Funded by

The Hong Kong Jockey Club Charities Trust

Organised by

The Nature Conservancy 大自然保護協會

賽馬會 Jockey Club
「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

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

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

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

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

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

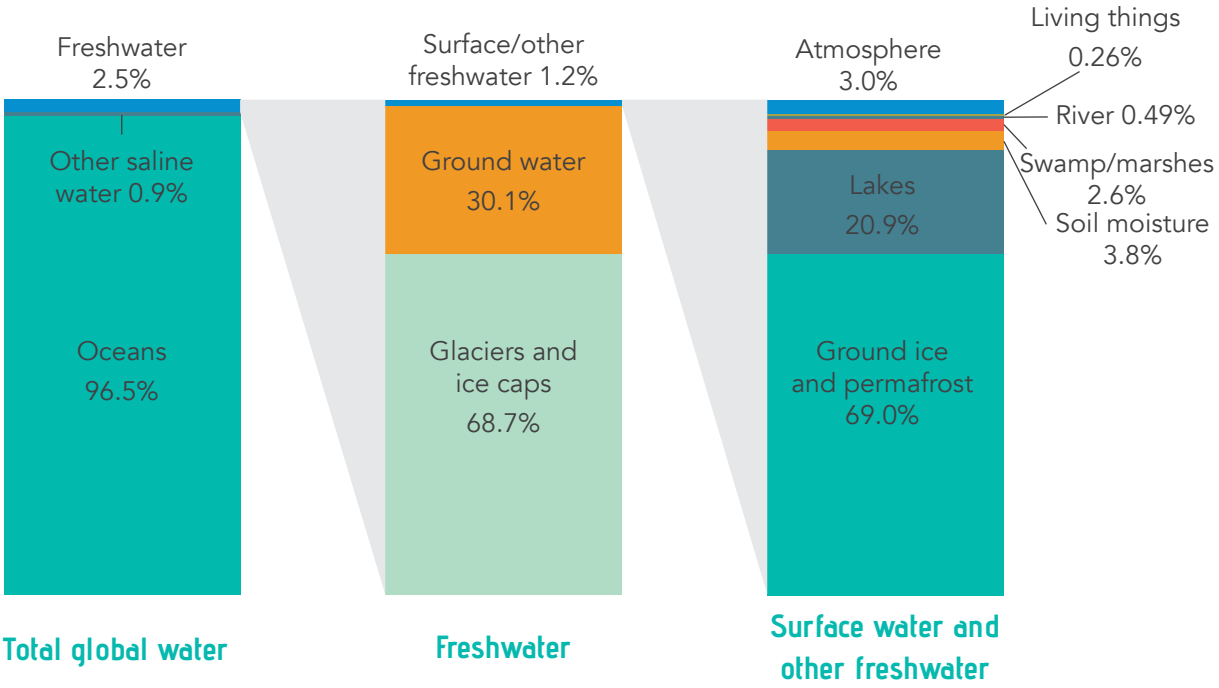
Duration: 30 minutes

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 (eidtor), 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:

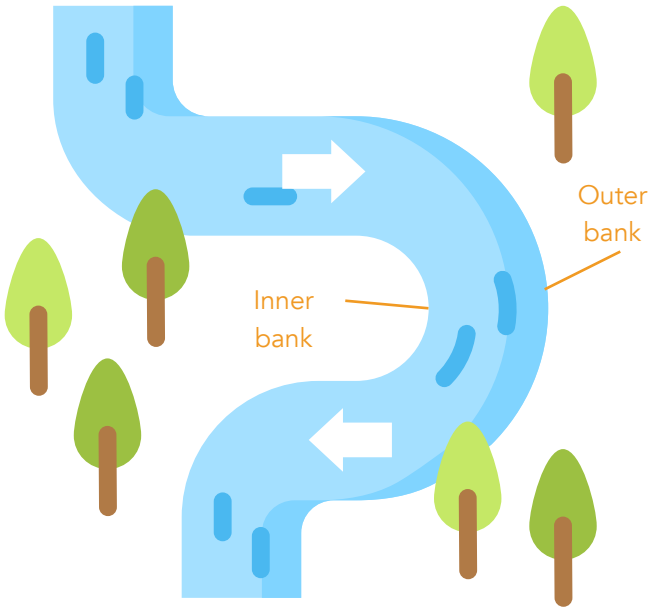
Landform features in the lower course

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.

