



CORALWATCH



THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA

Corals

At Your Doorstep

Capricorn Coast - Australia

**Year 7 Science
Lessons & resources**



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Great Barrier
Reef Foundation



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Capricorn Coast - Corals at Your Doorstep

Keppel Bay is a large and shallow bay off the nearby city of Rockhampton and Port Curtis is the harbour for Gladstone. Both cities are in Queensland, Australia. These bays are internationally recognised for having abundant and diverse animal and plant species having large areas of mangroves and seagrasses, corals, and a large fish population.

Seagrass meadows provide food for large populations of green sea turtles and dugongs. Extensive numbers of coral species grow in various habitats throughout these bays. A coral's health is extremely susceptible to changes in the environment. This makes coral an important species to monitor and used to indicate a decline in environmental conditions. Keppel Bay and Port Curtis are precious environments which need to be protected from environmental damage caused by anthropogenic pressures - created by humans and their activities.



Reef areas of Capricorn Coast where coral can be found.

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.
Reef data courtesy of the Great Barrier Reef Marine Park Authority.



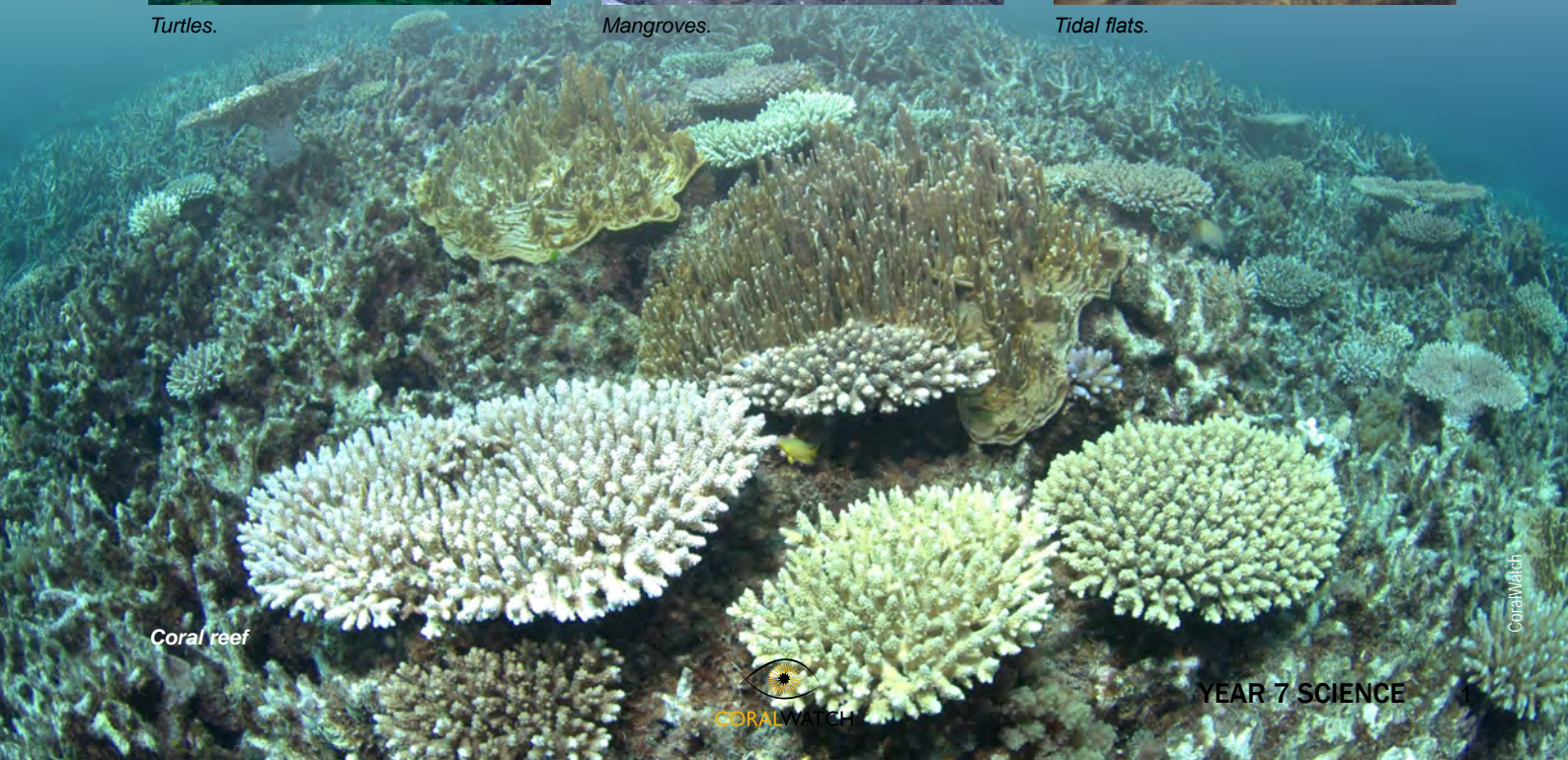
Turtles.



Mangroves.



Tidal flats.



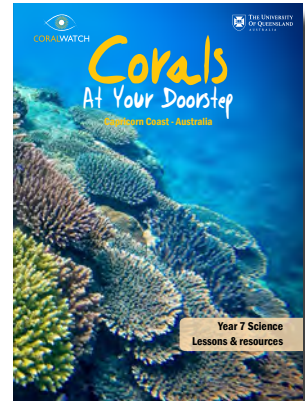
Coral reef

CoralWatch education

The lessons and resources of this '**Corals at Your Doorstep**' booklet are developed for high schools in Capricorn Coast and is part of the CoralWatch '**Capricorn Coast Education Package**'. The lessons and activities in the booklet are aimed at year 7 Science and are linked to the Australian Curriculum v8.3.

CoralWatch also produced '**Marine Ecosystems**' for year 7 with many more classroom worksheets focused on Classification, Food Web, Rhythm and Flow, and the Water Cycle. If you would like more background to the worksheets or need additional resources please contact CoralWatch for a free digital copy of this document.

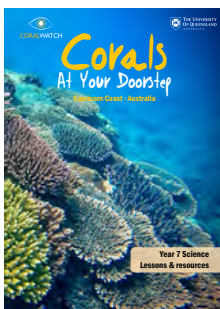
CoralWatch is a not-for-profit organisation based at the University of Queensland. CoralWatch uses the Coral Health Chart to promote active learning opportunities for citizen scientists of all ages. The content of this booklet extends beyond monitoring, and provides worksheets to bring reef science into the classroom. Most lessons relate to chapters in the education guide and DVD series, '**Coral Reefs and Climate Change – The Guide for Education and Awareness**' published by CoralWatch. The Virtual Reef tools, provide a real opportunity to learn about coral bleaching and reef monitoring in the classroom. They can be used to assist student preparations for a field trip, or can provide a valuable alternative to a field trip. However, we encourage you to take students in the field since this is the most valuable and intense experience learning about our beautiful coral reefs. All CoralWatch materials can be ordered from CoralWatch (www.coralwatch.org).



'Corals at Your Doorstep' Capricorn Coast Australia Year 7 Science, lessons and resources.

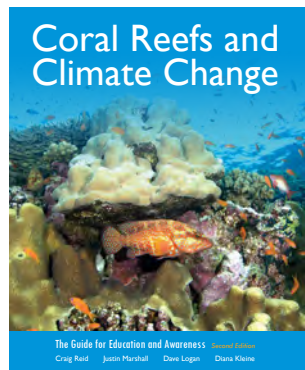


'Marine Ecosystems' Year 7 Science, lessons and resources.



'Capricorn Coast education package' includes: Capricorn Coast virtual reef, Capricorn Coast Coral ID sheet, year 7 lessons and resources, Capricorn Coast and Great Barrier Reef info flyers, Coral Health Chart with slate and Do It Yourself (DIY) monitoring instructions.

This publication is supported by Fitzroy Basin Association, through funding from the Australian Government's National Landcare Program.



'Coral Reefs and Climate Change' book.

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CORALWATCH MONITORING

CoralWatch uses the Coral Health Chart as a cheap, simple, non-invasive method for the monitoring of coral bleaching and the assessment of coral health. In the field, users simply compare colours of corals with colours on the chart and record matching codes. In addition, we ask you to record coral type.



The Coral Health Chart uses four coral types to classify corals. **Boulder** refers to any massive or rounded coral such as some *Platygyra* and *Porites* species. **Branching** refers to any branching coral such as *Acropora* and *Pocillopora* species. **Plate** refers to any coral that forms a plate-like formation such as tabular *Acropora* species, and the **soft** category refers to corals lacking a hard skeleton, such as *Xenia* species.

Corals can exist in many shapes, and some corals may not clearly match any of these categories. Our aim is to keep the chart and survey as simple as possible, so if you're experiencing difficulties when classifying your corals, please simply choose the closest coral type.



Boulder (BO)

Any massive or rounded coral, such as some *Porites* species.



Branching (BR)

Any branching coral, such as some *Acropora* species.



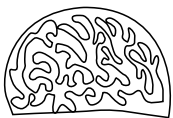
Plate (PL)

Any plate-like shape coral, such as tabular *Acropora* species.



Soft (SO)

Any corals lacking a hard skeleton, such as *Sarcophyton* species.



B1	B2	B3	B4	B5	B6	C1
E6						C2
E5						C3
E4						C4
E3						C5
E2						C6
E1						D6

How to Use the Coral Health Chart

1. Choose a random coral and select the lightest area.
2. Rotate the chart to find the closest colour match.
3. Record the colour code on a data slate.
4. Select the darkest area of the coral and record the matching colour code.
5. Record the coral type.
6. Continue your survey with other corals. Record at least 20 corals.
7. Submit your data using the CoralWatch Data Entry Apps or enter online at www.coralwatch.org.

Survey Methods include (depending on experience and location):

- **Random Survey** – Select corals randomly, such as the closest coral after every second fin kick.
- **Transect Survey** – Select corals by following a line (transect) and record every few meters.
- **Easily Identified Corals** – Select corals you can recognise and return to (permanent transect).

Tips

- Corals are fragile animals, make sure your survey has no affect on marine life.
- Due to colour loss at depth, use a torch when diving below 5 metres/15 feet.
- Avoid measuring growing tips of branching and plate corals since they are naturally white.
- Do not monitor blue or purple corals because they have a different bleaching response.
- Some corals are naturally lighter than others. Regular surveys are needed to look at coral health over time or pick up trends of bleaching and recovery.

Coral Types

Boulder (BO)

Branching (BR)

Plate (PL)

Soft (SO)

Instructions on how to use the Coral Health Chart can be found on the back of the chart.

CoralWatch in the classroom

Learning objectives

At the end of this session, students will be able to:

- Describe simple biology of corals.
- Identify different growth forms of corals.
- Understand how to use the Coral Health Chart.
- Describe the different coral types.
- Enter virtual data in Excel and analyse the results.

Key learning points

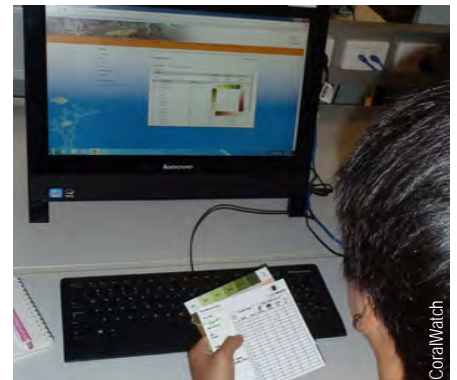
- Corals are animals, related to jellyfish.
- Corals build calcium carbonate skeletons that create reef structures.
- Corals need energy to build reefs. Corals obtain most of their energy via small symbiotic algae that live inside the coral tissue. These algae generate energy via photosynthesis.
- Because corals require sunlight for energy, they are mainly found in shallow tropical and subtropical waters.
- Most corals live within a narrow temperature range. Some corals have adapted to different temperatures. Corals in the Kimberley (northwestern Australia) have adapted to higher temperatures, whereas corals in Moreton Bay (Queensland) have adapted to lower temperatures.
- The Coral Health Chart is a simple, non-invasive tool that can be used for 'reef walking', snorkelling or diving.
- The colour chart standardises changes in coral colour, providing a simple way to quantify bleaching and monitor coral health.
- The colour charts are based on the actual colours of bleached and healthy corals. Each colour square corresponds to a concentration of symbionts contained in the coral tissue. This is directly linked to the health of the coral.
- The Coral Health Chart can be used in different survey methods, including random and transect surveys, and monitoring easy to identify corals.



Soft coral.



Practice monitoring using the virtual reef.



Entering CoralWatch data in the global database.

Background

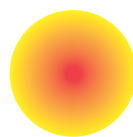
Corals – From polyp to reef

Corals are living animals and are part of the same invertebrate phylum as jellyfish, known as Cnidaria. Reef-building corals are part of the class Anthozoa, and order Scleractinia.

