STREAM ECOSYSTEM

STUDENT
HANDBOOK

Pre-trip Exercise 1 – Food Web of Stream Ecosystem

A food web shows how energy flows in an ecosystem. Answer the following questions according to the two food chains shown below.

Food Chain #1

Dead Leaves / Algae → Mayflies → Shrimp → Fish

Mayfly: An insect that spend most of their lifetime in aquatic environment.

Food Chain #2

Dead Leaves → Fungi/ Bacteria / Mayflies/ Caddisflies → Molluscs → Fish

**The arrows represent the energy flow of the ecosystem.*

1. Group the above organisms in different trophic level.

Trophic Level	Organisms
Decomposer	
Dead Organic Matter	
Producer	
Primary Consumer	
Secondary Consumer	
Tertiary Consumer	

2. Illustrate the relationship between different organisms in a stream ecosystem using a food web.

Stream Ecosystem

Field Trip Handbook

Field Site: Hok Tau, Pak Sin Leng Country Park

Duration: 110 minutes

Related Curriculum: S.4-S.6 Biology

- **Compulsory: Organisms and Environment**
- **Elective: Applied Ecology**

Learning Objectives:

Knowledge:

1. Examine the use of different water health indicators
2. Identify common species of freshwater stream
3. Recognize the relationships between different abiotic and biotic factors in freshwater streams

Skills:

1. Enhance scientific process skills: conduct practical work and primarily analyse data
2. Apply scientific language
3. Make accurate observations and measurements

Attitude:

1. Appreciate the high biodiversity in local stream ecosystem.
2. Recognise the effect of human activities on the stream ecosystem
3. Recognise the need and their responsibility to conserve local stream

Safety Code and Code of Conduct

A. Bring enough drinking water and outdoor equipment, including organic mosquito repellent and rain gear.
B. Wear shoes that cover the toes and heel.
C. Do not leave the group without the permission of teacher/ instructor.
D. When observing plant species, one should pay attention to the insects and animals that inhibit on branches and tree trucks. Avoid touching, disturbing, or hurting them.
E. Do not take away anything from nature. The fallen part of the plant can only be picked up for observation and should be put back in its original place.
F. Do not litter or pollute the natural environment.
G. Care for the environment and take your litter home.
H. Seek teacher/instructor's help if needed.

Equipment Checklist

Item	Quantity (per group)	✓
Field Trip Handbook	1-2	
Species Identificaiton Guide	1-2	
Pen/Pencil	2-3	
Clipboard	1-2	
Pairs of gloves (if needed)	1	
Sample Bottle (250mL)	1	
Portable pH Meter	1	
Dropper	1	
Refractometer	1	
DO Meter	1	
Data Logger	1	
White Tray	1	
Ruler (1m)	1	
Quadrat (0.5m x 0.5m)	3	
Rope	1	
Magnifier	1	
Viewing Box	1	

Photos of Equipment

DO Meter

Portable pH Meter

Refractometer

Data Logger

Ruler (1m)