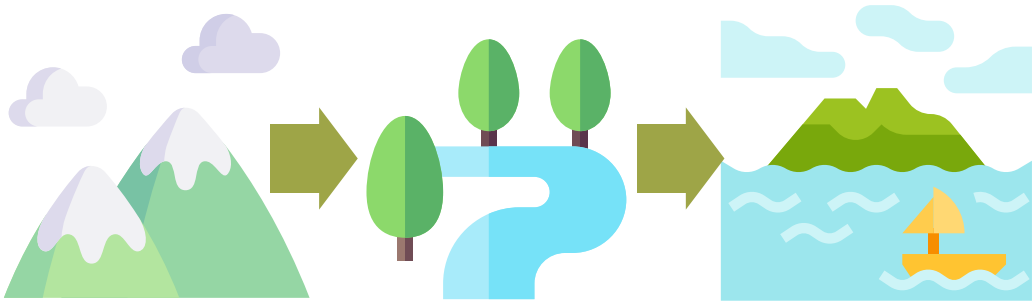
Duration: 30 minutes

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.

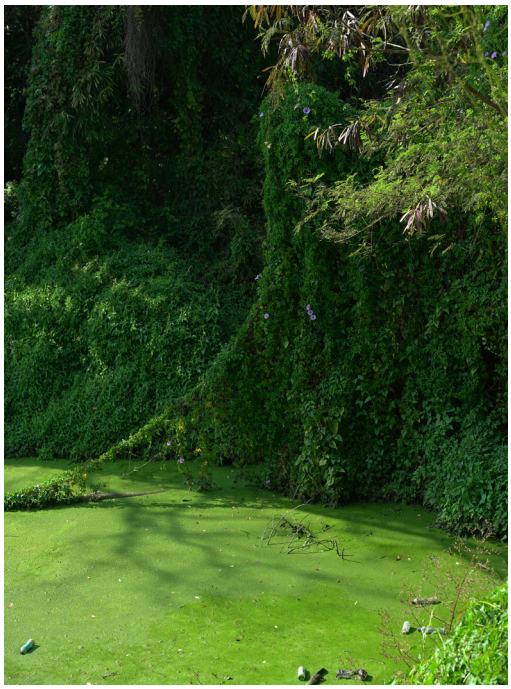
In some Asian and Latin American cities, improved watershed management has benefited the coral reef system and improved people's quality of life and well-being.



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

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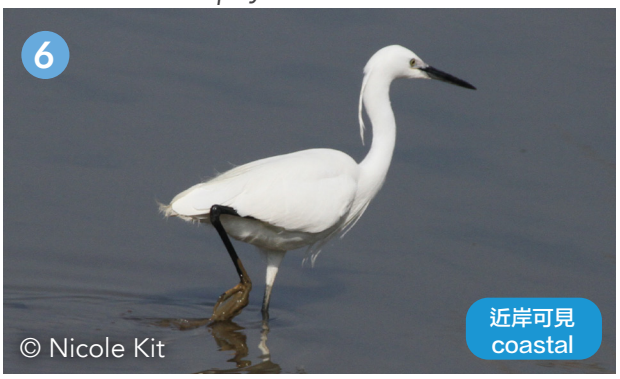
蒼鷺 Grey heron
Ardea cinerea

