海洋未來式

THE OCEAN WILL...

/ 新正常特展 /

數位導覽手冊

Digital Guidebook

地球有七成以上是海洋
提供海量資源
海納百川萬物

海洋的未來
就是地球的未來

海洋未來式
60 個關鍵思考
迎向未來
需要現在的行動

海洋 THE OCEAN WILL... 未來式

/ 新正常特展 /

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海洋未來式 - 新正常特展

The Ocean Will… - New Normal Special Exhibition

海洋是人類，甚至是地球的母親。它不僅孕育了豐沛的資源，也無私地接收了大量人造廢棄物。此外，海洋吸收了大氣中超過 90% 的熱量，並接納了人類所製造的溫室氣體。這些無法平衡的能量，最終總會以某種危機的形式顯現出來。換句話說，在我們過著日常生活的同時，海洋其實一直在默默承受。了解海洋、善待海洋，只要我們適度調整生活的步調，保護地球，這一點是我們每個人都能做到的。

「海洋未來式—新正常」特展，以海洋為關注範疇，未來為前瞻想像，在氣候變遷威脅下，啟發種種靈感，一同迎向未來可能的機會、使命與行動。展示命題主要包含地球氣候觀測、海洋生物多樣性、海洋能源未來應用及因應淨零碳排綠生活行動作，期待透過這四大面向，喚起民眾對於環境永續行動的反思。特展動線隱約呼應世界地理位置的延展，以全球視角串聯，一起認識我們知與未知的海洋，呼應聯合國 2030SDGs 與 2050 臺灣淨零排放的目標，透過敘事與展示，期待提供更前瞻的海洋視角與素養。

The ocean is the mother of humanity, and even of the Earth itself. It not only affords abundant resources but also selflessly absorbs vast amounts of human waste. The ocean absorbs over 90% of the heat from the atmosphere, taking in the greenhouse gases we humans produce. This excess energy will eventually tip the balance into crisis. While we go about our daily lives, the ocean has been silently bearing the brunt. Understanding the ocean and treating it with care—by simply living more sustainably to protect the Earth—is something each of us can do.

“The Ocean Will…” exhibition has its feet in the ocean and its eyes on the horizon—the future. As we face the threat of climate change, it gets us thinking, inviting us to embrace the opportunities that may lie ahead, new missions and actions. The exhibition’s four main themes are: 1. global climate observation, 2. marine biodiversity, 3. marine energy generation, and 4. how to achieve carbon neutrality. Through these four key areas, the exhibition aims to prompt reflection on action towards sustainability. The exhibition layout leads one towards a global perspective and an exploration of the world’s oceans, both the knowns and the unknowns. It aligns with the United Nations’ 2030 Sustainable Development Goals (SDGs) and Taiwan’s 2050 Net-Zero emissions target. Through stirring stories and informative displays, it aims to inspire and educate.

https://www.nmmst.gov.tw/chhtml/newsdetail/221/9577/0

展覽永續作為

Sustainable Exhibition Approach

本展覽透過選用永續材料以及模組化設計方式盡量減少一次性耗材之使用量，期能降低對環境之影響。

To reduce environmental impact and the use of single-use disposable items, this exhibition substitutes sustainable materials and adopts a modular design.

1. 主體木構採用 2,100 才（約 6 立方公尺）柳杉國產材，約可固碳 3,840 公斤。

The main wooden structure uses 6m^3 of domestically sourced cypress wood, which sequesters approx. 3,840kg of carbon.

2. 展板及展座箱體採樺木夾板，係現代家俱、玩具、建築用材料，也是永續森林木材。

Exhibition panels and display cases are made from birch plywood, a material sourced from sustainably managed forests and used in modern furniture, toys, and construction.

3. 全展廳木作不施化學油漆，呈現自然原色與温潤質感，並飄散木質香氣。

No chemical paint is applied to the wood used in this exhibition, showcasing its natural color, warm texture, and pleasant aroma.

