



環保基金探索浮游世界 浮游生物辨認卡 補充資料冊(教師用)

ECF DISCOVERY OF OCEAN DRIFTER PLANKTON IDENTIFICATION CHART SUPPLEMENTARY INFORMATION FOR TEACHERS

關於世界自然基金會

世界自然基金會是全球最具規模及公信力的環保組織之一, 分會及項目網絡遍及全球逾100個國家。本會的使命是透過 以下途徑遏止自然環境惡化,建立人類與大自然和諧共存 的未來:

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- 確保以可持續方式使用可再生天然能源
- 推廣減少污染和浪費的行為

世界自然基金會香港分會自 1981 年成立,致力推動香港成為 亞洲最可持續發展的城市。為響應世界自然基金會的全球 使命,香港分會透過保育、生態足印及教育項目提出解決 方法,以保育本地自然環境、減少碳排放造成的污染,及促進 可持續生活方式。

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- conserving the world's biological diversity
- ensuring that the use of renewable natural resources is sustainable
- promoting the reduction of pollution and wasteful consumption

WWF-Hong Kong has been working since 1981. In support of our global mission, WWF-Hong Kong's vision is to transform Hong Kong into Asia's most sustainable city where nature is conserved, carbon pollution is reduced, and consumption is environmentally responsible.

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前言



環保基金探索浮游世界,是一個為期兩年的學校夥伴計劃。計劃與 10所中學和10所小學合作,以海洋浮游生物為切入點,旨在培養 和提升學生對生物多樣性和海洋保育議題的認識。

夥伴中學生化身公民科學家,在香港沿岸不同地點進行浮游生物調查。部分在調查中常見的浮游生物已經歸納在「浮游生物辨認卡」內。透過「浮游生物辨認卡」和本補充資料册,我們鼓勵教師與學生分享美麗的海洋環境和其多樣性。

Foreword



ECF Discovery of Ocean Drifter project is a 2-year school partnership project with 10 secondary and 10 primary schools, with an aim to build up students' knowledge on biodiversity and marine conservation issues, with marine plankton as an entry point.

Under this project, secondary school students acted as citizen scientists to conduct plankton surveys in different spots along the Hong Kong shoreline. The "plankton identification chart" is a collection of the most commonly found plankton species in Hong Kong, in their samplings.

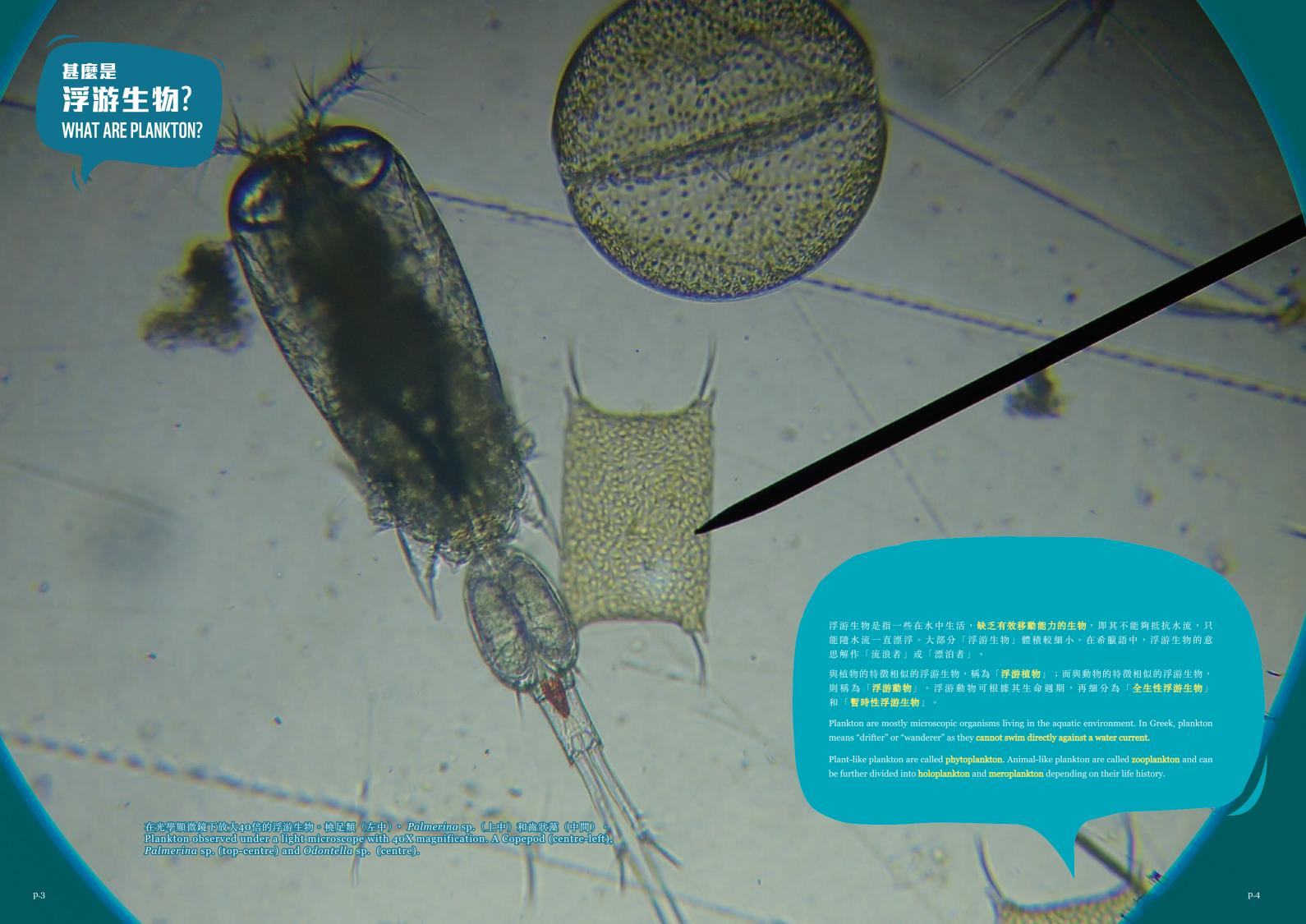
Together with the supplementary information in this booklet, we encourage teachers to share the beauty and diversity of marine environment with our younger generation.

