Under the Wharf

Turning up the heat on marine communities

An educational resource guiding students to investigate warming in the ocean

NEW ZEALAND MARINE STUDIES CENTRE
UNIVERSITY OF OTAGO

CURIOUS MINDS
HE HIHIRI I TE MAHARA

UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND
SAPERE AUDE

About Us

The New Zealand Marine Studies Centre (NZMSC) is part of the University of Otago's Department of Marine Science. It showcases marine life from southern New Zealand waters and provides expert knowledge and education about New Zealand's marine environment.

The NZMSC educational programmes involve students in the excitement of scientific discovery, help them develop knowledge and skills, and encourage individuals to take responsibility and action for the future of our ocean resources.

New Zealand Marine Studies Centre
Phone (03) 479 5826 | Email marine-studies@otago.ac.nz
www.marine.ac.nz

Acknowledgements

This resource has been supported by Curious Minds (Ministry of Business, Innovation & Employment) through the Otago Participatory Science Platform, and the University of Otago.

This resource was written and designed by Jessica Moffitt with assistance support from Sally Carson and the NZ Marine Studies Centre team.

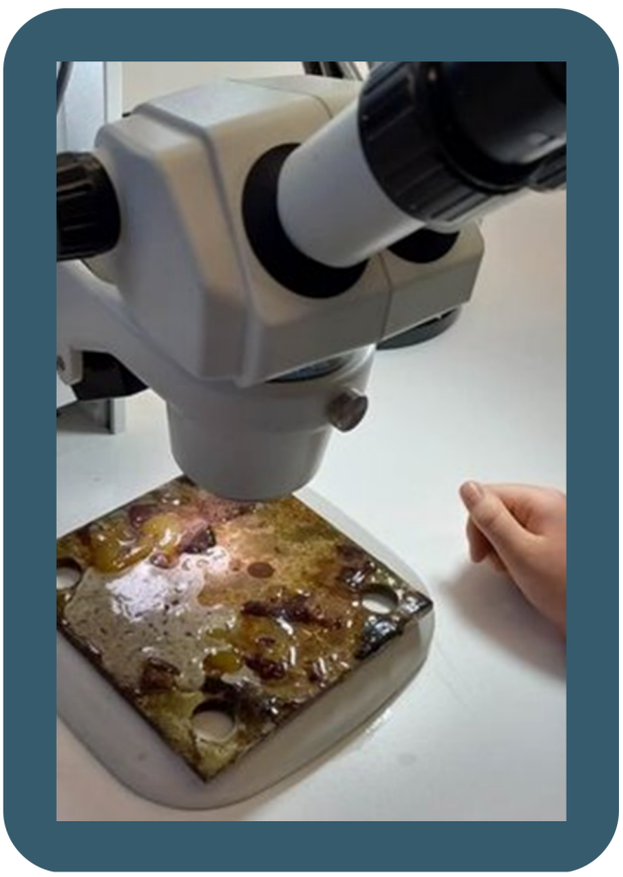
Table of Contents

Under the Wharf
What to expect?

Under the Wharf is a self directed marine monitoring programme where you can investigate the settlement, growth, and tolerance of benthic species under seasonal and future warming conditions.

The Under the Wharf project has developed tools for schools and community groups to measure change in the ocean environment at a local level. Here you will have the chance to explore ocean warming and capture stories of marine species to give meaning to scientific data, through completing the activities and monitoring your own settlement plates.

This is an excellent project to extend students with an interest in science and could be used to guide students in the design of a science fair project.



Students will need access to coastal wharf areas and will require appropriate supervision.

Subject Area:
Science - Nature of Science

Level :
Upper primary/Intermediate/Lower secondary

Aims and Objectives

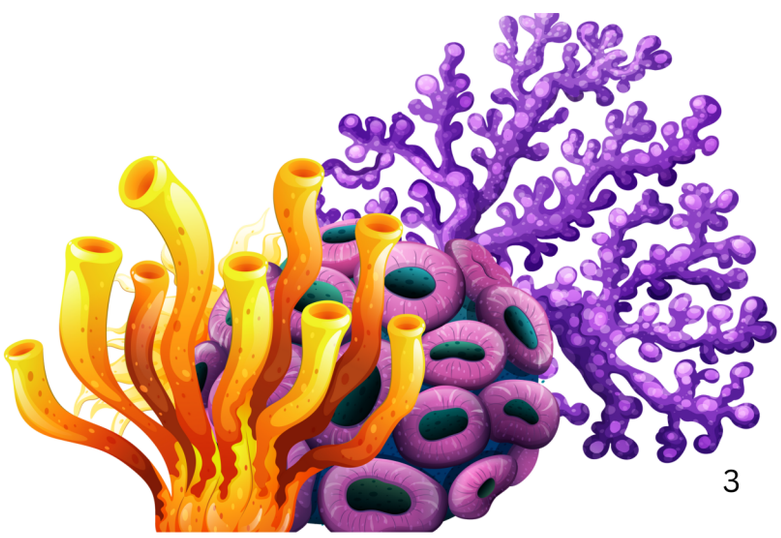
Under the Wharf is a programme that allows you to learn about encrusting benthic marine communities living under and around your local wharf.

By following this programme you will:

1. Learn about the local marine species living under your local wharf by looking at your own settlement plates.

2. Monitor how temperature and other environmental factors change over time in your local marine environment.

3. Compare this with 'Heated Settlement Plates' deployed in Portobello, Dunedin to understand how climate change might influence marine communities.



Water Temperature: What's the big deal?

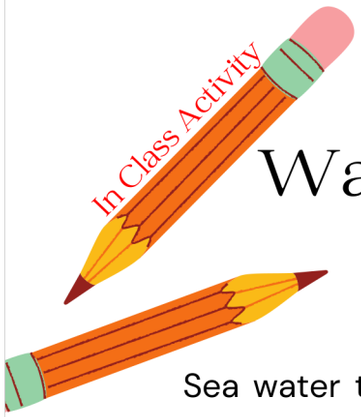
Ocean temperatures in New Zealand have warmed by 1 to 2°C over the past 40 years due to global climate change. This has potentially devastating effects on the marine environment, but most studies to date have focused on the effects of temperature changes on individual species, not marine communities as a whole.

Temperature impacts almost everything; growth rates, feeding behaviour, and where a species is able to live.

Each marine species has an optimal temperature, where it likes to live. Climate change is increasing temperatures, which means marine critters can find themselves in temperatures they don't like, particularly during the hot summer months!

The 'Under the Wharf' project will help develop simple ways for schools and the community to measure change in the ocean environment at a local level. In doing so, the students will have the chance to explore ocean warming data and capture stories of marine species to give meaning to scientific data. Participants will also develop a sense of responsibility to make active choices that minimise impacts on our environment.

The marine animals we are focusing on are sessile, meaning they are stuck in one place, so can't move if the water gets too warm.



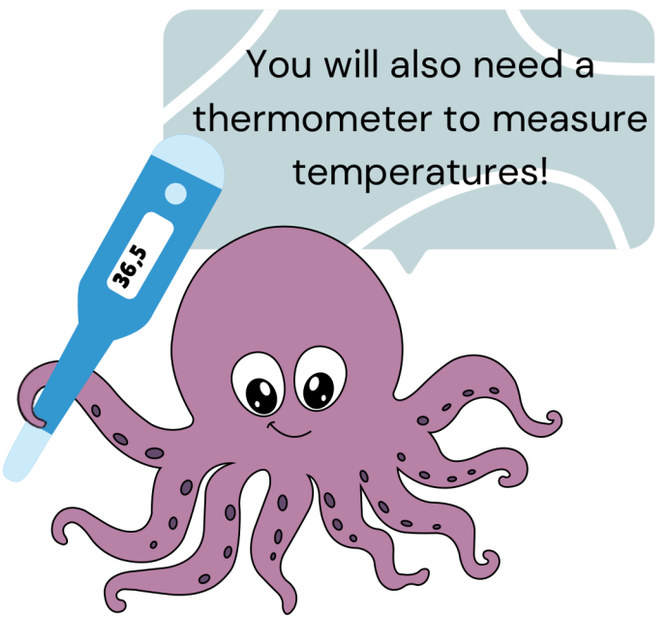
Water Temperature: Little changes make big differences

Sea water temperatures are warming, with an increase of 1-2°C expected by 2050. Warming can impact the survival and growth of many marine species. Marine invertebrates are cold-blooded, meaning that their body temperature is dependent on the ocean's temperature. In many cases, it is not well understood how an increase in seawater temperature will impact marine biodiversity.

Setting up the introduction activity!

- Fill three ice-cream containers, or similar, with water (1. from the fridge, 2. from the hot tap, and 3. from the cold tap)

- Mix the containers/tanks up so you don't know which is warm!

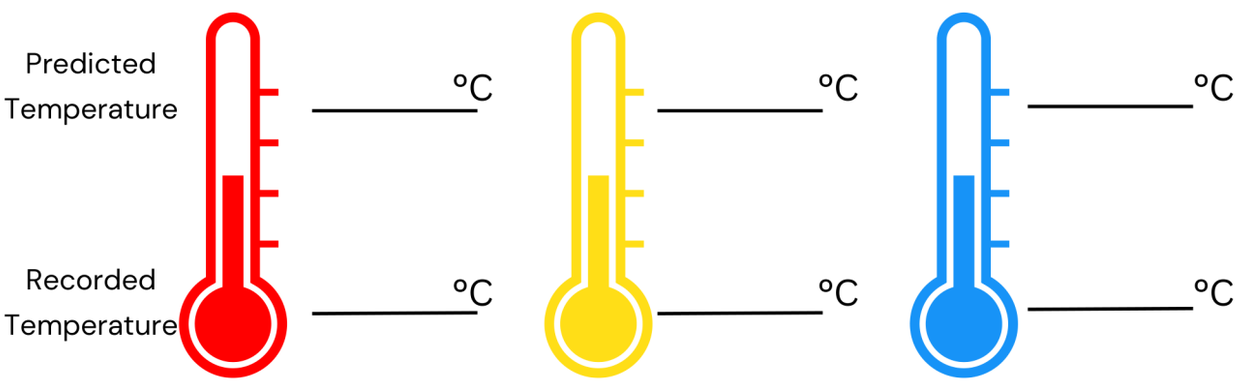


Health and safety: ask an adult before touching hot water!