Viewing Box

Any tray or container with a transparent bottom

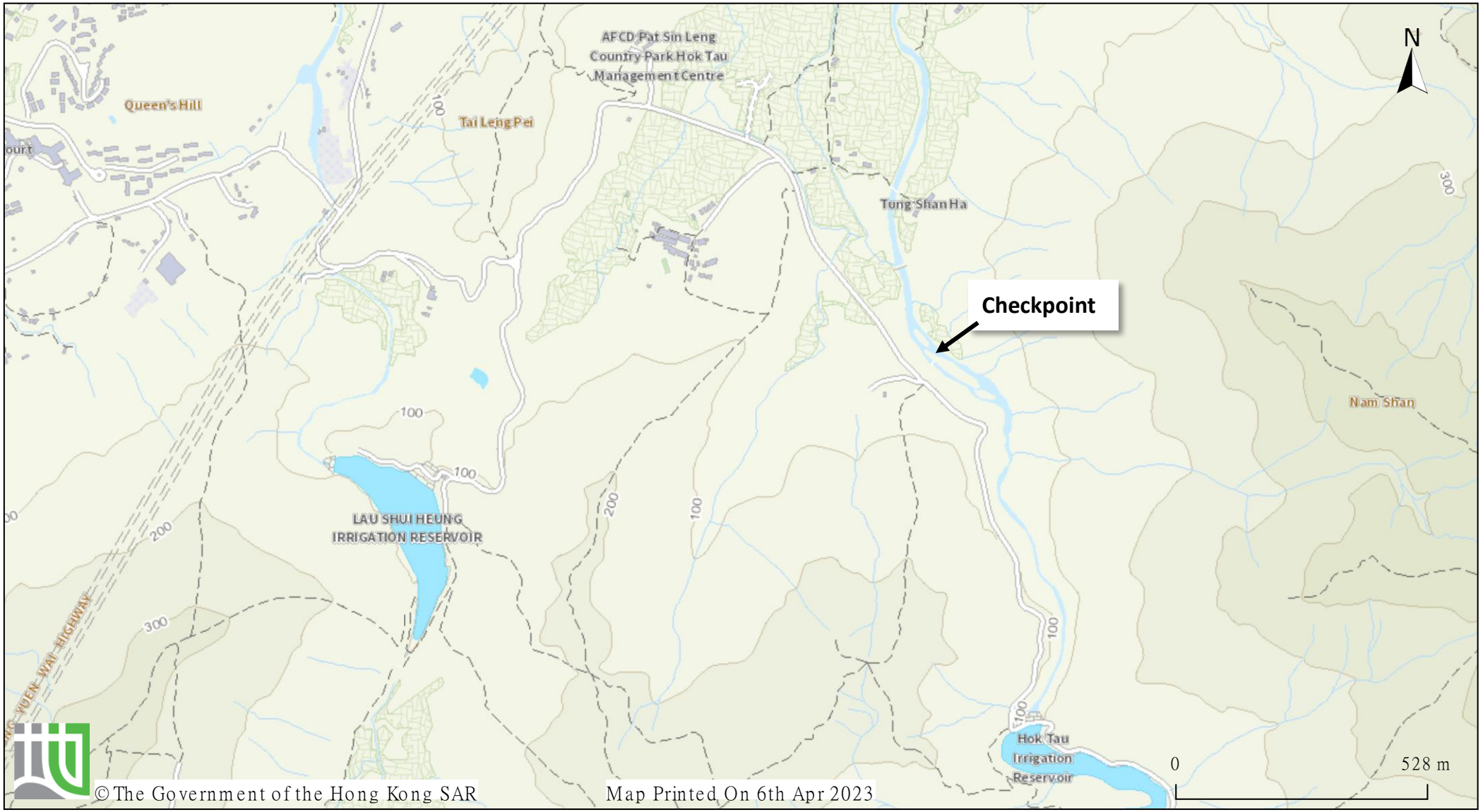
Sample Bottle (250mL)

White Tray

Map of Field Site

GEOINFO MAP 地理資訊地圖

Go to map: https://www.map.gov.hk/gm/geo:22.4981,114.1753?z=9028



Powered by GeoInfo Map: https://www.map.gov.hk

Note: The use of this map is subject to the Terms and Conditions and the IP Rights Notice of GeoInfo Map.

Activity 1. Water quality investigation: Using Physico-chemical Indicators

Investigate the water quality of the stream using physico-chemical indicators with the following steps:

Step 1. Collecting the water sample (Optional)

- Choose a point with well-mixed water (for example downstream of a riffle) to obtain water sample representative of the flowing stream.
- Collect water sample with a sampling bottle in the water of the chosen point.

Step 2. Measuring temperature (Physical Indicator)

- Place one of the measuring poles in the sampling water or the stream.
- Wait until the reading becomes stable.
- Read the temperature (°C/°F) from data logger and record the value on the field trip worksheet.

