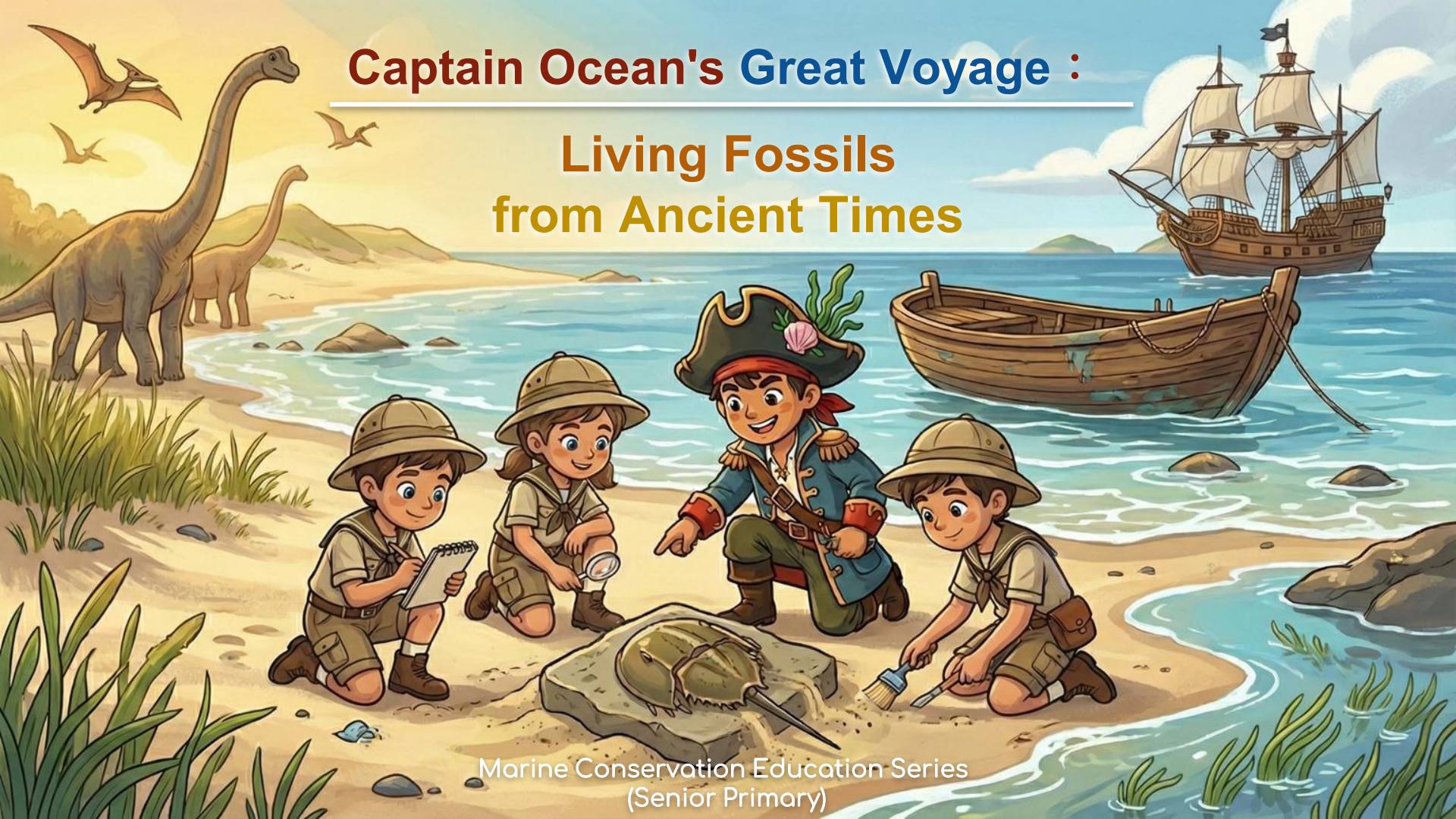


Captain Ocean's Great Voyage :

Living Fossils from Ancient Times



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 heard the island ahead is really nice! Why don't we anchor there, take a short break, and see what interesting creatures live on the island?



Key Learning Points | Cadet Sailors, Report for Duty!

Overview

Students step into the shoes of "Cadet Sailors" alongside Captain Ocean. Through an interactive voyage, they encounter horseshoe crabs—ancient "living fossils" that have survived since the age of dinosaurs. Students will explore their unique body structure, life cycle, and ecological importance. By helping a horseshoe crab find its missing friend, students investigate how human activities impact their survival and reflect on concrete actions to protect horseshoe crabs and their marine habitats.

Learning Objectives

1. Recognize the physical features and lifestyle of horseshoe crabs
2. Understand the relationship between a horseshoe crab's life cycle and various marine environments
3. Discover the importance of horseshoe crabs to human society
4. Learn how to take action to protect horseshoe crabs and their homes

Values and Attitudes

Commitment, Empathy, Responsibility

Lesson Duration

Two 40-minute lessons (80 minutes in total)

Part 1: The Voyage Begins



According to our map, this entire stretch is covered in sandy beaches! Let's go exploring along the shore to see what coastal wildlife we can discover together!





Look, Captain Ocean! I just dug this up from the sand. Any idea what it could be?

It looks like a hard animal shell, but also like a stone. Could it be a fossil?