Measuring Temperature

1. Place your hand in each of the tanks, can you tell the difference between the temperatures?

2. Arrange the tanks from warmest to coolest, and try to predict the temperature in each tank - write your predictions below:



3. Now, using your thermometer, measure the temperatures of each tank. Write the temperatures above.

4. Did you notice the difference between temperatures in the tanks? Why do you think small changes in temperature will impact marine animals?

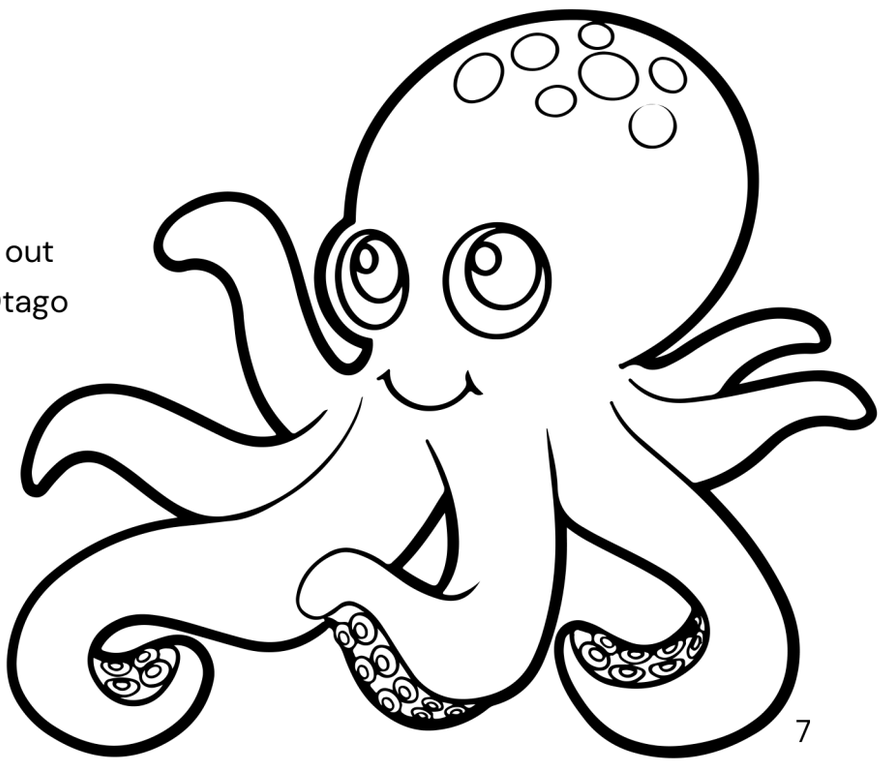
In Class Activity

5. How do you think increased temperature will impact the survival of marine animals?

6. Why is our response to changing temperature, different to marine invertebrates?

Curious about how ocean temperatures have been changing?

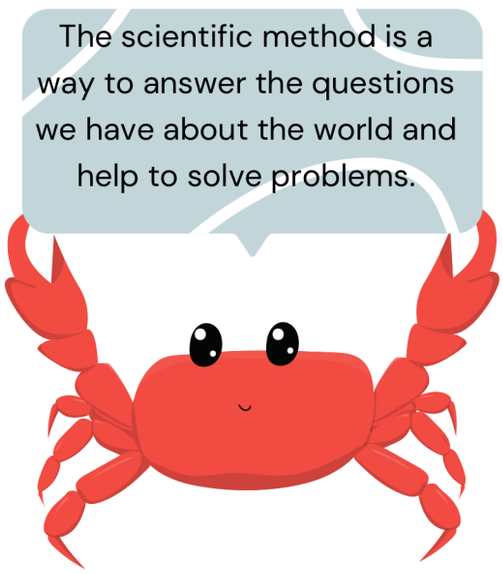
Follow the QR code to check out current temperatures in the Otago harbour!



Designing the Experiment

Before we start an experiment to investigate how changes in temperature affect marine species, we must think about what we want to achieve and how we want to achieve it.

We can do this by following the Scientific Method!



Initial thinking - *First, we must observe and think about our topic. What do we think is living under the wharf? What are some ways that we can find out?*

Developing a question of interest - *Next, we can think about what we want to find out, what questions can we ask?*

Making a hypothesis - *What do we think is going to happen?*

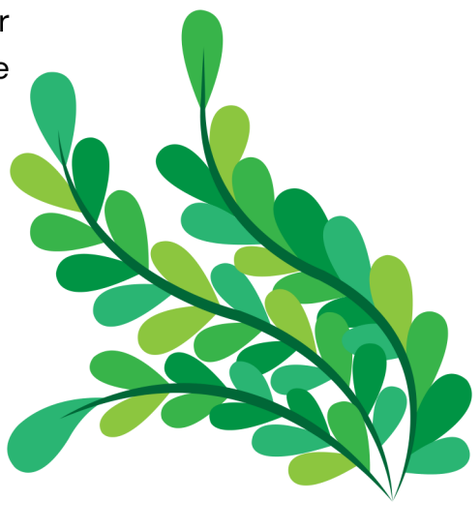
Designing an experiment - *What can we do in order to answer our questions?*

Gathering and recording data - *What data will we collect from our experiment?*

Discussing and sharing results - *How can we present our results to others?*

The following worksheet will help you outline your research question and design your settlement plate experiment!

Complete this as a class or in small groups!



Name: School: Date:

Under the Wharf

Research Plan

Our Question:

.....

.....

Where?

Describe features of a suitable study site.

Why?

Why is this research important? Think about who might be concerned about changing temperatures in the ocean and why?

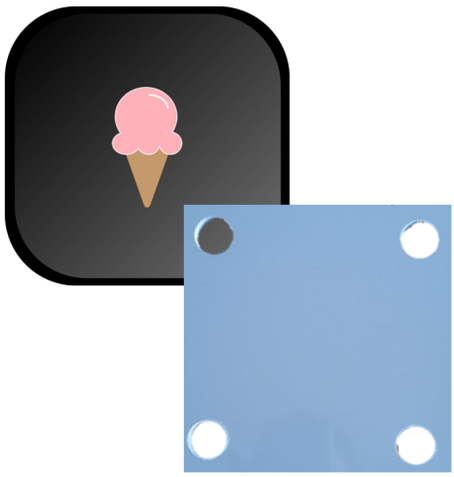
What?

What should we measure / record? What equipment / resources will we need?

When?

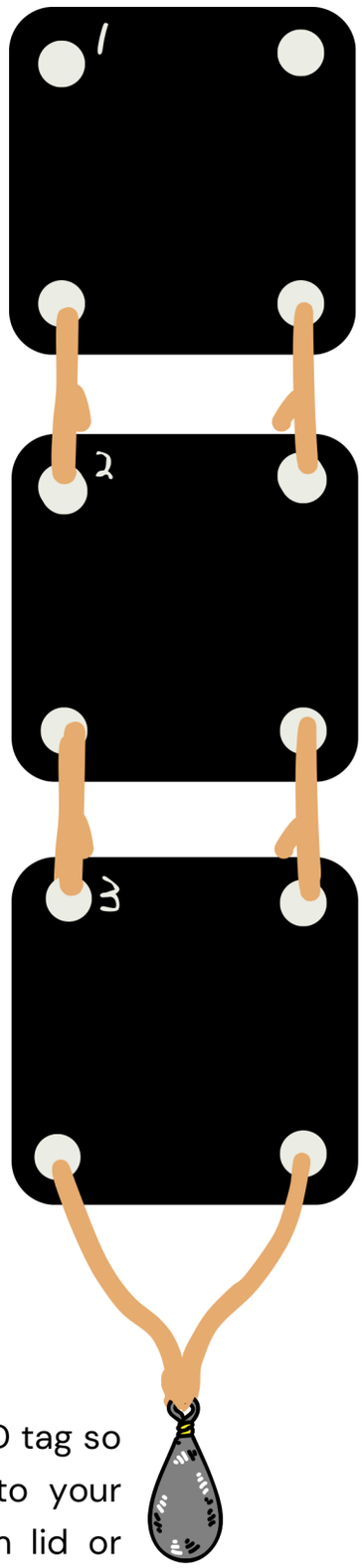
When and how often should we collect data? What other information would be useful?

Making your Settlement Plates



Equipment List:

- Thin rope
- Fishing sinker or weight
- Plastic ice-cream lids x 3 or PVC plates
- Laminated or plastic tag
- Sandpaper
- Hole punch or scissors



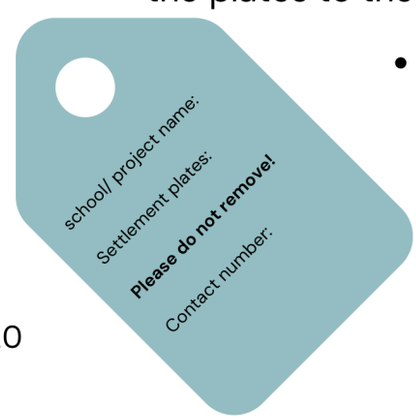
- First, we need to rough up the surface of the ice cream lids using sandpaper. This will encourage animals to settle on your plates!

  Hint: we recommend using the bottom of the ice-cream lid.

- Next, create four holes in each corner! You can do this using a hole punch or scissors, just make sure that the rope can fit through the holes!

- Next, you will need to tie the plates together using some rope. Also using some rope, attach the sinker to the bottom plate.

- Lastly, attach some rope to the top plate making a loop (Remember you will need some rope to attach the plates to the wharf)



- You might also want to make an ID tag so people know what is attached to your rope! You can use an ice-cream lid or other bit of plastic to make your label! Also label each plate with a number (1, 2, and 3)

Deploying your Settlement Plates

At the Wharf

Now that we have created our settlement plates, we can deploy them!

