars and sea cucumbers) are dominant, but there are some biodiversity hotspots – cold deep water coral reefs, whale falls and hydrothermal vents.

- The average mass of marine animals (per square metre) is about 200 g in shallow water but falls a thousandfold to 0.2 g in depths greater than 3 km.

- Plant eaters in the oceans tend to eat anything. Land-based plant eaters on the other hand tend to specialise. Photosynthesis on land is carried out by grasses and trees, whereas although there are giant seaweeds (kelp) most photosynthesis in the ocean is carried out by microscopic life.

- Marine ecosystems are defined by a combination of living (biotic) or non-living (abiotic) factors (and their interactions) in an area of the ocean. While there is no agreed number of marine ecosystems they include: warm water coral reefs, home to 1 in 4 marine species and 1 in 5 fish species; saltmarshes, mangroves and kelp forests, some of the most productive coastal regions in the world; polar regions with their large number of species found nowhere else; rocky shores and sandy shores, stomping grounds for every student who

wants to study biodiversity generally; hydrothermal vents with their unique chemosynthetic communities; the deep sea and open ocean some of the least explored areas on earth.

- Ocean life encompasses many unique examples of life cycles, evolutionary adaptations (e.g. to pressure), and key relationships among organisms (energy transfer, predator-prey relations, symbiosis) not found on land.

- Ocean life, and the ecosystems it forms, are currently facing unparalleled threats in the form of overexploitation (e.g. overfishing), degradation (pollution, coastal development, deep sea mining), and disruption (rapid global climate change, invasive species).

6. The oceans and humans are inextricably linked

- Our existence on earth is tied up with the ocean. What the ocean does for us, seemingly for free, is tied up with how we treat our environment.

Available at https://oceanservice.noaa.gov/facts/why-care-about-ocean.html

- In return for what the ocean gives us, we ‘give’ the ocean our carbon dioxide, our plastics and other pollutants, and our trash.

- At the same time we try and provide the ocean some measure of protection from our activities. One of the few Aichi global biodiversity goals even partially achieved in 2020 was Target 11 which included the conservation of at least 10% of the ocean. The actual figure conserved was 7.47%.

- Outlined in the *Post-2020 Global Biodiversity Framework* is a suggested global target of 30% of the ocean by 2030.

7. The oceans are largely unexplored

- Humans have always explored, used (for food and transport) and enjoyed the oceans - or at least the intertidal and shallow areas accessible to them.

- The first attempt to explore the whole ocean was a 130,000 km round the world voyage by HMS Challenger (1872-76). Scientists collected physical, chemical and biological data wherever they visited, and sampled even the deepest parts of the ocean using grabs and trawls. Some consider this the beginning of the science of oceanography.

- The deepest part of the ocean, the Mariana Trench (11,034 m deep) was first explored by a manned (solo) submersible on May 1, 2019. The visit lasted a total of 4 hours.

- There are many discoveries still to be made. Hydrothermal vents (known as ‘black-smokers’) and the unique life associated with them were only discovered in 1977. The latest vent discovered was in 2021 in the Gulf of Mexico. It spits out not black but clear boiling mineral water and has many new species associated with it. Also, in 2021 one of the largest coral reefs in existence was discovered a ‘mere’ 30m depth off Tahiti.

- On average 2,000 new marine species are discovered and described each year. The E.T. sponge, the Patrick sea star, and fighting Elvis worms are just three species that made an unofficial top ten new marine species of 2020.

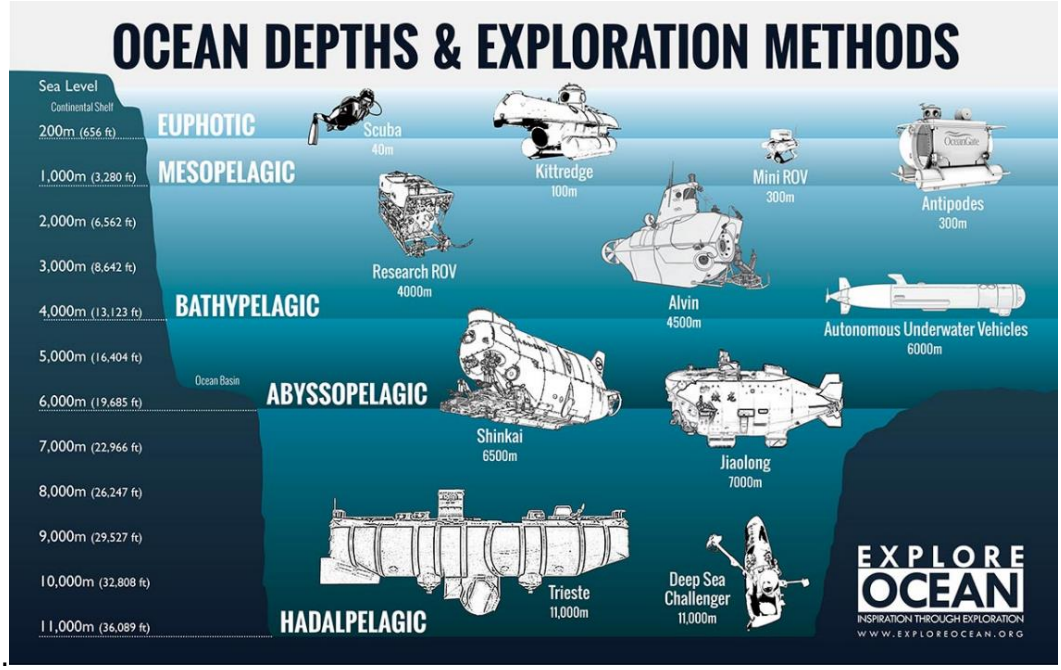
- At least 100 new chemical compounds are discovered in the ocean each year, some important for producing new drugs.

