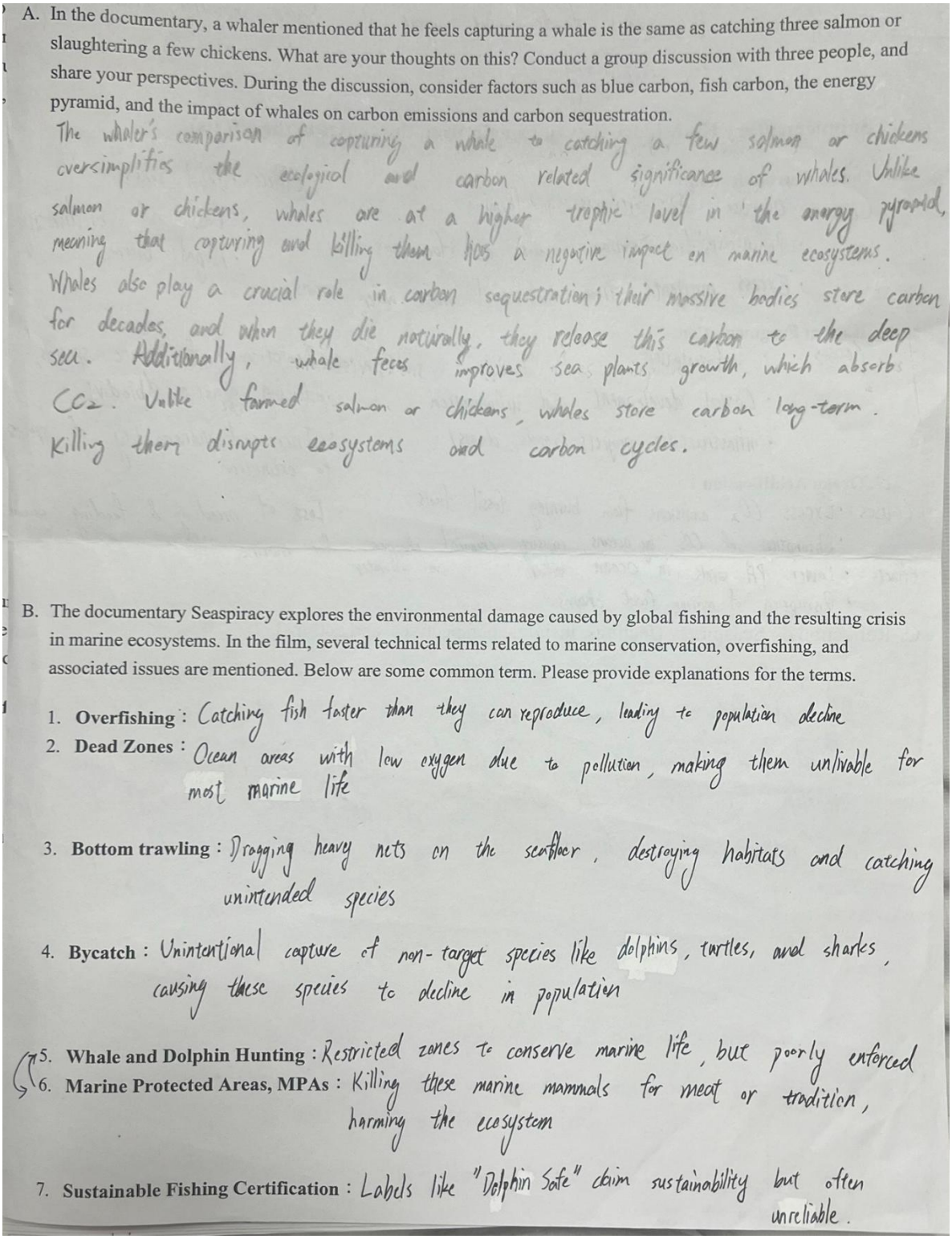
臺北市立中正高級中學113學年度

世界海洋日—永續海洋系列課程成果分享

此系列課程由三個系列課程做彙整(114年2月至6月期間)—
高一特色課程雙語實驗班海洋遊憩暨生態實地探索之學科部分(李智翰老師授課)、
高三多元選修雙語國際永續環境科學(李智翰老師授課)、
ESG及氣候拼圖外師講座(ESG永續規劃師外籍講師Agnes主講、李智翰老師協助翻譯與引導)

高一海洋課程的部分，一開始讓學生觀看海洋陰謀影片來進行破題，來引發學生對議題的關切並正視海洋危機，接著老師進行引導與回饋，對影片的內容提出論點反思與評論。並運用影片提及的外語專有名詞來進行相關教學及學生報告，然後讓學生寫學習單及心得。



A. In the documentary, a whaler mentioned that he feels capturing a whale is the same as catching three salmon or slaughtering a few chickens. What are your thoughts on this? Conduct a group discussion with three people, and share your perspectives. During the discussion, consider factors such as blue carbon, fish carbon, the energy pyramid, and the impact of whales on carbon emissions and carbon sequestration.

The whaler's comparison of capturing a whale to catching a few salmon or chickens oversimplifies the ecological and carbon related significance of whales. Unlike salmon or chickens, whales are at a higher trophic level in the energy pyramid, meaning that capturing and killing them has a negative impact on marine ecosystems. Whales also play a crucial role in carbon sequestration; their massive bodies store carbon for decades, and when they die naturally, they release this carbon to the deep sea. Additionally, whale feces improves sea plants growth, which absorb CO_2. Unlike farmed salmon or chickens, whales store carbon long-term. Killing them disrupts ecosystems and carbon cycles.

B. The documentary Seaspiracy explores the environmental damage caused by global fishing and the resulting crisis in marine ecosystems. In the film, several technical terms related to marine conservation, overfishing, and associated issues are mentioned. Below are some common term. Please provide explanations for the terms.

1. **Overfishing**: Catching fish faster than they can reproduce, leading to population decline
2. **Dead Zones**: Ocean areas with low oxygen due to pollution, making them unlivable for most marine life
3. **Bottom trawling**: Dragging heavy nets on the seafloor, destroying habitats and catching unintended species
4. **Bycatch**: Unintentional capture of non-target species like dolphins, turtles, and sharks, causing these species to decline in population
5. **Whale and Dolphin Hunting**: Restricted zones to conserve marine life, but poorly enforced
6. **Marine Protected Areas, MPAs**: Killing these marine mammals for meat or tradition, harming the ecosystem
7. **Sustainable Fishing Certification**: Labels like "Dolphin Safe" claim sustainability but often unreliable.