A single animal is called a coral polyp. Polyps can range in size from less than 1mm to more than 15cm. Most corals form colonies, where thousands of polyps share the same physical skeleton. Some corals are solitary and live as a single polyp. Corals absorb calcium and carbonate molecules from the seawater to construct a skeleton. Tiny algae, called zooxanthellae (or symbiotic algae), live within the coral tissue. Zooxanthellae provide the coral with colour and the energy they need to grow and receive a safe home in return.

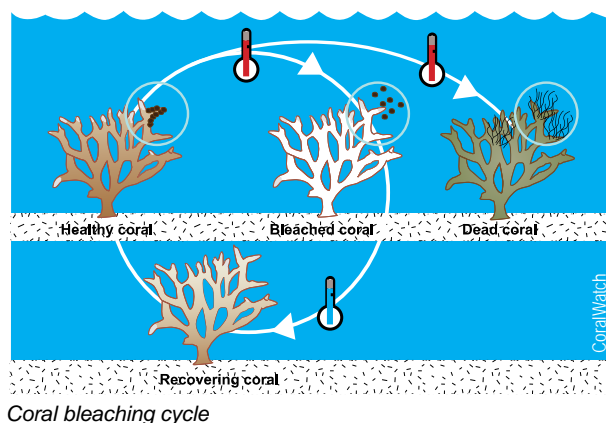
Using the sun for energy

Zooxanthellae are located within the inner cells of the coral tissue. Zooxanthellae use energy from sunlight to convert the coral's waste products into energy that the coral needs to grow. This process is called photosynthesis. This is why healthy corals need sunlight and clean water. Most reef-building corals grow most effectively when the ocean temperature is between 18°C and 29°C.



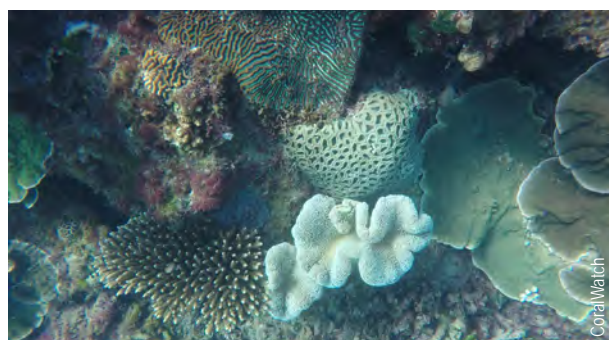
Coral bleaching

In a symbiotic relationship, the organisms live together with one another to the benefit of both. This relationship has happened over such a long period that many corals now cannot survive for very long without their algal partners. When coral becomes stressed from high sediment loads or high water temperatures, it can kick out the algae living inside. This process is known as coral bleaching. Bleaching is the term used because the algae are often what give the coral their brown or green appearance and when gone the white skeleton is visible underneath. If the corals cannot recover and get the algae back into their cells in time, they can die.



Coral growth forms

There are more than 800 known species of hard corals. The skeleton of each species is unique. Corals come in many different shapes and sizes - these are called coral growth forms. Branching corals are fast-growing and provide a home for many different types of reef fish. Large boulder corals grow more slowly and some may be more than 100 years old.



Reefs around Keppel island show various growth forms of corals.

What is CoralWatch?

CoralWatch is a not-for-profit organisation, based at The University of Queensland in Brisbane, Australia. CoralWatch integrates global monitoring of coral bleaching with education about coral reef conservation. In 2002, CoralWatch developed and validated the Coral Health Chart (Siebeck et al. 2006, Monitoring coral bleaching using a colour reference card. Coral Reefs 25:453-460). The chart standardises changes in coral colour, providing a simple way to quantify bleaching and monitor coral health. The Coral Health Chart is used by dive centres, scientists, school and conservation groups, management and tourists. Anyone can contribute to our global database! Collecting data is easy - you just compare colours of corals with colours on the chart and record matching codes. You don't need to wait until coral bleaching occurs - monitoring healthy reefs is also important. You can monitor any reef, any time, while diving, snorkelling or reef walking. Get involved in CoralWatch to monitor and protect reefs around the world.

CoralWatch promotes healthy reefs by

- Raising public awareness about importance of reefs, conservation, sustainability, and climate change.
- Developing and distributing education materials for diverse audiences.
- Engaging the global community in monitoring coral health and coral bleaching.

Why we need your help?

Very little is known about coral bleaching trends on a global scale. Monitoring is most effective when conducted regularly. But, there are not enough scientists to monitor all the world's reefs. This is where you can help! If many people around the world, like you, contribute to our global database, we will be able to answer questions about patterns of coral bleaching, severity of coral bleaching, and patterns of recovery. All data is publicly available and forms a great resource for student projects.

Find out more visit WWW.CORALWATCH.ORG.

Identifying coral types

Instructions

Corals can appear in different shapes.

For each coral pictured, identify the coral type and write this underneath.



Boulder



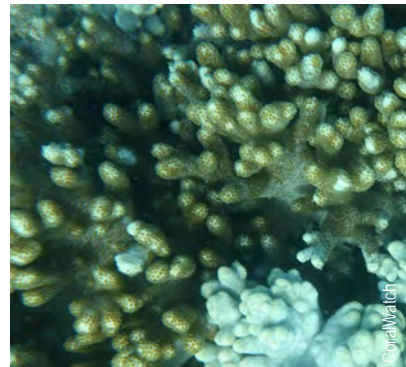
Branching



Plate



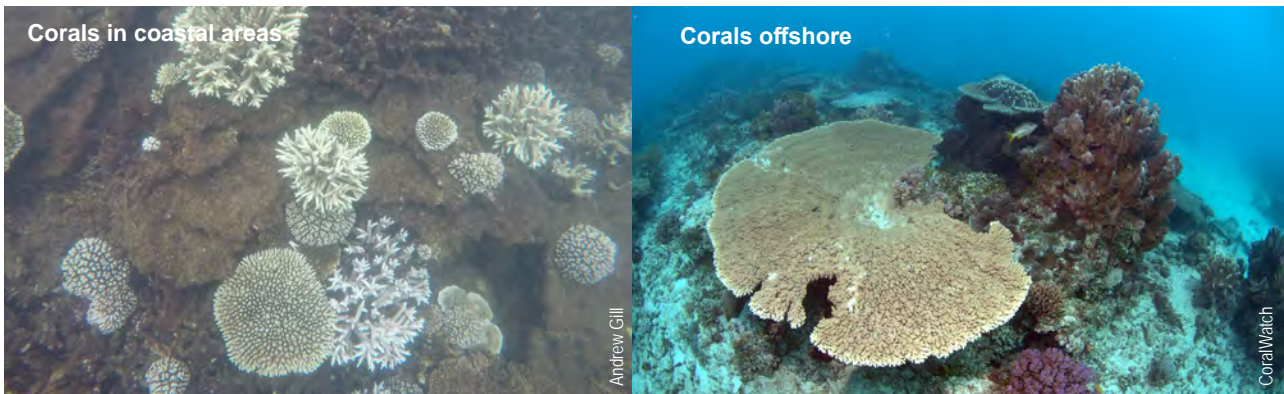
Soft



Capricorn Coast corals

The in-shore reefs of Capricorn Coast are home to more than 150 species of coral. Environmental conditions vary greatly between these reefs and each reef hosts a coral community that is specialised for its conditions. The in-shore reefs and coral communities of Capricorn Coast are of high ecological, economic and recreational importance and require our care.

In coastal areas water has lots of nutrient and sediment runoff. The main cause of high nutrient and sediment levels is from soil erosion from creeks and rivers, farming land and construction sites via our catchment and river systems. Too much sediment in the water can limit the sunlight that corals and their zooxanthellae need for energy. Because of this, only some species of coral can live in these inshore areas. Corals that can tolerate murky water tend to be small, round corals. As you travel away from the mainland, you can see changes in water quality and types of coral.



Monitoring coral health

Scientists monitor the health of corals to determine the health of the marine environment they are in. The health of a coral is determined by the number of symbiotic algae inside the coral cells. The brown/green zooxanthellae give the coral its brown/green colour. When corals are stressed they have less zooxanthellae and become pale or even white in colour, this is called coral bleaching. You can measure the level of coral bleaching by using the CoralWatch Coral Health Chart to identify its colour.

Saving our corals

One way to reduce stress to corals is to reduce the amount of sediment in the water. Look at the websites: Port Curtis, see Gladstone Healthy Harbour Partnership, ghhp.org.au and check the report cards at ghhp.org.au/report-cards. Keppel Bay, see Fitzroy Basin Association at www.fba.org.au and a description of Keppel Bay by Keppel Islands (Dr. Alison Jones) at keppels.com.au

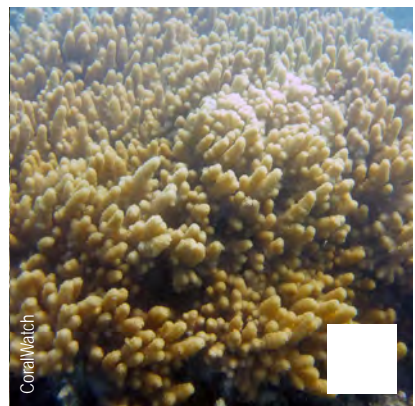
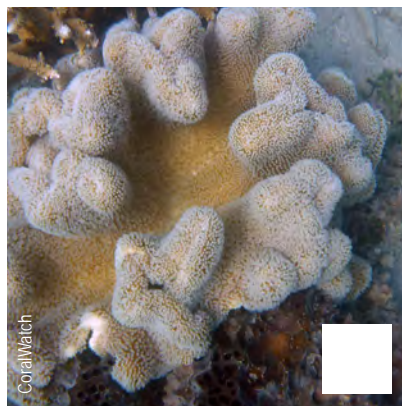
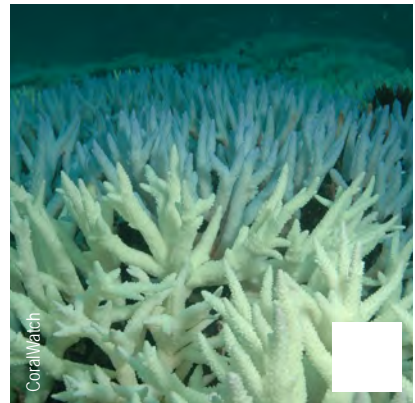
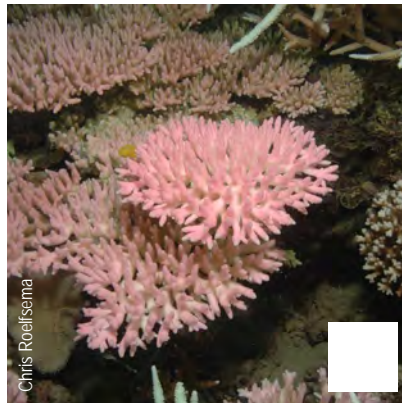
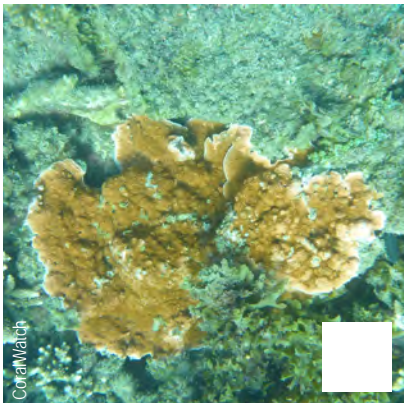
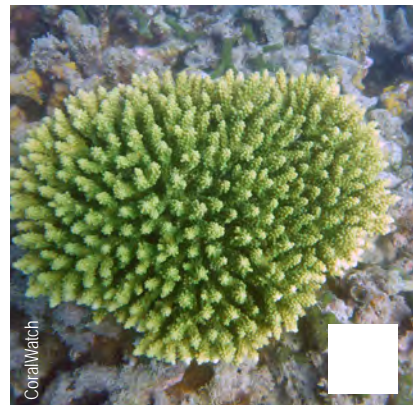
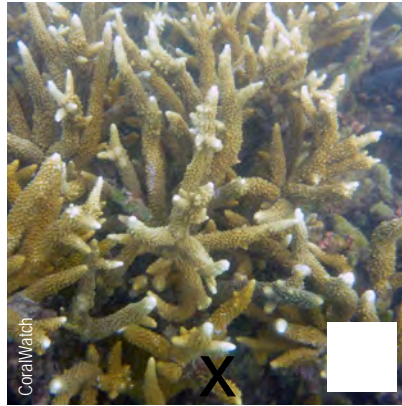
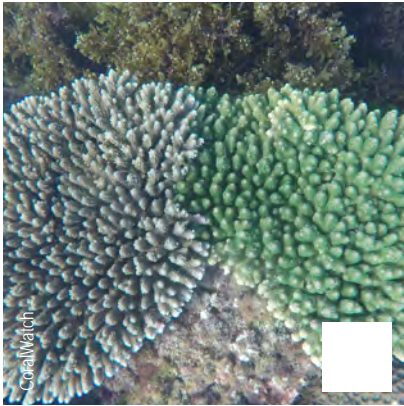
Questions

1. Draw and label features of the coral including the following labels: mouth, tentacles & zooxanthellae.
2. Why are corals important?
3. What is a symbiotic relationship? Explain the relationship associated with corals.
4. What is coral bleaching?
5. How can scientists measure coral health?

