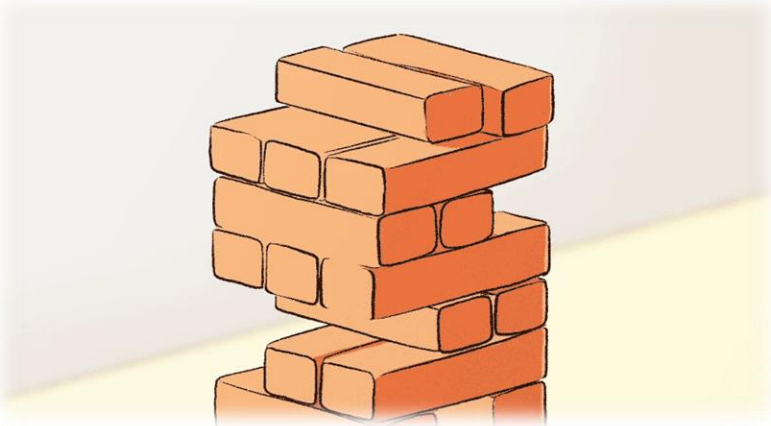
Using differentiated instruction for gifted/ more able students– Marine Food Web Jenga Model as an example



LEUNG, TERENCE WING CHEUK

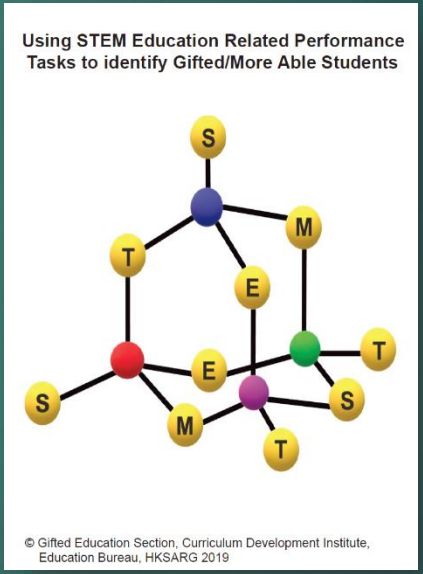
PLK MRS MA KAM MING – CHEUNG FOOK SIEN COLLEGE

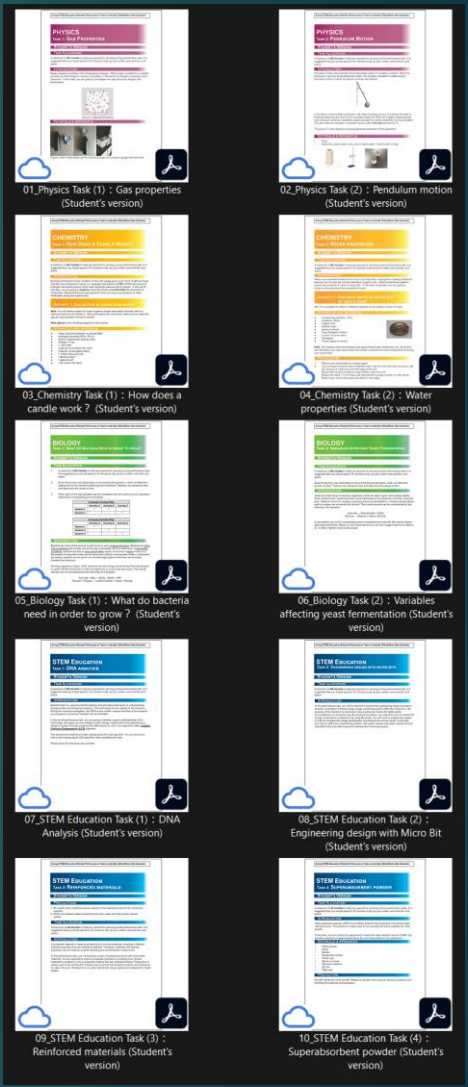
Background

- Band 2a school, S.1 Science classes
- MOI: EMI / mix-moded
- Learner diversity among classes: language barrier
- First trial: November 2021
- Topic: Ch3, Looking at Living Things

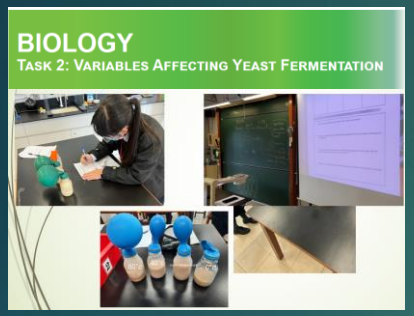
Previous Tryouts

- Using STEM Education Related Performance Tasks to Identify Gifted/ More Able Students
  - Consists of 10 performance tasks to identify and nurture gifted/ more able students in STEM education
  - Can be modified to implement in whole-class teaching or gifted education pull-out programmes.



