



Captain Ocean's Great Voyage: Exploring Underwater Coral City

Marine Conservation Education Series
(Senior Primary)

Welcome aboard the “**Ocean Guardian**” everyone! I'm Captain Ocean, the captain of this exploration ship.





Guess what? Oceans cover 70% of the Earth we live on! This vast blue world is full of unknown wonders and treasures far more precious than silver or gold...

Ready, cadet sailors? Let's sail into the vast ocean together to search for these precious treasures and learn how to protect them!



I just received a special invitation from the Mayor of Coral City! Put on your diving masks—let's go on an exciting underwater tour together!





Key Learning Points | Cadet Sailors, Report for Duty!

Overview

Students will step into the role of "Cadet Sailors" to explore basic coral ecology through interactive games. They will discover how corals act as "ecosystem engineers" for the ocean, reflect on the impacts of human activities, and raise awareness for marine conservation to take action in coastal protection.

Learning Objectives

1. Teach students about coral classification, structure, and biology
2. Help students understand interactions between corals and other marine life
3. Recognize the importance of corals in maintaining a stable ocean ecosystem
4. Inspire students to protect corals and their natural habitats in daily life

Values and Attitudes

Empathy, Responsibility, Commitment

Lesson Duration

Two 40-minute lessons (80 minutes in total)

OCEAN GUARDIAN

Part 1: The Voyage Begins



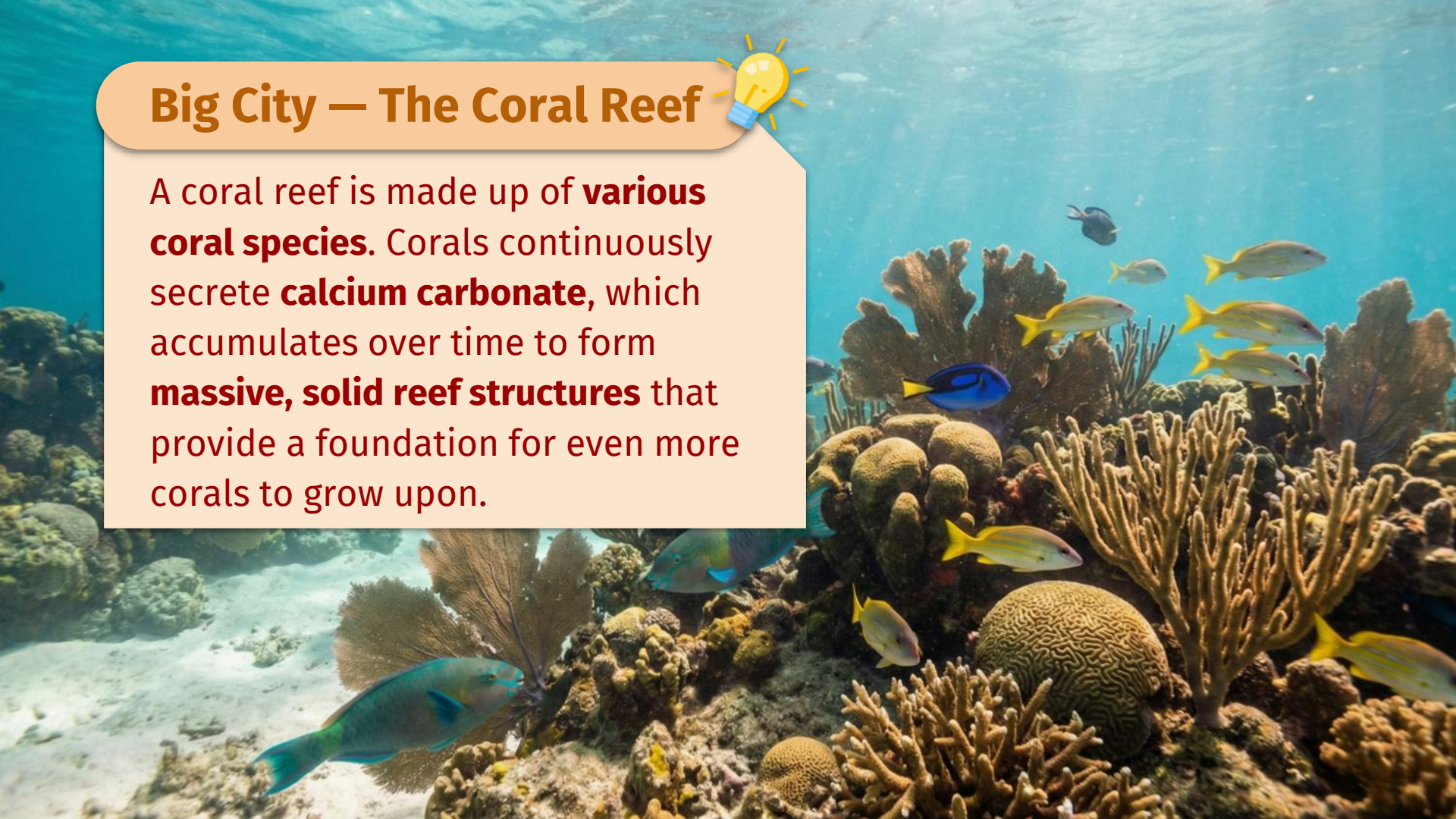


Hello everyone! I am Mayor Fish of Coral City, and welcome to our home! The region I manage features bustling major cities as well as cozy little towns.

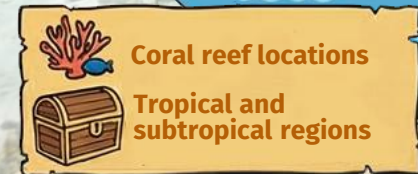
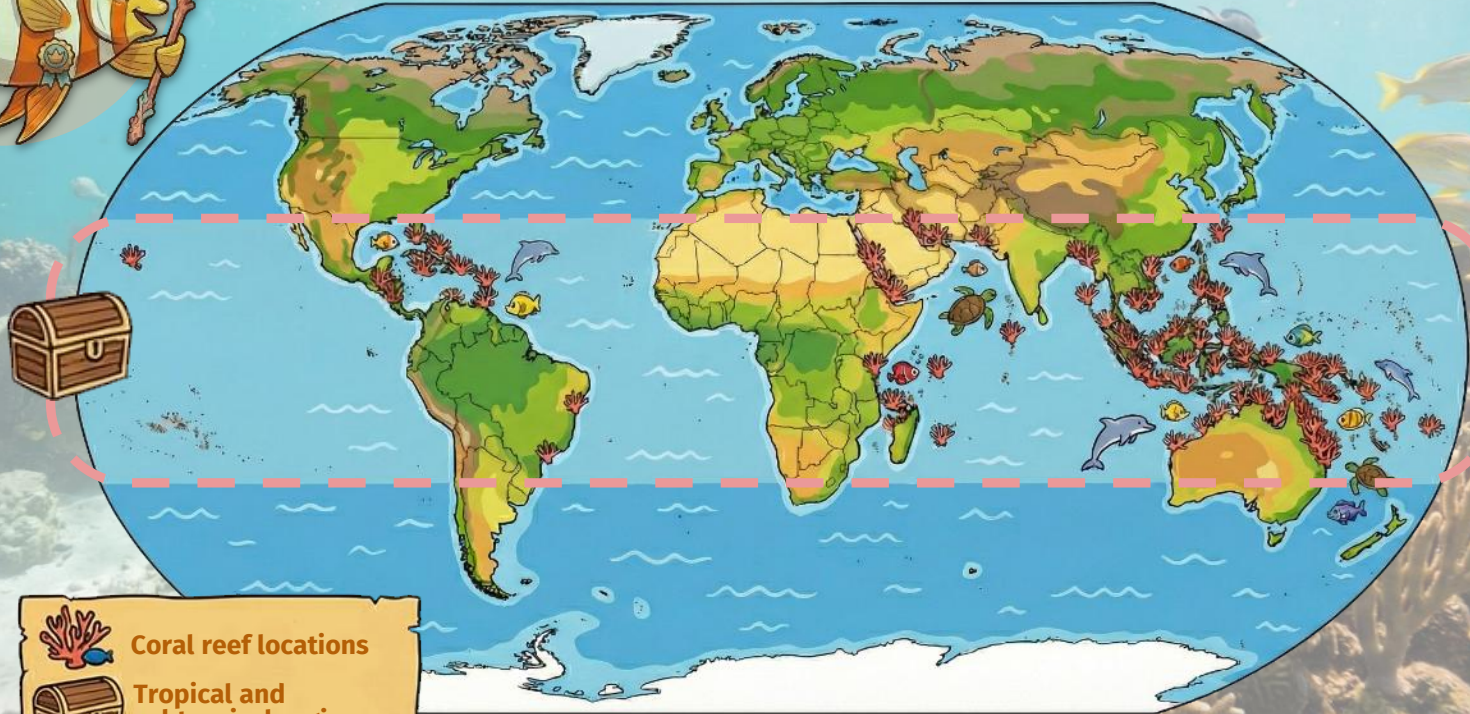


Big City — The Coral Reef

A coral reef is made up of **various coral species**. Corals continuously secrete **calcium carbonate**, which accumulates over time to form **massive, solid reef structures** that provide a foundation for even more corals to grow upon.



