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賽馬會 Jockey Club

「山海為一」環境教育計劃

“Ridge to Reef” Environmental Education Programme

Pak Nai Field Trip Teacher's Manual

Target audience

Students from secondary 1 to 3

Related subject

Geography

Themes

- “Ridge to Reef” concept
- Mudflat ecology

Suggested field trip duration

Three hours with travelling time (can be adjusted according to teaching content and weather conditions)

Suggested student to teacher ratio

30 to 2

About this manual

The field trip manual is designed for secondary 1 to 3 geography students to help facilitate the exploration of Hong Kong's mudflat ecology and to understand the “Ridge to Reef” concept and UN sustainable development goals. The teacher's manual includes: field trip route; suggested teaching objectives; identification charts of commonly found organisms; and student worksheets.

Key Words

“Ridge to Reef,” mudflat, sustainable development goals, SDGs, Pak Nai

Project Brief

Building on IUCN's (The International Union for Conservation of Nature) global conservation initiative, The Nature Conservancy (TNC) launched the Jockey Club “Ridge to Reef” Environmental Education Programme, with support from The Hong Kong Jockey Club Charities Trust. The holistic program aims to enhance the environmental literacy of Hong Kong's youth. Using TNC's Learn-Act-Lead model, we are working with Hong Kong's students, teachers and schools.



Sustainable Development Goals (SDGs)

The Sustainable Development Goals (SDGs) are the blueprint designated by the United Nations, setting up 17 goals and 169 targets. The agenda intended to lead the world's various governments, organisations, and bodies to achieve these goals and bring a more sustainable future for all. The SDGs were adopted by all 193 United Nations Member States and implemented in 2016 and are intended to be achieved by the year 2030.

Through the field trip in Pak Nai, teachers can guide students to think about some of the SDGs and related targets and discuss their relations with Hong Kong and our daily life.

SDG

11 SUSTAINABLE CITIES AND COMMUNITIES



Sustainable Cities and Communities

Make cities and human settlements inclusive, safe, resilient and sustainable.

Cities and metropolitan areas are the sources of economic growth, and they are accountable for about 70 percent of global carbon emissions. Rapid urbanization also leads to various environmental problems, such as pollution, sanitation, sewage and waste, freshwater supply and land-use problems. Therefore, development is closely related to the environment. To protect the Earth's environment and reduce negative impacts, urban development must comply with the principles of sustainable development.

Related targets:

- 114 Protect the world's cultural and natural heritage
- 116 Reduce the environmental impact of cities

SDG

12 RESPONSIBLE CONSUMPTION AND PRODUCTION



Responsible Consumption and Production

Ensure sustainable consumption and production patterns.

The consumption and production of natural resources promote economic growth but causes problems such as pollution and over-exploitation. In order to protect and reduce the impact on the environment, we must consume and produce responsibly.

By understanding the relationship between Pak Nai, oyster reefs and the fishing community, students can learn how to sustainably manage and use natural resources effectively and adopt a sustainable lifestyle to coexist harmoniously with nature.

Related targets:

- 122 Sustainable management and efficient use of natural resources
- 128 Promote sustainable lifestyles in harmony with nature
- 12B Sustainable tourism that creates jobs and promotes local culture and products

SDG

Life Below Water

Conserve and sustainably use the oceans, seas and marine resources.

The ocean occupies 70 percent of the Earth’s surface, provides food and energy to humans and plays an important role in elemental cycling , oxygen supply and climate control. To protect marine resources, we have to reduce pollution and overfishing.

Through the field trip to Pak Nai, students can understand mudflat and mangrove biodiversity and the resources they provide, as well as the importance of protecting marine environments.

14 LIFE BELOW WATER



Related targets:

- 14.1 Prevent and significantly reduce marine pollution, especially from land-based activities
- 14.2 Coastal ecosystem protection and management
- 14.5 Conserve coastal areas

SDG

Life on Land

Sustainably manage forests, halt and reverse land degradation, halt biodiversity loss.

Terrestrial ecosystems are as important to human survival as the ocean, providing oxygen, pollinating crops and providing resources such as food. Human activities have transformed the terrestrial ecosystems and threatened many terrestrial life forms. As a result, human livelihoods, economy, health and quality of life are also affected.

Through the field trip, students can understand the concept of “Ridge to Reef” and the close relationship between the land and the sea. Students can also learn how changing land use affects the surrounding land and ocean environment.

15 LIFE ON LAND



Related targets:

- 15.1 Ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and dryland
- 15.2 Sustainable management of forests, halt deforestation, restore degraded forests and increase afforestation and reforestation
- 15.5 Reduce the degradation of natural habitats, halt the loss of biodiversity and protect and prevent the extinction of threatened species
- 15.8 Prevent the introduction and reduce the impact of invasive alien species on ecosystems

Sustainable Development Goals (SDGs)



Preparation

Materials and tools:



Record forms and stationery



Binoculars



Drinking water



Rain gear



Tray, forceps and magnifying glasses for observing organisms



Mudflat organism field guide and ID charts



First aid kit



Outdoor gear:

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

Transportation

Green minibus:

- From the Yuen Long MTR station, it is about a 10-minute walk to the Tai Fung Street green minibus station. Take the number 33 minibus to Pak Nai Ap Tsai Hang.

Coach:

- As the road is narrow and rough, a 28-seat coach is the largest recommended size.
- Coaches can park at "App Store Cafe & Barbecue," but reservations must be made in advance. (Contact information - address: 283A, Nim Wan Road, opening from 2:00 – 7:00 p.m., Monday to Sunday, phone: 9804 3042)

Green Taxi:

- A green taxi from Tin Shui Wai MTR station to Pak Nai costs about \$80 and takes about 15 minutes.

Reminders and Safety Recommendations:

Before the trip:

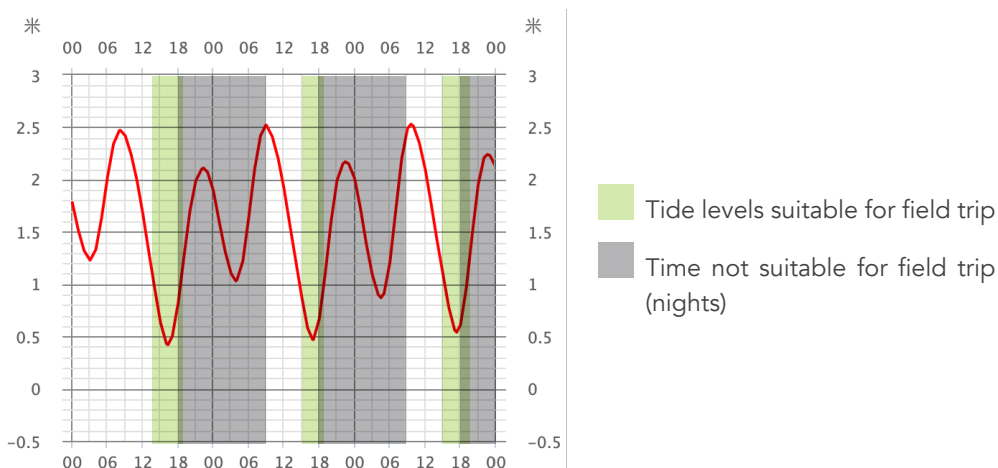
- Teachers should explain the field trip arrangement, schedule, suggested gear and safety recommendations to the students.
- Teachers should check the tide level and weather conditions on the Hong Kong Observatory website. The ideal tide level for field work is below one meter.

During the trip:

- Participants should wear light-coloured, long-sleeved clothing and a hat to protect from sunburn and heatstroke. Bring plenty of drinking water. Wear protective shoes, such as sport shoes or water boots. Open-toed slippers or sandals are not suitable.
- As students may come into contact with seawater during the field trip, teachers can recommend using ocean-friendly sunscreen and physical barriers for mosquitos. Avoid using chemical sunscreens to prevent contamination of the seawater.
- Teachers should pay close attention to the tide level on-site to ensure that students have sufficient time to leave the intertidal mudflat area before the tide goes up.
- Respect wildlife. Do not shout or yell in the field, or touch, interfere or harm organisms during observation. Beware of stepping on animals while walking.
- Do not take any animal, plant or anything that belongs in the field. Only trash should be taken away from the natural environment.

