賽馬會 Jockey Club
「山海為一」環境教育計劃
"Ridge to Reef" Environmental Education Programme

The Hong Kong Jockey Club Ridge to Reef Environmental Education Program

Integrated Science & Biology Lesson Plan – Oyster and Ridge to Reef

(A) Topics:
- Unit 2 Water
- Unit 3 Looking at Living Things

(B) Duration: 3 lessons (40min per lesson)
(C) Venue: normal classroom setting
(D) Lesson Flow:

Sustainable Development Goal
SDG 14

	Lesson 1	Lesson 2	Lesson 3
Sub-topic:	Basic understanding of oysters	Using identification key to understand the characteristics of oysters	Oyster and sustainable development
Core questions:	A. What is an oyster? What is an oyster reef? How are the oyster habitats look like? What are the ecological functions of oyster reefs? What are the treats to oyster reef?	B. Difference between various type of shellfish creatures. Anatomy of oyster.	C. Relationship between oyster and sustainable development? Ridge to reef concept.
Pre-lesson knowledge:	What is filtration? Basic concepts of ecosystems, habitats and organisms.	Use of identification key for classification. Different types of identification key. Classification between invertebrates and vertebrates.	17 sustainable development goals.
Key concepts:	A1 Water purification (2.3) A2 Biodiversity (3.3) A3 Effects of human activities on biodiversity (3.3)	B1 Grouping of living things B2 Put living things into different groups according to their key features (3.2) B3 Construct a simple key for identification of living things (3.2)	C1 Biodiversity (3.3) C2 Importance of biodiversity and conservation (3.3)
Learning objectives – Knowledge	1. Understand the characteristics of oyster reef. 2. Explain the role of oysters in ecosystem. 3. Recognize the current challenges of oysters in their natural habitats (Ridge to Reef conservation approach).	1. Understand the anatomy of oyster. 2. Classify different species by their characteristics. 3. Analyse the similarities and differences between different shellfish and animals.	1. Understand the relationship of sustainable development and importance oyster reef. 2. Suggest ways to conserve the natural environment & oyster reef with concept of ridge to reef. 3. Pre-field trip briefing.
Learning objectives – Skills	1. Integrate and apply knowledge to analyse problems collaboratively in real-life contexts	1. Able to read and draw identification key. 2. Able to apply scientific inquiry skills, such as thorough observation and systematic classification.	1. Able to demonstrate their mastery of scientific language. 2. Able to show understanding of concepts through the information research process.
Learning objectives – Attitude	1. Nurture a sense of reasoning through discussing challenging questions.	1. Able to make critical judgements through comparing different species.	1. Nurture students' awareness to the concept of upcycling (by making use of oyster shells). 2. Cultivate students with the sense of sustainable development and to protect the environment in daily-life practice.

Lesson 1

Time	Contents	Teaching materials/ activities	Guiding questions
Setting			
5min	**What is oyster?** Impressions/ common sense about oysters	- Discussion between teachers and students - Teachers share their own experience about oysters - Oysters photos are shown to students - Encourage students to raise hands and express their opinions - Student WS	Open-ended questions Q: How does it look like? Describe it. Q: Where can you see oysters? Q: Do you love eating oysters? Why or why not? Q: Are they only for eating? Any other purposes?
Development			
10min	**Habitat- Where do they live in Hong Kong?** Relate Oysters to the daily life of students - Long History of oysters farming in Hong Kong - Important role of oyster industry in social and economic development in local community Habitat Introduction - Pak Nai in Yuen Long, the new territories - Living in salty or brackish waters on coasts - Clustering on older shells, rock, piers, or any hard surface - Clustering together as they grow, provide habitat for other marine animals and plants, especially small crabs and fish Field trip in Pak Nai	- Showing pictures of oyster farming to students - AFCD Map on Oyster Farming - Pictures of Rich biodiversity eg. Chinese Horseshoe crabs, Mangrove Horseshoe crabs - Q&A	Q: How do we call the habitat of oysters? A: Reef. Q: What is clustering? A: living in a group/ gathering with other oysters to grow.
10min	**Challenges to their habitats (Ridge to Reef Concept)** Highlight of the movie clip - Linking river basins from land to coasts (all the natural habitats are connected) - Virtual Trip to the wetlands (invertebrates, mangroves, oysters, oyster industry) - Sustainable development to better water and ecosystem management Challenges of their habitats - Water pollution from the upper part (Sewage) - Human activities (overfishing, removal of trees) - Urbanization - Reclamation - Hill fire	- Movie clip: Ridge to Reef Introduction (3mins) https://www.youtube.com/watch?v=6rsl1xCLT3E (Chinese version) or https://www.youtube.com/watch?v=WHnzjkgqp3Y (English Version) - Ask students about the human activities damaging the natural oyster habitats (using the worksheet distributed in lesson 1- Flipped task sharing)	Q: Summarize Ridge to Reef concept after video. A: Damage on land will lead to problems in water. Land, Coasts, and rivers habitats are connected. Q: Why does urbanization affect the oyster habitat? A: Urbanization leads to economic activities, this process involves reclamation, which reduce the area of habitat of oysters and lower the water quality.
10min	**Role of oysters in ecosystem** Filtration function - Acting as natural seawater filtration system - Oysters are an integral part of marine ecosystems, serving as an ecosystem engineer and enhancing biodiversity - Removing toxic microscopic algae from the water by pumping large amount of water through their body	- Movie clip: Oyster filtration process time-lapse video https://www.youtube.com/watch?time_continue=16&v=N39nPt7k3p0&feature=emb_title - Discussion between teachers and students, using	Q: What is filtration? A: Improve water quality by removing impurities. Q: What is purpose of improving water quality? A: Enhance the biodiversity by removing pollutants and release cleaner water in

	- A single adult oyster can filter between 200 and 500 liters of water a day; 20 liters per hour on average - Lowering the chances and incidences of red tide <u>Three Importance of Oyster Reef to Ecosystem</u> - Improving fishery catches: provide habitats for juvenile fish and their prey - Coastal protection: buffer strong wave and reduce erosion - Improving water quality: filtering water and improve clarity of water, reduce eutrophication and filtering nitrogen compounds	the worksheet distributed in lesson 1 (Flipped task sharing)	which life can more easily develop. Q: What is red tide? A: Red tide is a common name for algal blooms, which are large concentrations of aquatic microorganisms.
Conclusion			
5min	**Conclusion** Ask students to discuss with peers to the three learning objectives. Invite response from the whole class	Discussion between students and share their thoughts in the whole class Can check Answer of the T/F questions	1. Understand the characteristics of oyster reef 2. Explain the role of oysters in ecosystem 3. Recognize the current challenges of oysters in their natural habitats (Ridge to Reef Concept)

Lesson 2

Time	Contents	Teaching materials/ activities	Guiding questions
Setting			
5min	**Revision of living things** Habitat of oyster in Hong Kong and current challenges Water Filtration: The role of oysters in ecosystem	- Summary slide of last lesson - Three major benefits of oyster reef - Q&A - Recall last lesson	Q: What is the special feature and function of oysters? A: Oyster can filter sea water, improving the water quality (cleanness and clarity). There are three benefits of oyster reef.
Development			
10min	**Basic Information and body structure** <u>Basic Information of oysters</u> - Size: 3 inches to 14 inches - Average life span: Up to 20 years - Shape: irregular, affected by environmental constraints, growing over or around adjacent objects, especially oyster shells(蠔苗依附在蠔殼上) *Interesting facts of oysters* - Oysters can change sex once or more during their lifetime - Oyster will not move when attached - Predators of oysters <u>Anatomy</u> - Gill, Mantle, Adductor Muscle, Hinge, digestive gland, mouth, stomach, anus etc (feed by extracting algae and other food particles from the water they are almost constantly drawing over their gills) <u>Extra info:</u> - Uses of its shell: they relax their single adductor muscle, allowing the two valves of the shell to open slightly, this process is called 'pumping'. Specialized cilia on the gill draw water into the shell cavity. - Reproduce when the water warms by broadcast spawning.	- Basic information of oyster (Name, size, family name, life cycle - highlighting the larvae will attach on oyster shells (spat), irregular shape) - Anatomy Understand the vocabulaires of external features and internal organs and fill the blanks on student WS (Show pictures and labelling) - Student WS	Q: From the picture you can see, why is the shell shape irregular? A: The shape is affected by environmental constraints, growing over or around adjacent objects. They tend to settle in dense aggregation, and usually overgrow, so the shapes change to accommodate the environmental challenges. Q: How do they eat? A: They relax their single adductor muscle, allowing the two valves of the shell to open slightly. Q: What are the similarities with human beings? A: Eg.mouth, heart, digestive glands, stomach Q: From the picture you can see, Which place is responsible for removing waste from the body? A: Anus Q: Which place is responsible for releasing substances to digest food? A: Digestive glands
8min	**Observe different creatures and compare their similarities and differences** Worksheet for recording - sizes - shapes - externals, colours - substrates and habitats	Group observation- Observe different shellfish, including American oysters, clams, pacific littlenecks, blue mussels, geoduck, and rock scallops Group Activity Worksheet : Information of size, habitats and external features) (Asking students compare their features)	Q: What do these species have in common? A: They do not have backbones, they have hard shells, soft-body feature, interior of the shells is mostly white, living in salt water, mostly brown or gray color, the habits are usually some mud, rock or hard surface Q: What are their differences? How would you classify them? A: By their sizes, shell shapes, external features, colors, locations

12min	**Grouping of living things by identification key** <u>Revision of Identification key</u> - Purpose of Identification key - Example of two formats of identification key (tree diagram and statement format) Animal classes: - Amphibian - Reptile - Mammal - Bird - Fish - Mollusca - Arthropods Features: - Vertebrates and invertebrates - Feather/ Tails/ Fins/ Gills/ Moist Skin - Mammary glands - Lay egg/ give birth to live young - Soft bodied with shells - Jointed legs with exoskeleton	Group activities- 1. Find the characteristics of the animals with a tick in a table (Student WS) Check the answer with the tick 2. Draw an identification key in group (in form of tree diagram) (Group WS) OR A3 Poster paper 3. Invite students to show their answer	Q: Without a backbone (Invertebrate), how are the bodies of an oyster supported? A: Oyster is invertebrate, without a backbone, so its body is supported by a hard shell Q: According to the chart, find the class of the animals? A: e.g. Elephant, Turkey, Clams and scallops
Conclusion			
5min	**Conclusion** Revise some body features and characteristics of oysters Compare the similarities and differences between different shellfish and animals (using identification key)	Q&A Can check Answer of the T/F questions	1. Understand the anatomy of oyster 2. Classify different species by their characteristics 3. Analyze the similarities and differences between different shellfish and animals

Lesson 3

Time	Contents	Teaching materials/ activities	Guiding questions
	Setting		
8min	**Revision of oyster basic information** Oyster anatomy Identification key of classifying animals according to their body features Ridge to Reef Concept - Human activities on land will impact the water quality in sea, and thus influencing the natural habitats of the oysters	- Q&A Asking students to suggest some human activities to show R2R concepts and explain the relationship between Land and Sea -Student WS	Q: Why urbanization and industry (land) will affect the oysters? A: Illegal discharge of sewage and dumping waste to rivers, the polluted water will flow to Deep Bay, affecting the water quality
	Development		
12min	**Relationship between oyster and sustainable development** <u>Present the concept of sustainable development</u> - Fulfillment of economic, social and environmental sustainability - The developments in the three aspects are mutually beneficial <u>Introduction of SDG 14.2 Goals</u> - Life below water: protecting the marine and coastal environment, strengthening the resilience and restore productive ocean <u>Oyster Restoration in Hong Kong</u> - TNC mission - Current situation of oyster reefs/ oyster restoration work around the world (e.g. Chesapeake Bay, Montauk) - Functions of oyster reefs - Actions in restoring oyster reefs in Hong Kong (TNC and oyster reef exhibit) <u>Upcycling: Uses of oyster shells</u> - The process of transforming by-products, waste materials into new materials of better quality and environmental value - Examples: Using oyster shells for artwork production (photos), building walls with oyster shells	Short Discussion between teachers and students: How do oysters bring sustainable development? (Economic benefit, Social benefit and Ecological functions) Movie clip: TNC is helping to restore Hong Kong's Oyster Reefs *Must watch https://www.youtube.com/watch?v=zURKkyIgOOo Movie clip: Oyster restoration in Chesapeake Bay (optional) https://www.youtube.com/watch?v=CUWePUvBGBE Article: LONG ISLAND WATER QUALITY: We're Oyster Farmers – Montauk (optional) https://www.nature.org/en-us/about-us/where-we-work/united-states/new-york/stories-in-new-york/long-island-water-quality/we-re-oyster-farmers/ Turning Waste Into Value For Hong Kong's Oyster Shells (TNC) https://www.tnc.org.hk/en-hk/what-we-do/hong-kong-projects/less-trash-more-reefs/	Q: Why did people start farming oysters? A: 1. For a living, and oyster farming 2. restore oyster reef for scientific research 3. conservation purposes Q: What happens if the world loses all the oyster reefs? A: Think about filtering water, 3 benefits of oyster reef, sustainable development Q: Why is it important to restore oyster reefs and promote sustainability? Q: Is it because of protecting the environment/ creating social benefits? A: No. It is because from a commercial standpoint, they initially want to start a business. They found that if they make their businesses more sustainable, they can generate more profits in the long term.
	Conclusion		
5min	**Highlight of the 3 lessons** - The habitat of oysters - Importance of oysters in water - The anatomy of oyster - Grouping of living things and identification key	Q&A If have time could play MC game (See extra learning activity)	Q: What have we learnt in these 3 lessons? (Could invite student respond)

	- Sustainable development and oyster restoration in Hong Kong		
Pre-trip briefing			
15min	**Preparation work** Flipped Task: Online research beforehand Example: - The geographical location of Pak Nai - Tide time and tide chart - To-bring list - Dress code (Walking on soft mud) - Tasks for students		Q: What is Low tide time? Q: Why do we have to select low tide time?

Reference:

- https://www.sterlitech.com/blog/post/oysters-act-as-a-natural-seawater-filtration-system
- http://baybackpack.com/blog/how_does_an_oyster_filter_water
- https://www.scmp.com/news/hong-kong/health-environment/article/3015724/millions-oysters-citys-coastline-could-help-clean
- https://www.youtube.com/watch?v=u7InXQ_c0MQ (Oyster reef restoration helps clear up Hong Kong coastal waters English subtitles with Cantonese narration - SCMP)

BASIC UNDERSTANDING OF OYSTERS

First lesson

賽馬會 Jockey Club
「山海為一」環境教育計劃
"Ridge to Reef" Environmental Education Programme

The Nature Conservancy
大自然保護協會

LESSON OBJECTIVES

1. Understand the characteristics and locations of oyster reef in Hong Kong
2. Explain the roles of oysters in ecosystem
3. Recognize the current challenges of oysters in their natural habitats (Ridge to Reef Conservation Concept)

WHAT DO YOU KNOW ABOUT OYSTERS?

How do they look like?

Where can you see them?

Do you love eating them?

LONG HISTORY OF OYSTER FARMING…

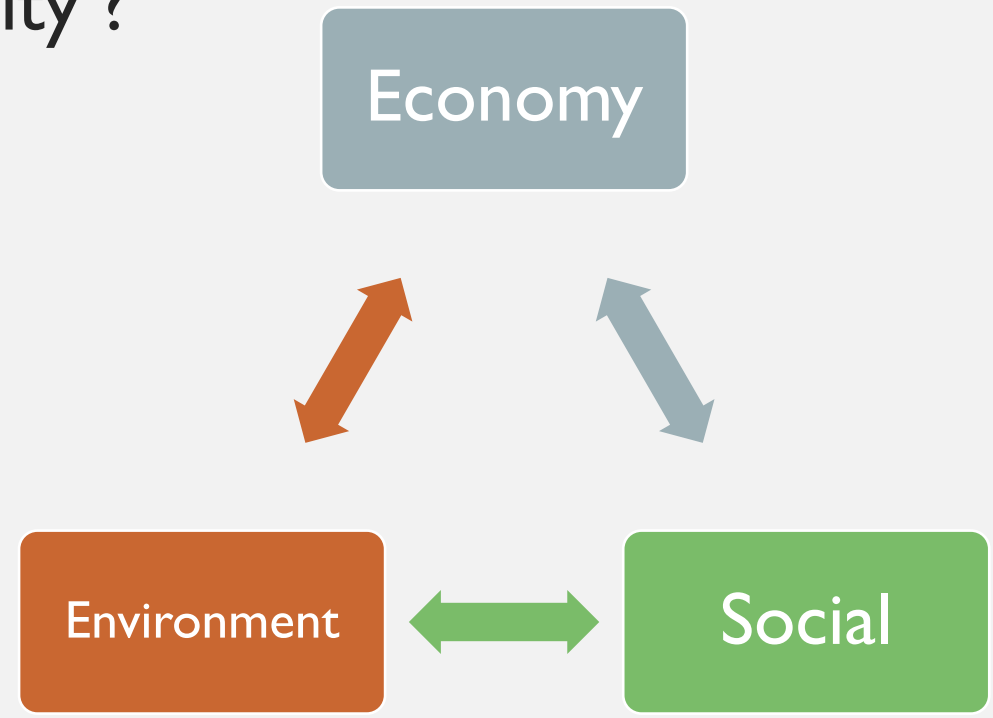
- Hong Kong has a long history culturing and harvesting oysters (at least 700 years)
- Traditional methods of oyster cultivation (bottom cultivation) designated as Hong Kong's Intangible Cultural Heritage

LAU FAU SHAN OYSTER INDUSTRY

- Bottom cultivation: laying bare substrate on mudflat, allowing oyster larvae in water colum to settle naturally
- Harvest after 3-4 years

IMPORTANCE OF OYSTER

- How does oyster industry benefit to the local community ?



TAKE A DEEPER LOOK ON OYSTERS…

Apart from eating & cooking…

- Where is the natural habitat for oysters?
- What are their roles in marine ecosystems?