There are a few important things to consider when deploying your settlement plates:

First, we want to consider the location...

Is our wharf: **Floating** *Moves up and down with the tides* or **Static** *Does not move at all*

If your wharf is static, we must make sure the plates are hanging low enough to stay under water during low tide!

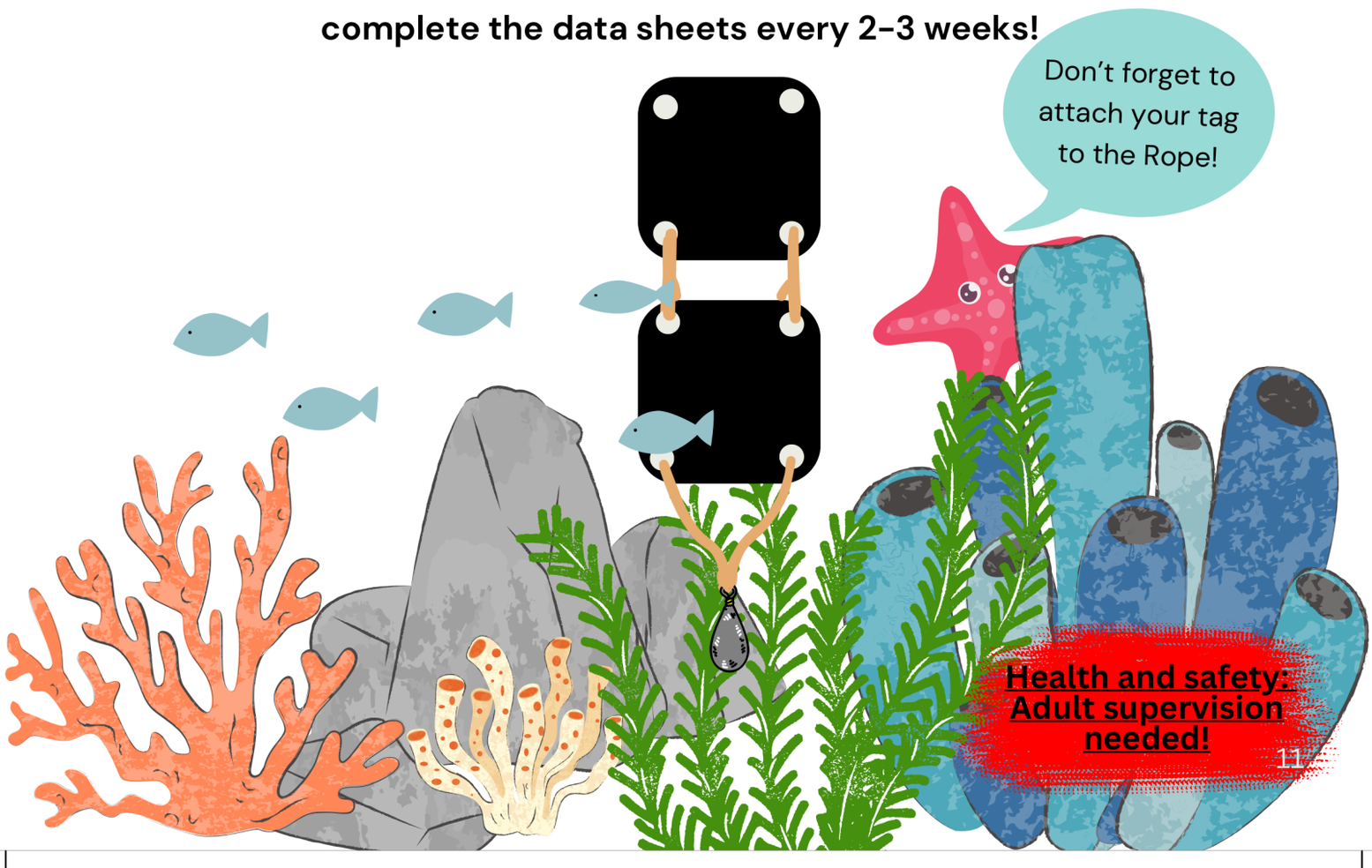
How deep is the water at low tide?_____meters.

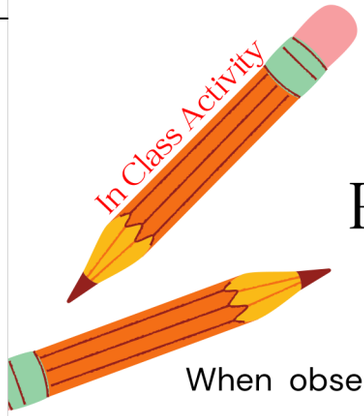
Using a weighted tape measure, drop the weighted end of the tape measure over the side of the wharf, holding tight to the other end. When the tape measure goes loose the weight has reached the sea floor!

Now we know the wharf type and water depth we can deploy our plates.

Find a structure that you can easily tie your settlement plates to, remember you don't want the plates touching the sea floor, and all three plates should be under the water!

Once deployed, you should pull them up to check them and complete the data sheets every 2-3 weeks!



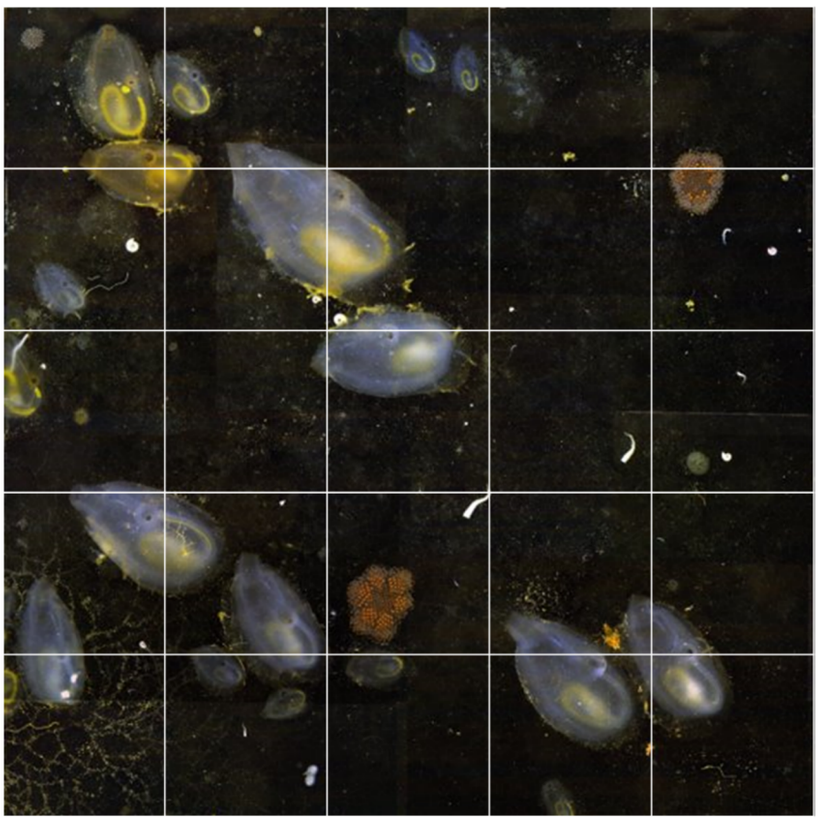


Estimating Percentage Cover!

When observing your plates you will be asked to estimate the percentage coverage of animals and plants on your plate. This activity will help you to practice your data collection methods!

Percentage cover is a measure of how much space a community is covering up. This can help us determine how a community is changing over time.
Visual estimations of percentage cover are a quick way to gather data while in the field. However, it takes some practice to be able to estimate the percentage cover accurately.

One way to do this is to divide the area into smaller sections, in the below example we have divided a settlement plate into 25 squares. This means each square is worth 4%.



1. Count the number of squares the animals / plants cover

_____

2. Divide this number by the total number of squares

_____/ 25 = _____

3. Multiply this answer by 100 to get an estimate of the percentage coverage

_____x 100 = _____%

The idea is we can use the squares to estimate coverage. For example, if we determine 4 out of 25 squares are occupied, that would translate to 16% coverage: (*4/25 x 100 = 16%* - Follow these steps above).

Using this method, try estimating the percentage coverage of animals/plants on the above plate. Is your estimate similar to other people's?

Example

Data Collection

Date: 9 \ 10 \ 2023

Time: 10:35 am

Ocean conditions

Tidal Height Mid Tide Weather Windy, with clouds

Water Clarity: Clear Cloudy Murky

Can you see the top of your plates? Can you see the sea floor?

Air Temperature: 13.2 °C

Water Temperature: 10.6 °C

Attach Photo of your plates here!

Pull up your settlement plates and photograph the surface of each plate.

Describe what you see:

We could almost see the top of the plates before pulling them up. Once we pulled up the plates, we noticed that they had a few new animals on them this week.

Other things to think about:

Do the plates have any mobile species on them (seastars, snails, or limpets)?
What is different from last week? Are there more on the plates?
Are there more or less on the plates than you expected?

Estimating Percentage Cover - *Refer to the percentage cover help sheet*

How much of each plate is covered in animals/plants?

Plate 1 30 % Plate 2 25 % Plate 3 11 %

What's living on the plates?

Using the ID sheets at the back of this booklet write down any animal that you see on your plates!

Animal Group	*Number of individuals/colonies present*
Bryozoans	9
Tube Worms	14
Sea Squirts	15
Sponges	3

You can record for each of the plates, or just the total

At the Wharf

Data Collection One

Date: \ \

Time:

Ocean conditions

Weather _____

_____

_____

Tidal Height

Low Mid High

Water Clarity

Clear Cloudy Murky

Can you see the top of your plates? Can you see the sea floor?

Attach Photo of your plates here or on back of page!

Air Temperature: _____ °C

Water Temperature: _____°C

Pull up your settlement plates and photograph the surface of each plate.

Describe what you see:

Estimating Percentage Cover

How much of each plate is covered in animals / plants?