Step 3. Measuring dissolved oxygen (Chemical Indicator)

- Insert the probe of the DO (dissolved oxygen) meter in the sampling water or the stream.
- Wait until the reading becomes stable.
- Record the DO (mg/L) on the field trip worksheet.

Step 4. Measuring pH (Chemical Indicator)

- Insert the probe of the pH meter in the sampling water or the stream.
- Wait until the reading becomes stable.
- Record the pH on the field trip worksheet.

Step 5. Measuring salinity (Physical Indicator)

- Uncover the prism of the refractometer.
- Transfer 2 to 3 drops of sampling water onto the prism with a dropper.
- Close the cover of the prism. Make sure the water fills the rectangular outline completely without any air bubbles.
- Wait for 30 seconds.
- Hold the refractometer horizontally.
- Read the scale through the eyepiece of the refractometer.
- Record the salinity (‰) on the field trip worksheet.

Conduct each measurement three times

The needs of multiple-measurement

Random error may be caused by slight fluctuations in an instrument and the environment. In order to address random error, scientists **utilized repeated measurements (replication).**

Replication refer to repeating a measurement many times and taking the average.

Water Quality Investigation: Using Physico-Chemical Indicator

Equipment Checklist	
Items	**Quantity (per group)**
Pen/Pencil	**2-3**
Clipboard	**1-2**
Sample Bottle	**1**
Portable pH Meter	**1**
Thermometer	**1**
Dropper	**1**
Refractometer	**1**
Field Handbook	**1**
DO Meter	**1**
Data Logger	**1**
Light Torch	**1**

Time needed: 30 minutes

Venue: Hok Tau, Pat Sin Leng Country Park

Group work: Form a group of 4 to complete the following tasks

Background

A nearby resident is concerned about the impact of human activities on the health of the stream. Your team as professional ***inspectors*** are invited to investigate the ***water quality of the stream*** and identify if there is any ***potential pollution source*** nearby. Please follow the following steps to conduct the analysis.

1. IDENTIFY THE PROBLEMS

Discuss the following questions with your groupmates

- **What physico-chemical parameters are used to investigate water quality?**
- **What are the major sources of water pollution in Hong Kong?**
- **Which parameter do you think is more reliable in investigating water quality? Abiotic or biotic? Why?**

2. SET THE INQUIRY QUESTIONS

- **Develop an inquiry question based on your research**
- **Set the question(s) with "How, What, When, Who, Which, Why or Where"**

Suggested: What is the water quality of the chosen stream?

Optional: Set your own inquiry question

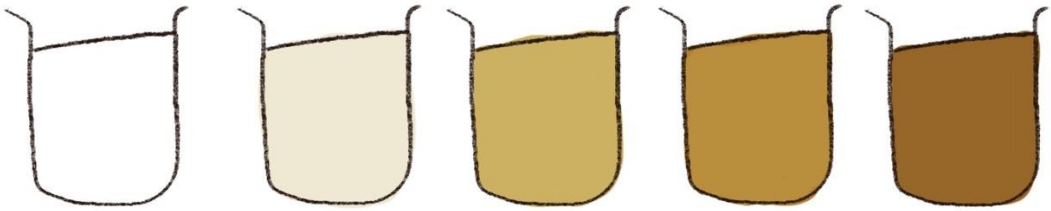
3. DATA COLLECTION

- **Record your data in "Primary Data Collection" Table.**
- **Present your data in an appropriate format.**

Primary Data Collection	
1	Record background information and qualitative observation.
2	Measure the temperature using a thermometer.
3	Measure the dissolved oxygen level using a DO meter.
4	Measure the pH using a portable pH meter.
5	Measure the salinity using a refractometer.