NATURAL HABITATS OF OYSTERS

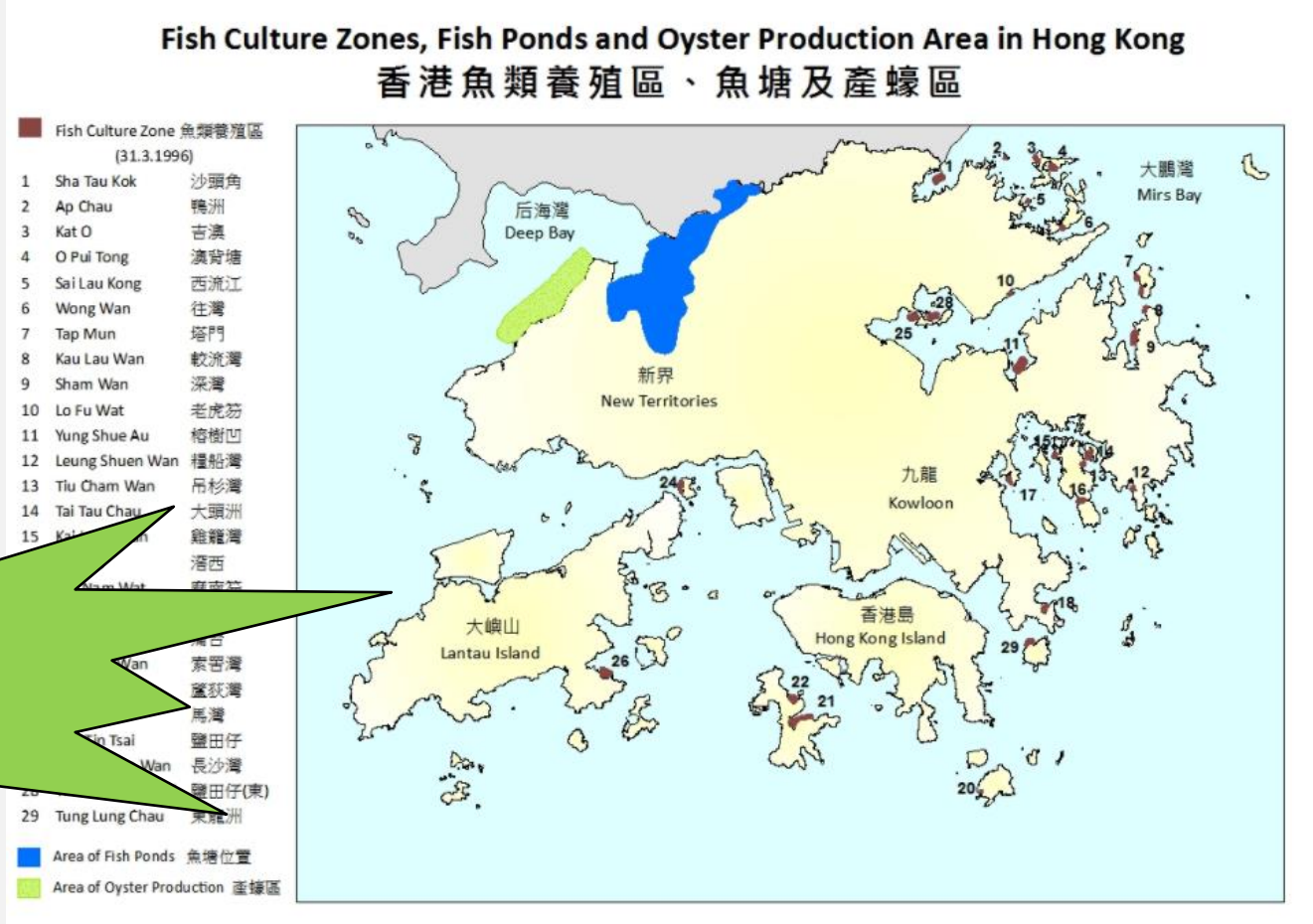
Location:

- Pak Nai (白泥) in Yuen Long
- Mudflat & Mangrove surrounded by mountain ranges
- Making up coastline as Sheung Pak Nai & Ha Pak Nai
- Rich biodiversity: Site of Special Scientific Interest (SSSI)

AFCD MAP SHOWING OYSTER FARMING

- **Hotspot for oyster reef:**
- North-West of Hong Kong
- Facing Deep Bay & Shekou (Shen Zhen)

Pak Nai Field Trip



CLUSTERING IN A REEF

Clustering:

- They live in a GROUP
- Living in a salty and brackish water on coasts
- Clustering on older shells, rock, piers, or any hard surface (**Oyster Reef**)
- Providing habitat for small crabs and fish

RICH BIODIVERSITY

Mangrove and Species Diversity

- Salinity of Pak Nai is lower than other coastal areas in HK
- Favors more species living here

RICH BIODIVERSITY

Mangrove horseshoe crab

Chinese horseshoe crab

RICH BIODIVERSITY

Mantis Shrimp

Razor clam

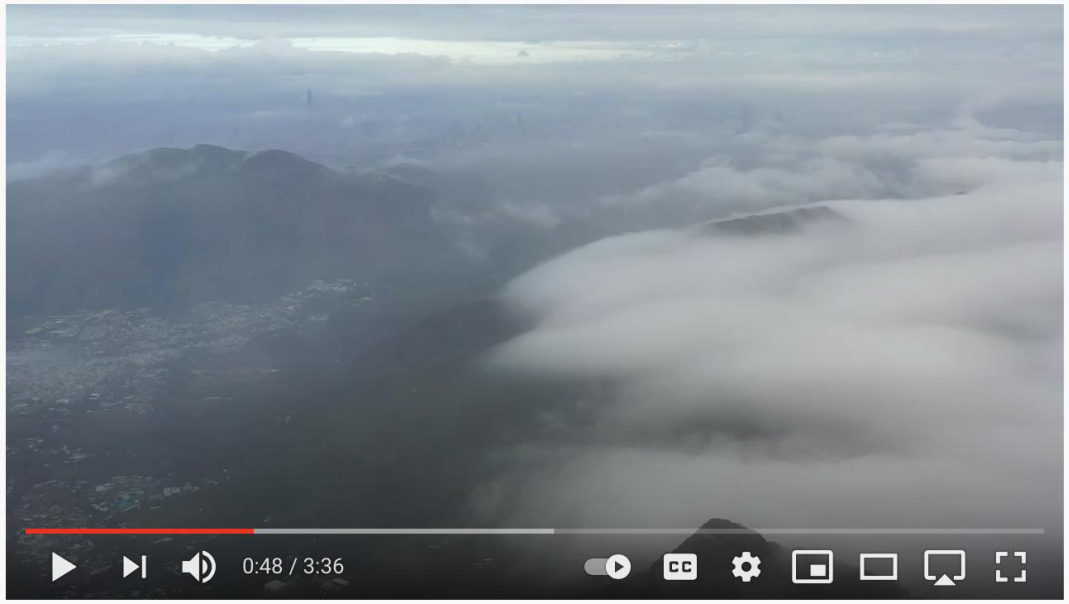
Black-faced spoonbill

THEIR HABITATS FACE CHALLENGES…

Ridge to Reef (R2R)
山海為一

Linking river basins
from land to coast

RIDGE TO REEF VIRTUAL FIELD TRIP (3 MIN)



#JockeyClubRidgetoReefEnvironmentalEducationProgramme #HKJCCharitiesTrust

Ridge to Reef Virtual Field Trip (3 min)

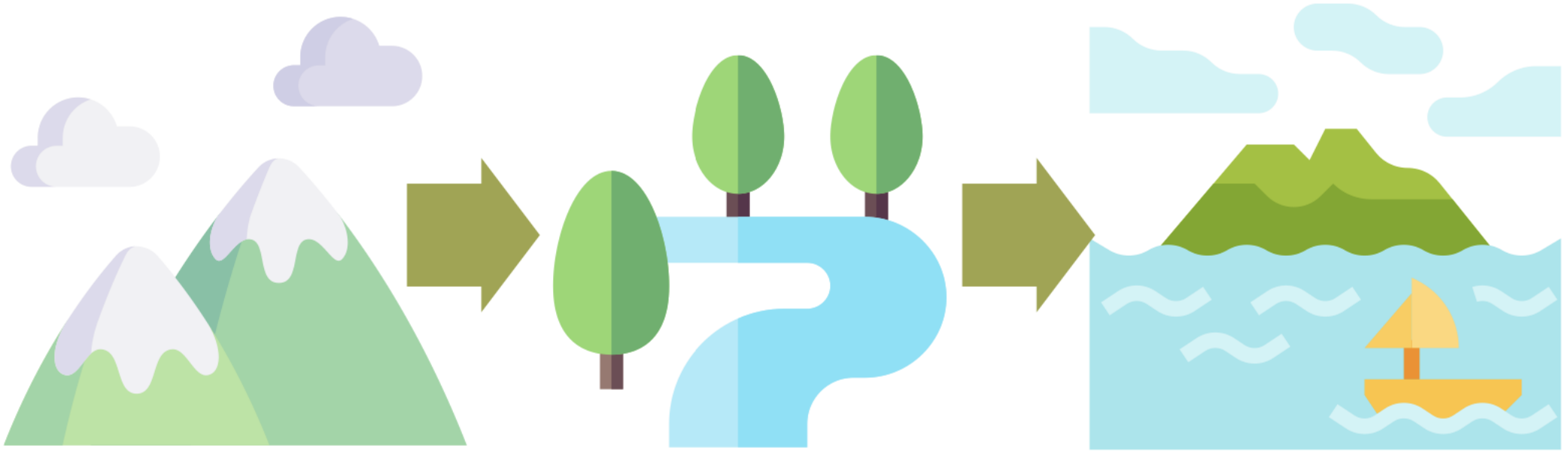
119 views • Apr 1, 2021

4 0 SHARE SAVE

TNC Hong Kong
550 subscribers

SUBSCRIBE

Can you summarize Ridge to Reef?



RIDGE TO REEF (R2R)

THEIR HABITATS FACE CHALLENGES…

- Upper-stream activities (including rivers and lands) will have an impact downstream
- Affecting wetlands, coral reefs and oyster reefs

Can you think of any human activities damaging the oyster habitats?

SHARING OF THE FLIPPED TASK

- 1. According to the video, what challenges are the oyster reefs facing?

- 2. What are the measures done, respectively, to reserve the oyster reefs and to promote the oyster farming industry?

The Nature Conservancy
大自然保護協會

ARE THE DAMAGES ON LAND NOT RELEVANT TO SEA?

Removal of trees

Hill fire

Overfishing

Urbanisation

Reclamation

Industry
Sewage

HOW DOES THESE AFFECT THE OYSTER HABITAT?

Shenzhen bay bridge

Urbanization, Reclamation →serious problem on the water quality

Removal of trees and hill fire → soil erosion and pollute water

RIDGE TO REEF (R2R)

Conservation Initiative

Proposed by International Union for Conservation of Nature (IUCN)

Promoting a better management on water resources and ecosystems

ROLE OF OYSTERS IN ECOSYSTEM

How oysters can clean up polluted water

240,278 views • Jun 23, 2019 3.7K 60 SHARE SAVE

South China Morning Post
2.34M subscribers
SUBSCRIBE

Can you recognize what the oysters are doing?

OYSTERS – NATURAL WATER CLEANERS

- Oyster filter the water for their food (eg. Phytoplankton, algae)
- Removing some sediments, toxic microscopic algae and toxins in the sea
- Acting as natural seawater filtration system

NATURAL FILTER FEEDERS

A single adult oyster can filter between 200 and 500 litres of water a day; 20 litres per hour on average

IMPORTANCE OF FILTRATION

- Remove water impurities
- Provide cleaner water for other marine organisms
- Enhance biodiversity
- Lower Incidences of red tide

RED TIDE – ALGAL BLOOM

- Due to excessive nitrogen compound (eutrophication)
- A large population of aquatic microorganisms near the coast
- Lowering oxygen content for other organisms in water → suffocation
- The algae will also release toxins to the sea

SHARING OF THE FLIPPED TASK

- What are the roles of oysters in our ecosystem?
- Which role impressed you the most?

THREE MAJOR BENEFITS OF OYSTER REEF

Improving fishery catches

- Oyster reef provides habitat for small fish and crabs
- Commercial and reactional fisheries

Coastal protection

- Buffer strong waves and reduce erosion
- Support seagrass beds

Improving water quality

- Filter 20-30L/hour of water
- Improve clarify and cleanness of water
- Reduce eutrophication

SUMMARY

- 1. Understand the characteristics and locations of oyster reef in Hong Kong

Appearance, grow as cluster

Food & Oyster Industry

Pak Nai (Wetland, Rich biodiversity)

SUMMARY

- 2. Explain the roles of oysters in ecosystem

Improve fish catches

Coastal Protection

Improve water quality

SUMMARY

- 3. Recognize the current challenges of oysters in their natural habitats (Ridge to Reef Conservation Concept)

Human activities (Reclamation, Ubranization)

Hill fire accidents

Water pollution

T/F QUESTION

Determine the statement whether they are true or false. If it is false, please correct it.

- The natural habitat of oysters is called “Oyster Farm”.
- Oysters without proper cooking are not recommended.
- Oysters can filter seawater.
- The largest oyster reef in Hong Kong is located at Ap Chau.

T/F QUESTION

Determine the statement whether they are true or false.
If it is false, please correct it.

- The natural habitat of oysters is called "Oyster Farm". F, Oyster Reef
- Oysters without proper cooking are not recommended. T
- Oysters can filter seawater. T
- The largest oyster reef in Hong Kong is located at Ap Chau. F, Pak Nai

USING IDENTIFICATION KEY TO UNDERSTAND OYSTERS

Second Lesson

賽馬會 Jockey Club
「山海為一」環境教育計劃
"Ridge to Reef" Environmental Education Programme

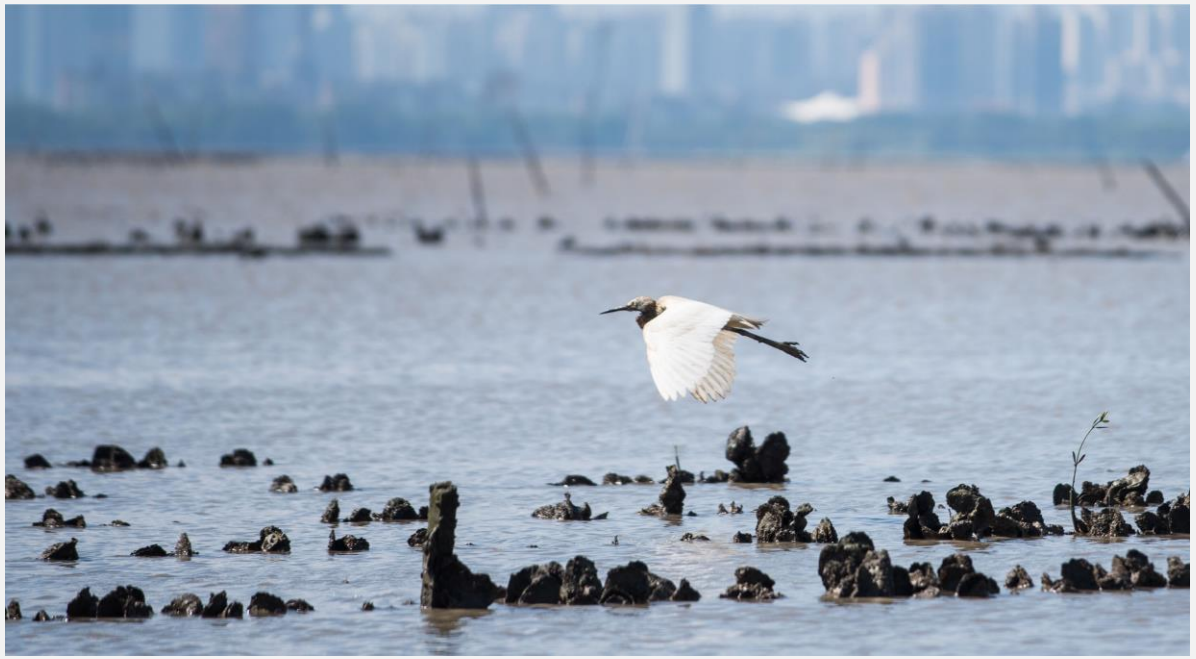
The Nature Conservancy
大自然保護協會

LESSON OBJECTIVES

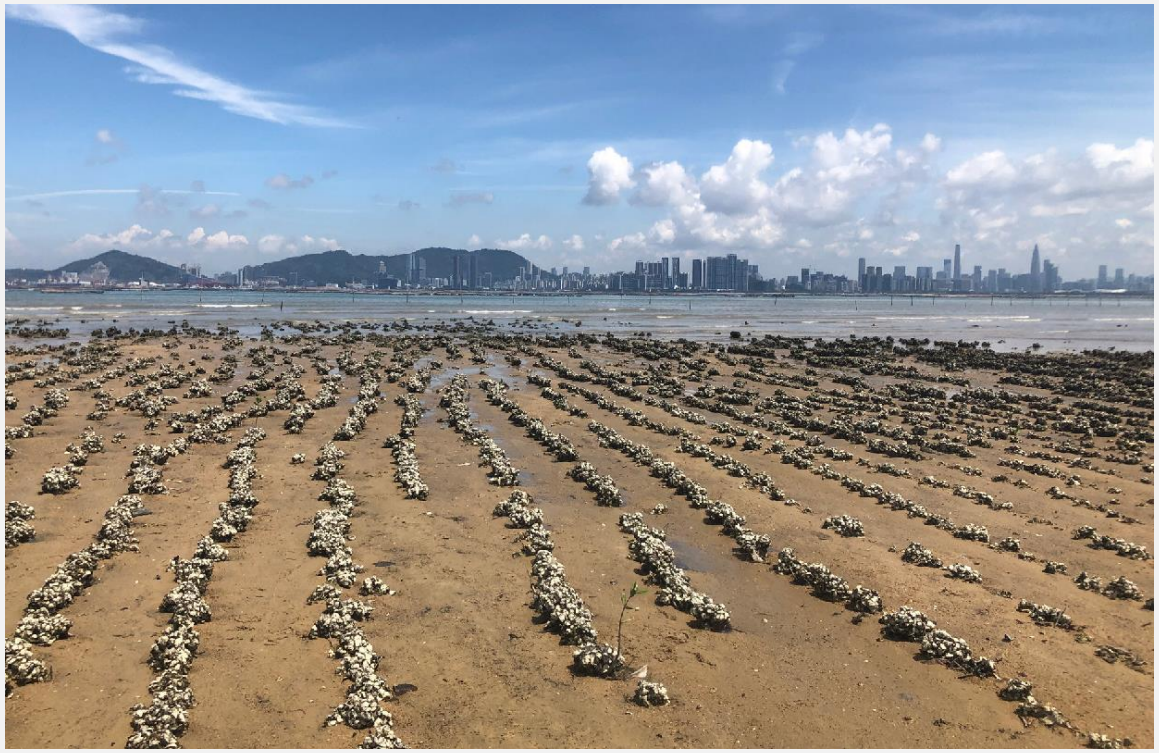
- 1. Understand the anatomy of oyster
- 2. Classify different species by their characteristics
- 3. Read and Draw identification key to classify different species

LAST LESSON

- Oyster Characteristics and locations
- Role of Oyster to ecosystems
- Ridge to Reef Conservation Concept
- Challenges of Oyster reef



DISTINCTIVE FEATURE OF OYSTERS



Filter sea water → ***improve cleaness and clarity of water***

Grown as a cluster on hard objects (along the coast)
Natural habitat: Oyster Reef

THREE MAJOR BENEFITS OF OYSTER REEF

Improving fishery catches

- Oyster reef provides habitat for small fish
- Commercial and reactional fisheries

Coastal protection

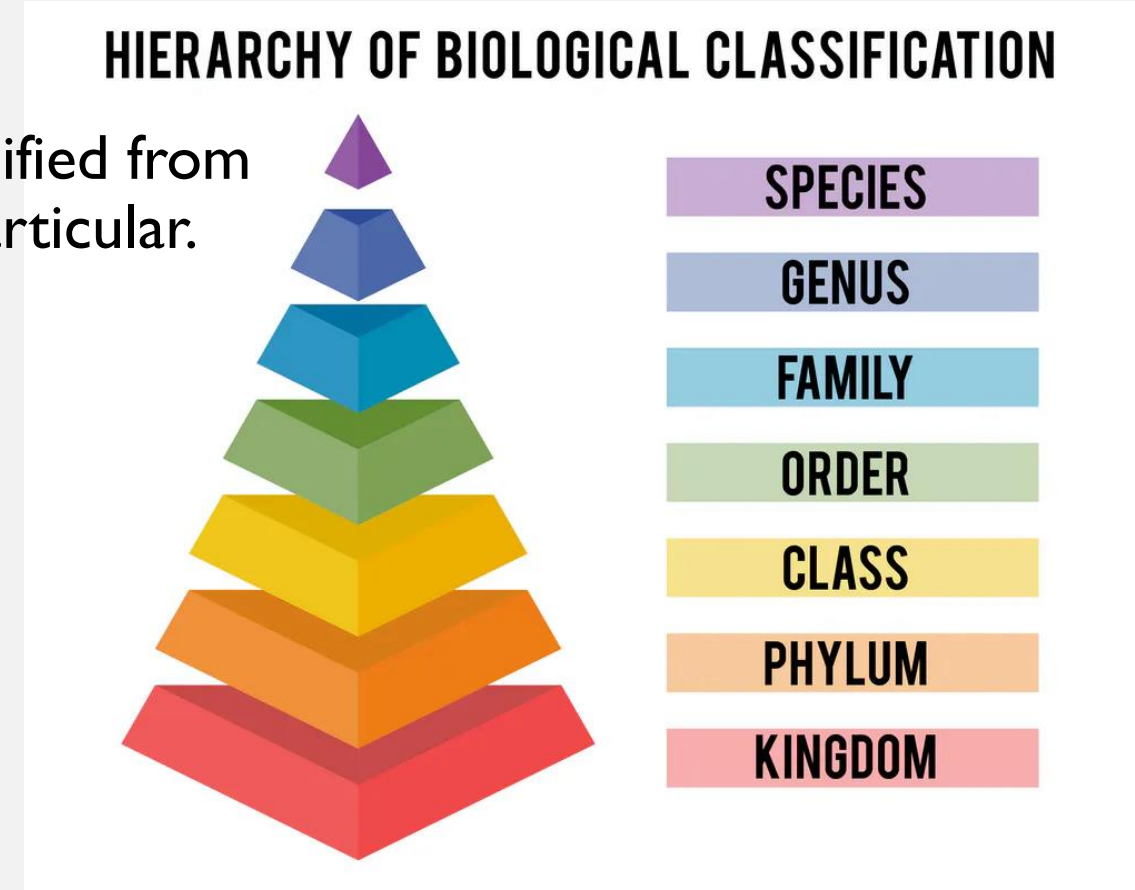
- Buffer strong waves and reduce erosion
- Support seagrass beds

Improving water quality

- Filter 20-30L/hour of water
- Improve clarify and cleanness of water
- Reduce eutrophication

BIOLOGICAL CLASSIFICATION OF OYSTERS

Animals are classified from general to the particular.