8. **Plastic Pollution** : Accumulation of plastic waste, harming wildlife and ecosystems

9. **Fishing Subsidies** : Government funds that support the fishing industry, often leading to overfishing

Supplementary Knowledge (has to explain from the causes to the effects)

10. **Ocean Eutrophication** :
Causes : · Overuse of fertilizers in farming
· Pollution from urban areas and factories
· Excess nutrients from industrial waste enter oceans.
Effects : · Dead zones
· Loss of biodiversity
· Algal blooms

11. **Habitat Fragmentation** :
Causes : · Deforestation
· Costal development and urbanization
· infrastructure projects (roads, dams)
Effects : · Isolation of marine species, reducing genetic diversity
· Increased vulnerability of species to extinction
· Loss of breeding & feeding grounds for marine life

12. **Ocean Acidification** :
Causes : · Excess CO_2 emissions from burning fossil fuels
· Absorption of CO_2 by oceans, causing chemical changes in seawater
Effects : · Lower pH levels in ocean water
· Disruption of marine food chains

C. Reflection on Seaspiracy (feelings, insights, perspectives, and actions)

Seaspiracy was shocking and eye-opening. It exposed the hidden impact of industrial fishing like overfishing, bycatch, and habitat destruction. I hadn't realized how destructive the seafood industry is or how little attention it gets. It changed my perspective on seafood, making me rethink my choices and consider more sustainable options.

接著帶領學生遊玩麻省理工學院研發的Fishbank模擬器，從中理解公地悲劇(TOC)對海洋資源的衝擊，以及非零和賽局合作對漁業的重要性。

Our goals of Fishbank Simulation today:

(a) Positive total assets for every team after 30 years

(b) Make profits and keep sustainability at the same time

(c) Make regulations, and reinforce implementation

1. Based on our fishbank experience last time, If you are running a fisherman's association(fishery guild), what regulations would you establish? (5min)

1. Catch quotas per boat
   · prevents overfishing and allow fish stocks to replenish
2. Fishing seasons restrictions
3. Resource monitoring system

2. What is TOC(Tragedy Of the Commons)? Give at least one example.

TOC is a situation in which individuals, acting in their own self-interest, overuse and deplete a shared resource, even though they don't want the resource to be destroyed.

Ex. In Fishbank Simulation, if every team tries to maximize short-term profits without limits, fish stocks collapse and everyone suffers from depleted fish stock.

3. Do you consider fisheries as zero- or non-zero-sum game? Why?

I'd consider fisheries as a non-zero-sum game since in a zero-sum game, if everyone cooperates, all teams can benefit over time; if everyone competes aggresively, everyone loses when fish stocks collapse

4. Give some examples for harmful fishery subsidies that contribute to overfishing, illegal fishing practices, or unsustainable exploitation of marine resources.

(optional) How does IUU gain benefits from harmful fishery subsidies?

Ex.
- Fuel subsidies: Reduce operating costs, encouraging more and longer fishing trips, even in over fished areas.
- Boat construction subsidies: Fund new vessels or upgrade fleets, leading to overcapacity.
- Port infrastructure subsidies in sensitive ecosystems: Allow access to remote, fragile areas.
- Subsidies with no sustainability conditions: Provide money without cooperating to environmental rules.

The IUU fishers often exploit weak regulation and lack of monitoring, more in areas where harmful subsidies increase the number of boats or reduce oversight costs.

5. Give examples of beneficial and sustainable fishery subsidies.

- Buy-back programs: Pay fishers to retire boats, reducing fleet size and pressure on stocks
- Stock assessment and science funding: helps monitor fish populations
- Marine protected area enforcement: Invest in security patrols to maintain no-take zones
- Training and transition support: help fishers diversify income (eco-tourism, aquaculture)

6. How do we resolve or mitigate the issue of overfishing? From which aspects can sustainability actions be undertaken?

1. Policy & governance
   - Catch limits: Use data to ensure fishing doesn't exceed replenishment
   - fishing licenses and permits: control who can fish and how much
   - MPAs: draw no-fishing or limited-fishing zones to allow ecosystems to recover
2. Technology
   - Stock assessments: regular evaluations of fish populations and ecosystems health
   - Remote monitoring: detect illegal fishing and improve security
   - Selective fishing gear: reduce bycatch and habitat damage
3. Social & community engagement
   - Fisher empowerment and management: Involve local communities in managing and protecting resources
   - Education & awareness: Inform fishers and consumers about sustainable practices and the long-term risks of overfishing
   - Other livelihoods: Support switching to aquaculture, eco-tourism etc.

7. What's your reflection on Fishbank Simulation and the lesson series?

The Fishbank simulation showed how overfishing happens when teams compete without rules, leading to resource collapse. It taught me the value of cooperation, regulation, and long-term planning. The lessons reinforced that sustainable fisheries need science, smart policies and shared responsibility.

Strategies and reflections brought by Fishbank Simulation

Classroom ,seat number, and name 11803 Cynthia

Our goals of Fishbank Simulation today:

(a) Positive total assets for every team after 30 years

(b) Make profits and keep sustainability at the same time

(c) Make regulations, and reinforce implementation

1. Based on our fishbank experience last time, If you are running a fisherman's association(fishery guild), what regulations would you establish? (5min)

- Quota System : Set limits on the number of fish each team can catch annually to prevent overfishing.
- Protected Areas : Designate no-fishing zones to allow fish populations to recover.
- Seasonal Fishing : Implement fishing seasons to avoid breeding periods and ensure sustainable reproduction.
- Penalties for Violations : Impose fines or reduced quotas for teams that break the rules.

2. What is TOC(Tragedy Of the Commons)? Give at least one example.

When shared resources (e.g. fish stocks) are overused for individual gain, leading to collapse.
Example : Overfishing in international waters, where no single entity owns the resource, and fishermen compete to catch as much as possible, depleting fish stocks.

3. Do you consider fisheries as zero- or non-zero-sum game? Why?

Fisheries are non-zero-sum. Sustainable management allows all parties to benefit long-term. Conversely, uncontrolled competition depletes resources, creating a scenario. Collaboration is key to avoiding collapse.

4. Give some examples for harmful fishery subsidies that contribute to overfishing, illegal fishing practices, or unsustainable exploitation of marine resources.

(optional) How does IUU gain benefits from harmful fishery subsidies?

Subsidy Type	Impact	Example
Fuel subsidies	Encourages longer, more destructive fishing.	China's distant-water fleet expansion
Vessel construction grants	Increases overcapacity	EU's now-reformed fleet modernization subsidies.
Tax exemptions	Reduces operating costs for large trawlers.	Thailand's tax breaks for fishing companies

5. Give examples of beneficial and sustainable fishery subsidies.

Eco-Friendly Gear Incentives

- Bycatch Reduction Devices (BRDs) : Funded in Australia's prawn fishery, cutting turtle deaths by 99%.
- Gillnet Alternatives : Support for LED-lit nets (reduces bycatch in Indonesia)

Capacity-Building Programs.

- Fisher Training : USA's "FishWatch" educates on sustainable practices
- Alternative Livelihoods : Philippines' seaweed farming subsities reduce fishing pressure.