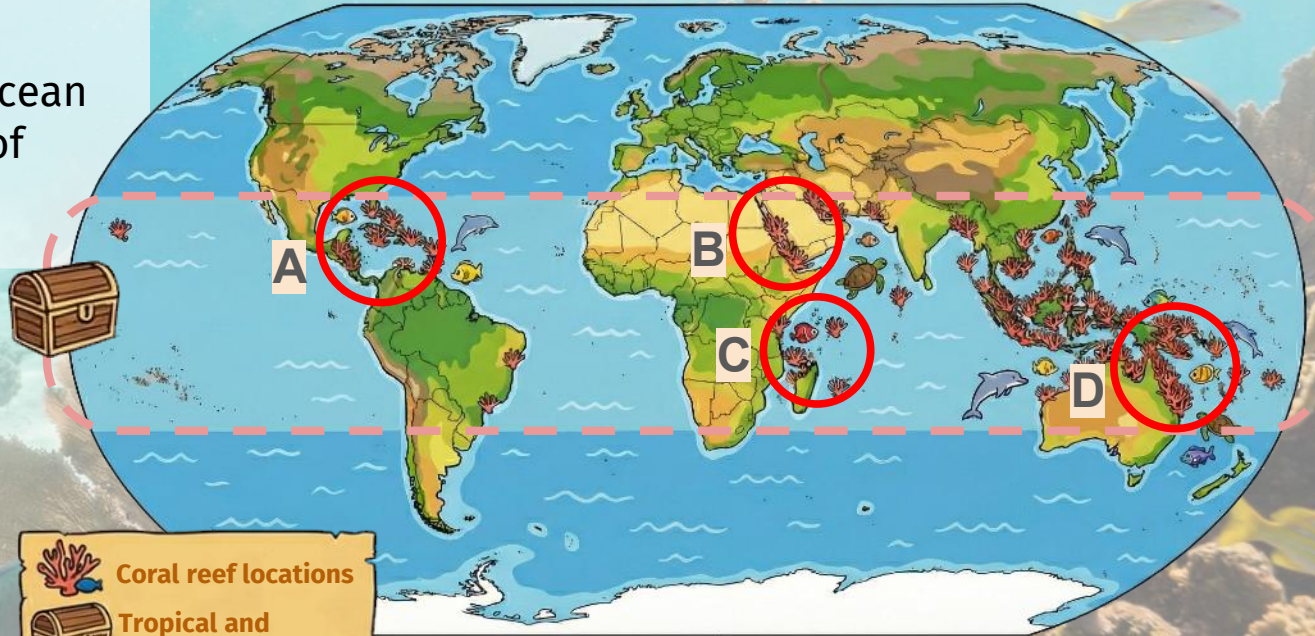
Coral reefs are generally distributed in **tropical and subtropical regions**. They thrive in **warm, shallow coastal waters** that are **clean and clear**.



Do you know where the world's largest coral reef is located?

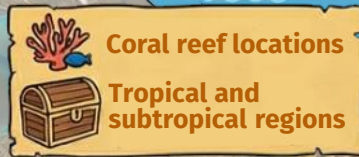
?

- A. Caribbean Sea
- B. Red Sea Coast
- C. Western Indian Ocean
- D. Northeast Coast of Australia



Do you know where the world's largest coral reef is located?

Our biggest city—the largest coral reef in the world—is the **Great Barrier Reef off the northeast coast of Australia**, covering about 348,700 square kilometres! I heard you are from Hong Kong! The Great Barrier Reef is about 126 times the size of Hong Kong!

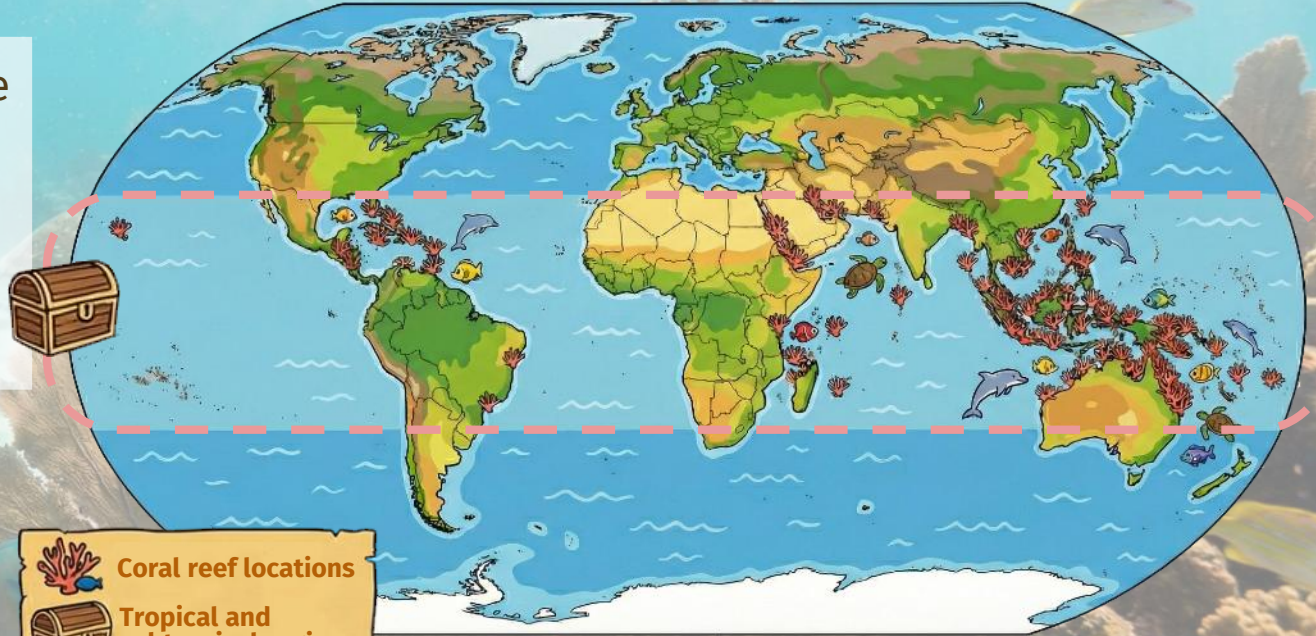


Small Towns — Coral Communities



Are there coral reefs in Hong Kong waters too?

Hong Kong does not have coral reefs, but it boasts rich and diverse **coral communities**. Let me introduce the corals of Hong Kong to you!