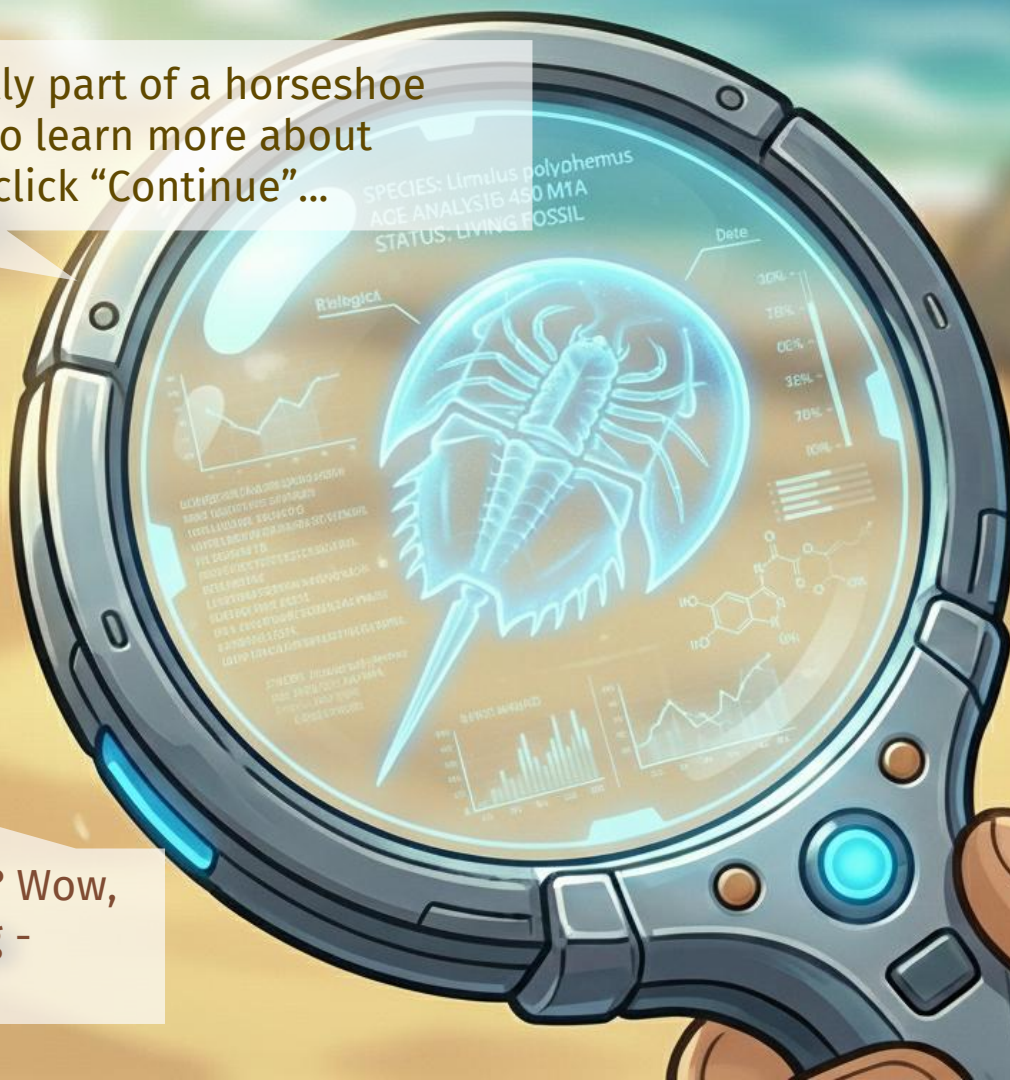
Curious to see what it really is? Try using this magical "X-Ray Lens"! It reveals the past and shows you what things are truly made of.



This item is actually part of a horseshoe crab! If you want to learn more about horseshoe crabs, click "Continue"...



A horseshoe crab? Wow, what a fascinating-looking creature!



Do you know what kind of creature a horseshoe crab actually is?

What Kind of Creature is a Horseshoe Crab?



Guess which of these animals is a close relative of the horseshoe crab!

?



© OWLHK

A. Insect



© OWLHK

B. Scorpion



© Vito | OWLHK

C. Crab



© OWLHK

D. Centipede



What Kind of Creature is a Horseshoe Crab?



Guess which of these animals is a close relative of the horseshoe crab!

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© OWLHK

A. Insect



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© Vito | OWLHK

C. Crab



© OWLHK

D. Centipede



Surprise! Horseshoe Crabs Are Not Crabs!



Taxonomy Classification



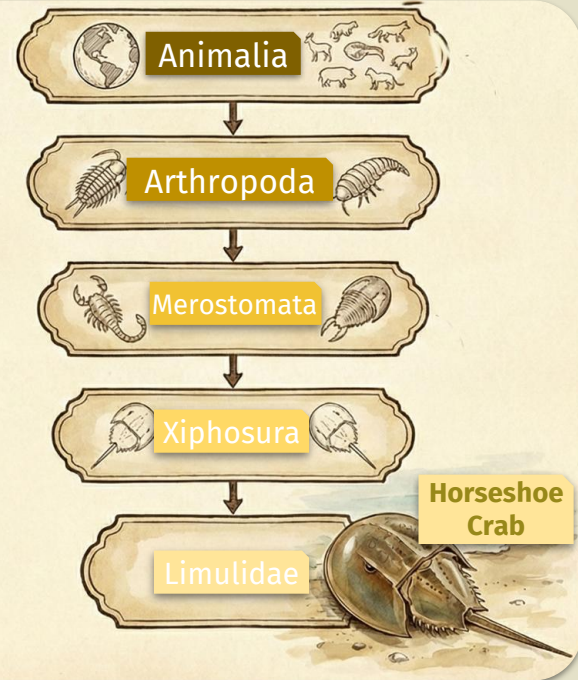
Scientists classify organisms based on their **physiological and morphological characteristics** using seven main ranks: **Kingdom, Phylum, Class, Order, Family, Genus, and Species.**



It turns out horseshoe crabs are not crabs at all! How are they classified?



Despite their name, they are actually more closely related to spiders and scorpions!



Surprise! Horseshoe Crabs Are Not Crabs!

So, how do horseshoe “crabs” and true crabs actually differ?



Crab

VS



Horseshoe Crab

Merostomata

Horseshoe Crabs

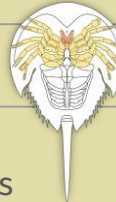
Body Structure

- Divided into three main parts:
1. Horseshoe-shaped head and thorax
 2. Hexagonal abdomen
 3. Long tail spine



Antennae

None



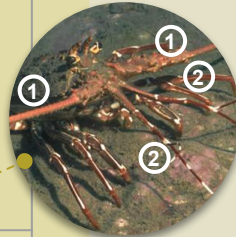
Legs

1 pair of chelicerae + 5 pairs of walking legs

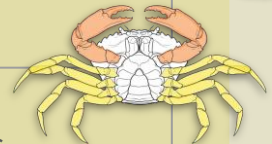
Malacostraca

Crabs, Shrimps, Lobsters, etc.

- Divided into three main parts:
1. Flattened head and thorax
 2. Segmented abdomen
 3. Shortened tail



2 pairs



1 pair of claws + 4 pairs of walking legs

Surprise! Horseshoe Crabs Are Not Crabs!