6. How do we resolve or mitigate the issue of overfishing? From which aspects can sustainability actions be undertaken?

Policy Interventions
- Science-Based Quotas: Set using Maximum Sustainable Yield (MSY) models.
- Traceability Tech: Blockchain in Thai tuna exports ensures legality.

Industry Actions
- Certification Programs: MSC labels guide consumer choices.
- Fishing Gear Innovation: Biodegradable nets.

Consumer & NGO Roles
- Demand for Sustainable Seafood: Shift away from unsustainably sourced species.
- Awareness Campaigns: WWF's "Save Our Seas" initiative pressures policymakers.

7. What's your reflection on Fishbank Simulation and the lesson series?

The simulation highlighted:
- Selfishness destroys shared resources; collective action is vital.
- Rules must align short-term profits with long-term sustainability.
- Sacrificing immediate gains ensures future abundance.

接著讓學生將這些海洋議題做成心智圖，連結彼此的因果關係。然後上台發表為何這樣連結這些議題，並比較與探討不同組別是基於什麼樣的想法來連結這些因果關係，老師則適時給予回饋。

然後讓學生分組針對這些議題提出可行的解決方案，並上台報告，老師給予回饋。

Energy-Recovery Sewage Treatment Plants

Where: In Berlin, Germany there are Multiple treatment plants operated by Berliner Wasserbetriebe

Plan: Utilizing anaerobic digesters to produce biogas, which is then used for electricity generation. Simultaneously, phosphorus is recovered for use as fertilizer.

How: By enhancing traditional sewage treatment processes to recover both energy and valuable resources.

Outcome:
Achieved energy self-sufficiency within the treatment facilities.
Reduced carbon emissions, aligning with Germany's green energy policies.

Current Solutions

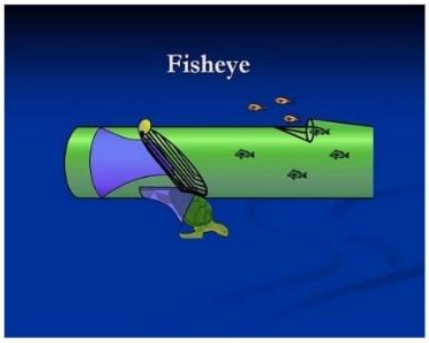
1.Improvement of Fishing Gear and Techniques

- Bycatch Reduction Devices (BRDs)
- Directional Sound or Light Sources

Example : Fisheye BRD

The escape opening installed at the end of the net selectively releases non-target fish.

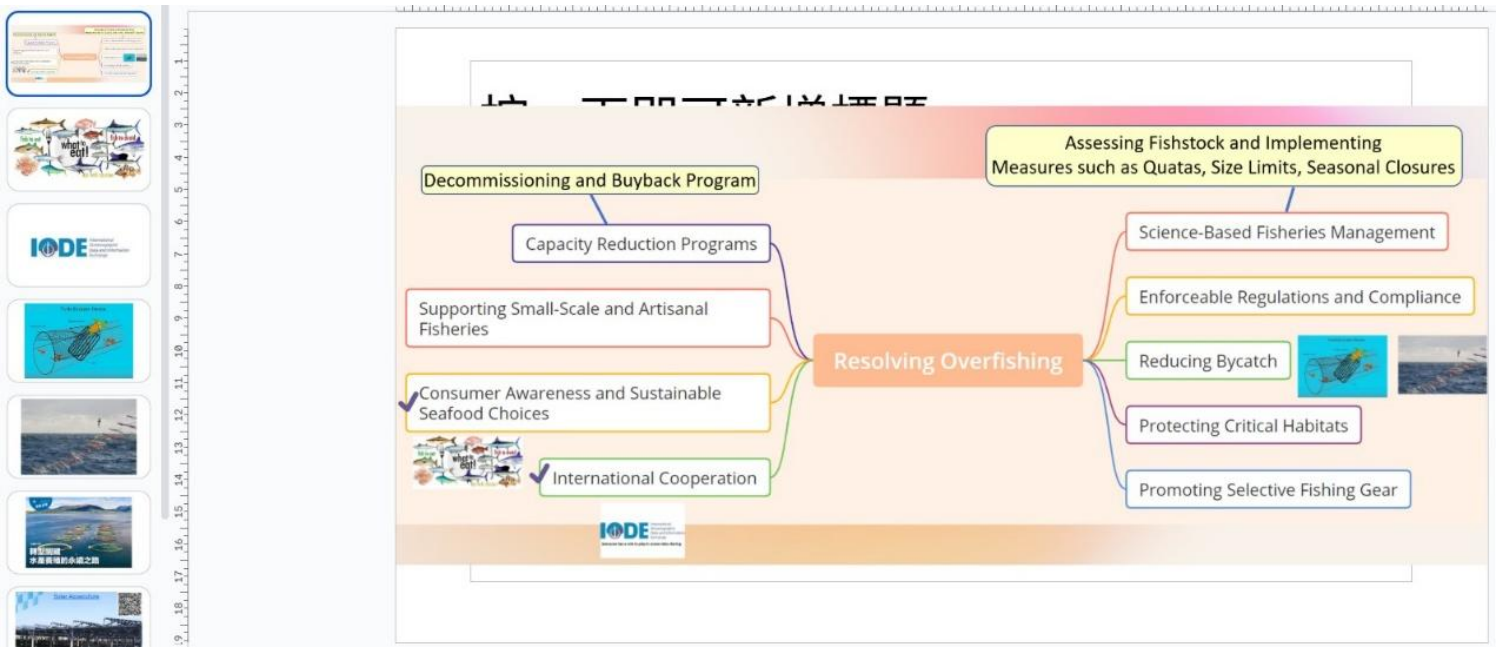
It can reduce bycatch rates by 20–60%.



