



探究河溪污染

Study of Stream Pollution



姓名 Name: _____ 組別 Group: _____ 日期 Date: _____

學習目標 Aims:

完成課程後，學生應能 After the course, students should be able to:

1. 仔細觀察、作出適當的提問、辨識問題關鍵所在及擬訂與污染相關的假說 Make careful observations, ask relevant questions, identify problems and formulate hypotheses for investigations related to pollution;
2. 設計、進行和報告有關水污染的實驗和考察活動 Design, conduct and report on field and laboratory investigations related to water pollution;
3. 在河溪紀錄和量度物理和化學因子 Record and measure physical and chemical factors in a freshwater stream;
4. 辨認本地常見的河溪水質指示生物 Identify common biological indicators in a local freshwater stream;
5. 在實驗室進行關於水質的簡單化學和生物分析 Do simple chemical and biological analysis of water quality in the laboratory,
6. 組織和分析數據作簡報之用 Analyze and organize data for presentation,
7. 與他人合作進行科學探究 Cooperate with others and work together in a scientific investigation
8. 知道生態學知識在社會上的應用及其對社會、道德倫理、經濟和環境的含意 Aware of the application of ecological knowledge in society and its social, ethical, economic and environmental implications.

Equipment and tools:

1	寫字夾板 Clipboard (x1)	7	取水樣瓶 Water sampling bottle (x2)
2	毛筆 Brush pen (x2)	8	橡膠手套 Rubber gloves (x2 pairs)
3	金屬篩 Metal sieve (x1)	9	膠整理盤 Plastic sorting tray (x1)
4	鑷子 Forceps (x2)	10	《生物圖錄》 "Wildlife Pictorial Guide" (x1)
5	小膠瓶 Small vials (x3)		
6	塑膠滴管 Plastic dropper (x2)	11	《水質評估指示生物》 Biological Indicators for water quality assessment (x1)

Schedule:

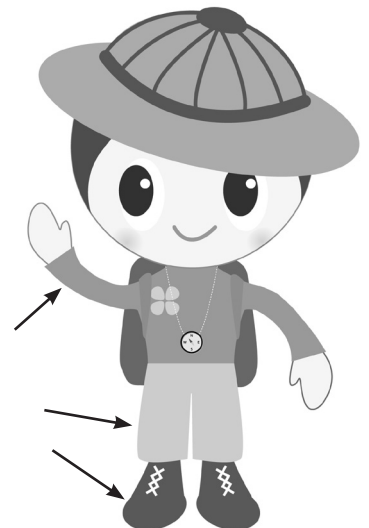
9:00 - 09:45	簡介 Briefing
10:10 - 11:50	野外考察 Field work
12:00 - 13:00	午膳 Lunch
13:00 - 14:00	實驗與數據分析 Lab. work & Data analysis
14:00 - 15:30	準備匯報 Prepare presentation
15:30 - 16:30	匯報與總結 Presentation & summary

衣著 Clothing:

1. 穿著長袖上衣和長褲能更有效防止蚊蟲叮咬，亦可減低被太陽曬傷的機會，不應穿著短褲 Long-sleeved shirt and trousers for better protection against mosquito and insect bites, as well as preventing sunburn. Shorts are not recommended.
2. 不應穿著拖鞋或涼鞋，而應穿著運動布鞋。 A pair of shoes for preventing injuries. Slippers and sandals are not recommended.

安全 Safety:

1. 避免踏足陡斜和濕滑的岩石表面。小心河床的玻璃碎和其他尖銳物件。 Avoid stepping on steep and wet rock surfaces. Beware of broken glasses and other sharp objects at the river bed.
2. 勿涉入深水區，避免直接觸及污水。 Never getting into deep water. Avoid direct contact with polluted water.



A. 考察地點 Field sites

考察地點為位於川龍的兩條河溪，其中一條人為干擾較多，另一條人為干擾較少。 Two stream sites would be investigated. Both sites are located in Chuen Lung, one is more influenced by human activities, another is less influenced.

B. 天氣概況 General weather conditions:

C. 觀察物理特徵 Observing physical characteristics

觀察並記下以下各項河溪的物理特徵 Observe and note down the following physical characteristics of the stream:

1. 周圍環境和土地用途(樹林、草地、耕地、荒廢耕地、鄉村...) Neighbouring habitats and land use. (e.g. woodland, grassland, farmland, abandoned farmland, village...)

2. 可能影響河溪的人為活動 (耕種、排放生活污水、清除植物、河道改造...) Human activities which may influence the stream. (farming, domestic effluents, clearing of plants, modifications of stream channel...)

3. 水面漂浮物 Floating materials on the water surface

4. 水的顏色 Colour of the water

5. 源自河溪的臭味 Any odour originated from the stream

6. 河床質地 (硬、軟、多泥、沙質、石質...) Nature of the stream bed (hard, soft, muddy, sandy, rocky...)

D. 取水樣 Water sampling

利用取水樣瓶在考察範圍具代表性的位置取水樣(樣本1)，在生活廢水流出的位置再取另一個水樣(樣本2)，水樣留待帶返實驗室作化學分析。抽取水樣時帶上橡膠手套，並且避免直接接觸污水。

Use a water sampling bottle to collect water sample (Sample 1) from a representative point in your study area. Collect another water sample from the outlet of domestic effluent (Sample 2). Keep the water samples for further chemical analysis. Use a pair of rubber gloves to prevent direct contact with the polluted water when collecting water sample.

E. 評估水質指示生物 Assessing biological indicators

1. 實地觀察 Field observation

a. 觀察並記錄生長於河溪兩岸的植物 Observe and note down the water plants growing along the stream sides.

