顯微鏡生態探索
Microscope Eco Exploration

姓名 Name _____ 組別 Group _____ 日期 Date _____

學習目標 Learning goals

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

1. 有效收集水生微生物及動物樣本 Effectively collect aquatic microorganism and animal samples;
2. 製作裝載水生微生物的玻片 Prepare temporary mounts of aquatic microorganism samples;
3. 正確地使用複式顯微鏡及立體顯微鏡 Correctly use compound microscope and stereo microscope;
4. 明白光場、暗場和相位差不同之處 Understand the differences between bright field, dark field and phrase contrast microscopy;
5. 辨別動物及認識其適應特徵 Identify animals found and understand their adaptation features;
6. 製作簡單科學報告 Make simple scientific report;
7. 欣賞大自然之美和尊重生物 Appreciate the wonder of nature and respect living things.

程序 Schedule

09:00 - 10:00	簡介 Briefing
10:00 - 10:30	考察 Field work
10:30 - 12:00	顯微鏡觀察 Microscopic observation
12:00 - 13:00	午膳 lunch
13:00 - 14:30	顯微鏡觀察 Microscopic observation
14:30 - 15:30	數據分析 Data analysis
15:30 - 16:30	匯報及總結 Presentation & summary

你知道嗎？ Do You Know?

2021年中國科學院海洋研究所的科學家透過電子顯微鏡對比塑膠表面降解情況，首次發現能有效降解塑膠垃圾的海洋微生物。研究成果已成功申請國家發明專利，望未來可協助解決海洋垃圾問題。

In 2021, scientists from the Institute of Oceanography, Chinese Academy of Sciences, made a groundbreaking discovery by identifying marine microorganisms capable of effectively degrading plastic waste. They used electron microscopy to compare the degradation of plastic surfaces. The research findings have been successfully applied for a national invention patent, and it is hoped that they can contribute to solve the issue of marine plastic pollution in the future.

儀器和工具 Equipment and tools

1	寫字夾板 (x1) Clipboard		6	立體顯微鏡 (x1) Stereo microscope	
2	平板電腦 (x1) Tablet computer		7	培養皿 (x2) petri dishes	
3	圖鑑 (x1) Wildlife Pictorial Guide		8	滴管 (x2) droppers	
4	小瓶 (x2) Vial		9	剪刀 (x1) scissors	
5	鑷子 (x1) Forceps				

衣著 Clothing

1. 不應穿著短褲。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。
   Shorts are not recommended. Long-sleeved shirt and trousers for better protection against mosquito and insect bites, as well as preventing sunburn.

2. 不應穿著拖鞋或涼鞋，而應穿著運動布鞋，以減低腳部受傷的機會。
   A pair of plimsolls 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。
   Avoid stepping on steep and wet rock surfaces.

2. 切勿闖入植物生長茂密的地方，以免觸及蜂巢或被植物割傷。
   To prevent being attacked by wasps from disturbed wasp nests or being injured by plant leaves and thorns, do not get into places with dense vegetation.

考察工作：收集樣本 Field work: Sample collection

1. 水生微生物樣本 Sample of aquatic microorganisms

(a) 生態池中藻類 Algae in the eco-pond：

– 在水池旁的位置，尋找綠色或褐色浮於水中的絲狀水藻，利用鑷子和小瓶收集。
Search for the green or brown filamentous algae at the edge of the pond. Collect them by using a pair of forceps and a small vial.

(b) 生態池沉積物 Sediment in the eco-pond：

– 利用滴管和小瓶於生態池收集沉積物。
Use a dropper and a small vial to collect the sediment in the eco-pond.

(c) 魚桶沉積物 Sediment in the fish bucket：

– 利用滴管和小瓶於魚桶收集沉積物。
Use a dropper and a small vial to collect the sediment in the fish bucket.

2. 動物樣本 Animal sample

在可觀生態徑或附近地方收集兩種不同細小動物，置於培養皿內。
Collect two different species of tiny animals in Ho Koon trail or nearby area and place them in petri dishes.

實驗室工作：檢視樣本 Laboratory work: Sample examination

1. 水生微生物樣本 Sample of aquatic microorganisms

i.製作臨時載玻片 Preparing temporary mount

(a) 生態池中藻類 Algae in the eco-pond：

– 用滴管攪拌樣本，抽取少量水樣，加一滴水於載玻片上；用鑷子抽取極少量的水藻，放入水滴中，用蓋玻片覆蓋。製作至少兩張臨時載玻片。
Use a dropper to stir and then transfer 1 drop of water sample onto a slide. Then use a pair of forceps to collect a very small amount of algae and add into the water droplet. Cover with cover slip. Prepare at least two temporary mounts for observation.