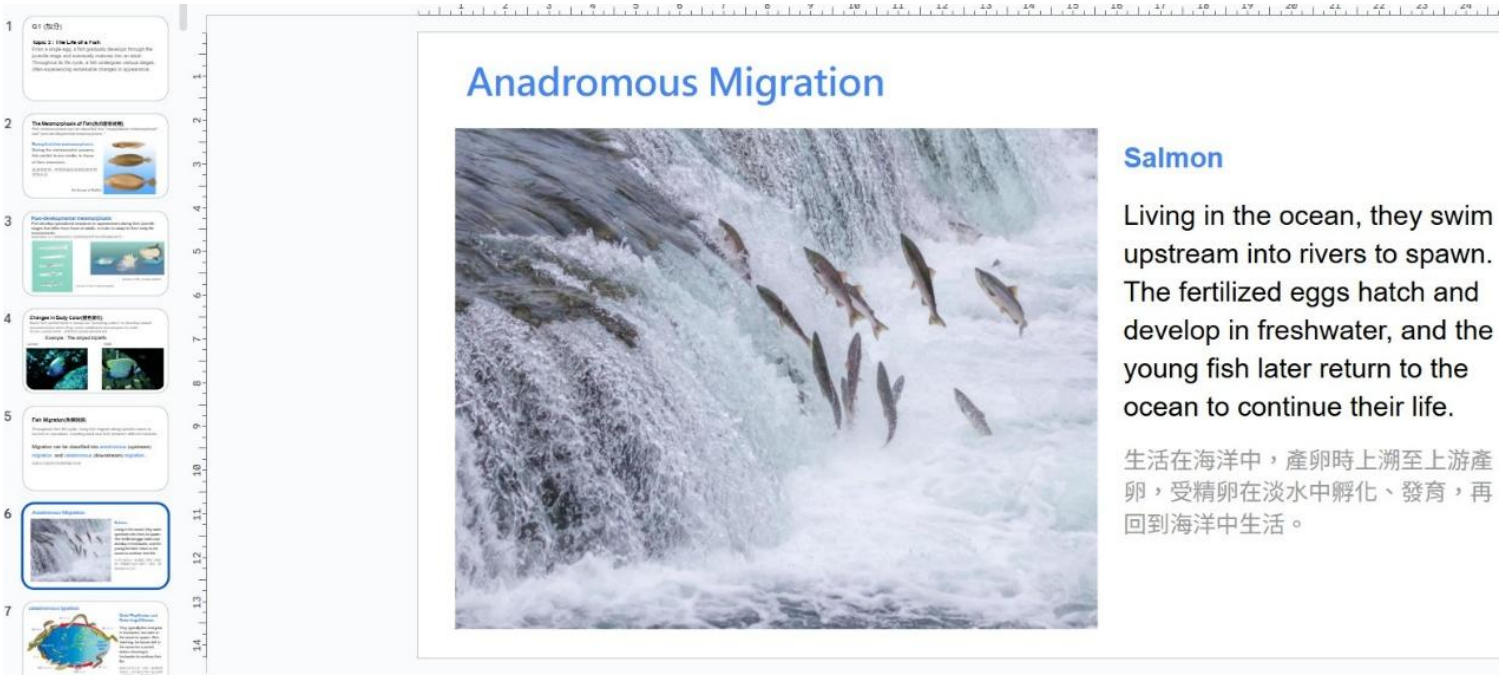
EXAMPLE:

Exploitation of Migrant Domestic Workers in Lebanon under the Kafala System

One well-known case is that of **Ethiopian domestic worker Alem Dechasa**, whose story shocked the world in 2012. A video surfaced of her being violently dragged by her employer outside the Ethiopian embassy in Beirut. She had reported abuse and wanted to return home, but her employer refused. Days later, Alem died by suicide while in a mental health hospital. Her death highlighted how trapped and powerless many migrant workers feel.



之後進入到魚類辨識及海洋生態的課程，教學生如何辨識魚種，並讓學生分組將台灣魚類資料庫新版網站的魚類學知識養成的頁面，用 Jigsaw 教學法讓負責不同魚知識網頁內容的同學們對各組進行初步的知識分享，接著進行簡報製作，搭配圖片將網站內容翻譯成雙語版本製作成簡報，再分組向全班發表，讓同學們瞭解魚類的習性與生態。



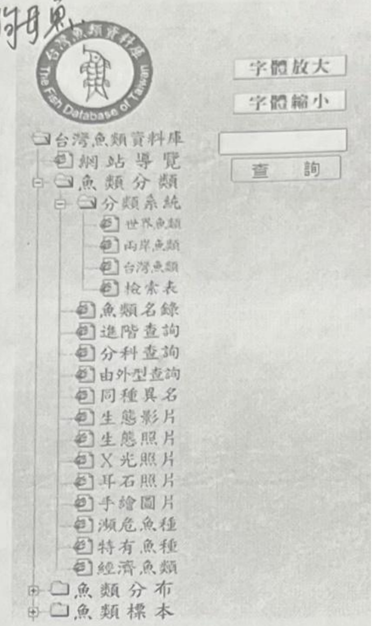
了解魚類知識之後，進行魚類辨識的課程，用學習單搭配 QRcode 讓學生觀看台灣魚類的影片及辨識方法，並讓學生分組共編學習單的內容，然後老師進行回饋及解答。

※Utilize Taiwan Fish Database or Online resources(wiki) to recognize the fish indicated below.
The QR codes below link to ecological videos and introductions for various fish species. Each group should divide the work and complete the worksheet, followed by an in-class fish identification quiz.

1. 請問下面哪些魚種是屬於雀鯛科？哪些魚種是屬於隆頭魚科？(G1)
Which of the following fish species belong to the family Pomacentridae (Damselfish)?
Which belong to the family Labridae (Wrasse)?

Damselfish：條紋豆娘魚、克氏雙鋸魚、霓紅雀鯛、雙帶鱗鰭烏尾冬 花斑擬鱗魨 康氏錐齒鯛 雙帶眶棘鱸

Wrasse：黑腕海豬魚、雜色尖嘴魚、曲紋唇魚、裂唇魚.



2. 請問鸚哥魚(parrotfish)的命名由來為何？(請由口腔齒的型態來簡述) (G2)
What is the origin of the name "parrotfish"?
(*Please briefly explain based on the shape of their oral teeth.*)

Because of their beak-like teeth

3. 請問下列的魚種當中，有哪幾科是屬於鱸形目隆頭魚亞目？(請善用右圖台灣魚類分類) (G3+G5)
Among the fish species listed below, which families belong to the order Perciformes, suborder Labroidei?
(*Hint: Use the Taiwan Fish Taxonomy Chart on the right*)

麗魚科、雀鯛科、隆頭魚科、鸚哥魚科.

4. 請問台灣的蝴蝶魚(butterflyfish)目前紀錄有幾種？ 46種
請問蝴蝶魚大多是夜行性還是日行性？(可查詢蝴蝶魚科之科解說) 日行性.
請問下表的 <u>白吻雙帶立旗鯛</u> 及 <u>耳帶蝴蝶魚</u> 的分類差異為何？(請善用檢索表) (G4+G6)
How many species of butterflyfish (family Chaetodontidae) are currently recorded in Taiwan?
Are butterflyfish mostly nocturnal or diurnal? (Refer to the family introduction)
What are the taxonomic differences between Chaetodon kleinii (Sunburst Butterflyfish) and Chaetodon auriga (Threadfin Butterflyfish)? (Use the dichotomous key)

耳帶：吻圓錐狀、中長、背鰭不延長 or 不成絲狀

白吻：吻圓錐狀、中長、背鰭延長 or 成絲狀

5. 鮃科和鰈科的魚類最主要的差別為何？(G5)
What is the main difference between fishes of the family Paralichthyidae (large-tooth flounders) and the family Pleuronectidae (right-eye flounders)?