Weather:

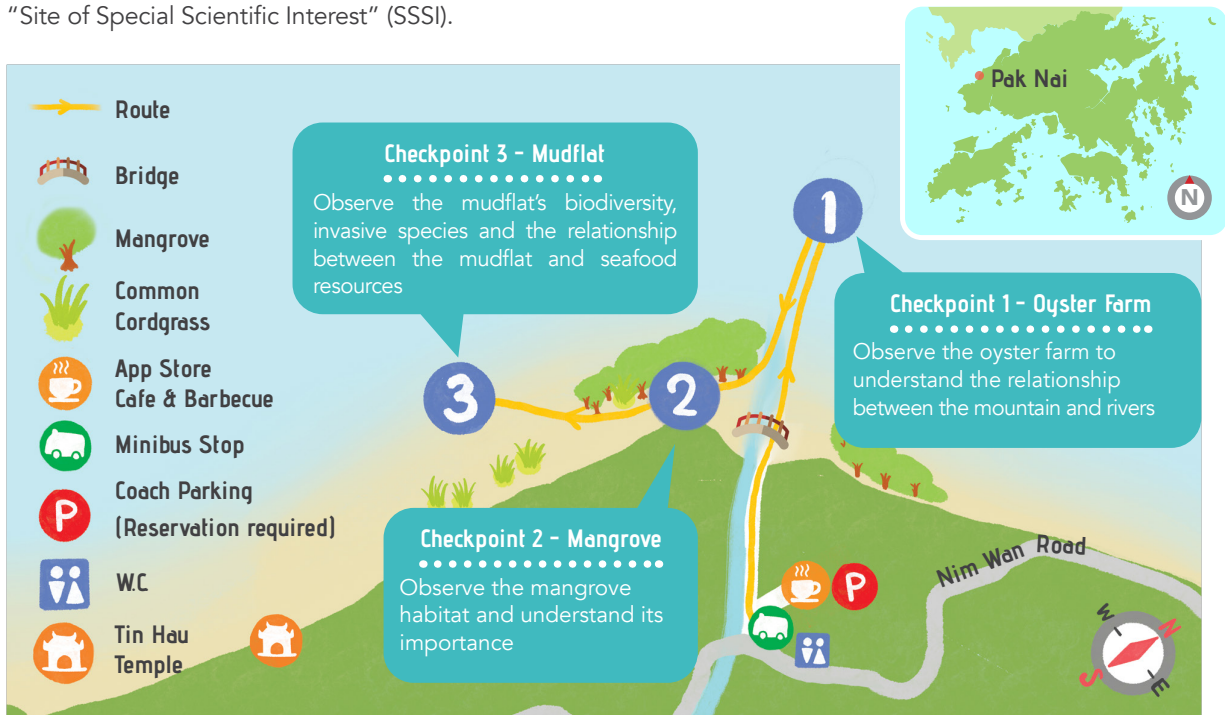
- If the Hong Kong Observatory issues the following signals two hours before the trip starts, teachers should consider cancelling the field trip:
 - ◆ Strong Wing Signal, Typhoon Warning Signal No. 3 or above
 - ◆ Any Rainstorm Warning
 - ◆ Regional Thunderstorm Warning
 - ◆ Very Hot Weather Warning
- How to check tidal information:
 1. Visit Hong Kong Observatory Website (<https://www.hko.gov.hk/>) or download the HKO app
 2. Choose "Geophysics > Tide > Predicted Tide" from the sidebar
 3. Choose the forecast date according to the day of the survey
 4. Check whether the tide at the proposed time is lower than one meter



Field Location and Route

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, because the Pearl River Estuary continuously supplies fresh water to Deep Bay and Pak Nai. The seawater salinity of Pak Nai is lower than other coastal areas in Hong Kong, which allows more organisms to grow.

Pak Nai is also home to two species of horseshoe crabs that can be found in Hong Kong – Chinese horseshoe crabs and mangrove horseshoe crabs. With Pak Nai being next to Deep Day, it attracts many migratory birds, including the globally endangered Black-faced spoonbill, seagulls and terns species, that use it for replenishment on their journey. For these reasons, Pak Nai is designated as a “Site of Special Scientific Interest” (SSSI).

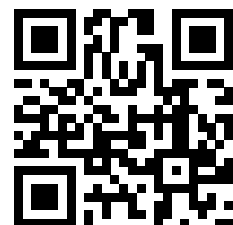


Be a citizen scientist - iNaturalist

Before the field trip, teachers can invite students to download the 'iNaturalist' app on their mobile devices. 'iNaturalist' can be used to record species observed in the field. When students upload a photo of an organism to the app and have the 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.

Species distribution in Pak Nai:

<http://www.inaturalist.org/projects/pak-nai-ecological-survey>



Field Trip Rundown

Checkpoint 1 - Oyster Farm

Location: Oyster Farm

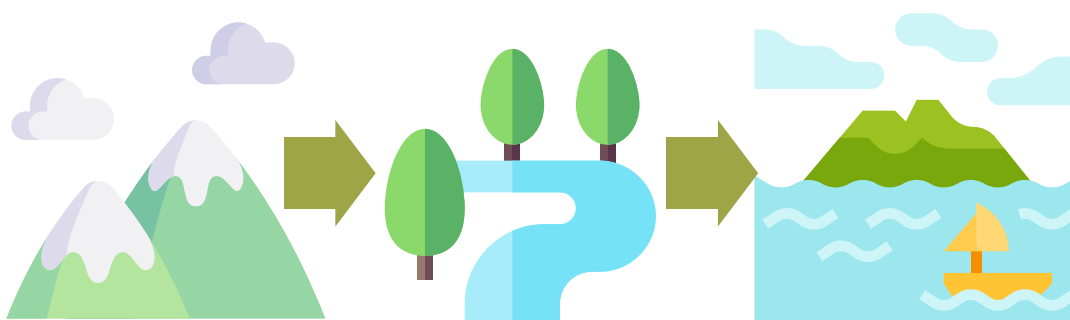
Duration: 40 minutes

Teaching content:

“Ridge to Reef” Concept

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. Therefore, the International Union for Conservation of Nature (IUCN) has proposed the “Ridge to Reef” (R2R) conservation initiative to link the river basins from land to coast, to better manage water resources and ecosystems. This initiative also applies to Hong Kong, because it is a coastal city, and proper management of coastal areas’ ecosystems and estuaries can support people’s livelihoods and increase income from fisheries and tourism.

In some Asian and Latin American cities, improved watershed management has benefited the coral reef system and improved people’s quality of life and well-being.



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

Teaching content:

History of oyster farming in Hong Kong:

- The Hong Kong oyster industry has over 700 years of history, and the oyster culture methodology was developed during the early Song Dynasty.
- The traditional methods of oyster cultivation (bottom cultivation) and oyster sauce production have been designated as part of Hong Kong's Intangible Cultural Heritage. "Bottom cultivation" means oyster farmers lay out bare substrate on the mudflat, allowing for oyster larvae in the water column to settle naturally. Oysters usually will reach marketable size and are ready to harvest after three to four years.
- Traditional oyster cultivation encourages sustainable harvesting practices, because oysters are only harvested well beyond maturity. Oysters reach reproductive maturity at about one year old but are harvested around three-to-four years old, leaving plenty of time to reproduce. This helps sustain natural wild oyster populations, including native oyster species in Hong Kong.
- The brackish conditions of Deep Bay make its waters ideal for growing oysters. Deep Bay has been an important oyster cultivation zone in Hong Kong for at least 250 years. Today, oyster farming in Deep Bay is a sunset industry, with only about 80 active oyster farmers left. Many have worked with their families since childhood, and most of them are now over sixty years old.
- Man-made oyster farms are not the same as naturally occurring oyster reefs, which have much denser oyster populations and are not as spread out. The artificial oyster clumps in the abandoned Pak Nai farm are still full of live oysters that can provide habitats to many other living creatures. Try to count the number of different species you find at the oyster farm.

Three major benefits of oyster reefs:

1. Improving fishery catches

- ◆ Oyster reefs can provide habitat for juvenile fish and their prey, which can benefit both commercial and recreational fisheries.

