

# Jockey Club Water Caretakers of Tomorrow Programme For Shore: Looking after Coasts and Estuaries - Unit 7

Organised by



Funded by



香港賽馬會慈善信託基金  
The Hong Kong Jockey Club Charities Trust

同心 同步 同進 RIDING HIGH TOGETHER

## About The Jockey Club Water Caretakers of Tomorrow Programme:






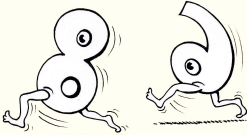
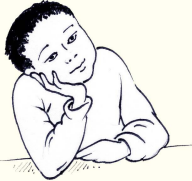
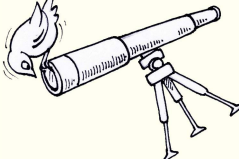
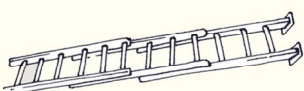

*Jockey Club Water Caretakers of Tomorrow Programme* is organised by Ocean Recovery Alliance, Ltd and funded by The Hong Kong Jockey Club Charities Trust. There are eight units in this program, and each of them is designed with you, a student in Hong Kong, in mind.

### These are the goals for your lessons, to:

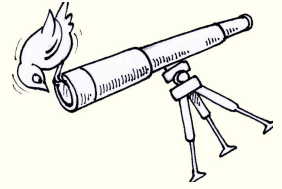
- Understand and appreciate how our water systems function on a local and global scale.
- Understand how watersheds function, and the interconnections of life within and between these watersheds.
- Be able to assess threats, such as pollution and habitat destruction, and learn how to lessen these effects.
- Be empowered to take an active role as caretakers of our water resources by sharing your commitment with your communities.

### Student introduction

- You will need access to the internet.
- In some activities using the camera in your smart phone or tablet will be useful.
- Your teacher will tell you if your work will be done on your computer, printed paper or notebooks.

Start of a new activity.		A new <b>amazing fact</b> .	
Get ready to do an <b>experiment</b> .		<b>Fast forward</b> to make your contribution to improving our world.	
Identify your <b>misconceptions</b> before your move on.		<b>Data</b> will be used to solve problems.	
Identify your <b>prior learning</b> .		These are the <b>goals</b> for this unit.	
An <b>extension</b> activity.		A <b>cross-curricular</b> activity.	

## Student aims:



## At the end of this unit, I will be able to:

- Connect the uses upstream with the effects downstream on the coast.
- Describe different coastal habitats.
- Explain the functions of coastal wetlands, and other coastal environments.
- Suggest ways to balance competing coastal uses.
- Anticipate the consequences of changes to sea level, storms, etc.
- Produce a final action piece for your communities, to reduce coastal degradation.

## Glossary

<b>Aquaculture</b>	The cultivation of fish for the purpose of agriculture.
<b>Beach</b>	A shoreline typically made up of sand or gravel.
<b>Beach Hinterland</b>	The region just inland from the coast.
<b>Boom</b>	A chain of connected timber floating across a river, lake or sea.
<b>Coast</b>	Where the land meets the sea.
<b>Coral</b>	An organism that lives in warm seas characterised by its hard exterior and its clustering together to form reefs.
<b>Degradation</b>	A decline or worsening of quality or condition.
<b>Dredging</b>	When the bed of a river, lake, or the sea is shovelled up and collected by big machinery. Dredging is used to deepen channels or land reclamation.
<b>Dune</b>	A sand mound formed by the wind.
<b>E. coli</b>	A type of bacteria that is normally found in the intestines of healthy people and animals. Most varieties are harmless but food or water that is contaminated with some strains of E. coli can cause serious illness.
<b>Estuary</b>	Where a river mouth meets the sea.
<b>Intertidal Zone</b>	The zone of coastline that is covered by the sea at high tide and exposed during low tide.
<b>Land Reclamation</b>	The action of building new land with sediments collected at sea.
<b>Litter Trap</b>	An invention to capture litter in a waterway.
<b>Littoral</b>	The area of land along the shore.
<b>Longshore Drift</b>	The process of waves moving material along the shore.
<b>Mangrove</b>	A shrub or small tree that grows in tidal and coastal areas.
<b>Microplastics</b>	Extremely small pieces of plastic in the environment that have been broken down and are less than 5 millimetres long.

<b>Migratory</b>	Referring to animals that travel from one place to another at particular times of year and often over great distances.
<b>Mudflat</b>	Piece of exposed muddy land after high tide retreats.
<b>Nursery</b>	A sheltered area used to start growing seedlings and other young plants.
<b>Oil</b>	A form of fossil fuel.
<b>Oil Spill</b>	When oil contaminates a body of water.
<b>Prevailing Winds</b>	The dominant direction from which the wind blows.
<b>Red Tide</b>	An algal bloom in the sea usually created by excess fertilisers draining from the land.
<b>Saltmarsh</b>	A habitat subjected to regular flooding of seawater.
<b>Saltwater Intrusion</b>	The contamination of a source of freshwater by seawater.
<b>Sea Wall/ Rip Raps</b>	An engineered coastal defence designed to absorb wave damage or protect against flood.
<b>Sediments</b>	Small particles and fragments of geological material.
<b>Shipping</b>	A method of transporting goods around the world by boat.
<b>Stormwater Drain</b>	Structures that transport excess rainwater from urban streets.
<b>Tides</b>	The rise and fall of the sea twice a day due to the gravitational influence of the sun and the moon.
<b>Waves</b>	Waves are usually caused by wind moving over the water's surface. A wave's size depends on wind speed, wind duration and the size of the area over which it moves.

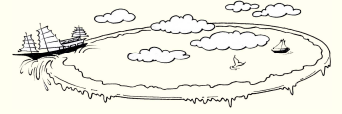


## Prior knowledge: Seaside sounds on holidays



Your teacher will play a soundtrack from the seaside.  
Close your eyes and imagine you are on your dream holiday.  
Your teacher will ask you to imagine some different things as you listen to the sounds.  
Recall your thoughts while listening to the soundtrack.

What did you see in your imagination?



What might be some of the environmental threats or safety threats to the vision you had?

## Lesson 1 - Coastal Habitats and uses


### Activity 1: Habitat and uses

A habitat is an animal's or plant's home.



Look at each photo and

- Describe the main features you can see in each photo
- Describe what you know about the habitat and the wildlife that uses the habitat
- Describe how we use these places
- Follow your teacher's instructions about researching one or more of the habitats
- Add to what you knew about that habitat.
- After your classmates have shared what they learned, complete the rest of the worksheet.

Habitat	Habitat
<p><b>Beach</b> Key features of habitat:</p> <p>Wildlife Uses:</p> <p>Human Uses:</p>	 A color photograph of a beach area. In the foreground, there is a sandy beach with several people. Behind the beach, there are several buildings, some with green walls, and large trees. The background shows a forested hillside.