Eye position, Body Orientation, Distribution.

6. 魔鬼蓑鮋(獅子魚 lionfish)的主要特徵為何？(G6)
What are the main features of the lionfish (*Pterois*, also known as devil scorpionfish)?

Morphological Features: Lionfish have long, fan-like dorsal and pectoral fins that resemble a lion's

7. 請簡單畫出飛魚(flyingfish)、秋刀魚(pacific saury)、金梭魚(barracuda)的親緣關係樹(樹狀圖)？(G1)
Draw a simple phylogenetic tree showing the relationship between flying fish, Pacific saury, and barracuda.

動物界 — 脊索動物門 — 輻鰭魚綱 — 硬骨魚目 / 鯖 鱵目 / 旗魚目 — 飛魚科 / 秋刀魚科.

15. 金梭魚、烏尾鮗(音同"疼")有「群游」的現象，許
意義？(教課期間寫)

Barracuda and *Scomberoides* (queenfish) exhibit sch
(e.g. birds, mammals) also show similar grouping beh
behavior? (*To be answered during class time*)

Protection from predators , Energy sa

16. 請舉例「再演性變態」和「後發性變態」的生物 (教
Give examples of "progenesis" and "neoteny" (types

Progenesis : frog. Neoteny : Insect

17. 請說明並舉例溯河洄游(Anadromous migration)
Explain and give examples of anadromous and catadr

Anadromous migration : Salmon
Catadromous migration : Eel.

Template and Modeling:

- **Show their images on your phone screen to you habit...et cetera.**

Most fish are bisexual (separate sexes), but some species are hermaphroditic and capable of sex reversal.
Give an example of a species/group that is *protogynous* (female first), and one that is *protandrous* (male first).

Protogynous
ex: 石斑魚 (Grouper) Groupers are born female and can change into males when they grow larger and have the opportunity to dominate a group.

Protandrous
ex: 小丑魚 (clownfish) Clownfish are born male, if the dominant female dies, the largest male will change into a female

9. (1)舉一個魚類「攻擊性擬態」(aggressive mimicry)的例子；(2)說明大多數蝴蝶魚幼年時期背鰭或身體後方有偽裝的眼睛，有什麼用途或意義？ (G3)
Give an example of aggressive mimicry in fish.
Why do juvenile butterflyfish often have false eyes (eye spots) on their dorsal fins or near the tail? What is the function or purpose? This species camouflages itself as floating seawood or debris, allowing it to approach.

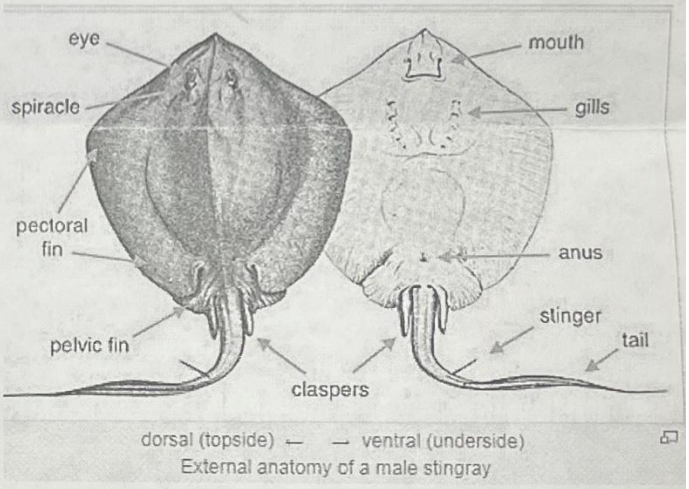
(1) Pygmy Pipehorse : Small prey such as crustaceans without being noticed..

(2) To mislead predators, protect vital organs.

10. 你認為具有護幼行為(parental care)的魚種，產卵量平均而言會比不具護幼行為的魚種產卵量要來得多還是少？請說明 R selection 跟 K selection 的差異。 (G4)
Do you think fish species with parental care generally have more or fewer eggs compared to species without such behavior? Explain the difference between r-selection and K-selection.

(1) 具有護幼行為，所以幼魚不易死亡.

(2) R selection : 量多且快繁殖. 重視數量.
K selection : 重視品質



External anatomy of a male stingray

11. 試說明部分魚種的「群居掩蔽」(grouping crypsis)行為 (G5)
Explain the "grouping crypsis" behavior observed in some fish species.

Visual Disruption : When fish group together and have similar colors or patterns, it becomes harder for predators to distinguish individual fish. This visual confusion makes it difficult to target a single fish

12. 魟魚的呼吸孔的功能 (G1)
What is the function of spiracles (breathing holes) in stingrays?

Spiracles allow rays to draw in water from above their bodies, bypassing the mouth and directing it to the gills for respiration.

13. 鯙的鼻管的功能，台灣鯽的鬚的功能 (G2)
What is the function of the nasal tubes in moray eels, and the barbels in Taiwan madtoms (Pseudobagrus)?

Nasal Tubes : These help morays locate prey hiding in crevices or buried in sand, especially at night.

Barbels : Their barbels help them detect food on the substrate, such as insect larvae or organic matter, by sensing chemical and tactile signals.

14. 裸海蝶(海天使)的攝食方式，及其在分類學的位置 (G6)
What is the feeding method of *Clione limacina* (sea angel), and where is it placed in taxonomy?

Clione captures its prey using six buccal tentacles that extend from its head.

Phylum: Mollusca | Class: Gastropoda | subclass : Heterobranchia | order : Gymnosomata.

接著分享一些海洋危險生物及有毒生物，接軌到海洋風險評估的單元，讓學生從 Padlet 上分享出遊前、出遊期間以及出遊後可能會遭遇的風險以及須注意的事項，這是用時序的方式來進行海洋遊憩的風險模擬；接著用分類的方式來進行歸納，將海洋風險歸納在自身技能、自身健康狀態、裝備狀態、海洋周遭環境因子的四大分類當中，並製作成檢核表供學生自我檢核狀態，以進行風險評估。

Before you head out the door, what risk factors do you need to be aware of?

- 3.check the traffic
- 25
  confirm your health condition
- 18 Prepare professional equipment
- 9
  Confirm the place
- 14preapare enough water
- 16 check the weather
- 21 don't drink too much
- 29 Check the weather there
- 15 dont eat too much
- 30 organize your equipments
- 24
  bring your health insurance card
- 20 knowing your destination's information
- 28 Check the weather
- 22
  Know the high and low tide times
- 6
  Find transportation to the locations
- 4 Prepare food,tool,clothes
- 12 Check if there are lifeguards on site
- 7
  Find a companion don't go alone

When you're on the way to the coast, what risk factors do you need to be aware of?