Plate 1 _____ % Plate 2 _____% Plate 3 _____%

What's living on the plates?

Using the ID sheets at the back of this booklet write down any animals that you see on your plates!

Animal Group	*Number of individuals/colonies present*

Once finished, return your plates to the water.

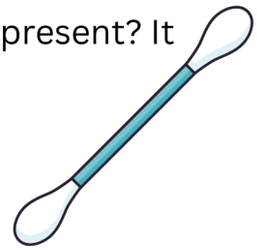
At the Wharf

Biofilm Growth

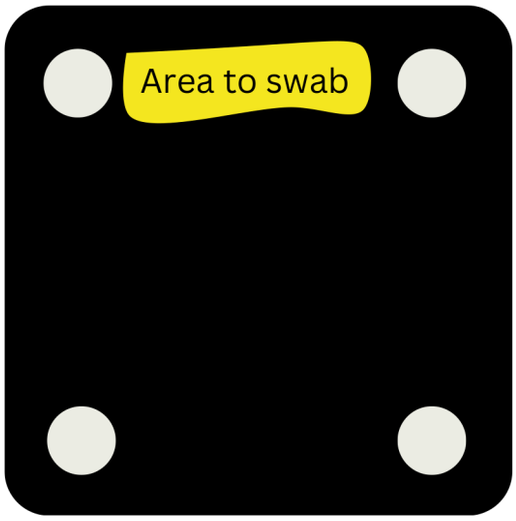
Bonus!

After one week, you may not see any obvious growth on the plate. However, biofilms are a thin layer of microscopic life and are the first things to settle on rocks and other surfaces in the ocean.

Look at the three settlement plates, do you think a biofilm is present? It might look like a thin layer of brown or green.



For this activity, you will need a cotton swab.



Wipe the cotton end across a small area on the plate.
(Remember not to remove too much biofilm!)

Describe what you see:
Does the cotton swab come back dirty? What colour is it?

Take a picture of the cotton swab (and remember to take it back to the rubbish with you!) **Once finished, return your plates to the water.**

At the Wharf

Data Collection Two

Date: \ \

Time:

Ocean conditions

Weather _____

_____

_____

Tidal Height

Low Mid High

Water Clarity

Clear Cloudy Murky

Can you see the top of your plates? Can you see the sea floor?

Attach Photo of your plates here or on back of page!

Air Temperature: _____ °C

Water Temperature: _____°C

Pull up your settlement plates and photograph the surface of each plate.

Describe what you see:

Estimating Percentage Cover

How much of each plate is covered in animals / plants?

Plate 1 _____ % Plate 2 _____% Plate 3 _____%

What's living on the plates?

Using the ID sheets at the back of this booklet write down any animals that you see on your plates!

Animal Group	*Number of individuals/colonies present*

Once finished, return your plates to the water.

At the Wharf

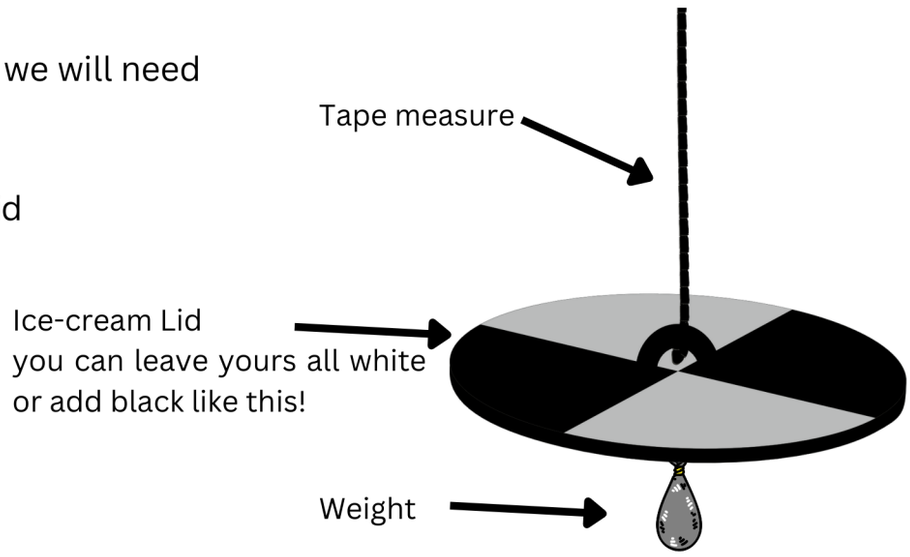
Measuring Turbidity

Bonus!

Turbidity is a measure of particles in the water column, such that when the water is clear there is low turbidity and when the water is cloudy there is high turbidity.
Here we are going to measure turbidity using a Secchi disk!

In order to do this we will need

- Fishing weight
- Tape measure
- An ice-cream lid



You want to attach your ice-cream lid to the tape measure with the weight below.

For this activity, you want to lower the disk into the water until you can no longer see it. This is known as the Secchi depth.

Secchi Depth _____

What do you think might change the turbidity of the water?

For more information or to load your data onto the secchi app, Follow the QR code:

http://www.secchidisk.org/

You can do this each time you collect data if you want!

At the Wharf

Date: \ \

Data Collection Three

Time:

Ocean conditions

Weather _____

_____

_____

Tidal Height

Low Mid High

Water Clarity

Clear Cloudy Murky

Can you see the top of your plates? Can you see the sea floor?

Attach Photo of your plates here or on back of page!

Air Temperature: _____ °C

Water Temperature: _____°C

Pull up your settlement plates and photograph the surface of each plate.

Describe what you see:

Estimating Percentage Cover

How much of each plate is covered in animals / plants?

Plate 1 _____ % Plate 2 _____% Plate 3 _____%

What's living on the plates?

Using the ID sheets at the back of this booklet write down any animals that you see on your plates!

Animal Group	*Number of individuals/colonies present*

Once finished, return your plates to the water.

At the Wharf

Data Collection Four

Date: _____

Time:_____

Ocean conditions

Weather _____

_____

_____

Tidal Height

Low Mid High

Water Clarity

Clear Cloudy Murky

Can you see the top of your plates? Can you see the sea floor?

Attach Photo of your plates here or on back of page!

Air Temperature: _____ °C

Water Temperature: _____°C

Pull up your settlement plates and photograph the surface of each plate.

Describe what you see:

Estimating Percentage Cover

How much of each plate is covered in animals / plants?

Plate 1 _____ % Plate 2 _____% Plate 3 _____%

What's living on the plates?

Using the ID sheets at the back of this booklet write down any animals that you see on your plates!

Animal Group	*Number of individuals/colonies present*

Once finished, return your plates to the water.

At the Wharf

Water Health Survey

Location: _____ Date: ____/____/____

How many times have you visited the area?

- ☐ This is the first time
- ☐ 1 -5
- ☐ 6-10
- ☐ Heaps

Would you eat the kaimoana from the area?

- ☐ Yes
- ☐ No

Explain your answer:

_____

_____

_____

What is the adjacent shoreline like?

- ☐ Sand
- ☐ Mud
- ☐ Rocky
- ☐ Other

What does the area smell like?

- ☐ Normal
- ☐ Stinky
- ☐ Other: describe _____

_____

What does the water look like?

- ☐ Clear
- ☐ Slightly murky
- ☐ Very murky

Can you see any of the following?

- ☐ River
- ☐ Stream
- ☐ Drains
- ☐ Farmland
- ☐ Foresty area
- ☐ Native bush
- ☐ Industrial area
- ☐ Houses
- ☐ Town
- ☐ City

What type of marine animals can you see?

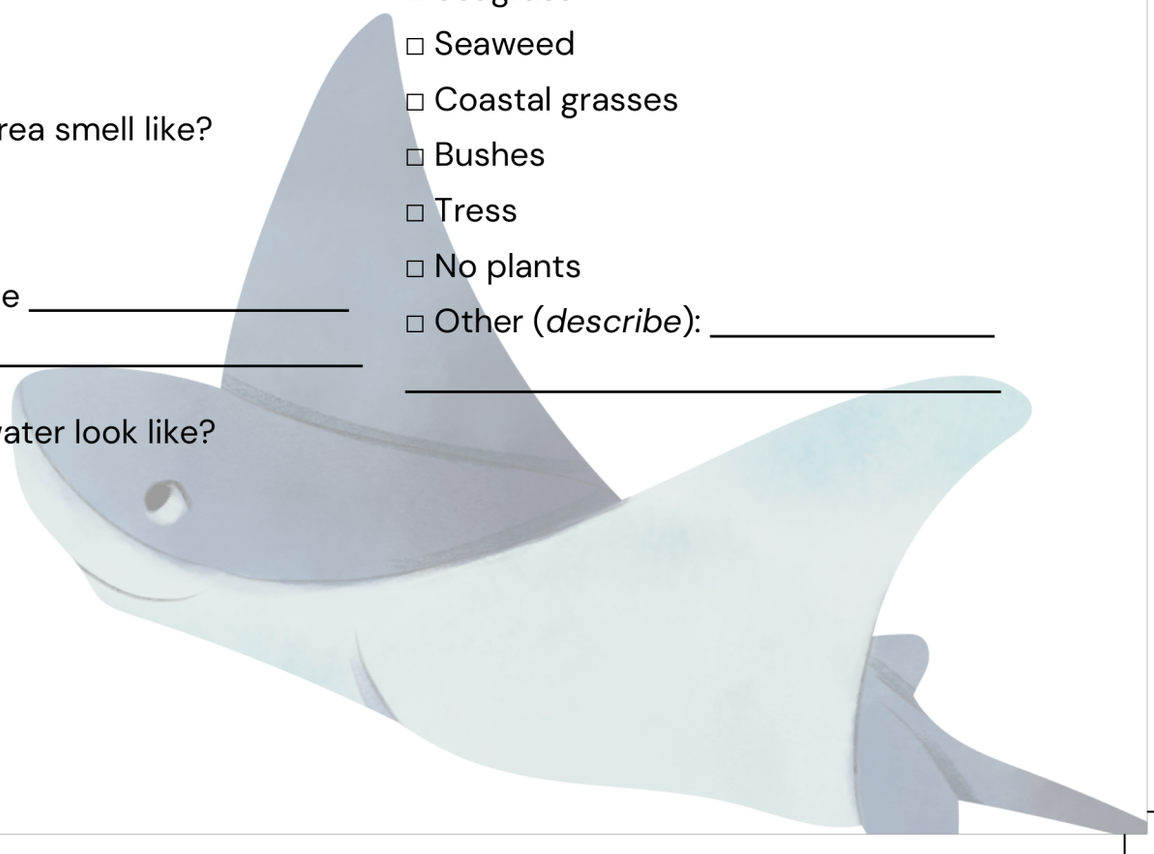
- ☐ Shelled animals (snails, cockles)
- ☐ Crabs
- ☐ Sea Birds
- ☐ Barnacles
- ☐ Fish
- ☐ Other (*describe*): _____

_____

What types of plants can you see?