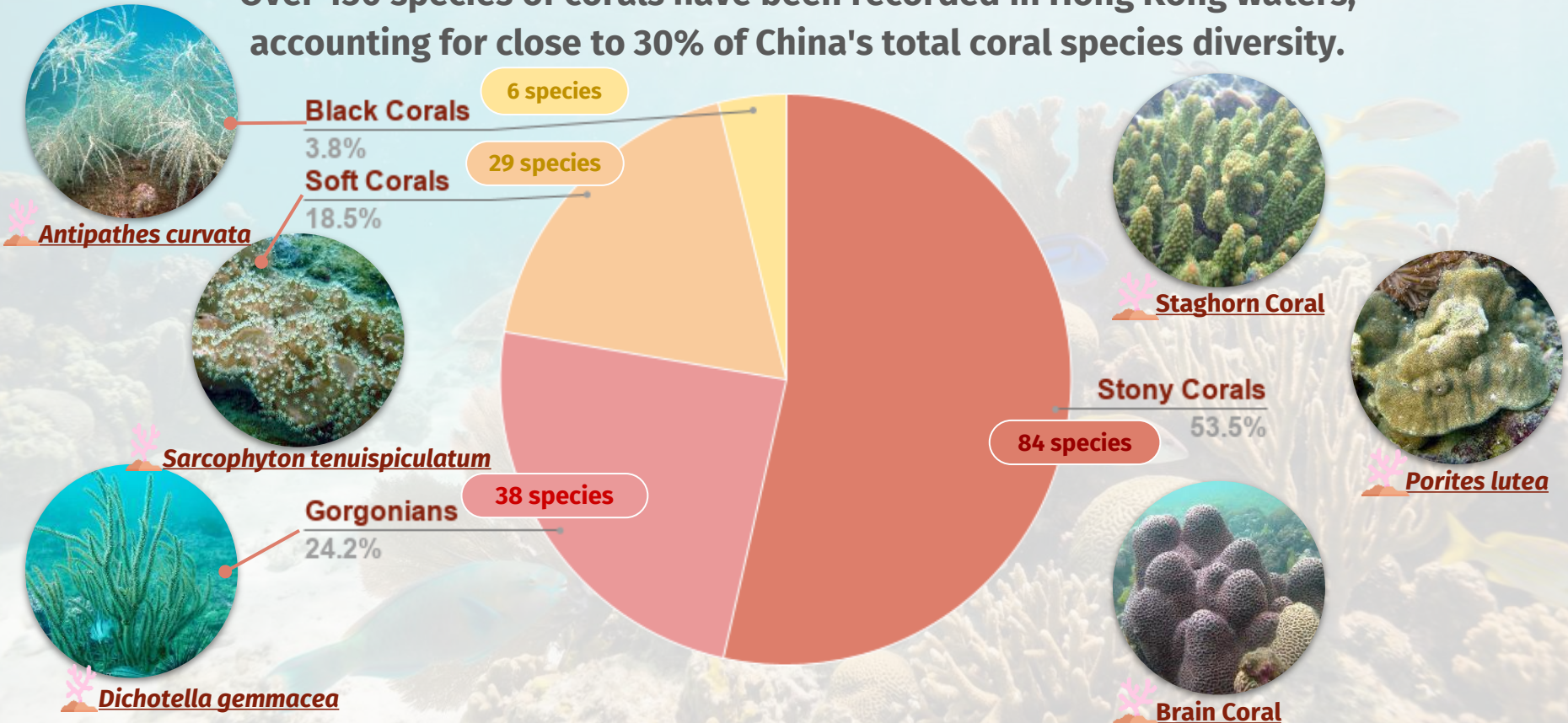
Coral reef locations



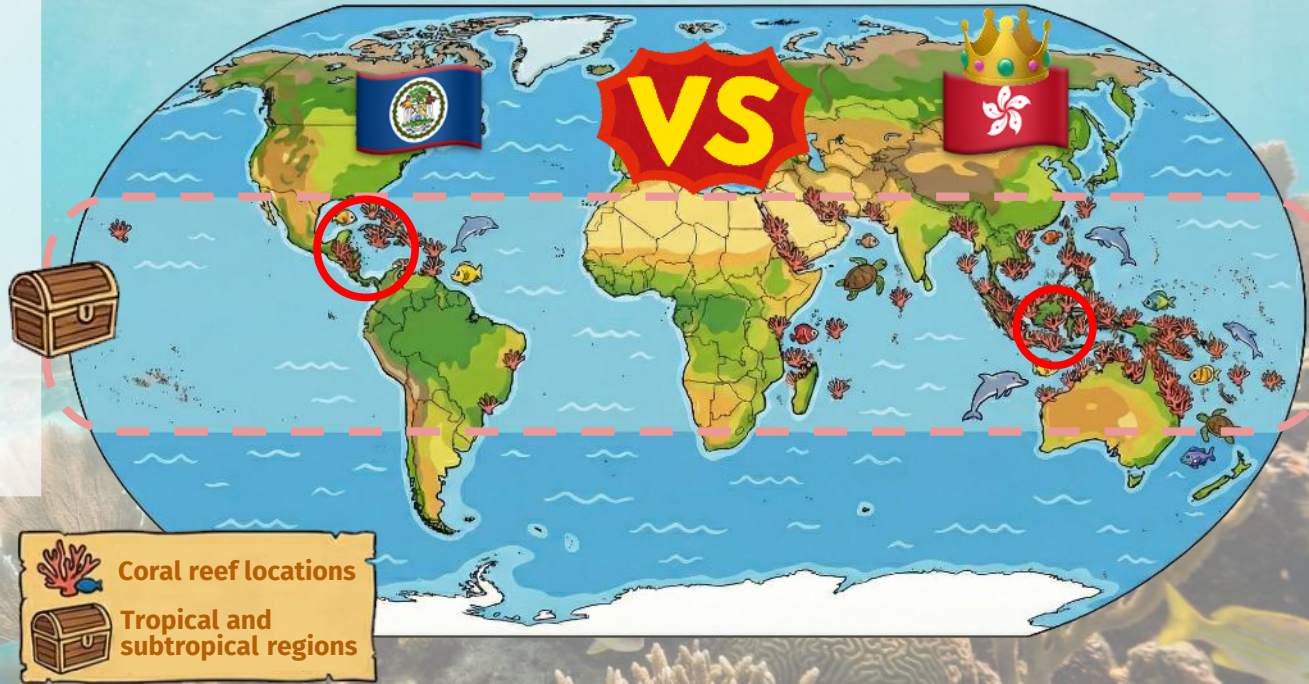
Tropical and subtropical regions

Corals in Hong Kong

Over 150 species of corals have been recorded in Hong Kong waters, accounting for close to 30% of China's total coral species diversity.



Hong Kong's coral communities are super special! Although they are much smaller than the **Belize Barrier Reef**, the second largest reef in the world, Hong Kong actually has **more hard coral species**! Hong Kong has 84 species of hard corals, while the giant Belize Barrier Reef only has 65!



Where Are the Corals?



Hong Kong boasts rich coral diversity, yet corals cannot be found in all local marine waters.

Corals thrive only under specific environmental conditions:



Seawater temperature maintained at 25–28°C



Seawater salinity maintained at 32–35 ppt



Hard substrate seabed for attachment



Gentle ocean currents



Shallow water areas no deeper than 30 meters

Where Are the Corals?



Hong Kong boasts rich coral diversity, yet corals cannot be found in all local marine waters.





Whether it is a big **coral city** or a small **coral town**, they all have unique and beautiful architectural styles!

Guess which group of animals corals are closely related to?



© trekh

A. Starfish



© lukas_pirkner

B. Jellyfish



© Vito | OWLHK

C. Crab



© Alexandra Hoschke

D. Seahorse



Corals Are Cnidarians



B. Jellyfish

Corals are close relatives of jellyfish, both belonging to the **phylum Cnidaria**. Their biggest shared feature is having **tentacles** packed with tiny **stinging cells**, which they use for defense and catching prey!



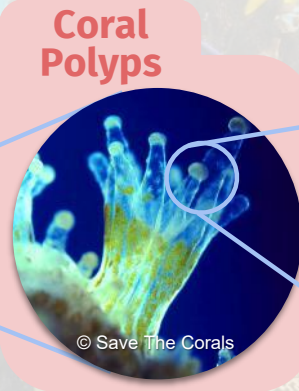
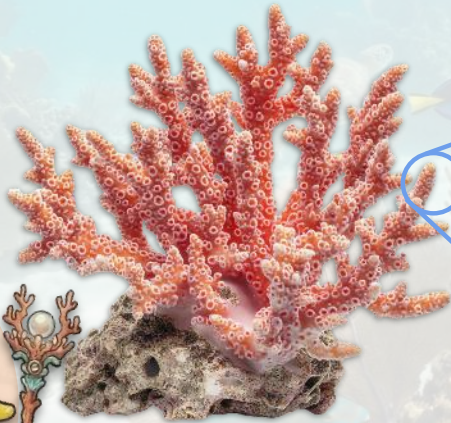
© tohamina

Corals look a lot like plants. Could these branch-like structures actually be their tentacles?