- 3.be aware of tide changes, strong winds
- 25
  avoid sailing accident
- 29 Listen to what others want you to notice
- 4Apply Ocean-Friendly Sunscreen on the car
- 18 Apply sunscreen
- 6
  Pre-trip training
- 7
  Check weather and equipment
- 9
  Stay happy
- 28 Warm up and practice
- 14check your bady feeling
- 15be aware of how your body feels, if you feel uncomfortable it may not besuitable for you to do water activities
- 21 don't drink too much
- 30 Take seasickness pills
- 20 use suncream
- 22
  Don't eat too much food
- 24
  eat food
- 12 pay attention to traffic safety

What risk factors do you need to be aware of when we get to the coast, and when we start entering the water and conducting SUP?

- 19
  sports injury
- 3.avoid the currents, wind speed
- 25
  avoid the Decompression sickness
- 29 notice whether all the time
- 18Do not exceed the safe range
- 9
  Always pay attention to status of the equipment
- 14be awareness of changes of the waves
- 15 remember to warm up before activities
- 30 Don't touch protected species
- 21 Don't go to the dangerous area
- 20 stay in safe area
- 12 Don't stay away from your companies
- 28 Heat stroke and exhaustion
- 24
  Check the wave conditions and currents

After this outdoor activity, what other risk factors should we pay attention to?

- 28 relax the muscle
- 3.be aware of risks like dehydration, sunburn
- 25
  check your equipment again to avoid lost
- 29 after the activities, take a good rest
- 28. Don't leave trash
- 18. Take your trash home
- 9
  `Make sure there is no marine life on the body`
- 21 drink more water
- Regang your strength
- 15 remember to drink enough water
- 22
  Don't take any marine life with you.
- 12 Take the Trash Away
- 20 don't leave any garbage
- 24
  sunburn

Risk Assessments for Standup Paddleboarding Offshore Operations

Class_____ Seat number____ Name_____

Assessment for Personal Status (35%)										
Personal Risk Category	Description(Need to describe the status and evaluation reasons in words, For example, there have been old injuries, diseases, easy to choke on water, etc.)	Status				Likelihood & Consequences				Risk Rating
		Excellent	Good	Poor	Severely poor	**Insignificant to Minor**	**Moderate**	**Major**	**Severe to Catastrophic**	
sleep adequacy		3	3	0	0	3	3	2	0	B
Water intake		3	3	0	0	3	3	2	0	B
Stretch and Warm-up		3	2	0	0	3	3	2	0	B
sea sickness degree		4	3	0	0	4	3	0	0	B
Today's physical condition		4	3	1	0	4	3	1	0	B
Costume	(rash guard or wetsuit, etc.)	4	2	0	0	4	3	2	1	B
The degree of Participation in indoor courses prior to outdoor education (A total of 2 SUP indoor courses plus 1 risk assessment course)		7 (fully participate and highly participate in other swimming lessons)	5 (fully participate and partially participate in other swimming lessons)	3 (partially participate)	0 (Not yet participate)	7	5	4	3	A
Any pre-existing injuries or illnesses that may affect athletic performance	(can write multiple)	4	2	0	0	4	3	1	0	A
Psychological Status		3	3	0	0	3	3	2	1	B

接著上潛水運動生理學、物理學及海洋風險的因應技巧課程，讓學生分組討論學習單的內容進行線上共編，再透過發表與分享，最後繳交學習單。在過程中也搭配真實的潛水影片及案例分享來說明海洋風險、生理變化、物理原理來進行探討。

Physiological Adaptations and Risk Management in Ocean Environments

1. How to escape a rip current

https://www.youtube.com/watch?v=PuAlDTC_gIQ&ab_channel=SurfLifeSavingAustralia

https://www.youtube.com/watch?v=xo49W7guSxU&ab_channel=%E5%BF%97%E7%A5%BA%E4%B8%83%E4%B8%83X%E5%9C%96%E6%96%87%E4%B8%8D%E7%AC%A6

(1) Do not swim against the current toward the shore.
(2) Let the current carry you for a short distance, then swim parallel to the shore to escape.
(3) If you're too tired, float on your back or raise your hand to call for help. ——8

20 How to Escape a Rip Current?

Stay calm.

Swim parallel to the shoreline (left or right), don't fight the current.

If you can't swim out, relax and float, and wave for help.

29 How to Get Out of a Rip Current

1. Stay calm – Don't freak out. The current pulls you out, not under.
2. Don't fight it – Don't Try to swim straight back to shore, is like swimming on a treadmill
3. Swim sideways – Go left or right, along the beach

2. Before engaging in any water activities, make sure to check the sea and wave conditions. How to Check Sea Conditions Before Participating in Water Activities?

https://www.imocwx.com/cwm.php?Area=1&Time=0

Check weather apps – Look for wind, wave height, and tide info.

Look at the ocean – Avoid if waves are too big or currents look strong.

Ask lifeguards – They know if it's safe.

Check flags/signs – Red = danger, Yellow = be careful, Green = okay. (7)

3. How to respond if you get caught in a whirlpool during river or stream activities?

https://youtube.com/shorts/8JM1AQY3Fn8?si=a1b3aZ8pJDTIEJ3j

https://youtube.com/shorts/9MxzZ7pvqVQ?si=JKcHH7SjXhwxC1vx

12 ：

Hydraulic翻滾流:

When a stream flows over a drop, it can create a strong rolling current. If you get caught, dive to the bottom, keep your body close to the riverbed, and swim downstream to escape.

Compression Flow覆蓋流:

When the river suddenly narrows, water from both sides pushes to the center, forming a whirlpool. If caught, face up, keep your arms close to your body, legs straight but slightly bent, and look downstream. The current will carry you out naturally.

Smiling Eddy (Whirlpool by Rocks)微笑流:

Near rocks, strong whirlpools may form. Stay calm and relaxed. Try to take a breath when you can. Keep your body straight like a stick, let the current push you out, then use your arms and legs to push off obstacles and swim out with the flow.

Stay calm – Panicking wastes energy and makes it harder to breathe.

Don't fight the current – Let the water carry you in a circle briefly.