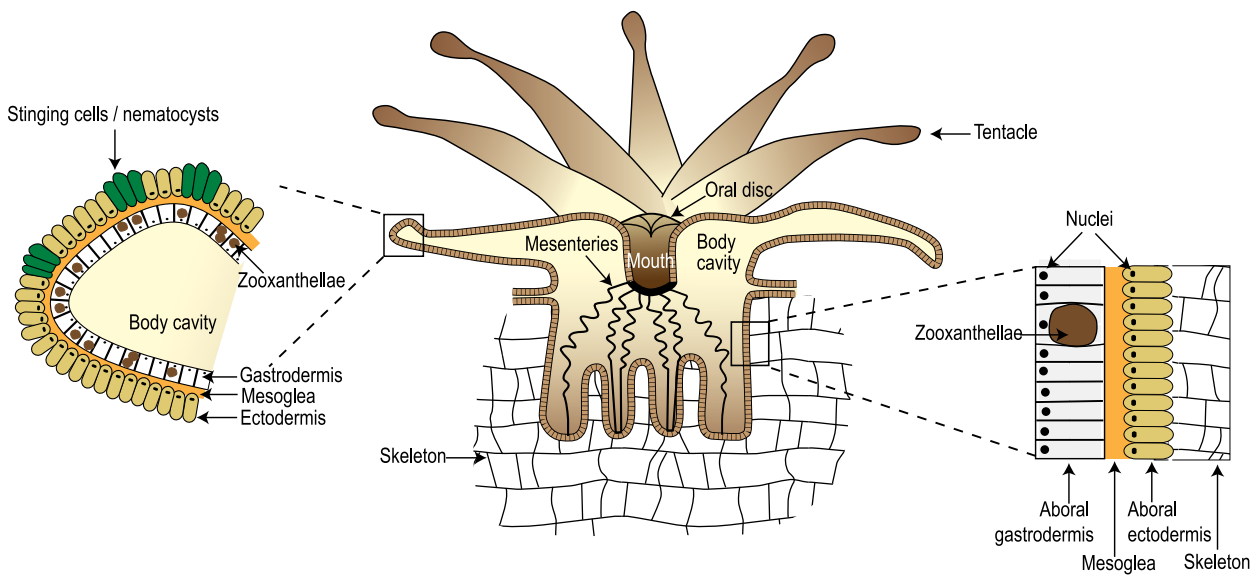
Coral bleaching - sign of stress

Instructions

For each picture, decide if the coral is healthy or bleached. Tick the boxes if the coral is bleached or unhealthy.



Corals: consumer or producer?



CoralWatch

Corals build hard structures that can be seen from the air and even from space. Corals are animals. They build reefs by secreting a skeleton which the animal uses to hold itself in place. When viewed close up, **tentacles** and a **mouth** are visible. Corals use these structures at night to capture **plankton** and feed. However, during the day something very different occurs. Corals often have a relationship with a special type of algae called **zooxanthellae** (pronounced 'zoo-zan-thel-ay'). The algae actually live inside cells in the inner cell layer of the coral. When exposed to sunlight, just like other algae, the zooxanthellae are able to produce their own food through photosynthesis. In fact, they are so good at producing their food that they have enough left over for the coral to share. In turn, the coral shares nutrients with the algae. This type of relationship is called a **symbiosis**. In a symbiotic relationship, the organisms live together with one another to the benefit of both. This relationship has happened over such a long period that many corals now cannot survive very long without their algal partners. When coral becomes stressed, it can kick out the algae living inside it. This process is known as **coral bleaching**. Bleaching is the term used, because the algae are often what give the coral their brown or green appearance and when gone the white skeleton is visible underneath. If corals cannot recover and get the algae back into their cells in time, they can die.



Chris Roalson

Corals: consumer or producer?

Some fish eat coral such as angelfish, butterflyfish and blennies. Other fish eat plankton such as damselfish and fusiliers. Sharks eat fish.

Instructions

1. Identify the primary producer in the coral-algae relationship.
2. Draw a food web on the worksheet with coral, plankton, zooxanthellae, coral-eating fish, plankton-eating fish and sharks.

Measuring coral health using the virtual reef poster

CORALWATCH This virtual reef shows you different coral types and the difference between bleached and healthy corals. You can use the Coral Health Chart to measure the health of these corals.

Capricorn Coast Virtual Reef

Do you know? Port Curtis and Keppel Bay have more than 150 coral species?

CORAL HEALTH CHART

The Coral Health Chart is based on the actual colours of bleached and healthy corals. Each square on the Chart corresponds to the concentrations of symbiotic algae which live in the coral tissue.

INSTRUCTIONS

For each coral, use the Coral Health Chart to record:

- darkest and lightest colour scores
- coral type

TIP Avoid touching or grazing type of corals because they are naturally sensitive to touch.

WWW.CORALWATCH.ORG

Visit our website to view Port Curtis, Keppel Islands and worldwide data for reefs, and compare coral health scores between reefs and over time.

Instructions

- Following the instructions on the back of the Coral Health Chart, match the coral colours on the virtual reef poster with the colour scores on the chart.
- Record your colour scores and coral types on a data sheet that you can download from www.coralwatch.org.

You can also download the CoralWatch 'data entry' mobile phone app and enter your data in **demo mode**.



DATA SHEET

Group name: _____ Your name: _____

Email address: _____

Participation field: dive centre / scientist / environmental / school or university / tourist

Country of reef: _____ Reef name: _____

GPS if possible: _____ Depth _____ m / feet Sea temp: _____ °C

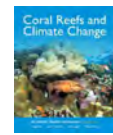
Date of survey: _____ / _____ / _____ Time collected: (ie, 14:00 or 2pm) _____

Weather: sunny / cloudy / raining Your activity: reef walking / snorkelling / diving

*Please note: data will not be accepted on the website if any of these fields are left blank

Coral Number	Colour Code		Coral Type			
	L=Lightest	D=Darkest	Br=Branching	Bo=Boulder	Pl=Plate	So=Soft
example	L: D2	D: E5	Br	Bo	Pl	So
1	L: D:	D: E:	Br	Bo	Pl	So
2	L: D:	D: E:	Br	Bo	Pl	So
3	L: D:	D: E:	Br	Bo	Pl	So
4	L: D:	D: E:	Br	Bo	Pl	So
5	L: D:	D: E:	Br	Bo	Pl	So
6	L: D:	D: E:	Br	Bo	Pl	So
7	L: D:	D: E:	Br	Bo	Pl	So
8	L: D:	D: E:	Br	Bo	Pl	So
9	L: D:	D: E:	Br	Bo	Pl	So
10	L: D:	D: E:	Br	Bo	Pl	So
11	L: D:	D: E:	Br	Bo	Pl	So
12	L: D:	D: E:	Br	Bo	Pl	So
13	L: D:	D: E:	Br	Bo	Pl	So
14	L: D:	D: E:	Br	Bo	Pl	So
15	L: D:	D: E:	Br	Bo	Pl	So
16	L: D:	D: E:	Br	Bo	Pl	So
17	L: D:	D: E:	Br	Bo	Pl	So
18	L: D:	D: E:	Br	Bo	Pl	So
19	L: D:	D: E:	Br	Bo	Pl	So
20	L: D:	D: E:	Br	Bo	Pl	So

Check out these resources...

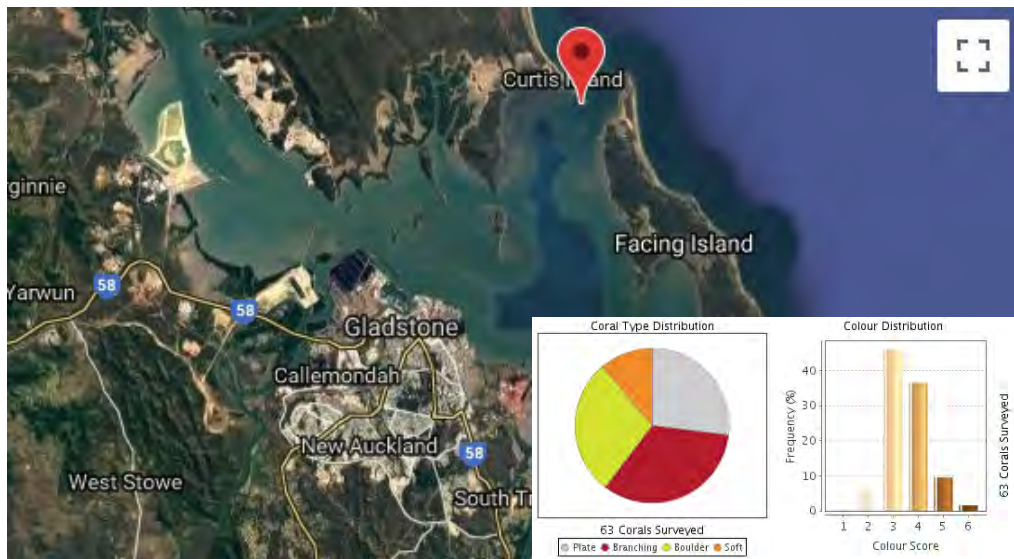


Reid, C., Marshall, J., Logan, D., Kleine, D. (2012) **Coral Reefs and Climate Change: the guide for education and awareness.** CoralWatch, The University of Queensland, Brisbane, Australia.

Siebeck, U.E., Marshall, N.J., Kluter, A. and Hoegh-Guldberg, O. (2006) *Coral Reefs* 25(3):453-460

Any other relevant information, e.g. average diving depth, species of coral, pollution, long term weather such as drought, flood, heat-wave.

Interpreting real data

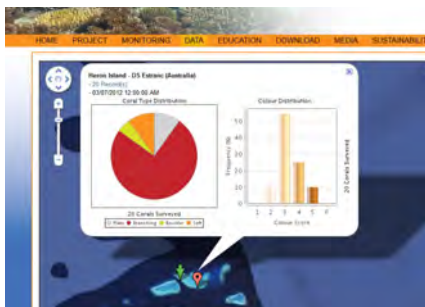


Map with inshore reef site in Port Curtis. Data shows average colour and coral type distribution for a selected reef, in this case Rat Island.

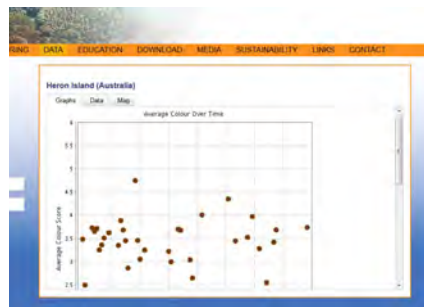
Instructions

In this activity you will analyse and compare data results from the CoralWatch website.

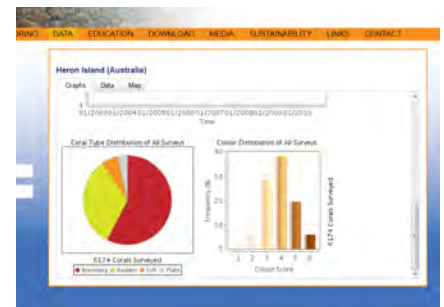
- Go to **www.coralwatch.org** and find the map under the data tab showing field data. Visit a site and choose one survey.
 - What is the name of your reef?
 - Which coral type was most abundant?
 - Which coral type was the least abundant?
 - Which colour score had the highest frequency?
 - Who collected this data? Circle the answer.
 dive centre / scientist / conservation group / school or university / tourist / other
- Compare all surveys conducted on this reef by various people. Go to data/reefs and find the name of your previous reef and view the graphs.
 - What is the average colour over time?
 - Which coral type was the most abundant at this reef?
 - Which colour score has the highest frequency?
 - How many corals have been surveyed in total?
 - When was the last survey?



Data results single survey.

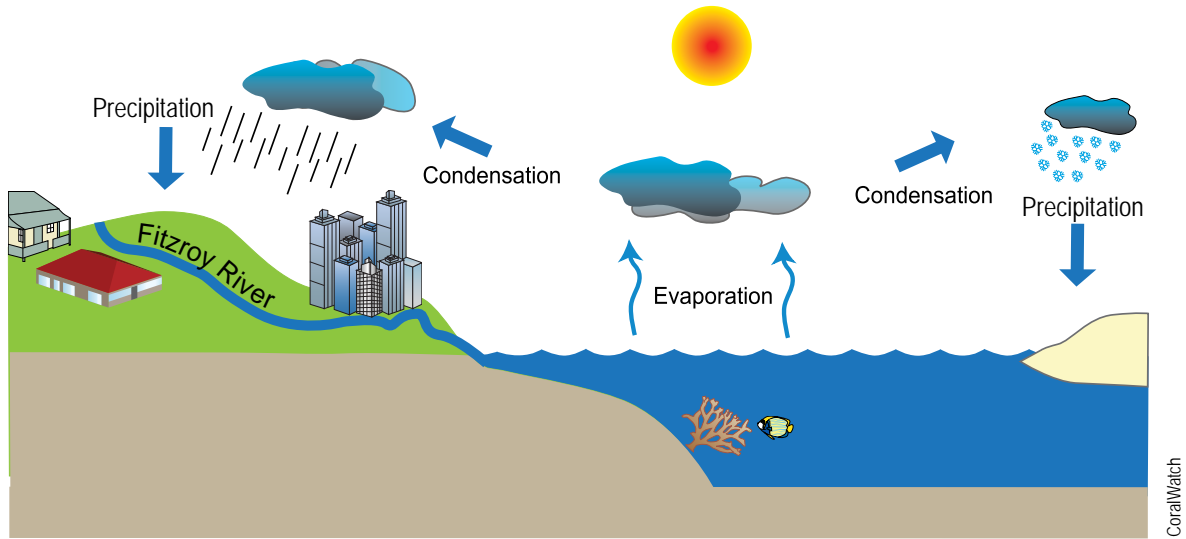


Average colour score over time comparing all surveys for one reef.



