SEA SCIENCE GALLERY
GALWAY CITY MUSEUM

Floor plan
The blue whale

• The majestic blue whale is the largest animal that has ever lived on earth. They can grow to over 30 m in length and weigh over 110 tonnes! The picture above is approximately the same size as a new-born blue whale (7.5 m long).

• Blue whales live in the surface waters and are found in all the world’s oceans. Recent sightings of blue whales off the coast of Ireland have been recorded in 2012, 2014 and 2015.

• Blue whales filter feed huge amounts of seawater through baleen plates to catch tiny crustaceans and small fish. Baleen is made from the same protein as our hair and nails.

• Blue whales are estimated to live for 35 – 40 years.

• Blue whales spend the summer months in Polar Regions, taking advantage of the abundant food supply. In winter months, they migrate towards warm waters near the equator to mate and give birth.

• Blue whales were abundant in most of the world’s oceans until the early 20th century, when most were hunted to near extinction. They were hunted for their valuable blubber, oil and meat. Most whaling was outlawed in 1986, but some countries still hunt them today.

• Blue whales are one of the loudest animals on earth. It is believed that they can communicate with each other using their whale song over distances of 1,600 km.
Mapping the Atlantic

The Atlantic Ocean is the second largest of the 5 oceans on Earth. It runs the length of the planet, with Europe and Africa on its eastern border, and North and South America on its western border.

- Animals such as the European Eel, the Loggerhead Turtle and some Humpback Whales cross this huge ocean (between 2,850 to 6,400 km across) during their annual migration cycles.
- The Atlantic Ocean first appeared, in full, on maps around 1507, and we have continued to explore it since then. However. The legend of St. Brendan recounts the story of an Irish monk crossing the Atlantic as far back as the 6th century – 500 years before the Vikings.
- In May 2013, an agreement, called the Galway Statement, was made between the European Union, Canada, the United States, and partner countries, to work together conducting research into the Atlantic Ocean.
- This Atlantic Ocean Research Alliance (AORA), of which the Marine Institute is a partner, is an international group, who have five main areas for investigation; ecosystem approaches to ocean health and stressors, observing systems, aquaculture, ocean literacy – engaging with society, seafloor and benthic habitat mapping.
- This group are currently working on mapping the North Atlantic, and by the end of 2016, there were 4 mapping surveys covering large paths across the seafloor in the North Atlantic.

1. In July 2015, the Canadian coast guard vessel, the CCG Louis St. Laurent, surveyed a swath of seabed in international waters between Halifax, Nova Scotia and Troms in Norway. They used multibeam sonar technology.
2. In June 2015, the Marine Institute’s research vessel, the RV Celtic Explorer, mapped a wide swath of the seabed in international waters between Galway and St. Johns, Newfoundland, Canada. In this survey they discovered a mountain range higher than Carrauntoohil.
3. In February 2016, the French research vessel, L’Atlante surveyed another swath of Atlantic, this time in international waters between Pointe-á-Pitre in Guadeloupe and Ponta Delgada in the Azores.
4. In May 2016, the Marine Institute’s research vessel, the RV Celtic Explorer, mapped another huge section of Atlantic seabed in international waters between Galway and St. Johns, Newfoundland, Canada.
The oceans and us

The ocean has huge influence over our daily lives and yet we still know very little about it. This exhibit has videos about people and their connection with the ocean:

- What has the ocean ever done for us? (Animation).
- Easkey Britton – surfer/marine social scientist.
- Dr Simon Barrow – lecturer at GMIT/ chief scientist of IWDG.
- Captain Brian Sheridan – harbour master of Galway Bay Port.
- Máirín Uí Chomáin – seafood chef.
- Ciarán Oliver – Fisherman/ Galway Lifeboat crew.
- Méabh Ní Ghionná – 9 year old girl talking about the sea.
- Aidan Fitzgerald – researcher at the Marine Institute/ ROV pilot.
- Nicola Corcoran - 6th class teacher.
- Michael Swan - lifeboat operations manager of Galway RNLI.
- Dr Noreen Burke - director of education at Galway Atlantauaria.
- Peter Heffernan - CEO of the Marine Institute.

Figure 3: The oceans and us exhibit.
Figure 4: Funny picture display.
Our ocean resource

Most of us know that we rely on the ocean for all kinds of things: food, seaweed, salt, transport, recreation, employment, fuel, building, minerals, and climate change regulation.