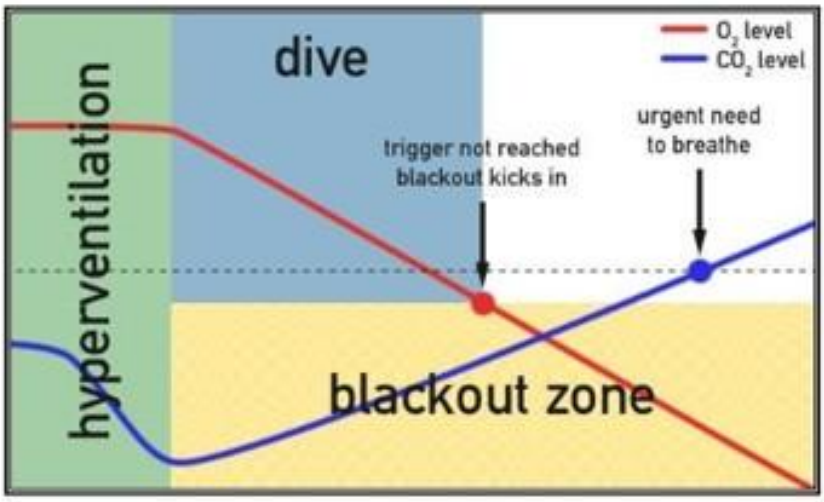
Swim sideways or diagonally – Wait for a chance, then swim across the current to escape the spiral.

Keep your body afloat – Use a floating position or tread water to stay above the surface.

Look for calm water – Try to move toward stiller water outside the whirlpool.

Signal for help – Raise one arm or call out if someone is nearby.

Get to shore safely – Once free, swim calmly toward the bank or a safe area. (7)



6. Explain "Black out" during freediving

Blackout happens when the brain does not get enough oxygen, usually near the surface after a long dive. The diver may lose consciousness underwater. (5)

20 In freediving, a "Blackout" refers to the diver losing consciousness underwater or just after surfacing due to lack of oxygen to the brain. It's a serious incident often caused by extended breath-holds or a drop in oxygen partial pressure during ascent.

7. What Is the Application of "Boyle's Law" in Freediving?

Boyle's Law says pressure and volume are related. As a freediver goes deeper, pressure increases and lung volume gets smaller. This affects breathing and equalizing. (5)

20

Boyle's Law and Diving Injuries & Prevention

In diving, Boyle's Law causes gas volume to decrease as pressure increases with depth. If air spaces in the body can't equalize, it leads to barotrauma (e.g., eardrum, lung injuries). Key prevention includes early equalization and diving progressively when in good health.

3

Boyle's Law is crucial for freediving in the following ways:

Breath-Holding: Increased pressure reduces lung volume, impacting breath duration.

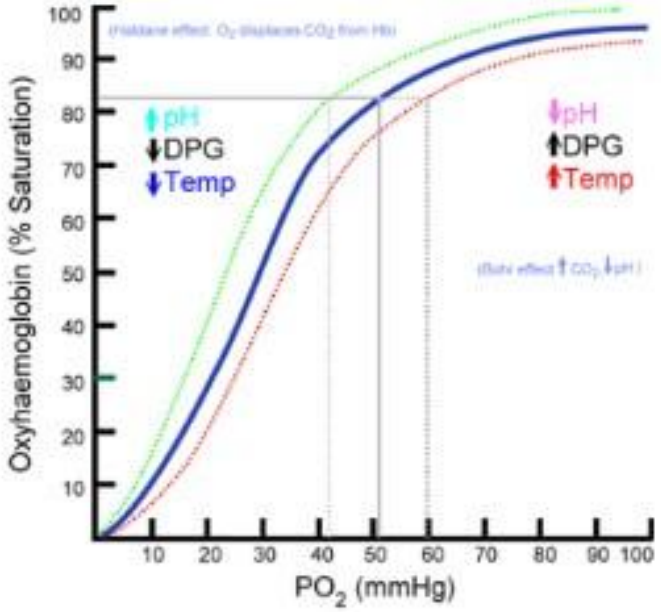
Equalization: Divers need to equalize pressure in their ears to avoid injury.

CO2 Buildup: Reduced lung volume increases carbon dioxide, affecting the urge to breathe.

Decompression: Rapid ascent can cause gas bubbles due to quick pressure changes.

Training: Understanding pressure helps improve techniques and breathing strategies.

8. How does "Bohr Effect" apply to Freediving?



The Bohr Effect helps freedivers because as CO_2 builds up and your body gets more acidic, your blood lets go of more oxygen where it's needed. ——8

12號

1. How to escape a rip current

1. Do not swim against the current toward the shore.
2. Let the current carry you for a short distance, then swim parallel to the shore to escape.
3. If you're too tired, float on your back or raise your hand to call for help.

2. Before engaging in any water activities, make sure to check the sea and wave conditions. How to Check Sea Conditions Before Participating in Water Activities?

Check weather apps – Look for wind, wave height, and tide info.
Look at the ocean – Avoid if waves are too big or currents look strong.
Ask lifeguards – They know if it's safe.
Check flags/signs – Red = danger, Yellow = be careful, Green = okay.

3. How to respond if you get caught in a whirlpool during river or stream activities?

1. Maintain a floating posture.
2. Do not struggle directly upward.
3. Swim out along the edge of the current.

4. Explain "Mammalian Diving Reflex" and "Contractions (Diaphragm Contraction)" while diving.

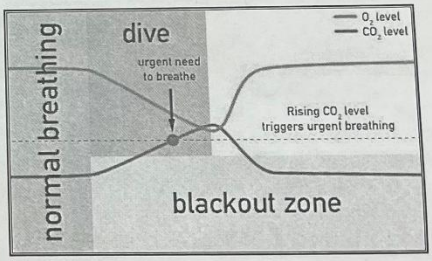
Mammalian Diving Reflex:
1. Heart rate slows.
2. Blood goes to brain and heart.
3. Helps save oxygen.

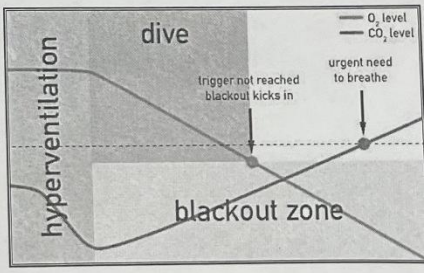
Contractions:
1. CO_2 builds up.
2. Diaphragm starts to spasm.
3. It's your body asking to breathe, not a lack of oxygen.

5. Explain the potential danger of "Hyperventilation" during freediving

- CO_2 is your trigger to breathe. Hyperventilation reduces CO_2 too much, so you don't feel the urge to breathe soon enough.
- You may black out underwater. Oxygen can run out before you feel the need to surface. This is called shallow water blackout.

Hyperventilation tricks your body – it doesn't give you more oxygen, just delays warning signs. That makes it one of the biggest risks in freediving.



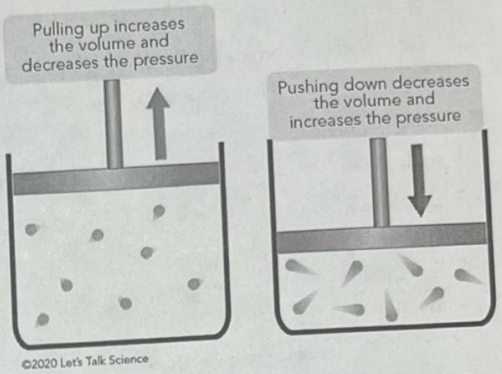


n "Black out" during freediving

ediving, a "Blackout" refers to the diver losing consciousness underwater or fter surfacing due to lack of oxygen to the brain. It's a serious incident often d by extended breath-holds or a drop in oxygen partial pressure during ascent.

t Is the Application of "Boyle's Law" in Freediving?

le's Law says pressure and volume are related.
a freediver goes deeper, pressure increases
d lung volume gets smaller. This affects breathing
d equalizing.