Human are called

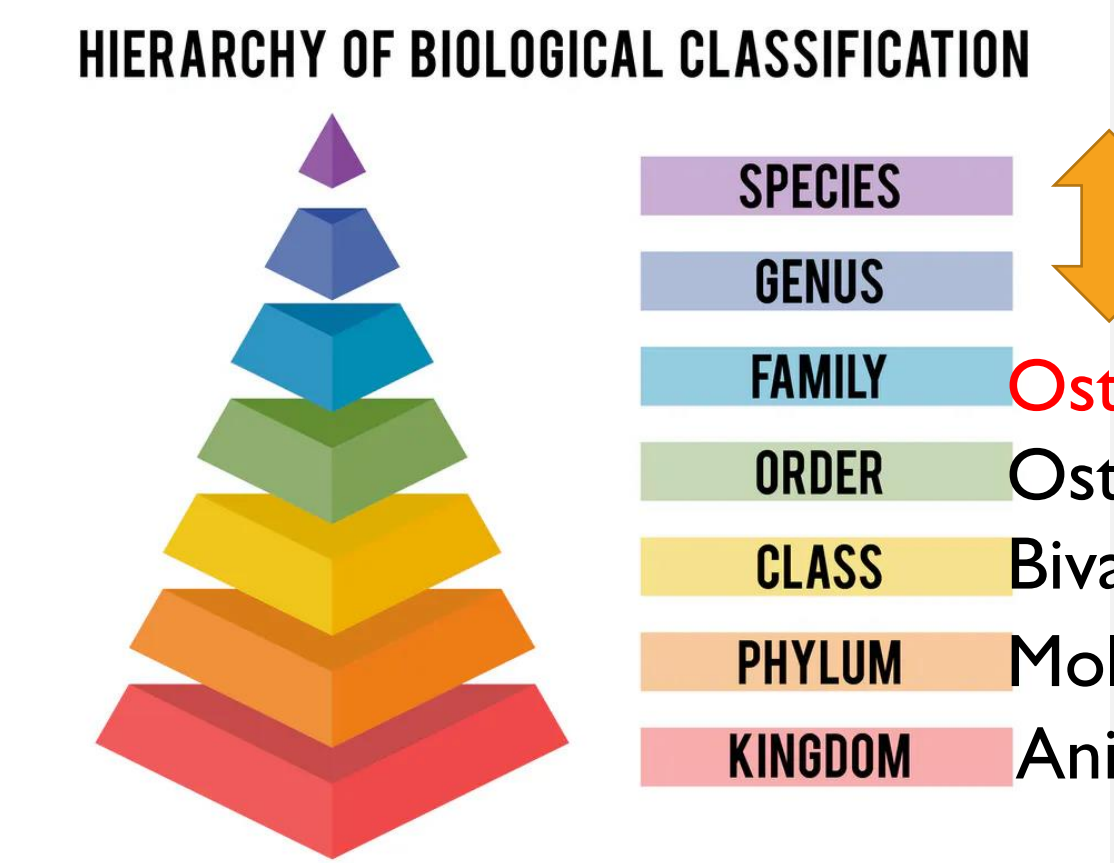
Homo sapiens

(genus name followed by species name)

INFORMATION OF OYSTERS

- Common Name: Oysters
- Scientific Name: Ostreidea (Family Name)
- Size: 3 inches to 14 inches
- Life span: Up to 20 years
- Hong Kong Oyster (Species Name):
- Crassostrea hongkonggensis

BIOLOGICAL CLASSIFICATION OF OYSTERS



Depending on specific species of oysters in different locations

Ostreidae

Ostreida

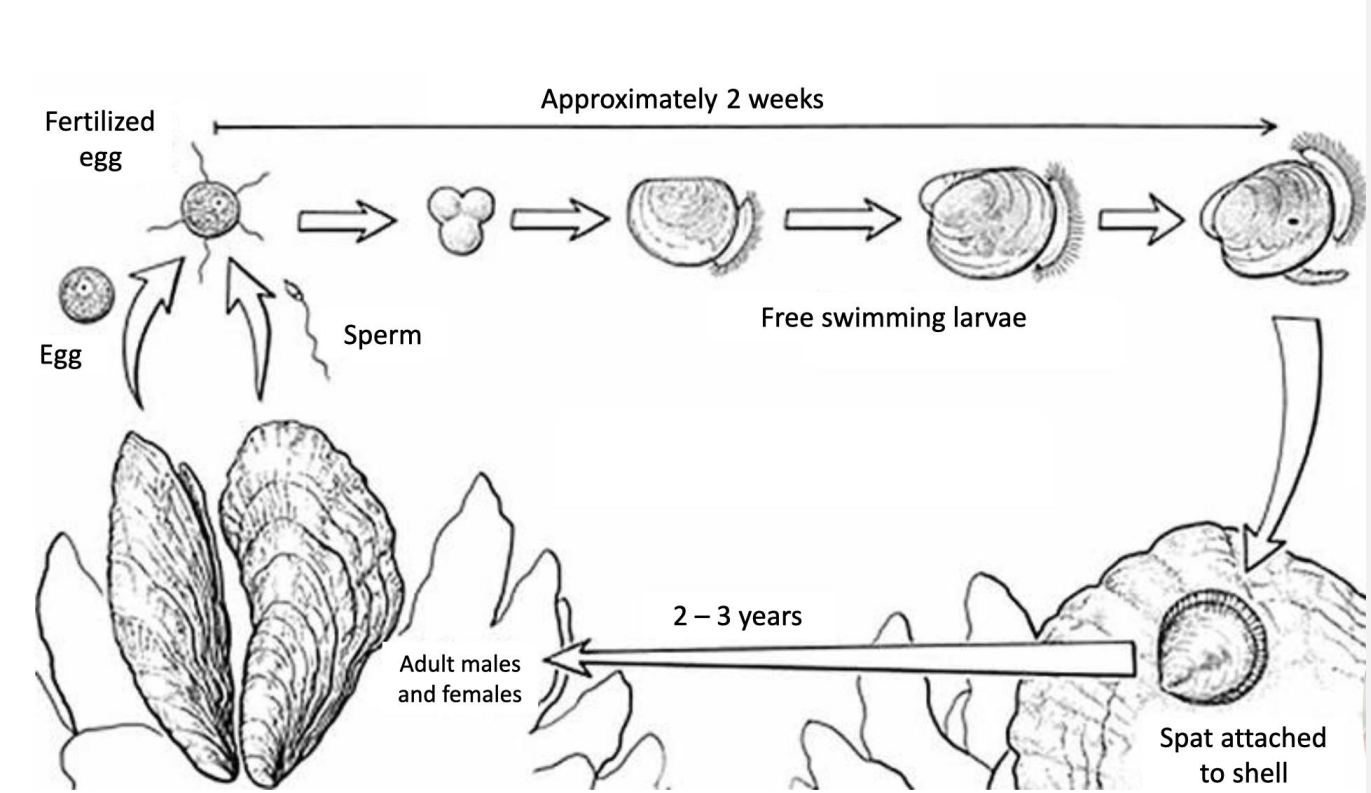
Bivalvia

Mollusca

Animalia

LIFE CYCLE OF OYSTER

- Oysters spawn tiny larvae
- Once attached on oyster shells, these larvae are called spat
- As generations of spat grow into adults, forming oyster beds or reefs.



ARE THEY REGULAR?

- A Great Variety of Size
- Irregular in Shape

Why?

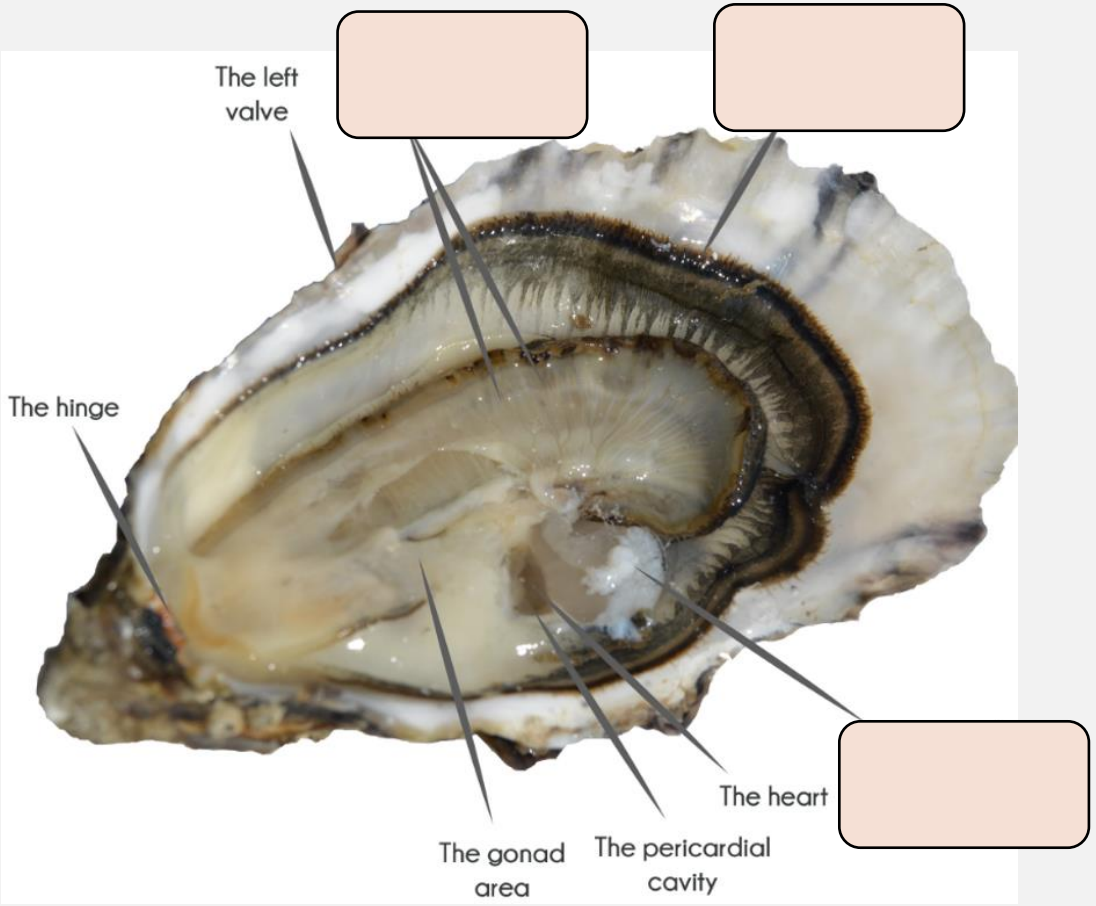
- Tend to settle in dense aggregations
- Usually overgrow each other
- Changing the shape of the shell to accommodate the crowded environment

INTERESTING FACTS OF OYSTERS

- Oysters change gender once or more in lifetime
- Once they are attached, the oysters will not move for the rest of their lives
- Predators include human, birds, sea turtles and fish.

BASIC ANATOMY OF OYSTERS

Choose the suitable words from the Worksheet



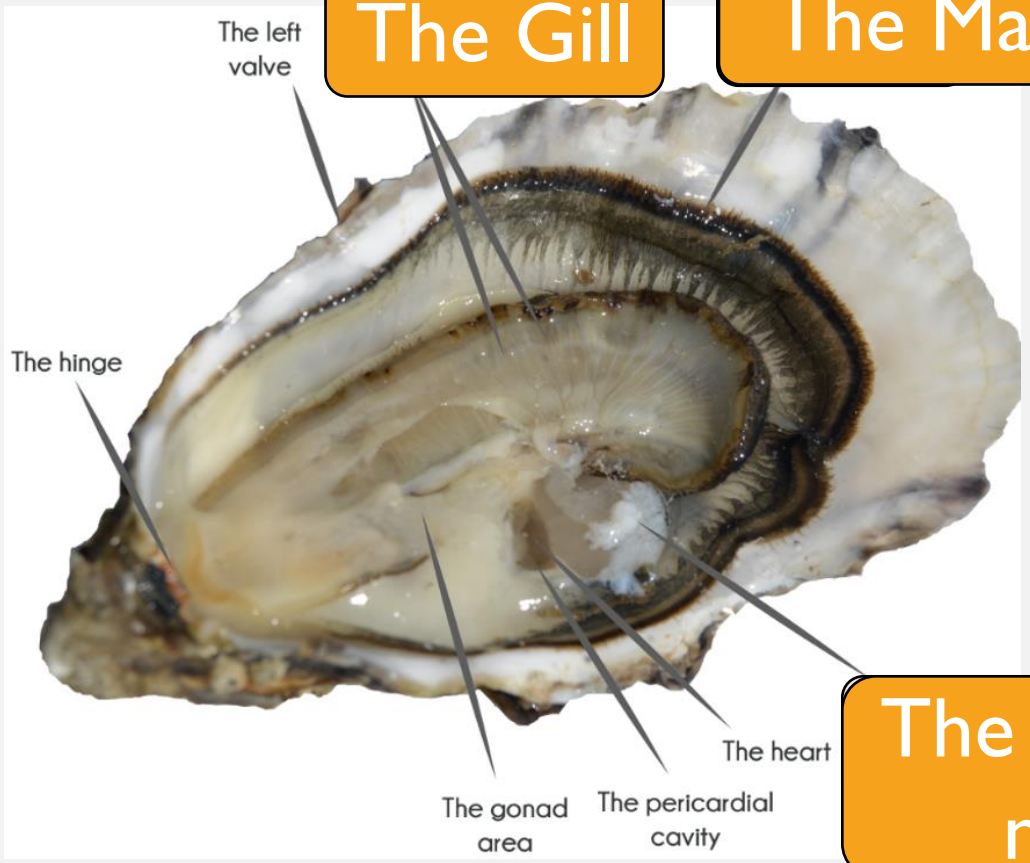
The Mantle

The Gill

The Adductor muscle

BASIC ANATOMY OF OYSTERS

Hinge:
Joining two valves together



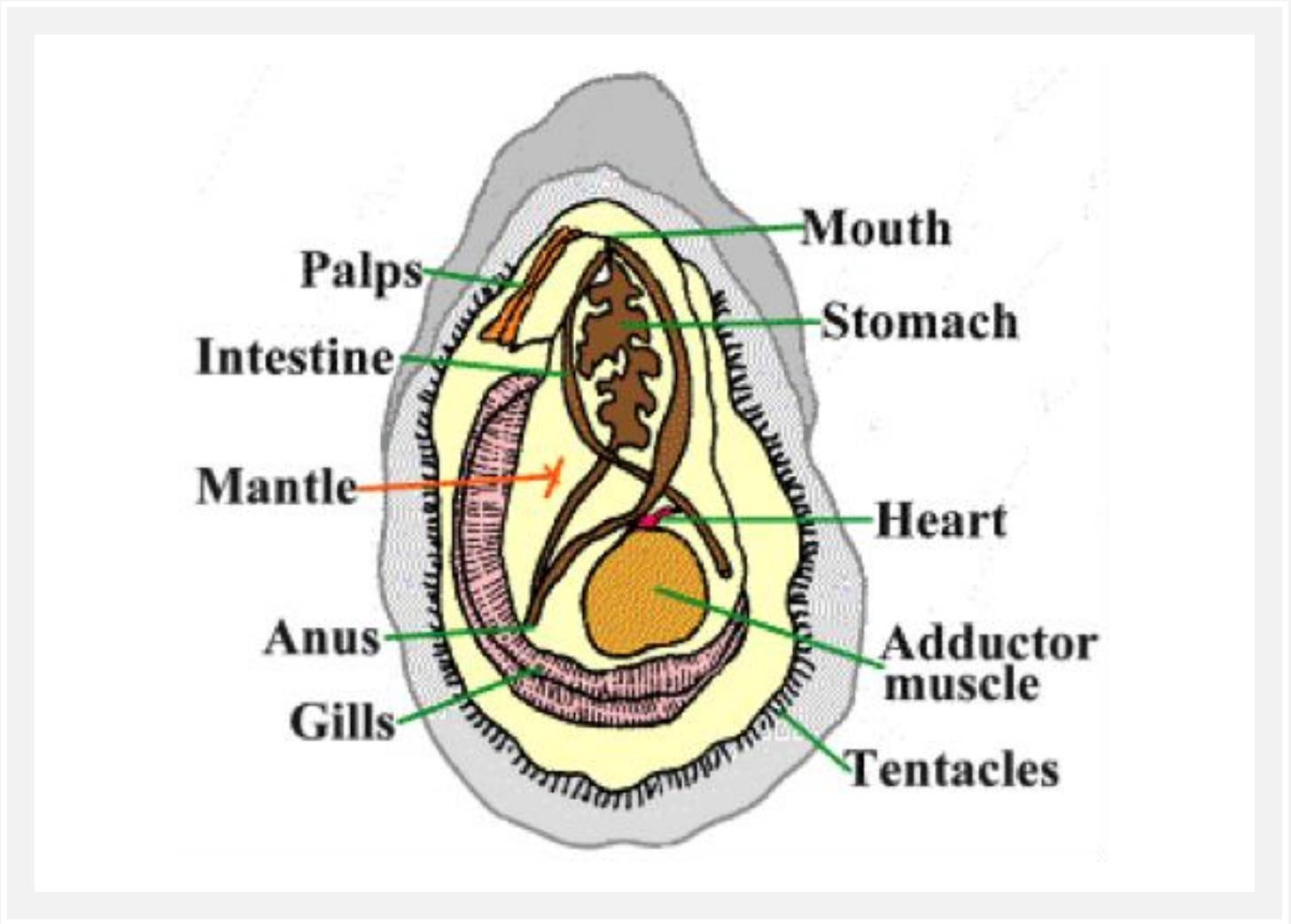
The Gill

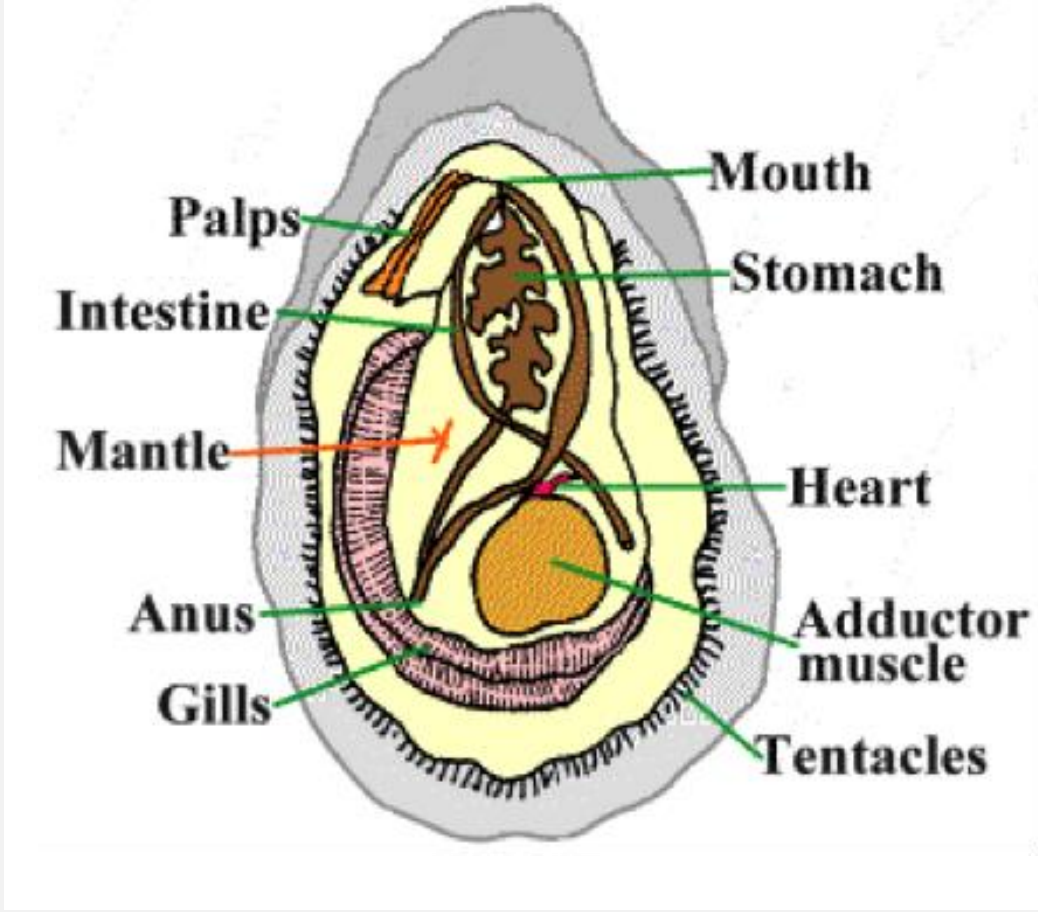
The Mantle

The Adductor muscle

THE ADDUCTOR MUSCLE

- They have extremely strong adductor muscles to close their shells when threatened.