The two most important things we rely on the ocean for are: 1) water, 97% of our drinking water comes from the ocean. 2) Air, about 50% of the oxygen in the air we breathe is produced by phytoplankton, tiny plants which live in the sea.

If there was no ocean there would be no life on earth.

The water cycle

Did you know that the water we drink begins in the ocean? It eventually returns there after we’ve finished with it!

Since seawater is salty and drinking water (potable water) is not, water from the ocean undergoes 3 important, natural processes before it reaches our drinking water reservoirs.

The sun evaporates water from the ocean. This vapour rises and cools, condensing into tiny droplets which come together to form clouds. The clouds move towards the land, moving higher and getting colder, until the droplets fall back to the ground as precipitation. The water then runs into rivers and lakes which run back into the ocean, and they cycle starts again.

- Evaporation: When the water in the oceans is heated (by the sun) it evaporates. Like steam from your kettle, some of the water turns into gas, called water vapour. Salt is left behind in the ocean.
- Condensation: As the water vapour rises into the atmosphere, it cools and gathers into tiny droplets. You can also see condensation on the outside of a glass of iced water on a warm day.
- Precipitation: When the condensing droplets of water vapour become heavier, they fall back to Earth as rain, hail, sleet or snow. This is known as precipitation.
Tides – where does the water go?

Discover how the gravitational forces and the orbit of the Moon affects the tides here on Earth.

High water – this is the highest water level of this tidal cycle. After this point the tide begins to go out (ebb). Tide going out (Ebb tide).

The Moon orbits the Earth, just like the Earth orbits the Sun. The tides are caused by the Moons gravity pulling at the water in the earth's oceans. Earth is also constantly turning, so the Moons gravitational pull effects different places around the world as each day goes on. So when the tide is out where you are it is also out on the other side of the planet, and halfway between, the tide will be in.

When the Sun, the Earth and the Moon are in a straight line, the pull of gravity is very strong. This causes very high and very low tides. These very high and low tides are called spring tides, and happen with the new and full Moon.

When the Sun, the Earth and the Moon form a right angle (L-shaped), the pull of gravity is not as strong as on the spring tides, and this causes high tides to be lower and low tides to be higher. These weaker tides are called neap tides, and happen with the waxing and waning Moons (half-Moons).

Figure 7: Tides - where does the water go? exhibit
Life in a drop of seawater

Plankton is the name given to the tiny little plants and animals which float along in the top layer of the ocean. There are two types of plankton.

Phytoplankton are small microscopic plants. Phytoplankton are so small that you can only usually see them under the microscope. If you filled up a drink can with sea water, there could be up to 100 million phytoplankton inside! These little plants are vitally important for life on Earth for:

Food – phytoplankton is food for lots of marine creatures – it’s like the grass of the ocean. Without it, most life in the ocean would not exist.

Oxygen – Up to 50 % of the world’s oxygen is produced by these tiny plants as part of the process called photosynthesis.

Carbon dioxide – Phytoplankton remove more than 50 % of carbon dioxide gas from our atmosphere.

Zooplankton includes many different animals, such as jellyfish, shellfish, squid and fish. Some of these animals live their entire lives in the plankton while others stay in the plankton for a while. Zooplankton feed mostly on phytoplankton and are the main source of food for many ocean animals including fish, basking sharks and whales.

The problem with plankton:

Harmful algal blooms – when there are too many nutrients in the ocean, phytoplankton can quickly grow into massive blooms. These can have a poisonous effect on the animals which feed on them.

Microplastics – As plastic ends up in the ocean, it breaks down into smaller pieces called microplastics. Microplastics are accidentally eaten by zooplankton and eventually make their way up the food chain into our food.

Ocean acidification – as the ocean absorbs more carbon dioxide, it becomes acidic and dissolves shells and coral.

Figure 8: Life in a drop of seawater exhibit.
Who eats who?

Growing up living in the ocean is a dangerous game for most of the animals living there. As well as hunting for food to survive, most animals are hunted by other predators. The complicated business of who eats who is known as a food web. This interactive helps you find out who dines on whom in the ocean, and where they sit in this vast food web.

Match the larvae to the adults:

Some marine animals completely change shape as they develop from their younger stages to adults. These changes are known as metamorphosis. It is the same process that a caterpillar goes through to transform into a butterfly. After metamorphosis, the creature may live in a different habitat and eat different food. The 6 animals provided as part of this exhibit are starfish, brown crab, sea urchin, jellyfish, thornback ray, and oyster.