(b) 生態池 / 魚桶沉積物 Sediment in the eco-pond / fish bucket：

– 用滴管抽取沉積物，將大部分的水排走，只留沉積物在滴管內；然後將一小滴水連沉積物加於載玻片上，再用蓋玻片覆蓋。製作至少兩張臨時載玻片以觀察。
Use a dropper to suck up the sediment then expel most of the water until only sediments remain. Add 1 drop of water with sediments onto a slide. Cover with cover slip. Prepare at least two temporary mounts for observation.

ii.複式顯微鏡檢視臨時載玻片 Observation of the temporary mounts slide under compound microscope

利用複式顯微鏡檢視載玻片。調節光強度和聚光器上的光圈大小，以獲取理想對比度和光亮度的影像。用明視野、暗視野和相位差模式觀察同一個樣本。辨認顯微鏡下觀察到的各種微生物，並在記錄表（第三頁）內記錄每種微生物的形狀、身體特徵、行為、移動方法等資料。
Use a compound microscope to examine all prepared slides. Adjust the light intensity and the aperture diaphragm of the condenser to obtain the image with the best balance of brightness and contrast. Use bright field, dark field and phase contrast to observe the same sample. Identify the microorganisms observed. Note the shape, physical characteristics, behaviour, locomotion and other features of each species in the record sheet in page 3.

2. 動物樣本 Animal samples

利用立體顯微鏡檢視動物樣本。調節光強度，以獲取最理想對比度和光亮度的影像。用不同放大倍數詳細觀察動物樣本的各個身體部分（如口器、翅膀、眼睛、腳等），並在記錄表（第四頁）內記錄觀察到的特徵。
Use a stereomicroscope to examine the collected animal samples. Adjust the light intensity to obtain the image with the best balance of brightness and contrast. Observe different parts of body (e.g. mouthpart, wings, eyes, leg, etc.) of the animal samples under different magnifications. Record all features observed in the record sheet in page 4.

A. 水生微生物記錄表 Aquatic microorganisms record sheets

樣本一：_____

	微生物名稱 Name of the microorganism	形狀 Shape	身體特徵 Physical characteristic	移動方法 Locomotion	行為 Behaviour	其他補充 Others
1						
2						
3						
4						
5						
6						
7						
8						

樣本二：_____

	微生物名稱 Name of the microorganism	形狀 Shape	身體特徵 Physical characteristic	移動方法 Locomotion	行為 Behaviour	其他補充 Others
1						
2						
3						
4						
5						
6						
7						
8						

光場、暗場、相位差的影像比較 Comparison of the differences between bright field, dark field and phase contrast microscopy

	光場 Bright field	暗場 Dark field	相位差 Phase contrast
背景顏色 Background colour			
微生物結構在影像中的清晰度 Sharpness of the structures of the microorganisms in the image (0: 不能觀察 Cannot be observed 1: 能勉強觀察 Barely observed 2: 能清晰觀察 Clearly observed)	☐ 纖毛 Cilia ☐ 鞭毛 Flagella ☐ 體內組織 Body's tissue ☐ 細胞器 Organelle	☐ 纖毛 Cilia ☐ 鞭毛 Flagella ☐ 體內組織 Body's tissue ☐ 細胞器 Organelle	☐ 纖毛 Cilia ☐ 鞭毛 Flagella ☐ 體內組織 Body's tissue ☐ 細胞器 Organelle

B. 動物樣本記錄表 Animal samples record sheet

樣本一 Sample 1		
動物名稱 Name of the animal		
身體特徵 Physical characteristic	口器 Mouthpart	
	翅膀 Wing	
	腳 Leg	
	眼睛 Eye	
	觸角 Antenna	
	其他 Others	
行為 Behaviour		
其他補充 Others		

樣本二 Sample 2		
動物名稱 Name of the animal		
身體特徵 Physical characteristic	口器 Mouthpart	
	翅膀 Wing	
	腳 Leg	
	眼睛 Eye	
	觸角 Antenna	
	其他 Others	
行為 Behaviour		
其他補充 Others		

C. 分析和討論 Analysis and Discussion

1. 簡略描述兩個水樣本所找到的微生物。
   Briefly describe the aquatic microorganisms found in the two water samples.
2. 比較光場、暗場和相位差不同之處。
   Compare the differences between bright field, dark field and phase contrast microscopy.
3. 繪畫一種在水樣本找到的原生動物高倍生物圖（X400）。
   Draw a high power biological drawing (X400) of a protozoan that found in the water samples.
4. 揀選一種你研究的動物樣本，介紹其外貌特徵與其行為習性的關係。
   Choose one of the animal sample investigated and introduce its external features in relation to its behaviour.