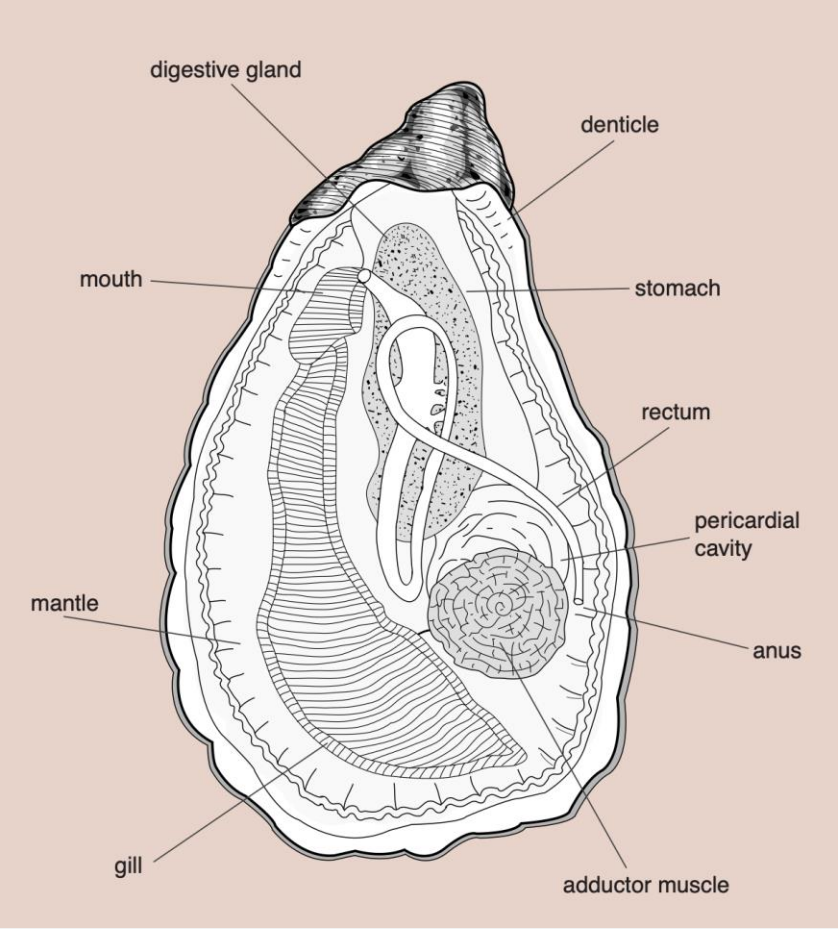




FEEDING

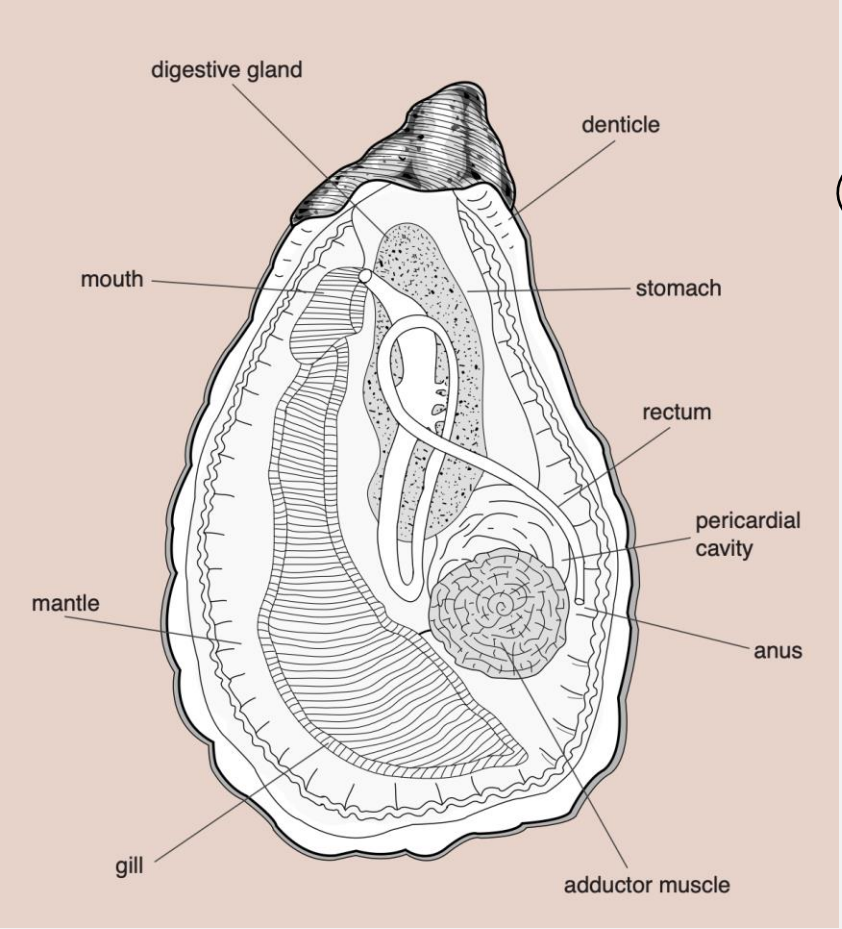
- Feed by extracting algae and other food particles from the water they are almost constantly drawing over their gills
- Natural filter feeders

BASIC ANATOMY OF OYSTER… LIKE HUMAN



Which organs can also be found in human ?

BASIC ANATOMY OF OYSTER… LIKE HUMAN



Which place for removing the waste from the body ?

Which place for releasing substances to digest food?

TWO BIG CLASS OF ANIMALS

EVOLUTIONARY RELATIONSHIP

- Oysters are closely related to **scallops, clams and mussels**
- Share similar characteristics with them

SHELLFISH (GROUP TASK)

Razor clams

Blue Mussels

Pacific littlenecks

Geoduck

Rock Scallops

American Oysters

GROUP TASK

What are their *similarities* in these shellfish?

- Suggest at least three similarities of these species.

What are the *differences* among their body features? How can you distinguish them?

- Suggest at least three ways to classify these species.

SIMILARITIES

- Do not have backbones
- Hard shells
- Soft-bodied features
- Interior of the shells is mostly white
- Living in salt water
- Mostly brown or gray colour
- The habits are usually some mud, rock or hard surface

…

CLASSIFY THEM

- Size
- Shell shape
- External features
- Colours
- Habitat locations
- …

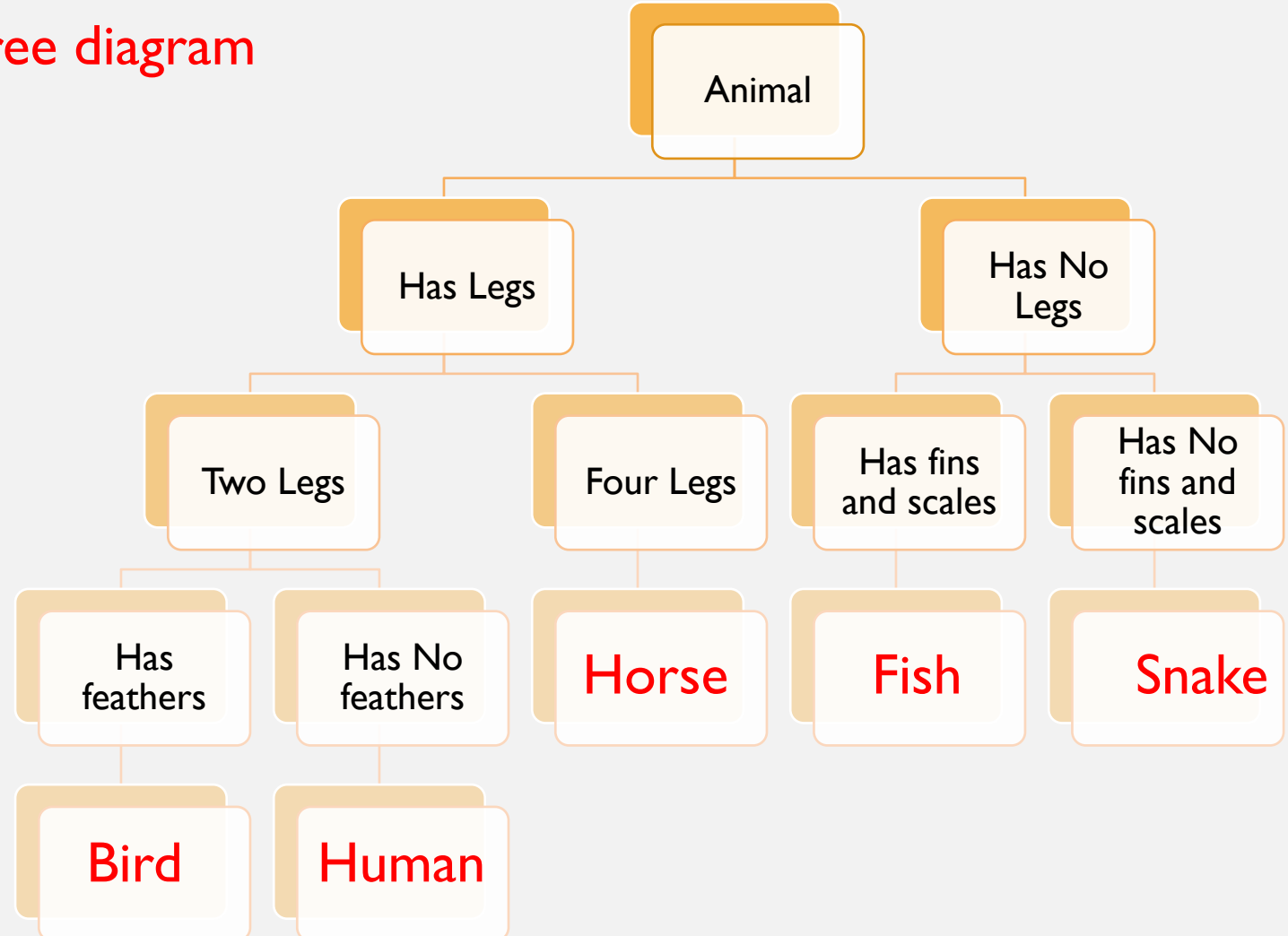
IDENTIFICATION KEY

- Rich biodiversity on Earth
- Require an organized classification on species

- Function:
- 1. Use the key to identify the unknown species
- 2. Classify and identify the similar species with distinctive characteristics

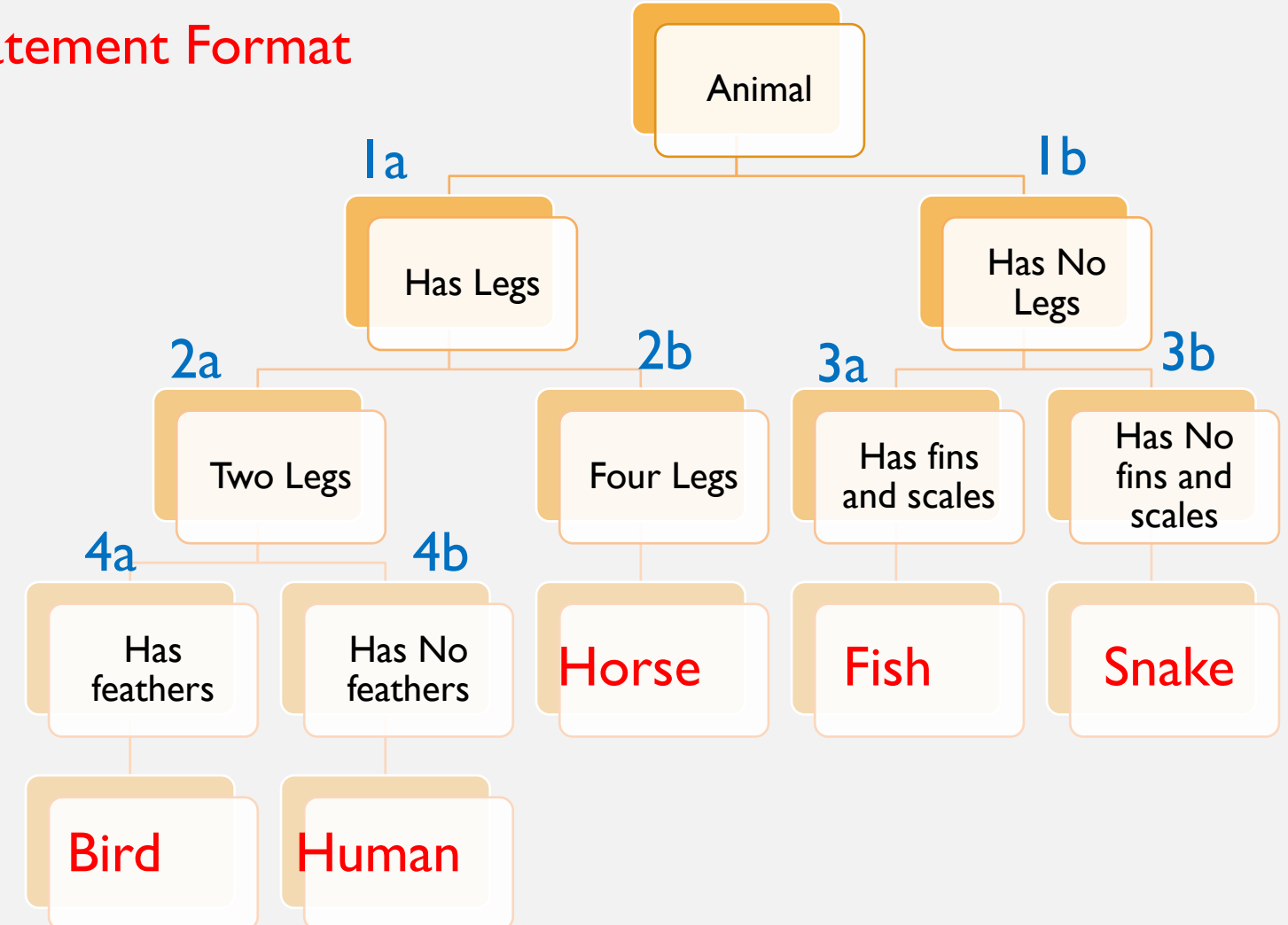
TWO FORMATS OF IDENTIFICATION KEY

- For example, there are fish, snake, human, horse, and bird
- Tree diagram



TWO FORMATS OF IDENTIFICATION KEY

- For example, there are fish, snake, human, horse, and bird
- Statement Format



TWO FORMATS OF IDENTIFICATION KEY

- For example, there are fish, snake, human, horse, and bird
- Statement Format

1 a Has legs …… 2
b Has no legs ……3
2 a Has two legs ……..4
b Has four legs…… Horse
3 a Has fins and scales ……..… Fish
b Has no fins and scales ……. Snake
4 a Has feathers……...Brid
b Has no feathers……..…Human

GROUP TASK-DRAW IDENTIFICATION KEY

	Fish	Amphibians	Reptiles	Birds	Mammals	Mollusca	Arthropods
Moist Skin							
Has feathers							
Has gills in adult							
Has backbone							
Has mammary glands							
Soft-bodied with shells							
Jointed legs with exoskeleton							
Example(s)						Oysters, snails, scallops	Spiders, ants, lobsters

1. Put a tick in the box if the animals have that features

GROUP TASK-DRAW IDENTIFICATION KEY

	Fish	Amphibians	Reptiles	Birds	Mammals	Mollusca	Arthropods
Moist Skin		✓					
Has feathers				✓			
Has gills in adult	✓						
Has backbone	✓	✓	✓	✓	✓		
Has mammary glands					✓		
Soft-bodied with shells						✓	
Jointed legs with exoskeleton							✓
Example(s)	Groupers, goldfish	Frog, Salamanders	Snake, Lizard, Turtles	Parrots, Owls	Dolphins, Human, dogs	Oysters, snails, scallops	Spiders, ants, lobsters

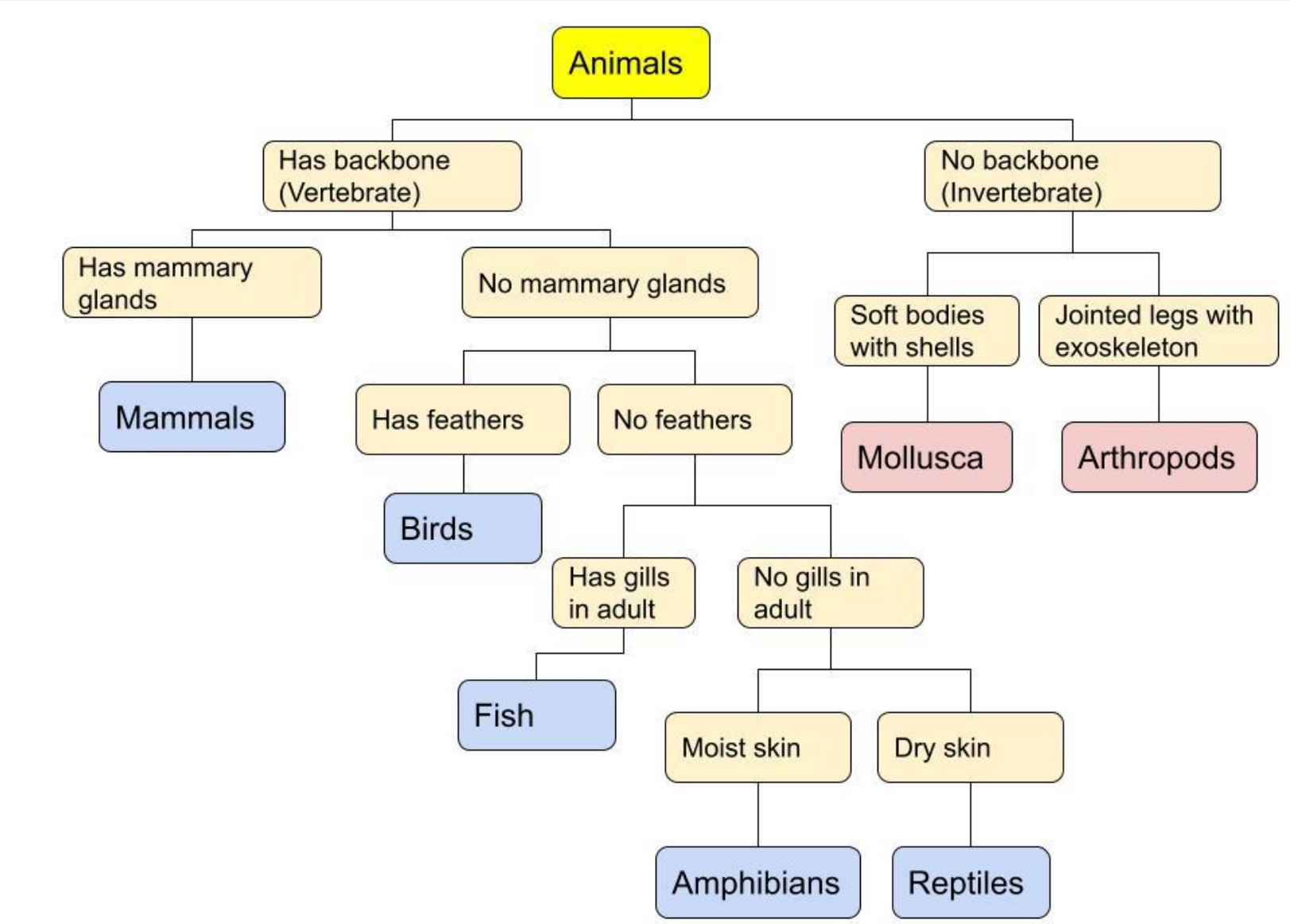
GROUP TASK-DRAW IDENTIFICATION KEY

	Fish	Amphibians	Reptiles	Birds	Mammals	Mollusca	Arthropods
Moist Skin		✓					
Has feathers				✓			
Has gills in adult	✓						
Has backbone	✓	✓	✓				
Has mammary glands							
Soft-bodied with shells							
Jointed legs with exoskeleton							✓
Example(s)	Groupers, goldfish	Frog, Salamanders	Snake, Lizard, Turtles	Parrots, Owls	Dolphins, Human, dogs	Oysters, snails, scallops	Spiders, ants, lobsters