Primary Data Collection

Record your data collected in the following table:

Background Information				
Field Site:				
Date:				
Time:	HH:MM – HH:MM			
Investigators:				
Precipitation:	None / Light / Moderate / Heavy			
Qualitative Observation				
Stream Flow:	Dry / Scattered Pools/ Not Flowing/ Low Flow/ Moderate Flow/ High Flow/ Flooding			
Water Clarity:	(Very Clear) 1 2 3 4 5 (Very Murky) 			
Water Odour:	None/ Fresh Algae/ Chlorine/ Rotten Eggs/ Sewage/ Other:			
Physico-chemical Measurement				
	1st Trial	2nd Trial	3rd Trial	Average
Temperature (°C/ °F):				
DO (mg/L):				
pH:				
Salinity (‰):				

4. DATA ANALYSIS

Standards for physico-chemical indicators are set by authorities. Compare the data recorded in "Primary Data Collection" Table with the standard measurements.

TIPS: Check out Water Quality Reports by Environmental Protection Department and find ***Water Quality Objectives (WOQ)***

1. **Dissolved Oxygen (DO)**

   What is the minimum dissolved oxygen (mg/L) according to Key WQOs for the stream to be healthy? Did the average DO measured pass the minimum requirement?

2. **pH Range**

   What is the pH range according to Key WQOs for the stream to be healthy? Did the average pH measured lie within the range of key WQOs?

3. **Salinity**

   Water salinity with less than 0.5 ppt is categorised as "Fresh" water. Did the average salinity measured lie within the range of "Fresh" water?

5. DRAW CONCLUSIONS

Answer the compulsory inquiry question:

What is the water quality of the chosen stream?

According to your data analysis results, does the value of the 3 parameters (pH, temperature, DO, salinity) measured match with the provided standard of a healthy stream?

Parameter	Standard	Result
pH	6.5 – 8.5	
DO	>4 mg/L	
Salinity	< 0.5 ppt	

Does the water quality of the stream meet the standard? If not, can you name some possible reasons for the measured result?

Optional: Answer your own inquiry question:

Discussion:

Based on the data collected and your own knowledge, answer the following questions:

a. How water temperature will affect the amount of dissolved oxygen in the stream?

b. What are the potential pollution sources near the stream?

Exploring Biotic Community in the Local Stream

Equipment Checklist	
Items	**Quantity (per group)**
Pen/Pencil	**2-3**
Clipboard	**1-2**
Field Handbook	**1**
Dropper	**1**
White Tray	**1**
Ruler (1m)	**1**
Quadrat	**3**
Observation Box	**1**
Light Torch	**1**

Time needed: 60 minutes
Venue: Hok Tau, Pat Sin Leng Country Park
Group work: Form a group of 4 to complete the following tasks

Instructions

Explore the biotic community of the stream with the following steps:

Step 1. Identifying different microhabitats (15 minutes)

Step 2. Conducting a biological survey using a quadrat – plant, mollusc, larvae (30 minutes)

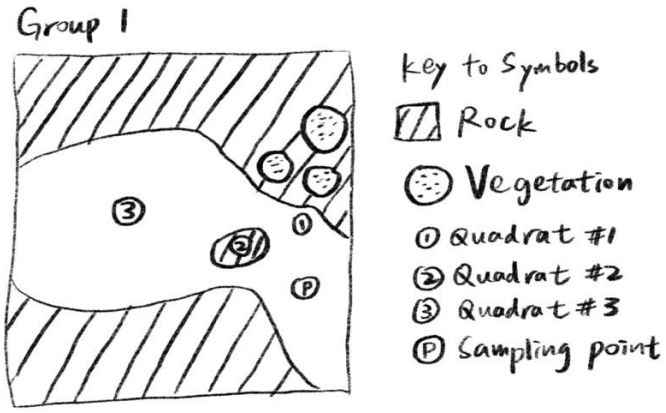
Step 3. Conducting a biological survey for fast-moving organisms – fish, shrimp, insects, crab, Hong Kong Newt (15 minutes)

Step 1. Identify different microhabitats in the stream

Sketch a map of the survey area of the survey area of the stream you are investigating and label the microhabitats in the drawing.