## Estuary

Key features of habitat:

Wildlife Uses:

Human Uses:



## Mangrove

Key features of habitat:

Wildlife Uses:

Human Uses:



## Cliff

Key features of habitat:

Wildlife Uses:

Human Uses:



## Buildings and piers

Key features of habitat:

Wildlife Uses:

Human Uses:



### **Mudflats**

Key features of habitat:

Wildlife Uses:

Human Uses:



### **Seagrass**

Key features of habitat:

Wildlife Uses:  
(hint: fish breeding)

Human Uses:

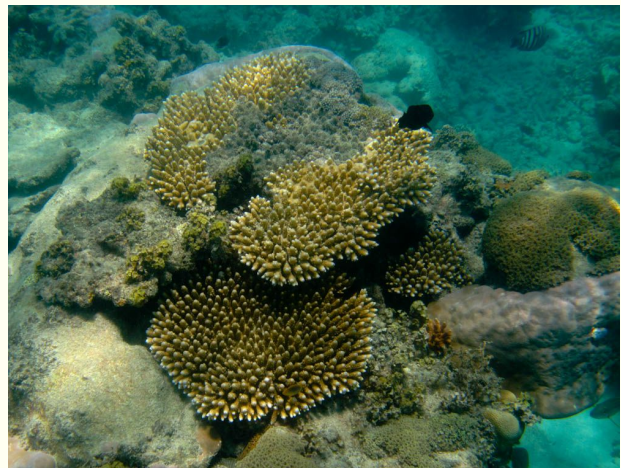


### **Coral reef**

Key features of habitat:

Wildlife Uses:

Human Uses:

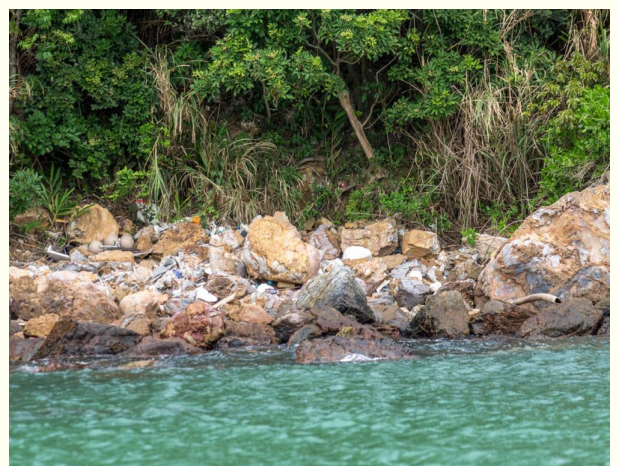


### **Rocky shore**

Key features of habitat:

Wildlife Uses:

Human Uses:



**Sea wall - boat harbour**

Key features of habitat:

Wildlife Uses:

Human Uses:



**Sea wall - city waterfront**

Key features of habitat:

Wildlife Uses:

Human Uses:



**Artificial reef**

Key features of habitat:

Wildlife Uses:

Human Uses:





## Activity 2. Google maps habitats



Review as a class what you understand about longitude and latitude coordinates.

This website has a short explanation about longitude and latitude:

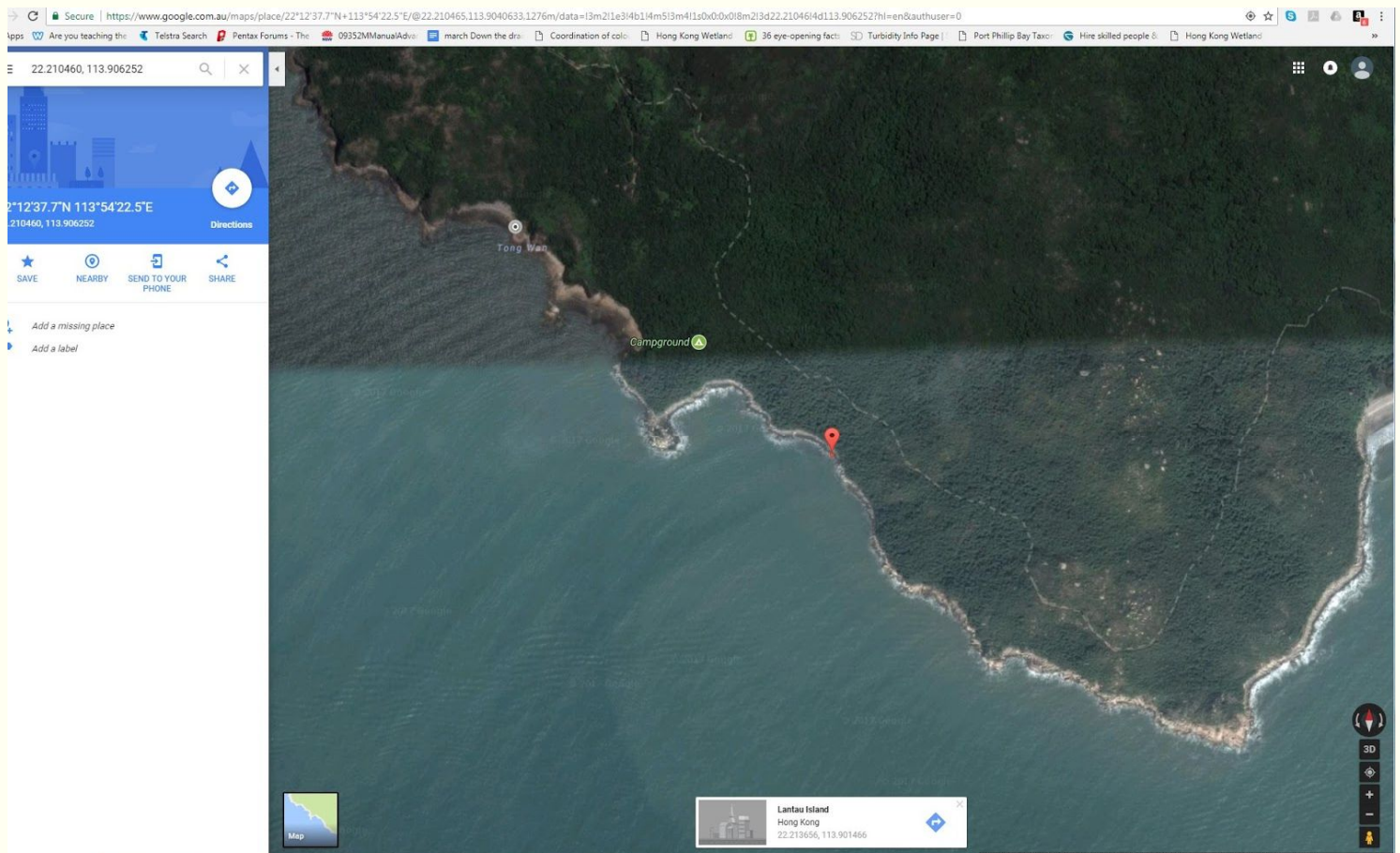
<http://www.learner.org/jnorth/tm/LongitudeIntro.html>







This short Youtube video also explains longitude and latitude:


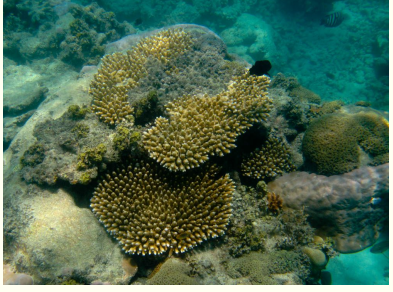
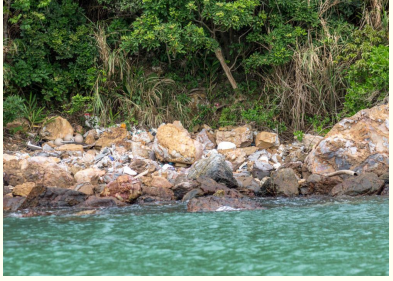

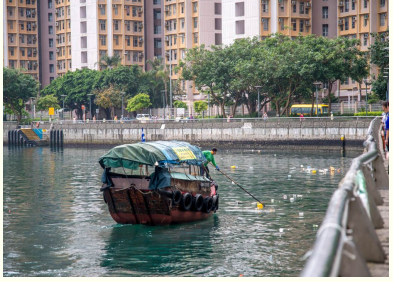
<https://www.youtube.com/watch?v=cTrsvGytGG0>

In this activity you will use Google Maps to locate one or more coastal habitats by looking for coastal features. Zoom in and find coastal features such as cliffs, reefs, coastal forests, beaches, mangroves, estuaries, etc. Use the chart below to record the features, habitats and coordinates. You do not need to find every habitat. Some habitats can only be observed if the satellite photos were taken at low tide.