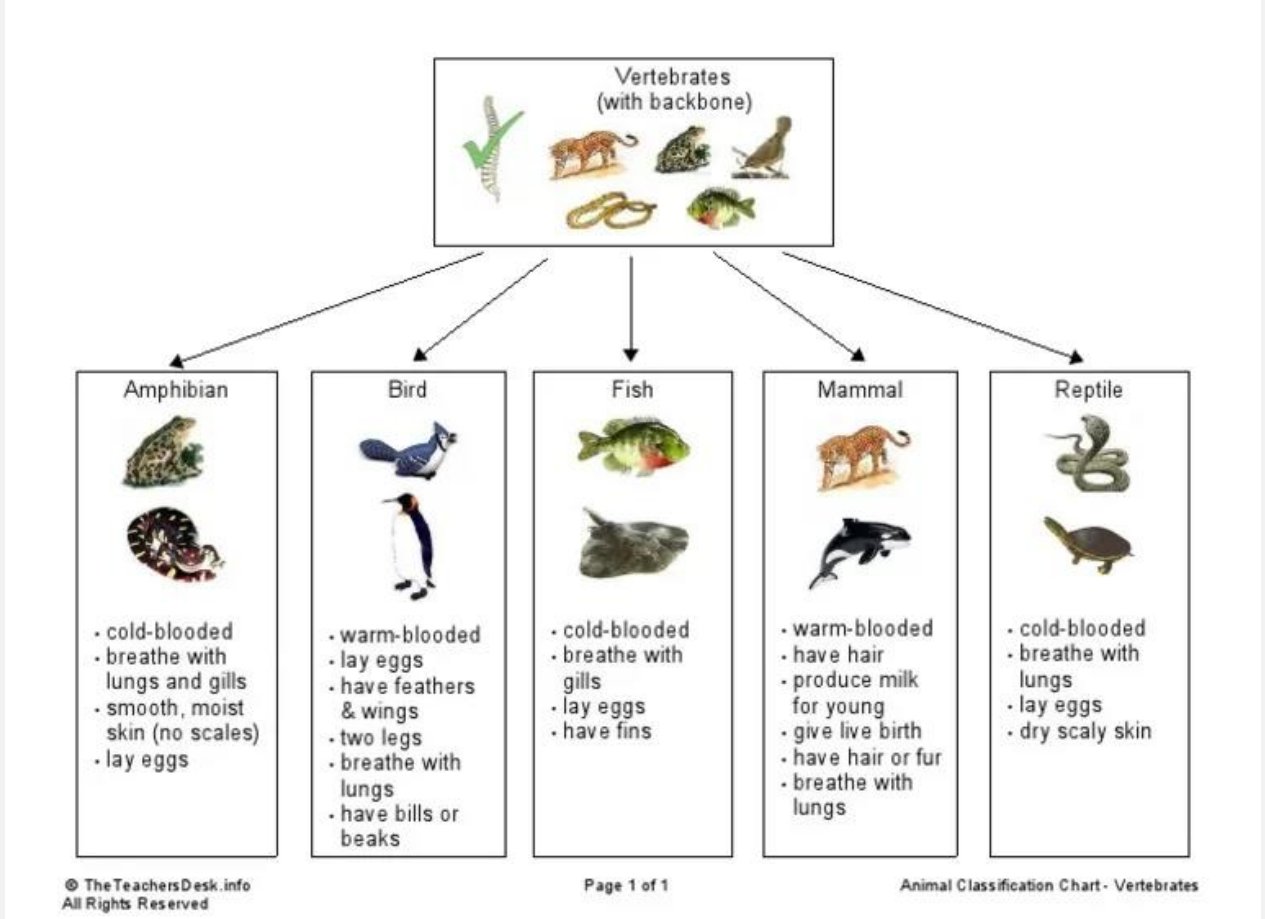
2. Discuss and draw an identification key with your classmates (in the form of tree diagram).

_____ MINUTES

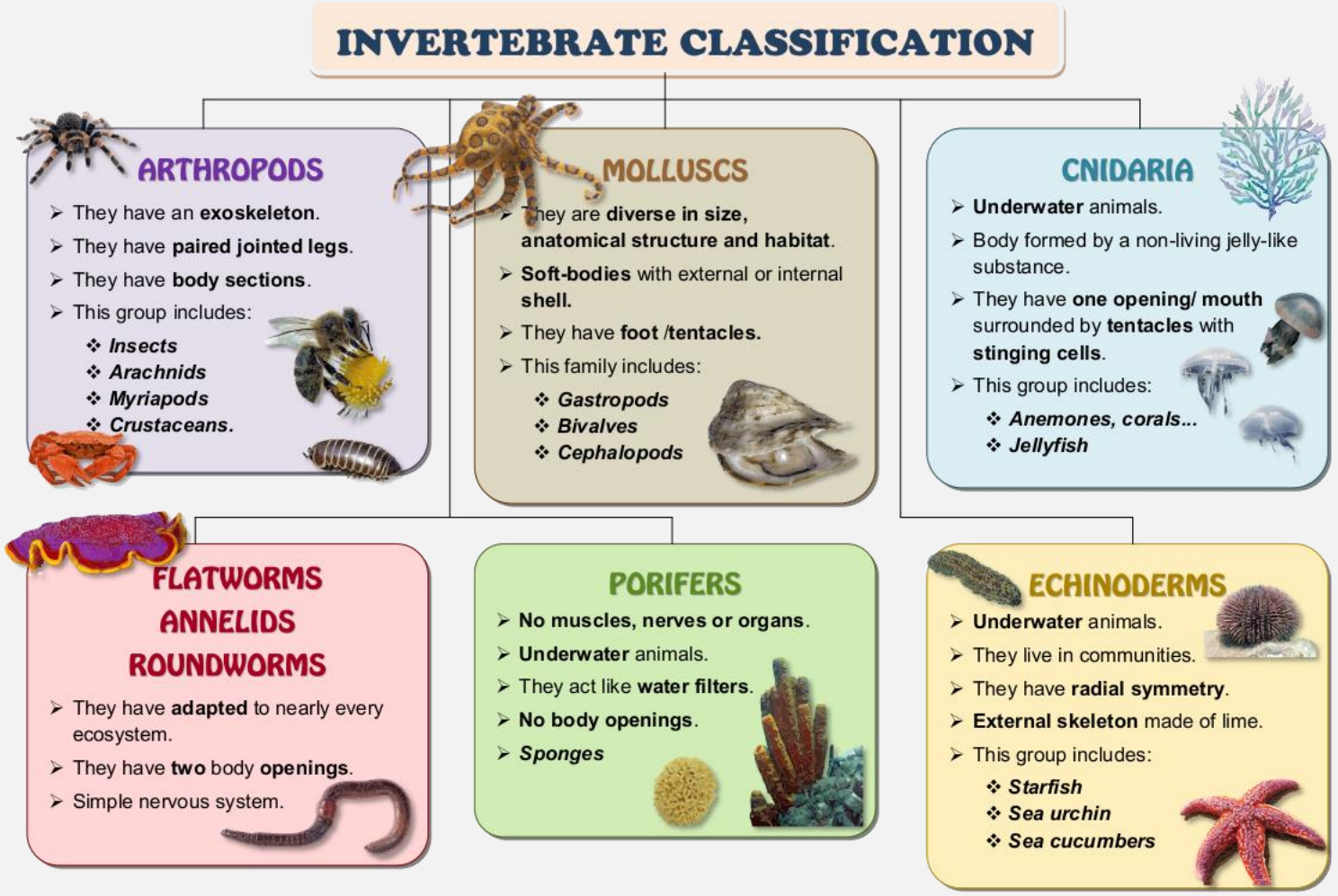
CLASSIFICATION KEY



VERTEBRATES (BACKUP)



INVERTEBRATES (BACKUP)



ACCORDING TO THE CHART, WHICH TYPE OF ANIMALS?

- Flat ears
- Living in savannas
- Breathe with lungs
- Has fur
- Has mammary glands

Mammals

ACCORDING TO THE CHART, WHICH TYPE OF ANIMALS?

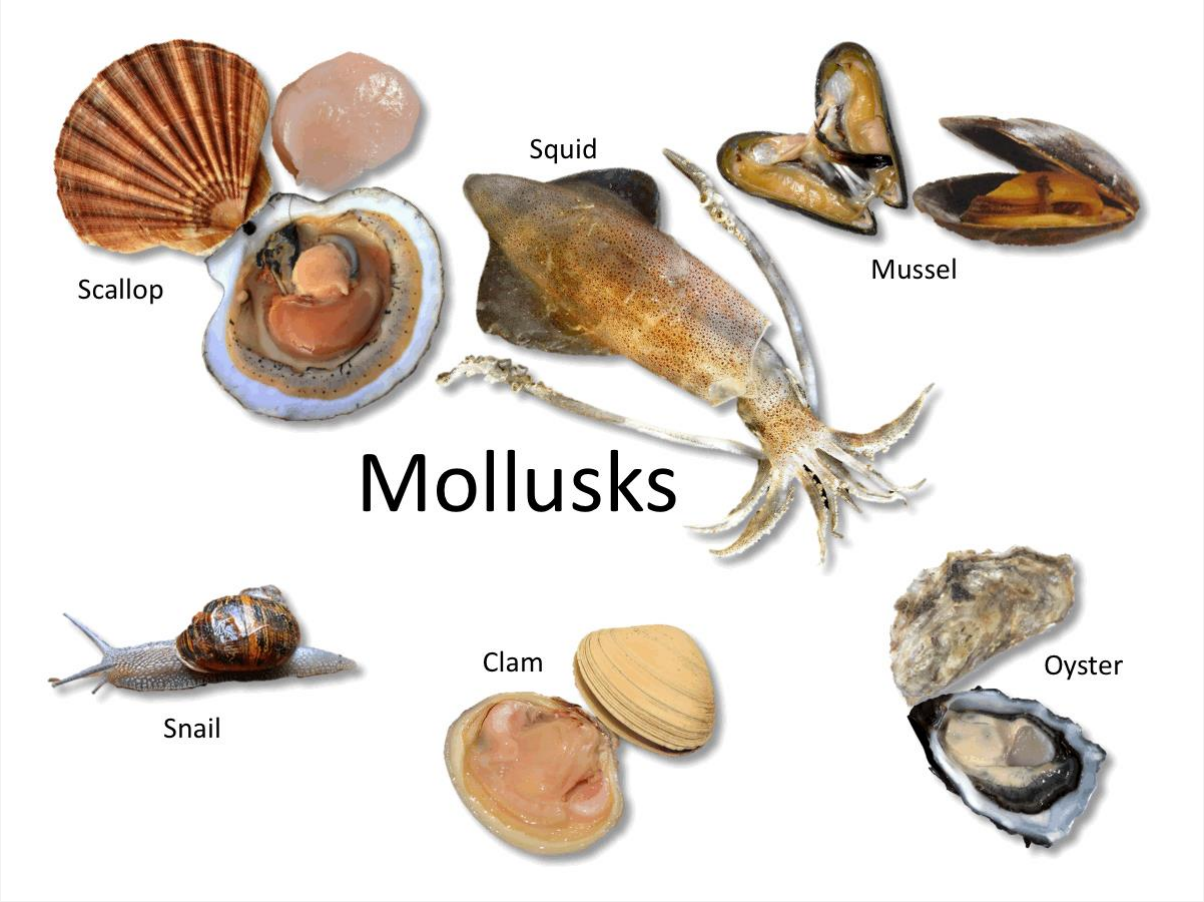
Mammals

Birds

ACCORDING TO THE CHART, WHICH TYPE OF ANIMALS?

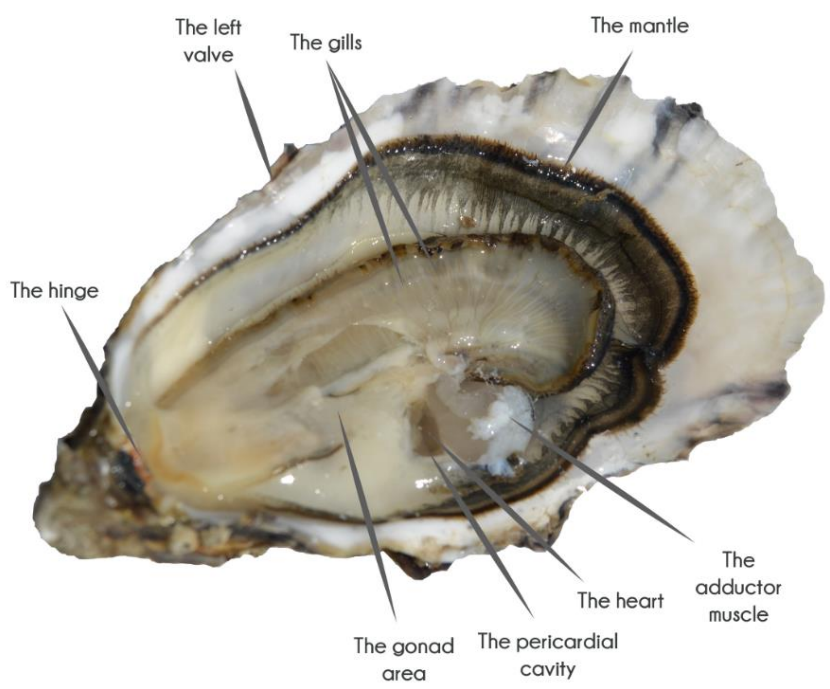
Mollusca

MOLLUSKS



CONCLUSION

- 1. Understand the anatomy of oyster



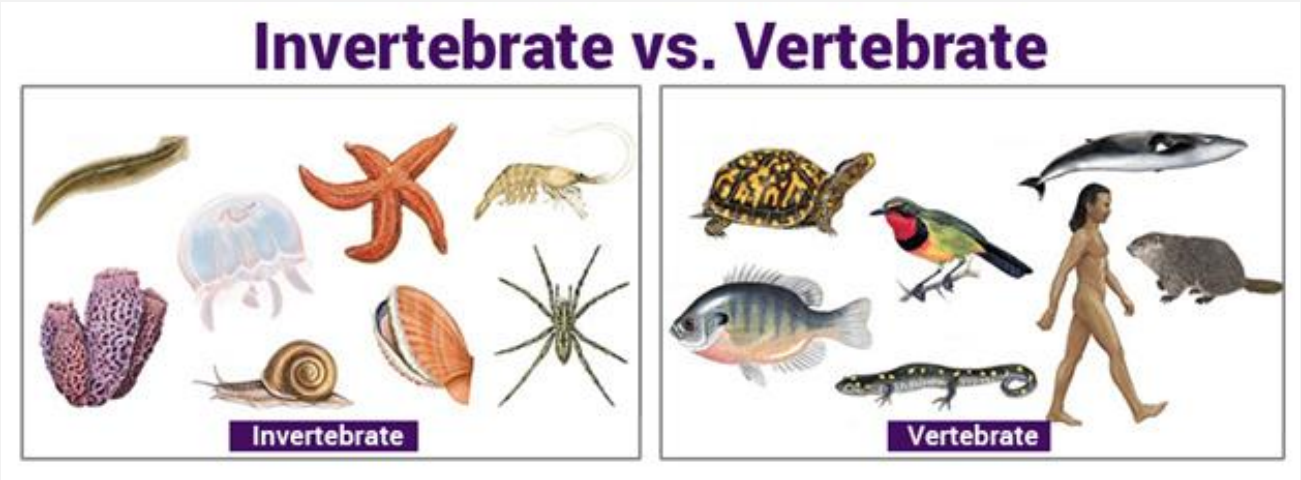
Hinge, adductor muscles, mantle, gills

Irregular shell shape
Change gender

CONCLUSION

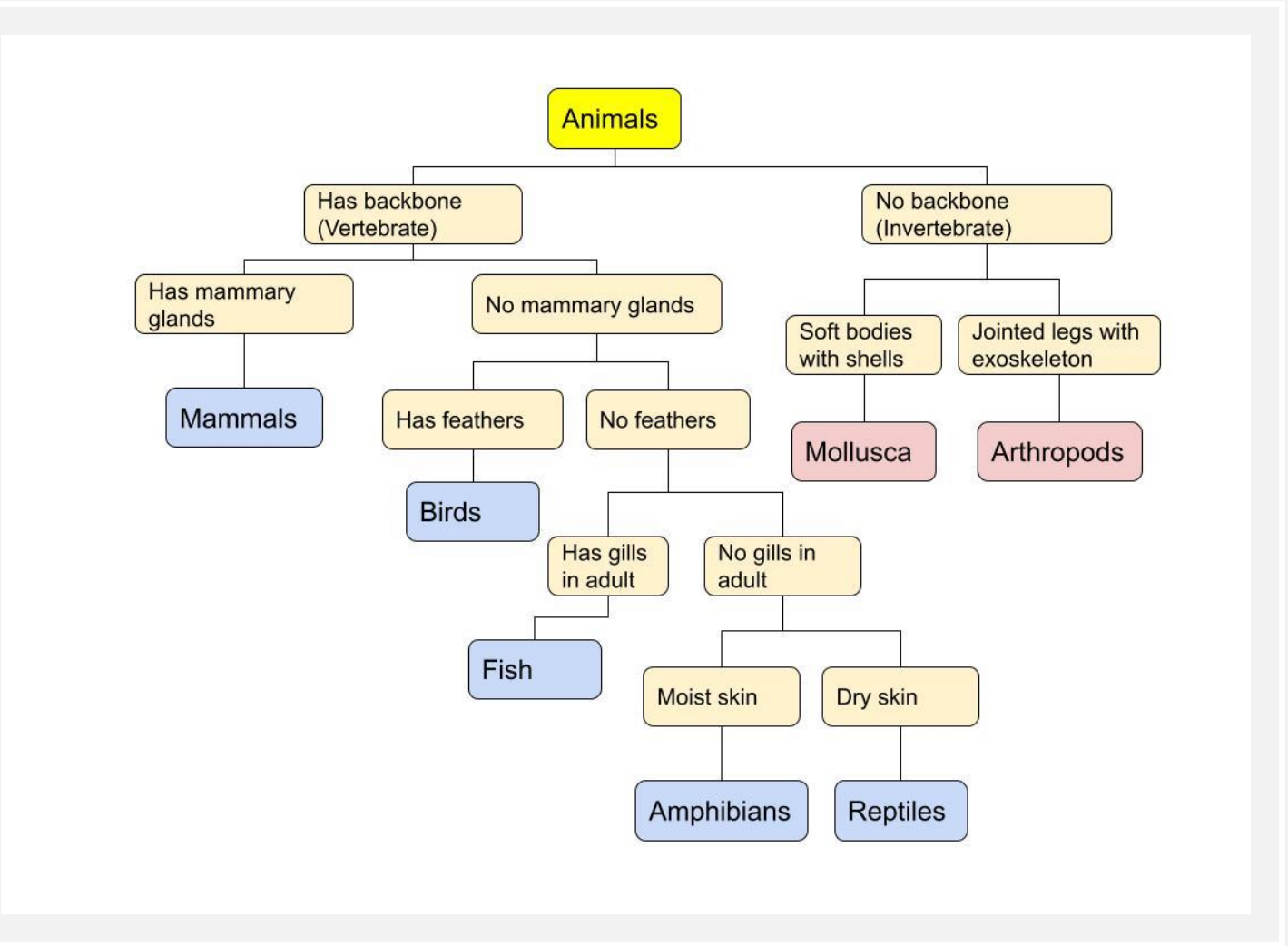
2. Classify different species by their characteristics

- **Body features, colours…**



CONCLUSION

- To identify and classify the species…
- Read and Draw identification key to classify different species



T/F QUESTION

Determine the statement whether they are true or false. If it is false, please correct it.