2. Coastal protection

- ◆ Oyster reefs can buffer strong waves and reduce erosion, which makes the coast more stable and supports the growth of seagrass beds.
- ◆ Since oyster reefs are alive, they can grow taller when the sea level rises and can rebuild after a typhoon.

3. Improving water quality

- ◆ A Hong Kong oyster can filter 30L of water per hour.
- ◆ Oysters are filter feeders, mainly feeding on plankton that can improve the clarity of the water, allow sunlight to penetrate deeper and benefit aquatic plant growth.
- ◆ Oyster reefs can reduce eutrophication in the coastal environment by filtering excessive pollutants, especially nitrogen compounds.

Field Trip Rundown

Checkpoint 1 - Oyster Farm

Teaching content:



Abandoned oyster farm (Pak Nai, Hong Kong)



Natural intertidal oyster reef (Jiangsu Province, China)

Field Trip Rundown

Checkpoint 1 - Oyster Farm

Teaching content:

Biodiversity:

- Biodiversity means the number and variety of different life forms.
- It is generally categorized into ecosystem diversity, species diversity and genetic diversity (differences between individuals).
- Having a wide variety of life, or maintaining biodiversity, is key for organisms to be able to adapt to changes and maintain the stability of the ecosystem. If high biodiversity is maintained, when a few species decline or disappear from an ecosystem, or when sudden environmental changes occur, the impacts can be reduced and allow organisms to play different ecological roles and functions.
- High biodiversity provides many advantages, called “ecosystem services”, including the production of food, medicine, clothing and construction materials.



Suggested Activity 1: Explain the nearby attractions

Objective:

To help students understand the interconnectedness of people and nature.

Activity content:

1. Have the students stand by the river near the mudflat, then look at the mountains. Using the environment around you to introduce the R2R concept to students, explain that activities happening on the mountain, such as hill fires and sewage discharge, will affect the mudflat ecosystem beneath their feet through the river, and eventually affect the ocean. Therefore, if we want to protect the ocean, we also need to protect the environment in the mountains.
2. Make use of the environment in front of you. Encourage the students to think of examples related to R2R and discuss the interconnectedness of protecting the mountains and the sea.
3. Teachers can explain that the river connects the mountains to the oyster reefs, and then point out the high-polluting industries near Pak Nai on the map, such as the West New Territories Landfill and the Black Point Power Plant.
4. Teachers can tell students that the West New Territories Landfill previously had a pollution leakage accident, and sewage infiltrated the rivers in Pak Nai and heavily impacted the water quality, microorganisms and fish.
5. Students can discuss how the oyster industry in Lau Fau Shan will be affected if the river is polluted, and they can consider the relationships between the river, mangrove forests and oyster reefs.

Suggested Activity 2: Observe the biodiversity in the oyster farm

Objective:

To learn about the biodiversity in oyster farms and the importance of its ecological services.

Activity content:

1. Divide the students into groups and ask them to observe and record the animals found inside and outside the oyster farm (please refer to P.14 for the ID chart) and compare the results.
2. Emphasize the ecological services of oyster farms.

Field Trip Rundown

Checkpoint 2 - Mangrove

Location: Mangrove forest

Duration: 30 minutes

Teaching content:

Mangrove:

- Mangrove forests are a unique intertidal habitat, usually found in the high tide areas in tropical and subtropical estuaries, mainly distributed on hidden coasts. As this habitat is often affected by both freshwater from the river and saltwater from the ocean, the salinity, oxygen content and soil moisture fluctuate often. Organisms living in this habitat have evolved to overcome this constantly changing environment.
 - There are around 60 mangrove forests in Hong Kong, covering over 500 hectares found in Sai Kung, Deep Bay, Lantau Island and other locations.
 - Mangroves can be divided into two types: true mangroves and mangrove associates:
 - **True mangroves:**
 - ◆ Located in the intertidal zone, they have evolved at least one physiological or morphological adaptation to survive in this harsh environment.
 - ◆ There are eight native true mangrove species in Hong Kong: *Acrostichum aureum*, *Aegiceras corniculatum*, *Avicennia marina*, *Bruguiera gymnorhiza*, *Excoecaria agallocha*, *Heritiera littoralis*, *Lumnitzera racemosa*, and *Kandelia obovate*.
 - **Mangrove associates:**
 - ◆ Grow closer to the land side of the mudflat and are seldom flooded by tides.
 - ◆ Common examples include: *Talipariti tiliaceum* and *Clerodendrum inerme*.
- (*Please refer to the Pak Nai Common Organism Field Guide on P.14 for plant photos.)

Environmental characteristics:

1. The temperature is generally high and is exposed to sunlight
2. Unstable and loose substrate
3. Salinity in the substrate fluctuates
4. Interchanging oxygenated and anoxic state in the substrate
5. Sometimes saturated by the tide and sometimes surrounded by dry air

Importance of mangroves:

1. Act as natural barrier to absorb the impact of waves, prevent soil erosion
2. Fallen leaves provide food sources for marine life
3. Complex root systems provide a suitable nursery ground for marine life
4. Filter harmful substances in the water
5. Carbon sequestration and alleviate the effects of climate change

Suggested Activity 1:

Observe the biodiversity in the mangroves

Objective: To explore the mangrove ecosystem and its importance.

Activity content:

1. Divide the students into groups and ask them to observe the animals found inside the mangrove forest and their distribution (please refer to Pak Nai Field Guide).
2. Emphasize the ecological services of mangroves.



Field Trip Rundown

Checkpoint 3 - Mudflat

Location: Mudflat

Duration: 30 minutes

Teaching content:

Intertidal Mudflat:

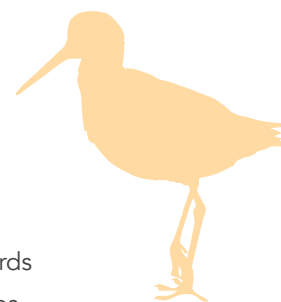
- The intertidal mudflat is one type of wetland habitat that connects the ocean and land. Most mudflats are located along the coasts, away from intense waves, and the mudflat is formed by the natural deposition of fine silt and clay. As the mudflats are located in the intertidal zone, it is exposed to the air and the sun during low tide and immersed in the sea during high tide. Therefore, organisms living in the mudflats have evolved to adapt to this extreme changing environment, similar to those organisms living in mangrove forests.
- The mud is rich in organic matter with an abundance of algae growing on its surface. The sediment is fine, and the oxygen content is generally low, creating an anoxic environment that is favorable for the growth of Sulphur bacteria. These algae, bacteria and other organic matter are the food source of invertebrates such as oysters, shellfish, conchs and crabs. Fish and birds, in turn, feed on these invertebrates. Therefore, the mudflat can support rich biodiversity and a large number of organisms and be an important replenishment station for migratory birds.
- There are many mudflats in Hong Kong, located in areas such as Mai Po, Deep Bay, Pak Nai, Luk Keng and Tsim Bei Tsui. In the past, mudflats were thought to have no economic value with an unpleasant environment, resulting in many mudflats being reclaimed and converted into agricultural land, shrimp pond, fishpond or for development. Today, mudflats still face threats of being excavated, used for artificial seawalls and converted for other purposes, in addition to suffering from water pollution and overharvesting.

Environmental characteristics:

1. Connects the sea and ocean
2. Waves with less energy
3. Affected by the tide, sometimes exposed to the air or sometimes immersed in seawater
4. Sediment is small and can hold a large amount of organic matter

Ecological value and its importance:

1. Support rich biodiversity
 - ◆ Commonly found animals: mudskippers, fiddler crabs, egrets, horseshoe crabs, oysters, razor clams
 - ◆ Commonly found plants: seagrass, i.e., Beccari's seagrass
2. Rich in food resources, an important replenishment stop for migratory birds
3. Suitable nursery and feeding ground for marine life, such as fish and crabs
4. Nursery ground for two local horseshoe crab species – Chinese horseshoe crabs and mangrove horseshoe crabs



Field Trip Rundown

Checkpoint 3 - Mudflat

Teaching content:

Invasive Plant: Common cordgrass (*Spartina anglica*)

- This invasive species can be found along the mudflat. It is fast-growing, has a high tolerance to salt and flooding, and with roots firmly anchored in the soil, it is able to withstand strong wind and waves. These characteristics cause it to over-occupy mudflats and mangroves and quickly turn them into grassland, leaving organisms to lose their habitat. In some cases, their growth has caused the widespread death of shellfish, crabs, algae, fish and other animals. Cordgrass spread will also block waterbirds and other animals from foraging.
- In 2000, common cordgrass was listed as one of the World's Worst Invasive Alien Species by IUCN.