1. Open Google Maps in a web browser.
2. Click on satellite box at bottom left.
3. Move around map until you find a feature of interest.
4. Click on the location of the feature on the map.
5. A white box at the middle bottom provides a general location name and the exact coordinates. Click on the coordinates.
6. These coordinates appear in the top left hand box. Copy the coordinates (highlight and use Ctrl C).
7. Paste into your worksheet (Ctrl V).
8. Then describe the coastal feature and the kind of habitat or habitats that would be found in these features.



Feature and Habitat	
<p><b>Beach</b> Coordinates: Describe area:</p>	
<p><b>Estuary</b> Coordinates: Describe area:</p>	
<p><b>Mangrove</b> Coordinates: Describe area:</p>	
<p><b>Cliff</b> Coordinates: Describe area:</p>	
<p><b>Buildings and piers</b> Coordinates: Describe area:</p>	
<p><b>Mudflats</b> Coordinates: Describe area:</p>	

<p><b>Seagrass</b> Coordinates: Describe area:</p>	
<p><b>Coral reef</b> Coordinates: Describe area:</p>	
<p><b>Rocky shore</b> Coordinates: Describe area:</p>	
<p><b>Sea wall - boat harbour</b> Coordinates: Describe area:</p>	
<p><b>Sea wall - city waterfront</b> Coordinates: Describe area:</p>	

### Activity 3. Natural coastal habitats have many benefits



**Beach** - recreation, beach sand reduces coastal erosion, sand helps to clean water, sand is home to many marine and intertidal animals.

**Estuary** - sheltered waters which are safer from storms for people and their buildings, place where fishing and safe boating can occur, location where some fish breed, home to many coastal marine animals.

**Mangrove forest** - shelters coasts from major storms, protecting people and buildings, major breeding location for many fish we eat, one of the best ways to take carbon dioxide from the atmosphere.

**Cliffs** - barrier from the powerful sea.

**Mudflats** - store carbon in the form of dead plants in the sediments, reducing our effect on climate change. They are a rich source of food for wading birds including migratory waders which move across distances such as Siberia to southern Australia.

**Seagrass beds** - hold the sand and mud together so the coast doesn't change too much and too often. Majority of fish you eat will spend some of their life cycle among the seagrass.

**Coral reef** - one of the most diverse ecosystems on Earth, a valuable tourist attraction if they are in reasonable condition.

**Rocky shore** - reduces the impact of waves and storms on the coast, home to many marine and intertidal animals.



Pick one of the coastal habitats listed above, that you have visited recently. Describe your impressions. Try to use as many of your senses as possible, in describing it.

---

---

Locate a specific place in Hong Kong that is classified as one of these types of habitats. Find some Google Images of the place that might indicate more than one of the benefits described above.

Insert a photo or draw the habitat.

Benefits of the habitat:

---

---



---

#### Activity 4. Habitat destruction - pick your disaster



The coastal environment is always changing from natural processes such as wave action, weather and storms. Humans have also had an impact along the coast. There are many threats to our coastal environment. In some cases, human activities have indirectly affected the intensifying of natural processes such as beach erosion or rising sea levels. Other activities such as dredging, trawling and land reclamation are uniquely human impacts.

Each photo and text describes an environmental impact along our coast due to a combination of natural and human causes. Explain how each of these disasters are made worse by human impact and some of the problems it causes for people and marine life. Describe how each photo is linked to human activity.

Disaster	
Climate change - more powerful storms	
Climate change - coral bleaching from higher temperatures	

Climate change - increase in sea level



Litter



Oil spills



Palm oil spill in Hong Kong



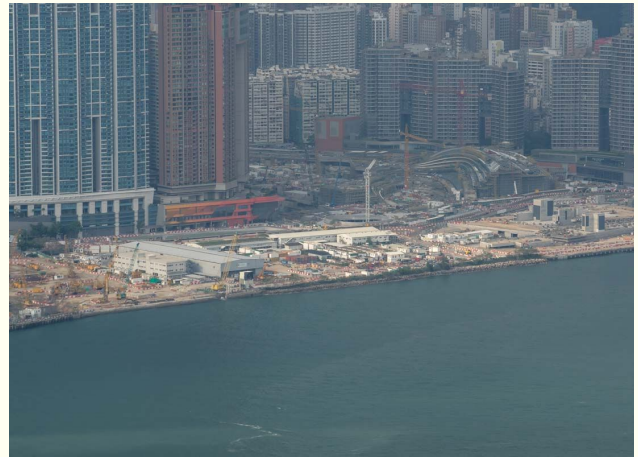
Dead reef from river pollution - seaweed and sponges growing on dead coral



Other pollution



Development



Seagrass destruction



Mangrove destruction (some mangroves in front of refinery)



### Activity 5. Welcome to my home

Choose any animal that lives along the coast. It could live on the beach, in the intertidal zone, under the sea, along a cliff, etc.



My marine animal is:

---



Insert a photograph or draw the animal:



Find the answers to these questions to help you describe your chosen animal.

<b>Search for an answer</b>	<b>My research</b>
How does the animal get oxygen? What features does it use?	
How is the animal affected by temperature? What climate is it found? Can it cope with extreme changes?	
If it can survive out of the sea, what features does it have to help it?	
Does it live in the intertidal zone where the sea comes and goes with the tides?	
Where does it breed? What is special about its breeding?	
If it is being hit by waves, how can it survive?	
In what part of the marine environment does it spend most of its time?	
What different ways can it move? What features does it have to help it move?	
How does it protect itself?	
What does it eat and what features does it have to obtain food?	
What is special about where your animal lives?	

## Lesson 2 - Coastal Geomorphology



### Activity 1. A changing coastal environment

Watch this video to see how erosion and the movement of sand and mud shapes the coasts. <https://www.youtube.com/watch?v=mUYnxbHeyi8>

#### Conducting experiments:

1. Read through the setup for the experiment.
2. Record your prediction for the outcome of the experiment.
3. Gather the materials that are needed.
4. Find a suitable location to conduct the experiment.
5. Review all safety requirements including handling glassware safely and using heat and heated substances. Ask your teacher if you are not sure. Report any accidents.
6. Record your observations as you complete the experiment.
7. Clean and return equipment.

#### Experiment: A model of coastal change

In groups you will build a clay model of a particular feature of coastal geomorphology.

Imagine how the coastal landscape might change over many decades. Changes could be due to weather, storms, waves, currents, development, climate change etc. Show three different time periods in which it is evolving into something different.

#### Materials:

- Modelling clay
- Large tray to make the model on
- Some blunt knives for scraping clay
- Digital camera e.g. tablet or smartphone

#### Method:

1. Each group is provided with a lump of clay, a tray and a couple of blunt knives for shaping details in the clay. You could also use pencils and rulers to model the clay.
2. Decide in your group which landform you will model.
3. After making the model, take a photo. Remember at what angle the photo was taken.
4. Decide what kind of events (waves, storms, climate change etc.) are shaping the model.
5. Remove or reshape the clay to show how the events have shaped the model.
6. Take another photo. You might like to place a note with the model describing the events.
7. Decide how future events might shape your model.
8. Shape the model again to reflect the events you have chosen.
9. Take another photo. You might like to place another note with the model describing the events.