Corals Are Made of Coral Polyps



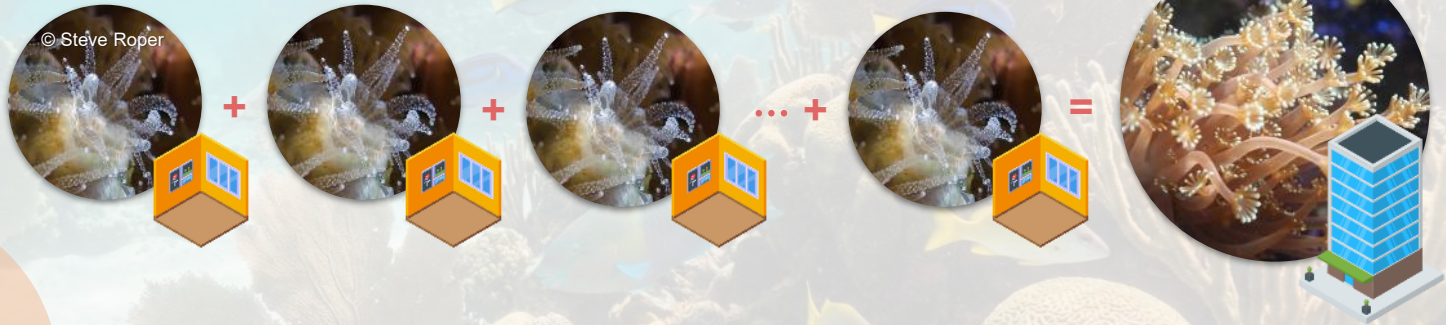
Haha... that's not quite right! These coral buildings are actually built with lots of care by our amazing architects—**coral polyps**! The tentacles actually refer to the ring of tentacles surrounding the coral polyp's mouth.



Coral Polyps, Assemble!



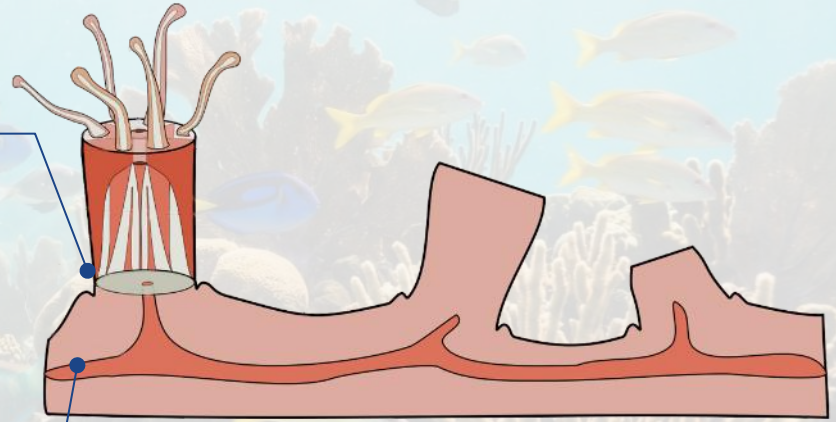
Although individual coral polyp architects can live all on their own, only when they gather together and work as a team can they build massive corals and create vital habitats for countless marine creatures!



Coral Polyps, Assemble!



- The base of every coral polyp is firmly attached to a hard surface, like a solid **calcium carbonate** skeleton.
- The central gastrovascular cavities of individual coral polyps are interconnected through **canals**, sharing nutrients and fluids with neighbouring polyps.



© Laszlo



Coral Polyps, Assemble!



Different coral polyp architects have totally unique building styles! By gathering and arranging themselves in different ways, they build all kinds of amazing corals!

Can you match the corals to their shapes below?



A. Massive



B. Columnar



C. Laminar



D. Tabular



E. Branching



**Goniopora
columna**



**Acropora
solitaryensis**



Brain Coral



**Antipathes
curvata**



**Pavona
decussata**



Coral Polyps, Assemble!



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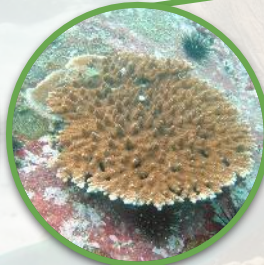
D. Tabular



E. Branching



Goniopora
columna



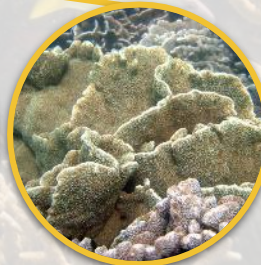
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Good Neighbours of Corals

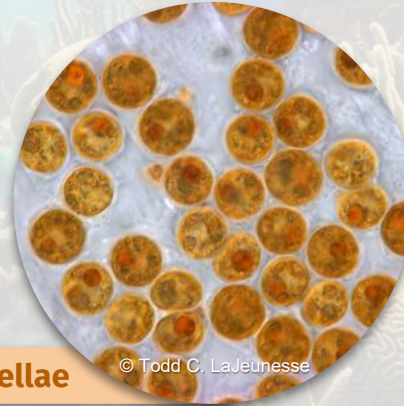


With such grand underwater buildings, who else comes to help our coral polyp architects?



Coral polyps have a wonderful work buddy—**zooxanthellae**!

They share a special relationship that scientists call **mutualistic symbiosis (mutualism)**. This means two different species live together, depend on each other, and bring great benefits to one another!



Zooxanthellae

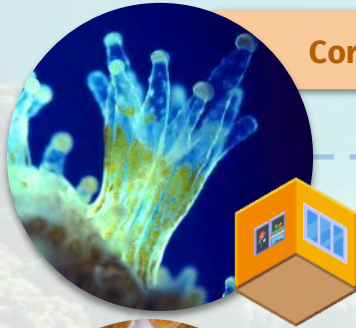
© Todd C. LaJeunesse



Good Neighbours of Corals



Some coral species have tiny zooxanthellae algae living inside their body cells! To understand their awesome teamwork, we first need to learn how they eat!



Coral Polyp

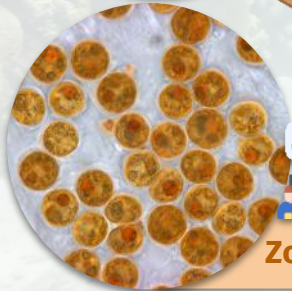


© Jeff Rotman

Predation



Actively capturing organic particles and plankton in the water using their tentacles



Zooxanthellae

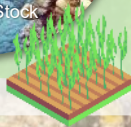


© Adobe Stock

Photosynthesis



Performing photosynthesis using sunlight to produce their own food, making them self-sufficient



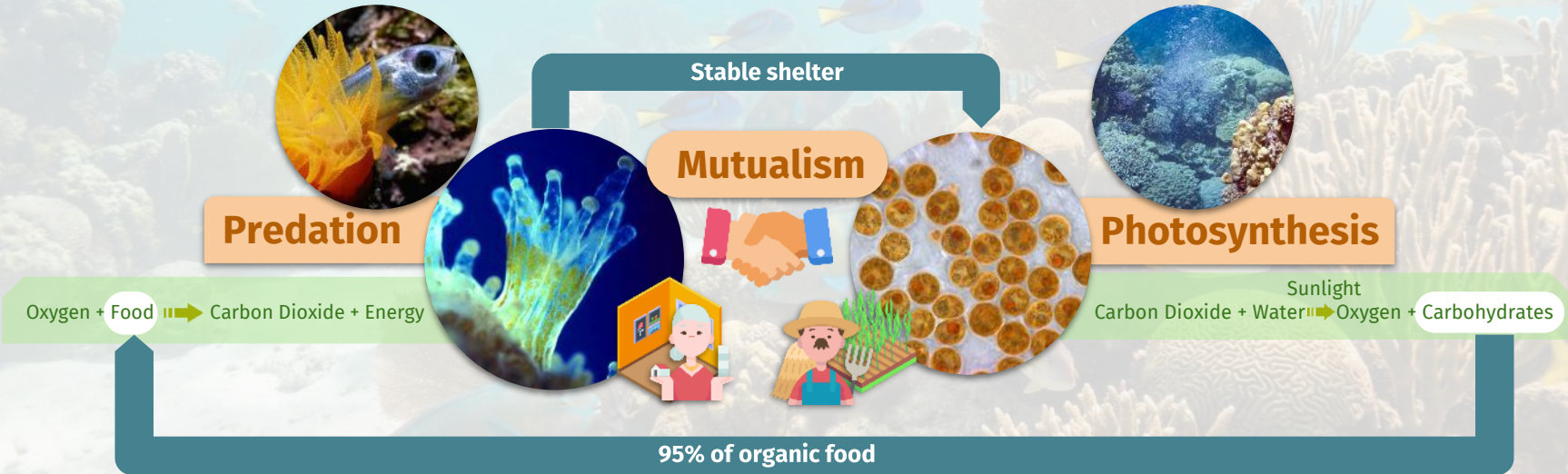
Sunlight
Carbon Dioxide + Water $\rightarrow$ Oxygen + Carbohydrates



Good Neighbours of Corals



I get it now! Isn't zooxanthellae basically a chef doing a "work exchange"? They provide yummy food in exchange for a cozy place to live! And the carbon dioxide released when coral polyps breathe becomes the raw ingredient for zooxanthellae to do photosynthesis!