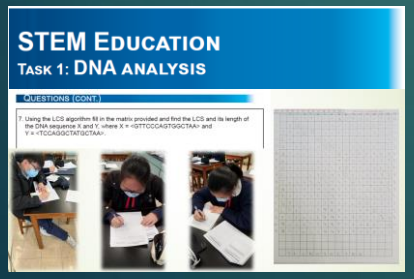


Classes Involved



- S.1 - Biology Task (2)：Variables affecting yeast fermentation
  - Nov. 2021: As extension of S.1 Scientific investigation
  - Lesson time: a double lesson (60 min.)

- S.4 - Biology Task (1)：What do bacteria need in order to grow？
  - Dec. 2021: As extension of S.4 Food & Nutrition
  - Lesson time: a double lesson (60 min.)



- S.6 - STEM Education Task (1)：DNA Analysis
  - Jan. 2022: As extension of E4 Biotechnology
  - Lesson time: a double lesson / after mock (60 min.)

Common Misconceptions of Food Chain Model

lettuce

grasshopper

lizard

eagle

- Grasshopper is a 'producer' for lizard.
- Mixing up the direction of the arrow.
- Organisms at a higher level in the food chain can consume *all* the organisms below.
- The feeding relationship depends on the size of the organisms.
- Names/ diagrams of the food chain refer to a single organism instead of a population of an organism.

(Allen, 2014)

Enrichment The Learning of Gifted / More-able Ss

- Keystone species
  - Some species are more important than other.

Connection to Daily Life

港海微塑膠濃度 四年激增11倍

2019年03月14日 03:50

【海洋生態】城大研究指禁拖網捕魚助本港海洋生物多樣性　東、西部水域捕食性蟹數量增6倍及13倍

社會 17:18 2021/03/25

讚好 45

西貢綠蛋島發現綠海龜屍體　體內殘留未消化食物疑遭「鬼網」

撰文：勞敏儀

出版：2021-05-14 14:14　更新：2021-05-14 19:05

10

Learning Objectives

- **Knowledge:**
  - To understand the concept of 'ecological balance' and 'keystone species'
  - To predict, explain and evaluate the effects that a change in a population could have on other populations in the same community
- **Skill:**
  - To develop communication skills and modelling skills through constructing and using the Marine Food Web Model
- **Attitude:**
  - To be aware of ecological sustainability that all organisms (including humans) interact among organisms and their environments.

Learning Objectives

- Gamify the learning of some topics in ecology
  (e.g. food chains, human impact on the environment, biomass, keystone species…etc.)
- Master causal relationship with language aid

If (CAUSE) then I predict that (EFFECT) because (REASONING).

If **the marketing demand of Hai Piao Xiao is very high** then I predict that **the population of cuttlefish decreases** because **the cuttlefish are killed for making Hai Piao Xiao**.

Identification of Gifted / More-able Ss

Characteristics and abilities of scientifically gifted students

- Strong curiosity about objects and environment;
- High interest in investigating scientific phenomena;
- Tendency to make observations and ask questions;
- Ability to make connections between scientific concepts and observed phenomena;
- Ability to generate creative and valid explanations;
- Interest in collecting and classifying objects.

Yager, R.E.(1989) Teaching science to gifted science students. In R.M Miligram (Eds.) *Teaching gifted and talented learners in regular classrooms* (pp. 223-248). Springfield, IL Charles C. Thomas.

Lesson Plan & Teaching Materials

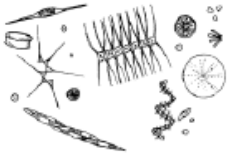
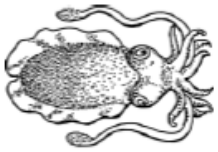
- Instructions to Ss
  - You are advised to work in groups of 4 students
  - Read the guide sheet and propose the food web by filling in the blanks with appropriate organisms.
  - Why is shrimp considered as keystone species?
  - Referring to the instruction sheet and the guide sheet, let's build the Marine Food Web Model.