- ☐ Seagrass
- ☐ Seaweed
- ☐ Coastal grasses
- ☐ Bushes
- ☐ Tress
- ☐ No plants
- ☐ Other (*describe*): _____

_____

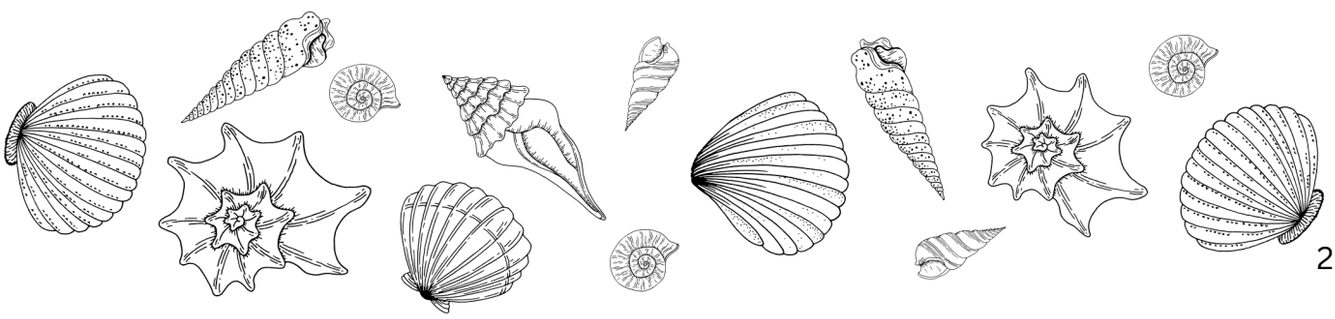


What human activity do you think is affecting the area? (e.g. fishing, roads, rubbish)

Is there anything else you find interesting about the area? (e.g. lots of shells or seaweed washed up)

What other information or measurements would be helpful to assess the health of the area?

What is the value of looking closely at an area over time?



At the Wharf

Data Collection Five

Date: _____

Time:_____

Ocean conditions

Weather _____

_____

_____

Tidal Height

Low Mid High

Water Clarity

Clear Cloudy Murky

Can you see the top of your plates? Can you see the sea floor?

Attach Photo of your plates here or on back of page!

Air Temperature: _____ °C

Water Temperature: _____ °C

Pull up your settlement plates and photograph the surface of each plate.

Describe what you see:

Estimating Percentage Cover

How much of each plate is covered in animals / plants?

Plate 1 _____ % Plate 2 _____% Plate 3 _____%

What's living on the plates?

Using the ID sheets at the back of this booklet write down any animals that you see on your plates!

Animal Group	*Number of individuals/colonies present*

Once finished, return your plates to the water.

At the Wharf

Data Collection Six

Date: _____

Time: _____

Ocean conditions

Weather _____

_____

_____

Tidal Height

Low Mid High

Water Clarity

Clear Cloudy Murky

Can you see the top of your plates? Can you see the sea floor?

Attach Photo of your plates here or on back of page!

Air Temperature: _____ °C

Water Temperature: _____ °C

Pull up your settlement plates and photograph the surface of each plate.

Describe what you see:

Estimating Percentage Cover

How much of each plate is covered in animals / plants?

Plate 1 _____ % Plate 2 _____ % Plate 3 _____ %

What's living on the plates?

Using the ID sheets at the back of this booklet write down any animals that you see on your plates!

Animal Group	*Number of individuals/colonies present*

Once finished, return your plates to the water.

At the Wharf

Data Collection

Date: ____\ ____\ ____

Time:_____

Ocean conditions

Weather _____

_____

_____

Tidal Height

Low Mid High

Water Clarity

Clear Cloudy Murky

Can you see the top of your plates? Can you see the sea floor?

Attach Photo of your plates here or on back of page!

Air Temperature: _____ °C

Water Temperature: _____°C

Pull up your settlement plates and photograph the surface of each plate.

Describe what you see:

Estimating Percentage Cover

How much of each plate is covered in animals / plants?

Plate 1 _____ % Plate 2 _____% Plate 3 _____%

What's living on the plates?

Using the ID sheets at the back of this booklet write down any animals that you see on your plates!

Animal Group	*Number of individuals/colonies present*

Once finished, return your plates to the water.

At the Wharf

Data Collection

Date: ____\ ____\ ____

Time:_____

Ocean conditions

Weather _____

_____

_____

Tidal Height

Low Mid High

Water Clarity

Clear Cloudy Murky

Can you see the top of your plates? Can you see the sea floor?

Attach Photo of your plates here or on back of page!

Air Temperature: _____ °C

Water Temperature: _____°C

Pull up your settlement plates and photograph the surface of each plate.

Describe what you see:

Estimating Percentage Cover

How much of each plate is covered in animals / plants?

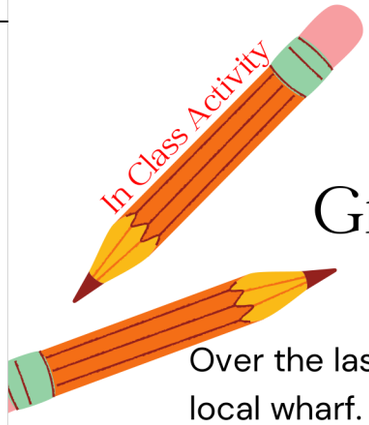
Plate 1 _____ % Plate 2 _____% Plate 3 _____%

What's living on the plates?

Using the ID sheets at the back of this booklet write down any animals that you see on your plates!

Animal Group	*Number of individual/colonies found on plates*

Once finished, return your plates to the water.



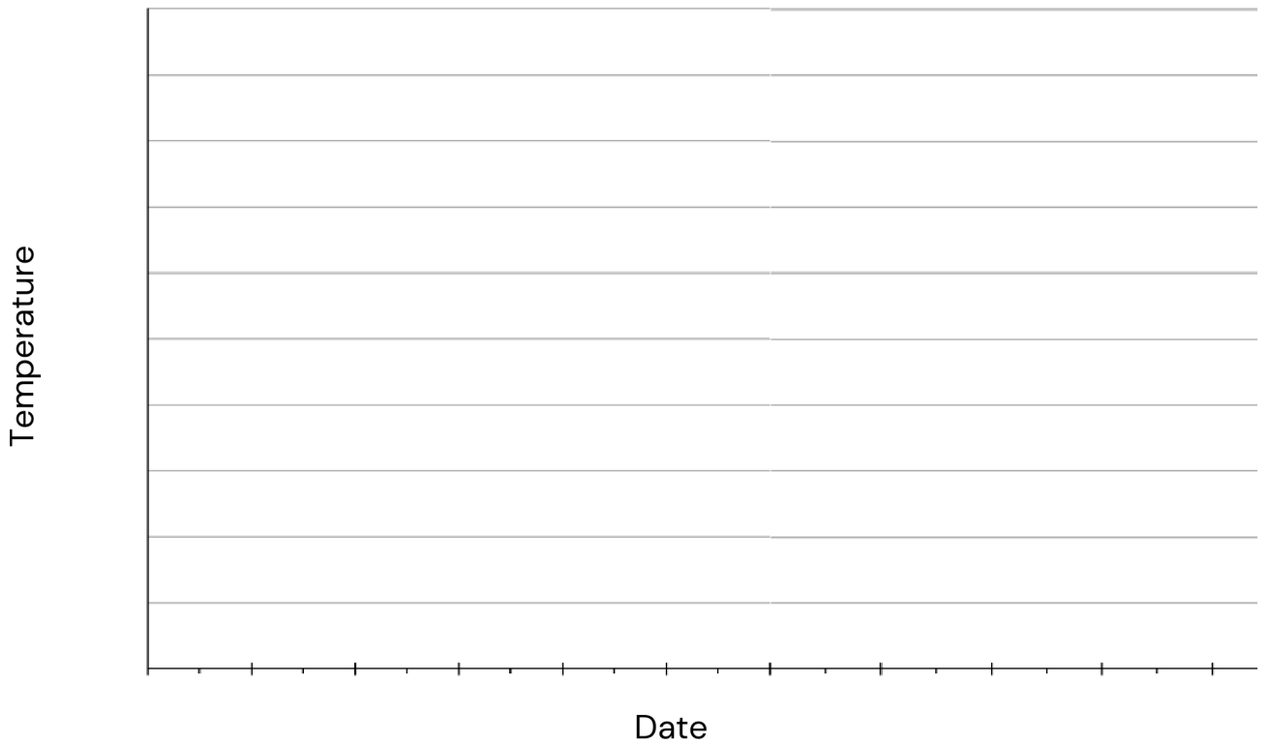
Graphing your Temperature Data

Over the last few months you have been recording the temperatures at your local wharf.
This activity will allow us to see how these temperatures have changed during this time.