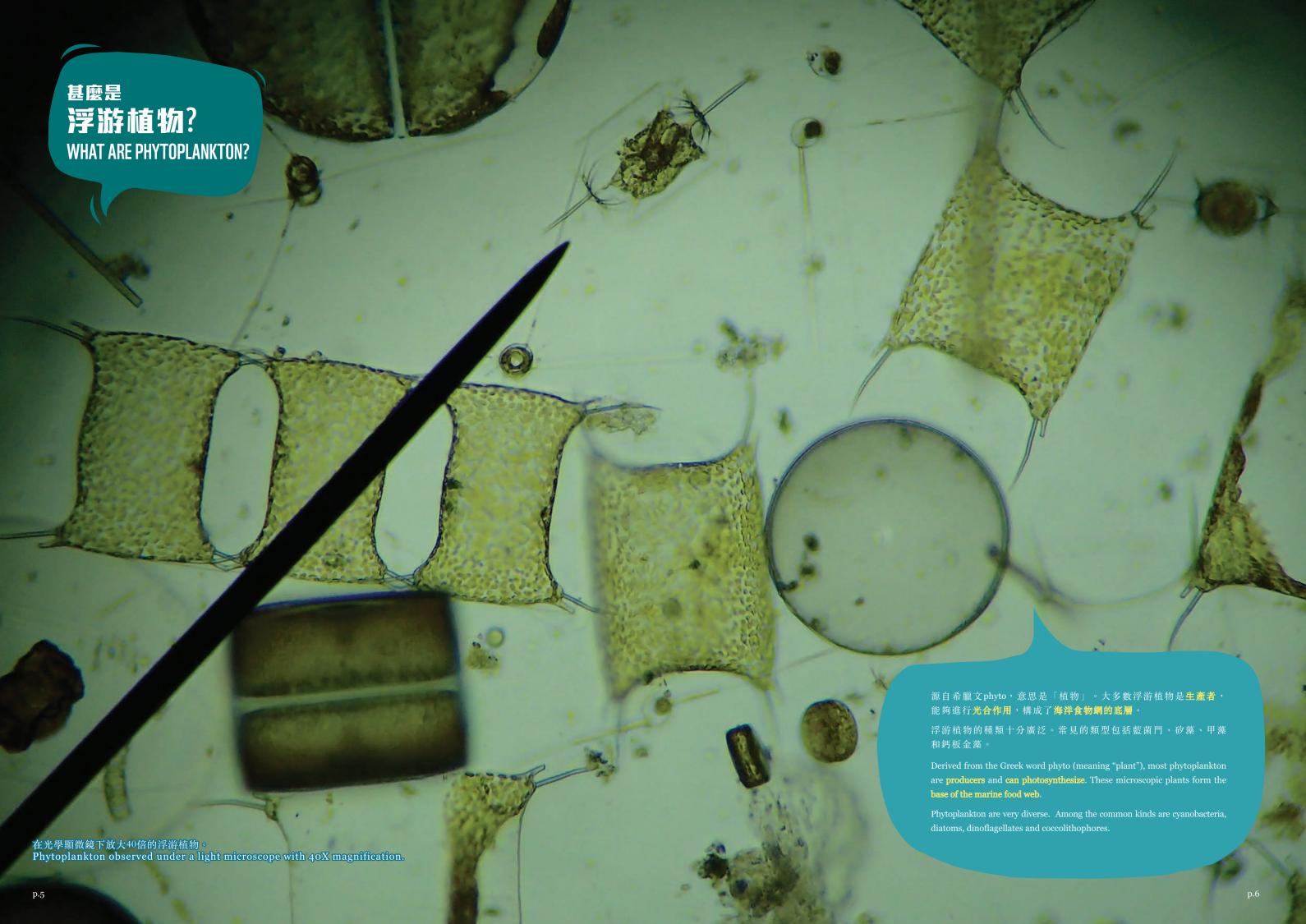
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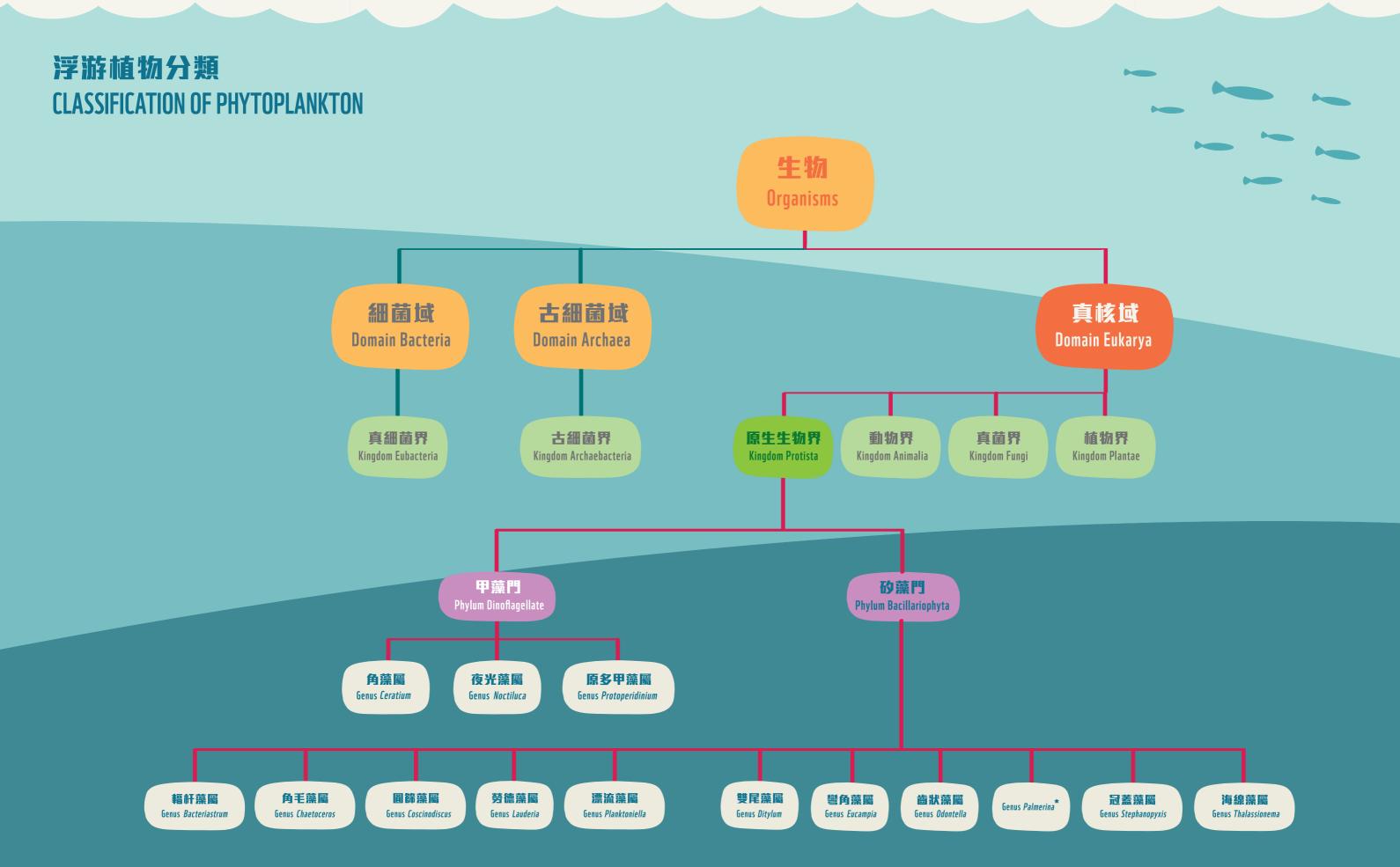
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* 暫沒有中文譯名

浮游植物-矽藻 **PHYTOPLANKTON - DIATOMS**

矽藻在海洋和淡水環境中都很常見。

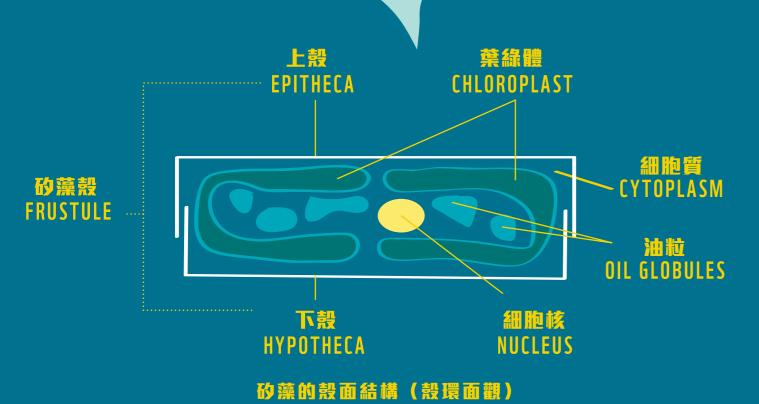
地們表面被稱為「矽藻殼」的玻璃狀材料(二氧化矽)覆蓋。矽藻殼由兩個半片狀, 稱為上殼 (epitheca) 和下殼 (hypotheca) 組合而成,像盒子上的蓋般合上。

矽藻可以是單細胞,或由細胞彼此連接成鏈狀。當使用光學顯微鏡觀察時, 經常呈現黃色或淺棕色。

Diatoms are commonly found in both marine and freshwater habitats.

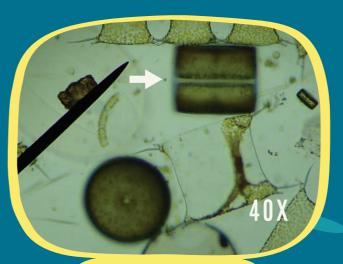
They are distinguished by a unique structure called 'frustule' composed of glass-like material (silica), which encloses the cell. The frustule consists of two valves, epitheca and hypotheca, that fit over each other like the lid on a box.

Diatoms are either solitary or in loose chain forms and often appear yellow or light brown when viewed using the light microscope.

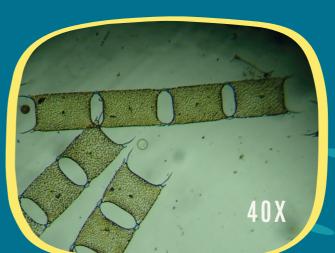


THE STRUCTURE OF A DIATOM (GIRDLE VIEW)

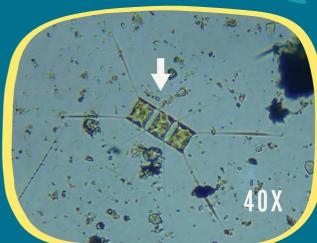




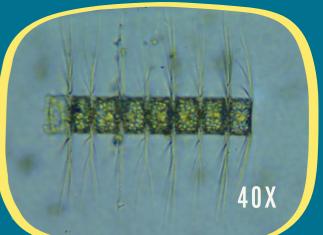
圓篩藻 Coscinodiscus spp.