A food chain shows the order of who eats whom in an ecosystem. Primary producers make their own food, usually by photosynthesis. Primary consumers eat the primary producers. Secondary consumers eat the primary consumers, and so on up the food chain to the top level predators like sharks and humans.

Figure 9: The 3 exhibits a part of the Who eats who gallery.
Making a chart

Nautical charts contain information about the coastline and seafloor, and are essential for mariners to plan voyages and navigate safely.

Video of how marine maps and charts have been created throughout the years:

- Lead and line survey (1700s)
- Single beam sonar survey, this method enabled boats to survey long lines of the seabed.
- US Navy develop multibeam sonar survey this method enables boats to survey large swaths of seabed.

The Marine Institute, along with the Geological Survey of Ireland have worked as INFOMAR to create one of the largest seabed maps in the world – the ‘Real Map of Ireland’.

The real map of Ireland

Did you know that Ireland’s underwater territory is more than 10 times the size of our land territory?

This model is an accurate representation of our marine territory, which was generated using multibeam mapping data collected by the Marine Institute and the Geological Survey of Ireland as part of the INFOMAR programme. It is one of the largest seabed mapping programmes in the world.

The water depth in this area can be as deep as 5000 m, and Irish research teams, including NUIG and UCC, have discovered some amazing new creatures living here. Ireland has the exclusive right to explore, research and sustainably use the area enclosed within the red line.

Find out more about this fascinating map and the INFOMAR programme at www.infomar.ie
What am I?

Have you ever picked up a shell or other beach find and wondered what type of animal it is or was?

By answering some simple questions, this interactive will help you put a name to some of the most common animals we find along the rocky shore.

If you need some inspiration have a look at the creatures on our model.

The interactive in this exhibit is a key to try and work out what organism you have picked.

*Figure 11: What am I? exhibit.*
**Under pressure**

Under water the weight of water pushes in from all sides, causing pressure. Deep water pressure is so strong that it can squeeze air so it becomes compressed and takes up less space – like in a scuba diver’s air tank.

Local schoolchildren decorated heads and cups made from polystyrene which were sent down from the Celtic Explorer to a depth of 2800 m. The pressure at this depth squeezed all the air out of the polystyrene and the heads and cups were shrunk to the size you see here.

Water pressure at that depth is roughly about the same as balancing an adult elephant on your thumbnail.

This dynamometer measures grip strength. Squeeze the bulb to see how much pressure you can produce and how this compares to ocean depths.
Galway Bay ocean observatory

The camera, which is in 20 m of water, is part of Ireland’s Marine Test and Demonstration Facility for renewable energy. The observatory has a range of sensors which collect information including; air temperature, sea surface temperature, water temperature at 20 m, wave height, salinity, and chlorophyll concentration.

This data is used to help develop new underwater technology such as wave energy devices which can harness the power of the wild Atlantic and turn it into clean energy. Just imagine having the power of Atlantic storms power your television.

This video footage is coming live from the SmartBay underwater observatory at Spiddal in Galway Bay! To watch this feed live visit spiddal.marine.ie

Figure 13: Galway Bay ocean observer exhibit.
Deepwater ecosystems

The deep sea (more than 200 m) is very different environment to that of shallower waters in terms of pressure, food and light. The pressure at the deepest point of the world’s ocean, the Mariana Trench in the Pacific, is so great that it is roughly the equivalent of you holding a stack of 48 jumbo jets!

Food in the depths is not as plentiful as it is in the shallower waters, so most of the animals grow and move much more slowly, with deep sea creatures taking much more time to reach sexual maturity than those who live in shallower water.

Atlantic mackerel take 2 years to reach maturity and live for up to 17 years in the shallows, while the orange roughy can take up to 30 years to mature and can live up to 125 years in the depths.