© OWLHK

Scorpion

Arachnida



© Shubham Chatterjee

Horseshoe Crab

Merostomata

Horseshoe crabs are closely related to spiders and scorpions because they all possess an **extra pair of chelicerae (pincers)** located in front of their mouths.

These little pincers act like tiny hands to **help them eat**. In fact, some species can even use them to **inject venom** and **pre-digest** their food!



© Marshal Hedin

Sun Spider



© Mila

Horseshoe Crab



© Steven Clark

Spider



Let's tap "Continue" and see what happens!

Who are they? What are they doing at my home?



Whoa! Look, there's a dinosaur behind!

The ancestors of horseshoe crabs existed on Earth over 400 million years ago...

Horseshoe Crabs Are Living Fossils!

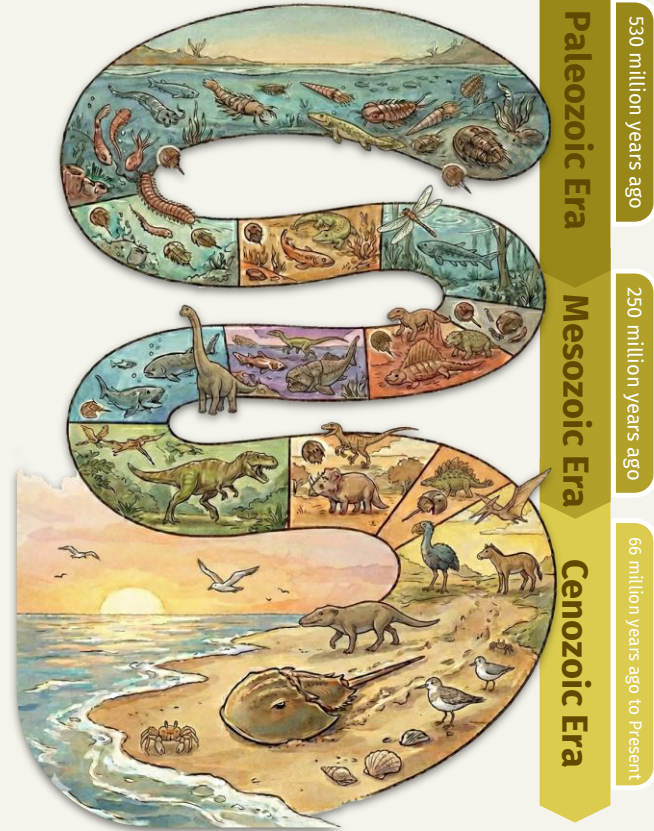


Hey, can you see the dinosaur popping up on the X-Ray Lens?



Why are dinosaurs showing up? Did we just scan an actual fossil?!

The ancestors of the horseshoe crab species first appeared during the Ordovician period of the Paleozoic Era more than 400 million years ago. Their population has persisted to this day, having survived and overcome unprecedented climate extremes





Fossil records show that horseshoe crab ancestors date back to the **Ordovician Period**.



They survived mass extinctions before the Jurassic Period, making them creatures that once **coexisted with dinosaurs**.



So horseshoe crabs are even tougher than many prehistoric creatures!

Exactly! That's why this ancient survivor is called a **"living fossil"**.



Throughout their evolutionary journey, horseshoe crabs have survived **ice ages, volcanic eruptions, and meteor impacts**—yet they still look exactly the same today.

So... is what we're holding a real fossil, or a dead horseshoe crab?







SWOOSH!

SWOOSH!

Suddenly, a mysterious creature dashes out from the bushes straight towards Captain Ocean and the Cadet Sailors!



Hey! Who are you guys anyway?



Sorry to startle you! I'm Captain Ocean. My crew and I are taking a break on this island. They love wildlife and got super excited because it's their first time seeing a horseshoe crab!



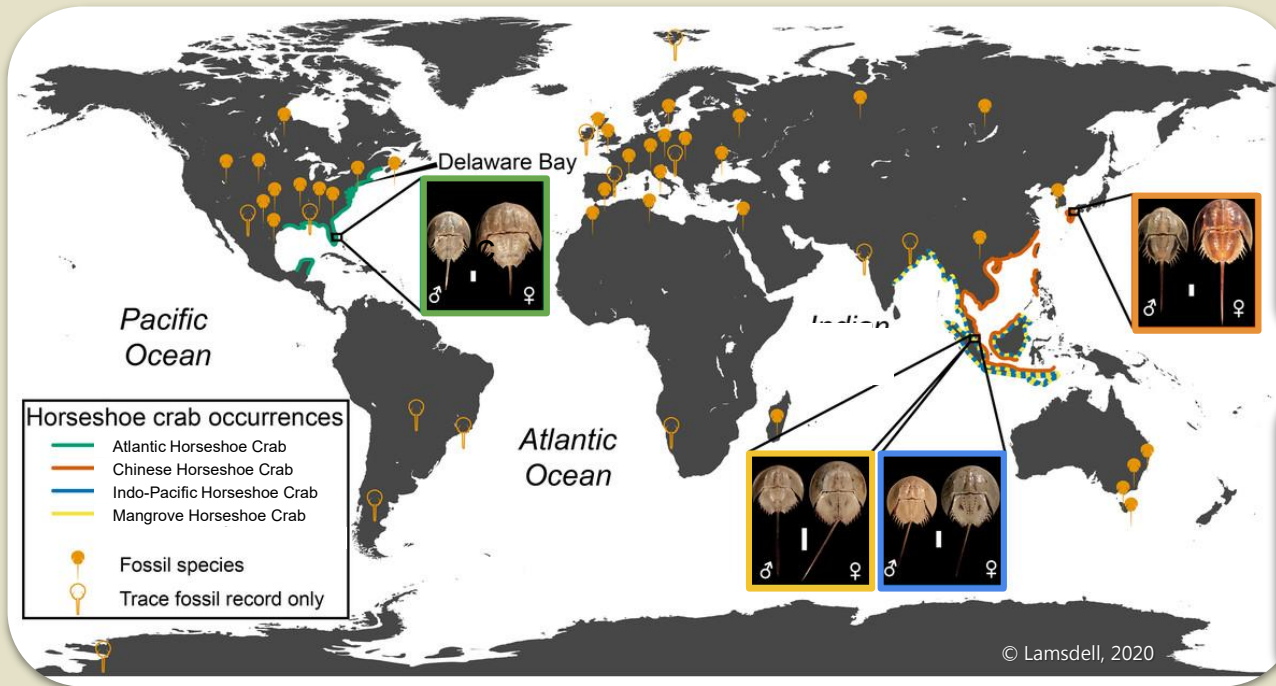
Whoa! It's a real, live horseshoe crab!