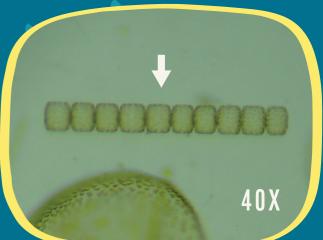
齒狀藻 Odontella sp.



角毛藻 Chaetoceros sp.



輻杆藻 Bacteriastrum sp.



勞德藻 Lauderia sp.







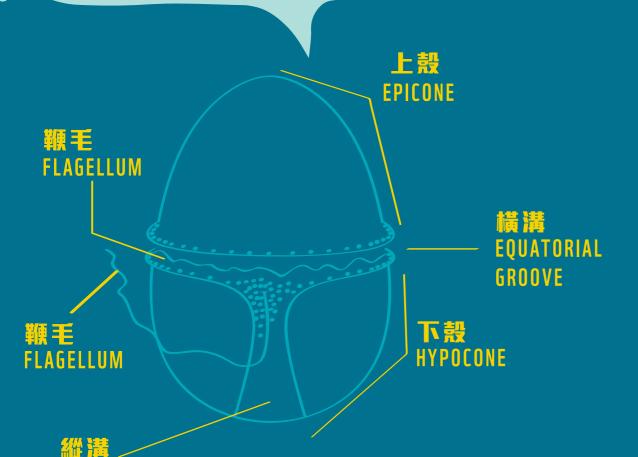
<mark>浮游植物-甲藻</mark> PHYTOPLANKTON - DINOFLAGELLATES

甲藻主要生活在海洋,牠們因具有兩條鞭毛(只能在非常高的放大倍數下 看到)幫助牠們在水中移動,因此又名雙鞭毛蟲。

牠們大多數的結構是被纖維素板覆蓋及具有頂角,但是夜光藻(一種非常常見的雙鞭毛蟲)卻是例外。

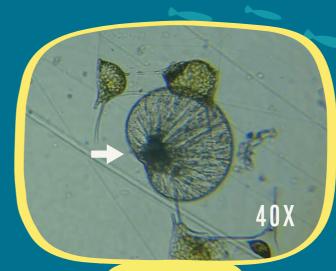
Dinoflagellates are mostly marine. They are notable for having two flagella (which can only be seen under very high magnification) to help them move through the water.

Most forms are covered in cellulose plates and have apical horns, but *Noctiluca*, a very common dinoflagellate, is an exception.





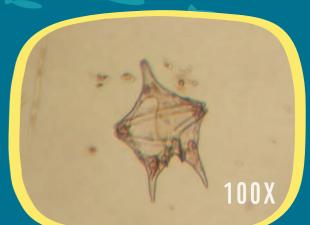
角藻 *Ceratium* spp.



夜光藻 *Noctiluca* sp.



角藻 *Ceratium* sp



原多甲藻 Protoperidinium sp.





LONGITUDINAL GROOVE



甚麼是 **浮游動物?** WHAT ARE ZOOPLANKTON?

源自希臘文zoo,解作「動物」。大多數浮游動物<mark>都是 消費者</mark>,以其他生物或有機物為食物。然而,與浮游 植物相反,牠們<mark>不能進行光合作用</mark>。

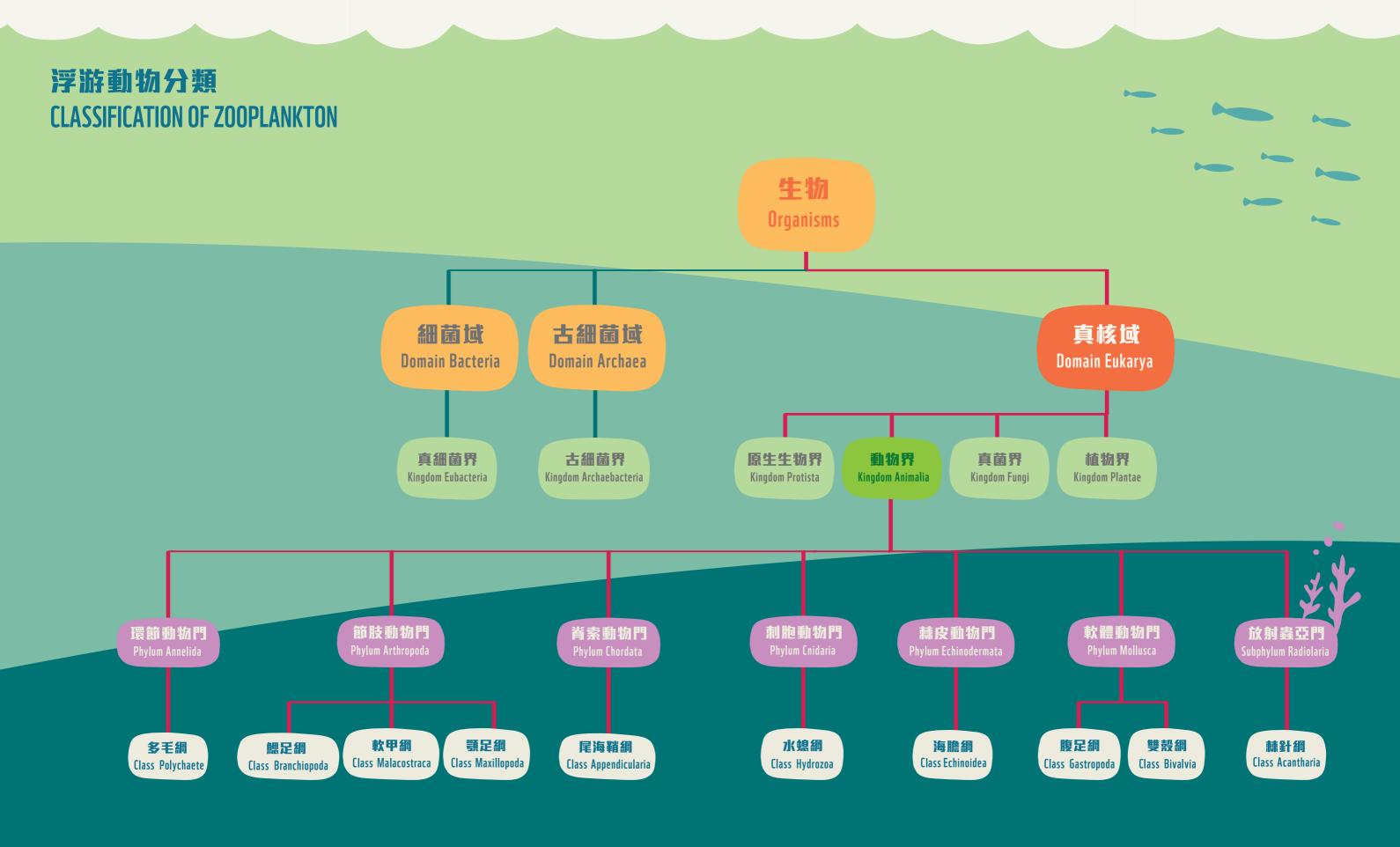
Derived from the Greek word zoo (meaning "animal"), most zooplankton are **consumers**, they feed on other organisms or organic matters. However, unlike phytoplankton, they are **not able to undergo photosynthesis**.

在光學顯微鏡下放大40倍的海膽幼體,是一種在香港可以收集到的浮游動物。 A sea urchin larva, a type of zooplankton found in Hong Kong, observed under a light microscope with 40X magnification.

不是所有浮游生物都是體型微小的,例如水母。 水母是全生性浮游生物,某些物種可生長至約3米。 Plankton are not always small. Jellyfish are holoplankton and some can grow up to 3 meters long.

> 在海下灣海岸公園漂浮的成年水母。水母是全生性浮游生物的其中一個例子。 An adult jellyfish drifting in Hoi Ha Wan Marine Park. Jellyfish is an example of holoplankton.

p.13



浮游動物-環節動物 ZOOPLANKTON - ANNELIDS



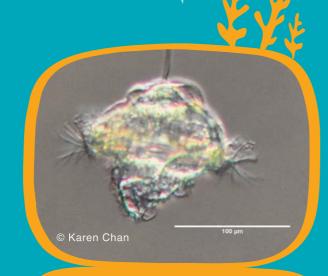
多毛綱動物幼體 Polychaete worm larva



成年的多毛綱動物 Adult polychaete worm

成年的環節動物大多是身體分節的蟲狀生物。分節可以大大增強牠們在底層內鑽孔的能力。有些海洋環節動物居住在管子裏。大多數的成年體是底棲生物,相反幼蟲通常是浮游生物。

Adult annelids are mostly worm-like creatures that have a segmented body. Segmentation greatly enhances the ability of some annelids to burrow within the substrate. Some marine annelids are tube-dwelling, with reduced cephalization. Most are benthic as adults, but their larval forms are planktonic.