Average colour and coral type distribution comparing all surveys for one reef.

The water cycle of Keppel Bay



The water cycle of Keppel Bay begins with **liquid** water molecules on the surface of the bay and land heating up from the sun and **evaporating** into the air as a gas called water vapour. Here they rise up and enter the cool air high in the atmosphere. Once cool, the gaseous water molecules **condense** to form small liquid water droplets creating clouds. When the water droplets in clouds get too heavy, they fall to the ground as **precipitation** (rain). Often the precipitation will be deposited on land hundreds of kilometres away. When precipitation occurs in Rockhampton and to the west of Rockhampton, some liquid water is absorbed into the ground and excess surface water drains into local creeks. Waters of the Mackenzie and Dawson rivers drain into the **Fitzroy River**. From source to mouth, the Fitzroy River is joined by thirty-six tributaries. The '**catchment area**' of the Fitzroy River is the land area where excess water drains into the river and includes 142,665 square kilometres stretching from the Carnarvon Range in the west making it the largest river catchment flowing to the eastern coast of Australia. The Fitzroy River drains its collection of fresh water into the salty waters of Keppel Bay. Water that has fallen on the land hundreds of kilometres away will travel via creeks and the Fitzroy River and eventually into Keppel Bay. This completes the cycle of the Keppel Bay **water cycle**.

Questions

1. Look in a dictionary and write the definition for the words in bold.

Liquid	Precipitation	Condense	Evaporating
Catchment area	Water cycle	Brisbane River	

2. Complete the table below listing water cycle stages. Fill in the physical states of water molecules and the location it can be found.

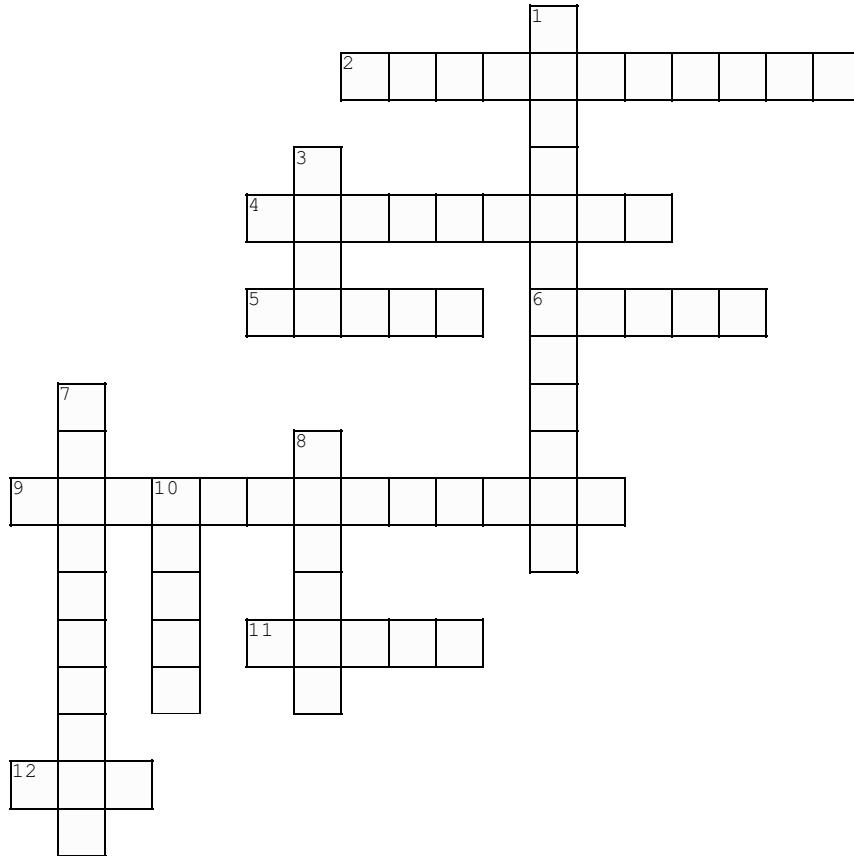
Water cycle stages	Sea water	Water vapour		Rain	Flood water		Sea water
Location	Ocean					River	

Water cycle crossword

Name: _____

The Water Cycle Crossword

Complete the crossword below



Across

- 2. When water molecules in a liquid changes to a gas.
- 4. The land area where excess water drains into creeks
- 5. When rivers and creeks are unable to carry all the excess water this causes?
- 6. The physical state of water when it gets very cold.
- 9. When water vapour in the sky forms water droplets and falls to the ground.
- 11. Large drainage channel where all water in a catchment eventually goes through before entering the ocean.
- 12. The physical state of water when it moves into the atmosphere

Down

- 1. The process which leads to clouds forming.
- 3. Sometimes thunderstorms lead to precipitation of water in a solid state.
- 7. A large body of water off the coast of Brisbane.
- 8. The physical state of water in rivers, creeks and the ocean is?
- 10. Small channel where water drains and feeds into larger bodies of water.

Sediment runoff - water turbidity

What is sediment?

Sediment is soil particles that are washed off the land into creeks and rivers. Sediment can be a range of different sizes including large sand particles and smaller fine mud or clay particles.

Think, Pair, Share Activity

Pair up with a friend and discuss the following. Make sure you write down your ideas!

- Fast moving water carries sediment with it. Imagine running the hose with the tap fully opened in a sand pit.
What happens to the sand?
Where does it move to?
- What do you think happens when there is heavy precipitation and flooding in the Fitzroy River catchment?
Where does the sediment end up?
How does this sediment affect the Keppel Bay inhabitants?



Fitzroy River in flood.

Sediment in Keppel Bay and Port Curtis

High levels of sediment entering waterways are a major environmental concern. The main cause of high sediment levels in the river is soil erosion from creeks and rivers, farming land and construction sites. Keppel Bay and Port Curtis are vulnerable to high sediment loads entering it through the Fitzroy, or Boyne and Calliope Rivers. The high amount of soil particles suspended in the water causes the water to become cloudy which is called water turbidity. High water turbidity is harmful to its inhabitants by blocking sunlight and smothering seagrasses and corals that require light to grow, consequently reducing the amount of food available for turtles, dugongs and fish.

Instructions turbidity activity

1. Label 3 identical bottles with lids with 'fine', 'medium' and 'course'.
2. Fill all bottles with equal amounts of water up to 3cm from the top.
3. Collect equal volumes of 3 types of sediment. Use course sand for course type sediment, fine sand for medium type sediment and super fine dust-like soil for fine type sediment (look for this in high traffic areas around your school). If you cannot find super fine sediment, use talcum powder.
4. Add a different sediment type to each of the 3 bottles corresponding to your sediment labels.
5. Shake vigorously for 30 seconds and place in a location where they will not be moved.
6. Observe the water turbidity and record the time it takes for the water to become clear.
7. Discuss your results.
 - a. Which sediment size settled to the bottom first? How long did it take?
 - b. Which sediment size settled to the bottom last? How long did it take?
 - c. What implications does sediment particle size have on inhabitants of Keppel Bay and Port Curtis?
 - d. What inhabitants of Keppel Bay and Port Curtis need light to survive? Why?
 - e. How are these inhabitants affected by high turbidity?

Sediment runoff - altered food webs

Port Curtis is famous for its extensive seagrass meadows which provide food for large populations of green sea turtles and dugongs. Unknown to most people, Port Curtis like Keppel Bay is an important habitat for corals. Corals are important because they provide food and shelter for fish and other marine creatures. A coral's health is extremely susceptible to changes in the environment. This makes coral an important species to monitor and use to indicate environmental conditions. Keppel Bay and Port Curtis are part of a precious environment which needs to be protected from environmental damage caused by humans and their activities.

High sediment levels entering our waterways is a major environmental concern. Floods, river bank erosion and soil washed into rivers and creeks from farmland and construction sites are some of the many causes. Sediment suspended in the water causes high water turbidity reducing sunlight penetrating through the water column and smothering benthic organisms such as seagrass and corals. With this, other organisms down the food chain are affected. The loss of seagrass and corals results in less food available for many animals such as fish, turtles and dugongs. Additionally, the break down of the coral's structure affects small organisms such as crabs and snails that seek shelter in and between corals.

This exercise will examine the effects on a food web when the community structure and biodiversity in the ecosystem is altered.

Questions

1. Draw a food web including, coral, seagrass, turtles, dugongs, coral-eating fish, plankton, plankton-eating fish, and sharks. Sharks are predators of fish, turtles and dugongs.
2. Consider what would happen to the food web in the event of large amounts of rain pushing extra sediment into Keppel Bay or Port Curtis and how it may affect the system. Put a red cross through the organisms directly affected by the sediment in your food web.
3. Describe what effect this would have to all organisms in your food web. What about organisms at higher orders of consumption? Would anything happen to those organisms?
4. Draw a new food web for the ecosystem based on the alterations you have described for the first food web. How has the large amount of rain falling on the city effected biodiversity?
5. In groups of three consider some ways to help reduce the sediment running into the area. Describe what this may do in the short, medium and long term and report this back to the class.
6. Consider what your area may have looked like prior to European settlement.
7. How do corals and coral bleaching fit into your food web and discussions? Can you think of any events that may have caused coral bleaching and or smothering with sediment that may have been observed by indigenous groups in the area at the time? Are these events still a possibility today?



CAPRICORN COAST – VENOMOUS MARINE ANIMALS

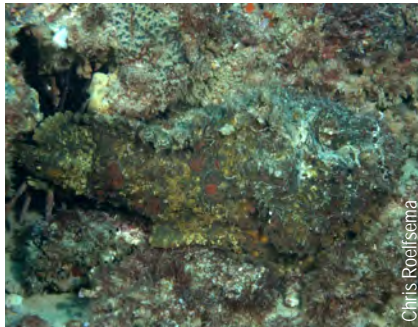
Tips for avoiding marine injuries

- Don't touch any marine organisms
- Avoid picking up shells
- When in the water, always be aware of your surroundings
- Shuffle your feet when walking into the water in sandy areas
- Always take a first aid kit and manual for marine stings

Before you go out into the field, make sure you have access to up-to-date first aid advice. When in doubt, seek medical care.



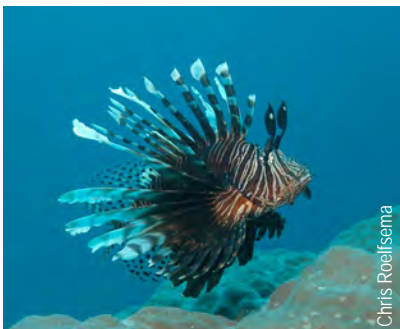
Stingrays - When stepped upon, spine can cause immediate pain.



Stonefish - Dorsal spines capable of piercing through shoes.



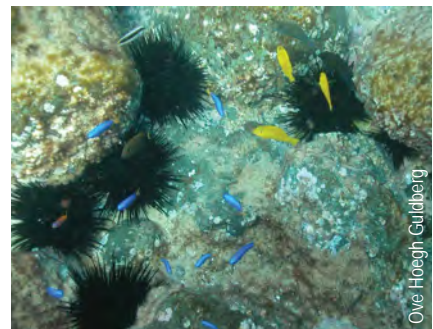
Scorpionfish - Tips of fins carry poisonous venom and can affect body part in minutes.



Lionfish - Spines have venom and can cause severe pain after a sting.



Blue bottle jellyfish - Discharge nematocysts can present complications.



Sea urchin - Sharp and brittle spines which can inject poison. Painfull.



Cone shell - Shoots tiny harpoon (venomous). Painless to excruciating.



Fire coral - Tentacles with nematocysts. Prickling sensation to extreme pain.



Hydroids - Nematocysts. Stinging sensation to extreme pain.



Blue ringed octopus - Serious bite. Painfull, can be fatal and needs treatment.



Box jellyfish - Nematocysts. Serious sting which is painful and can be fatal.



Fire urchin. Stinging sensation to extreme pain.

Thorough planning is required to make your fieldtrip successful.