Write a short report using the photos that were taken, explaining your reasoning for the changes in the landscape.

As a class share how all the models changed and what events led to the change.

## Activity 2. Coastal landforms and their use



Use the powerpoint “Coastal landforms” to explore the different kinds of landforms along the coasts. As a class answer the questions on each of the slides. Which landforms are you familiar with and which examples have you been to? Look at each slide for evidence of action from weather, waves, currents, people, etc.

Identify some of the ways people use different landforms. Which landforms are used for:

- Recreation
- Housing
- Fishing
- Fish farming (aquaculture)
- Transport
- Kept as natural habitat



This sign is a safety and warning designed for another country. Choose a waterfront you are familiar with around Hong Kong. List the things people do along that waterfront. Identify the risks and dangers in the area. Draw a safety sign to warn people of the dangers. Alternatively, draw a sign that tells them what not to do in order to protect the environment. Try to provide compelling reasons for taking good care of the area. Try to keep your words to a minimum.





### Activity 3 – How much development is too much development?

Use the Powerpoint called “Development” along with the activity sheet below, called “Development.” Go through the Powerpoint and discuss each image and compare the images.

Go through the Powerpoint again and choose one of the images. Respond to the following:

- How is the area being used?
- How has the area been changed over time?
- What are the best features of the area?
- How might the particular use in the area affect the environment and the local community?
- Provide your opinion and reasons for whether or not you believe that the level of development seen in the photo is too great.
- Suggest how government has controlled development.



How would the photo look different and how would the environment and community be affected if there were:

- A large factory near the coast?
- A large freeway built along the coast?

#### Development

Choose **one** photo from the powerpoint and respond to the questions:



How is the area being used?

How has the area been changed over time?

What are the best features of the area?

How might the use in the area affect the environment and the local community?

Provide an opinion and give your reasons you believe if the level of development seen in the photo is too great.

Suggest how government is controlling the development at this location.

### Lesson 3 - Coasts - Who Needs Them?

#### Activity 1. This is fun



The sea has a special attraction for many people around the world. Are you attracted to the sea? What activities do you like to do? Which activities have you done? Which would you like to do?

*Pontoon used for snorkelling and diving on a coral reef.*

What would you like to do on a coral reef?

Can you have this experience in Hong Kong?



*Busy beach during a Mauritian holiday*

Would you see a busy beach like this in Hong Kong?

Which are the best Hong Kong beaches?



### *Surfing in Bali*

Would you like to try surfing?

Would you go to Bali to spend time on the beach and in the sea?



### *Tourist attractions in Singapore*

How do tourist attractions help the economy?

What would you like to do at a tourist attraction on a coast?



### *Fishing in Hong Kong*

Would you want to fish?

Why do some people like fishing?



### *Boating in South Africa*

What kinds of boats have you travelled in?

What activities have you done on a recreational boat?



*Walking along a path in Hong Kong*

How often do you go for a recreational walk?

What are the benefits of walking along the coast?



*Party boat in Melbourne, Australia*

What makes a party on a boat different?

What would you do if you organised a boat party?



*Wedding on a Bali beach*

Why do you think these people went to Bali to have a wedding?

What special occasion would you like to celebrate on a beach?



*Windsurfing in Mauritius*

Would it be safe to windsurf around Hong Kong?

Which water sports would you like to try?



## Activity 2. World populations



### Amazing fact

Half the world's population lives within 200 km of the coast.

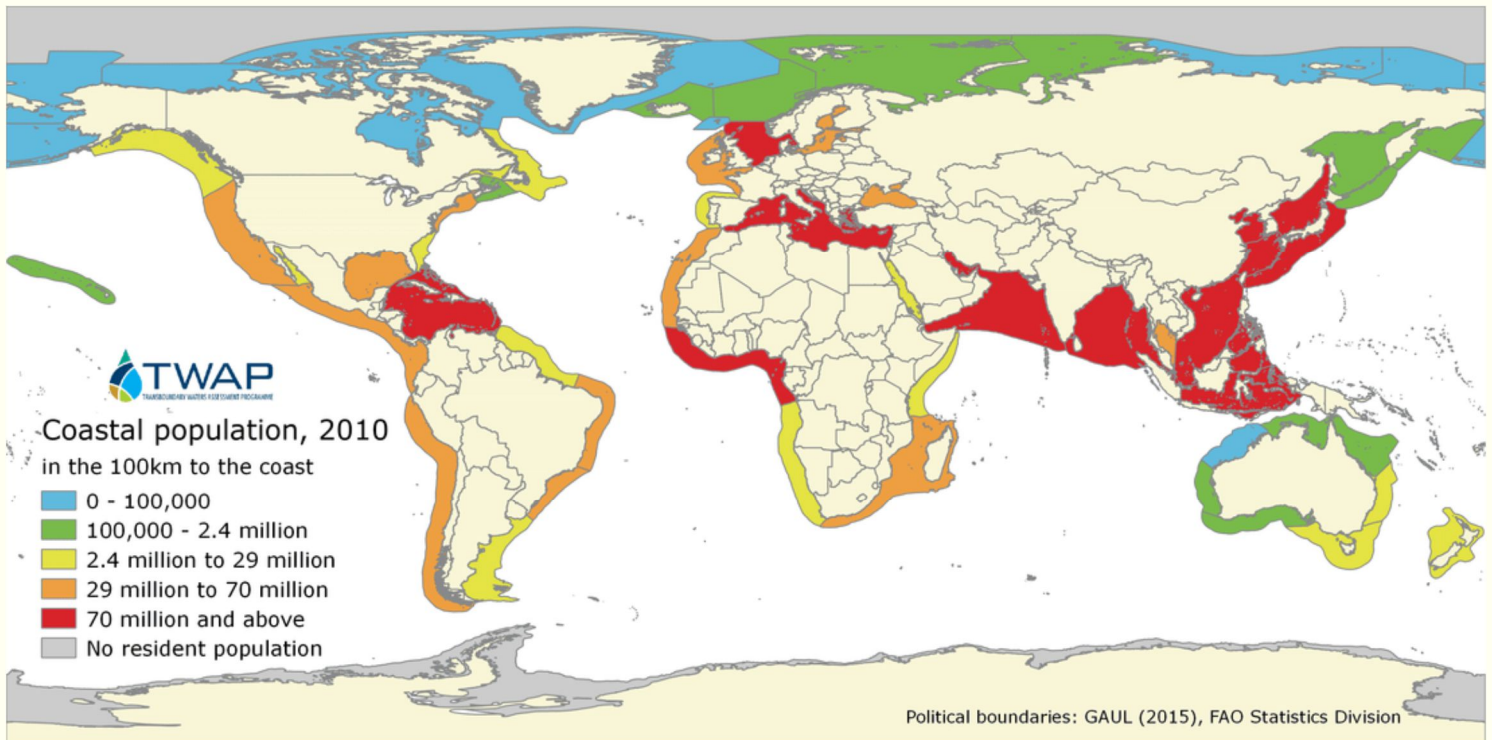


Why do you think so many people want to live on or near a coast?