1. Draw an area of observation (3m x 3m)
2. Draw down the biotic and abiotic factors observed
3. Label 3 microhabitats
4. Mark down the area for quadrat (1m x 1m) sampling

[Example]



Percentage of area of quadrat which is not covered by vegetation: 35%
Percentage of area of quadrat which is not covered by large rocks: 90%

Percentage of area of quadrat which is not covered by vegetation: _____
Percentage of area of quadrat which is not covered by large rocks:_____

Discussion:

Discuss the following questions with your groupmates before the survey

a. Predict what organisms can be observed during the survey.

Step 2. Conducting a biological survey using a quadrat

Complete the "Biodiversity Survey Record Sheet" according to your observations. Identify the slow moving or immobile species with the help of the identification card.

1. Choose a microhabitat marked in step 1.

2. Place a quadrat on the survey area you want to investigate.

3. Record the slow moving or immobile organisms observed within the quadrat.

Conduct the survey in three microhabitats, each in 10 minutes

Tips for species identification
Sometimes, it is hard to identify the species even with the identification card. A clear and detailed record of the observation can help you with species identification after the field study.

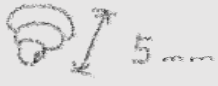
- Take photos and videos of the organisms if possible
- Write down detailed description, distinctive features or draw pictures of the organisms

Biodiversity Survey Record Sheet (plant, mollusc, larvae)

Background Information	
Field Site:	
Date:	DD/MM/YYYY
Investigators:	

Microhabitat 1

General Description	
Precipitation:	None / Light / Moderate / Heavy
Water Flow:	Slow / Fast / Not moving
Time:	HH:MM – HH:MM
Location:	Terrestrial / Aquatic
Water Depth (m):	
Litter:	Coverage:  <5% 6-10% 11-25% 26-50% 51-75% 76-90% >91% Reference Source: GROW Observatory, n.d.
Riverbed substrate:	Sand / Stone / Rock / Cement / Other:
Canopy Coverage:	Coverage:  <5% 6-10% 11-25% 26-50% 51-75% 76-90% >91%

Biotic Community		
Species (Species Name/ Drawing)	Number	Description (Size/ Location/ Characteristics)
[Example] Mollusc 		1. Around 5mm long 2. Brown 3. Algae attached to shell 4. Under a large rock 5. Not moving

Biotic Community		
Species (Species Name/ Drawing)	Number	Description (Size/ Location/ Characteristics)

Microhabitat 2

General Description	
Precipitation:	None / Light / Moderate / Heavy
Water Flow:	Slow / Fast / Not moving
Time:	HH:MM – HH:MM
Location:	Terrestrial / Aquatic
Water Depth (m):	
Litter:	Coverage:  <5% 6-10% 11-25% 26-50% 51-75% 76-90% >91% Reference Source: GROW Observatory, n.d.
Riverbed substrate:	Sand / Stone / Rock / Cement / Other:
Canopy Coverage:	Coverage:  <5% 6-10% 11-25% 26-50% 51-75% 76-90% >91%

Biotic Community		
Species (Species Name/ Drawing)	Number	Description (Size/ Location/ Characteristics)

Biotic Community		
Species (Species Name/ Drawing)	Number	Description (Size/ Location/ Characteristics)

Microhabitat 3

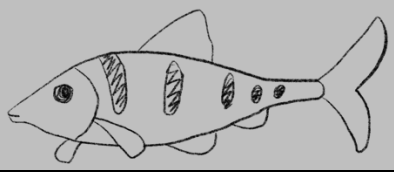
General Description	
Precipitation:	None / Light / Moderate / Heavy
Water Flow:	Slow / Fast / Not moving
Time:	HH:MM – HH:MM
Location:	Terrestrial / Aquatic
Water Depth (m):	
Litter:	Coverage:  <5% 6-10% 11-25% 26-50% 51-75% 76-90% >91% Reference Source: GROW Observatory, n.d.
Riverbed substrate:	Sand / Stone / Rock / Cement / Other:
Canopy Coverage:	Coverage:  <5% 6-10% 11-25% 26-50% 51-75% 76-90% >91%