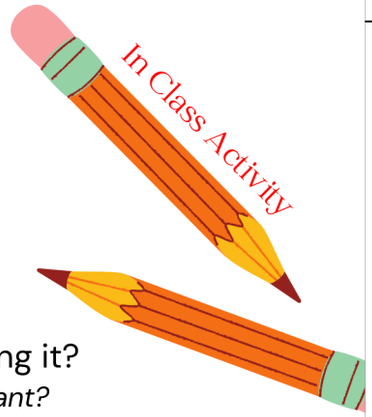
First let's list all the temperatures we have recorded:

Date	Water Temperature	Air Temperature

We are now going to plot the above data as a line graph, on the chart below:



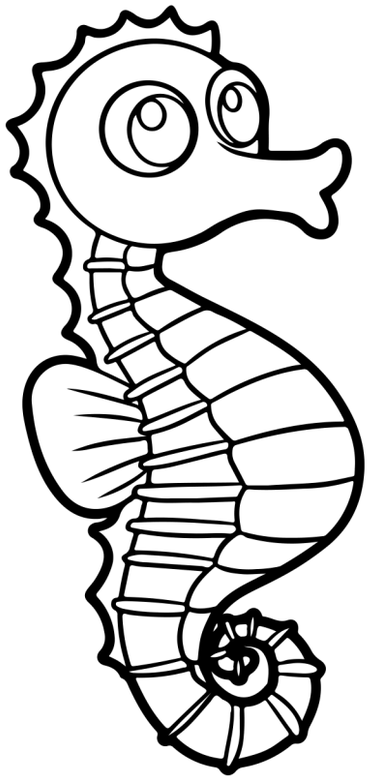
You might want to plot air and water temperatures in different colours.

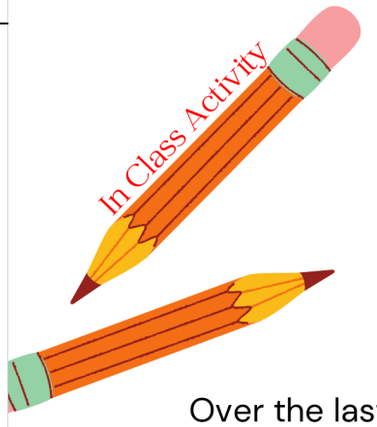


How has the temperature changed since you have been measuring it?
Why do you think this has happened? What time of year is it? Is that important?

What do you think will happen to the temperature over the next few weeks?
Why do you think this will happen? Do you think air and water temperatures will follow the same pattern?

As a group discuss the possibility of repeating the experiment in another season!





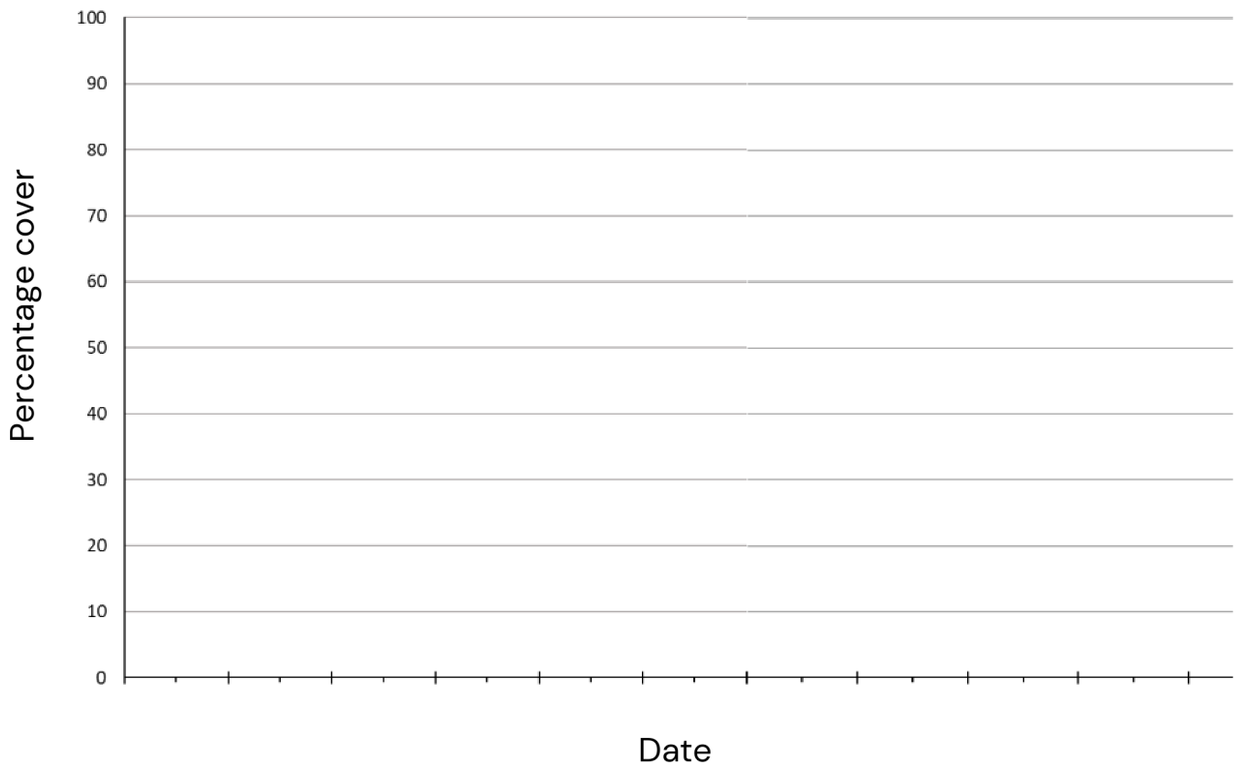
Graphing your Percentage Cover Data

Over the last few months you have also been recording the percentage cover of animals / plants on the plates.

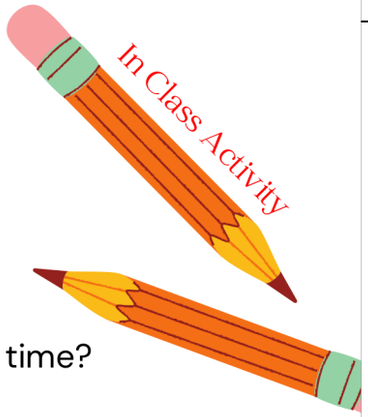
First let's list all the percentage covers we have recorded:

Date	Plate One	Plate Two	Plate Three

We are now going to plot the above data as a bar graph, on the chart below:



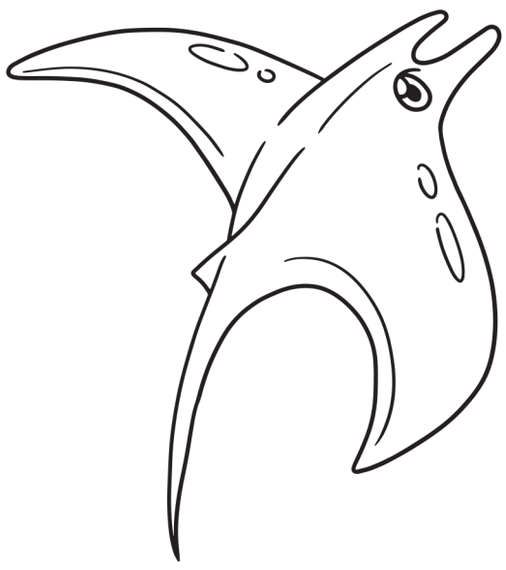
You might want to plot plate numbers in different colours.



How does the percentage cover of life on the plates change over time?
Why do you think this has happened?

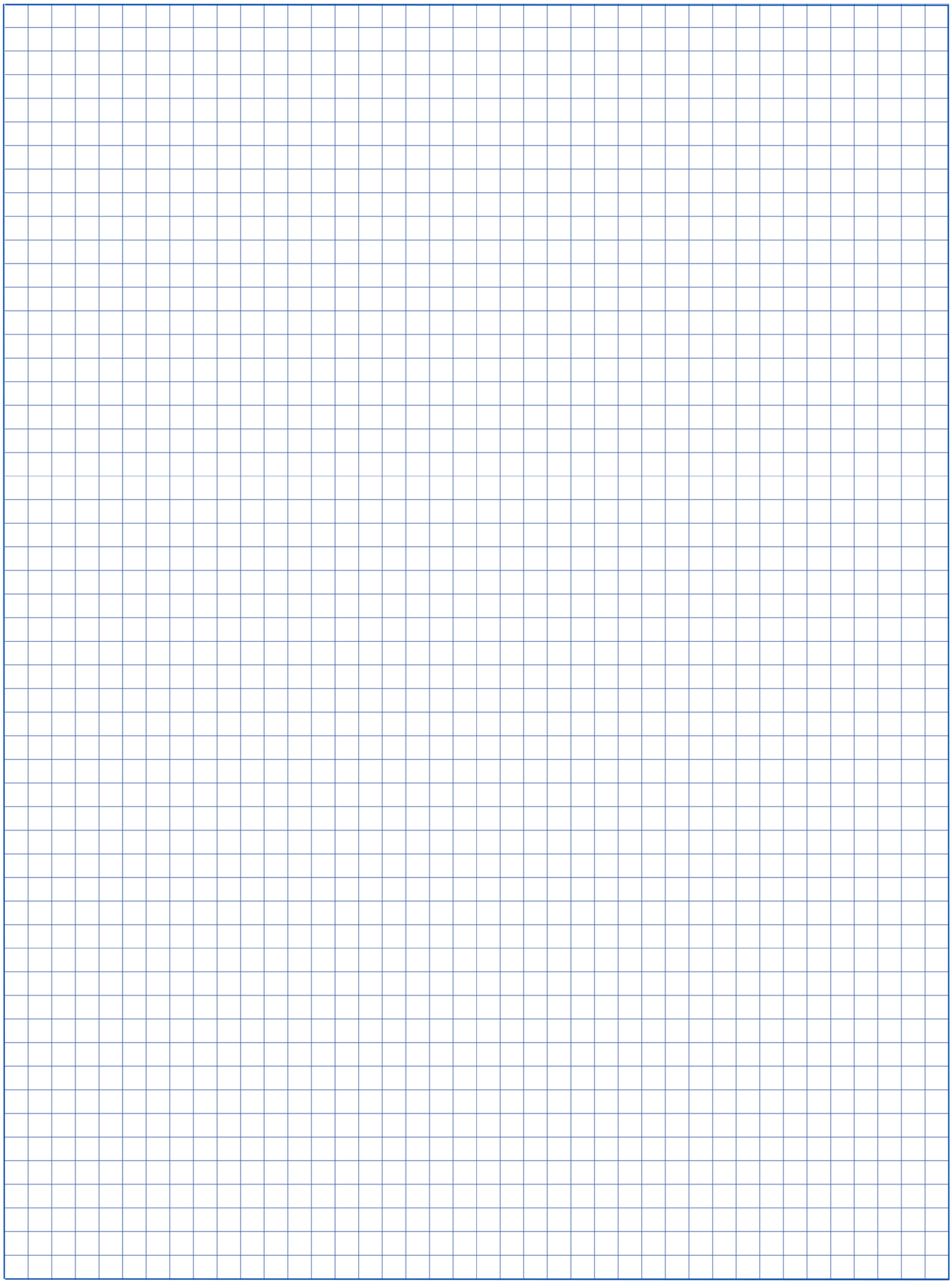
If you left the plates in the sea for longer, how do you think the coverage of life on the plates would change?