Good Neighbours of Corals



However, not all coral polyp architects have this great partner, only **reef-building corals** do!



Corals Community



Besides zooxanthellae, coral polyps have many other wonderful neighbours! Let me show you around the vibrant marine community where I live!



Chinese Spiny
Lobster



Coral Fish



Bluestreak
Cleaner Wrasse



Impatient Sea
Cucumber

Coral reefs provide us with a rich ecological environment, supporting us through different stages of our lives:

- Shelter and hiding places
- Mating and courtship grounds
- Spawning sites
- Nursery grounds
- Cleaning stations

Corals Community



Do you also have a mutualistic relationship with coral polyps, just like zooxanthellae do?

While I cannot provide direct benefits to coral polyps the way zooxanthellae do, we live peacefully without causing any harm to the corals! Different sea creatures find cozy homes within the complex coral structures, while the corals themselves gain no benefit nor suffer any harm.

Scientists call this relationship **commensalism**—where two different species live together, **one gets awesome benefits, while the other is completely unaffected!**



Corals Community

The diverse environment of coral reefs attracts various species to inhabit the area! Because of that, it also provides us with plenty of delicious food sources!



 Carnivorous

Yellow
Hawkfish



 Omnivorous

Hongkong
Butterflyfish



 Detritivorous

Banded
Coral Shrimp



 Herbivorous

Blue-Barred
Parrotfish



Corals Community



Let me introduce one of our outstanding neighbours—it contributes so much to our community!



© University of California

Parrotfish clean away algae growing on coral surfaces, helping the symbiotic zooxanthellae carry out **photosynthesis** efficiently, enabling corals to grow healthier and stronger!



Herbivorous

Blue-Barred Parrotfish

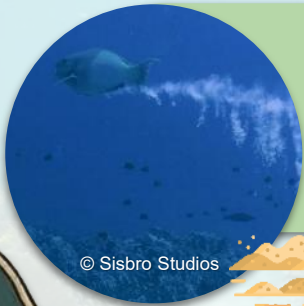


Corals provide food for the parrotfish, while parrotfish ensure the corals grow healthily. This is another wonderful example of mutualistic symbiosis!



Corals Community

It also holds another special title—scientists refer to it as an **Ecosystem Engineer**!



Parrotfish occasionally ingest coral skeletons, grinding them down into **sand** that form **part of the seabed**.



By promoting beach formation, parrotfish actively **alter and maintain the structure of ecological habitats**, playing a vital role in shaping marine ecosystems!

The Importance of Corals



In fact, corals themselves are remarkable **Ecosystem Engineers**! Coral communities form a unique and irreplaceable habitat, constructing an entire ecosystem that nurtures over 800,000 marine species!



The Importance of Corals



Corals provide us humans with amazing **ecosystem services** (all the great benefits we get directly and indirectly from nature), including:



Supplying
global fishery
resources

Depositing
limestone that
forms beaches
and protects
coastal soils



Raw materials
for medicine
development

Boosting local
economies
through reef
sightseeing
(eco-tourism)



The Importance of Corals



Corals provide us humans with amazing **ecosystem services** (all the great benefits we get directly and indirectly from nature), including:

Carbon Sinks



Corals absorb carbon dioxide from the water to build their **calcium carbonate skeletons**, while symbiotic zooxanthellae utilise carbon dioxide during **photosynthesis**, thereby acting as vital carbon sinks that help reduce greenhouse gases and cool our planet!



Summary

- Corals belong to the phylum Cnidaria.
- Corals are made of coral polyps, with different species exhibiting diverse shapes and structural forms.
- Corals establish various symbiotic relationships with diverse marine organisms.
- Corals play a vital and critical role in sustaining marine ecosystems and human society.



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Part 2: The Adventure Continues



Recap of the Last Episode

- Corals belong to the phylum Cnidaria.
- Corals are made of coral polyps, with different species exhibiting diverse shapes and structural forms.
- Corals establish various symbiotic relationships with diverse marine organisms.
- Corals play a vital and critical role in sustaining marine ecosystems and human society.



Captain Ocean! The real reason I invited you all here today, besides giving you a tour of our beautiful Coral City, is that we really need your help with something...

Follow me and swim up ahead to see for yourselves!



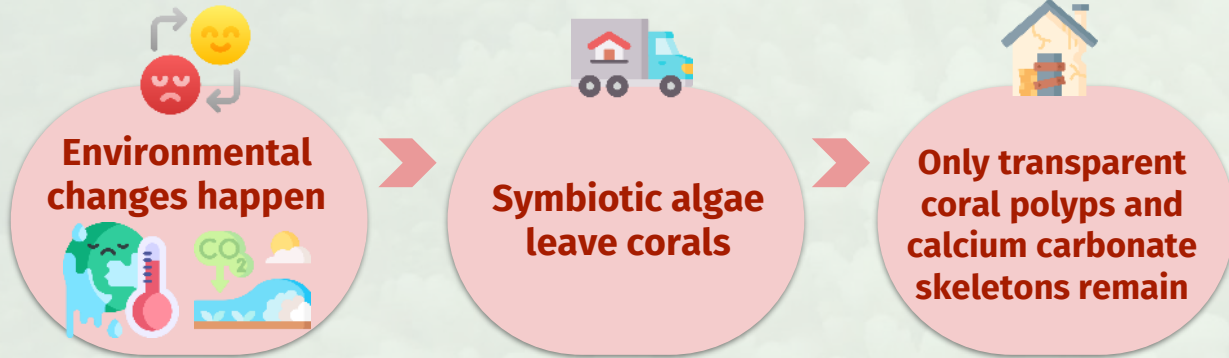
Right here! We recently discovered that a huge patch of corals has turned completely white, and the whole coral building looks abandoned! I know Captain Ocean is super knowledgeable, so I wanted to ask—what exactly is happening here?



What is Coral Bleaching?



Oh no! This phenomenon is called **coral bleaching**, and it's a huge **stress reaction** from the corals!



How Severe Is Coral Bleaching?



I have encountered coral bleaching in other parts of the world as well. Here are several photos I took during my previous expeditions:



Samoa



How Severe Is Coral Bleaching?



I have encountered coral bleaching in other parts of the world as well. Here are several photos I took during my previous expeditions:



Hong Kong

73% of the corals at Sharp Island experienced coral bleaching (2024)



How Severe Is Coral Bleaching?



I have encountered coral bleaching in other parts of the world as well. Here are several photos I took during my previous expeditions:



Australia

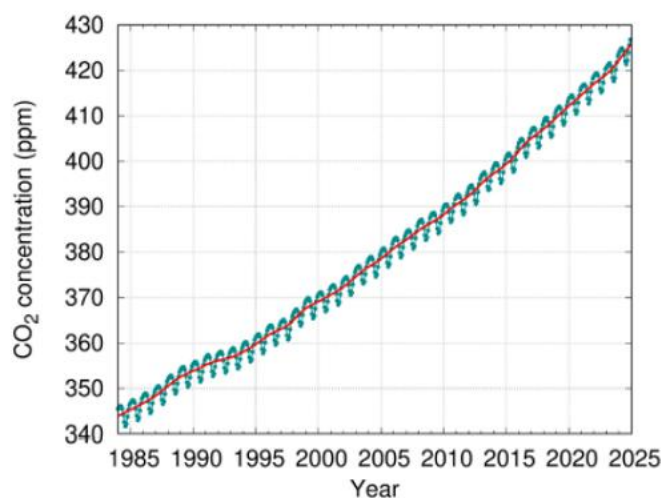
75% of the Great Barrier Reef region experienced coral bleaching (2024)



How Severe Is Coral Bleaching?