管蟲的擔輪幼體 Tubeworm trochophore larva

浮游動物 — 節肢動物 ZOOPLANKTON - ARTHROPODS

節肢動物是浮游動物中主要的群體。牠們是無脊椎動物,但擁有 外骨骼,身體分節並具有一對對相連的附肢。其中以橈足類的 數量最多,因此在海洋食物網中擔當重要的角色。

Arthropods are one of the major zooplankton groups. They are invertebrate animals with an exoskeleton, a segmented body and paired jointed appendages. A dominant group found in the plankton throughout their lives are the copepods, which play a significant role in the marine food web.



鈎蝦 Gammarid



橈足類 Copepod



短尾蚤 Podon





浮游動物一資索動物 ZOOPLANKTON - CHORDATES

脊索動物包括全生性浮游動物 (例如尾海鞘綱) 和暫時性浮游動物 , 牠們都具有脊索 (一種柔韌的棒狀結構)。有些脊索動物會在成年後 失去脊索 (如被囊動物) , 而另一些會被脊椎 (如魚類) 取代。

Chordates, include both holoplanktonic (e.g. larvaceans) and meroplanktonic forms, possess a notochord, a flexible rodlike structure. Some will lose it in the adult form like tunicates, while in others it will be replaced by the backbone (such as fishes).



住囊蟲 *Oikopleura* sp.



魚類幼體 Fish larva

心臟 鰓縫 肛門 背神經管 背索 肌肉 肛後尾 HEART GILL SLITS ANUS DORSAL HOLLOW NERVE CORD NOTOCHORD MUSCLE BLOCKS POST-ANAL TALL 浮游動物一刺胞動物 ZOOPLANKTON - CNIDARIANS

> 刺胞動物包含各種各樣的生物,如水母和珊瑚。牠們均呈輻射對稱狀, 並且口部周圍也長有觸手。成年體則具有被稱為刺囊的刺細胞。

> Cnidarians include a diverse range of organisms such as jellyfish and corals. They share radial symmetry and possess tentacles around their mouth. Adult forms can be distinguished by having stinging cells called nematocysts.



水母 True jellyfish



脊索動物幼蟲的身體結構(側視) THE BODY STRUCTURE OF A CHORDATE LARVA (SIDE VIEW)







浮游動物一軟體動物 ZOOPLANKTON - MOLLUSCS

軟體動物是無脊椎動物內的一個類別,其中許多都是海洋生物,包括螺、 魷魚、墨魚和蜆。牠們身體兩邊對稱,其中一些具有硬殼。而在浮游 生物階段,一些(腹足動物和雙殼類)可能具有用於游泳的瓣(緣膜)。 而頭足類動物的幼體,如魷魚和八爪魚,與成年體很相似。

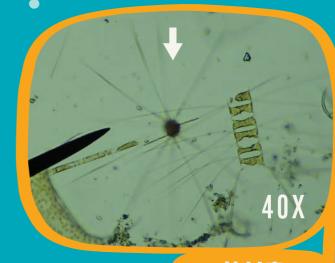
Molluscs are a diverse group of invertebrates, many of which are marine and include snails, squid, cuttlefish, and clams. They are in bilateral symmetry and some of them have a hard shell. During their planktonic larval stage, some (gastropods and bivalves) may have ciliated lobes (velum) for swimming. Cephalopods, such as squid and octopus, have their paralarval forms look alike adults.



浮游動物一放射蟲 ZOOPLANKTON - RADIOZOANS

放射蟲是具有細胞核的單細胞生物,牠們不是動物也 不是植物。牠們具有一個堅硬的矽外殼及許多突起的 針狀物。

Radiozoans are single-celled organisms with a nucleus and are neither animals nor plants. They have a silica test (hard external covering) with a lot of needle-like protrusions.



放射蟲 Radiolarian









變態 METAMORPHOSIS



陶瓷蟹幼體 Porcelain crab larva



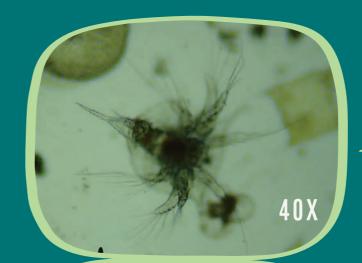
成年陶瓷蟹 Adult porcelain crab

變態是一種生物演化過程,常出現在甲殼動物、棘皮動物、刺胞動物和軟體動物的幼蟲中。牠們通過細胞生長和分化改變身體結構,以減少物種間的競爭,因為幼蟲通常需要與成體不同的資源。

Metamorphosis is also common among larvae of crustaceans, echinoderms, cnidarians and mollusks. It is a biological process an animal develops to abruptly change the body structures through cell growth and differentiation.

Metamorphosis helps reduce competition as animals at larval stage typically consume completely different resources from their adult forms.

蜕殼 MOLTING



藤壺無節幼體 Barnacle nauplius larva



伸出細毛的成年藤壺 An adult barnacle with its cirri extended

在甲殼類動物中,例如藤壺,動物的生長會受到硬殼(外骨骼) 的大小所限。因此,幼蟲和成體都需要脫落舊的外骨骼並以新的取 代,以增加體形,這個過程稱為**蛻殼**。

In crustaceans, such as barnacles, the growth of the animal is hindered by the hard outer shell (the exoskeleton). Therefore, both larvae and adults require shedding of the old exoskeleton and formation of a new one to increase its size. This process is called **molting**.



成年藤壺的舊殼 Moult (exuviae) of an adult barnacle



浮游生物的 重要性 **IMPORTANCE OF PLANKTON**

提供氧氟 **OXYGEN SUPPLY**

> 浮游植物的光合作用 The photosynthetic activities of phytoplankton



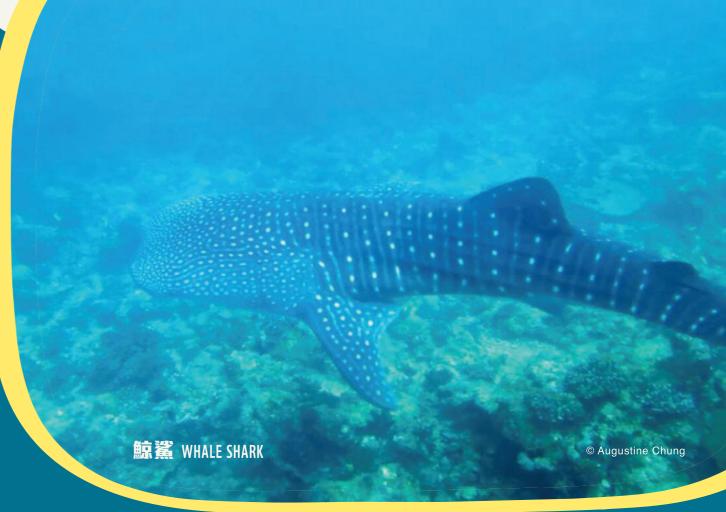






More than half of the oxygen we breathe on Earth is created through the photosynthetic activities of phytoplankton!





食物來源 **FOOD SOURCE**

浮游植物進行光合作用產生食物,以供給食物鏈 上一層的浮游動物;然後浮游動物又被更高營養 級別的海洋生物(如魚類)捕食。

另外,一些大型海洋生物,如世界上最大的魚類-鯨鯊等,都是以浮游生物為食物。如果缺少了 浮游生物,整個海洋生態系統將崩潰。

Phytoplankton support the marine food web as they use photosynthesis to produce food, which is passed along the food chain to zooplankton and in turn are consumed by marine animals at higher trophic levels, such as fish.

Some marine animals, such as whale shark, the largest fish in the world, feed directly on plankton. Without plankton, the entire marine ecosystem will collapse.



幼魚 JUVENILE FISH











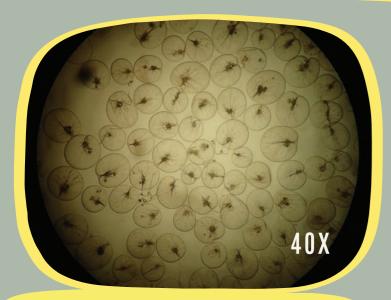


人類對 浮游生物的影響 HUMAN IMPACTS ON PLANKTON

藻華 ALGAL BLOOM

排放大量農業肥料或未經處理的污水會令水中的營養物過多,有利藻類(浮游植物)的繁殖, 這稱為藻華。藻華會影響水質,並在夜間使用水中的氧氣,令水中溶氧量下降,導致海洋生物 可能因窒息而死。有部分藻類的品種具有毒素,如果藻華由這些毒素引起,又稱為有害藻華 (HAB)。而紅潮則一般用作形容一些由紅色或粉紅色的藻類(如夜光藻)所引起的藻華。

Excessive nutrients in water bodies originating from intensive use of agricultural fertilizers or untreated sewage discharge can favour the formation of algal blooms. These will degrade the water quality by lowering dissolved oxygen levels during the night time, which will cause other marine life to suffocate and die. Harmful algal blooms (HABs), are used to describe the algal blooms caused by algae that contain toxins. Red tide is a common term to describe the algae bloom caused by algae with red or pink pigments, e.g. *Noctiluca* sp.