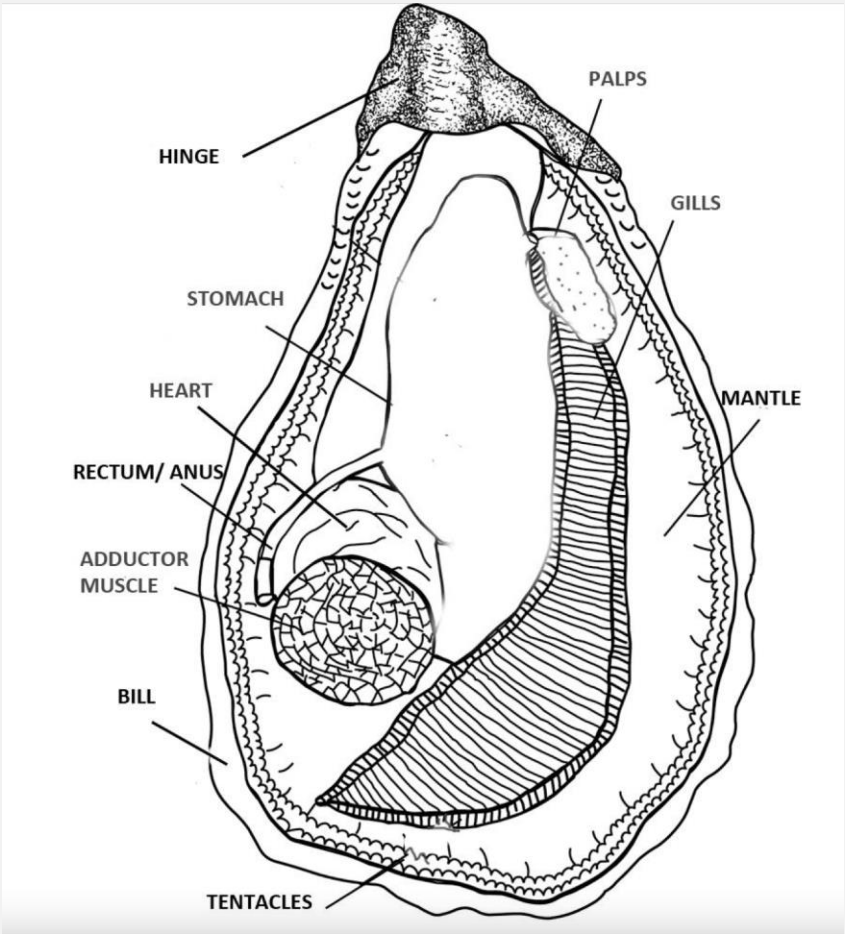
1. Oyster’s gender changes over time.
2. Hong Kong does not have its own oyster species.
3. Oysters can be classified as animal.
4. Oyster is vertebrate.
5. The size of oyster depends on the depth of its shell.

T/F QUESTION

Determine the statement whether they are true or false. If it is false, please correct it.

1. Oyster's gender changes over time. T
2. An oyster species is named by Hong Kong. F, Crassostrea hongkonggensis
3. Oysters can be classified as animal. T
4. Oyster is vertebrate. F, invertebrate
5. The size of oyster depends on the depth of its shell. T

BACKUP


PALPS
HINGE
GILLS
STOMACH
HEART
MANTLE
RECTUM/ ANUS
ADDUCTOR
MUSCLE
BILL
TENTACLES

OYSTER AND SUSTAINABLE DEVELOPMENT

Third Lesson

賽馬會 Jockey Club
「山海為一」環境教育計劃
"Ridge to Reef" Environmental Education Programme

The Nature Conservancy
大自然保護協會

LESSON OBJECTIVES

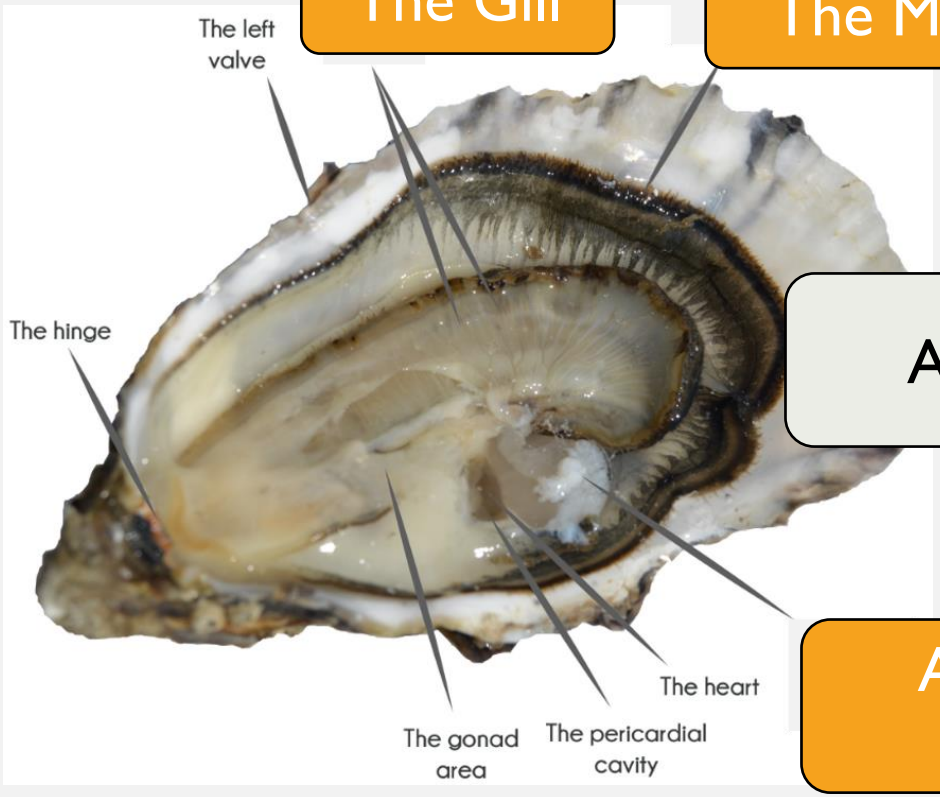
- 1. Understand the relationship of sustainable development and importance oyster reef
- 2. Give examples of ridge to reef concept and the ways to conserve the marine environment (oyster restoration)
- 2. Pre-trip Briefing and preparation work

LAST LESSON

Irregular shell shape
Change gender

The Gill

The Mantle



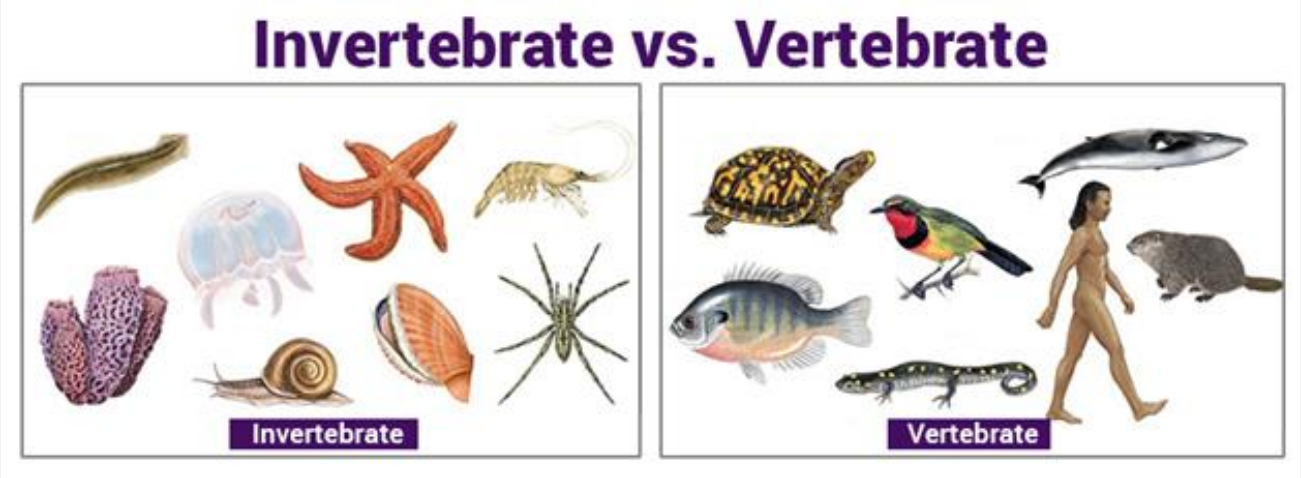
Anatomy

Adductor muscle

LAST LESSON

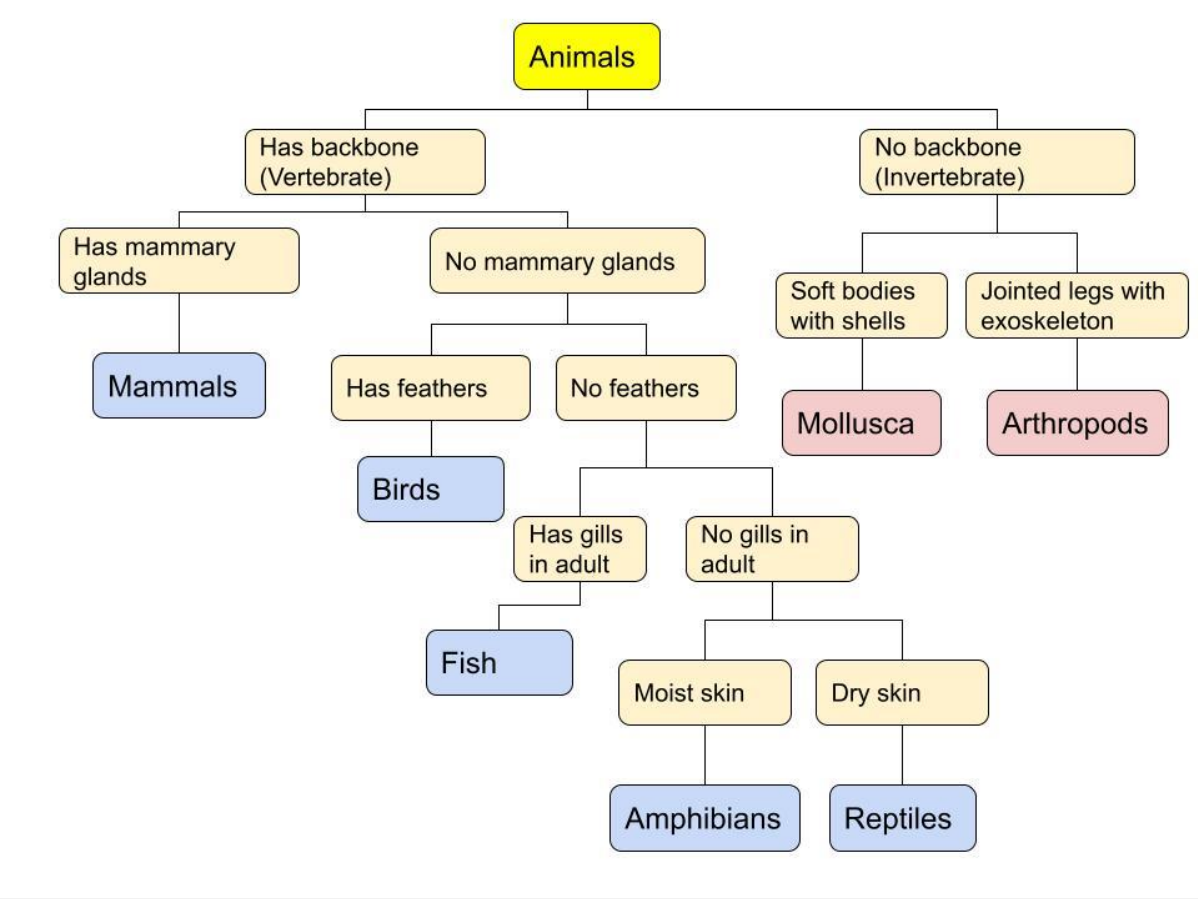
Classify different species by their characteristics

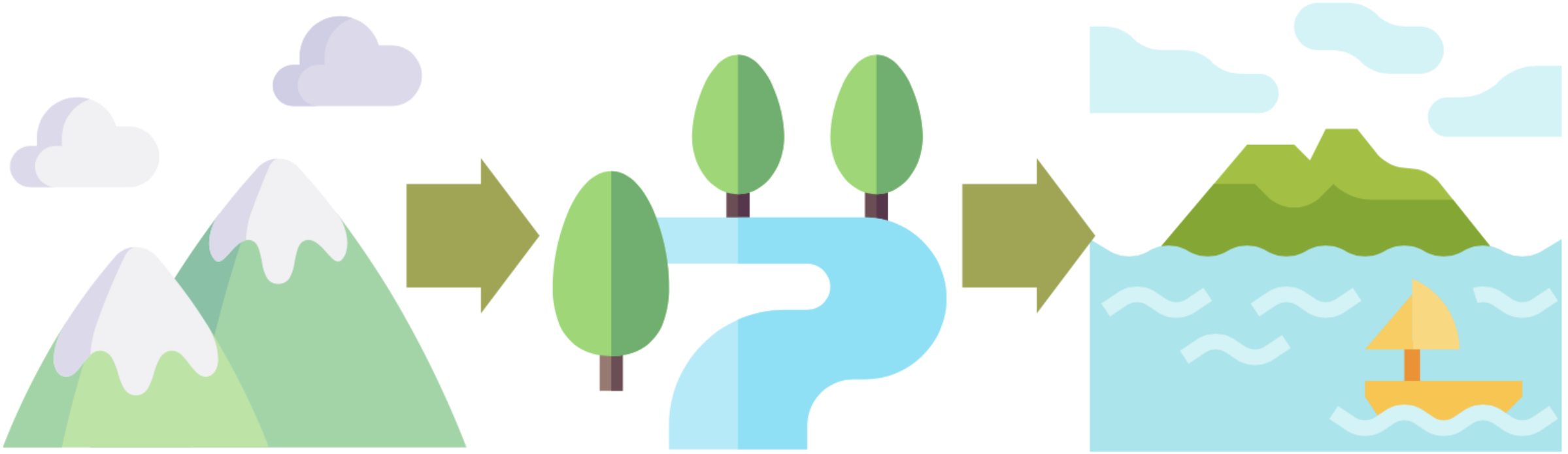
- **Body features, colours…**
- **Oyster: Mollusca (soft-bodies with shells)**



IDENTIFICATION KEY

- Scientific and organization way of classification





RIDGE TO REEF

- Through **rivers and streams**, everything that happens on **land** (e.g., sewage and litter) will have an impact downstream, including **intertidal habitats** and eventually, **the sea**. The ocean and intertidal wetlands are ecosystems with rich biodiversity, so healthy and clean rivers and streams are crucial to maintaining healthy estuaries, coastal areas, wetlands**, coral reefs and oyster reefs**.

CAN YOU THINK OF ANY EXAMPLES/ HUMAN ACTIVITIES TO SHOW RIDGE TO REEF CONCEPT?

ARE THE DAMAGES ON LAND NOT RELEVANT TO SEA?

Removal of trees

Hill fire

Overfishing

Urbanisation

Reclamation

Industry
Sewage

ANY DAILY EXAMPLES OF RIDGE TO REEF ? - SEDIMENT

Hill
- Castle Peak

Problem
- Removal of vegetation
- Soil erosion

Sea
- Sediment goes to the sea
- (eg. Deep Bay)

R2R
- Affecting the water quality
- Lowering biodiversity

ANY DAILY EXAMPLES OF RIDGE TO REEF ? - SOIL

Land
- Nam Sang Wai

Problem
- Hill fire (Human and natural causes)

Sea
- Polluted soil goes to the sea
- (eg. Deep Bay)

R2R
- Affecting the water quality
- Lowering biodiversity

ANY DAILY EXAMPLES OF RIDGE TO REEF ? – SEWAGE, WATER POLLUTION

Land
- City urbanization, reclamation
- City industry, transportation

Problem
- Illegal discharge of sewage
- Dumping of wastes to rivers

Sea
- Polluted water goes to the sea
- (eg. Deep Bay)

R2R
- Affecting the water quality
- Affecting marine ecosystem

ANY DAILY EXAMPLES OF RIDGE TO REEF ? – AIR POLLUTION

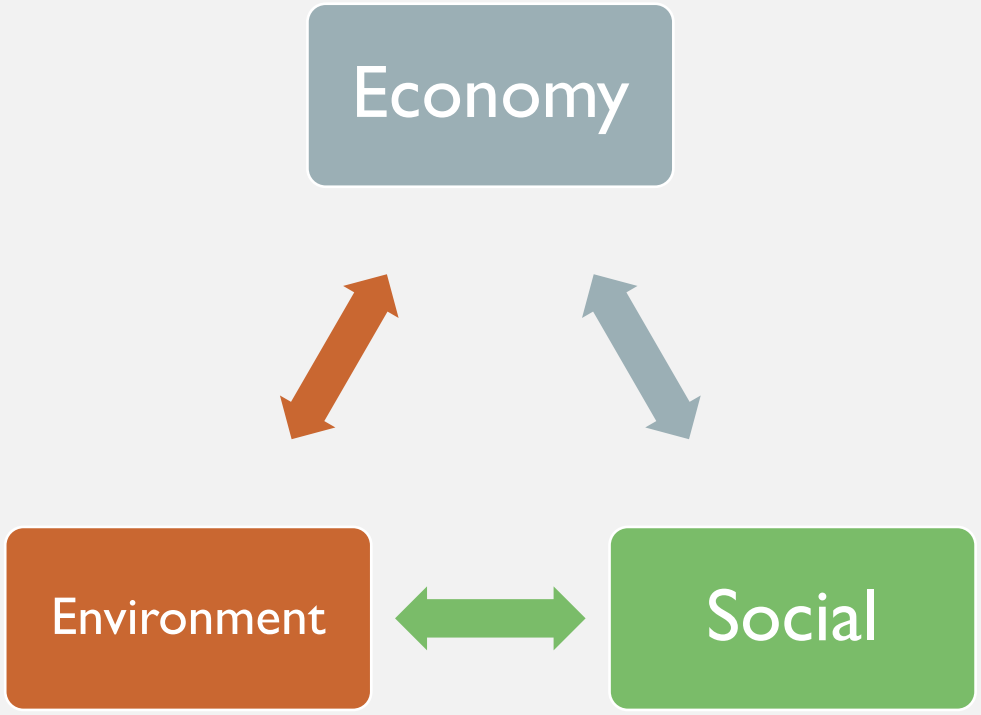
Land
- City industry (Yuen Long)
- Black point power station
- New Territories West Landfill

Problem
- Air pollutants
- Transportation emission

Sea
- Sewage goes to the sea (eg. Deep Bay)
- Rainfall dissolve the air pollutants to the sea

R2R
- Affecting the water quality
- Affecting marine ecosystem

SUSTAINABLE DEVELOPMENT AND OYSTER



OYSTER AND SUSTAINABLE DEVELOPMENT

Economic benefit

- Oyster farmers income
- Oyster sellers/restaurant/supermarket profits

Social benefit

- Oyster catch for general public (clean and suitable for consumption)
- Oyster industry (intangible heritage and collective memory)

Ecological function

- Filtering sea water, improve water quality
- Maintaining a rich biodiversity in the sea

17 SUSTAINABLE DEVELOPMENT GOALS - UNITED NATIONS

GO TO THE WEBSITE…

Goals

14

Conserve and sustainably use the oceans, seas and marine resources for sustainable development

https://sdgs.un.org/goals

Target

14.2

By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans

LIFE BELOW WATER

More than **3 billion people** rely on ocean for their livelihoods

The vast oceans, seas and marine resources are under **continual threat,** causing disruption marine ecosystems

Improved regulations, effective monitoring, scientific research and management system can improve the overfished and over-polluted habitats to **biological sustainable levels**