But the biggest difference between the depth and shallows is light:

- Epipelagic/Sunlight Zone (0 – 200 m), most of the plants and animals we know about live here, where photosynthesis happens.
- Mesopelagic/Twilight Zone (200 – 1000 m), there is not enough light for photosynthesis, so there are no living plants. Some animals can live here, having adapted to living with less light.
- Bathypelagic/Midnight Zone (1000 – 4000 m), there is no sunlight at all, but some animals can make their own light (bioluminescence), which can be used for communication, defence and hunting.
- The Abyssopelagic Zone/ the abyss (4000 – 6000m), about three quarters of the ocean seafloor is located at this depth. Animals here move slowly in the near freezing water
- The Hadalpelagic Zone / The Hadal Trenches (6000 – 11000m), in the deepest, darkest reaches of the ocean there is still life (and we are still exploring to find out more).

Figure 14: Deepwater ecosystems exhibit.
Ecosystem impacts

An ecosystem is the name given to a community of plants and animals, and the environment in which they live and interact with one another. Ecosystems are incredibly complex because of the number of different components involved.

Earth’s oceans can be considered a single, huge ecosystem, but it also contains smaller, individual ecosystems, like the rocky shore or a rock pool.

Here are a few examples of living and non-living components of the ocean ecosystem:

- Living: animals and plants native to the area, species of bacteria, animals and plants not native to the area, predator-prey interactions.
- Non-living: pollution, salinity, water temperature, oxygen, waves and currents, ocean acidity.

A change in a single element of an ecosystem has an impact on lots of other elements. An example of this is overfishing. If we remove too many of one type of fish from the ocean ecosystem, animals further up the food chain (which feed on that fish) will either die off or will begin to feed on a different animal.

Further down the food chain, the animals or plants which used to be eaten by the fish we remove form the ecosystem, can grow to huge numbers because their numbers are no longer being kept in check. The Marine Institute has a section called Fisheries Ecosystem Advisory Service (FEAS) which monitors the stock levels of fish and shellfish. This data is used to develop sustainable fisheries management plans.

Figure 15: Ecosystem impacts exhibit.
What is it like to explore the ocean?

Have you ever wondered what it would be like to explore our oceans on a modern research ship?

This interactive lets you just do that by selecting interviews with some of our finest sea-going scientists, engineers and ship’s crew from the Marine Institute, the INFOMAR project and NUIG Ryan Institute.

This interactive screen has video clips about the programme INFOMAR, life on board a research vessel, survey vessels and equipment, meet Dr Louise Allcock, meet Thomas Furey, and the first collaborative Atlantic survey. The intro ‘what is it like to explore the ocean’ overlaps certain video clips when you click into them which means you have two voices talking at the same time. Also, it is quite difficult to hear Dr Louise Allcock and Thomas Furey talking, particularly when the museum floor is busy, because the video clips audio is low.

![Image of the exhibit](image_url)

*Figure 16: What is it like to explore the ocean exhibit.*
Our fishery species

Irish waters contain some of the most productive fishing grounds in all of Europe, and we depend on these for food, employment and income.

Although there are over 350 species of fish in the waters around Ireland, only around 30 of these fish species are fished commercially. The amount of fish which Irish fisherman are allowed to catch is determined by Europe, and guided by the stock book, produced annually by the Marine Institute.

Some of the species of fish which are commercially important to Ireland include, mackerel, herring, cod, whiting, haddock, hake, plaice, sole, john dory and salmon.

Other marine species which are fished commercially in Ireland include: oysters, mussels, prawns, periwinkles, crabs, lobsters, scallops, and squid.

Massive migrations

Current estimates are that there are over 29 billion mackerel in the Atlantic stock – this is more than 4 mackerel for every single person on the planet.

For a relatively small fish (30 – 40 cm long), Atlantic mackerel can travel huge distances as they travel from their feeding grounds in the northern waters to their spawning grounds off the south and west coasts of Ireland. That’s over 5000 km a year.

The northern limit of where Atlantic mackerel are found is changing – up until 2008, Iceland had no mackerel fishery and now it does. Mackerel are even being caught east of Greenland, which has never happened before. Scientists think that the more fish there are, the more food they need, so they have to spread out.

The size of the northeast Atlantic mackerel stock is assessed each year using information from the total quantity of fish caught and the numbers of each age group caught. Every 3 years there is also an international survey, which is based on the numbers of mackerel eggs found in the sample areas.
The lab

Figure 18: The lab, there are some corals on display, however, they have no information about species.

Anatomy of a fish
There are over 32,000 species of fish in our oceans, which can be split into 3 different categories:

- Jawless – lampreys and hagfish.
- Cartilaginous – sharks, skates and rays.
- Bony – all other fish.