Create a fieldplan including

- Risk assesment
- Safety and Code of Conduct
- Emergency procedures
- Snorkelling and reef walking procedures
- A list of animals that are dangerous/venomous and an up-to-date first aid guide for treatment of contact with venomous marine creatures
- Checklist of items that students are required to bring such as sunscreen protection and water



Check the following

- Medical records from students
- Parent permission
- Permits, allowing you to do research

Where to go

Suitable sites for reef walking are:

KEPPEL BAY

- Great Keppel, Humpy, Miall, Middle, Nth Keppel, Pumpkin Islands.

PORT CURTIS

- Farmers, Oaks, Rat Reefs; Facing Island; Gatcombe Head, North Point.

Suitable locations (accessible by boat) for snorkelling are:

KEPPEL BAY

- Bald, Egg, Man & Wife, Outer Rocks; Barren; Great Keppel, Middle Islands.

PORT CURTIS

- Gatcombe Head, North Point, East Point, Pearl Ledge; Sable Chief, Seal, Curtis Rocks.



Food webs - intertidal rocky shores

Instructions

Field Activity

1. Find an area that your teacher determines is safe to walk through.
2. Record any animals and plants observed in this location in the table as a group.
3. Refer to the field guide to help with species identification.

Questions

1. Use the information provided in the field guide to determine what animals eat the plants, and identify any other animals you can observe in the area. Record this in the table.
2. Predict which species are producers or consumers.

Back in the classroom activity

1. Construct a food web using all the plants and animals recorded in the field. Try to draw representative pictures of each animal or plant in the food web.
2. What types of corals did you observe in your field study? How do they fit into the food web of the intertidal zone?
3. Suggest what may happen if one of the first order consumers is removed from the system?



Rat Island, Port Curtis

CoralWatch

COMMON FLORA AND FAUNA – INTERTIDAL COASTAL REGIONS



Codium spongiosum (Green sponge weed)



Padina australis (Brown algae)



Sargassum (Brown macroalgae)



Galaxauria rugosa (Red coraline algae)

MACROALGAE ('seaweeds') are a diverse group of Red (Rhodophyta), green (Chlorophyta) and brown (Phaeophyta) algae. The colours of macroalgae are due to the different pigments in the algae, some of which are used to convert sunlight into chemical energy through photosynthesis.



Zostera and halophila (Seagrass)



Aplysia dactylomela (Sea hare)

SEAGRASS are highly specialised marine flowering plants adapted to soft sediments. Seagrasses need sunlight to produce food.

SEA SLUGS live in and around seagrasses and rocky shores. They feed on sponges, green and red algae. Some can be up to 15cm long.



Avicennia marina (Grey mangrove)



Sarcocornia quinqueflora (Beaded Samphire)

MANGROVE PLANTS are trees or shrubs that are found in the intertidal zone. Roots poke through the sand into the air.

SALTMARSH is a marine plant ecosystem that occupies the upper tidal zone above mean sea level, and requires regular but infrequent tidal flooding.

COMMON FLORA AND FAUNA – INTERTIDAL COASTAL REGIONS



Tapas dorsatus (Tapestry Venus Clam)

BIVALVES are shells with two parts protecting the soft body of the animal inside. Bivalves filter food (phytoplankton & zooplankton) from the water. Many were important foods for local indigenous people for thousands of years.



Pyrazus ebeninus (Hercules club mud whelk)

GASTROPODS are sea snails and slugs. They live on rocks and in seagrass beds. They often eat seagrasses and algae in the marine environment.



Casella atromarginata (Nudibranch)

NUDIBRANCHES are a group of soft-bodied, marine gastropod molluscs which shed their shells after their larval stage.



Class *Holothuroidea* (Sea cucumber)

SEA CUCUMBERS burry in sand and inhabit rocky shores. They feed on detritus and algae. When disturbed some species can eject masses of sticky white tendrils.



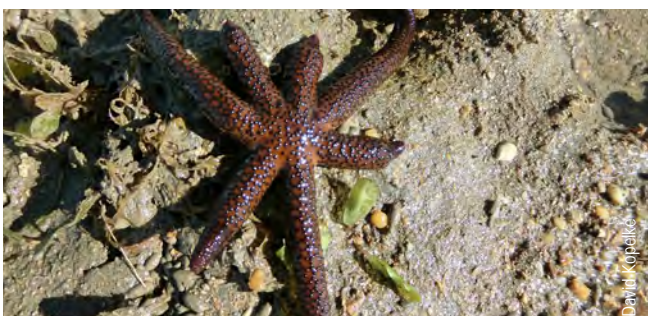
Scylla serrata (Mud crab)

CRABS eat many things including shrimp, gastropods, molluscs and even dead fish.



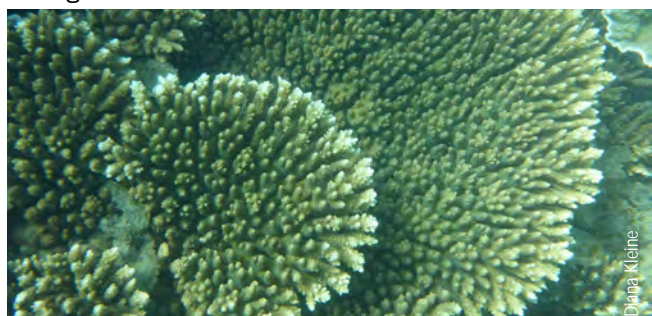
Mictyris longicarpus (Soldier crab)

The **SOLDIER CRAB** lives in sandy estuaries and mangroves, and occurs in massive groups that seem to emerge from nowhere all at the same time.



Echinaster luzonicus (Starfish)

The **STARFISH** is not a fish. It's an echinoderm, closely related to sea urchins and sand dollars.



Acropora sp. (Hard coral)

CORALS can be found in rocky shores. They can have a stony skeleton or may be soft.

Food webs - intertidal rocky shores

Food web field activity results table

Group member names:

Location:

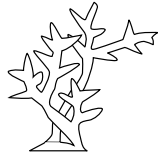
Date:

Time:

Record No	Observed organism	Possibly food for?	Possibly feeds on?	Producer or Consumer
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				

Identifying coral type using the Coral Health Chart

CoralWatch



Branching (BR)



Boulder (BO)



Plate (PL)



Soft (SO)

The Coral Health Chart uses four coral types to classify corals. **Branching** refers to any branching coral, such as *Acropora* and *Pocillopora* species. **Boulder** refers to any massive or rounded corals, such as some *Platygyra* and *Porites* species. **Plate** refers to any coral that forms a plate-like shape, such as tabular *Acropora* species, and the **soft** category refers to corals lacking a hard skeleton, e.g. *Sarcophytum* species.

Instructions

1. Copy the coral type template on a waterproof slate.
2. Locate a colony of coral, observe it and record the coral type. Use the types described on the Coral Health Chart.
3. Sketch the coral.
4. List any marine organisms that you observe near the coral.
5. Answer the following questions:
 - a. Are there mainly soft or hard corals in your local area?
 - b. In which zone do most corals appear to be?
 - c. What is the most common coral growth form?
 - d. What is the most common species of coral? Use your coral ID card.

CORAL TYPES	
Branching	Boulder
Plate	Soft

Identifying coral type using the Coral Health Chart

The **aim** of this activity is to identify coral types using the Coral Health Chart.

ACARA curriculum links

Science understanding (ACSSU111)

Science as human endeavour (ACSHE119, ACSHE223)

Science inquiry skills (AC SIS125, AC SIS126)

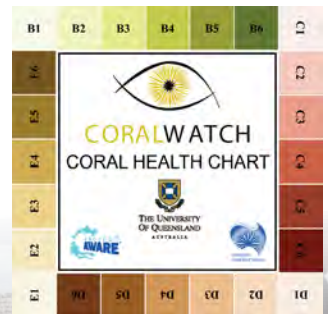


Instructions

- This activity should be conducted at low tide.
- Because identifying coral species is very difficult, CoralWatch classifies coral types in easy identifiable groups. For this purpose, coral types are described by the overall shape ('growth form') of coral colonies. There are hundreds of different coral species, each with unique shapes and colours. Sometimes the colour or shape may not clearly match the options on the Coral Health Chart. If it is difficult to select a colour or coral type, simply record the closest match. If a particular coral is too difficult to classify, just skip this coral and move on to the next one.
- CoralWatch classifies most free living, tabular, encrusting and foliaceous corals as plates.
- CoralWatch classifies most digitate, bushy and staghorn corals as branching.

Equipment

- Booties, hat and sunscreen
- Coral Health Chart
- Waterproof slate or paper with pencil
- Underwater camera (if available)
- Viewing tube (if available)
- Waterproof ID guide (if available)
- ID reference books (if available)



How to Use the Coral Health Chart

1. Choose a random coral and select the lightest area.
2. Rotate the chart to find the closest colour match.
3. Record the colour code on a data slate.
4. Select the darkest area of the coral and record the matching colour code.
5. Record the coral type.
6. Continue your survey with other corals. Record at least 20 corals.
7. Submit your data using the CoralWatch Data Entry Apps or enter online at www.coralwatch.org.

Survey Methods include: (depending on experience and location)

- Random Survey - Select corals randomly, such as the closest coral after every second fin kick.
- Transect Survey - Select corals by following a line (transect) and record every few meters.
- Easily Identified Corals - Select corals you can recognise and return to permanent transect.

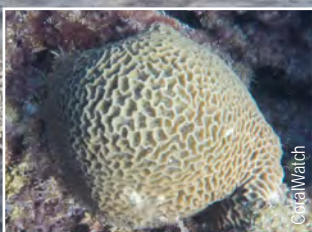
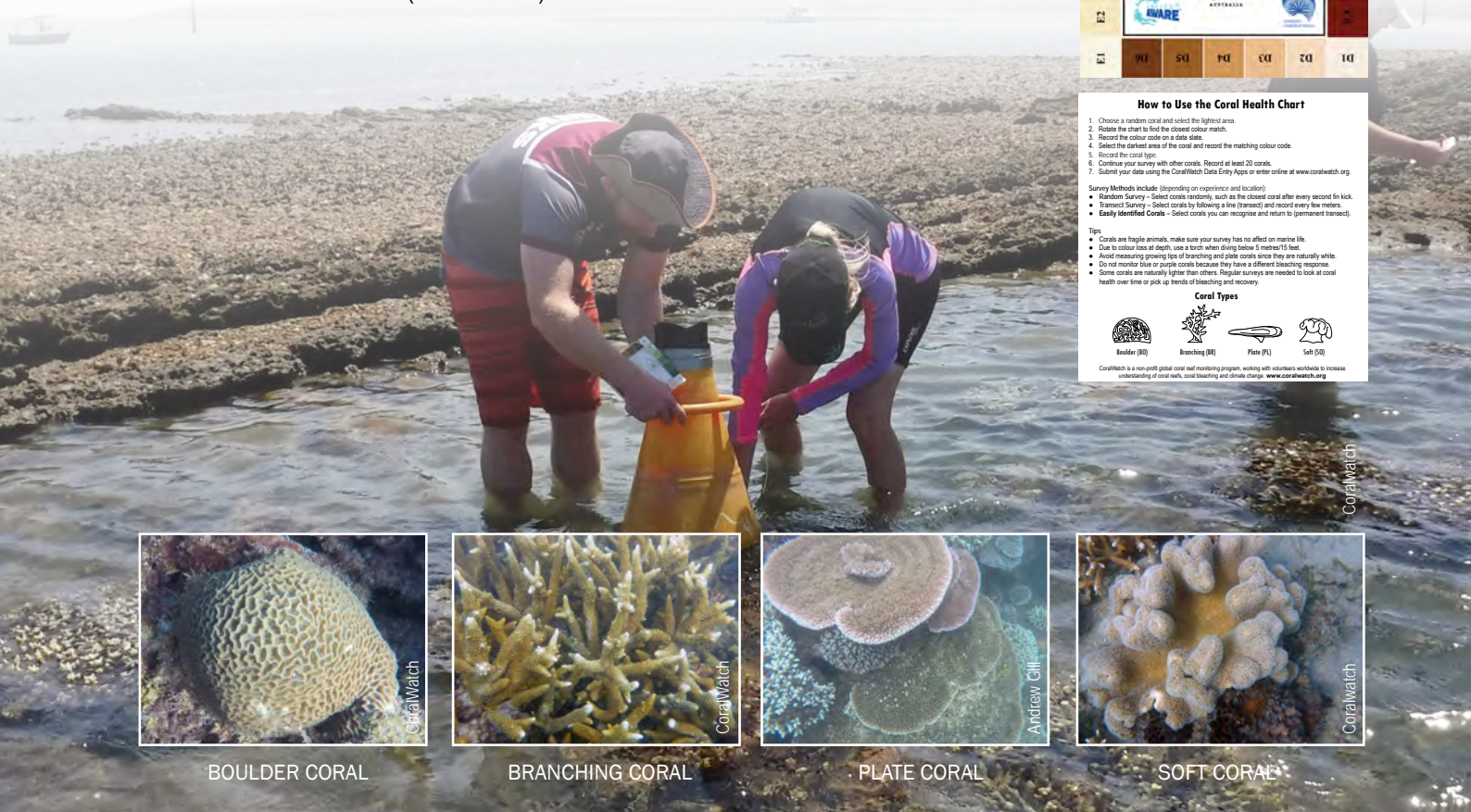
Notes:

- Corals are fragile animals, make sure your survey has no effect on marine life.
- Due to colour loss at depth, use a torch when diving below 3 metres/10 feet.
- Avoid measuring growing tips of branching and plate corals since they are naturally white.
- Do not monitor blue or purple corals because they have a different bleaching response.
- Some corals are naturally lighter than others. Regular surveys are needed to look at coral health over time or pick up trends of bleaching and recovery.