植物名稱及相對多度 Plant name and relative abundance	植物名稱及相對多度 Plant name and relative abundance
<input type="checkbox"/> 少量 few <input type="checkbox"/> 很多 many	<input type="checkbox"/> 少量 few <input type="checkbox"/> 很多 many
<input type="checkbox"/> 少量 few <input type="checkbox"/> 很多 many	<input type="checkbox"/> 少量 few <input type="checkbox"/> 很多 many
<input type="checkbox"/> 少量 few <input type="checkbox"/> 很多 many	<input type="checkbox"/> 少量 few <input type="checkbox"/> 很多 many
<input type="checkbox"/> 少量 few <input type="checkbox"/> 很多 many	<input type="checkbox"/> 少量 few <input type="checkbox"/> 很多 many

b. 觀察並記錄生長於溪水表面的植物 Observe and note down the water plants growing on the water surface.

c. 檢視以下各種生物是否存在及其密度

Check the existence and approximate density of the following living organisms in the water:

i. 污水真菌 Sewage fungi <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many	xiii. 石蛾若蟲 Caddisfly larvae <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many
ii. 絲狀藻類 Filamentous algae <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many	xiv. 斑魚蛉幼蟲 Fishfly larvae <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many
iii. 顛蚓 Tubifexs <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many	xv. 水錢 Water penny <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many
iv. 塘螺 Pond snails <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many	xvi. 淡水蝦 Freshwater shrimps <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many
v. 凸旋螺 Ramshorn Snails <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many	xvii. 淡水蟹 Freshwater crabs <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many
vi. 海南溝螺 Large Stream Snails <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many	xviii. 香港瘰螈 Hong Kong Newts <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many
vii. 紅蟲 Bloodworms <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many	xix. 鰕虎魚 Gobies <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many
viii. 水黽 Water skaters <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many	xx. 麥氏擬腹吸鰍 Sucker-belly loaches <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many
ix. 蜉蝣若蟲 Mayfly nymphs <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many	xxi. 擬平鰍 Hillstream loaches <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many
x. 豆娘若蟲 Damselfly nymphs <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many	xxii. 異鱸 Predaceous Chubs <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many
xi. 蜻蜓若蟲 Dragonfly nymphs <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many	xxiii. 寬鰭鱒 Freshwater Minnows <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many
xii. 石蠅若蟲 Stonefly nymphs <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many	其他 Others

2. 顯微鏡觀察 Microscopic observation

a. 用一個大的塑膠滴管在取水樣的位置吸取水底的沉積物，並存於密封的膠小瓶內。 Use a large dropper to collect soft sediment with water at the same locations as the two water samples are collected. Keep the samples in sealed vial.

b. 在實驗室，吸取1-2滴水 and 沉積物的混合物，置於玻片上，蓋上蓋玻片，用顯微鏡觀察；用同樣方法製作另外4張玻片。 In the laboratory, use a small dropper to transfer 1-2 drops of the mixture of water and sediment to a glass slide, cover it with cover slip, observe under microscope. Use the same method to prepare another 4 slides.

c. 檢視以下各種微生物是否存在及其大約密度 Check the existence and approximate density of the following micro-organisms on the slides:

樣本 1 Sample 1	樣本 2 Sample 2
i. 單細胞藻類 Unicellular algae <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many	i. 單細胞藻類 Unicellular algae <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many
ii. 草履蟲 Paramecium <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many	ii. 草履蟲 Paramecium <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many
iii. 輪蟲 Rotifers <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many	iii. 輪蟲 Rotifers <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many
iv. 線蟲 Roundworms <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many	iv. 線蟲 Roundworms <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many
v. 桿吻蟲 Stylaria worms <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many	v. 桿吻蟲 Stylaria worms <input type="checkbox"/> 沒有none <input type="checkbox"/> 少量few <input type="checkbox"/> 很多many
其他 Others	其他 Others

3. 大腸桿菌培養 *E. coli* culture

在載有培養基的培養皿中央注入1毫升的水樣，以蒸餾水作對照，將培養皿置入保持攝氏35度的恆溫箱24小時，之後數算藍色的菌落。 Drop 1ml of each water sample onto the middle of the culture plate. Use distilled water as control. Store them in the incubator operating at 35°C for 24 hours. Count the number of colonies coloured blue.

樣本 1 Sample 1: _____

樣本 2 Sample 2: _____

蒸餾水 Distilled water: _____

F. 化學測試 Chemical analysis

1. 測試兩個水樣本的以下各項化學特性 Do chemical tests of the following parameters of the two water samples:

	樣本 1 Sample 1	樣本 2 Sample 2
i. 溶解氧 Dissolved oxygen (mg/l)		
ii. pH		
iii. 總溶解物 Total dissolved solids (ppm)		
iv. 總懸浮物 Total suspended solids (mg/l)		
v. 氮含量 Ammonium content (ppm)		
vi. 磷酸鹽含量 Phosphate content (ppm)		

問題討論 Questions for discussion

1. 評估該河溪受人為干擾的程度。怎樣可以改善情況？ Evaluate the degree of human impacts to the freshwater stream habitat. What can be done to improve the situation?
2. 水質指示生物的數據顯示了什麼？描述和解釋。 What do the records of biological indicators tell? Describe and explain.
3. 顯微鏡觀察和大腸桿菌的數據顯示了什麼？描述和解釋。 What do the records of microscopic observation and *E. coli* tell? Describe and explain.
4. 如何比較兩個水樣本的各项化學特性？試解釋各項差異(如有) How would you compare the chemical parameters of the two water samples? Suggest possible explanations for the differences (if any).