- The whole ocean floor is mapped to a resolution of 5 km^2 For comparison the area of Bushy Park, north of Hampton Court Palace in London, is 4.45 km^2.

- Less than 0.05% of the ocean floor has been mapped to the level of detail required for detecting important features such as submerged volcanic vents. We already have this level of detail for features on Mars and our own moon.

This means we have better maps of the moon and nearby planets than we do of our ocean floor.

- New technologies and sensors are expanding our ability to explore the ocean. There is increasing use of satellites, subsea observatories, deep water submarines, deep sea microphones, Remotely Operated Vehicles (or ROVs) and other autonomous underwater vehicles.



- Today ocean exploration is truly interdisciplinary. Biologists, chemists, climatologists, computer scientists, engineers, geographers, geologists, hydrographers and even social scientists and adventurers work together to increase our knowledge and understanding of the ocean.

APPENDIX 2

BEACH ACTIVITIES IN DEVON

Beach activities designed for participants to experience the awe and wonder of God's creation; They can include special *Citizen Science* hands-on events that include outdoor activities which take worship from the church, onto the beach to explore the marine environment.

The Marine Biological Association, Torbay Countryside service and others, such as Wembury, regularly run beach safaris, check on local authority websites/visitor centres for details. You may be able to arrange a church group specific guided walk.

Citizen Science activities enable community involvement in real scientific research. There are a number of such activities on our Devon coastline for getting your hands wet and doing things on the beach or coast:

1. **The Rock Pool Project - Expert-led rock pool activities in Devon and Cornwall.** Their rock pool safaris are a unique and exciting way to explore the hidden world of the intertidal zone. Led by experienced guides, you will have the opportunity to discover a diverse range of marine life.
   The safaris are suitable for all ages and levels of experience and promise an unforgettable adventure for the whole family. To book simply visit their website at https://www.therockpoolproject.co.uk/ and select your preferred date and time. If you have any questions or need further assistance, don't hesitate to contact us at ecotourism@therockpoolproject.co.uk

2. **Exploring Mansands Beach and Wetlands area South Devon**

   https://www.southwestcoastpath.org.uk/rdpe-projects/280/#

   Mansands is a beach and wetland area situated on the South Devon coast two miles west of Brixham, managed by the *National Trust*. A key part of the Trust's strategy is to bring people closer to nature and to increase the enjoyment of their visits to our properties and get involved.

   A bird hide with interpretation centre was built in early 2012 for the use of visitors to the area. The aim of the interpretation project is to provide information for visitors about Mansands and what species can be seen there at various times of year.. A map showing the nearest car park the site of the bird hide, and a series of circular walks in the area, can be found on the website.

3. **South Devon Rivers Discovery Programme**

   https://citizan.org.uk/discovery-programmes/south-devon-rivers/

   CITiZAN, (which stands for Coastal and Intertidal Zone Archaeological Network) is a national community-led project that maps and introduces the public to England's coastal archaeology. It covers six different areas including the South Devon Rivers region which runs from Wembury to Seaton, focusing on the tidal reaches of the Rivers Exe, Teign and Dart. Like the Citizen Science projects CITiZAN involve individuals and groups in mapping and understanding the wide range of archaeological features, including abandoned boats and barges, the remains of coastal industries and lost prehistoric landscapes in our area.

4. **North Devon Coast Areas of Outstanding Natural Beauty (AONB)**

   https://www.northdevon-aonb.org.uk/projects

   The North Devon Coast Areas of Outstanding Natural Beauty (AONB) covers 171 square kilometres (66 square miles) of mainly coastal landscape including special places such as Combe Martin, Lee Bay, Woolacombe, Croyde, Saunton, Northam Burrows Country Park, Westward Ho!'s Pebble Ridge, the Hartland Peninsula and Braunton Burrows, a UNESCO World Biosphere Reserve.

The landscape varies from wild coastal cliffs, spectacular waterfalls and rocky coves to sand dunes and beaches, wooded combes and valleys with sheltering villages.