Coral Types

- Boulder (B)
- Branching (BR)
- Plate (P)
- Soft (S)

CoralWatch is a non-profit global coral reef monitoring program, working with volunteers worldwide to increase understanding of coral reefs, coral bleaching and climate change. www.coralwatch.org



BOULDER CORAL



BRANCHING CORAL

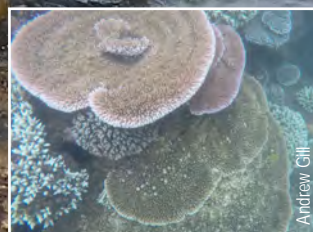
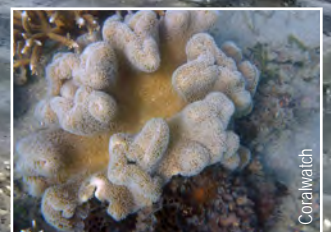


PLATE CORAL



SOFT CORAL

Measuring coral health using random surveys

The **aim** of this activity is to monitor the health of corals using the Coral Health Chart in a random survey as research technique.

ACARA curriculum links

Science understanding (ACSSU116)

Science as human endeavour (ACSHE119, ACSHE223)

Science inquiry skills (AC SIS124, AC SIS125, AC SIS126)



Instructions

- The most important part of a random survey is that it is truly random: don't pick the corals you like or because they are bleached.
- This activity can be conducted snorkelling or reef walking.
- The CoralWatch Virtual Reef Activity is a useful preparation for using the Coral Health Chart in the field.
- The CoralWatch data slate contains all required survey details. You can also create your own data slates by transcribing all the information onto a blank waterproof slate. Make sure you don't miss any details!

Steps to take for a random survey

1. Read the instructions on the back of the Coral Health Chart.
2. Make sure you have all your equipment as listed.
3. Start with recording survey details on your data slate: name, date, time, GPS coordinates (if possible), water temperature, depth, activity and conditions.
4. Choose how often you will measure a coral colony (e.g. every 6 steps or 2 fin-kicks).
5. Begin in a clear direction drawing an imaginary line in your direction of travel.
6. Every 2 fin-kicks, measure the colour scores and coral type of the coral colony closest to you.
7. Repeat this for at least 20 corals.

Equipment

- If snorkelling - mask, snorkel and fins
- If reef walking - booties, hat and sunscreen
- Coral Health Chart
- Waterproof data slate (see picture) with pencil
- Thermometer
- Underwater camera (if available)
- Viewing tube (if available)
- GPS to record coordinates (if available)

Reef name and country:

Your name:

Date and time:

GPS:

Depth:

Sea temp:

Sunny / cloudy / raining:

Walking / snorkelling / diving:

Enter all your data online at WWW.CORALWATCH.ORG

Your data is important to us!

Coral No.	COLOUR CODE		CORAL TYPE (Shrub-like)			
	Lightest	Darkest	Bleaching	Buzzard	Pinna	Soft
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

Example of CoralWatch data slate.



This reef walker has chosen to survey a coral every 6 steps (or 2 metres). You can choose to survey your corals closer together or further apart - as long as the distance you choose is consistent throughout the survey.

Measuring coral health using transect surveys

The **aim** of this activity is to monitor the health of corals using the Coral Health Chart along a transect line as research technique.

ACARA curriculum links

Science understanding (ACSSU116)

Science as human endeavour (ACSHE119, ACSHE223)

Science inquiry skills (AC SIS124, AC SIS125, AC SIS126)



Instructions

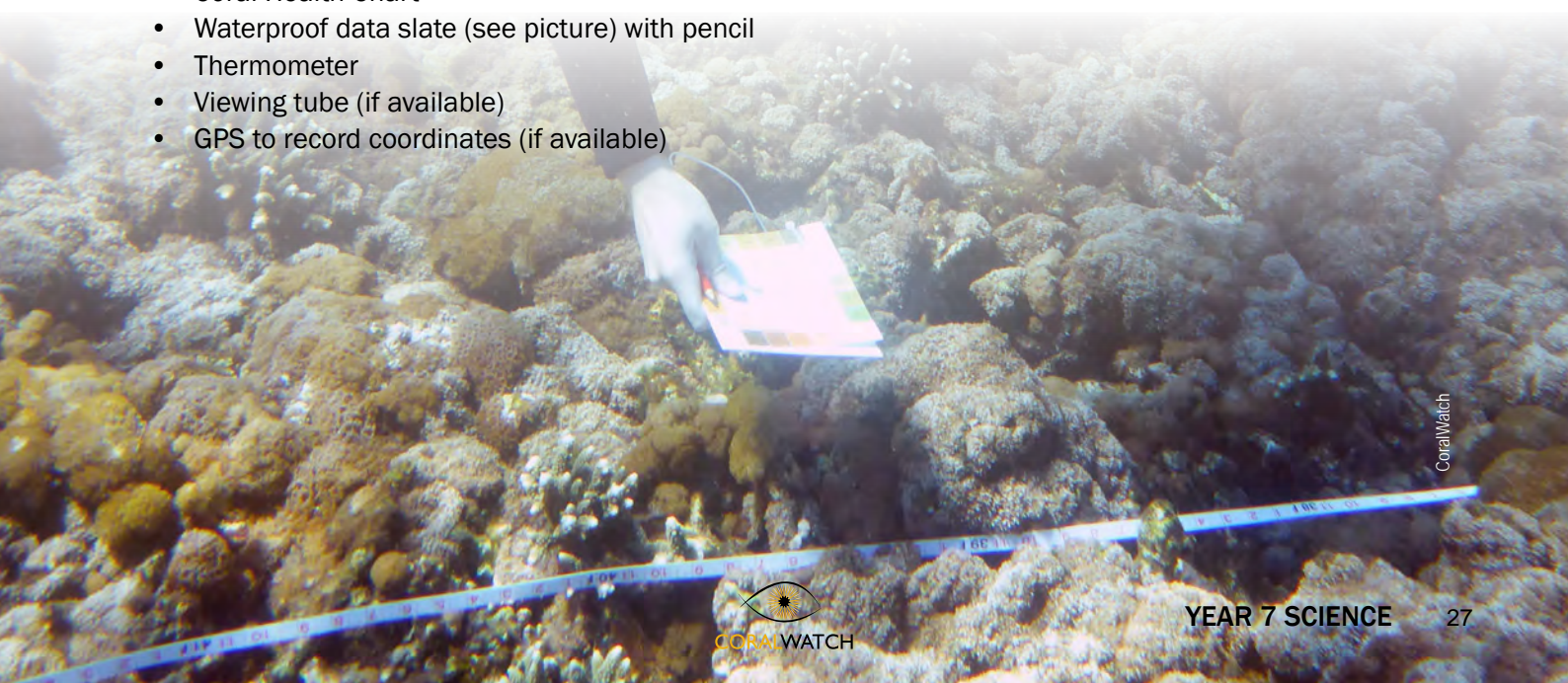
- This activity can be conducted snorkelling or reef walking.
- The CoralWatch Virtual Reef Activity is useful preparation for using the Coral Health Chart in the field.
- The CoralWatch data slates contain all required survey details. You can also create your own data slate by transcribing all the information onto a blank waterproof slate. Make sure you don't miss any details!
- The distance along the transect line between measurements can vary depending on coral cover. If there is no coral underneath the assigned reading, students can pick the closest coral colony.
- Ensure students don't damage the coral as they lay out the tape or when taking measurements.
- For future reference, students could mark the start and end of your transect using GPS coordinates.

Steps to take for a transect survey

1. Read the instructions on the back of the Coral Health Chart.
2. Make sure you have all your equipment as listed.
3. Start with recording survey details on your data slate: name, date, time, GPS coordinates (if possible), water temperature, depth, activity and conditions.
4. Lay out a tape measure or string with measurements marked on it. To decide what intervals to use on the transect tape you should consider the coral cover in your area. With high coral density you could collect data every half a meter, meter or with low density it might be best to take 2 meter intervals.
5. Swim or walk along the tape, and record data every 50cm (depending on coral cover). Aim to collect data for 20 different coral colonies.

Equipment

- If snorkelling - mask, snorkel and fins
- If reefwalking - booties, hat and sunscreen
- Coral Health Chart
- Waterproof data slate (see picture) with pencil
- Thermometer
- Viewing tube (if available)
- GPS to record coordinates (if available)



The **aim** of this activity is to enter CoralWatch field data into an Excel spreadsheet and discuss findings.

ACARA curriculum links

Science understanding (ACSSU116)

Science as human endeavour (ACSHE119, ACSHE223)

Science inquiry skills (AC SIS124, AC SIS125, AC SIS126, AC SIS129, AC SIS130, AC SIS131, CSIS132)



Instructions

1. Download and open the 'Reef Fingerprint 100' template.
2. Go to 'Raw Data Input' tab:
 - Record name, email, date and time, water temp, reef zone, activity and weather conditions.
 - Record brightest and darkest colour scores for each coral that you sampled.
3. Go to 'Data Summary' tab and look at the results from your survey.
4. Go to 'Reef Evaluation' tab and compare your results with the examples of healthy and bleached reefs. Do your results indicate a healthy or more bleached reef?

Please note

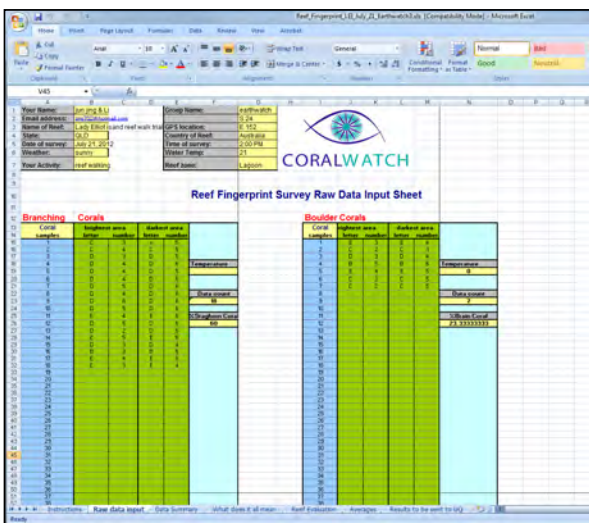
- This tool does not send the data to our online global database. If you have collected real data from the field, please enter it online, as described in the next activity.
- This tool is also suitable for entering practice data recorded as part of the Virtual Reef Activity.

Equipment

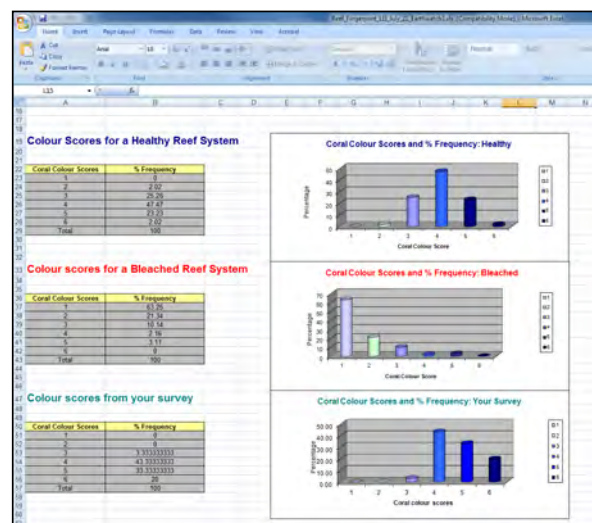
- Computer, with Microsoft Excel installed
- Your data collected in the field

Resources

- 'Reef Fingerprint 100' template - can be downloaded from the CoralWath website (www.coralwatch.org/web/guest/monitoring-materials).



Example of the raw data input sheet.



The reef evaluation will enable you to compare your survey with a healthy versus bleached reef.

The **aim** of this activity is to enter CoralWatch field data into the CoralWatch online global database and compare and analyse your own data with existing data (if applicable).