Guide Sheet 工作紙

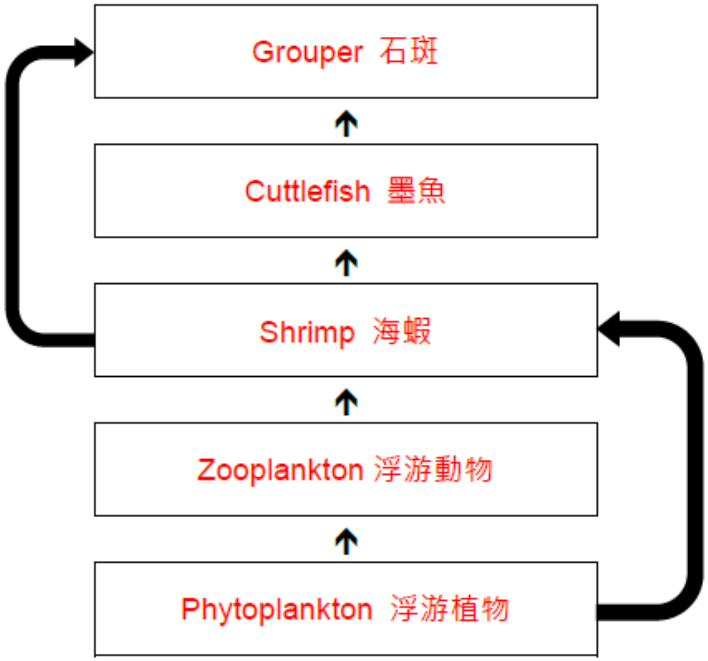
Complete the food web diagram using the following facts:
根據以下的資料，完成食物網：

- Phytoplanktons are producers.
  浮游植物是生產者。
- Groupers are the top predator.
  石斑是頂級捕食者。
- Shrimps are keystone species.
  海蝦是關鍵物種。
- Zooplanktons are the primary consumers.
  浮游動物是初級消費者。
- Cuttlefish and shrimps are the prey of groupers.
  墨魚和海蝦都是石斑的獵物。

Organisms 生物

Phytoplankton 浮游植物		Groupers 石斑	
Zooplankton 浮游動物		Cuttlefish 墨魚	
Shrimps 海蝦			

Food Web Diagram 食物網

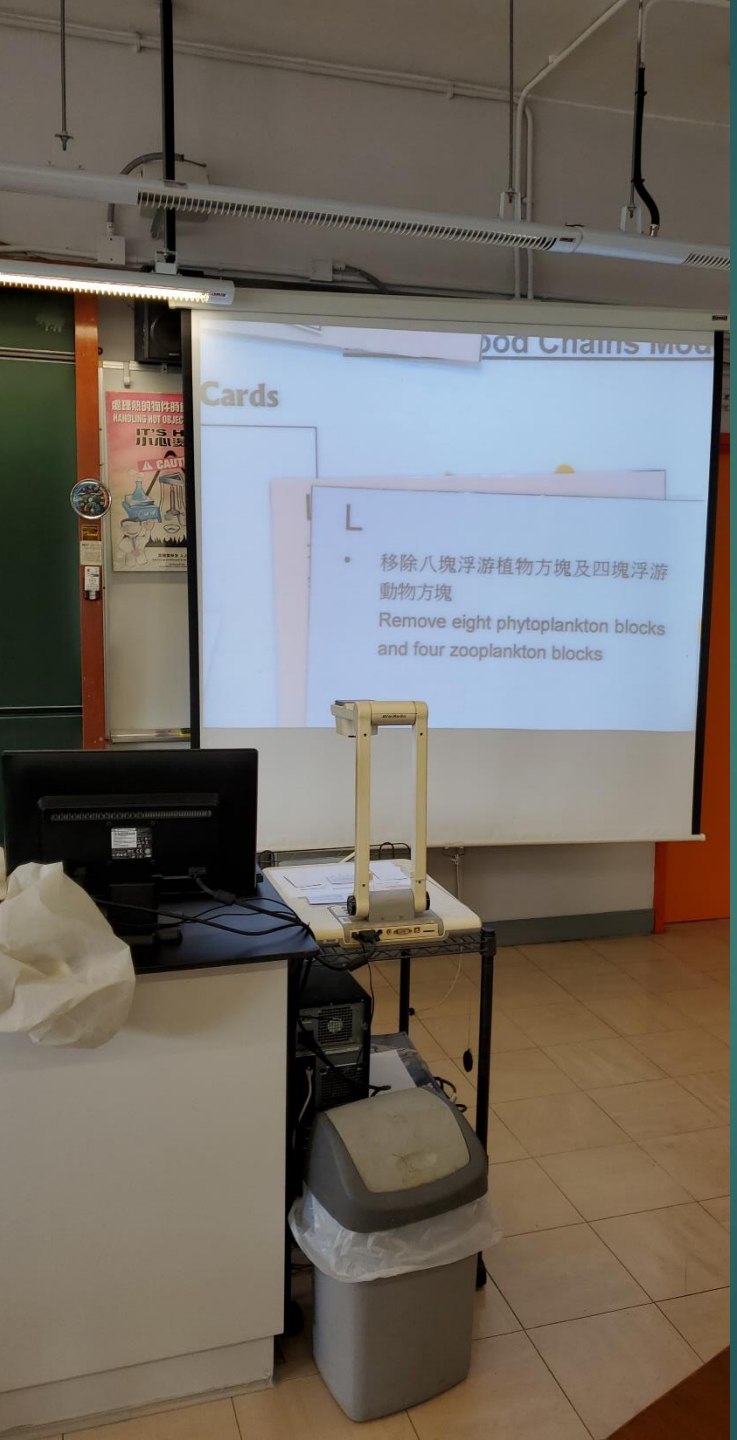


Sentence prompt: 語句提示：

If (CAUSE 原因) then I predict 預計 that (EFFECT 結果) because (REASONING 推理).