We can use physical characteristics to help identify different types of fish:

- Body shape: Long and thin (anguilliform), flat (dorsiform), and torpedo shaped (fusiform).
- Tail shape: Round for quick, short darting movements (flounder), truncate for sprinting short distances (salmon), forked for very fast swimming (herring), lunate for fast continuous swimmers (tuna), and pointed for fast swimmers which keep moving (some sharks).
**Hydrothermal vents**

The mid-ocean ridge system is 65000 km long, deep sea mountain range which wraps around the globe like the seam on a hurley sliothar. Along this ridge, the plates of the Earth’s crust are slowly pulling apart – these are known as ‘spreading centres’. Hydrothermal vents are incredibly special deep sea features which are found along the mid-ocean ridge. At spots along the spreading centres, water seeps down into the Earth’s crust where it dissolves minerals and becomes superheated to over 450 °C. The water then gushes back into the pitch black ocean through cracks in the seabed. Because of the mineral dissolved in this extremely hot water, it forms clouds of black or white smoke as it hits the cold ocean water.

Hydrothermal vents were discovered in 1977. In 2011, the Marine Institute were partners along with the National Oceanographer Centre Southampton, the University of Southampton, NUI Galway and the geological survey of Ireland, in an expedition led by the University College Cork. The expedition discovered a previously unknown hydrothermal vent on the Mid–Atlantic Ridge which has been called the Moytirra vent field, meaning plain of pillars in Irish mythology.

As hostile an environment as this is, hydrothermal vents are teeming with life. Different types of bacteria use the minerals in the superheated water to make food in a process called chemosynthesis. Many animals like crabs and squat lobsters rely on these bacteria as food for themselves. Perhaps strangest of all are the giant tube worms and clams which have the mineral eating bacteria growing inside them to feed them directly!

![Figure 19: Hydrothermal vents exhibit.](image)
Ocean currents
This interactive globe shows how ocean currents transport massive amounts of water around the world, regulating our climate. See how the Gulf Stream carries warm water towards Ireland, maintaining milder temperatures than the east coast of Canada, which is the same distance from the equator.

Ocean currents:
The deep ocean is always on the move. The pull of the Moon and the Sun rocks the water backwards and forwards in the tides. Winds drive currents near the surface of the ocean. Heating and cooling also drive currents deep within the ocean. The currents act like rivers and carry nutrients, plankton and fish from one part of the ocean to another. They also carry heat. Look for the Gulf Stream carrying warm water from the Gulf of Mexico into the North Atlantic where it warms the winds that blow towards Europe. The strongest currents are often very narrow and get squashed against the western coasts of the ocean. The largest current of all is the Antarctic Circumpolar Current. A very deep current, it separates the cold waters around Antarctica from the warmer waters further north and helps to stop Antarctica melting. Currents bring nutrient rich water into the surface layer of the ocean. The resulting algal blooms can be seen from space and allow plankton and fish to prosper and support major fisheries.

Surface currents:
In the sub-tropics (40 °N to 40 °S), the main wind driven currents are limited to the warm surface layers of the ocean.

- Gulf Stream: starting in the Gulf of Mexico and running northwards close to the North American current, the Gulf Stream is an important part of the clockwise circulating North Atlantic gyre. It also includes part of the global conveyor belt carrying water north to sink in the high North Atlantic. The return branch of the conveyor belt runs southwards below the Gulf Stream.
- Kuroshio Current: The Kuroshio Current is the North Pacific equivalent of the Gulf Stream, running from Indonesia to Japan. Like the Gulf Stream it meanders wildly after leaving the coast and generates many eddies that propagate across the ocean.
- Brazil Current: The Brazil Current is the western boundary current of the South Atlantic. It’s not as strong as the Gulf Stream but below the surface layers it includes the return branch of the oceanic conveyor belt.
- Agulhas Current: The Agulhas Current is the western boundary current of the South Indian Ocean. It is also an important part of the oceanic conveyor belt, carrying salty water from the equatorial Indian and Pacific Oceans and generating large eddies which carry this water into the Atlantic.
- East Australian Current: The East Australian Current is a weak western boundary current, which carries tropical water from the Great Barrier Reef towards Sydney. It then turns offshore to pass around the north of New Zealand.
- Antarctic Circumpolar Current: the largest of all ocean currents, the Antarctic Circumpolar Current encircles Antarctica. It is driven by the strong westerly winds but it is also affected by the ocean stratification to the north and south. It has a braided structure with jets, which break apart and re-join, whilst the current also twists and turns as it finds its way around the obstacles.
The Global Oceanic Conveyor belt:
The circulation of the deep ocean is driven by heating and cooling, and also by evaporation and rainfall, at the surface of the ocean. Warmer water is less dense, so it moves to the surface. Cold water is more dense so it sinks, drawing in warm water to replace it at the surface. If the cold water is very salty, it will sink in greater volume. In the salty North Atlantic, winter storms cool the ocean causing the water around Iceland and Greenland to sink. It is replaced by warmer water from the south, like a big ocean conveyor belt. You can see the warm Atlantic water flowing northwards past Europe to take its place. Meanwhile in the North Pacific where the ocean is less salty, the winter storms cool the ocean in the same way, but the water is not salty enough to sink down in such large volumes. There is no conveyor belt to pull in warm water; so western North America stays cold, compared to Europe’s milder climate. The sinking water in the North Atlantic is the start of the ocean conveyor belt, a journey around the world that can take water hundreds of years to complete. First it flows southwards under the Gulf Stream. It continues past the equator, under the Brazil Current until, not far from the tip of South America, it joins the Antarctic Circumpolar Current. This carries it around the world into all the other oceans.