Suggested Activity 1: Mix-and-Match seafood found on the mudflat

Objective: To understand that the mudflat is the nursery ground of many marine organisms, including many seafoods that are commonly in Hong Kong. The mudflat is not as distant as it seems as it actually has a direct relationship with our daily life.

- Activity content:**
1. Teachers can ask the students to observe the organisms found on the mudflat and ask them where they can find these animals in daily life.
 2. Teachers can list a few kinds of seafood found in the wet market, such as fish, shrimp, crab, razor clams, and then ask the students to search for their juveniles on the mudflat. (The teacher can also prepare some photos to help the students recognize the seafoods.)
 3. Students will understand that the mudflat is a nursery ground for many marine organisms.

Suggested Activity 2: The effect of common cordgrass

Objective: To understand and view the impact of invasive common cordgrass through comparing the differences between the mudflat and cordgrass habitats.

- Activity content:**
1. Lead the students to an area with common cordgrass and a mudflat without common cordgrass. Record the differences between two sites, including the properties of the soil (soil moisture, temperature, fineness of the sediment), environmental characteristics, abundance of species, etc.
 2. Ask the students to think of the mudflat as an organism and how their life could be affected if the mudflat was turned into grassland.

Field Trip Rundown Activity Debriefing

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

Duration: 30 minutes

Suggested activity 1

Activity content: After the field trip, the teacher can split the students into small groups to discuss and report to the class, and then the teacher can summarize the findings and debrief. Suggested time for discussion is five minutes and reporting is two minutes per group.

Discussion questions	Teaching objectives
<ul style="list-style-type: none"> Name the most interesting organisms found today, explain with one of the characteristics of that organism 	<ul style="list-style-type: none"> Point out the importance of biodiversity
<ul style="list-style-type: none"> Describe something that happens on land or on the mountain that will affect the marine environment 	<ul style="list-style-type: none"> Emphasize that the environments of the mountain and the ocean are closely connected to each other; things that happen on land will affect the sea Put personal practices into consideration as our choices will also affect the environment
<ul style="list-style-type: none"> List the threats faced by mangroves and mudflats and discuss how to protect them 	<ul style="list-style-type: none"> Point out that each person has the responsibility to protect the environment, starting from their own choices/actions, and they can take initiative to reflect their opinions to the government



Photo credit © Nicole Kit unless otherwise noted.

Commonly found invertebrates in Pak Nai (A)



Chinese horseshoe crab



Mangrove horseshoe crab



Mantis shrimp



Pistol shrimp



Fiddler crab



Metopograpsus sp.



Pyrhila sp.



Sentinel crab

Commonly found invertebrates in Pak Nai (B)



Hong Kong oysters



Rock oysters



Mussel



Razor clam



Barnacles



Sea slug



Snail

Commonly found vertebrates in Pak Nai



Black kite



Collared crow



Common kingfisher



Common sandpiper



Chinese pond heron



Little egret



Blue mudhopper



Shuttles hoppfish

Commonly found plants in Pak Nai



1 *Kandelia obovata*



2 *Avicennia marina*



3 *Acanthus ilicifolius*



4 Beccari's seagrass



5 *Sonneratia caseolaris*



6 *Sonneratia apetal*



7 *Bidens pilosa*



8 Common cordgrass



Pak Nai Field Trip Worksheet

Name: _____ Class: _____ () Date: _____



1. Geographical information of Pak Nai

Pak Nai is located at the _____ side of Hong Kong with its back to the mountain and facing the sea. Its back is _____ facing _____. It is located near the border, opposite _____.

2(A). Oyster Reefs

Please list out three benefits oyster reefs can bring to the environment:

1. _____
2. _____
3. _____

2(B). Mangroves

Please list out three environmental characteristics of mangroves:

1. _____
2. _____
3. _____

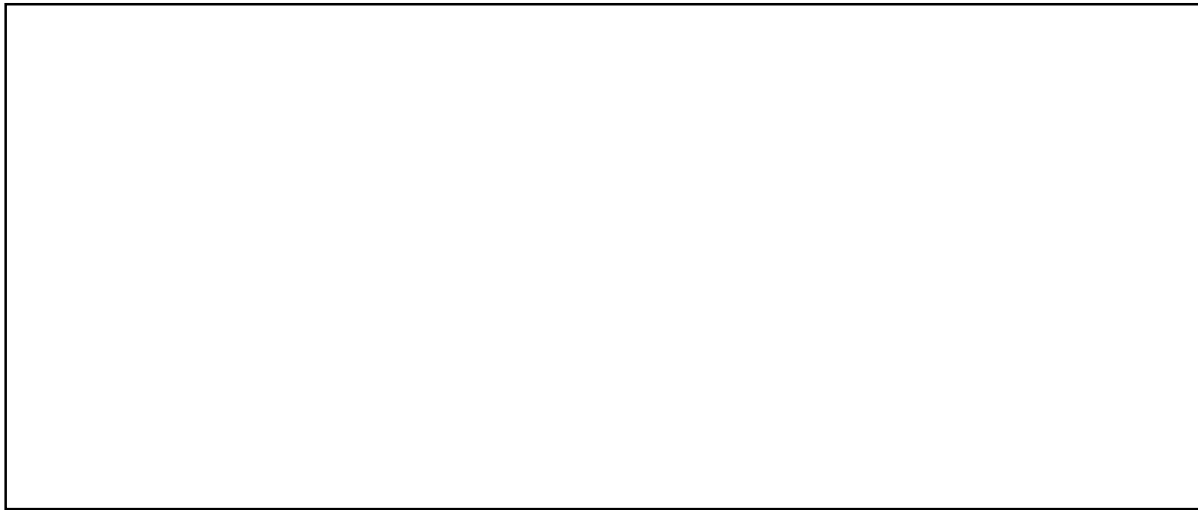
2(C). Mudflat

How do mudflat animals adapt to the environment? Please list out two examples.

1. _____

2. _____

Please draw two marine organisms that you found on the mudflat and write down their names:



2(D). Common Cordgrass

Please list out two negative impacts of common cordgrass that affects the animals living in mudflats and mangroves:

1. _____

2. _____

3. Protect Pak Nai

(A). What is the "Ridge to Reef" concept? Please explain with a specific example.

(B) Why should we protect mudflats and mangrove habitats?

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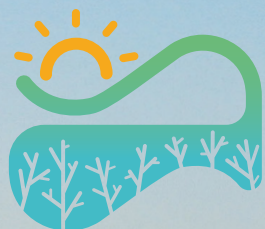


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「山海為一」環境教育計劃

“Ridge to Reef” Environmental Education Programme

Pak Nai “Kon Pak Stream” Field Trip Teacher’s Manual

Target audience

Students from secondary 4 to 6

Related subject

Geography

Themes

- “Ridge to Reef” concept
- Fluvial process and landform features
- Strategies to tackle river problems
- Ecology of water stream

Suggested field trip duration

Three hours with traveling time (can be adjusted according to teaching content and weather conditions)

Suggested student to teacher ratio

30 to 2

About this manual

The field trip manual is designed for secondary 4 to 6 geography students, to help facilitate the exploration of the ecology and environment of water streams and rivers in Hong Kong, understand the “Ridge to Reef” concept and UN sustainable development goals. The teacher’s manual includes: field trip route; suggested teaching objectives; identification charts of commonly found organisms; and student worksheets.

Key Words

“Ridge to Reef,” river, water stream, sustainable development goals, sustainable development goals (SDGs), Kon Pak Stream

Project Brief

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Through the field trip in Pak Nai, teachers can guide students to think about some of the SDGs and related targets and discuss their relations with Hong Kong and our daily life.