ACARA curriculum links

Science understanding (ACSSU116)

Science as human endeavour (ACSHE119, ACSHE223)

Science inquiry skills (ACSIS124, ACSIS125, ACSIS126, ACSIS129, ACSIS130, ACSIS131, CSIS132)



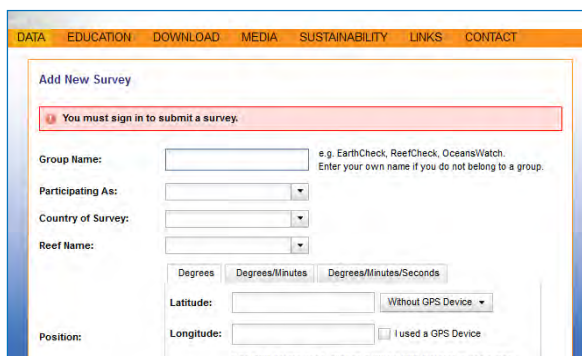
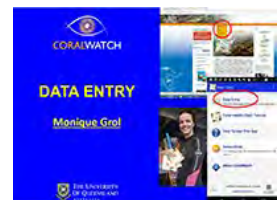
Instructions

1. Go to www.coralwatch.org
2. Go to the 'Download' tab and select 'Education Materials'.
3. Download the 'Data Entry' and 'Data Analysis' guidelines for step-by-step instructions.
4. Go to the 'Data' tab and select 'Enter data'.
5. You need to be signed in to submit a survey: you have to become a member to be able to enter data. Membership is free.
6. Enter all your details from your data slate and submit.
7. If you don't have GPS coordinates you can find your location on the map.
8. Enter all data records and look at your results.
9. Compare the data you collected to:
 - a. Past data on the same reef (if available).
 - b. A nearby reef.
 - c. Fellow students.

Point out the importance of entering real data. Entering survey data into the online CoralWatch global database ensures that the data can be used by reef managers and scientists studying coral bleaching.

Equipment

- Computer
- Internet access
- Your field data
- Data analysis (download from CoralWatch)
- Data entry (download from CoralWatch)



Example of the 'add new survey' page.



CoralWatch website allows you to view all the data recorded for a particular reef.

Entering data using the CoralWatch data entry apps

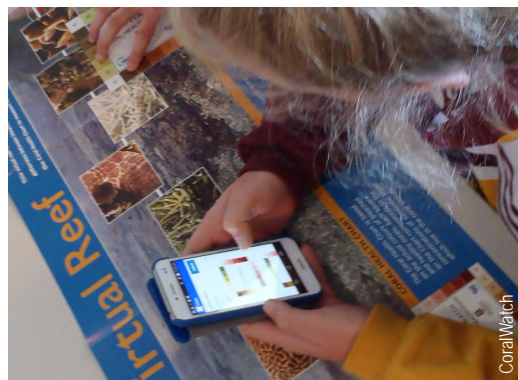
The **aim** of this activity is to enter CoralWatch field data using CoralWatch phone apps, view and analyse survey results, and upload the data to the CoralWatch global database.

ACARA curriculum links

Science understanding (ACSSU116)

Science as a human endeavour (ACSHE119, ACSHE223)

Science inquiry skills (AC SIS124, AC SIS125, AC SIS126, AC SIS129, AC SIS130, AC SIS131, CSIS132)



Students can practice entering data on the mobile app using demo mode with the virtual reef.

Instructions

1. Download CoralWatch data entry app. Available for Android and Iphone.
2. Login/register as a member.
3. Set your phone preferences to online/offline use - you can store data and upload it later.
4. Download from the website the 'Data Entry' guideline for step-by-step instructions if needed (www.coralwatch.org/download-education-materials).
5. Add a new survey and enter all details as requested.

Notes about GPS

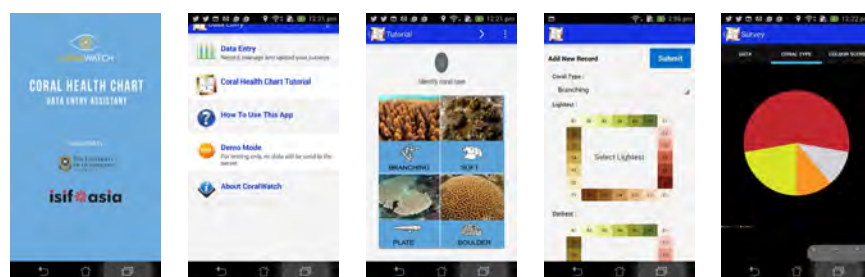
- Only select 'Use your current location' when you are at the actual field site. Don't use this option when you are back in the classroom.
 - If you revisit an existing field site - GPS coordinates will appear automatically and you can select 'Use above coordinates'.
 - Choose the 'Use map to choose location' to place a marker at your field site. This can be done in the field or classroom.
 - Or enter you coordinates manually.
6. After entering all your metadata, enter your survey data by selecting coral type, then the lightest and darkest colour for each coral.
 7. Once finished, check results and upload data to the database. You have to manually upload data.

Please note

- To practice entering data use 'demo mode' - no data will be send to the global database.
- You will still need your Coral Health Chart and slate to collect your data in the field, but this app will make it quick and easy to upload your data to CoralWatch.

Equipment

- Android or Apple mobile phone
- Internet access
- Your field data



Different screen previews of the CoralWatch data entry app.

CoralWatch data entry apps allow you to:

- Enter CoralWatch data on your phone.
- Record the GPS coordinates on the spot.
- View your survey results.
- Store your survey data, work offline and upload at a later time.



ACARA CURRICULUM LINKS

The lessons in this booklet are linked to year 7 Science: Classification – Foodwebs – Water cycle

Science understanding

- Classification helps organise the diverse group of organisms (ACSSU111)
- Some of Earth's resources are renewable, including water that cycles through the environment, but others are non-renewable (ACSSU116)








Science as a human endeavour

- Scientific knowledge has changed peoples' understanding of the world and is refined as new evidence becomes available (ACSHE119)
- Science knowledge can develop through collaboration across the disciplines of science and contributions of people from a range of cultures (ACSHE223)



Science inquiry skills

- Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge (ACSIS124)
- Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed (ACSIS125)
- Measure and control variables, select equipment appropriate to the task and collect data with accuracy (ACSIS126)
- Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships in data using digital technologies as appropriate (ACSIS129)
- Summarise data from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence (ACSIS130)
- Reflect on scientific investigations including evaluating the quality of the data collected and identifying improvements (ACSIS131)
- Use scientific knowledge and findings from investigations to evaluate claims based on evidence (ACSIS132)
- Communicate ideas, findings and evidence based solutions to problems using scientific language, and representations using digital technologies as appropriate (ACSIS133)

General capabilities

-  Literacy
-  Numeracy
-  Information and communication technology capability
-  Critical and creative thinking
-  Personal and social capability
-  Ethical understanding
-  Intercultural understanding.

Cross-curriculum priorities

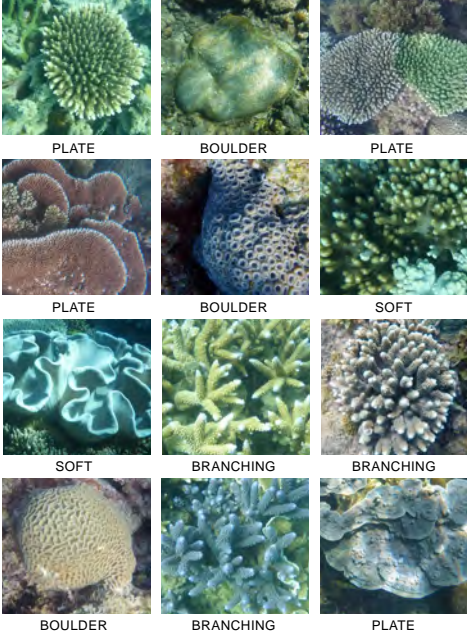
-  Aboriginal and Torres Strait Islander histories and cultures
-  Sustainability

ACARA CURRICULUM LINKS AND ANSWER KEY FOR WORKSHEETS

WORKSHEET 1 - Identifying coral types

ACARA curriculum links

Science understanding (ACSU111)



WORKSHEET 2 - Moreton Bay corals

ACARA curriculum links

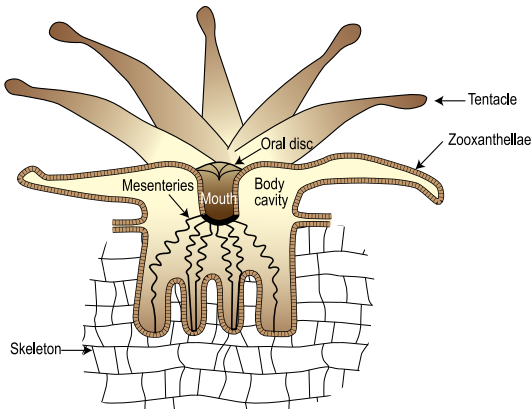
Science understanding (ACSU112)

Science inquiry skills (AC SIS124, CSIS132, ACSIS133)

Science as human endeavour (ACSHE223)



1.



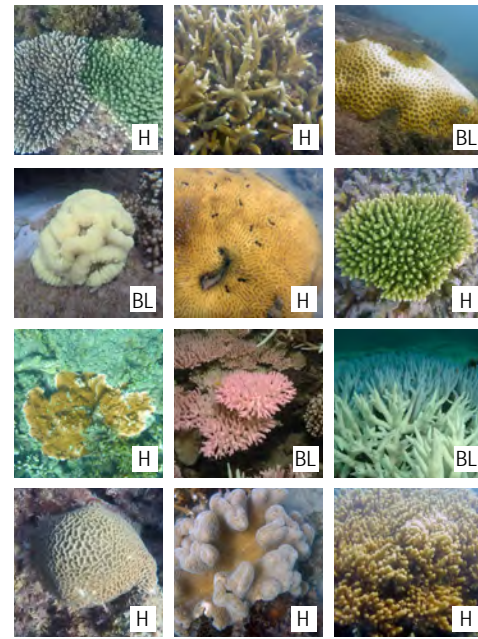
2. Healthy reefs produce food for millions of people and help to protect coastal land from cyclones and storm surges. Reefs support local economies, providing employment from tourism and fishing industries.
3. In healthy coral, symbiotic algae (zooxanthellae) live within the coral tissue. Algae provide the coral with food and energy and give the corals their characteristic brown colour. In return the coral provides a home for the algae. Both parties benefit from living together.
4. Stressful environmental conditions can cause the coral to expel the algae, changing the coral colour to white. This whitening of coral is called 'coral bleaching'.

5. Coral health can be measured with the CoralWatch Coral Health Chart. CoralWatch uses colour as an indicator of coral health. However, coral colour is just one indicator of coral health. Other indicators could be % coral cover, species diversity & richness, the amount of macroalgae and fish present.

WORKSHEET 3 - Coral bleaching - sign of stress

ACARA curriculum links

Science inquiry skills (AC SIS124)



WORKSHEET 4 - Corals: Consumer or Producer?

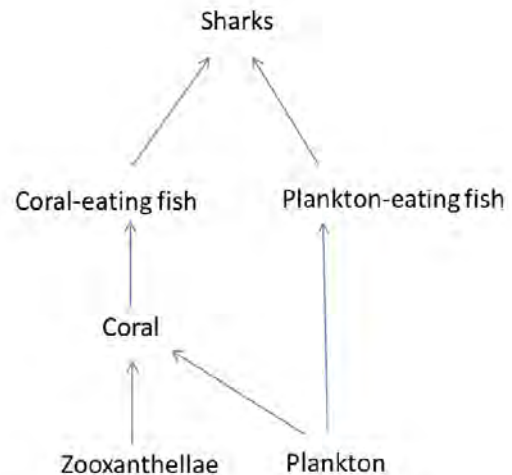
ACARA curriculum links

Science understanding (ACSU112)

Science as human endeavour (ACSHE223)



1. The primary producer in the coral-algae relationship are the algae named zooxanthellae.



ACARA CURRICULUM LINKS AND ANSWER KEY FOR WORKSHEETS

WORKSHEET 5 - Measuring coral health using virtual reef poster

ACARA curriculum links

Science understanding (ACSU112)
 Science inquiry skills (AC SIS124, ACSIS125, ACSIS126, ACSIS129, ACSIS130, ACSIS131, ACSIS132, ACSIS133)
 Science as human endeavour (ACSHE119, ACSHE223)



The Virtual Reef provides an opportunity to learn about coral bleaching and collect scientific data without visiting the reef - it can be used to prepare for a reef field trip or as a valuable alternative.

Discuss in class the results - results may vary slightly due to the use of photos with some shading.

WORKSHEET 6 - Interpreting real data

ACARA curriculum links

Science understanding (ACSU112)
 Science inquiry skills (AC SIS124, ACSIS125, ACSIS126, ACSIS129, ACSIS130, ACSIS131, ACSIS132, ACSIS133)
 Science as human endeavour (ACSHE119, ACSHE223)



Answers will vary, depending on the reef choice

WORKSHEET 7 - The water cycle of Keppel Bay

ACARA links

Science understanding (ACSSU116)



- Liquid** - a runny substance composed of molecules that move freely among themselves but do not tend to separate like those of gases; neither gaseous nor solid.

Precipitation - falling products of condensation in the atmosphere, as rain, snow, or hail.

Condense - to reduce to another and denser form, as a gas or vapor to a liquid or solid state.