El Nino:
In a normal year, the winds of the Pacific cause upwelling of nutrient rich water off North and South America. These waters support a huge bounty of sea life and some of the world’s most productive fisheries. The trade winds also push the equatorial surface waters westward forcing them to make the long journey to the West Pacific. As they travel they are heated by the equatorial sun and when eventually they arrive they form a thick layer of very warm water called the west pacific warm pool. The temperature of this warm pool is 30 °C or more. It loses a huge amount of energy into the atmosphere, and as a result the region is one of the main drivers of the atmospheric circulation – supplying the energy behind the jet streams and weather for much of the world.

Having been in the Sun for so long, most of the nutrients in the water have been used up so it is nutrient poor and supports little life. Below the surface, some of the water tries to return to the east in a narrow current called the equatorial undercurrent. This is usually very weak.

However, every few years the trade winds falter and the equatorial undercurrent grows and reaches the surface, carrying huge amounts of warm water back to the Americas. When it reaches South America the current forms a thick layer of nutrient poor water. Any upwelling still occurring is nutrient poor too. As a result, the plankton die and local fishermen and their families can starve. When the fishery fails, it is often fails around Christmas. So it is called El Niño – Spanish for ‘the boy child’

Mediterranean:
In the Mediterranean, more water is lost to the atmosphere through evaporation than is returned in rain or in the rivers. This has a huge impact on the currents of the Mediterranean itself and the deep circulation of the global ocean.

Evaporation increases the salinity of the ocean, it increases the density, and it means that when the water is cooled by winter storms it is much more likely to sink to the bottom of the ocean.

Surface Atlantic water enters the Mediterranean past Gibraltar. As it slowly moves east, evaporation increases its salinity, so it has its maximum salinity when it reaches the eastern Mediterranean. Here it is cooled by winter storms. It sinks to the bottom of the ocean – drawing in more surface water from the Atlantic – and starts its slow trip back to the west. At this stage it is denser than any of the deep Atlantic waters. It passes Gibraltar again and tumbles down the continental slope but on the way it mixes with less dense Atlantic water. It settles out, initially at around 1500 m and then spreads all over the North Atlantic. This extra input of salinity from the Mediterranean is one of the reasons why the
Atlantic is the saltiest of the great oceans. Because it is so salty, the Atlantic is the driving force behind the ocean conveyor belt. Its saltiness is also the reason why the North Atlantic is warm. In the future, the effect of Mediterranean salinity may increase. Irrigation means that the outflow from the Nile and other rivers is decreasing. This is thought to be responsible for the increased salinity of the deep waters formed in the eastern Mediterranean.