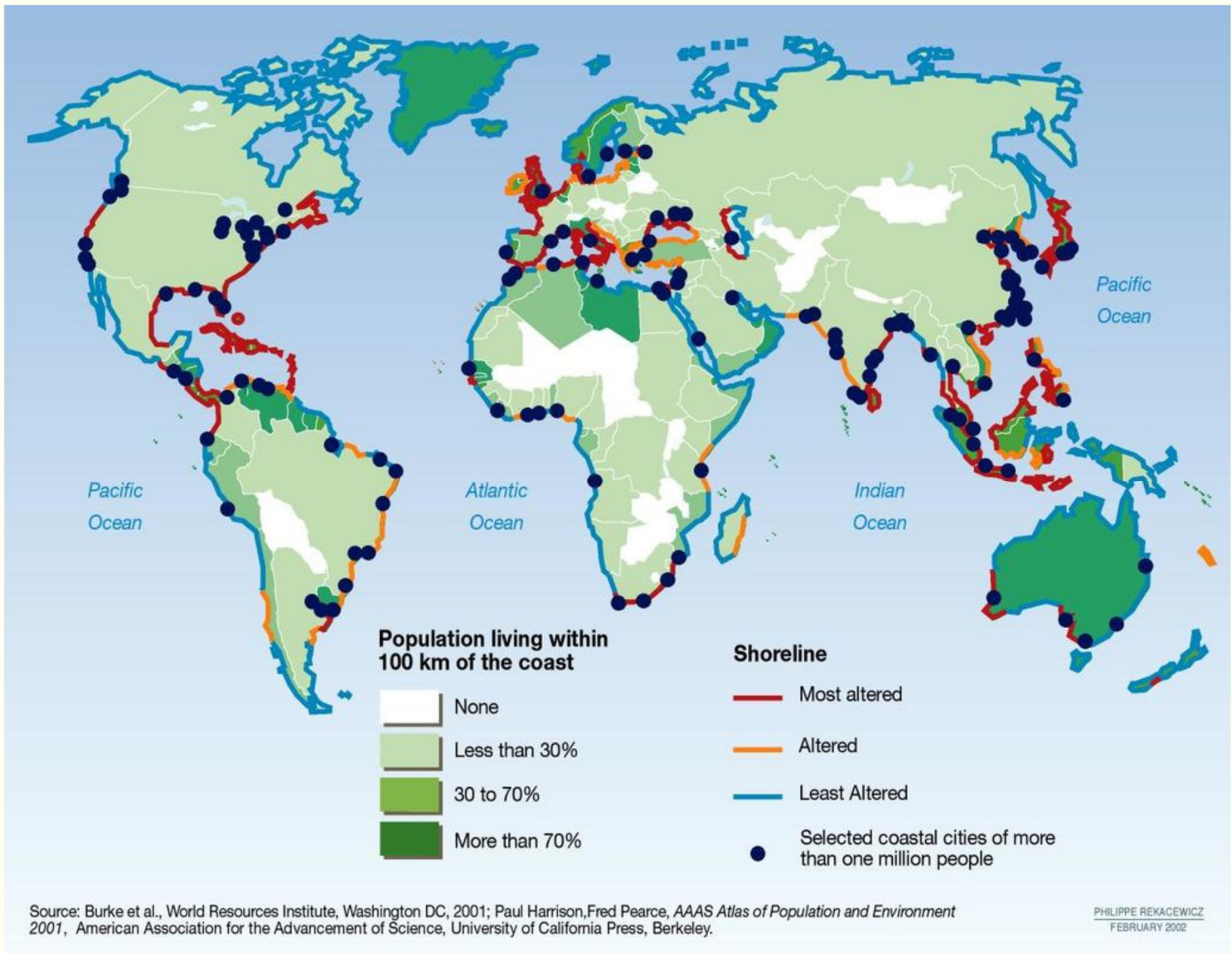
---

---

These two maps use different criteria to show where populations are concentrated along the coast. Large populations of people along the coast have a greater impact on the sea and coastal habitat. Countries that can't provide services such as sewage and rubbish disposal will have an even a greater impact on the sea.







Source <http://www.thegeographeronline.net/crowded-coasts.html>

Interpret the two maps. Which regions have the highest coastal populations? Which regions would you expect to have the greatest impact along their coasts? Which regions would you expect to have the least impact along their coasts?

---



---



---



---



---



---



---



---

### Activity 3. Indigenous peoples



#### Amazing fact

The Australian Aboriginal peoples have had stable cultural groups for over 50,000 years. This means that before recorded history, this group of people had traditions, language, and a way of life that has endured to this day.



#### What does the term “Indigenous people” mean?

Indigenous people are those people who are identified as the original inhabitants of a region. They usually have cultural practices that go back thousands of years. There are Indigenous groups across the world. Most are losing their unique languages and their cultural traditions.

#### Torres Strait Islanders

Torres Strait is located between Australia and Papua New Guinea. There are many islands within the strait. It is part of Australia. Two islands have towns with large communities. Other islands have small communities and many islands are not inhabited. The Indigenous people of Torres Strait are seafaring, having always made their living from resources from the sea. Today, families are more likely to own a small powered boat than a car. The people still prefer to eat traditional foods from the sea.

Two of the Islands in Torres Strait.



An Elder with a traditional boat under construction. Locals have a deep understanding of season change, currents and winds.



Using modern and traditional methods to catch fish.



Family members travelling on the sea between islands like people on land using cars



The islands have not escaped the dumping of waste in inappropriate places.



Students learning the different ways to stay safe at sea and operate small boats.



### Indigenous people using the sea: research.

Materials

Writing and drawing material

Large sheet of paper for illustrating

Choose an Indigenous people that live by the sea. Find out how these people lived in the past as well as in the present. For Indigenous people living on many Pacific Islands, many of their traditional ways of life are still practiced.

Produce a labelled diagram that shows how these people use the sea for food and cultural activities.

### Activity 4. Spiritual meaning of the sea

The idea of “spiritual” for some people has ties to religion. For many people “spiritual” refers to how their spirit or soul provides a feeling of wellbeing and understanding of their world. The opposite of spiritual is material, which relates to things we can perceive with our senses.



Hong Kong has a rich spiritual and cultural tie with the sea. There are bronze age stone carvings in three or four different sites around the territories, most notably on Cheung Chau island or Clear Water Bay. The yearly festival at Tin Hau temple is where people make offerings to the god of the sea.



Are you one of the many people who have spiritual feelings when you are deeply immersed in a special place?

The places that give me the deepest feelings are:

---

---

Tam Kung temple is close to the sea in Hong Kong 22°16'58" N 114°13'50" E (cut and paste coordinates into Google Maps). It probably once had a beautiful view of the sea, but now you can see that the area is full of light industry.

Use Google Images to find a photo of a temple by the sea that you think would make you feel good. You could use the search words - "temple, sea". Where is the temple? What religion does it represent?

---

---

Then use Google Images to search - "spiritual, sea". How are the photos different?

---

---

Looking at the photos, what kind of places by the sea might help you feel spiritual?

### Activity 5. Feeding the world



#### Amazing fact

Most of the sea and ocean fish we eat, spend part of their early life among sea grasses or mangroves.



#### Will we run out of fish?

There seems to be plenty of fresh fish at the local market.

Fish consumption is highest in Asia followed by Europe. It's also important in island states and coastal regions in poorer countries.

However, some popular species of fish which were cheap to buy have now become expensive because the great supply is no longer there. Some species have become more popular, but these species are becoming harder to catch. In the past, the world's fishing industry consisted of a large number of small fishing boats with basic fishing equipment. It provided millions of families with an income.