Game Time

- When you remove a block, put it off to the side.
- When adding a block, make sure to put it in the correct trophic level
  - e.g. groupers cannot be added to the same trophic level as zooplanktons
- Keep playing until the tower collapses
  - Once your tower falls, put the pieces back in the box and discuss the questions in the red card as a group



Collaborative reflection

- Once your tower falls, put the pieces back in the box and discuss the questions in the red card as a group.

Tiered discussion cards

Discussion Card 1 In this food web, what is/ are the producer(s) and what is/ are the consumer(s)? 在這個食物網中，哪些生物屬於生產者？哪些生物屬於消費者？	**Discussion Card 2** How many food chains are shown in the food web? List them all. 在這個食物網中包含多少條食物鏈？ 請列舉出來。	**Discussion Card 3** Which organisms are in competition for the same food? 哪些生物在競爭同樣的食物？
Discussion Card 4 Who is to blame for the ecosystem destruction? 生態系統受到破壞，你認為誰應該負責？	**Discussion Card 5** Do you think that all organisms are important in the ecosystem? Share your thought. 你認為在生態系統中，是否所有的生物都同樣很重要？分享你的想法。	**Discussion Card 6** How would you locate humans in the food web diagram? Are humans competing with other predators? 你認為人類應該在食物網中哪個位置？ 人類是否與其他掠食者一同競爭？
Discussion Card 7 How can you help keep the marine ecosystem healthy? 你認為如何幫助維護海洋生態系統健康？	**Discussion Card 8** Considering all the events that have affected our trophic chain up to now, if you were an ecologist, what policies would you implement to manage this ecosystem? 如果你是生態學家，你會實施什麼政策來管理這個生態系統？	**Discussion Card 9** The Tsunami that struck Japan in 2011 produced many marine debris. What would happen if invasive species were introduced by the debris at Hong Kong marine? 2011 年的日本海嘯產生了許多海洋垃圾。若海洋垃圾帶來外來物種並流入本港，這會對香港海洋生態有何影響？

Prompts for More Able Ss

T	Question 4, who is to blame for the ecosystem destruction?
S1	Human.
T	How? Why do you say that?
S1	Overfishing
T	Overfishing. Great! Okay. Can you elaborate more? What is the result of overfishing? Excuse me others. Please keep quiet and listen to what your classmate says. (Talk to S1) Yes, please.
S1	(Inaudible) How should I say? How many fishes you hunt and the fishes they grow… If the rate of hunting is faster than the rate of their reproducing. They (the fishes) are going to be extinct.
T	Very good. You are mentioning a very important rule of ecosystem. That means the rate of production and the relationship to the rate of the loss of certain species. When it produces more than it consumes, there will be something left. But if the loss is greater than the production, then it will make the species extinct. Right? Okay, very good! Overfishing is one of the causes. Any other causes? Other than overfishing, 除咗捕魚之外仲有無其他人為嘅，做嘅嘢會令到……
S2	食魚翅
S3	人類喺海洋裡面排出廢料。
T	Very good! 可唔可以講多少少？
S3	(Inaudible)
T	會排出啲咩廢料出泥？
S3	啲廢料會有 DDT
T	DDT 農藥，Yes，會點架？
S3	仲會排出垃圾同廢水
T	排啲垃圾或者啲廢水，佢地會點樣樣架？
S3	可能會令人生病。
T	即係浮浮動物或者浮游動物食左會死啦，又可以點架？如果佢地唔死，(DDT)積存左喺身體，一路食上去，類積類積，愈來愈多時候會點？
S3	**我地自己都會受害。**
T	我地自己都會受害。Okay, very good! This is the reason why human should be blamed for the ecosystem destruction.

Exit Slip

- Based on your experience in the lesson, what is meant by the term ‘ecological balance’?

- If a plant goes extinct, could this cause some animals to go extinct as well? If so, how?
  - Hints:
    What if the animals are herbivores (animals that eat only plants)?
    What if the animals are carnivores (animals that eat only other animals)?

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