**Nutrients:**
The building blocks for all ocean food webs are microscopic plant-like plankton, which contain the green chlorophyll found in all plants. They need sunlight and nutrients to grow, but when conditions are right, these microscopic plants form blooms so large they can be seen from space. Satellites can measure chlorophyll in the surface layers of the ocean. So if you look at the satellite chlorophyll pictures, you can see which areas of ocean are teeming with sea life and which areas are most like deserts. Sunlight strong enough for plant growth only occurs in the top 100 m of the ocean. Near the equator and in the sub-tropics there is always sunlight for growth but the nutrients are soon all used up. The equator is a bit special, but in all the great oceans you can see that the sub-tropics contain huge desert like areas where chlorophyll values are low. High sub-tropical chlorophyll values are found in the upwelling regions, off North-West and South-West Africa and to the west of North and South America. Upwelling also occurs along the equator. These are regions where, in the ocean temperature images, you will see low temperature due to the upwelled cold nutrient rich water. Further towards the North and South Poles, there is not enough sunlight in winter for the plankton to grow. In the winter months, nutrients are slowly mixed up from below into the ocean surface layer. In the spring, when strong sunlight returns, there are great outbursts of plankton growth and for a few months the ocean teams with life. When plants and animals die and fall to the bottom of a shallow sea, their nutrients stay within the sunlit area and so can soon be used again by the next generation of life forms. As a result, the shallow seas around continents are often the most productive areas of the ocean.

*Figure 20: Ocean currents exhibit.*
Get electric

1. Magnetic attraction: some materials are magnetic and some are not. A magnet can attract or push away another magnetic object. It does this because it has an invisible field called a magnetic field. A magnet has a North and South Pole. Due to the fact that opposites attract some magnets will stick together, and other times they will push each other away. The first ingredient to making electricity is a magnet!

2. Magnetic field: What you are seeing in the fluid at this station is effectively the magnetic field of a bar magnet. When moved, this magnet triggers a response in the tiny particles of magnetic iron which are contained within the fluid.

3. Creating a current: everything on earth (including you) is made of tiny parts called atoms. In these atoms are even tinier parts called electrons. Electrons like to be on the move! When they move an electric current is generated. Materials that let electrons move easily are called conductors. The second ingredient to making electricity is a conductive material containing lots of electrons. Copper wire is a good material for this.

4. Making a current work for you: the hand crank behind you is connected to a generator. Inside the generator are the first two ingredients for making electricity. When you turn the hand crank you make the magnet spin, and cause its magnet field to rotate too. This rotating magnetic field causes the electrons in the copper wire to move, creating an electrical current, otherwise known as electricity! A force is the third ingredient for making electricity.

Figure 21: Get electric exhibit.
The submarine

The submarine has 4 interactive screens inside it. The first screen is all about discovering Galway Bay and shows the different fauna and flora found here. The second interactive lets you do your own ROV dive around various locations off the coast of Ireland. The third interactive is of various sounds of the sea, for example, the bottlenose dolphin. The fourth interactive is about the various shipwrecks around Ireland. The do your own ROV dive interactive often freezes throughout the day. To fix this you just turn it off and on. The sound of the sea interactive often exits out of the application.

Sea sound

What is sound? Sound is a type of energy made by vibrations. Sound causes molecules in the air to vibrate as the sound waves travel from their source (like a speaker) to your ear. The pitch of sound is related to its frequency.

What is subsea sound? Acoustic scientists and engineers use beams of sound to map the sea bed. The research vessel has equipment that sends out pulses of sound, which echo (bounce) off the seafloor and return to the ship. The echoes are displayed on a screen and the researchers look at the amount of time it took for the sound to bounce back – as this is related to how far away (how deep) the sea floor is and how the volume (amplitude) and pitch (frequency) of the sound has changed – as this says something about what material the sound has bounced off. Very useful for geologists to find out what types of rocks make up the sea floor.

People use undersea sound for lots of other reasons too, including fishing, communication and navigation.
Biodegradation

Almost all natural and industrial products will eventually break down (rot) into pieces so small that they are essentially part of the natural environment again. This process is called biodegradation. Have a look in your compost bin and see biodegradation in action! Microorganisms such as bacteria and fungi, together with chemical reactions with air and water cause materials to biodegrade.

How does so much rubbish end up on our beaches? Litter can enter the ocean from rivers and coastlines, and sometimes it is dumped directly into the ocean from boats at sea. This plastic can then travel with ocean currents, washing up on shores hundreds of miles away, and many years later!

Plastic shopping bags take 20 years, tin cans take 50 years, plastic bottles take 450 years, cigarette butts take 5 years and an apple takes 2 months.