顯微鏡下大量繁生的夜光藻 Bloom of *Noctiluca* sp. under microscope



藻華 Algal bloom

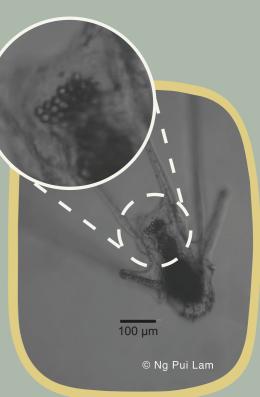
海洋垃圾 MARINE LITTER

海洋垃圾是世界各地日益嚴重的問題。大的垃圾經常被沖上岸或沉到海底,而漂浮在水中的微小碎片可被浮游動物和魚類攝入。對於某些物種,攝入微塑膠(直徑小於5毫米的)可能會危害其健康及生長。

Marine litter is an increasingly serious problem around the world. Large litter are often washed up on shores or sink to the ocean bottom, while small or microscopic fragments that drift in the water column can be ingested by zooplankton and fishes. For some species, ingestion of microplastics (diameter less than 5mm) may adversely affect their health and growth.



香港垃圾灣 Lap Sap Wan in Hong Kong



海膽幼體攝入微膠粒 Sea urchin larva ingesting microplastics





建議教學方案(一)

RECOMMENDED TEACHING PLAN - I

收集、觀察和辨認浮游生物樣本

Plankton Collection, Observation and Identification



Related Modules

常識科(小四至小六)	科學科(中一至中三)	生物科(中四至中六)
General Studies (Primary 4-6)	Science (Secondary 1-3)	Biology (Secondary 4-6)
• 學習範疇二:人與環境 Strand 2: People and Environment	 中一級課程單元 「單元一:科學入門」及 「單元三:觀察生物」 Secondary 1 curriculum: "Unit 1: Introducing Science" and "Unit 3: Looking at Living Things" 科學過程技能 Science Process Skills 	 必修部分(III. 生物與環境) Module III Organisms and Environment 科學探究技能 Scientific investigative skills

學習目標

Learning Objectives

	常識科(小四至小六) General Studies (Primary 4-6)	科學科(中一至中三) Science (Secondary 1-3)	生物科(中四至中六) Biology (Secondary 4-6)
1. 知識 Knowledge	• 明白浮游生物的定義、 身體構造及習性 Understand the definition, basic morphology and behaviors of plankton.	 知道科學家根據生物的 主要特徵來把它們分類 Understand that scientists put living things into different groups according to their key features. 	• 生物多樣性的重要性 Importance of biodiversity.
2. 技能 Skills	 安全及正確使用浮游生物網收集浮游生物樣本 Use plankton net safely and correctly to collect plankton samples; and 根據生物特徵進行分類及辨認 Classify and identify living things according to their biological characteristics. 	• 運用「科學過程技能」中的 「觀察」及「分類」技能 Utilize the essential science process skills - "observing" and "classifying".	 製作浮游生物玻片和使用 光顯微鏡的技巧 Preparation of plankton sides and skills of using light microscope; and 仔細觀察和準確記錄 Make careful observations and accurate records.
3. 態度 Attitude	 欣賞大自然的奧妙,表現對探索環境的與趣 Appreciate the wonder of Nature and show interest in exploring our environment. 明白保育的需要及可持續發展的重要性 Understand the need for conservation and importance of sustainable development. 		

建議教學活動 - 浮游生物收集 Recommended Teaching Activity -Plankton Collection

- 1 在進行取樣之前,請使用帶有標記的繩索或樣線來測量水底的深度。(注意:因為潮汐的關係,即使是在相同的收集地點,每次都需要先測量深度。)
- 將浮游生物網放至水面,使海水流入採樣瓶內,令整個浮游生物網有足夠的重量沉至海底。
- ③ 降低浮游生物網,直到網與海床相差1米,然後慢慢將浮游生物網拉出水面。
- 4 把步驟3重複3至5次,以確保收集足夠的浮游生物樣本,並記錄浮游生物網下降的深度。
- ⑤ 將網拉至水面,並用海水沖洗浮游生物網的外面,防止浮游生物樣本受到海水污染。
- 6 在你離開採樣點之前,記錄當日的天氣狀況和資料,以便進行分析,例如:日期、時間、天氣、水深、 浮游生物網口的直徑和收集方法、海水顏色等。
- 1 Before plankton collection, use a labelled rope or transect line to measure the water depth of your sampling site. (Note: you have to do this every time, even for the same sampling site, as there is daily fluctuation of tidal level.)
- 2 Lower the plankton net into the water and fill the sampling bottle with seawater, to ensure the net is heavy enough to sink to the bottom.
- 1 Lower the plankton net until it is 1 meter above the seabed (as measured in step 1), and slowly pull out the plankton net to the surface.
- Repeat the vertical tow in step 3 for 3 to 5 times to make the plankton sample collected more concentrated, and record the maximum water depth reached by the plankton net.
- 5 Slowly raise the net from the water, and use seawater to rinse all plankton retained on the inner surface of the net to the sampling bottle.
- 6 Before you leave the sampling site, record the weather conditions and sampling information, e.g date, time, weather, water depth, diameter and method of plankton tow, seawater color etc. This information is useful for data analysis.

垂直收集 VERTICAL TOW 極期 TOW ROPE V集方向 TOW DIRECTION | 浮游生物網 (有不同的網眼大小) PLANKTON NET (WITH DIFFERENT PORE SIZE)

注意 NOTE

> 你可以根據採樣點的水流及深度選擇使用垂直地、 水平地或傾斜地的方法收集浮游生物。例如,如果 你在淺水的地方收集浮游生物,水平收集會比垂直 收集更適合,因為可以避免海床沉積物進入浮游生 物網。

> You may conduct your plankton tow in vertical, horizontal or oblique directions, depending on the depth of the water column and water current at the sampling site. For example, if you are planning to collect plankton in shallow water, horizontal tow is better than vertical tow, which can avoid sediment from the seabed entering the plankton net.

.31 **WEIUHI**

觀察樣本

Plankton Observation

- ② 如果你想觀察載玻片內的某個浮游生物,請從光學顯微鏡的較低倍數(10-40X)開始觀察,然後再調較至較高的倍數(40-100X)觀察。觀察浮游生物時,除了調整焦距外,也可能需要調整顯微鏡的光源強度和對比度。
- 1 Stir the plankton sample, use dropper to add a few drops of the sample on a clean glass slide, slowly lower the slip to cover the sample. (You may need to place some modeling clay at the corners of the cover slide, if you have a thick plankton sample.)
- 2 Begin plankton observation under the light microscope from the lower magnification (10-40X), then switch to higher magnification (40-100X) if you want to observe single planter on the slide.

 (You may need to adjust the light intensity and contrast of the microscope for better observation, in addition to adjusting the focus.)



注意 NOTE

觀察浮游植物需要使用較高的倍數(例如:100X),而觀察浮游動物則需要相對較低的倍數(例如:40X),因為浮游動物通常體形較大,並且移動得較快。

Use higher magnification (e.g. 100X) for phytoplankton observation and relatively lower magnification (e.g. 40X) for zooplankton observation, as the zooplankton are usually larger and move more quickly.

辨認技巧

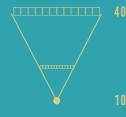
Identification Skills

為什麼觀察同一種浮游生物時有時看起來會不同? Why do the same kind of plankton sometimes look different?

不同放大倍數Different magnifications







顯微鏡的放大倍數(10X,40X,100X等)會影響所觀察之浮游生物的結構細節。通常,我們會使用10X至40X倍數來觀察浮游動物, 而40X至100X倍數則用來觀察浮游植物。

Magnification of the microscope affects the degree of structural detail revealed. Usually, we use 10X to 40X for zooplankton observation and 40 X to 100X for phytoplankton observation.

不同角度Different orientations

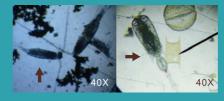
學校的顯微鏡通常只會提供浮游生物的平 面圖像,因此有些浮游生物的頂視圖和側 視圖在形狀和外觀上可能會完全不同。

Plankton images observed under microscopes in schools are usually two-dimensional while the top view and side view of some plankton can be totally different in shape and appearance.