Biotic Community		
Species (Species Name/ Drawing)	Number	Description (Size/ Location/ Characteristics)

Biotic Community		
Species (Species Name/ Drawing)	Number	Description (Size/ Location/ Characteristics)

Step 3. Conducting biological survey for fast moving organisms (fish, shrimp, insects, crab, Hong Kong Newt)

Complete the "Biodiversity Survey Record Sheet" according to your observations. Identify the fast-moving species with the help of the identification card.

General Description		
Precipitation:	None / Light / Moderate / Heavy	
Water Flow:	Slow/ Fast/ Not moving	
Time:		
Biotic Community		
Species (Species Name/ Drawing)	Number	Description (Size/ Condition/ Location/ Adaptation)
[Example] 北江光唇魚 Acrossocheilus beijiangensis 		1. Most are around 10 cm long; one is particularly small, around 4 cm long. 2. Found mostly in the middle column of the stream. 3. Two have injured fins, all have 5 vertical black stripes on each side.

Biotic Community		
Species (Species Name/ Drawing)	Number	Description (Size/ Location/ Characteristics)

DISCUSSION

Based on your own observation and knowledge, answer the following questions:

List the indicator species you have observed during the field trip.

Why should multiple species be chosen as a biotic indicator in this survey?

What are the limitations of quadrat sampling?

Are the organisms found during the survey same as the predicted list before observation? If not, why?

Post-trip Activity (1): Fieldwork Conclusion & Discussion

Based on the data collected in the field activity and your own knowledge, discuss the following questions with your groupmates:

1. Which factor (abiotic or biotic) contributes more significantly to the investigation of water quality?

2. How do the following physico-chemical factors (dissolved oxygen, pH, salinity) affect the composition of biotic communities (plants and animals) in different microhabitats?
   How do physico-chemical factors vary in the microhabitats of a freshwater stream?

3. EPD conducts River Water Quality Monitoring annually. Why is it important to monitor the water quality of rivers in Hong Kong?

Challenging Question

4. According to your own knowledge or observation during the field trip, what are the challenges that aquatic animals in stream face? What are the adaptive features of these organisms to the challenges found in their environment?
   Use one microhabitat as an example and explain the adaptive features of the organisms living in that microhabitat.

Post-trip Activity (2): Biodiversity of Stream

Food Web

Based on your findings in the field trip, draw at least one food chain to represent the feeding relationship of the organisms.

With reference to the above food chains, construct a food web of the investigated stream.

Discussion

1. What organisms can you find in each trophic level?
2. At least how many organisms should be removed from the food web to disturb the balance of the ecosystem?

Post-trip Activity (3): Conservation of Natural Streams

Conservation Actions Taken by the Government

The government has put continuous effort in natural streams conservation in Hong Kong to protect the precious biodiversity and natural resources. For instance, legal protections, development plans, policies, guidelines, professional trainings, waste and sewage treatment are enforced. Hence, the water quality of streams improves significantly throughout the years.

Discussion

1. Compare the map of river monitoring stations and their water quality index gradings in 1987 and 2020. Is the overall water quality of Hong Kong stream improving? What is the cause of this change?

2. Why stream conservation is important to us?

3. What are the major challenges faced by Hong Kong streams conservation?

Take Home Questions

4. Besides the government, who are affected and responsible for the health of streams in Hong Kong? How can each of the above stakeholders take action to protect the stream ecosystem in Hong Kong?

5. How can we contribute to the conservation of streams in Hong Kong as a visitor?