More and larger boats were constructed and they used larger nets and sonar to track the fish. As they got even larger, some ships can now operate as factories, packaging and freezing the fish. These large ships take vast quantities of fish. For many fishermen using small boats from coastal fishing villages and towns, their catch is dropping. In many cases, very large fishing vessels are taking more fish than can be replenished.



Have a look at this short animated video

made by a Middle School student in Hong Kong who is passionate about fish and the issue of seafood sustainability:

<https://www.youtube.com/watch?v=r7E61lcQcNc>



What is your favourite seafood?

---

Where does your favourite seafood come from and how is it caught? (hint: search on the internet for the brand as well as the species)

---

---

---

**Amazing facts: Seagrass food web**

Seagrass is home to a huge variety of animals. Only dugongs and some turtles eat seagrass. The seagrass is plastered with millions of tiny animals. All the other animals find the seagrass meadows an excellent home.



Dugong



Seagrass



Seagrass creatures



## Lesson 4 - Our changing coast

### Disgusting fact

Over half the seabirds across the entire world have plastic in their stomach. Within 30 years almost all seabird species will have plastic in their stomach.

<https://theconversation.com/seabirds-are-eating-plastic-litter-in-our-oceans-but-not-only-where-you-d-expect-46740>

<http://www.abc.net.au/news/2015-09-01/scientists-warn-almost-all-seabirds-will-ingest-plastic-by-2050/6738862>

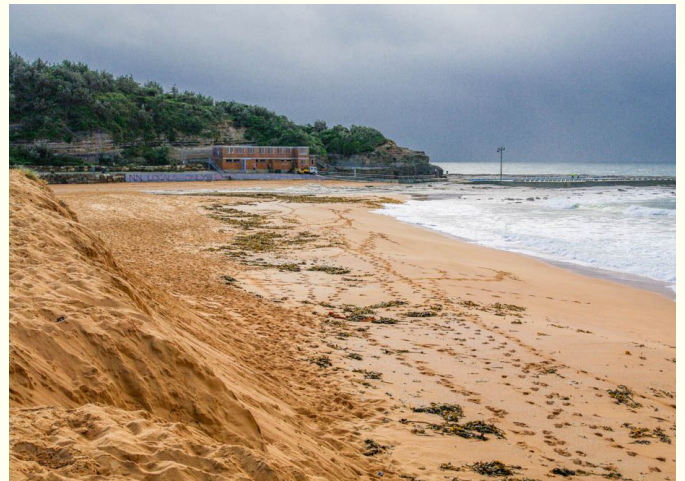


### Activity 1. Nature at work

Have you ever been knocked over by a big wave? Big waves are very powerful and they are constantly changing the coast. They move around thousands of tonnes of sand, eat away at cliffs and grind rocks down to sand.



Hundreds of metres of beach and a big sand dune have been eaten away in one big storm. Can you explain the consequence of this change?



How has the rock been shaped by waves, wind and changing temperatures? What will happen to the hanging rock over time?



Why are small boats placed in ports surrounded by sea walls?



What do you predict will happen along this beach over the next 10 years? Do you give the tree any chance to survive?



Why have these rocks been cemented into a sloping wall?



Coastlines get rough treatment so its inhabitants need to be rather special. Imagine being any animal living in the intertidal zone. This is the area between high tide and low tide. The animals must cope with:



- Crashing waves
- Hot summer days in the scorching sun
- High levels of salt as they dry out in the sun
- Freshwater rain
- Getting covered in sand
- Birds and other animals trying to eat you
- Pollution in the water

A Closer Look

How do these two animals survive the intertidal zone? Remember learning about adaptations in Unit 4? Can you see any adaptations that might make life easier for them in the intertidal zone? Write this in the boxes below.

Learn More

Research limpets and sea urchins and add a few bullet points for each in the boxes below.

<p>Limpet</p>	 A photograph showing two limpets on a wet, mossy rock. The limpets have dark, rounded bodies with distinct orange and brown stripes along their edges. They are positioned on a greyish-green rock surface.
<p>Sea urchin</p>	 A photograph of a sea urchin in a shallow tide pool. The urchin has a dark, almost black, spherical body covered in numerous sharp, reddish-brown spines. It is surrounded by wet rocks and some green algae.



## Activity 2. Land reclamation



There is a lot going on in this photo. It was taken from The Peak, looking over Kowloon.



How are the land and sea being used?

---

---

---

What changes have been made to this area?

---

---

---

What areas do you think have been reclaimed from the sea?

---

---

Hong Kong is a growing city by the coast. Like many coastal cities around the world it has few options for growth. One of these options is to keep building out into the sea. What is your opinion about the best way to manage Hong Kong growth? Is land reclamation an appropriate way to go or should there be limits? Do you think the effects of climate change might be a future issue for these areas?

---

---

---

---

---

---

---

### Activity 3. Dredging our ports - good or bad?



Dredging in the sea is usually the removal of sand but sometimes mud from the bottom of the shallow sea. It is done for a number of reasons.

- In ports, the channels where ships need to pass fills up with sand and other sediment. These channels must remain deep or ships will become grounded.
- Dredging is also done for land reclamation projects. The land needs to be built up, so the dredging materials are used as landfill.
- In some places around the world, recreational beaches lose their sandy material during storms. Dredging is used to replace the lost beach sand.



Hidden in this sand and mud are our polluting chemicals. Dirty industrial processes from the past to the present that have built up, don't cause much trouble until stirred up by the dredging process.

### Class discussion

Is it better to dredge channels for ships or to stop dredging so the sea isn't polluted from the nasty chemicals in the sand and mud? Which might be the bigger danger, pollution in the sea or ships running aground? What is your opinion about other impacts of dredging on the environment?



## Activity 4. Litter disaster



It isn't hard to find the effects of litter around Hong Kong. Litter along with other pollution gets washed down into the drains. The drains run into the sea or rivers. After rain the roads are washed clean, but the sea becomes more polluted. When lots of litter and pollution come out of drains on dry days, it is often because people have washed their dirty pavements and gutters and poured oil and grease down the stormwater drains.



Your bay:  
What can you see?

Where did it come from?



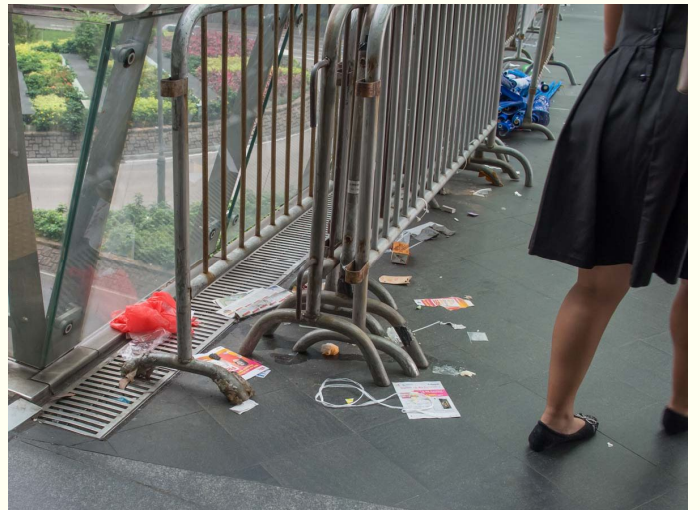
Your beach:  
What can you see?

Where did it come from?



Your walkway:  
What can you see?

Where did it come from?