OYSTER RESTORATION

OUR VISION

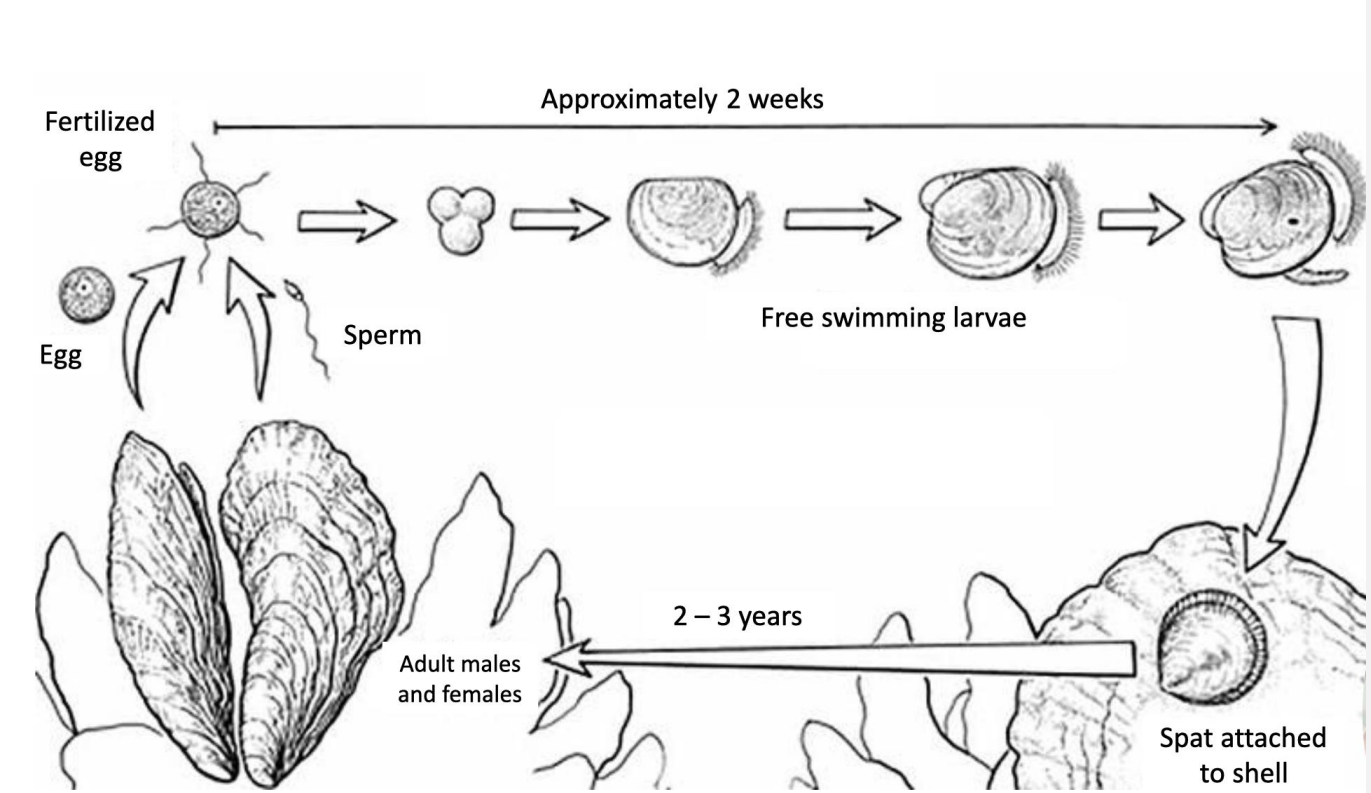
- TNC's vision is a world where **people and nature thrive together**.
- **Protecting land and water**
- **Tackling climate change**
- Providing **food and water sustainably** for a growing population
- Building healthy cities
- **Connecting people and nature**.

The Nature Conservancy
大自然保護協會

LIFE CYCLE OF OYSTER

Remember this?

- Oysters spawn tiny larvae
- Once attached on oyster shells, these larvae are called spat



OYSTER RESTORATION IN HONG KONG

TNC is helping to restore Hong Kong's Oyster Reefs

367 views • Nov 27, 2019 1 0 SHARE SAVE

TNC Hong Kong
556 subscribers

SUBSCRIBE

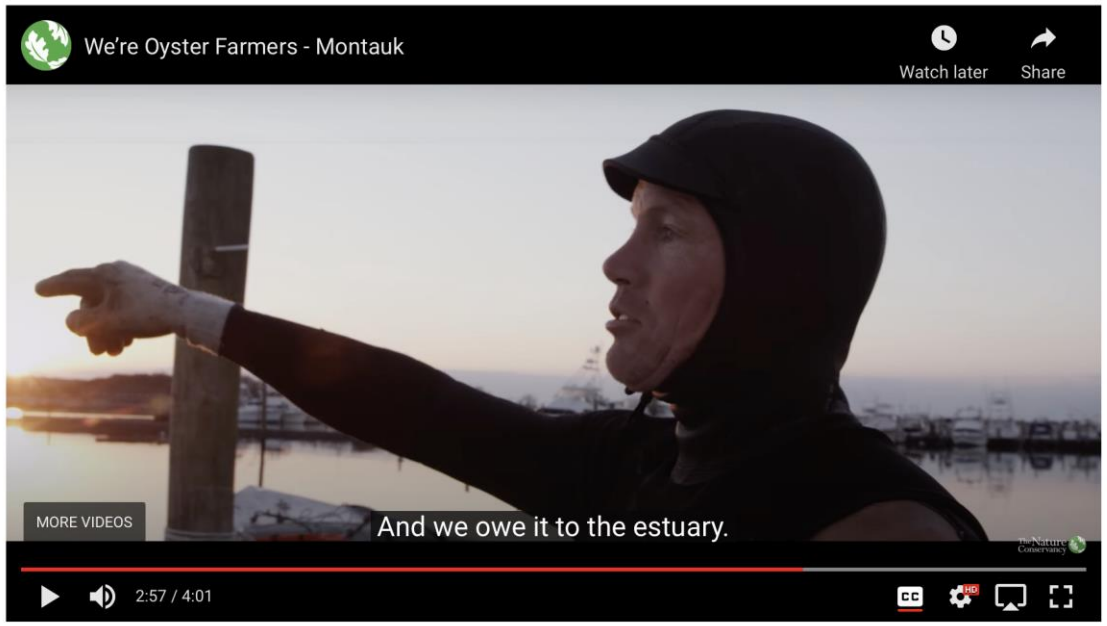
TNC is using oyster reefs to clean water.

https://www.youtube.com/watch?v=zURKkylgOOo

THREE MAJOR BENEFITS OF OYSTER REEF

- 1.Improving fishery catches (fish and crabs)
- 2.Coastal protection (damage from storm surges)
- 3.Improving water quality (filtering waters)

OYSTER RESTORATION AROUND IN THE WORLD

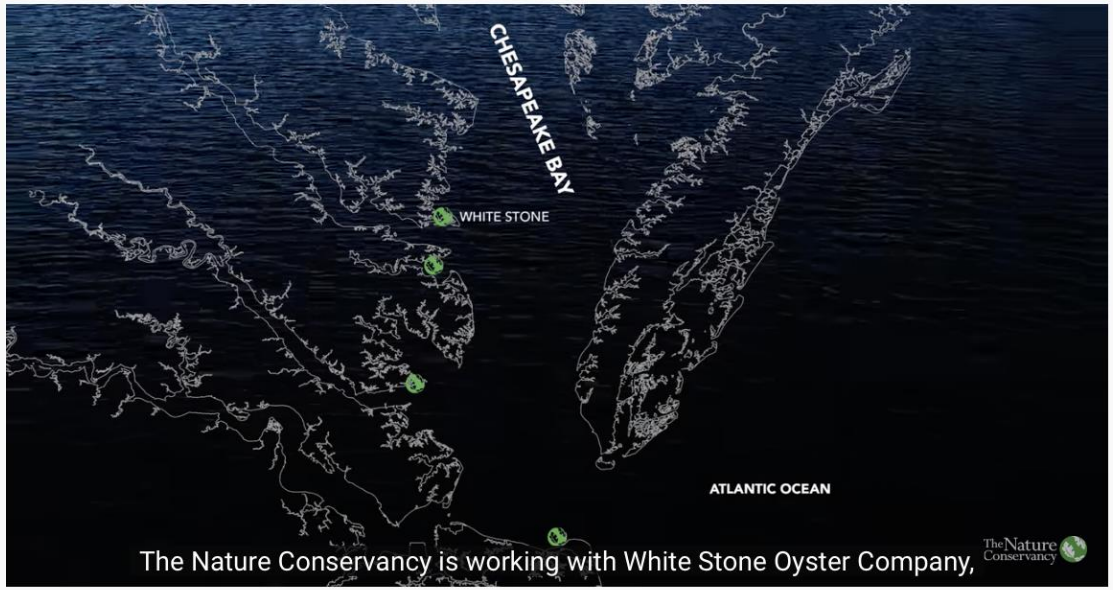


OYSTER FARMERS Mike Doall and Mike Martinson's Montauk Shellfish Company is threatened by deteriorating water quality and harmful algae

- (2:30- 3:38)The oyster are doing their part (by cleaning up the ocean, filtering the nitrogen compound and algae in the water) , and we are trying to do our part (by managing oyster and water resources, making living with harvesting oysters and helping to protect the environment...). We are responsible for that, we owe it to the estuary.

Farmed oysters also can release millions of eggs each year. Oyster larvae disperse and colonize nearby areas. In this way, oyster farms can help establish and supplement wild oyster populations. - Montauk

AQUACULTURE BY DESIGN, CHESAPEAKE BAY



Aquaculture by Design, Chesapeake Bay

7,073 views • Mar 8, 2017 54 5 SHARE SAVE

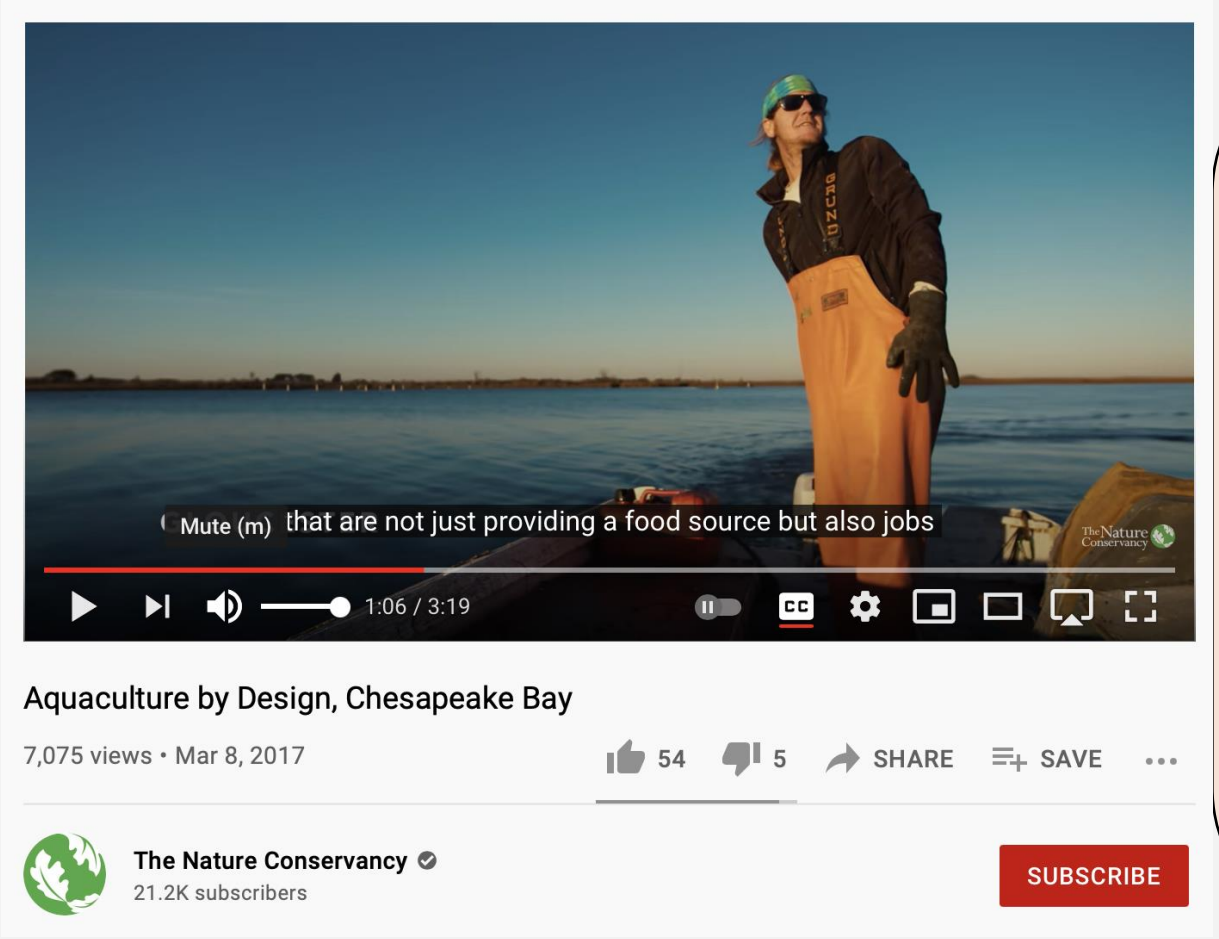
The Nature Conservancy
21.2K subscribers
SUBSCRIBE

The Nature Conservancy in Virginia is working with four oyster aquaculture growers to measure ecosystem services around their operations in the Chesapeake Bay. The research study conducted by the Virginia Institute of

SHOW MORE

https://www.youtube.com/watch?v=CUWePUvBGBE
(0:33-2:48)

OYSTER RESTORATION AROUND IN THE WORLD



We are doing the project to better understand and quantify the ecological benefits and services provided by oyster aquaculture. We are aiming not just providing a food source but also jobs . – Chesapeake Bay

OYSTER- MANAGEMENT AND SUSTAINABILITY

- Can be a sustainable seafood product
- Maintenance of natural oyster beds
- Maintain a clean coastal waters (reduce the damage on land -R2R)
- Monitor the chemical levels in oyster (safe to consume)

OYSTER RESTORATION

- 1. Oyster reef restoration
- Using the old oyster shells to re-create the habitats for the oyster larvae
- Restore the natural oyster reef

- 2. Hong Kong Oyster Reefs Exhibit
- Location: Ap Tsai Hang in Pak Nai
- History of Deep Bay
- Scientific Information about oysters

RECYCLE THE OYSTERS' SHELLS (UPCYCLING OF OYSTER SHELLS)

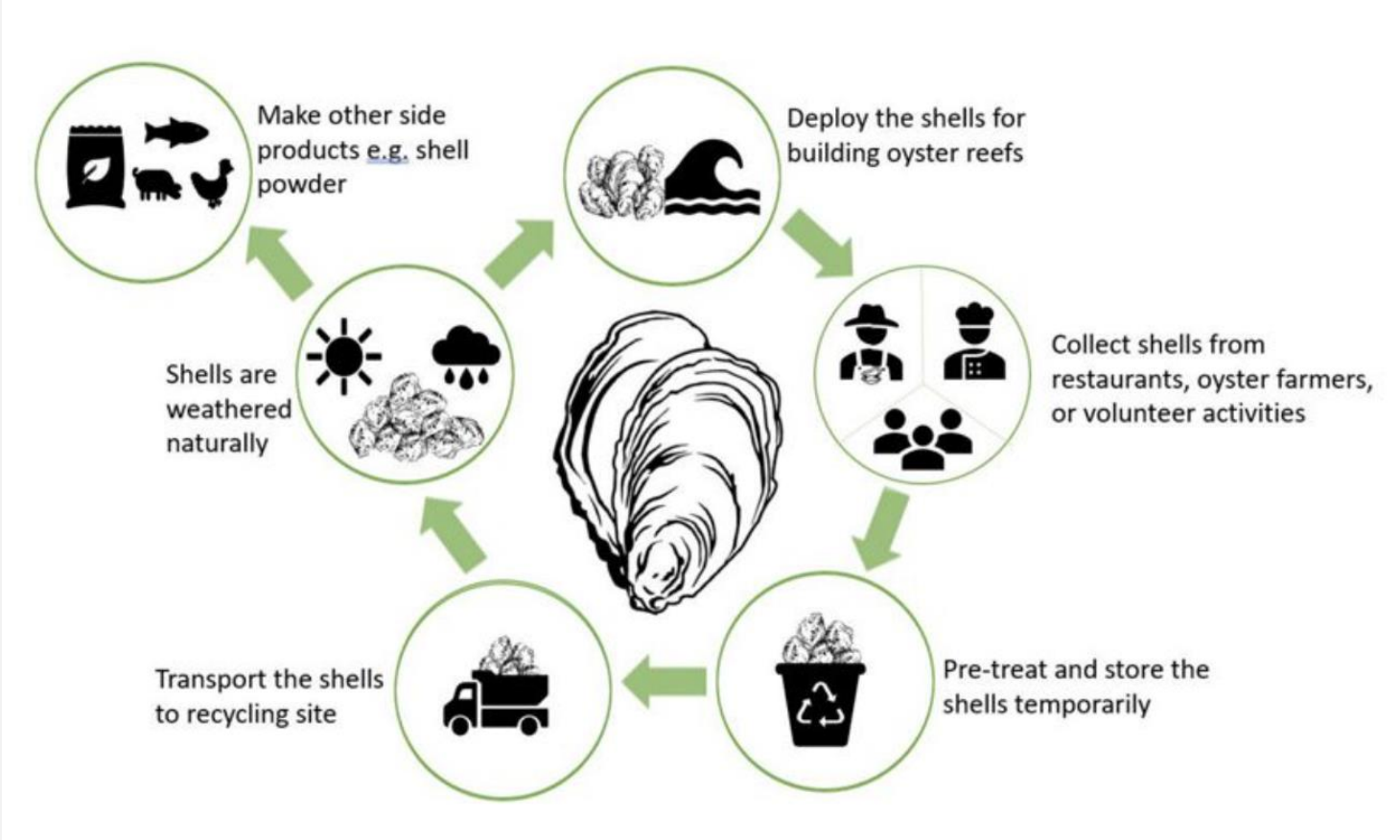
- The process of transforming by-products, waste materials into new materials of better quality and environmental value

- Examples: Using oyster shells for artwork production, building walls with oyster shells

TURNING WASTE INTO VALUE FOR HONG KONG'S OYSTER SHELLS

- Collect waste or discarded oysters' shells from food and beverage industry as well as aquaculture farmers to recycle
- lowering the negative impact on the environment and diverting food waste from the landfill
- Helping to create a cleaner environment for native species such as seagrasses, horseshoe crabs and shorebirds.

RECYCLING OF OYSTERS SHELLS



ARTWORK PRODUCTION

(DIY Oyster shells Craft)

(Home decoration)

(Oyster shell dish after colouring)

CONCLUSION

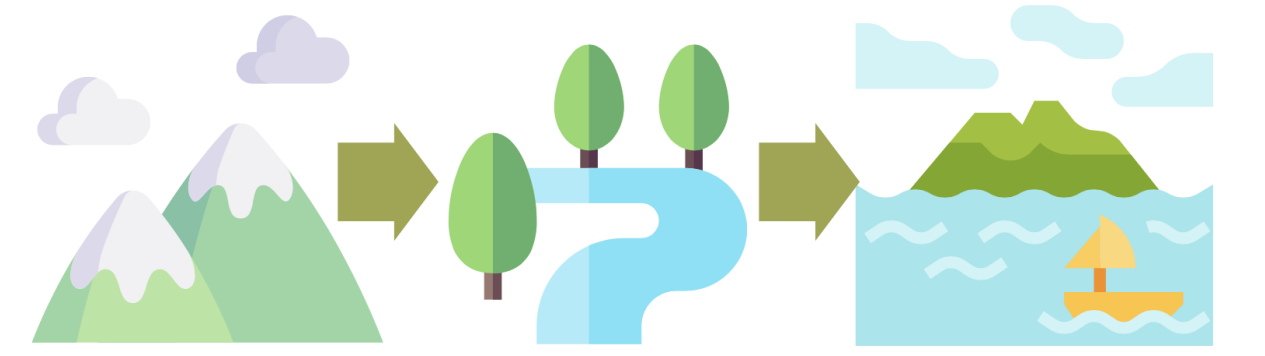
- 1. Understand the relationship of sustainable development and importance oyster reef
- Economy

Environment ⇔ Social

Sustainable development brought by oysters

CONCLUSION

- Give examples of ridge to reef concept and the ways to conserve the marine environment (oyster restoration)



Minimize the destruction on land

Oyster restoration and upcycling of oyster shells

WHAT HAVE WE LEARNT IN THESE 3 LESSONS?