The water in the world’s oceans is continually moving, in patterns called currents. If you look at a map of the world you can see that all the world’s oceans are really part of one big global ocean. Because all the water is connected and always in motion, currents can move litter and other debris all over the world. There is one major circulation pattern – which oceanographers often refer to as the ‘Global Oceanic Conveyor Belt’ – that cycle’s water around the entire globe over a 1000 year period! So, the water you swim in down in Salthill this summer could travel back just in time for your great-great-great-great-great plus another 30 great grandchildren to swim in.
Phytoplankton, what are they and why do some of them glow?
The ocean is full of tiny single celled organisms called phytoplankton. Some types of phytoplankton are bacteria, but most are plants. Just like plants that grow on land, phytoplankton are very important for making oxygen for us to breathe. Scientists estimate that they convert at least as much carbon dioxide into oxygen as all of the plants on the planet! They are also very important food for other creatures – being at the bottom of the marine food chain you could say that all other life in the ocean depends on them.

Creatures glow through a process called bioluminescence for a number of reasons: to attract a mate, to lure prey, or to communicate with one another. It is thought that some plankton bioluminesce to avoid being eaten by predators, by flashing their lights to make their predator becomes visible to its own enemies.

Creatures of the deep

- Viper fish: huge teeth, long slim body and a bioluminescent lure on its back. The Viper fish is a ferocious predator of the deep. It can be seen motionless, waving its lure to attract prey.
- Lantern fish: shines light from their underbellies to disguise them from predators looking upwards from the depths.
- Squid worm: squid worms were only discovered by scientists in 2007. They are a type of bristle worm, but what makes them unique is that it can live on the sea bed and swim freely in the water.
- Dumbo octopus: the Dumbo octopus is named for the large ‘ears ‘on the side of its head.
- Phronima: is a tiny shrimp-like creature with huge claws. Less than 3cm long, they attack and hollow out their prey of salps, then live inside its empty carapace and reproduce.
- Sea pig: is a type of sea cucumber, related to starfish and urchins, which crawl along the seafloor. They live in depths of around 6000 m, and were first recorded by scientists in 1882.

Explore ocean depths
Habitats and marine life in Galway Bay

Galway bay is made up of a number of habitat types (habitats are places to live and grow). Habitats including reefs, kelp forests, sea caves, and open waters can all be found in parts of Galway Bay. Habitats are special places that support many amazing creatures and plants that need our protection.

In Galway Bay these habitats are protected by both Irish and European laws. Special Areas of Conservation (SACs) get extra protection from activities that might harm them – like pollution, building, and fish farming. There are 4 SACs connected to Galway Bay: Inishmore Island, Kilkieran Bay and Islands, Blackhead Poulssallah and Galway Bay (look at the map to the right).

Have you ever wondered what lives under the water? Nick knows. He is a marine biologist. He spends a lot of time diving in the deep ocean exploring a world most of us have never seen. He photographs and checks out the creatures, plants and their special habitats – together known as Marine Life – keeping an eye out for any damage to this fragile world.

1. Inishmore: Lies at the entrance to Galway Bay. It is open to the Atlantic Ocean and has a clear, unpolluted water providing its marine life with a never ending supply of healthy food.
2. Kilkieran Bay and Islands: Lies on the north side of Galway Bay. It’s clear, open water and sheltered and interconnecting bays are home to a number of protected species – the harbour and grey seal, the European otter, and birds.
3. Black head Poulssallah complex: Lies at the southwest corner of Galway Bay and has some great examples of rocky reefs and sea caves. The marine area around here has lots of habitats that need protection.
4. Galway Bay Complex: Lies on the inside of the Bay – includes parts of the Galway and Clare coasts. It also includes the area around Galway city – starting with the section of the river Corrib right outside the museum.

Nick Pfeiffer is an independent marine ecologist who monitors and assesses impacts of human activities on marine habitats and wildlife. He came to study and live in Galway in 1985 and has been diving and studying the marine life of Galway Bay ever since. Nick regularly carries out underwater biological surveys and never dives without bringing his camera gear with him. His work as a marine ecologist brings him to all oceans. Here goes Nick across the sand and splash! Into the blue green water. It’s clear down here and quiet and calm lots to explore underwater. Crabs are hiding in the kelp and seals are bobbing on the surface, otter on the reef and here’s a dolphin or a porpoise. Shark alert! And down he plunges dark and deep. He passes silver sprat and wrasses and down below he spots a ray. He loves this place, his habitat, the one and only Galway Bay.