The AONB Partnership supports sustainable development for our coastal communities and the rural economy, whilst conserving the outstanding wildlife, landscape and heritage of North Devon.

5. **South Devon AONB Life on the Edge Project**

   https://www.southdevonaonb.org.uk/projects/life-on-the-edge/#:~:text=The%20Project,and%20connect%20communities%20with%20nature.

   This is a project that aims to help restore thriving populations of some of the UK's rarest insects living along the South Devon Coast between Berry Head and Wembury The team working with residents parish councils, schools and landowners to protect and restore precious coastal wildlife and connect communities with nature.

6. **Explore Devon – Citizen Science Projects**

   https://www.exploredevon.info/news-items/citizen-science/

   Here are two wo Citizen Science projects, based in Devon, that you can get involved in

2. Westcountry CSI. Run by the Westcountry Rivers Trust and the project is about educating and engaging people with the water environment to help improve water quality and create a network of catchment communities that are invested in their local environment.
3. Shoresearch. Run by ***Devon Wildlife Trust*** Shoresearch provide training and the opportunity for volunteers to identify and record the wildlife on shores across the UK. The data collected helps experts to monitor our fragile sea life and better understand the effects of pollution, climate change and invasive alien species.

7. **Marine Conservation Society Beachwatch**

   https://www.mcsuk.org/what-you-can-do/join-a-beach-clean/

   As well as cleaning up our coastline, Beachwatch volunteers record all the items they find in a 100m stretch of beach. Every lolly stick, lost toy or piece of plastic – they record it. This information is hugely important as it helps them track litter back to source and enables them to campaign for change.

8. **The Devon Wildlife Trust Captivating Coasts**

https://www.devonwildlifetrust.org/devons-captivating-coasts

Devon is the only English county with 2 separate coastlines and they are very different indeed! On the north coast there are the rugged, tall cliffs with spectacular views and the UK's first UNESCO Biosphere Reserve! The long stretches of sandy beach on the north contrast markedly to the winding coastline of South Devon, with its beautiful estuaries, coves and busy beaches.

National Marine Week is The Wildlife Trusts' nationwide celebration of all things marine run over 15 days to allow for the variation in tide times around the country.

https://www.wildlifetrusts.org/national-marine-week

APPENDIX 3

Marine Conservation Organisations

a) **A Rocha Marine Conservation -**
https://arocha.org/en/conservation/marine/

b) **Marine Conservation Society**
https://www.mcsuk.org/

c) **World Wide Fund (WWF)**
https://www.wwf.org.uk/where-we-work/oceans

d) **RSPB**
https://www.rspb.org.uk/join-and-donate/donate/appeals/sealife-guardians/our-work-for-sealife/the-threats-to-our-sealife/

e) **Scientists in Congregations**
Equipping Christian Leadership in an age of science (ECLAS)

https://www.eclasproject.org/congregations/

f) **Christians in Science**
https://www.cis.org.uk/

g) **The Faraday Institute for Science and Religion**
"Wonders of the Living World: Margaret Miller, Marine Biologist – conservation and hope"
https://www.faraday.cam.ac.uk/churches/church-resources/posts/wonders-of-the-living-world-margaret-miller-marine-biologist-conservation-and-hope/

h) **Ocean Literacy Framework -**
http://oceanliteracy.wp2.coexploration.org/ocean-literacy

APPENDIX 4

DIOCESE WITH COASTAL BOUNDARIES

Bath and Wells	45mls
Blackburn	137mls
Bristol	10mls
Canterbury	350mls
Carlisle	120mls
Chelmsford	350mls
Chester	25mls
Chichester	140mls
Durham	39.5mls
Ely	10mls
Exeter	185mls
Gloucester	92mls
Lincoln	50mls
Liverpool	12mls
Newcastle	40mls
Norwich	84mls
Portsmouth	20mls
Rochester	20mls
Sodor and Man	99mls
Salisbury	88mls
St Edmundsbury and Ipswich	50mls
Truro	422mls
Winchester	230mls
York	45mls

Total coastline within diocese boundaries **2,663ml**

COASTLINE PROTECTED AREA DESIGNATIONS

- **MPA** - Marine Protected Areas
- **HPMPA** - Highly Protected Marine Areas
- **MCZ** - Marine Conservation Zones
- **SAC** - Special Areas of Conservation
- **SPA** - Special Protections Areas
- **SSSI** - Sites of Special Scientific Interest
- **Ramsar** Sites.
- **MNR** - Marine Nature Reserves
- **NT** – National Trust Heritage Coast
- **AONB** – Area of Outstanding Natural Beauty

BOOKS

'Blue Planet Blue God' *Co author* Prof Meric Srokosz

Biodiversity: a beginner's guide – Prof John Spicer

The Marine Environment and Biodiversity – Dr Mike Kent (1922)

Rewilding the sea by Charles Clover. Witness books 2022