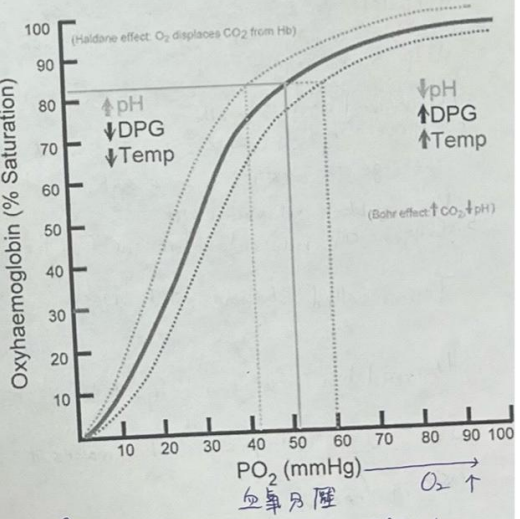


w does "Bohr Effect" apply to Freediving?

ohr
he Bohr Effect describes how certain conditions affect Oxyhaemoglobin's ability to release oxygen

Occurs: CO_2↓ (like diving)
PH↓
Temp↑

It ensures that active tissues (muscle tissue) get more oxygen.

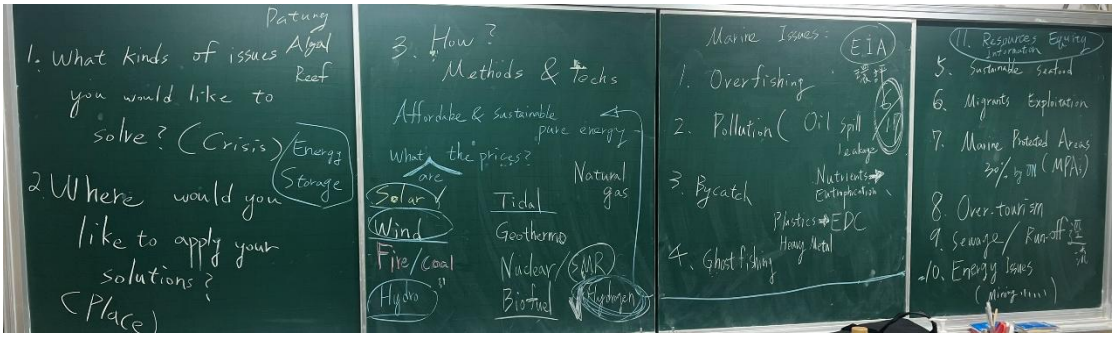


Curve shifts right → Bohr Effect

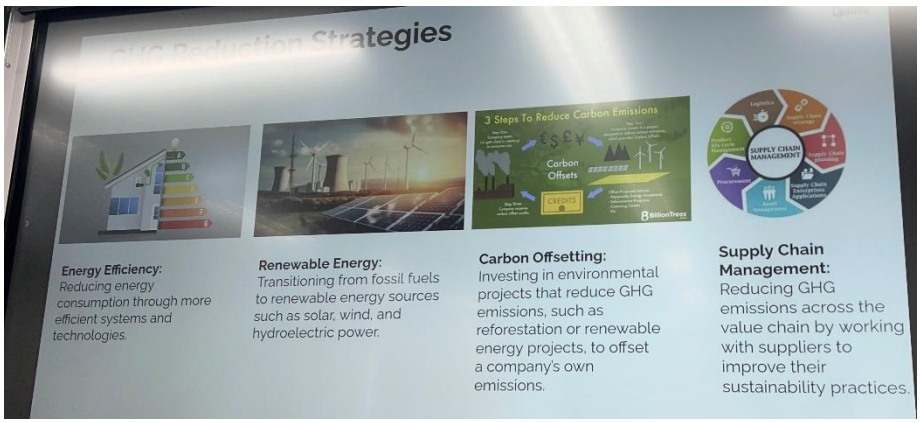
- (PH↓. DPG↑. Temp↑)
- Occur: exercise, diving
  Curve shifts left
- PH↑. DPG↓. Temp↓
- occur: cooler environment

六月第一周為世界海洋周，先用影片來觀看 2023、2024 年的臺灣海洋國際青年論壇的一些活動花絮，讓學生觀看台灣的高中、大學、碩博生及世界專家如何提出各種海洋議題的因應方案；再分享給學生永續能源展覽及永續都市展覽的相關影音資料，藉此提供給學生素材來進行期末報告。

最後是針對海洋議題做總複習，除了簡介各種海洋議題以外，主要聚焦在能源議題的探討上，探究不同能源的兩難性及代價，以及分享最創新的能源技術及未來趨勢。綜合以上的教學內容，學生的視野會有所拓展，因此具備足夠知識針對期末報告提出加深版的海洋解決方案，需提及待改善的議題、施作的地點、扮演的角色(可扮演多種角色)、解決方法、預期成效；並針對素材資源當中，用簡述的方式彙整出 30 個例子，來做為加廣的總結評量。



有關 ESG 及氣候拼圖系列課程(114 年 4-5 月期間，總共 8 小時)，受眾為高三學生及高一的 IBDP 學生，高三生是選修雙語國際永續環境科學的學生，高一的 IBDP 學生則是將於高二進行 CAS 創意行動服務課程，此課程將有助於 IB 學生未來的 CAS 成果報告。課程一開始先進行 ESG 相關教學，由外籍 ESG 規劃師 Agnes 來進行四小時的授課，李智翰老師來進行翻譯及引導，學生除了了解 ESG 的基礎以外，也從分析不同企業的永續報告書的 KPI 中，來了解企業如何評估永續轉型的成效。



接著進行四小時的氣候拼圖工作坊，讓學生建構出人類活動與溫室氣體對氣候、海洋、陸地、生態等的影響

與因果關係，讓學生了解議題的急迫性，並且探究可行的解決方案。


Human Armageddon
Melting Ice Sheets
Melting Glaciers
Rising Temperatures
Rising Water Temperature
Melting Sea Ice
Sea Level Rise
Access to Freshwater
Cyclones
Human Health
Population displacement
Coastal Flooding
River Flooding
Wildfires
Droughts
Reduced Crop Yields
Carriers of Disease
Heatwaves
Terrestrial Biodiversity
Armed Conflicts
Famine
Key
Growing Inequality
School


STAR WARS
FRESH