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Sustainable Cities and Communities

Make cities and human settlements inclusive, safe, resilient and sustainable.

Cities and metropolitan areas are the sources of economic growth, and they are accountable for about 70 percent of global carbon emissions. Rapid urbanization also leads to various environmental problems, such as pollution, sanitation, sewage and waste, freshwater supply and land-use problems. Therefore, development is closely related to the environment. To protect the Earth's environment and reduce negative impacts, urban development must comply with the principles of sustainable development.

By exploring the natural environment of the streams, students can understanding how the river is being managed, and they can learn about the livelihoods of local farmers and the impacts of nearby development. Students can reflect on the difficulties of maintaining the balance between people and nature so they can thrive together.

Related targets:

- 11.4** Protect the world's cultural and natural heritage
- 11.6** Reduce the environmental impact of cities

SDG

12 RESPONSIBLE CONSUMPTION AND PRODUCTION



Responsible Consumption and Production

Ensure sustainable consumption and production patterns.

The consumption and production of natural resources promote economic growth but causes problems such as pollution and over-exploitation. In order to protect and reduce the impact on the environment, we must consume and produce responsibly.

By closely investigating the issue of littering that is a byproduct of irresponsible consumption, students can understand the importance of adapting a sustainable lifestyle.

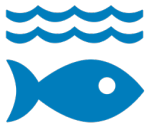
Related targets:

- 12.2** Sustainable management and efficient use of natural resources
- 12.8** Promote sustainable lifestyles in harmony with nature
- 12.B** Sustainable tourism that creates jobs and promotes local culture and products

SDG

Life Below Water

14 LIFE BELOW WATER



Conserve and sustainably use the oceans, seas and marine resources.

The ocean occupies 70 percent of the Earth’s surface, provides food and energy to humans and plays an important role in elemental cycling , oxygen supply and climate control. To protect marine resources, we have to reduce pollution and overfishing.

Field trips allow students to understand: the biodiversity of coastal estuaries and mangroves; how ecosystem services can benefit humans; and the importance of protecting our marine ecosystem.

Related targets:

- 14.1 Prevent and significantly reduce marine pollution, especially from land-based activities
- 14.2 Coastal ecosystem protection and management
- 14.5 Conserve coastal areas

SDG

Life on Land

15 LIFE ON LAND



Sustainably manage forests, halt and reverse land degradation, halt biodiversity loss.

Terrestrial ecosystems are as important to human survival as the ocean, providing oxygen, pollinating crops and providing resources such as food. Human activities have transformed the terrestrial ecosystems and threatened many terrestrial life forms. As a result, human livelihoods, economy, health and quality of life are also affected.

Through the field trips, students can understand the concept of “Ridge to Reef” and the close relationship between the land and the sea. Students can also learn how changing land use affects the surrounding land and ocean environment.

Related targets:

- 15.1 Ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and dryland
- 15.2 Sustainable management of forests, halt deforestation, restore degraded forests and increase afforestation and reforestation
- 15.5 Reduce the degradation of natural habitats, halt the loss of biodiversity and protect and prevent the extinction of threatened species
- 15.8 Prevent the introduction and reduce the impact of invasive alien species on ecosystems

Sustainable Development Goals (SDGs)



Preparation

Materials and tools:



Record forms and stationery



Binoculars



Drinking water



Rain gear



Tray, forceps and magnifying glasses for observing organisms



Mudflat organism field guide and ID charts



First aid kit



Outdoor gear:

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

Transportation

Green minibus:

- From the Yuen Long MTR station, it is about a 10-minute walk to the Tai Fung Street green minibus station. Take the number 33 minibus to Pak Nai Ap Tsai Hang.

Coach:

- As the road is narrow and rough, a 28-seat coach is the largest recommended size.
- Coaches can park at "App Store Cafe & Barbecue," but reservations must be made in advance. (Contact information - address: 283A, Nim Wan Road, opening from 2:00 – 7:00 p.m., Monday to Sunday, phone: 9804 3042)

Green Taxi:

- A green taxi from Tin Shui Wai MTR station to Pak Nai costs about \$80 and takes about 15 minutes.

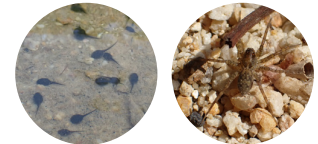
Reminders and Safety Recommendations:

Before the trip:

- Teachers should explain the field trip arrangement, schedule, suggested gear and safety recommendations to the students.
- Teachers should check the weather forecast on the Hong Kong Observatory website.
- Teachers should check the boundary of Tsing Shan Firing Range and access the government's press releases on their website, to avoid entering firing range areas.

During the trip:

- Participants should wear light-colored, long-sleeved clothing and a hat to protect from sunburn and heatstroke. Bring plenty of drinking water. Wear protective shoes, such as sports shoes or water boots.
- Open-toed slippers or sandals are not suitable.
- As students may come into contact with the stream water and wildlife during the field trip, teachers can recommend using ocean-friendly sunscreen and physical barriers for mosquitos. Avoid using chemical sunscreens to prevent contamination of the water.
- Teachers should pay close attention to the current weather condition and rainfall on-site to ensure that students have sufficient time to leave safely.
- Respect wildlife. Do not shout or yell in the field, or touch, interfere or harm organisms during observation. Be careful to not step on animals while walking.
- Do not take any animal, plant or anything that belongs in the field. Only trash should be taken away from the natural environment.



Weather

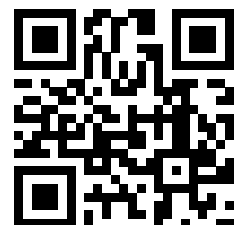
- If the Hong Kong Observatory issues the following signals two hours before the trip starts, teachers should consider canceling the field trip:
 - ◆ Strong Wing Signal, Typhoon Warning Signal No. 1 or above
 - ◆ Any Rainstorm Warnings (i.e., Amber, Red and Black)
 - ◆ Regional Thunderstorm Warning
 - ◆ Very Hot Weather Warning

Be a citizen scientist - iNaturalist

Before the field trip, teachers can invite students to download the 'iNaturalist' app on their mobile devices. 'iNaturalist' can be used to record species observed in the field. When students upload a photo of an organism to the app and have the 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.

Species distribution in Pak Nai and Kon Pak Stream:

<http://www.inaturalist.org/projects/pak-nai-ecological-survey>



Field Location and Route

Kon Pak Stream, also known as Ap Tsai Hang, is located northwest of Hong Kong. The river source originates from Kon Shan inside the Castle Peak Hinterland. The primary water stream flows southeast to northwest, and eventually the stream water discharges into Deep Bay via Pak Nai. The riverbed of the Kon Pak Stream is quite sandy, and the stream water sometimes has a milky color, because the stream passes through the heavily eroded Castle Peak Hinterland, where granite is the major rock type, which is vulnerable to weather during Hong Kong's monsoons and heavy rain. The Kon Pak Stream forms a dendritic drainage pattern on the map.

Pai Nai is not only famous for watching sunsets and coastal exploration, the estuary and lower course of the Kon Pak Stream are also suitable for exploration and studying the fluvial process, landform features, water stream ecology and the "Ridge to Reef" conservation approach.

The middle and upper courses of the Kon Pak Stream are within the Tsing Shan Firing Range, which is a restricted military zone that is prohibited to enter. There are signs located along the boundary of the military zone to remind visitors. In addition, red flags or red lamps will be hoisted at the firing areas before and during firing practice. More details can be accessed from the Hong Kong government's press releases.