HIGHLIGHT OF 3 LESSONS

- The habitat of oysters
- Importance of oysters in water
- The anatomy of oyster
- Grouping of living things and identification key
- Sustainable development and oyster restoration in Hong Kong

PRE-TRIP BRIEFING

PRE-TRIP BRIEFING

- To solidify the knowledge of mudflat ecology and R2R concept after the field trip through group discussion and reporting.

PRE-TRIP BRIEFING

- Pai Nai is located northwest of Hong Kong, facing Deep Bay and Shekou, Shenzhen. Pai Nai is not only famous for watching sunsets, it also has rich natural resources and biodiversity. It is a hotspot for oyster reefs, mudflats, seagrass beds and mangroves,

DRESS CODE & TO BRING LIST

Outdoor gear:

- Light-colored, breathable, long-sleeved clothing
- Sports shoes, water boots
- Hat
- Jacket

Drinking water

Record forms and stationery

iNaturalist

DOWNLOAD

‘iNaturalist’ can be used to record species observed in the field.

GPS function ON, the experts and other users on iNaturalist will identify the species. The images help scientists understand the latest wildlife distribution and contribute to ecological survey data.

FLIPPED CLASSROOM (VIDEO)

Extended Reading Materials

- The Hong Kong Jockey Club Ridge to Reef (R2R) Environmental Education Programme Educational Animation
  - Episode 1

    https://www.youtube.com/watch?v=bYD2DlinVpw
  - Episode 2

    https://www.youtube.com/watch?v=XZocxB-J-YU
- International Coral Reef Initiative Case Studies: From Ridge to Reef
  https://www.env.go.jp/nature/biodic/coralreefs/pamph/C-community_EN.pdf

ONLINE RESEARCH

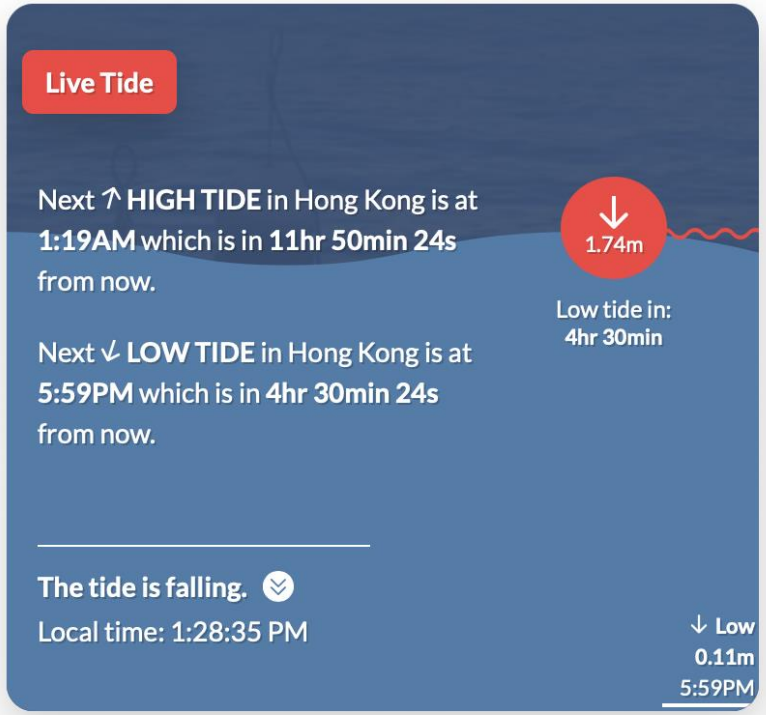
- Tide time and tide chart

- **Q:What is Low tide time?**
  Q:Why do we have to select low tide time?
-

TIDE TIME

Today's tide times for Hong Kong, China

The predicted tide times today on Sunday 27 June 2021 for Hong Kong are: first high tide at 00:29am, first low tide at 3:35am, second high tide at 10:12am, second low tide at 5:59pm. Sunrise is at 5:41am and sunset is at 7:11pm.

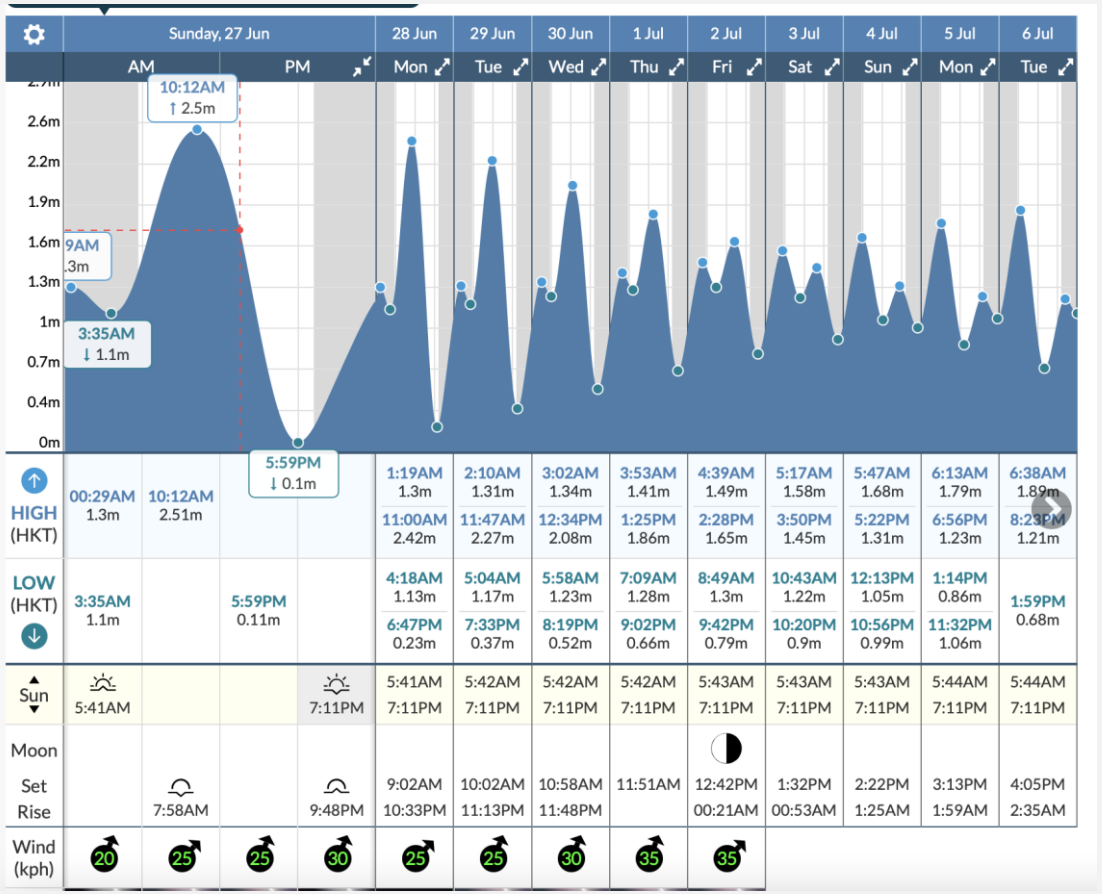


Today's tide times for Hong Kong: Sunday 27 June 2021

Tide	Time (HKT) & Date	Height
High Tide	00:29 AM *(Sun 27 June)*	1.3 m *(4.27 ft)*
Low Tide	3:35 AM *(Sun 27 June)*	1.1 m *(3.61 ft)*
High Tide	10:12 AM *(Sun 27 June)*	2.51 m *(8.24 ft)*
Low Tide	5:59 PM *(Sun 27 June)*	0.11 m *(0.36 ft)*

Tide Datum: Mean Lower Low Water

TIDE CHART


Sunday, 27 Jun
AM
PM
28 Jun Mon
29 Jun Tue
30 Jun Wed
1 Jul Thu
2 Jul Fri
3 Jul Sat
4 Jul Sun
5 Jul Mon
6 Jul Tue
2.6m
2.2m
1.9m
1.6m
1.3m
1m
0.7m
0.4m
0m
10:12AM
↑ 2.5m
9AM
.3m
3:35AM
↓ 1.1m
5:59PM
↓ 0.1m
HIGH (HKT)
00:29AM 1.3m
10:12AM 2.51m
1:19AM 1.3m
11:00AM 2.42m
2:10AM 1.31m
11:47AM 2.27m
3:02AM 1.34m
12:34PM 2.08m
3:53AM 1.41m
1:25PM 1.86m
4:39AM 1.49m
2:28PM 1.65m
5:17AM 1.58m
3:50PM 1.45m
5:47AM 1.68m
5:22PM 1.31m
6:13AM 1.79m
6:56PM 1.23m
6:38AM 1.89m
8:23PM 1.21m
LOW (HKT)
3:35AM 1.1m
5:59PM 0.11m
4:18AM 1.13m
6:47PM 0.23m
5:04AM 1.17m
7:33PM 0.37m
5:58AM 1.23m
8:19PM 0.52m
7:09AM 1.28m
9:02PM 0.66m
8:49AM 1.3m
9:42PM 0.79m
10:43AM 1.22m
10:20PM 0.9m
12:13PM 1.05m
10:56PM 0.99m
1:14PM 0.86m
11:32PM 1.06m
1:59PM 0.68m
Sun
5:41AM
7:11PM
5:41AM 7:11PM
5:42AM 7:11PM
5:42AM 7:11PM
5:42AM 7:11PM
5:43AM 7:11PM
5:43AM 7:11PM
5:43AM 7:11PM
5:44AM 7:11PM
5:44AM 7:11PM
Moon
Set
Rise
7:58AM
9:48PM
9:02AM 10:33PM
10:02AM 11:13PM
10:58AM 11:48PM
11:51AM
12:42PM 00:21AM
1:32PM 00:53AM
2:22PM 1:25AM
3:13PM 1:59AM
4:05PM 2:35AM
Wind (kph)
20
25
25
30
25
25
30
35
35

ENJOY & LEARN FROM THE FIELD TRIP

The Hong Kong Jockey Club Ridge to Reef (R2R) Environmental Education Program

Lesson 1_Basic Understanding of Oysters

Name: _____ (_____) Class: _____ Date: _____

1. **Oyster and Hong Kong People**

How are oysters related to Hong Kong people? Give some examples.

2. **Natural habitat of oyster**

- Location in Hong Kong: _____
- Special geological features of this location: _____
- Rich biodiversity examples: _____
- Role of oysters in improving water quality: _____

3. **Summarize Ridge to Reef (R2R) Concept**

4. **Three Major Benefits of the Oyster Reef**

- _____
- _____
- _____

T/F questions

Determine the statement whether they are true or false. If it is false, please correct it.

1. The natural habitat of oysters is called “Oyster Farm”. _____
2. Oysters without proper cooking are not recommended. _____
3. Oysters can filter seawater. _____
4. The largest oyster reef in Hong Kong is located at Ap Chau. _____

The Hong Kong Jockey Club Ridge to Reef (R2R) Environmental Education Program

Lesson 1_Basic Understanding of Oysters (Flipped Task)

Name: _____ (_____) Class: _____ Date: _____

1. Habitat of oysters (Restoring Hong Kong's Lost Oyster Reefs for Nature and People)

https://www.youtube.com/watch?v=1QaB12zzX9I **(00:00-3:18)**

Guiding questions:

1. According to the video, what challenges are the oyster reefs facing?

2. What are the measures done, respectively, to reserve the oyster reefs and to promote the oyster farming industry?

2. Roles of oyster in ecosystem (Ridge to Reef Virtual Field Trip 16 mins)

https://www.youtube.com/watch?v=fqnvZbQcFM4&feature=youtu.be **(12:35-15:16)**

Guiding questions:

1. According to the video, what are the roles of oysters in the ecosystem?

2. From the roles mentioned above, which one impressed you the most? Why?

The Hong Kong Jockey Club Ridge to Reef (R2R) Environmental Education Program

Lesson 2_Using identification key to understand oysters

Name: _____ (_____) Class: _____ Date: _____

1. General Information of Oyster

Family Name:	
Hong Kong Oyster Scientific Name:	
Size:	_____ inches to _____ inches
Life span:	Up to _____ years
How do they reproduce?	

2. Anatomy of an oyster

Fill in the blanks with the suitable words.

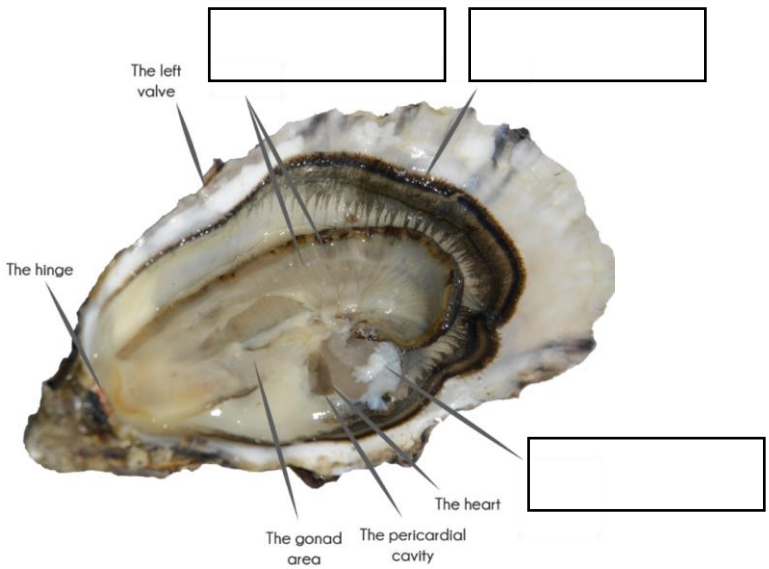


Photo Reference: https://www.zapcoaquaculture.com/resources/knowledgebase/all-about-the-oyster/the-anatomy-of-the-oyster

Choose the suitable words to correct place.

The Mantle	Fine fleshy layer of tissue surrounding oyster body, ensuring the development of oyster shell
The Gill	Play an important role in respiration and feeding, responsible for generating water current for feeding
The adductor muscle	The muscle flex and keep the shell closed. When the environment is favourable, it relaxes, so the shell can open
What is the function of the hinge?	

3. Inner structure

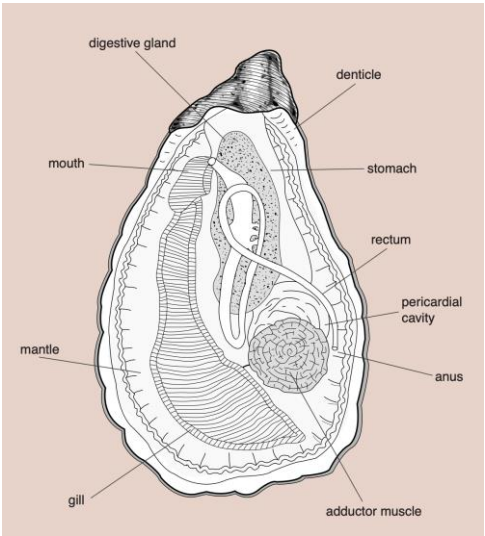


Photo Reference: http://www.fao.org/3/y1679e/y1679e03.pdf

Write down the function of ONE organ in above picture to the survival of oysters.

Organ	How does it play the role in the survival of oysters?

4. Similarities and differences with other shellfish

Write down one similarity and one difference between oyster and another type of shellfish.

Similarity	
Difference	

5. **Classification of animals**

a) Please put a tick in the box if the animals process that particular characteristics.

b) Discuss and draw an identification key with your classmates (in the form of tree diagram).

	Fish	Amphibians	Reptiles	Birds	Mammals	Mollusca	Arthropods
Moist Skin							
Has feathers							
Has gills in adult							
Has backbone							
Has mammary glands							
Soft-bodied with shells							
Jointed leges with exoskeleton							
Example(s)						Oysters, snails, scallops	Spiders, ants, lobsters

T/F questions

Determine the statement whether they are true or false. If it is false, please correct it.

1. Oyster's gender changes over time. _____
2. Hong Kong does not have its own oyster species. _____
3. Oysters can be classified as animal. _____
4. Oyster is vertebrate. _____
5. The size of oyster depends on the depth of its shell. _____

Lesson 2_Using identification key to understand oysters

Shellfish information

Type of Shellfish	Characteristics
Razor clams  (https://bushcraftbuddy.com/how-to-gather-razor-clams/)	Size: Up to 6 inches Shape: Oblong External feature: Gaping oblong shell with concentric rings Colour: Brown and yellow Substrate: Sand Habitat: Intertidal coastal (ocean beaches)
Blue Mussels  (https://wildkratts.fandom.com/wiki/Blue_Mussel)	Size: Up to 3 inches Shape: Oblong External feature: Blue-black or brown shell Colour: Blue black Substrate: Rocks, boats, pilings, , other hard surfaces Habitat: Intertidal region
Pacific littlenecks  (https://www.doh.wa.gov/CommunityandEnvironment/Shellfish/RecreationalShellfish/IllnessPrevention/Identification)	Size: Up to 2.5 inches Shape: Oval to round External feature: Concentric rings with radiating ridges forms a lattice pattern. Cream/gray colored, but sometimes mottled with brown. White interior of the shell. Colour: Cream and gray coloured Substrate: Gravel, mud Habitat: Normally mid-tide level to lower intertidal. Sometimes subtidal.

Geoduck  (https://wdfw.wa.gov/species-habitats/species/panopea-generosa)	Size: 2.5 lbs average, (shells up to 10 inches) Shape: Oblong External feature:: Gaping oblong shell with concentric rings. White with flaky brown skin. The siphon and mantle extend far beyond the shell. Colour: Brown and white Substrate: Gravel, mud, sand Habitat: Subtidal (some intertidal, accessible only on extreme low tides)
Rock Scallops  (https://www.flickr.com/photos/rwolf/5193653108)	Size: Up to 8 inches Shape: Fan shaped with two triangular attachment to the hinge External feature: Light brown with two triangular attachments to the hinge Colour: Brown Substrate: Rocks and crevices Habitat: Low tidal to subtidal
American Oysters  (https://medium.com/age-of-awareness/the-rise-and-fall-of-the-american-oyster-and-why-its-important-now-371c5b3ccb7f)	Size: 2-6 inches long, 2 inches wide Shape: Irregular shells, oval or pear shaped External feature: generally whitish-gray in outer shell color, and their inside shell is usually a porcelain white. Colour: Brown and gray Substrate: Rocks and oyster shells Habitat: Oyster reef, Hard, rockt, sandy, muddy or shell-strewn bottoms below the tide line

Reference :
https://www.edc.uri.edu/restoration/html/gallery/invert/amero.htm
http://www.seator.org/PDF_Documents/AK%20Shellfish%20ID%20Chart.pdf
https://www.nationalgeographic.com/animals/invertebrates/facts/oysters

Group Task

1) **What are their similarities in these shellfish?**
   Suggest at least three similarities of these species.

1.	
2.	
3.	
Other	

2) **What are the differences among their body features? How can you distinguish them?**
   Suggest at least three ways to classify these species.

1.	
2.	
3.	
Other	

The Hong Kong Jockey Club Ridge to Reef (R2R) Environmental Education Program

Lesson 3_Oyster and Sustainable development

Name: _____ (_____) Class: _____ Date: _____

1. **Ridge to Reef Concept**

Give ONE example that show that the destruction on land will eventually harm the marine ecosystem. (Land to Sea)

Land destruction (Natural cause or human activities)	
Impact on Sea (Marine ecosystem or water quality)	

2. **Oyster and sustainable development**

How do oysters contribute to the sustainable development in Hong Kong?

Economic aspect	
Social aspect	
Environmental aspect	

3. **Conservation**

How do people around the world conserve the oyster habitats and oyster biodiversity?

_____

_____

How can you contribute to the conservation of oyster habitats?

_____

_____