Hmm... alright then! You don't look like trouble. I'm Pony!

The Global Footprints of Horseshoe Crabs

I am a **Mangrove Horseshoe Crab**, one of the two species found right here in Hong Kong—the other is the **Chinese Horseshoe Crab**! I also have two distant cousins living in the Americas and Southeast Asia.



Atlantic Horseshoe Crab



Chinese Horseshoe Crab



Indo-Pacific Horseshoe Crab



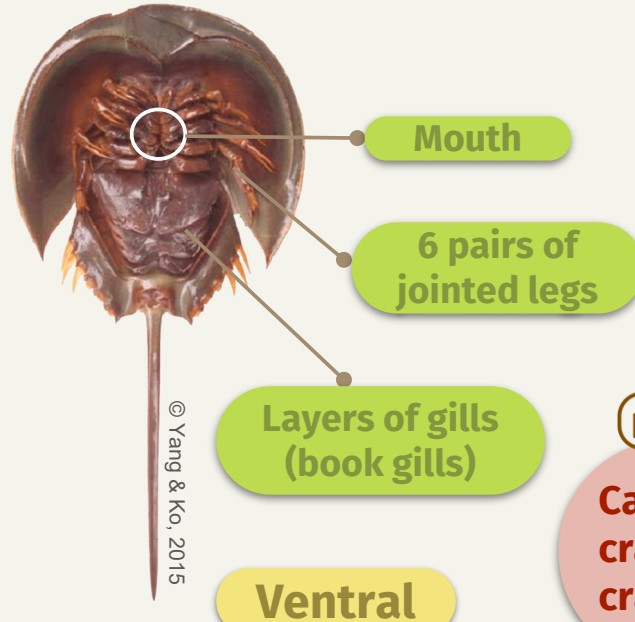
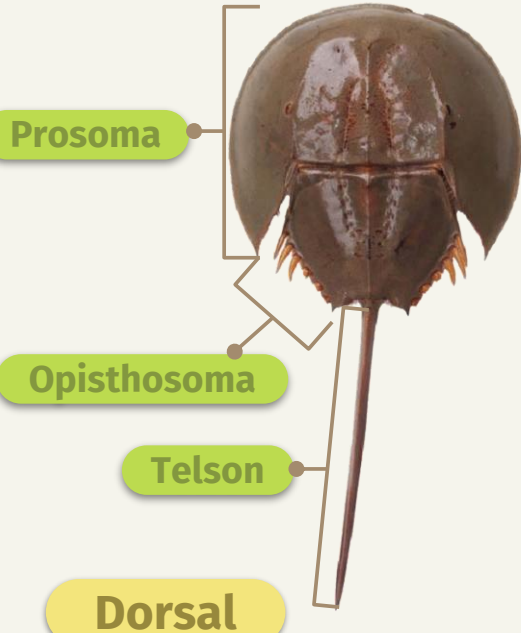
Mangrove Horseshoe Crab



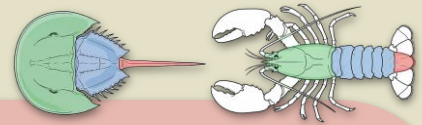
Let's check out our X-Ray Lens
to learn all about you!

The Amazing Body of Horseshoe Crabs

We rely on this body to overcome all kinds of environmental challenges!



REMINDER



Can you recall how a horseshoe crab's body is different from crabs, shrimps, and lobsters?

?

The Multi-Functional Legs of Horseshoe Crabs



- 1 pair of chelicerae (pincers) and 5 pairs of walking legs
- Serve various functions:
 - Swimming
 - Crawling
 - Clasping onto females during mating
 - Chemical sensors on the legs that help detect the aquatic environment
- In both species found in HK, the male individuals possess two pairs of specialized walking legs!

We spend most of our time walking on the seabed, but sometimes—like when we need to escape danger or head ashore to breed—we **flip upside down to swim!**



The Amazing Vision of Horseshoe Crabs



Guess what? It's not just my legs—
I have a whole bunch of 'eyes' too!

- 1 pair of **compound eyes** on the back
- 1 pair of rudimentary eyes located behind each compound eye
- **3 eyes** on top of the shell to detect visible light and UV lights
- Light-sensitive cells scattered all along the tail
- 1 pair of eyes on the underside to observe what's beneath and look for prey



The Horseshoe Crab's Breathing Secret



Just like fish, we absorb oxygen from the water using gills—but mine are extra special! They're stacked together in neat layers, just like the pages of a book, so scientists call them “**book gills**”!

We have a total of 6 pairs of book gills. This layered structure allows us to continue breathing for a period of time even after leaving the water!



© Casey R. Culligan

The Life Journey of a Horseshoe Crab



初生馬蹄蟹的寬度和長度約半厘米。
牠們約需要十個年頭。

A newly hatched horseshoe crab is about 0.5 cm in length and width. After moulting for about 17 times (at about age 10), they reach sexual maturity at a length of more than 40 cm

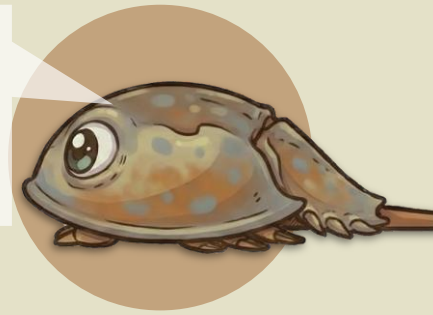


Remember that “fossil” you dug up earlier? It wasn't actually a fossil, and it wasn't a dead creature either! That was my old shell—a souvenir from my growing up! We grow bigger by **molting (shedding our shells)**.



The Life Journey of a Horseshoe Crab

Our whole life is one grand adventure—traveling all the way from shallow sandy shores into the deep blue sea!



© OWLHK

Hatching:

Lacks a tail (telson); drifts in shallow water feeding on organic debris.

Growing:

Hides in mudflats, feeding on algae and worms. Takes 10+ years and multiple molts to mature.

Maturing:

Moves to the seabed to live.