Field Trip Rundown Checkpoint 1 - Estuary

Location: Coastal estuary

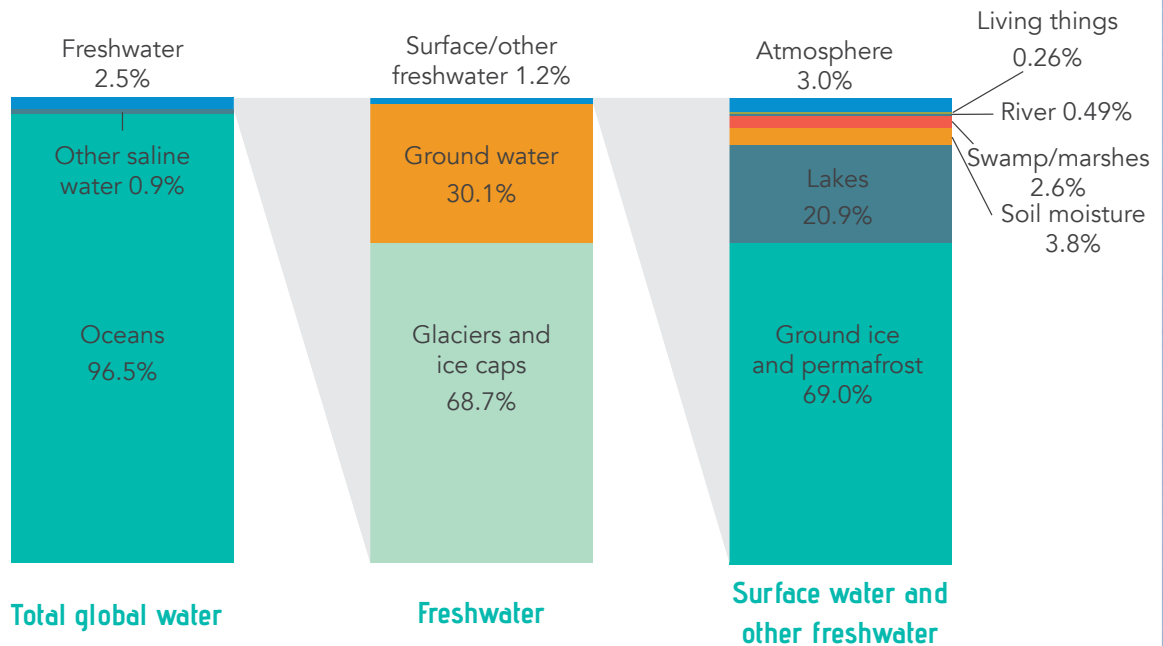
Duration: 30 minutes

Teaching content:

Hydrological Cycle

The stream water from the Kon Pak Stream flows via the estuary in Pak Nai to Deep Bay all year round. Even though the amount of stream water will be less in the dry season than the wet season, why wouldn't the stream water dry up completely? Which factors cause Kon Pak Stream to be a perennial stream?

Only 3 percent of the Earth's water resources are freshwater. They are distributed along streams, lakes, in soil (as groundwater) and ice caps, etc. And the rest – 97 percent – of the Earth's water resources are stored as seawater in the ocean. The hydrological cycle, also known as water cycle, is vital for the Earth, because it can ensure we, human beings, and the wildlife living on this biosphere, especially those living on terrestrial ecosystems, can access clean freshwater for survival. Water usually exists as a liquid, however it can also exist as a solid (e.g., ice) or as a gas (e.g., water vapor or steam), depending on its surrounding temperature and pressure.



Data source: Igor Shiklomanov. World fresh water resources. in Peter H. Gleick (editor), 1993, *Water in Crisis: A Guide to the World's Fresh Water Resources*.

The hydrological cycle means that water, through the absorption of heat from the sun, continuously moves between different reservoirs and reaches an equilibrium stage. The water on Earth is stored in three different reservoirs: ocean, land (including groundwater) and atmosphere. When water moves between these reservoirs, its state is also converted. For example, liquid water stored in the sea and vegetation is heated by absorbing heat from sunlight, and it will evaporate as gas into the atmosphere. When the water vapor cools down, it forms a droplet, and a concentration of droplets will form a cloud. When there is precipitation, such as rain or snow, water is returned to land and sea as liquid. If precipitation falls on land, the water will be absorbed by vegetation or into the soil. Alternatively, it can be collected by the river. If the temperature is low when the precipitation falls, the water may be a solid like snow or hail.

Field Trip Rundown **Checkpoint 1 - Estuary**

Teaching content:

Estuary

An estuary is a partially enclosed coastal body, with one or more rivers or streams flowing into it, that is freely connected to the sea. An estuary will be affected by tides, waves and seawater from the sea, as well as by sediment and freshwater from the rivers. An estuary is an area with brackish water and continuously receives organic matter from rivers. For example, fallen leaves can be carried from the middle and lower course of the stream. Therefore, the estuary's brackish water is usually full of nutrients that makes it a highly productive natural habitat. This is why communities often use the estuary for aquaculture cultivation.

Common geological features of an estuary are low basin gradient and low basin altitude.

Due to the brackish water and loose sediment, mangrove stands, mudskippers and seagrass are commonly found in the estuary, because they can adapt to these environmental factors. Sometimes large estuaries can also attract water birds, horseshoe crabs and larger mammals.



Field Trip Rundown **Checkpoint 2 - Lower Course**

Location: Lower course

Duration: 30 minutes

Teaching content:

How does rainwater enter streams?

Precipitation is when the condensation of water vapor from the atmosphere falls to the land. Precipitation is one of the important processes in the hydrological cycle. Rain is the most common type of precipitation in Hong Kong, and rainwater can fall directly into streams or enter streams through overland flow, throughflow and groundwater flow.

Overland flow is when rainwater falls to the ground and then the water flows into the stream from the surface of the land. Throughflow is when rainwater infiltrates the soil and then flows into the river. And groundwater flow is when rainwater infiltrates the soil, down into the rocks and then into groundwater through percolation, finally entering the river as groundwater.

Channelization

The lower course of the Kon Pak Stream is close to the road, where man-made channelization (concrete) covers some of the riverbank to prevent river overflow and flooding during wet season. But the natural river channel environment and its biodiversity are being affected. Channelization is an example of a hard strategy, meaning to alter the river using a man-made structure. Since the Kon Pak Stream carries lots of sediment from the mountain to the lower course, the government regularly dredges to deepened the channel and to increase the bankfull discharge.



Field Trip Rundown **Checkpoint 3 - Lower Course**

Location: Lower course

Duration: 30 minutes

Teaching content:

Landform features in the lower course

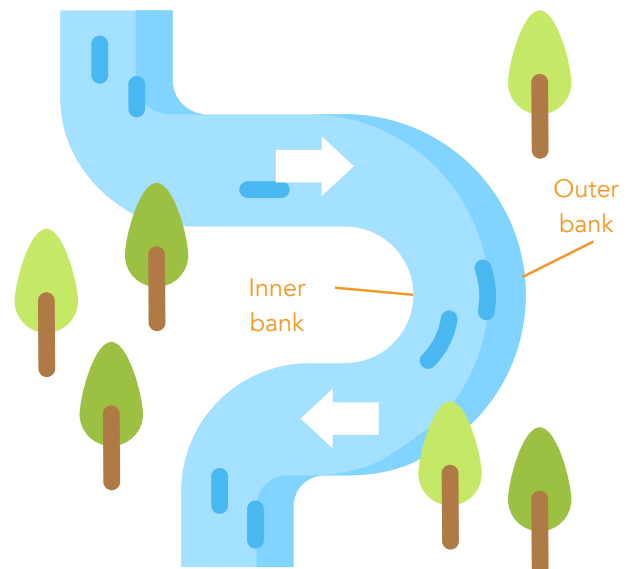
The lower course usually has a higher volume of flow, because it is where the tributaries merge together. The river valley becomes flat, widened and smoother due to lateral erosion. Because of the fluvial transportation and lateral erosion, the loads are smaller in size but the amount of load increases. In general, the lower course has a higher flow volume, faster flow speed and higher river energy.

When we walk up from the lower course towards the source, we can gradually observe the difference in landform features between the lower course and the middle course. The most obvious change is an increase in altitude and gradient, as well as the valley becoming more narrow and forming a wider-shaped V. Other changes, like the size of the sediment load, increase and become rougher.



Meander

Meanders are a major fluvial landform feature in the lower course, and they form the concave (outer) and convex (inner) bank. Water flows faster on the concave banks, and water flows slower on the convex bank, and sediment on the convex bank is usually smaller and finer than on the concave banks.