Have you noticed any recent changes in our environment? The first reason might be related to **pH levels!**



Atmospheric concentrations of CO2

According to the carbon dioxide detector on my vessel, the concentration of atmospheric carbon dioxide is currently rising!

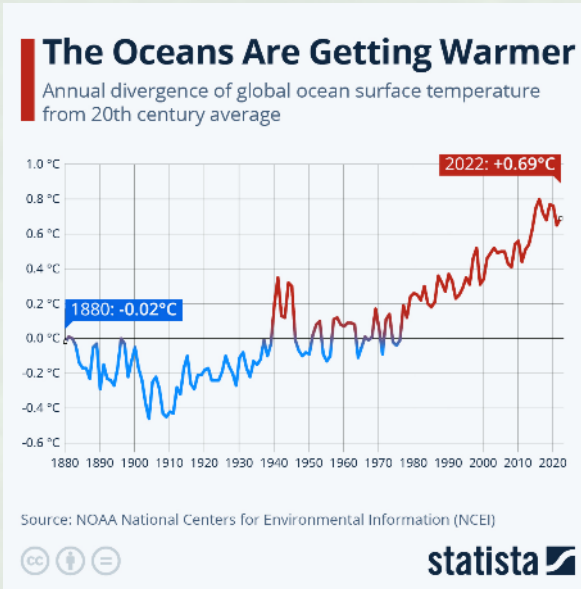
As **atmospheric carbon dioxide increases**, surface seawater absorbs more carbon dioxide, causing **ocean acidification**. Since coral skeletons are mainly made of **calcium carbonate**, their **calcification** process is hindered!



How Severe Is Coral Bleaching?



Have you noticed any recent changes in our environment?
The second reason might be related to **temperature!**



As atmospheric **carbon dioxide rises**, the **greenhouse effect** intensifies, leading to higher **seawater temperatures**, and increased “**thermal stress**” on corals!



Other Threats Faced by Corals



So climate change leads to coral bleaching!
Apart from this threat, what other challenges is Coral City currently confronting?

There are three major threats:

- Environmental pollution 
- Recreational activities 
- Fishing activities 



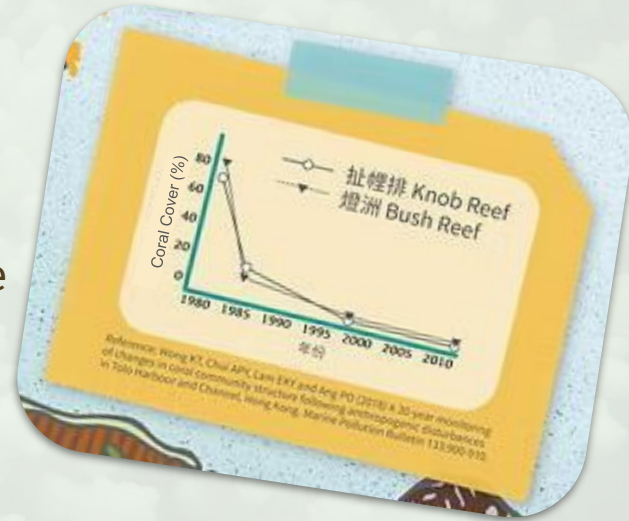
Environmental pollution



In Coral City, we conduct regular surveys! We calculate “**Coral Coverage**”, the percentage of total seabed area occupied by live reef-building hard corals, to estimate how many underwater buildings have been abandoned.

Have you ever heard of a place called **Che Lei Pai**? Located in Tolo Harbour, it used to be one of the busiest, most bustling towns in Coral City!

Back in the 1980s, it had a coral coverage of **80%**. However, city development discharged so much wastewater and harmed coral growth, its coverage plummeted to just **2%** by 2012!



Environmental pollution



Oh! cadet sailors, did you use **sunscreen** today?

We all did! Why do you ask so suddenly?

Because scientists recently discovered that some chemicals in sunscreen make corals **bleach much more easily** and **grow abnormally!**

I forgot to remind you this morning to check if your sunscreen contains these ingredients:

- Oxybenzone
- Octinoxate (also known as OMC)



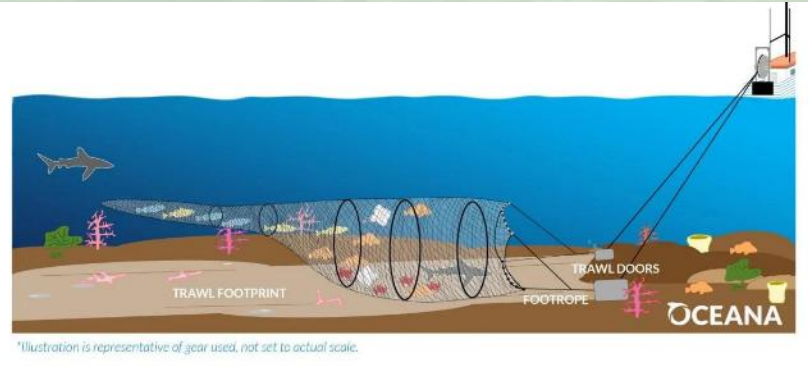
Fishing Activities

Everyone, watch out! There's a big vessel coming straight towards us!





Fishing Activities



That's terrible! That is a **bottom trawler**, which uses a highly **destructive** fishing method! It not only **destroys the seabed** and damages coral reef benthic ecosystems, but also stirs up heavy sediment that **blocks sunlight**, making it hard for corals to do **photosynthesis**!



Ghost Nets



Phew... The trawler finally sailed away! Is everyone okay?

Don't worry, we are fine! But it seems to have left something behind...





Ghost Nets



Everyone, watch out! There is danger ahead!

This is fishing gear abandoned in the ocean by humans. Because it **entangles corals** and other marine organisms, causing injury, suffocation, or even death, we call it a “**Ghost Net**”!

Plus, it also blocks sunlight, **making it hard for corals to do photosynthesis!**



Recreational Activities

The ocean is full of hidden dangers! We have to stay alert every single day to overcome these continuous challenges.

Earlier, Coral City received reports of damaged buildings and missing neighbour cases. After investigating, we found out it was caused by beginner divers **trampling on corals** and **catching fish in the coral zone!**



Corals Conservation Efforts



Mayor Fish, after hearing about all the tough challenges you've faced along the way, I feel so ashamed...

Why is that? You haven't done anything wrong!



Because every single threat Coral City facing is linked directly or indirectly to human activities! Captain Ocean, what can we do to help?

Actually, humans realise their impact on corals too, and they're already working hard to take different steps to protect them!



Legal Protection



Remember when I took you all diving at Tung Ping Chau last time? That area is a Marine Park, meaning it is legally protected by law!

The Hong Kong Government enacted the **Marine Parks Ordinance** (Cap. 476) long ago specifically to regulate and manage activities within Marine Parks and Marine Reserves.

Legal Protection

Several Marine Parks and Marine Reserve were **established specifically for coral conservation!**



**Cape D'Aguilar
Marine Reserve**



Rich biodiversity, housing stony corals, soft corals, and sea fans (gorgonians)



**Hoi Ha Wan
Marine Park**



Contains one of the finest and healthiest coral communities in Hong Kong



**Tung Ping Chau
Marine Park**



Features high stony coral diversity, high coral coverage, and species richness



Legal Protection

Earlier, we saw so many wonderful coral structures! Even though corals are colorful and pretty like works of art, people cannot just take them home!

Because the **Protection of Endangered Species of Animals and Plants Ordinance** (Cap. 586) controls the import and export of corals, and you must have a special license to keep **protected corals**!



Protected corals include blue corals, organ pipe corals, black corals, stony corals, fire corals, and lace corals!



Legal Protection



Captain Ocean, I still feel so scared thinking about that trawler we ran into earlier...