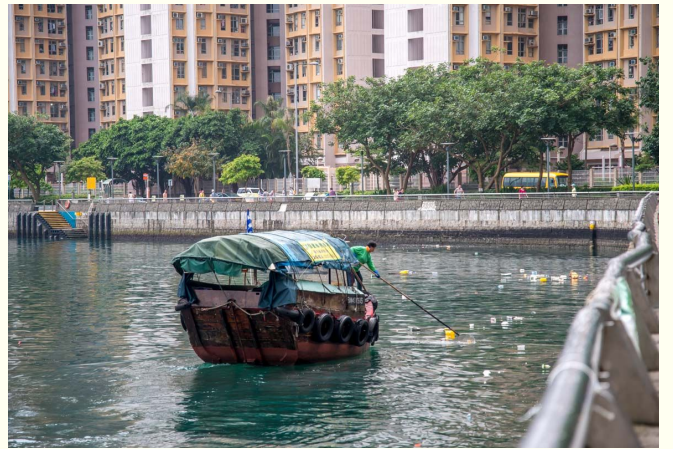


Your mangroves:  
What can you see?

Where did it come from?

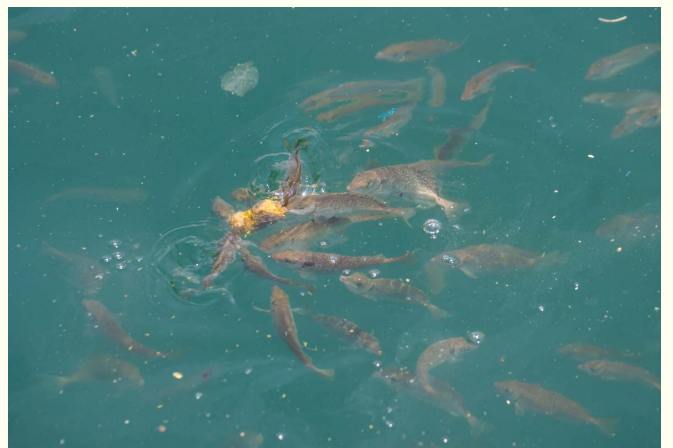


Cleaning up some of the litter:  
What can't this boat clean up?



Fish eating litter:  
How might it affect the fish?

How might it affect people eating the fish?



What happens when this dead fish which died from pollution, is eaten by an eagle?



## Activity 5. Finding better solutions



### Amazing fact

Mangroves can store more carbon in the form of dead leaves and branches than a rainforest.



### Protecting our coasts

Hong Kong will always be lashed by monster storms which can damage our buildings and roads along the coast. We could get even bigger storms due to climate change.

Mangroves are one of nature's ways of protecting the coast. They grow in the intertidal zone and their roots need to be regularly covered by water and also exposed to the air. The roots hold together all the nutrient-rich mud. The mud is home to an amazing range of animals.

#### Mangroves

How do you think these small trees protect the land during big storms?



Why should we protect mangroves and encourage more mangroves to grow?

---

---

---

If we build roads and buildings by the sea, we must then protect them from the sea. These are some structures that are used to stop the sea from reclaiming the land.

Rubble rock seawall



Jumbled up, odd shaped, interlocking concrete blocks



Concrete sea wall



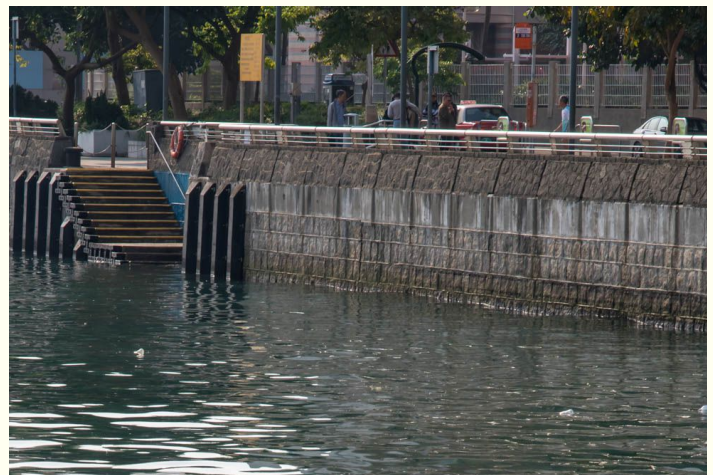
Harbour wall



Large, carefully placed rocks



Coastal wall to stop the land behind falling in



Which of these structures are best to stop storms causing damage? Think about what happens when you spill water on a floor, on a carpet or on soil.

Which of the structures do you think would be better for wildlife and why?

---

---

Which structures do you think would have the least wildlife and why?

---

---

### Activity 6. Design a reef that protects the coast

These are examples of structures that marine animals including marine birds live and breed on.



The pylon on this pier is encrusted with seaweed, marine worms and shellfish.



These pylons are home to oysters.



These seals live and breed on this special platform built just for them.



These large concrete domes are one type of artificial reef.



Thousands of birds nest on this artificial island. Underwater are magnificent seaweeds, sponges, fish and much more.



This is what it looks like below the artificial island.



This 100 year old Antarctic shipwreck is home for a colony of terns.



One of the many breeding terns.



These platforms have been constructed for cormorants to build their nests.



Shipwrecks quickly become home to an amazing range of marine life.





## Design an artificial reef

1. What will your reef be made from?
2. How will the reef be built without polluting the sea?
3. What animals and plants would you like to live on your reef?
4. Where will your reef be built?
5. How will you prevent boats and ships from running into it?
6. Will your reef need protection from fishing and other human activities?
7. How large will the reef be?

Make a labelled diagram of your reef and include some of the animals above and below water and any signs or signals you would have around the reef.



## Lesson 5 - Balancing competing interests

### Activity 1. Flash points

Choose one of these issues that requires solutions or pick an issue of your choice that affects the marine environment. Do not have more than three people in your research group and make sure the tasks are divided evenly.

When doing your research about marine issues, eg animals, plants, beach etc:

- How does it depend on the marine environment?
- What is special about it?
- Do we get benefits from it?
- How is it being affected by people?
- What is being done to reduce the impact?

What are your recommendations? Explain how we might be able to have development and still look after the animal, plants, beach, etc. that you have been investigating. The following are some examples of issues you might research:

### Sea turtles

Sea turtles are in decline.

Many of the beaches that they once nested on have been developed.

When nesting, turtles get confused by street lights and head inland instead of back to sea.

People and their pets disturb their nests.

They get hit by boats.

They eat plastic because it looks like jellyfish.



### Pink Dolphin

The number of pink dolphins around Hong Kong waters have been steadily declining. There are less than 100 of these dolphins left. The few that are left are tourist attractions.

They remain inshore so they are vulnerable to human activity.

Dredging the seabed stirs up the old pollution hidden in the mud and sand from many years ago affecting the health of all sea life.

<http://www.hkdolphinwatch.com/>



### Mangroves

Mangroves protect the land behind them from big storms. They are also home to many juvenile fish.

Mangroves have been cleared for land reclamation, to construct ports and because people in the past didn't understand their value. Often mangroves die and we have no idea why.



### Beach access

On the other side of these light industry buildings is the sea. Hong Kong provides good access to the waterfront, but there are many places people are blocked off from going. In other countries there are private beaches that are parts of resorts and other people are blocked from using them.



### Residential development

In the past, most people lived in small dwellings and built whatever they wanted on their land. Areas with large populations require good planning. Does Hong Kong have good solutions for protecting the environment when they build new residential areas? What can be improved?