Field Trip Rundown **Checkpoint 3 - Lower Course**

Teaching content:

Stream ecology

According to data from the Agriculture, Fisheries and Conservation Department (AFCD), the total length of natural rivers and streams is about 2,500 km with most located in rural areas. These natural rivers and streams are ideal habitats for wildlife. A natural stream or river refers to a channel that is naturally fed with water from upper terrains that covers both perennial streams and intermittent streams. The streambed is made of natural elements, such as a mixture of bedrock, boulders, cobbles, gravels, sand, silt and/or clay. The banks are also largely natural and defined and covered with vegetation.

The stream ecosystems are important habitats for freshwater fish, shrimp, amphibia and insects, and they are also ecological indicators of the stream. In general, the more ecological indicators in the stream, the cleaner the stream is.



Development planning and legal protection by-laws

We need to try our best to protect the natural ecology of streams and rivers, especially those with high ecological value and rare species. According to the "Country Park Ordinance," Hong Kong has about 40 percent of its land designated as country parks, and all the streams and rivers within country park areas are protected by this ordinance. For streams and rivers outside country park areas, they are also protected by the "Town Planning Ordinance," the "Environmental Impact Assessment Ordinance" and the "Water Pollution Control Ordinance."

Construction and development work can only be conducted when it serves an urgent public need and is approved by the environmental impact assessment under the ordinance. However, measures must be designed and implemented to prevent direct impacts to the environment during construction. If the impacts cannot be avoided, they need to be reduced and ecological mitigation measures must be conducted after the construction.

Field Trip Rundown **Checkpoint 4 - Activity Round-up**

Objective: To solidify the geological knowledge of the river, stream ecology and “Ridge to Reef” concept after the field trip.

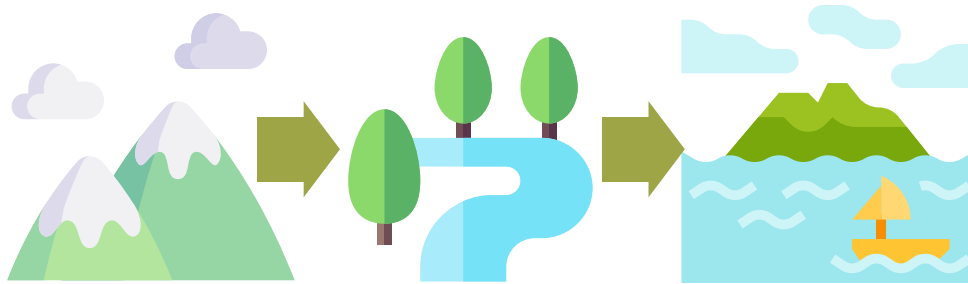
Duration: 30 minutes

Teaching content:

“Ridge to Reef” Concept

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. Therefore, the International Union for Conservation of Nature (IUCN) has proposed the “Ridge to Reef” (R2R) conservation initiative to link the river basins from land to coast, to better manage water resources and ecosystems. This initiative also applies to Hong Kong, because it is a coastal city, and proper management of coastal areas’ ecosystems and estuaries can support people’s livelihoods and increase income from fisheries and tourism.

In some Asian and Latin American cities, improved watershed management has benefited the coral reef system and improved people’s quality of life and well-being.



Personal actions to protect the stream, coast and sea

- **In our daily life**

- ◆ **Choose organic crops**

Most farmers apply chemical fertilizer to increase crop yield. However, chemical fertilizers can discharge into streams during heavy rain, and then further reach the coast and sea carried by streams. If the concentration of chemical fertilizers is high and there is sufficient sunlight, algal blooms (e.g., red tides) may occur on coasts and cause animal suffocation, which is a direct, negative impact on marine animals. In contrast, organic farming practices do not apply any chemical fertilizer to the soil, and the effects to the soil and stream are reduced. You can purchase more organic crops from the market to encourage more farmers to practice organic farming.



Field Trip Rundown **Checkpoint 4 - Activity Round-up**

Teaching content:

Personal actions to protect the stream, coast and sea

- **In our daily life**

- ◆ **Reduce water consumption**

Our household sewage in Hong Kong is eventually discharged into the sea. Even though the sewage collected in urban areas is treated before it is discharged, it is very hard to process the sewage back to cleanliness levels. Hong Kong people use 130 L of water per person per day, which is much higher than the global average of 110 L. Therefore, a reduction in water consumption can directly reduce the sewage that ends up in the sea.

- ◆ **Replace household chemical detergents with natural substitutes**

Detergents, shampoo and washing powder are all chemicals, and they will discharge to the sea eventually. Replacing these chemical products with natural substitutes such as tea seed powder, vinegar, lemon or warm water can help reduce water pollution.

- **In the countryside**

- ◆ **Pay extra attention when using fire**

Lighting or using fire in the country parks is not only illegal, it can lead to hill fires. Hill fires not only burn trees and vegetation but burn their root systems. When barren land loses roots from plants, it loses its ability to hold soil and will increase soil erosion during heavy rain, causing sediment to discharge into the sea and coast through rivers.

- ◆ **Take away your litter**

Most of the litter found in the sea and on the coast is the result of human activities on land. By taking away your litter when you are in the countryside, you can avoid litter entering nature and the sea that will affect the marine ecosystem. Even better, make it a daily practice to reduce single-use materials and choose reusable products. If possible, you can also help clean up and take away litter that you find when you are in nature.



Field Trip Rundown **Checkpoint 4 - Activity Round-up**

Teaching content:

Personal actions to protect the stream, coast and sea

- **In the countryside**

- ◆ **Use and walk on established hiking routes**

Walking on undeveloped hiking routes or stepping on the sides of the hiking trails damage the vegetation. Land that is frequently stepped on by visitors decreases its water storage ability and makes it harder for plants to grow again. This also makes it easier for topsoil to be washed away by rain and increases the sediment in streams and estuaries.



Sustainable Development Goals (SDGs)

- ◆ The 17 sustainable development goals were proposed by the United Nations in 2015 as a blueprint to achieve a better and more sustainable future for all. These 17 SDGs are endorsed by all UN members and call for collaborative actions to reduce poverty and protect the natural environment so all humans can enjoy peace and prosperity.
- ◆ SDG 12, 14 and 15 are about responsible consumption and production and protecting life below water and on land. Details about SDGs can be found on page 2 and 3 of this booklet.



乾白石澗常見生物 - 脊椎類

Vertebrates



蒼鷺 Grey heron
Ardea cinerea



黑臉噪鶇 Masked laughingthrush
Garrulax perspicillatus



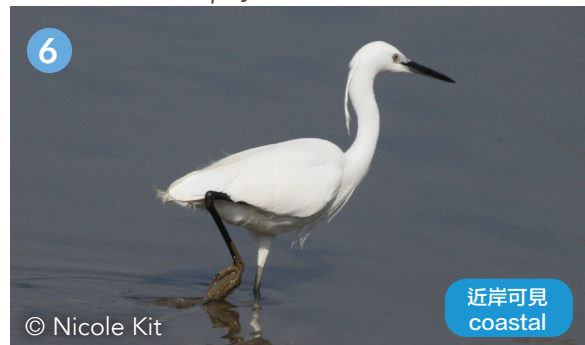
白胸苦惡鳥 White-breasted waterhen
Amaurornis phoenicurus



鵲鴝 Oriental magpie-robin
Copsychus saularis



金眶鸻 Lesser ringed plover
Charadrius dubius



小白鷺 Little egret
Egretta garzetta



野豬 Wild boar
Sus scrofa



黑眶蟾蜍 Asian common toad
Duttaphrynus melanostictus

乾白石澗常見生物 - 無脊椎類 Invertebrates



狼蛛科
Lycosidae



黑尾灰蜻 Common blue skimmer
Orthetrum glaucum



灰蝶科
Lycaenidae



紅鋸蚊蝶 Red lacewing
Cethosia biblis

乾白石澗常見生物 - 蕨類 Fern



芒萁
Dicranopteris pedata



小葉海金沙
Lygodium scandens



華南毛蕨
Cyclosorus parasiticus

乾白石澗常見生物 - 攀援植物 Climber



相思子 *Abrus precatorius*



魚藤 *Derris trifoliata*



海島藤 *Gymnanthera oblonga*



菟絲子 *Cuscuta chinensis*



薇甘菊 *Mikania micrantha*



五爪金龍 *Ipomoea cairica*

乾白石澗常見生物 - 草本植物 Herb



海芋
Alocasia odora



豬籠草
Nepenthes mirabilis



火炭母
Polygonum chinense

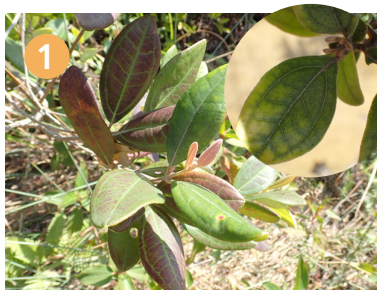


老鼠簕
Acanthus ilicifolius



方骨草
Hedyotis acutangula

乾白石澗常見生物 - 灌木 Shrub



崗稔
Rhodomyrtus tomentosa



土蜜樹*
Bridelia tomentosa



布渣葉*
Microcos paniculata



桐花樹
Aegiceras corniculatum



毛萼
Melastoma sanguineum



馬纓丹
Lantana camara

*土蜜樹和布渣葉可以被歸類為灌木或喬木。
Bridelia tomentosa and *Microcos paniculata* can be category as shrubs or trees.