It is perfectly understandable to be concerned, as that fishing vessel should not have been operating here at all!

The government updated the subsidiary regulations of the **Fisheries Protection Ordinance** (Cap. 171), **banning non-selective bottom trawling in all Hong Kong waters** effective December 31, 2012.



Legal Protection

What are non-selective fishing methods?



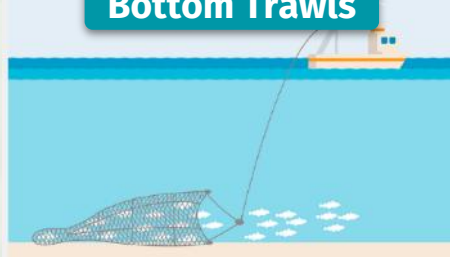
This refers to fishing methods that **do not target specific species, size classes, or population limits, indiscriminately harvesting all marine life** within range. Compare the three fishing methods below. Which one is the most eco-friendly?

Pole-and-lines



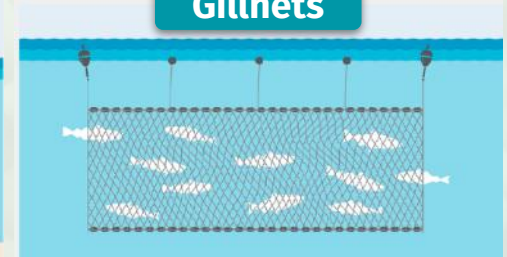
Fishermen use rods, lines, and hooks to lure and catch target fish individually one at a time.

Bottom Trawls



Vessels drag massive, heavy nets across the seabed, capturing all marine life in their path.

Gillnets



Large nets float vertically with ocean currents. When fish swim through, their gills become trapped or entangled in the mesh.

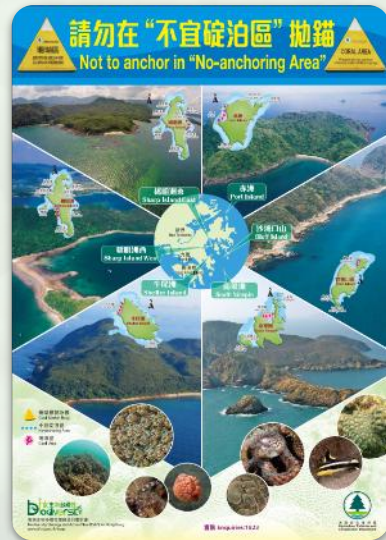
Marker Buoys



There's also something I want to show everyone! Look at this thing floating on the water! I can't read human words—can you tell me what it says?

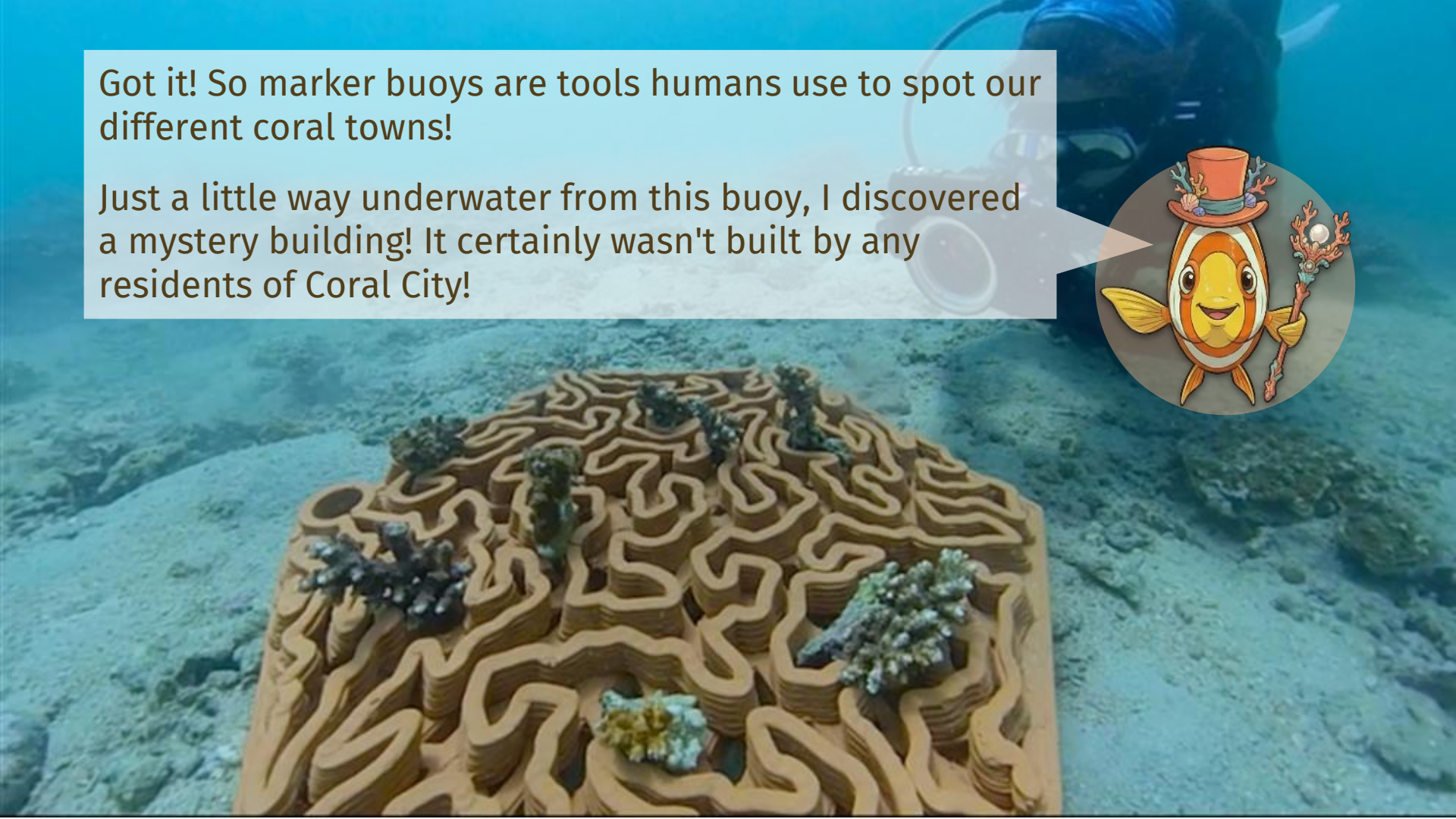


It reads **“Coral Area: No Anchoring Inside Marker Area”**. Captain Ocean taught us that this buoy indicates a high coral cover zone, where dropping anchors is strictly prohibited to avoid reef damage.



Got it! So marker buoys are tools humans use to spot our different coral towns!

Just a little way underwater from this buoy, I discovered a mystery building! It certainly wasn't built by any residents of Coral City!



3D-Printed Coral Reef Tiles



Is this a maze? Or a fun toy for sea creatures? It looks like so much fun!

This is a special **coral reef tile** made by scientists using **3D-printing technology**! Broken coral fragments can attach to it and grow, giving them a much better chance to survive. It's one of the awesome ways to **restore corals**!



That's wonderful! It turns out humans have established coral hospitals to help us recover!



Coral Restoration

 Playback Time : 02:35 - 04:49

Let's learn
about coral
restoration
work!

環境及自然保育基金資助
珊瑚復育大行動
Environment and Conservation Fund
Coral Restoration Action

認識香港珊瑚 及修復工作

Exploring Hong Kong Corals and Restoration Work

© WWF-Hong Kong



Hong Kong Reef Check



Coral restoration work sounds so complex! Is there anything we cadet sailors can do to help out together?

I know! Now that we've all mastered our diving skills, it's time to form a team and join the **Hong Kong Reef Check!**

This is an annual citizen science programme co-organized by the Agriculture, Fisheries and Conservation Department (AFCD) and the Hong Kong Reef Check Foundation since 2000.



Hong Kong Reef Check



That's right! What data do we need to help collect?

The survey mainly gathers two types of data:

1. Coral Coverage

To assess local coral distribution, population trends, and health status

2. Indicator Species

To evaluate the biodiversity and overall ecosystem health of the coral reefs



Butterfly Fish



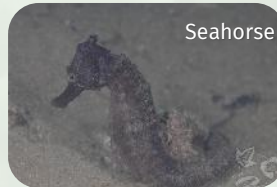
Diadema urchins



Nudibranch



Arabian Cowrie



Seahorse



Grouper



Coral Bleaching Sighting Report



But what if I miss out on this once-a-year event?