### Loss of mudflats

Mudflats may not look attractive to you, but they are home to vast numbers of mud-loving creatures which are food for some of the world's most amazing animals. Hong Kong mudflats are used by migratory waders as they move between the northern hemisphere where they breed (e.g. Siberia and Alaska) and places like Australia where they holiday. When mudflats disappear, the birds that stop over to recover can also disappear.



### Save our hermit crabs

Have you ever played with a hermit crab by the sea? They are found around rocky areas in the intertidal zone and down below the waves. When their rocky homes get covered during development there are fewer homes for hermit crabs and many other fascinating marine creatures.



### Nothing is safe

This is a dead albatross on a beach. It's likely its death isn't natural. It may have swallowed fish hooks or litter drifting in the sea. There may have been a fish shortage and it starved. It could have crashed into a ship's mast at night. They normally have a long life, so we can assume this albatross death was premature.



## **Marine fish need somewhere to breed and grow**

There can be many reasons why some fish stocks in the sea are lower than others. Besides fishing sustainably, we need to protect the habitats where fish breed and their young grow. The small young often live in nutrient-rich habitats such as mangroves, seagrass and estuaries. These habitats need protection if we want to catch fish in the sea.



Decide how you will present your report on your research topic. You could use a Powerpoint presentation, a poster, write as a formal report, make a podcast, do a TV interview using a video camera etc.

## **Activity 2. Plan a coastal excursion**

### **Planning to visit the sea**

Design your own study of a seashore ecosystem and gather data to be analysed, interpreted and presented back at school.



### **What will you investigate? Here are just some suggestions:**

- Describing how organisms are adapted to living in the intertidal zone.
- Mapping how organisms are distributed in the intertidal zone.
- Measuring the species biodiversity.
- Describing the difference between organisms.
- Comparing niches along the coast.
- Comparing the diversity of living molluscs in a pools and rocky platforms with the dead empty shells on the beach.
- Finding evidence of human impact.
- Recording the type and density of litter that is found.
- Comparing rocky areas where people walk and don't walk.
- Recording visitors' behaviour including what they allow their dogs to do.
- Evaluating the signs on the beach if they are effective in encouraging safety and conservation.

### **Develop an investigation to gather and record data**

Divide up into groups in which you are likely to be most productive.

You will be developing at least two agreed investigations to be done on the coast. You will need to submit your plan for investigations so the teacher can make comments and ask for modifications.

What is your brief? An example of an investigation brief is below.

### **Getting organised:**

- Who is in the group?
- Describe what the group will be investigating.
- Describe the kind of data the group will record.
- List any units of measurement students will be using.
- Explain how the group will go about gathering data.
- Explain how the students' method of collecting data is scientific.
- Design a data record sheet for the data. How will the data sheets remain dry?
- Identify what information the group needs to gather the data.
- Identify what equipment the group needs.
- Design simple equipment if needed.
- Identify other equipment that is required.
- Explain how sensitive equipment will remain safe, eg cameras.
- Explain how the group will remain safe.
- Explain how the group will avoid damaging the area.
- How long will the investigation take?
- Provide the teacher with the plan for the investigation for the teacher's comment.
- Depending on the teacher's feedback make modifications to the investigation plan.

### **Gather necessary equipment:**

- Gather the equipment you need.
- Decide what equipment is too risky to take to a wet, sandy and salty environment.
- Discuss the best way to transport equipment.
- Identify the best way to keep equipment safe.
- Identify the best way to make sure equipment is not lost.

This is a photo of a moderately expensive digital camera that has fallen into the sea and is destroyed. The owner understood their camera could not be fixed when it fell into the water and didn't bother to fish it out.



### **Gathering data in the field:**

- If there aren't toilet facilities at a safe walking distance from the coast, make sure you use the closest public toilet facility before you arrive at the coast.
- On arrival at the coast revise the most important issues starting with where students may go and can't go. Remind yourselves of the safety and conservation codes. Secure food from the sun, birds and the wind.
- Go over the time you have on the coast and when you need to start the investigation.
- Ask your teacher for help as soon as you feel stuck over what you need to do next.
- The teacher may prefer to gather all the data sheets before you return to school.
- Confirm all the equipment is back at school.

### **Analysing data and presenting to class**

- Present and describe your data. Where appropriate, data should be presented in a graphical form along with tables explaining what their data means.
- Analyse your data: What conclusions does the data enable you to reach?
- Develop a short report that can be written or presented as a PowerPoint, etc. to the class.

### Activity 3: Your Coastal Visit

This activity involves producing a small booklet about your coastal visit. Follow your teacher's instructions about this.



### Activity 4. Looking forward

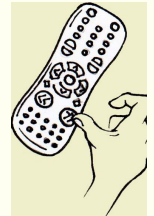
There are many community projects you can become involved in, or you can start your own community project. Before you get started, define your goals and the amount of time you will be able to spend on your project. Have a look at the following suggestions:

#### Ready-to-go community projects:

- **Beach cleanups:** Join Hong Kong Cleanup <http://hkcleanup.org/>
- **Use your smartphone to monitor your most littered coastlines.** Watch this video from Ocean Recovery Alliance <https://www.youtube.com/watch?v=ABXANevSYyq> and <https://vimeo.com/132602003> and then download the app to your smartphone.
- **Grate art:** Use your artistic talents to explain to your community that their litter and pollution goes down the stormwater drains and pollutes the sea. <http://www.oceanrecov.org/other-projects/hong-kong/grate-art.html> and <https://www.youtube.com/watch?v=plII3YjRyIM>

#### Design your own community project

The following are just some suggestions. You can come up with some of your own as well!



- **Educate on plastics:** Design your own community education project on plastics. You might like to use available resources such as <https://www.youtube.com/watch?v=ABXANevSYyq> on social media or other methods for networking with your community
- **Recreational opportunities:** Make an online travel guide on the best places for your community to enjoy their coastal environment. Provide examples of what people can do to enjoy the coast.
- **Field trips to the coast:** Suggest field trips to other schools so they can also appreciate and learn about our coasts
- **Storm surge protection ideas:** Suggest ideas to your community about how we can reduce the impact of storm surges. Collect a wide range of ideas from around the world so your community can see what is possible.
- **Tree planting/habitat improvement possibilities.** Have a look at what other countries are doing to use nature to help protect their coasts. Make your own version that suits the community and environmental needs of Hong Kong. Go out and sell your ideas. Anyone can make a start.
- **Compare nature at work on our coast.** Use cameras and GPS coordinates to document the most impressive coastal land formations carved out by waves, storms, wind and rain. Share the photos on the internet and get others to contribute.
- **Crystal ball predictions:** Predict how the coast will change over time due to natural events, human activity and climate change impact. Be realistic. Explain the dangers but don't exaggerate the problems. Look at the alternative future scenarios.

## **Acknowledgements**

The Ocean Recovery Alliance thanks The Hong Kong Jockey Club Charities Trust for their generous funding support on this education programme.

**Project manager:** Doug Woodring

**Writer, photography and design :** Bob Winters

**Curriculum manager and editor :** Charlotte Charny Nielsen

**Editor and school outreach:** Alex Hale

**Additional thanks:** Jasmine Nunns and Sandra Merazzi

© 2017 Ocean Recovery Alliance and Authors.

Outside the school environment, the text, photos and artwork may not be reproduced, except where permitted by the relevant Copyright Act. These materials may not be modified and distributed by print or electronic means without written permission. Teachers may modify these education materials for the use of their students and school provided it is not distributed any further. Those wishing to reproduce part of this publication must submit their application to the Ocean Recovery Alliance. [www.oceanrecov.org/contact-us.html](http://www.oceanrecov.org/contact-us.html)