黑臉噪鶥 Masked laughingthrush
Garrulax perspicillatus

白胸苦惡鳥 White-breasted waterhen
Amaurornis phoenicurus

鵲鴝 Oriental magpie-robin
Copsychus saularis

金眶鴴 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

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狼蛛科
Lycosidae

黑尾灰蜻 Common blue skimmer
Orthetrum glaucum

灰蝶科
Lycaenidae

紅鋸蛺蝶 Red lacewing
Cethosia biblis

乾白石澗常見生物 - 蕨類 Fern

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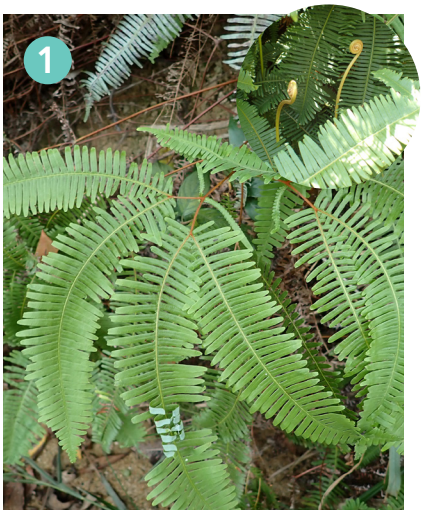
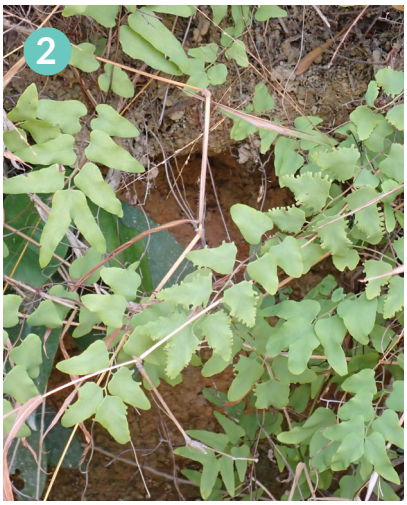


芒萁
Dicranopteris pedata



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

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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

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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

毛蒝
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

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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.

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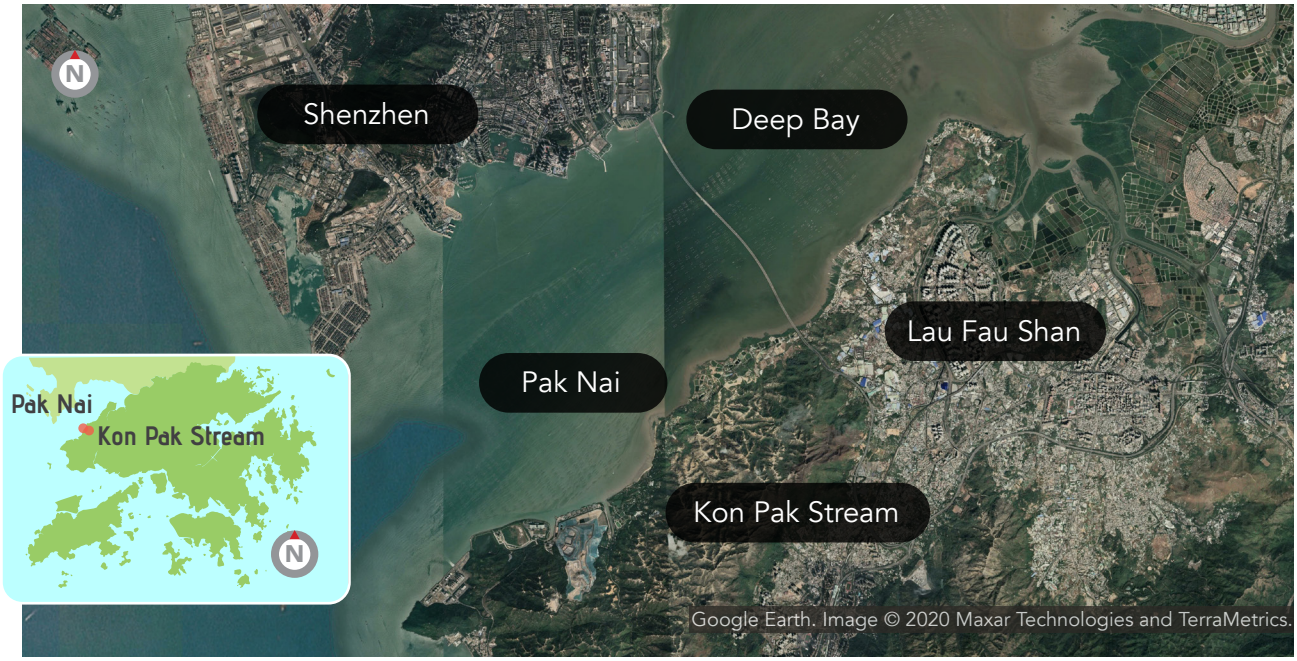
Pak Nai Field Trip Worksheet

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


NIM WAN RD
68
手榴彈
練靶場
Grenade Range
Tsing Shan Firing Range Boundary
188
100
200
NIM WAN ROAD
青山練靶場界線
106

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 stragegies: _____

Soft stragegies: _____

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?

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