Don't worry! We can also contribute by submitting a **Coral Bleaching Sighting Report**. If we encounter coral bleaching during our routine dives, we can notify AFCD via an online form for further investigation and follow-up.



香港特別行政區政府
Agriculture, Fisheries and
Conservation Department

香港珊瑚白化觀察報告

Coral Bleaching Sighting Report in Hong Kong

感謝閣下提供珊瑚白化的資料。這些資訊可協助我們掌握更多有關香港珊瑚白化的分布、程度、受影響的品種及區域等資料。

漁農自然護理署可就閣下所提交的資料作研究及教育之用，而您的個人資料亦只會作聯絡用途。如有任何疑問，歡迎透過電郵 mar_con_biodiv@afcd.gov.hk 或電話 3468 5465 聯絡我們。

請只提交在香港水域發現之珊瑚白化紀錄，而每一份表格只能填寫一個發現地點之紀錄。

Ghost Gear Monitoring



Besides filling out coral bleaching sighting reports, is there anything else we need to report?

If we discover “Ghost Nets” in Hong Kong waters, we can also use an online form to fill out a **“Coral Saver Ghost Gear Record”** to alert AFCD and WWF-Hong Kong!



WWF珊瑚守護者鬼網報告

為使各方對珊瑚礁保育地點及香港水域中的鬼網有更深入的了解，我們需要你的協助提供更多鬼網的資料，請瀏覽 wwf.org.hk/ghostgeardetective_zh 了解更多。

每份報告代表一件鬼網。每個小區只填寫每件鬼網提交一次報告。

你所提交的資料將給予WWF作研究用途。除個人資料以外，所提交的鬼網資料亦將即時轉發到漁農自然護理署。

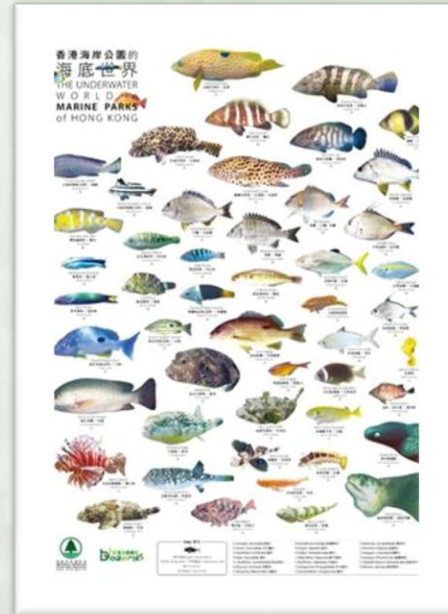
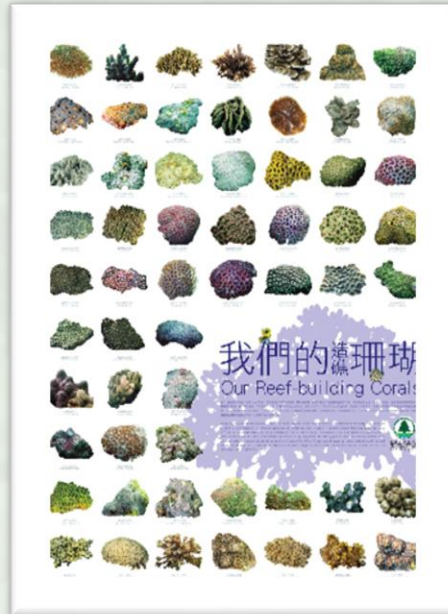
你所提交的相片或影片將給予WWF作教育或宣傳之用。

如有疑問請電郵至 natalieleung@wwf.org.hk 或致電2161 9656聯絡 梁婉怡小姐。



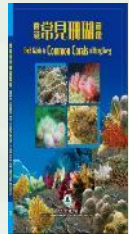
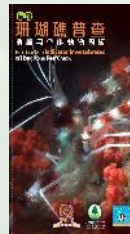
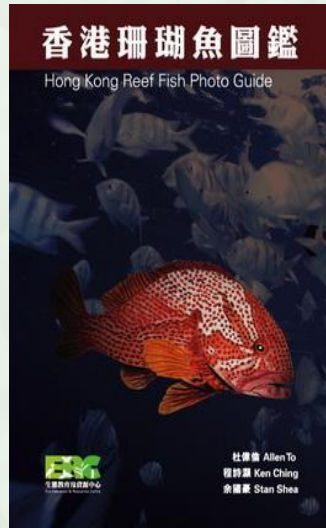
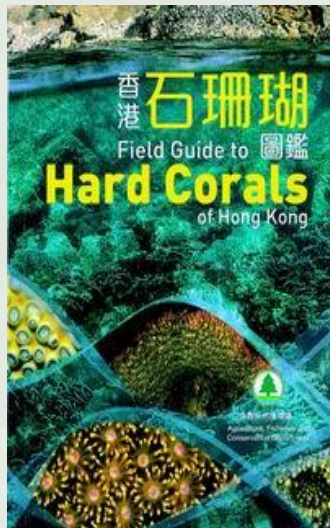
Education & Outreach

If you wish to learn more about corals, you can refer to publications published by the AFCD, such as posters.



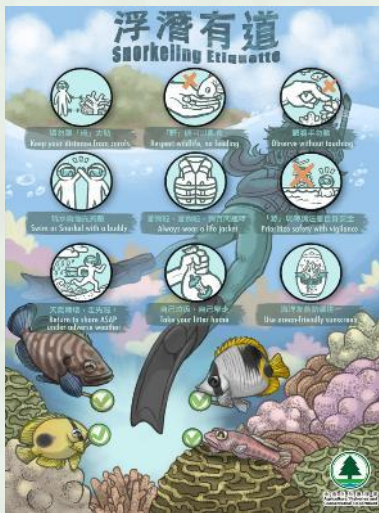
Education & Outreach

You can also borrow books from public libraries for further reading!



Education & Outreach

You can strictly follow conservation and safety guidelines when participating in recreational water activities.



Promotional Clip



Education & Outreach

Additionally, you can visit the **Hoi Ha Visitor Centre**. As Hong Kong's first visitor centre themed around marine parks, it uses diverse interactive elements to introduce Hong Kong's marine parks, reserves, and marine biodiversity!



Guided Eco-tour



Hard Coral Specimens



Workshop



Our Actions



Cadet sailors, never underestimate the power of your actions—there is so much we can contribute, like choosing “Ocean-Friendly” Sunscreen Products!



© iherb



© iherb



© iherb

Our Actions

And more!

- Reduce carbon footprint in daily life 

- Reduce plastic consumption 

- Participate in coastal cleanup activities 

- Never disturb or catch marine creatures 

- Be a responsible diver 

- Take part in the Hong Kong Reef Check 



Our Actions



Everyone, do you still remember the 3D-printed coral tiles we saw earlier? Why don't we work together to design a brand-new model?



That sounds wonderful! Once your designs are complete, I will forward them to scientists to produce real 3D-printed tiles. Afterwards, we can deploy them across various locations in Coral City to repay the corals for their valuable contributions!

Thank you all! Let's stand together to protect Coral City!



Cadet Sailors, congratulations on successfully completing this journey! We have learned how corals face various threats due to human activities. I hope that once you return to land, you will actively share these conservation messages with your family and friends. Let's work together to protect our corals and preserve Hong Kong's precious marine resources!



Summary (1)

- Coral bleaching is a stress response in corals caused by environmental changes, such as shifting water temperatures and pH levels.
- Beyond climate change, corals face several major threats:
 - Environmental Pollution
 - Destructive Fishing Activities
 - “Ghost Nets”
 - Recreational Activities

Summary (2)

- Everyone in society can team up to protect our corals:
 - Legal Protections
 - Deployment of Marker Buoys
 - Scientific Research & Monitoring
 - Coral Restoration
 - 3D-Printed Coral Reef Tiles
 - Hong Kong Reef Check
 - Coral Bleaching Sighting Report
 - Ghost Gear Record
 - Education & Public Outreach