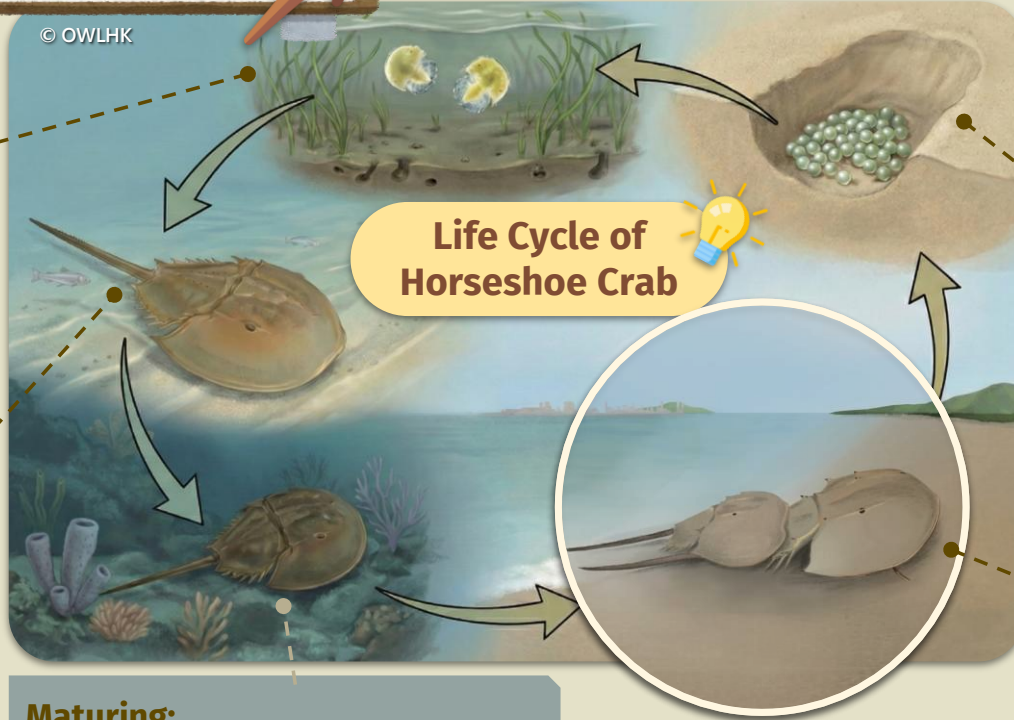
Life Cycle of Horseshoe Crab

Spawning:

Females bury eggs in the sand, where solar heat hatches them.

Mating:

Adults return to intertidal beaches to mate.



A Moonlight Date for Horseshoe Crabs



© Mike Sega

Summer is my favorite season because love is in the air! It's our breeding season!

We prefer to meet on beaches during **full moons and high tides**. After mating and laying our eggs, we return to the ocean until we meet again next time.

Ooh! Pony, do you have a love story to share with us?



Actually... my best friend went missing!
She didn't show up for our last full moon
date, and I've looked everywhere for her!

?





Captain Ocean, can your magic gadget help me find my friend?

We'd love to help!
Although this "X-Ray Lens" can't track horseshoe crabs directly, it can still help us spot tracks left behind by animals!



Don't worry, Pony—we'll do our absolute best to help you! Let's set off!



So, Captain Ocean and the crew set off along the shoreline to search for Pony's friend. Not far away, Captain Ocean spotted some mysterious animal tracks...



The X-Ray Lens revealed a pool of blue blood left behind at the scene...



Horseshoe Crabs Are “Blue-Blooded Crabs”



Yes! Just like you, horseshoe crabs need blood cells to carry oxygen throughout our bodies. Besides red **haemoglobin**, other proteins in nature perform the same function.

The **hemocyanin** in our blood contains copper ions, which turn blue when combined with oxygen.



Is... is this horseshoe crab blood?!



Then let's follow the blood trail and see if we can find your friend!



And so, following the trail of blue blood,
Captain Ocean and the crew embarked on a
journey to find Pony's friend...



TO BE CONTINUED...