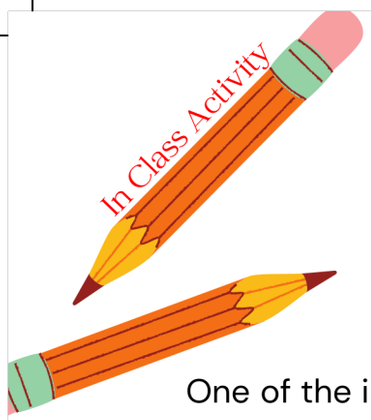
What other graphs can we create with our data? Use the graph paper on the following page to create more of your own graphs.



Graph Paper

Name:

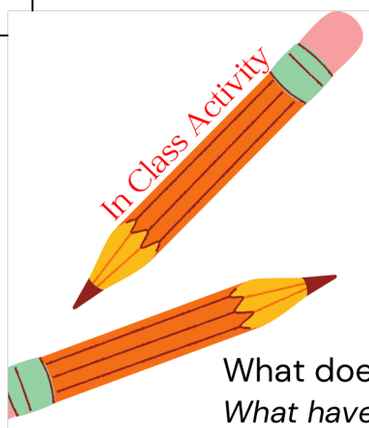




Presenting your Data

One of the important steps in science is presenting your data, as this allows us to explain what we have found out to other people! Brainstorm ways you think you can present the data we have collected!

Now pick one or more of your ideas to present your data!



Data Reflection

What does your data tell us?

What have you learnt from the experiment and collecting this data?

How can you use this data to understand the impact of temperature change on marine species?

Are you planning on extending the experiment?

Now that you have examined and presented your data, you can compare your results with the temperature under the wharf at Portobello (https://harbourconditions.otago.ac.nz/)

Try to repeat the experiment in another time of year, and look at the difference between seasons!

Identification Sheet

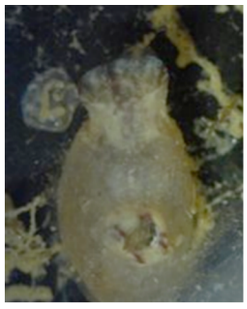
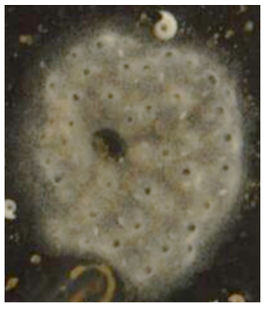
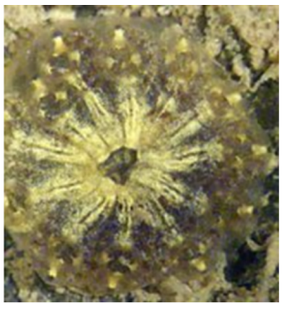
Tube Worms:

Tube worms are easily identified by their hard white tube.



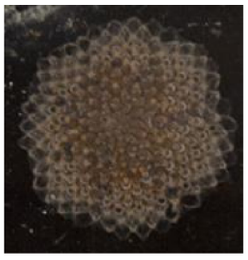
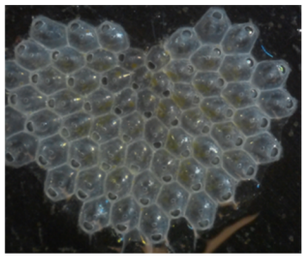
Ascidians “Sea Squirts”

Sea squirts come in many shapes and sizes but will have large holes (siphons) .

Bryozoans

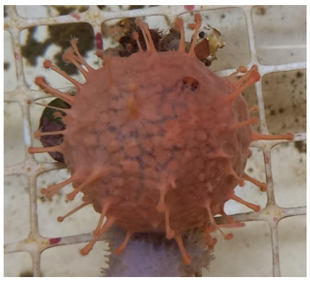
Bryozoans are small colonies of animals that can be flat, round, growing on the surface of the plates, or branching - it’s easy to mistake branching bryozoans for plants!

Sponges

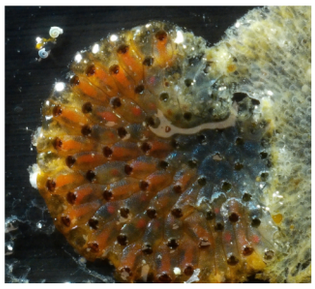
Sponges come in many shapes and colours, it’s often hard to tell the difference between sponges and sea squirts.





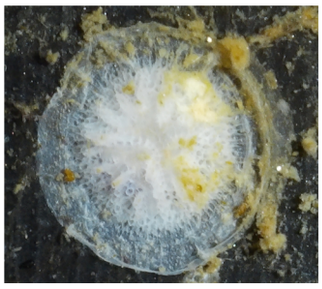
Bryozoans

Bryozoans are animals despite the fact that they look more like plants. For this reason they are often called Moss Animals. They grow in many different shapes, often with a partially calcified structure



Encrusting Bryozoan

Branching Bryozoan



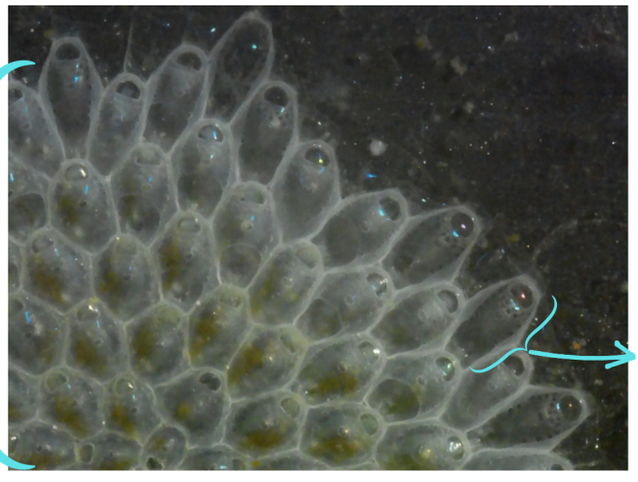
Mounding Bryozoan

Lophophore: Bryozoan feeding structure

This is what a Bryozoan looks like under a microscope.

Did you know these structures differ from the regular tentacles seen on other marine animals, as they are hollow?!

Bryozoans form colonies of multiple individuals called zooids. Each individual animal lives as a colony and cannot live on their own. Different zooids can have different functions within the colony, for example, autozooids are responsible for feeding.

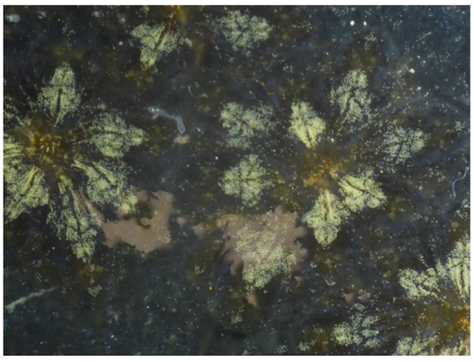


Colony

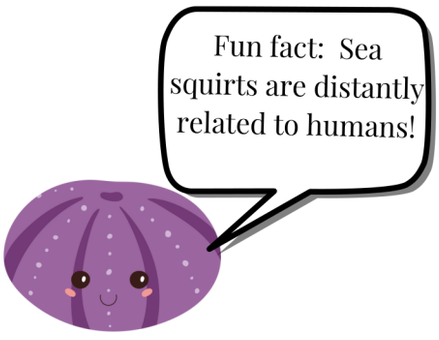
Individual Zooid

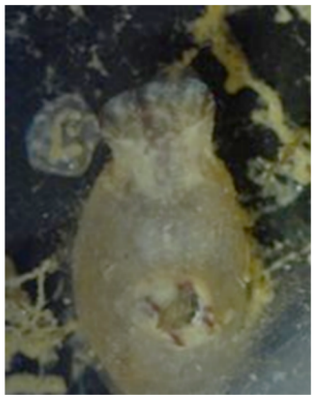
Ascidians

Ascidians are a group of marine animals commonly known as sea squirts. Ascidians can either be solitary or colonial. Colonial ascidians are made up of multiple individual animals who are able to share resources.