Evaporating - to change from a liquid or solid state into vapor.

River - a natural stream of water of fairly large size flowing in a definite course or channel or series of diverging and converging channels.

Catchment area - a drainage basin composed of the area drained by a river and all its tributaries / creeks.

Water Cycle - the natural sequence through which water passes into the atmosphere as water vapor, precipitates to earth in liquid or solid form, and ultimately returns to the atmosphere through evaporation.

Please note that Dictionary.com was used to obtain these definitions.

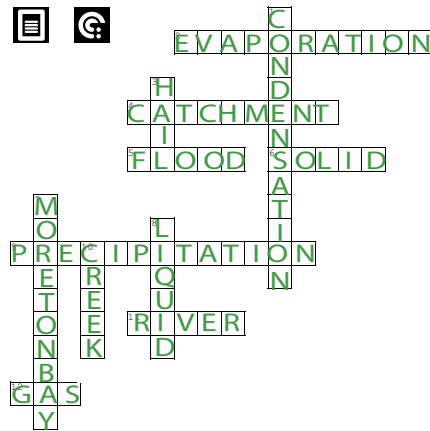
2.

Water cycle stages	Sea water	Water vapour	Water droplets	Rain	Flood water	River water	Sea water
Location	Ocean	Atmosphere	Atmosphere	Atmosphere	Catchment area	River	Ocean

WORKSHEET 8 - Water cycle crossword

ACARA curriculum links

Science understanding (ACSSU116)



WORKSHEET 9 - Sediment runoff – human impact

ACARA curriculum links

Science understanding (ACSSU116)
 Science inquiry skills (AC SIS126, ACSIS130, ACSIS131, ACSIS133)



- The course sediment size should settle to the bottom first.
- The fine sediment size should settle to the bottom last.
- Course sediment will settle at the mouth of the rivers but fine sediment will stay suspended blocking sunlight and eventually settle further out to sea smothering the inhabitants on reefs.
- Aquatic plants, seagrass, algae and coral need sunlight to photosynthesise and produce the food and energy they need to survive, grow and reproduce.
- Aquatic plants, seagrass, algae and coral will die if they are consistently smothered with sediment or have the sunlight blocked from reaching their photosynthetic cells.

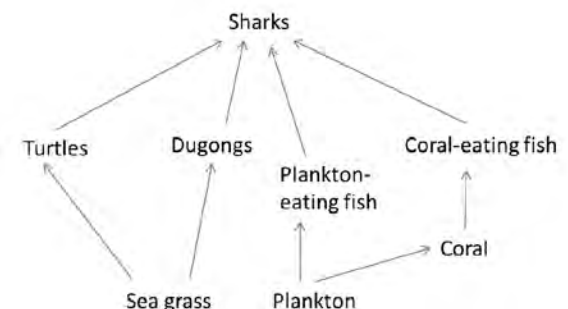
WORKSHEET 10 - Sediment runoff - ltered food webs

ACARA curriculum links

Science understanding (ACSU112)
 Science inquiry skills (AC SIS124, ACSIS129, ACSIS130, ACSIS132, ACSIS133)
 Science as human endeavour (ACSHE223)



1.



2.



3. The number of turtles, dugongs and fish would reduce because they don't have enough food to eat if the algae and coral die from the sediment. The sharks would have less food to eat due to the reduced numbers of turtles, dugongs and fish. The sharks would eat more clams than before to make up its diet. Therefore the number of plankton-eating fish would also reduce.
4. The sediment influx caused by the heavy rain and exposed soil from farming and construction has reduced the biodiversity from 8 different types of organisms to 3 types of organisms.



5. The Fitzroy River is the third largest alluvial source of sediment discharged into the Great Barrier Reef lagoon, carrying between 2-10 million tonnes annually. The amount of sediment entering the waterways can be reduced by various means including the following:
 - a) Planting vegetation along river banks to stabilise the banks and stop the soil washing down stream in heavy rainfall. See channel erosion: <http://hlw.org.au/report-card/focusareas/channel-erosion> and water management: <https://portbris.com.au/environment/water-management>
 - b) Building a rain garden, see: <http://hlw.org.au/getinvolved/help/raingarden>
 - c) Construction sites stop exposed sediment from washing into drains by implementing 'Erosion & sediment control' (ESC) practices. These practices include covering exposed soil and putting sediment barriers in drains at the construction site. See: <http://hlw.org.au/initiatives/esc/principles>

Preventing sediment from entering waterways by any or all of the above methods will improve the water clarity and quality. The clearer water will allow more sunlight to penetrate to the bottom and increase the numbers of aquatic plants and corals. With an increase of aquatic plants and corals available for animals to eat, more snails, crabs, fish, turtles and dugongs will be able to survive and thus increasing the biodiversity of the associated marine environment.

6. Keppel Bay and Port Curtis would have had clearer waters with more corals and bigger seagrass meadows. This environment would have supported a greater variety of animals and plants including turtles, dugongs and fish.
7. Prior to European settlement, coral bleaching may have occurred from high sediment runoff resulting from extreme floods. Extreme floods would have occurred as a result of tropical cyclones. Unlike now, the thick vegetation around the waterways would have filtered the sediment saving Moreton Bay from severe sediment loads. Also, there was less exposed soil available for washing into waterways because aboriginal farming and construction practices did not produce wide scale destruction of natural vegetation.

WORKSHEET FIELD 1 - Food webs - intertidal rocky shores

ACARA curriculum links

Science understanding (ACSSU116)
 Science inquiry skills (ACSIS124, ACSIS125, ACSIS129)



Answers will vary depending on the flora and fauna findings by students in the intertidal rocky shores.

Examples of producers (photosynthetic) are:
 Algae and seaweeds, seagrass, mangroves, kelp, zooxanthellae, phytoplankton.

Examples of consumers are:
 Filter feeders (e.g. sponges, sea squirts, tunicates, clams, mussels, bivalves), limpets, crabs, gastropods, corals, shrimps, stingrays.

Primary consumers are herbivores. When we remove those from our foodweb, our next level up, secondary consumers (carnivores) may get into trouble. For example, removing zooplankton from the system will affect many filter feeders as they filter zooplankton from the water as their main/only food source.

WORKSHEET FIELD 2 - Identifying coral type

ACARA curriculum links

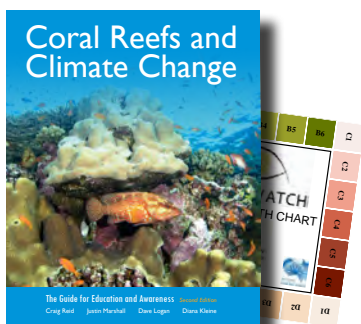
Science understanding (ACSSU116)
 Science inquiry skills (ACSIS125, ACSIS126, ACSIS129, ACSIS130, ACSIS133)



Answers will vary depending on the coral type and species the students find.

Drawings of coral types should reflect the graphics on the back of the Coral Health Chart; boulder, branching, plate and soft.

CORALWATCH RESOURCES



'Coral Reefs and Climate Change' book with free Coral Health Chart and monitoring instructions.

Coral Reefs and Climate Change The Guide for Education and Awareness

CoralWatch has published the 2nd edition of the book 'Coral Reefs and Climate Change'. Beautifully illustrated, this book is targeted to students, reef enthusiasts and the general public. Chapters cover oceanography, coral reef ecology, climate change and conservation. This 2nd edition has been fully updated and includes the latest scientific findings. All books come with a Coral Health Chart and Do-It-Yourself kit. The book can be purchased alone or with our educational DVD series with short movies complementing the book.

Published by CoralWatch, The University of Queensland - 2012

ISBN: 978-0-646-59085-1. Paperback, 264 pages

Authors: Craig Reid, Justin Marshall, Dave Logan and Diana Kleine. Edited by Angela Dean



'Coral Reefs and Climate Change' DVD.

Educational DVD Series

Illustrated through animated diagrams and photos, interviews with scientists, clear language, and footage from around the globe, this series brings concepts from the book to life. Each of these 22 stand-alone videos (3-8 min each) explore key topics in oceanography, coral reef ecology, climate change and reef conservation. Suited to use in a variety of settings, this series may be used independently or in conjunction with other CoralWatch education materials.

Published by CoralWatch, The University of Queensland - 2012

ISBN: 978-0-646-57942-9



'DIY Kit' with monitoring instructions.

Do It Yourself Coral Health Monitoring Kit

Includes Coral Health Chart, underwater data recording slate with pencil, instructions and information brochures, sticker and postcard. All packed in waterproof folder.

CoralWatch packages

Whether you are an individual or an educator, our education materials provide you with everything you need to get involved in protecting reefs.



Power of One package

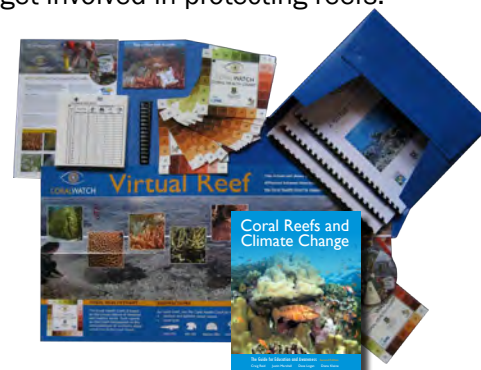
Includes Book and DVD, Do It Yourself (DIY) monitoring instructions and reading materials packed in CoralWatch bag.



Education packages

Moreton Bay (MB) or Capricorn Coast (CC)

Available for primary or high school. Includes virtual reef (MB or CC), Coral ID sheet (MB or CC), year 1 and/or year 7 lessons and resources, MB or CC and GBR info flyers, Coral Health Chart with slate and DIY monitoring instructions.

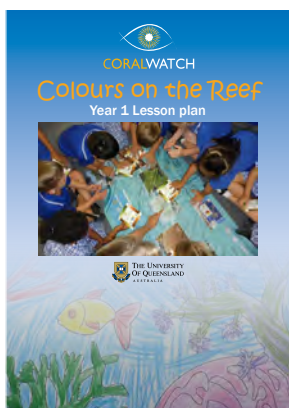


Ultimate teaching package

Includes Book and DVD, activity CD, workbook, class set of Coral Health Charts and slates, DIY monitoring instructions, virtual reef materials, posters and booklets. See orderform for full contents.

CORALWATCH RESOURCES

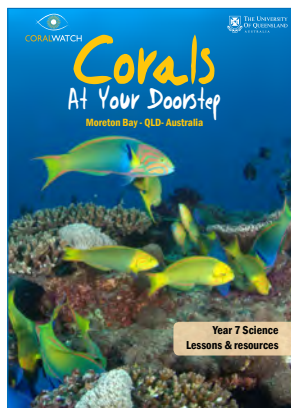
Australian curriculum linked lesson materials



'Colours on the Reef'
Year 1 Science
Lesson plan



'Marine Ecosystems'
Year 7 Science
Lessons and resources

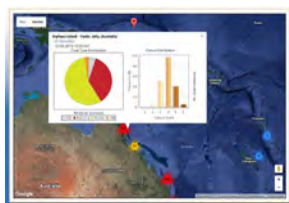


'Corals at Your Doorstep'
Year 7 Science
Lessons and resources
Moreton Bay QLD Australia
Capricorn Coast Australia



'Marine Systems - Connections and Change'
Year 11-12 Marine Science
Lessons

CoralWatch Data



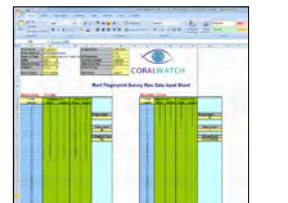
'CoralWatch global database'
Data freely available from
78 countries, 1527 reefs and
8431 surveys



'Data entry'
Guide to entering CoralWatch
data online or by App

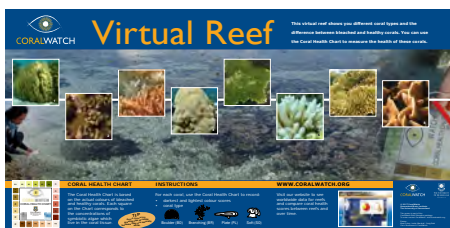


'Data analysis'
Guide outlining applications of
CoralWatch data



'Raw data input sheet'

Virtual reef materials



'Virtual Reef poster' - 4 versions
Tropical Reef or Moreton Bay or
Keppel Bay or Port Curtis



'Virtual lab booklet'



'Virtual reef booklet'

Monitoring



'CoralWatch DIY instructions'
Available in 12 languages

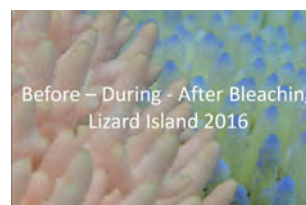


'Coral Health Charts'
Available in 5 languages

Coral Bleaching



'Great Barrier Reef 2019 -
4 page information leaflet'



'Before - During - After Bleaching'
Photo series from bleaching
event Lizard Island 2016



CORALWATCH

Citizen Science

for the future of our reefs



www.coralwatch.org



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