乾白石澗常見生物 - 樹/喬木 Tree



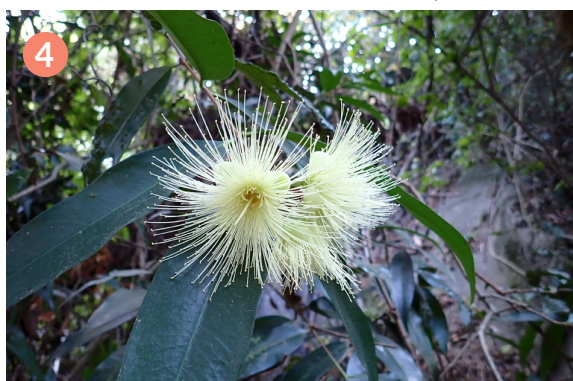
秋茄樹 *Kandelia obovata*



銀合歡 *Leucaena leucocephala*



鵝掌柴 *Schefflera heptaphylla*



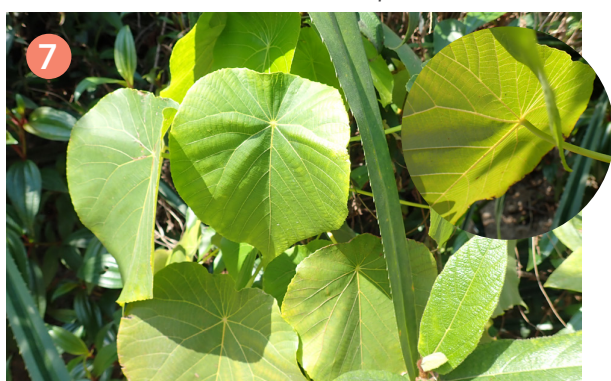
蒲桃 *Syzygium jambos*



海桑 *Sonneratia apetala*



無瓣海桑 *Sonneratia caseolaris*



血桐 *Macaranga tanarius*



露兜樹 *Pandanus austrosinensis*

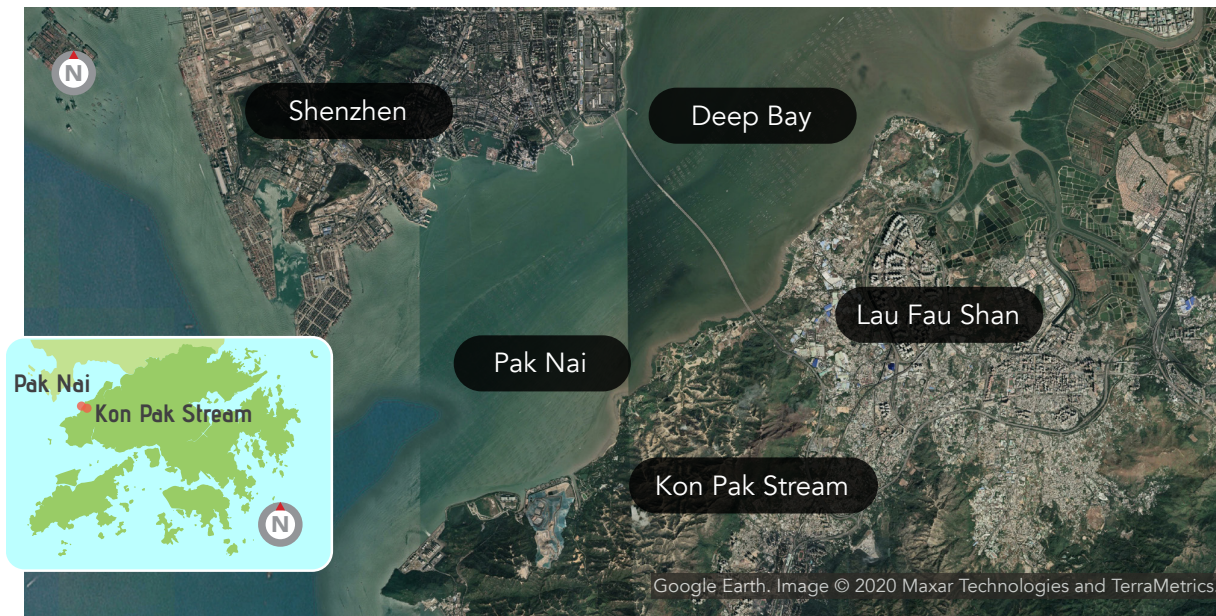
*露兜樹可以被歸類為灌木或喬木。
Pandanus austrosinensis can be category as shrubs or trees.



Pak Nai Field Trip Worksheet

Name: _____ Class: _____ () Date: _____

Before the field trip



1. Geographical information of Pak Nai "Kon Pak Stream"

Kon Pak Stream, also known as Ap Tsai Hang, is located _____ of Hong Kong. The river source originates from Kon Shan inside the Castle Peak Hinterland. The water of the main stream flows from _____ to _____, and eventually, the stream water discharges to Deep Bay via Pak Nai. The Kon Pak Stream forms a _____ drainage pattern on the map.

2. River basin and watershed

A river basin, also known as the river catchment area, is _____
 _____. The boundary of the river basin is called a _____.

Draw a dotted, red line on the map below to indicate the watershed of Kon Pak Stream.

3. Stream order

Stream order is a hierarchy to measure the size of a stream. Add numbers on the map below near the Koi Pak Stream and its tributaries to show the stream order. Koi Pak Stream is a _____
 _____ order stream.

During the field trip

1. Features of the rivers

Through experiment and observation during the field trip, complete the table and questions below:

Date: _____ Time: _____

Location: _____ Weather: _____

	Checkpoint (1) Estuary	Checkpoint (3) Lower Course	Change from (1) to (3)	Remarks/ other observations
Altitude				
Channel gradient				
Volume of flow				
Channel roughness				
River overall energy				

2. "Ridge to Reef"

"Ridge to reef" means through rivers and streams, everything that happens on land will have an impact downstream, including intertidal habitats, coasts and eventually, the sea. According to what you have observed during the field trip, the land on the side of the Koi Pak Stream has been used for farming and fishponds. How would this change in land use affect the wildlife in the Pak Nai mudflat and the water quality of Deep Bay? What suggestions can you propose to maintain the biodiversity of the mudflat and improve the water quality?

1 : 10 000





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After the field trip



1. From the drone photo above, list two human activities that may affect the stream basin:



2. The photos above show the flooding of the Ap Tsai Hang lower course in the summer of 2020. List two hard strategies and two soft strategies that could alleviate the flooding.

Hard strategies: _____

Soft strategies: _____

3. With Pak Nai being next to Deep Day, it attracts many migratory birds, such as the globally endangered black-faced spoonbill, seagulls and terns, that use it as a rest area for replenishment on their journeys. For these reasons, Pak Nai is designated as a "Site of Special Scientific Interest" (SSSI). As a follow-up to the previous question, if the government wants to solve the flooding issue, what suggestions would you give to the government authority? Would you propose hard strategies or soft strategies, why?