Summary

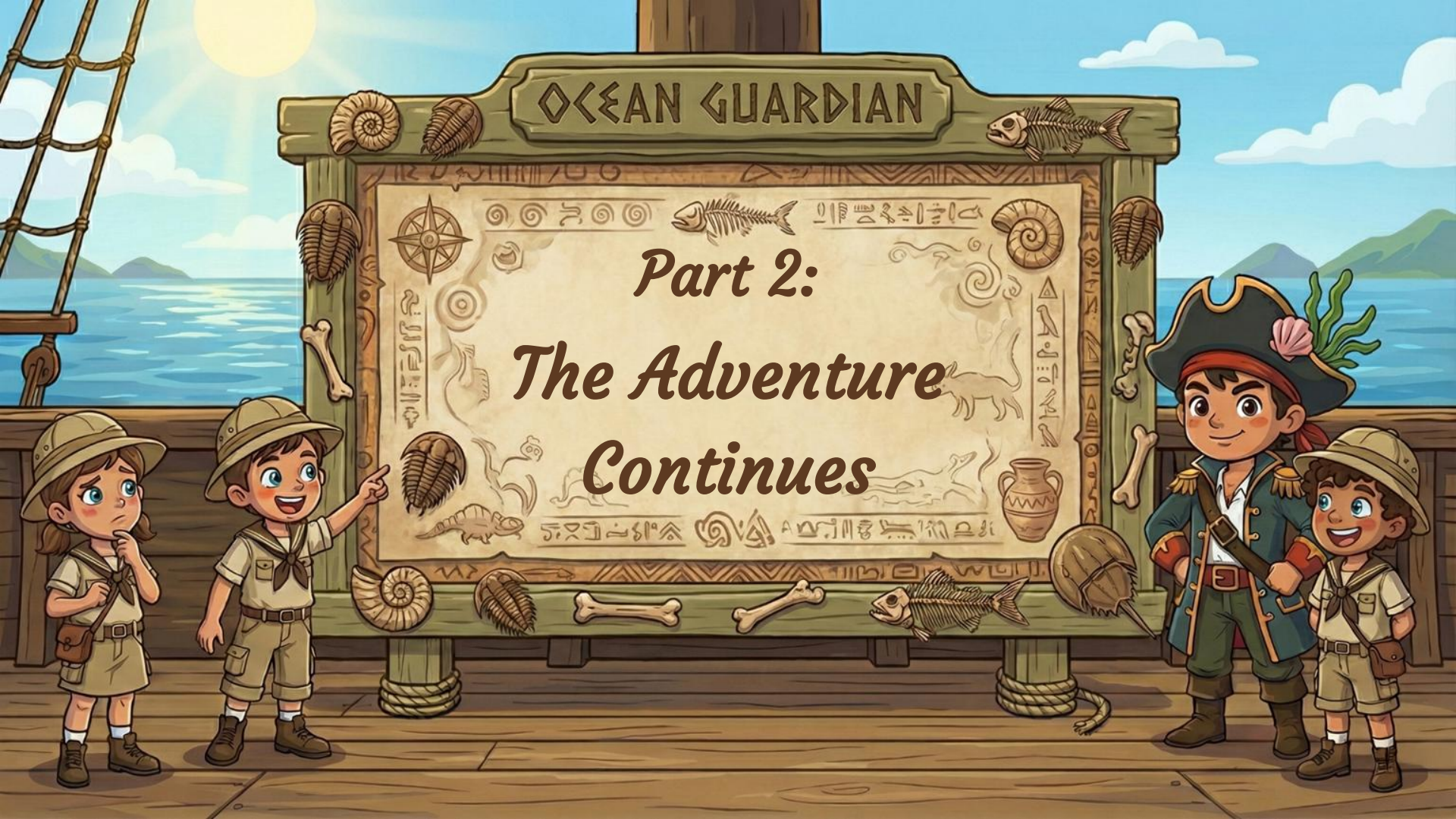


- Horseshoe crabs have existed on Earth for over 400 million years, making them true **“living fossils”**.
- They are closely related to **arachnids like spiders and scorpions**.
- Their body structure has retained its most **primitive form**.
- They rely on the **tides** to gather on **intertidal beaches and mudflats** to breed.



OCEAN GUARDIAN

Part 2: The Adventure Continues





Recap of the Last Episode



- Horseshoe crabs have existed on Earth for over 400 million years, making them true **“living fossils”**.
- They are closely related to **arachnids like spiders and scorpions**.
- Their body structure has retained its most **primitive form**.
- They rely on the **tides** to gather on **intertidal beaches and mudflats** to breed.





Previously on our adventure... Captain Ocean and the crew met a local horseshoe crab resident named Pony. Pony asked them for help to track down a dear friend who had been missing for a long time...

Challenges Faced by Horseshoe Crabs Today



According to local university research and global expert evaluations, horseshoe crab **populations worldwide are declining** and facing severe **survival threats!**

How could a creature that survived multiple mass extinctions be in such trouble today? **Their future demands our serious attention.**

Oh no, the blue blood trail stops here! We'll have to find another clue. Truth is, we hear about fellow horseshoe crabs vanishing all the time..

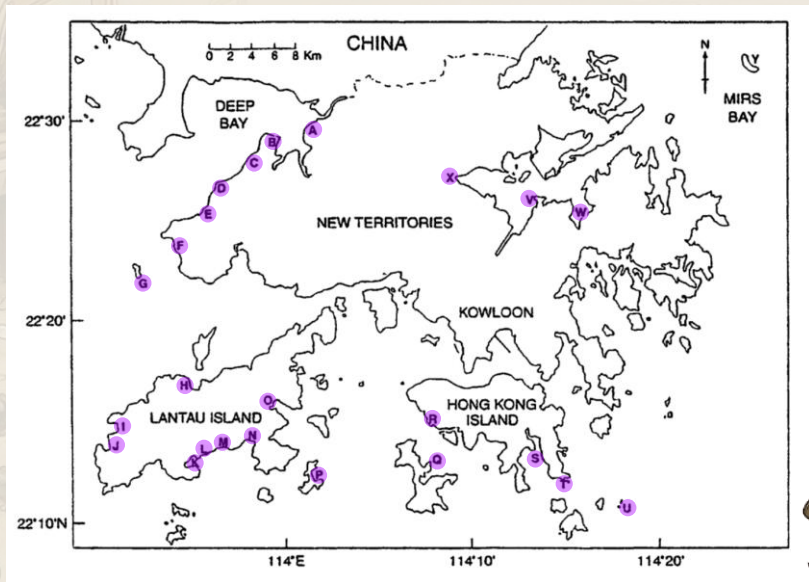
Now that you mention it, it really feels much harder to spot you guys nowadays...

I've done some research before and found a few clues linked to these missing horseshoe crab cases!



This is a secret family map handed down through generations! It shows all the coastal spots where my family used to live **before 1995**.

What a coincidence! I have a map right here that shows all the land reclamation areas in Hong Kong!



© Chiu & Morton, 2000



© Christopher DeWolf



Threat: Coastal Development



It turns out my ancestors once left their footprints all across Hong Kong's coastal areas. As humans needed more land, continuous **land reclamation** projects destroyed many of our **nesting and nursery grounds**.

My grandma often told me that her hometown was a place called **"Hau Tei Square" (literally "Horseshoe Crab Land Plaza" in Chinese)** because horseshoe crabs used to gather there. But I've never known where that place actually is.

Which district in Hong Kong is "Hau Tei Square" located in?

- A. Tuen Mun
- B. Tsuen Wan
- C. Tsim Sha Tsui
- D. Chai Wan



Threat: Coastal Development



Hau Tei Square is located in **B. Tsuen Wan**, and that area used to be a sandy beach! The reason you could never find it is that it was reclaimed from the sea many years ago.



Thank you so much! Now I finally know where Grandma's old hometown was! I'm thinking... maybe our friends aren't just vanishing because our beaches are shrinking. Could it also be caused by these mysterious tiny beads?

I found them scattered across the mudflat a couple of days ago—do you know what they are?



Wait... isn't this plastic?
The most common type of plastic we use every day is called **PET**, which is typically used to make bottled water containers. When exposed to sunlight and broken down by wind and waves over time, it slowly fragments into tiny pieces **under 5 mm** in size. We call these “**microplastics**”.



Threat: Marine Pollution



Everyone! I just found a video showing how microplastics affect horseshoe crabs. Let's check it out and see if we can find any new clues!



再從中辨識不同種類的微塑膠

Threat: Marine Pollution



Scientists are already investigating how dangerous microplastics are to us! Even though this study was done in a lab, the findings show that living in an environment with microplastics can lead to **reduced body weight, smaller size, and decreased mobility or activity levels** in horseshoe crabs.