同一目但不同屬 Same class but different genus



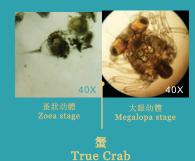
辨認卡中列出的浮游植物和浮游動物只分類到「目」的級別。因此,如果樣本屬於不同「屬」,可 能與圖中的示例看起來不同。

Phytoplankton and zooplankton listed in the ID chart are only identified to the Class level. Therefore, the specimen may look different from the photo examples in the ID chart if they belong to a different genus.

不同發育的階段 Different developmental stages

有些浮游生物成長時會有不同的發育階段,每個階段會展現出不同的特徵。例如,在生物變態發生 之前,幼蟲階段的螃蟹會經歷溞狀幼體和大眼幼體階段。

Some plankton go through a series of developmental stages with different features exhibited in each stage. For example, the crabs at larval stage go through zoea stage and megalopa stage before metamorphosis takes place.



 $\mathrm{p.33}$

建議教學方案(二)

RECOMMENDED TEACHING PLAN - II

小三至小六級 視覺藝術科 VISUAL ARTS, PRIMARY 3-6 編者 Editor:

Pario Arts

意見提供:

九龍灣聖若翰天主教小學 中文科及視藝科老師 陳藹欣主任

Advisior

Ms. Chan Hoi Yan, Visual Arts and Chinese Teacher of Kowloon Bay Saint John the Baptist Catholic Primary School

浮游生物製作活動 DIY Plankton Art Activity

學習目標 Learning Objectives

1. 知識 Knowledge

- 明白浮游生物的定義、特點及習性 Understand the definition, features and behaviors of plankton
- 明白浮游生物的身體構造(基本造形特徵) Understand the body structures of plankton (basic morphology)

2. 技能 Skills

- 發揮創意及運用想像力創作具特色的浮游生物 Create unique plankton with own imagination
- 安全及正確使用工具以造出浮游生物的形態
 - Use the tools safely and correctly to exhibit the shapes and forms of plankton
- 以不同方式排列包裝紙小碎塊以突出浮游生物的造型。
 Highlight the appearance of plankton with different arrangement of the snack package small pieces.

3. 態度 Attitude

培養對海洋主題藝術品的審美觀
 Nurture aesthetic sensitivity towards marine-themed artwork

一齊來做一隻 「環保浮游生物」吧! Let's make an Eco-plankton!

嶢足類

建議教學活動 - 浮游生物製作活動 Recommended Teaching Plan -DIY Plankton Art Activity

教師準備工作Preparation work for teachers:

- . 預先提醒參與課堂的學生準備零食包裝袋(反光面、不同的圖案或色彩) Remind students to prepare snack packages in advance (Shiny surface with different patterns or colors).
- 預備紙皮雞蛋托、白膠漿、剪刀
 Prepare egg carton, white glue and scissors.

製作步驟Procedures 例子Example:橈足類 Copepod



1. 把雞蛋托張開成x字形。 Cut the egg carton into an 'X' shape.



2. 把向下的兩塊捲成身體,以白膠漿穩固。 Roll the two lower pieces to become the body part of the copepod. Use white glue to fix.



3. 將向上兩塊剪或捲成長長的觸手,保留 所有紙碎。 Roll or cut the two upper pieces to become the long antennae. Keep all the leftover paper pieces.



4. 紙碎用白膠漿貼在身體上,成為 尾巴和觸手。 Stick the pieces onto the body part with white glue and make a "tail" and antenna for the copepod.



5. 把零食包裝紙剪成小碎塊,以不同的排列方法貼在橈足類的身體上,造成不同的閃亮效果(模仿大多數浮游生物身體透明的特點)。

Cut the snack packages into small pieces and stick them onto the body part. Students can adopt different patterns and arrangement method to create various glittery effects (imitate the transparent body of most of the plankton).



6. 完成 Done



所需課節:兩堂 (70至80分鐘)

Lesson required: 2 lessons (70 - 80 minutes)

建議時間分配:

Recommended time allocation:

時間 TIME	教學活動 TEACHING ACTIVITIES	學 習目標 LEARNING OBJECTIVES	教具/教材 MATERIALS/TOOLS
5 分鐘 min	・簡單介紹浮游生物(浮游生物的定義、大小和生境等) ・簡介浮游植物及浮游動物的不同之處 ・簡介浮游植物及浮游動物的不同之處 ・配識浮游生物性 ・認識浮游生物性 ・認識浮游生物性 ・認識浮游生物性		• 參考本補充資料冊 • Reference from this
	and habitat of plankton) •Briefly introduce the difference between phytoplankton and zooplankton	plankton and how it affects plankton behavior • Learn the diversity of plankton	supplementary booklet
	示範 ・示範浮游生物藝術品的製作步驟	運用想像及觀察,探索雞蛋托如何變成浮游生物嘗試運用剪、摺、捲等方法把雞蛋托改造成浮游生物的形態,以突出生物特徵	• 浮游生物圖片
10 分鐘 min	Demonstration • Observe artwork demonstration by teacher	 Explore how to turn an egg carton into a plankton artwork through imagination and observation. Try different methods like cutting, folding and rolling to rearrange the shape of an egg carton to plankton. 	• Plankton photos
50 分鐘 min	創作浮游生物 • 透過預先準備的浮游生物圖片,讓學生選擇自己喜歡的浮游生物造型,加以想像進行創作 • 從旁引導思考,鼓勵學生發揮創意,設計獨一無二的浮游生物	學習如何安全及正確使用膠水及剪刀造出浮游生物的形態利用零食包裝袋的反光面作為裝飾圖案物料,以不同的排列方法貼在浮游生物的身體上	・紙皮雞蛋托・白膠漿・剪刀・零食包装袋(反光面)
50 万鲤 IIIII	Plankton artwork creation • Let students choose the favorite plankton with the photos prepared and create the artwork with own imagination • Facilitate the artwork production and encourage students to create his/her own unique artwork	 Learn how to use glue and scissors safely and correct to show the shape and form of plankton Use the shiny snack package to decorate the plankton body with different arrangement methods. 	Paper egg carton for the whole class White glue Scissors Shiny snack packages
	總結 ・邀請學生分享作品構思及製作心得	表達個人對自己作品的意見聆聽其他學生的創作心得反思物盡其用的重要性,如升級再造成為「浮游生物大使」,向他人宣揚保護海洋的重要性	
5-15分鐘 min	Conclusion • Invite students to share their artwork idea and creation process	 Express opinions about own artwork Listen to the sharing of other students Reflect on the importance of making the best use of unwanted materials, e.g. upcycling Become 'plankton ambassador' to promote the importance of marine conservation 	

建議教學方案(三)

RECOMMENDED TEACHING PLAN - III

中一至中三級 科學科 SCIENCE, SECONDARY 1-3

編者

張振興伉儷書院 化學科及科學科科主任 吳華彪老師 Editor:

Mr. Ng Wa Piu, Head of Chemistry and Science Panels, Chong Gene Hang College

製作簡單檢索表分辨浮游生物

Construct a simple key for identification of plankton

與科學(中一至中三)課程的聯繫

- 中一級課程單元 「單元一:科學入門」及「單元三:觀察生物」
- 科學過程技能

Related modules in science (secondary 1)

- Secondary 1 curriculum: "Unit 1: Introducing Science" and "Unit 3: Looking at Living Things"
- Science Process Skills

學習目標

Learning Objectives

完成課堂後,學生應能

l. 知識

- 明白把生物分類的重要,知道科學家根據生物的主要特徵來把牠們分類
- 明白生物多樣性對自然環境,以及對人類的益處

2. 技能

- 運用「科學過程技能」中的「觀察」及「分類」技能
- 製作簡單檢索表以分辨一些浮游生物

3. 能用

列舉一些會導致生物多樣性減少的人類活動例子,反思可持續發展的重要性。

After lessons, students will be able to:

1. Knowledge

- Recognize the need of grouping living things, and understand that scientists put living things into different groups according to their key features
- Recognize the importance of biodiversity to the natural environment, and its benefits to humans.

2. Skills

- Utilize the essential science process skills "observing" and "classifying"; and
- Construct a simple key for identification of plankton.

3. Attitude

Give examples of human activities leading to biodiversity loss, and reflect the importance of sustainable development.