Colonial Ascidian

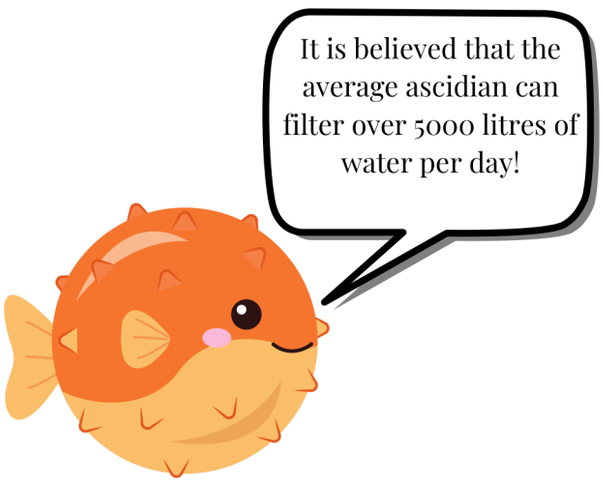


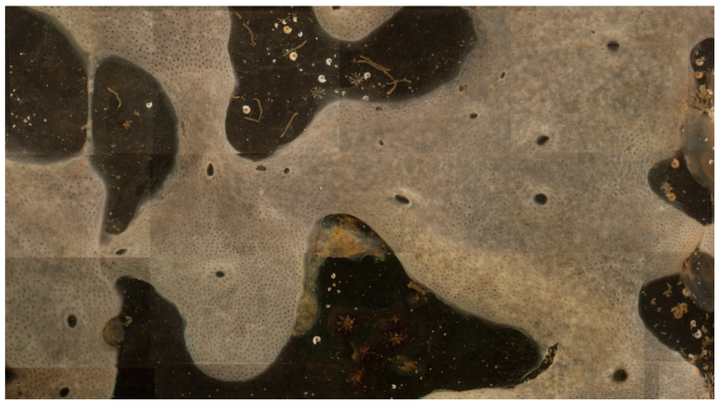


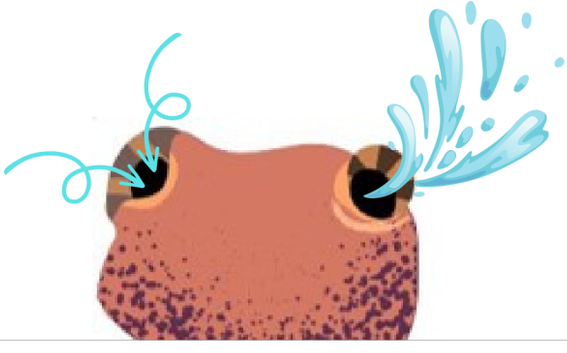
Solitary Ascidian

Ascidians are very common, particularly on man-made structures such as wharfs. They are filter feeders, meaning they gather food from the ocean by pumping water through their body.

Some marine ascidians are able to over grow other animals, allowing them to cover up lots of space. This is a trait that is particularly common in invasive species (species that are not native), and gives them an advantage over native species.

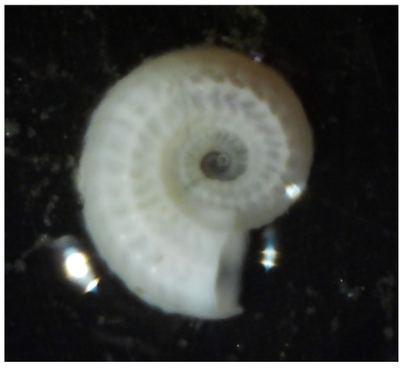






Tube Worms

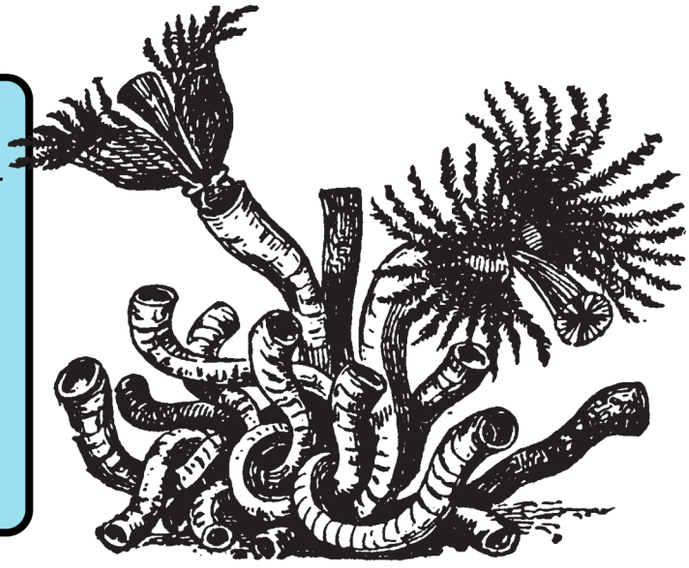
These segmented worms are named after the calcium carbonate shell or 'tube' they create to protect their soft bodies. They are commonly found on the rocky shores. If you see them at low tide they will most likely be hiding within their tubes.

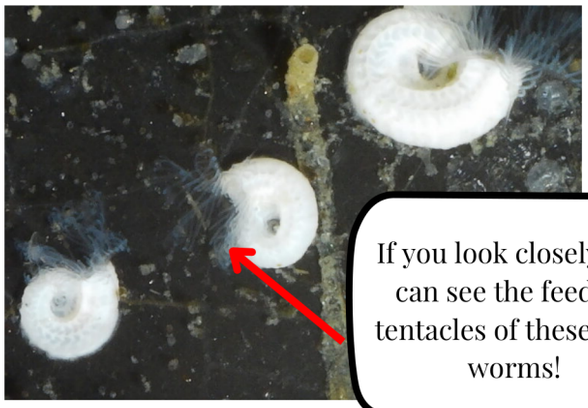


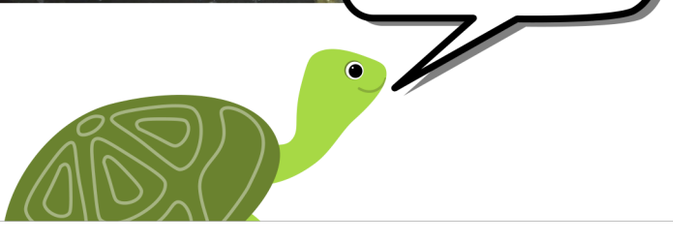
Different species of tube worms have different patterns on their tubes and grow in different directions.

When under water, the worms extend their feeding tentacles so they can filter food out of the water!

You can identify some species of tube worms based on their tentacles e.g. the “red tube worm” has bright red feeding tentacles!

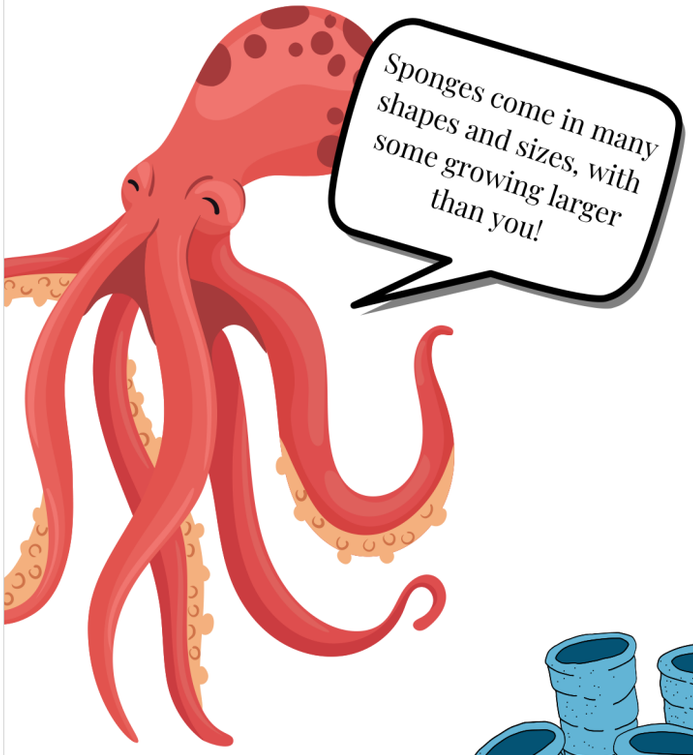






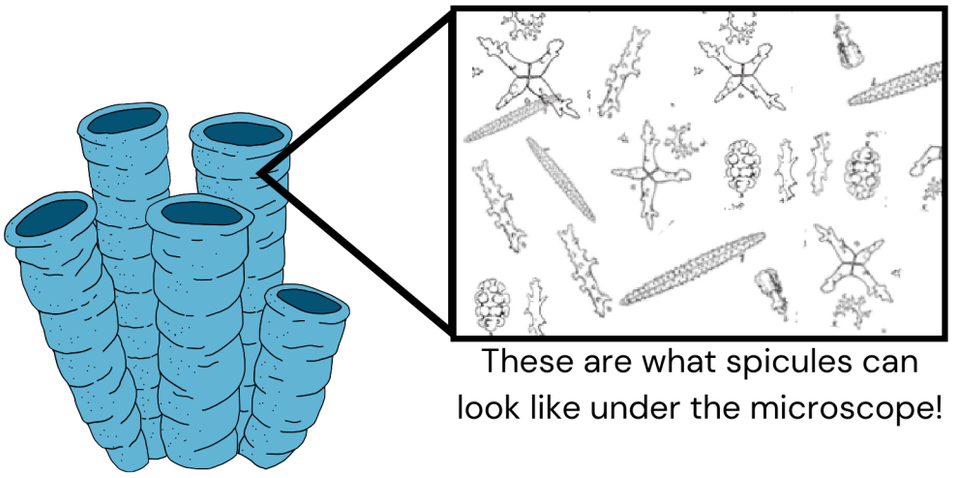
Sponges

Sponges are the most common marine invertebrate we have in New Zealand.
They are also some of the world's simplest animals!
Sponges are covered in little holes called pores, they use these to pump water through their bodies to collect food.



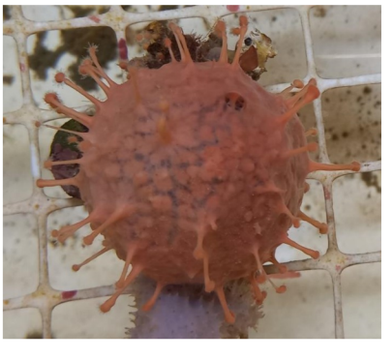
It can be quite hard to identify sponges by eye, as the same species can look different if living in different environments.

Scientists identify sponges through hard structures called spicules, which can be found within the sponge.



These are what spicules can look like under the microscope!

Below are some examples of the colourful sponges you might see around New Zealand!



Pink golf ball sponge

Purple encrusting sponge