Oh no... maybe your friend hasn't been feeling well and that's why she missed the party! Don't worry, let's keep searching further down the beach!



Threat: Ghost Nets



Oh no! One of my friends over there got caught in a “**ghost net**” (an **abandoned net** left by humans) wash up on the beach. He may **get injured or even die!!!!**



Quick, everyone! Let's go rescue him!



Threat: Overexploitation



By the way, does anyone ever hunt or catch you on purpose?

We need to be careful and stay clear of those “ghost nets”!



That happens too. In parts of Asia, people may catch horseshoe crabs for **food**!



Threat: Harvesting for Medical Use



My distant cousins living in the Americas say they get caught all the time too. Our blue blood is super special. It can detect dangerous bacteria! Scientists turn it into a testing agent called LAL to make sure new vaccines and medicines are completely safe for humans to use!



Even though we managed to save our fellow horseshoe crab, there's still no word on your missing friend...



Don't lose hope! See that person taking a walk on the sand over there? Let me run over and ask if he's spotted your friend!

Okay, sounds good!



Hello! Have you seen a horseshoe crab around here?
I'm looking for my friend.

Wow, a horseshoe crab! I've finally found you!



Are you looking for me? But... I don't think
we've met before!

Hello! I'm Dr. Ma from **Agriculture, Fisheries and
Conservation Department (AFCD)**. I'm a scientist
who studies horseshoe crabs.





Hello Dr. Ma! I'm Captain Ocean. My crew and I are looking for a missing horseshoe crab. Could you help us?

Of course! Protecting horseshoe crabs is actually part of my job.



Dr. Ma, what made you want to study horseshoe crabs?

At first, I just thought their unique, fossil-like appearance was fascinating. But after learning that they are endangered, I knew I wanted to help protect them!



How Do We Know If Species Are Threatened?



International Union for Conservation of Nature (IUCN)

The IUCN is the world's largest conservation organization.



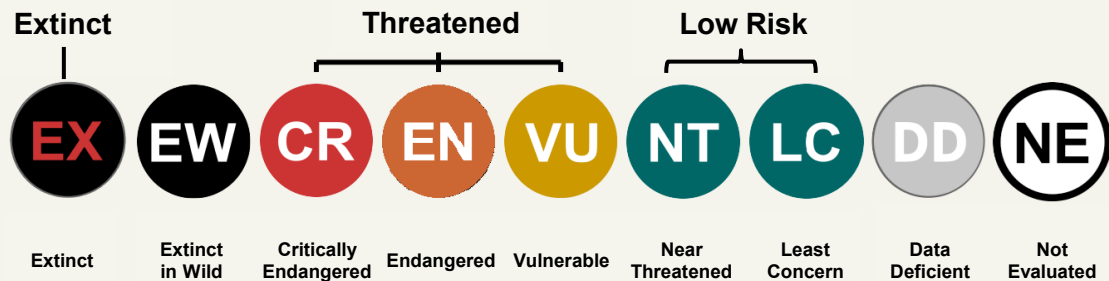
To assess the **conservation status** of animals, plants, and fungi, the IUCN compiles a dedicated list that categorizes species according to their level of threat:



The IUCN Red List of Threatened Species



How Do We Know If Species Are Threatened?



© IUCN Red List

Do you know which categories the different species of horseshoe crabs belong to?



**Atlantic
Horseshoe Crab**



 **Chinese
Horseshoe Crab**



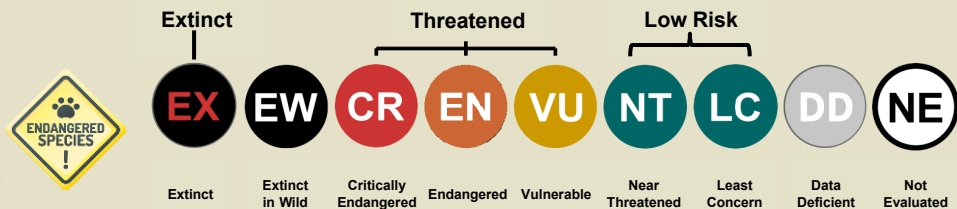
**Indo-Pacific
Horseshoe Crab**



 **Mangrove
Horseshoe Crab**



Current Conservation Status of Horseshoe Crabs



© IUCN Red List



Vulnerable



**Atlantic
Horseshoe Crab**



Endangered



**Chinese
Horseshoe Crab**



**Data
Deficient**



**Indo-Pacific
Horseshoe Crab**



**Data
Deficient**



**Mangrove
Horseshoe Crab**

Remember, 'Data Deficient' doesn't mean these horseshoe crabs are safe! It just means scientists still need to gather more clues and information to understand how many are left in the wild!



Conservation Efforts: Legal Protection



The Chinese Horseshoe Crab and Mangrove Horseshoe Crab are officially listed as **Grade II National Key Protected Species** under China's List of Wildlife under Special State Protection! They are rare and precious, which is why AFCD works hard to protect our local horseshoe crabs through strong conservation measures.

Enacting the **Marine Parks Ordinance** (Cap. 476):

- Horseshoe crabs are listed as **“Protected Marine and Coastal Species”** under the ordinance.
- It provides legal protection for adult horseshoe crabs living within Marine Parks and Marine Reserves.



Dr. Ma, do you have any good ways to help us find horseshoe crabs?



We can try some of the methods I usually use during my research. Follow me this way!



Conservation Efforts: Monitoring & Research (Population)

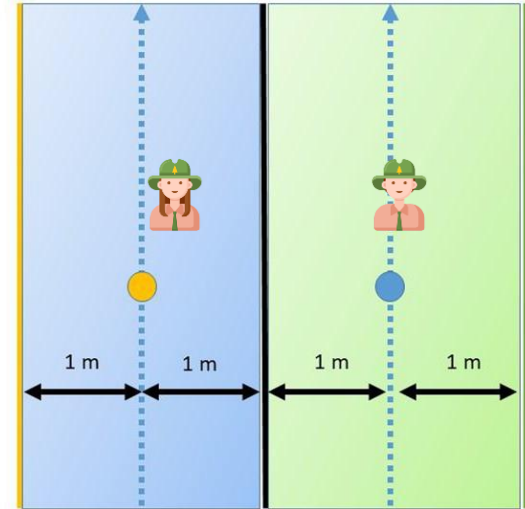


We can start with two traditional methods commonly used to study the **distribution** and **population size** of juvenile horseshoe crabs.