建議教學活動 - 製作簡單檢索表分辨浮游生物

Recommended Teaching Plan -Construct a simple key for identification of plankton

教師準備工作 Preparation work for teachers:

- 1. 在本「教師補充資料冊」找出4至5張不同種類的浮游生物圖片,建議包括浮游動物和浮游植物 Select 4 to 5 plankton photos (including both phytoplankton and zooplankton) from this "supplementary information for teacher" booklet.
- 2. 指出該生物的特徵和分類,引導學生思考生物分類的過程 Point out features and classification of the selected plankton, in order to guide students to think about the classification process, for example:

图比市野学的特徵

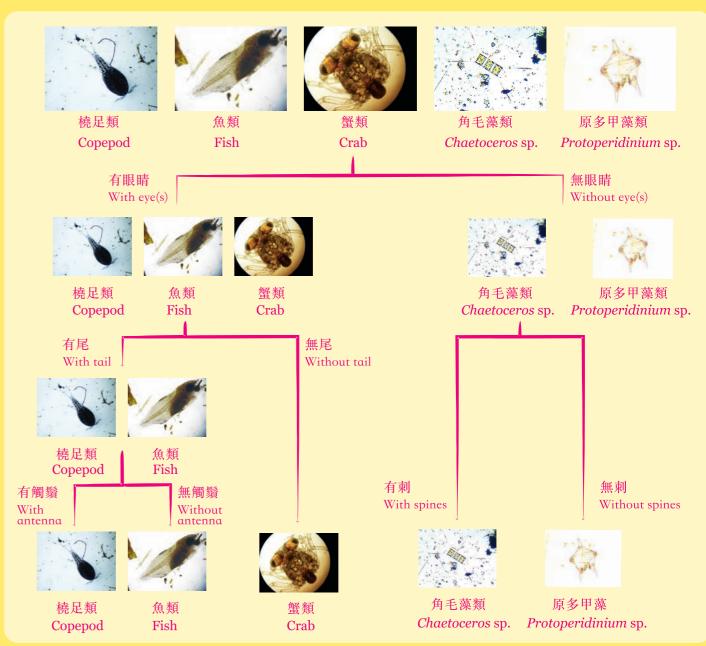
	名稱及分類 NAME and CLASSIFICATION	圖片 PHOTO	圖片中顯示的特徵 FEATURES SHOWN IN PHOTO
	節肢動物 (橈足類) Arthropod (Copepod)		 一隻眼睛 尾巴 一對觸鬚 An eye A tail A pair of antenna
浮游動物 Zooplankton	脊索動物 (魚) Chordate (Fish)		 一隻眼睛 (另一隻未能在圖片中顯示) 魚身、魚頭及魚尾 A pair of eyes (an eye on the other side cannot be shown in this photo) Head, body and tail
	節肢動物 (蟹) Arthropod (Crab)		 一對眼睛 腳(10隻) A pair of eyes 10 legs
浮游植物	矽藻 (角毛藻) Diatoms (<i>Chaetoceros</i> sp.)		 三個細胞排成鏈狀 刺由細胞延伸 Consists of 3 cells aligned together into a chain-form Spines extended from the cells
Phytoplankton	甲藻 (原多甲藻) Dinoflagellates (<i>Protoperidinium</i> sp.)		• 横溝在中間 • A girdle in the middle of the cell

製作一張檢索表工作紙,讓學生分組(2至3人)進行分類
Prepare a worksheet of identification key and ask students to complete in groups (2-3 students in a group).

建議工作紙 Recommended worksheet



建議工作紙答案 Answer key for the recommended worksheet



所需課節:一堂 (35至40分鐘)

Lesson required: 1 lesson (35-40min)

建議時間分配:

Recommended time allocation:

時間 TIME	教學活動 TEACHING ACTIVITIES	學 習目標 LEARNING OBJECTIVES
7-8 分 鐘 min	 介紹 ・簡介浮游生物(浮游生物的定義、大小和環境等) ・簡介浮游生物對海洋和人類重要性(支持海洋的食物鏈、為人類提供氧氣和海鮮) Introduction ・Briefly introduce plankton (definition, size and its environment) ・Introduce the importance of plankton to human and the ocean (support marine food chain, provide oxygen and food to humans) 	 了解大部分的浮游生物都是「微生物」^ 知道不同生物的體型大小差異可以很大 生物多樣性對海洋環境的重要性 生物多樣性對人類的益處 Understand most marine plankton are "micro-organisms"^ Become aware of the wide range of body size of different living things Realize the importance of biodiversity to the marine environment Understand the benefit of rich biodiversity to humans
10 分鐘 min	生物特徵 •派發浮游生物圖片,讓學生分組討論,列出各浮游生物的特徵 Plankton features • Distribute plankton photos and ask students to list out the features of plankton through group discussion	 連用「科學過程技能」中的「觀察」技能 同儕間協作學習 Practice science process skill - "observing" Peer-learning
10 分鐘 min	檢索表及分類 • 派發檢索表工作紙,讓學生分組完成浮游生物檢索表 Identification key and classification • Distribute the worksheet, ask students to complete the identification key of plankton in groups	 運用「科學過程技能」中的「分類」的技能 明白把生物分類的重要 製作簡單檢索表以分辨一些浮游生物 明白浮游生物的種類繁多,當中包括浮游植物和浮游動物 同儕間協作學習 Practice science process skills - "classifying" Recognize the importance of classification Construct a simple key for identification of plankton Understand the variety of plankton, including phytoplankton and zooplankton Peer-learning
7-8分鐘 min	總結 • 利用剪報講解浮游生物面對的威脅 Conclusion • Use news clips to address the threats that plankton are facing	 明白生物多樣性對自然環境可持續發展的重要性,以及對人類的益處 列舉一些會導致生物多樣性減少的人類活動例子 反思可持續發展的重要性 Recognize the importance of biodiversity to the natural environment, and its benefits to humans Give examples of human activities leading to biodiversity loss Reflect the importance of sustainable development

(^微生物是一些體積較小,一般需要在顯微鏡下放大觀察的生物,微生物不一定是動物或植物)

(^Micro-organisms are living things that have a relatively small body size, which usually require the use of microscopes for observation. Micro-organisms are not necessarily animals and plants.)

建議教學方案 (四)

RECOMMENDED TEACHING PLAN - VI

中四至中六級 生物科

BIOLOGY, SECONDARY 4-6

編者

保祿六世書院 生物科科主任 劉惠賢老師 Editor:

Mrs. Chu Lau Wai Yin, Head of Biology, Pope Paul VI College

利用浮游生物製作簡單的海洋食物鏈和生態錐塔

Construct a simplified marine food chain and ecological pyramids with plankton

與生物科(中四至中六)課程的聯繫

- · 課程單元 III. 生物與環境
- 課程單元 VI. 應用生態學
- 科學探究技能。

Related modules in biology (secondary 4 - 6)

- Module III Organisms and Environment
- Module VI Applied Ecology
- Scientific investigative skills

學習目標

Learning Objectives

完成課堂後,學生應能

1. 知語

- 知道在各組織層次研習生物與其環境
- 利用食物鏈、食物網、數量錐體和生物量錐體來表達生物間的攝食關係及各營養級 的能量流
- 了解生態系內能量傳遞的效率
- 了解生物多樣性的重要性

2. 態度

明白保育的需要及可持續發展的重要性

After lessons, students will be able to:

Knowledge

- Be aware that organisms and their environment are studied at different levels of organization
- Use food chains, food webs, pyramids of numbers and biomass to represent the feeding relationships of organisms and energy flow between different trophic levels
- Understand the efficiency of energy transfer in an ecosystem
- Understand the importance of biodiversity

2. Attitude

Understand the need for conservation and the importance of sustainable development

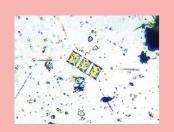
建議教學活動 - 利用浮游生物製作簡單的海洋食物鏈和生態錐塔

Recommended Teaching Plan - Construct a simplified marine food chain and ecological pyramids with plankton

教師準備工作:

Preparation work for teachers:

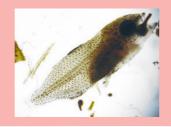
1. 在本「教師補充資料冊」找出1張浮游植物和2張浮游動物的圖片。
Select one phytoplankton and two zooplankton photos from this "supplementary information for teachers" booklet.



浮游植物 (例如:角毛藻屬) Phytoplankton (e.g. *Chaetoceros* sp.)



浮游動物 (例如:雙殼綱) Zooplankton (e.g bivalve)



浮游動物 (例如:魚類的幼體) Zooplankton (e.g fish larva)

2. 列印以下建議工作紙。(有關「浮游植物」和「浮游動物」的定義在此「教師補充資料冊」P.46詞彙表中找到) Print the below recommended worksheet. (Definition of "phytoplankton" and "zooplankton" are available in P.46 - Glossary in this booklet)

建議工作紙 Recommended worksheet:

請將以上3張浮游生物照片排列成一個簡單的海洋食物網,並填寫下表。
Arrange the 3 plankton photos in a simplified food web and fill in the table below.