Method 1: Transect Survey

1. Set up a transect line—our designated research path—across the study area using a measuring tape
2. Each transect line is 2 meters wide, walked by two researchers standing 2 meters apart
3. Move forward along the line, recording the quantity and species of any horseshoe crabs found along the way

Thanks to this method, we've actually discovered juvenile horseshoe crabs in areas where they were previously thought to have disappeared!



Conservation Efforts: Monitoring & Research (Population)



Method 2: Quadrat Survey

1. Set up four parallel transect lines (research paths) across the study area using measuring tapes
2. Randomly place five quadrat frames of equal size along each transect line
3. Record the quantity and species of horseshoe crabs found inside each quadrat frame



Let's quickly
follow Dr. Ma's
instructions to
help out!





Dr. Ma, we've just completed both surveys, but we still haven't found any horseshoe crabs. Is there any other method we can try?

We have one more cutting-edge method to try! Have you ever heard of DNA (Deoxyribonucleic acid)?

What is DNA?



- A. A substance that helps us digest food
- B. A substance that helps transport oxygen in our body
- C. A substance that aids in bone formation
- D. A substance that stores our genetic information



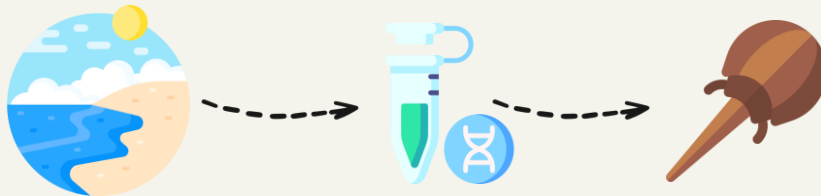
Conservation Efforts: Monitoring & Research (eDNA)



The answer is **D - A substance that stores our genetic information!**

As horseshoe crabs interact with their environment, they shed DNA (e.g., through bodily fluids, skin cells, or waste) which accumulates in their surroundings. We call this **environmental DNA (eDNA)**.

By collecting **water and sediment samples** from different study sites, we can check if they contain horseshoe crab eDNA. If we catch a match, it proves horseshoe crabs are living nearby, even if they're hiding!





However, this method has one limitation: we can't get instant results. I'll need to take the samples back to the laboratory for analysis, which takes a few days!

No problem at all! Let us help gather the water and sediment samples!



While we wait for the tests to run, **I have other important missions** you can lend a hand with!

Thank you, Dr. Ma!



Conservation Efforts: Market Surveys & Outreach



Try checking around local seafood restaurants and market stalls to see if you can find any clues!

AFCD teamed up with WWF-Hong Kong to start the **“Horseshoe Crab Counts” campaign!** This encourages restaurants and stalls to pledge **not to sell or display horseshoe crabs**, and to display a special sticker for consumers to identify them.

If you see this sticker, you can rest assured—that shop won't be serving or displaying horseshoe crabs!



Conservation Efforts: Horseshoe Crab Sighting Report



感謝你提供在本地自然生境發現馬蹄蟹的報告。這些資料將幫助我們更了解馬蹄蟹在自然生境中的分布、品種和數量。請注意，如果你發現馬蹄蟹被困於棄置漁具中，可於自身安全情況下將其救出，並在附近適合的地方釋放。如有需要協助，請致電3468 5394與我們聯絡（辦公時間：星期一至五早上9點至下午5點30分，公眾假期除外）。



If you spot a horseshoe crab, you can notify AFCD using our **online form**! In addition to the date and location of the sighting, you can also share details like its **habitat**, **species**, and **body size**.

Horseshoe Crab Sighting Report



Conservation Efforts: Breeding & Rehabilitation



 **Survival rate jumped from 0.01% to 76%.**

CityU breeds juvenile horseshoe crabs in laboratories.



Secondary students monitor and **care** for the juveniles in schools.



Microchips are implanted to track survival rates.



Horseshoe crabs are **released into natural habitats** with ongoing monitoring.



Students can join this program directly through their schools!



Conservation Efforts: Ghost Net Removal



In Hong Kong, **ban on commercial bottom trawling and destructive fishing methods** has been implemented to restore benthic habitats and marine ecosystem health

AFCD has also partnered with green groups to inspect horseshoe crab spawning and nursery grounds. The initiative **removes abandoned nets and provides rescue services** for trapped horseshoe crabs.

Help us clear ghost nets whenever you safely can!

Conservation Efforts: Public Education



AFCD hosts talks, exhibitions, eco-tours, and coastal cleanups to build public support and spread awareness for horseshoe crab protection. Join our activities with your friends to help protect horseshoe crabs!



Conservation Efforts: Be a Horseshoe Crab Guardian



Participate in beach cleanups to remove ghost nets

Do not buy or eat horseshoe crabs

Choose reusables to prevent ocean pollution

Share horseshoe crab sightings with the AFCD

Avoid destructive tours or non-scientific release events

Do not disturb or harm horseshoe crabs



Conservation Efforts: Be a Horseshoe Crab Guardian



Thanks Dr. Ma! We can't wait to hear back from the lab!

Cadet sailors, how about we team up to design a **“Missing Horseshoe Crab” poster**? We can teach our school friends all about horseshoe crab features, habits, and threats! The more kids who learn about them, the more eyes we'll have searching for our missing friend!

My pleasure! I'll speed through the lab tests and update you right away. Good luck, team!



Congratulations on completing this journey! Although we haven't heard any news about our missing horseshoe crab friend just yet, we can still do our part to protect them and conserve Hong Kong's precious marine resources!



Summary (1)

- Major Threats to Horseshoe Crabs
 - Coastal Development
 - Marine Pollution
 - Ghost Nets
 - Overexploitation
 - Harvesting for Medical Use
- The IUCN Red List of Threatened Species helps us assess the extinction risk and vulnerability level of each species
- Threatened Species: Chinese Horseshoe Crab and Atlantic Horseshoe Crab
- Data Deficient: Insufficient data currently available to evaluate the Indo-Pacific Horseshoe Crab and Mangrove Horseshoe Crab

Summary (2)

- Collaborative Conservation Actions with AFCD and the society
 - Habitat Protection
 - Legal Compliance
 - Monitoring & Research
 - Market Surveys & Outreach
 - Rehabilitation Programs
 - Sightings Report
 - Public Education
 - Personal Action