海洋食物網:
Food chain:

角毛藻屬
Chaetoceros sp
Bivalve

摩游植物 / 浮游動物
Phytoplankton / zooplankton

管養級

脊椎動物/無脊椎動物 Vertebrate/Invertebrate

生物在食物鏈的角色 Role of organisms

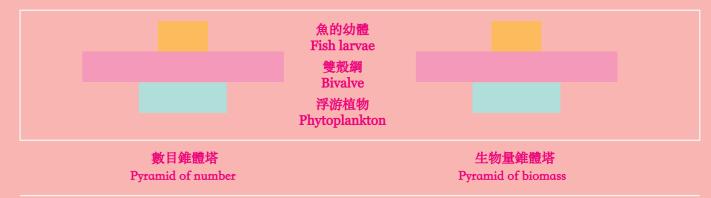
能量的傳遞 Energy flow

Trophic level

3. 建議工作紙答案 Recommended answers for the worksheet:

請將以上3張浮游生物照片排列成一個簡單的海洋食物網,並填寫下表。 Arrange the 3 plankton photos in a simplified food web and fill in the table below.						
海洋食物網: Food chain:	角毛藻屬 Chaetoceros sp		雙 <mark>殼綱</mark> Bivalve		魚的幼體 Fish larvae	
浮游植物 / 浮游動物 Phytoplankton / zooplankton	浮游植物 Phytoplankton		浮游動物 Zooplankton		浮游動物 Zooplankton	
營養級 Trophic level	初級 First		次級 Second		第三級 Third	
生物在食物鏈的角色 Role of organisms	生產者 Producer		消費者 Consumer		頂級消費者 Top Consumer	
脊椎動物 / 無脊椎動物 無脊椎動物 Vertebrate / Invertebrate Invertebrate Vertebrate						
能量的傳送 Energy flow						

4. 準備倒置的數目錐體塔和生物量錐體塔,並請學生分組討論這兩個錐體塔是否符合上述海洋食物鏈的模型。 Prepare the inverted pyramids of number and biomass, ask students to form groups and discuss whether the two pyramids fit into the above food chain model.







所需課節:一堂 (35至40分鐘)

Lesson required: 1 lesson (35-40min)

建議時間分配:

時間 TIME	ded time allocation: 教學活動 TEACHING ACTIVITIES	學 習目標 LEARNING OBJECTIVES
5分鐘 min	介紹 •介紹浮游生物和浮游生物的種類 Introduction • Briefly introduce plankton (definition, and types)	 知道在各組織層次研習生物與其環境 簡單地了解浮游生物的生態和浮游植物如何支撐海洋生態系統 Be aware that organisms are studied at different levels of organization Have a brief idea on plankton ecology and how phytoplankton support the marine ecosystem
5分鐘 min	重溫 • 重溫與應用生態學相關的用語和概念,例如營養級、不同生物在食物鏈的角色、脊椎動物和無脊椎動物 Revision • Revise the ecological terms and concepts in Applied Biology, e.g. trophic level, role of organisms in food chain, vertebrate and invertebrate	
10 分鐘 min	活動:製作海洋食物鏈 • 通過製作海洋食物鏈,讓學生應用生態用語和概念 Activity: create a marine food chain • Apply students' knowledge on ecological terms and concepts, by creating a marine food chain	 利用食物鏈、食物網、數量錐體和生物量錐體來表達生物間的攝食關係及各營養級的能量流 Use food chains, food webs, pyramids of numbers and biomass to represent the feeding relationships of organisms and energy flow between different trophic levels
15 分鐘 min	討論:倒置的數目錐體塔與生物量 錐體塔 • 讓學生將倒置的數目錐體塔與生物量錐體塔的 知識應用在討論 Discussion: inverted pyramids of number and biomass • Apply students' knowledge on inverted pyramids of number and biomass in discussion	• 了解當較低營養級別生物(如浮游植物)的繁殖率遠高於較高營養級別生物(如雙殼類)時,生物量錐體塔會出現倒置形狀 • Understand that a pyramid of biomass may become inverted, when organisms at a lower trophic level (e.g.phytoplankton) have a much higher reproduction rate than organisms at a higher trophic level (bivalve)
10 分鐘 min	總結 • 了解浮游生物對海洋生態系統的重要 Debriefing • The importance of plankton to marine ecosystem	 了解人類活動的對數目和生物量錐體塔的影響 明白保育的需要及可持續發展的重要性 Understand how humans affect the stability of pyramids of number and biomass Understand the need for conservation and importance of sustainable development

<mark>詞彙表</mark> GLOSSARY

浮游植物是能夠進行光合作用的浮游生物,常見的類別包括矽藻和甲藻。

Phytoplankton (phyto- means "plant") are plankton that are able to photosynthesize. Common groups include diatoms and dinoflagellates.

浮游動物是不能夠進行光合作用和需要進食其他浮游生物的浮游生物。

Zooplankton (200-means "animal") are plankton that cannot conduct photosynthesis and have to feed on other plankton.

全生性浮游生物是指該生物整個生命週期均是浮游生物,例如: 橈足類。

Holoplankton are organisms that are planktonic throughout their entire life cycle, e.g. copepod.

暫時性浮游生物是指該生物部分生命週期是浮游生物階段,例如:蟹。

Meroplankton are organisms that spend part of their lives in planktonic stage, e.g. crab.

矽薬門是其中一類常見的浮游植物。矽藻是單細胞生物,被二氧化矽的外殼(矽藻殼)組合而成,但同時可組成鏈狀或以之字形狀出現。

Phylum Bacillariophyta (Diatoms) are a common type of phytoplankton. Diatoms are unicellular, enclosed by silica cell wall (the frustule), but can be joined together to appear in chains or zig-zag clusters.

甲藻門是其中一類常見的浮游植物。甲藻是單細胞生物和有兩條鞭毛作移動。

Phylum Dinoflagellates are one of the major groups of phytoplankton. Dinoflagellates are unicellular and have two flagella for locomotion.

環節動物門是身體分節的蟲狀生物,例如:多毛綱動物。

Phylum Annelida are segmented worms, e.g. polychaete.

節肢動物門是身體分節的無脊椎動物,並擁有外骨骼和一對對相連的附肢,例如:甲殼類動物。

Phylum Arthropoda are segmented invertebrates with an exoskeleton and jointed appendages, e.g. crustacean.

刺胞動物門是具有輻射對稱的動物。成年的刺胞動物有獨特的刺細胞稱為刺囊,例如:水母和珊瑚。

Phylum Cnidaria are radially-symmetrical animals and the adults have unique stinging cells called nematocysts, e.g. jellyfish and coral.

脊索動物門是一種有脊索在部分生命週期的動物,例如:尾海鞘類和魚類。

 $\textbf{Phylum Chordata} \ \text{are animals that have a notochord at some stages of their life cycle, e.g. larvacean and fish.}$

棘皮動物門是有棘狀外型皮膚的動物,例如:海膽、海星和海參。

Phylum Echinodermata are animals with spiny-looking skin, e.g. sea urchin, starfish and sea cucumber.

放射蟲亞門是其中一類有矽外殼和針狀突出物的原生生物。

Subphylum Radiolaria are protozoa that have a silica test, with many needle-like protrusion.

軟體動物門是有柔軟身體、大部分都有鈣質外殼的動物,例如:螺、蠔、硯、八瓜魚和魷魚。

Phylum Mollusca are soft-bodied animals that often have calcareous shells, e.g. snail, oyster, clam, octopus and squid.





1,000,000+

一滴海水可藏有多達一百萬隻浮游生物個體。

There can be up to a million single-celled plankton in one single drop of seawater.



我們吸入的氧氣中,超過50%是由浮游植物透過光合作用來製造。

More than half of the oxygen we breath on earth is created through the photosynthetic activities of phytoplankton.



由中學組成的學生團隊在香港水域進行了 20次浮游生物調查,這計劃所發佈的浮游 生物辨認卡總結了他們的研究成果。

Student teams from secondary schools conducted 20 plankton surveys in Hong Kong waters, their results were summarized in the plankton identification chart, published in this project.



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世界自然基金會香港分會透過這個2年的學校 夥伴計劃,與20間中小學合作,讓超過14,000 名學生、教師和公眾人士認識香港海洋的生物 多樣性及推廣海洋保育。

WWF-Hong Kong engaged 20 primary and secondary schools through this 2-year partnership project, reaching over 14,000 students, teachers and members of public to appreciate local marine biodiversity and promote marine conservation.