4. 主體結構模組化，可拆卸移地組裝並適地調整規模。

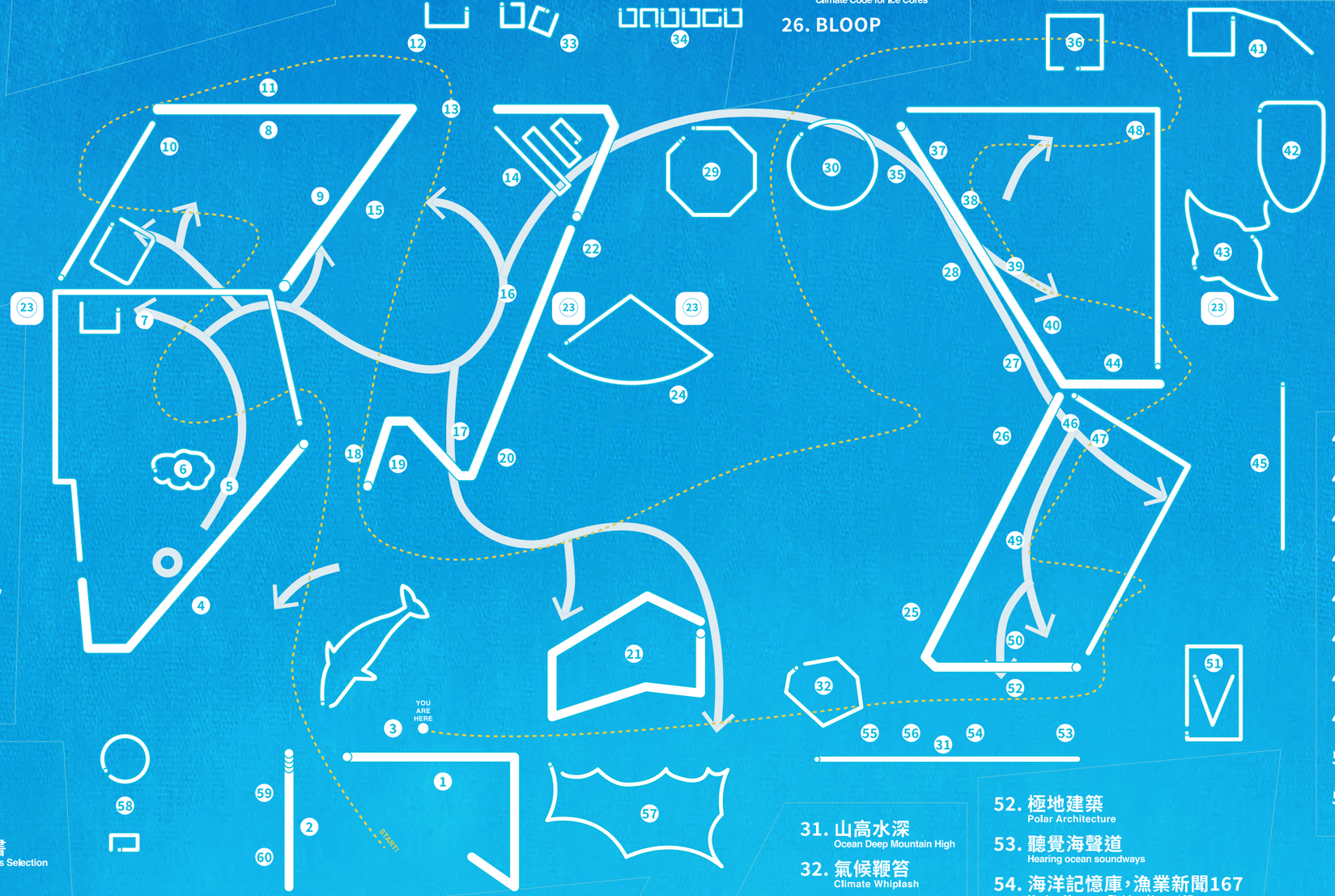
The main structure is modular, allowing for disassembly, off-site reassembly, and on-site scale adjustment.

5. 展品採模組化設計，展座箱體即裝運箱，有移動承載的能力。

Exhibition items are designed with modularity in mind, with display cases serving as transport containers, enabling mobility and load-bearing capacity.

全區導覽

Site Map



4. 氣候情緒娃娃臉
Climate Sentiment Emoticon
5. 藍色經濟
Blue Economy
6. 未知雲
Cloud of the Unknown
7. 不能沒有水
Can’ t live without water
8. 塑膠無所不在 & 無塑未來式
From plastic is everywhere to a plastic-free future
9. 無塑未來式，未來食物超市
Plastic-Free Future Supermarket
10. 塑膠微粒高頓板
Microplastic Galton Board
11. 嬰兒潮與玩具潮
The baby and toy booms

12. 海廢拉霸機
Sea waste slot machine
13. 藍碳，黃碳，綠碳，碳安息
Blue Carbon, Yellow Carbon, Green Carbon, Carbon, RIP
14. 藻 藍碳
Algae Blue Carbon
15. 臺灣海洋能源發展潛力
Taiwan’ s Energy Development Potential
16. 浮游式黑潮發電渦輪機
Floating Kuroshio Turbine

17. 海洋分子結構
Marine Molecular Structure
18. 去碳燃氫
Hydrogen can help decarbonize the energy supply
19. 懸賞溫室氣體
Wanted: Greenhouse Gases
20. 抱卵母蟹
Gravid Crab
21. 熱浪
Heat Wave

22. 永續鯖
Mackerel Forever
23. 海洋六大汙染
Six major pollutants in the ocean
24. 氣候條紋船帆
Climate stripe spinnaker
25. 冰芯的氣候密碼
Climate Code for Ice Cores
26. BLOOP

27. 海洋生態系指標物種
Marine Ecology Indicator Species
28. 本產品含衛星成分
This product contains satellite content
29. 復育之心
Heart of Restoration
30. AMOC大西洋經向翻轉環流
Atlantic meridional overturning circulation

33. 潛水的北火熊
Diving Power Bear
34. 北極熊的冰箱
Polar bear’ s fridge
35. 鱷
Hemiramphidae
36. 冰山一角
Tip of the Iceberg
37. 豆丁海馬蒙太奇
Pygmy Seahorse Montage
38. 沒有等一下了
No time to wait
39. 鯨豚的內在外在
Cetaceans inside and out
40. 氣候預估
Climate Forecast
41. 福爾摩沙衛星七號
FORMOSAT-7

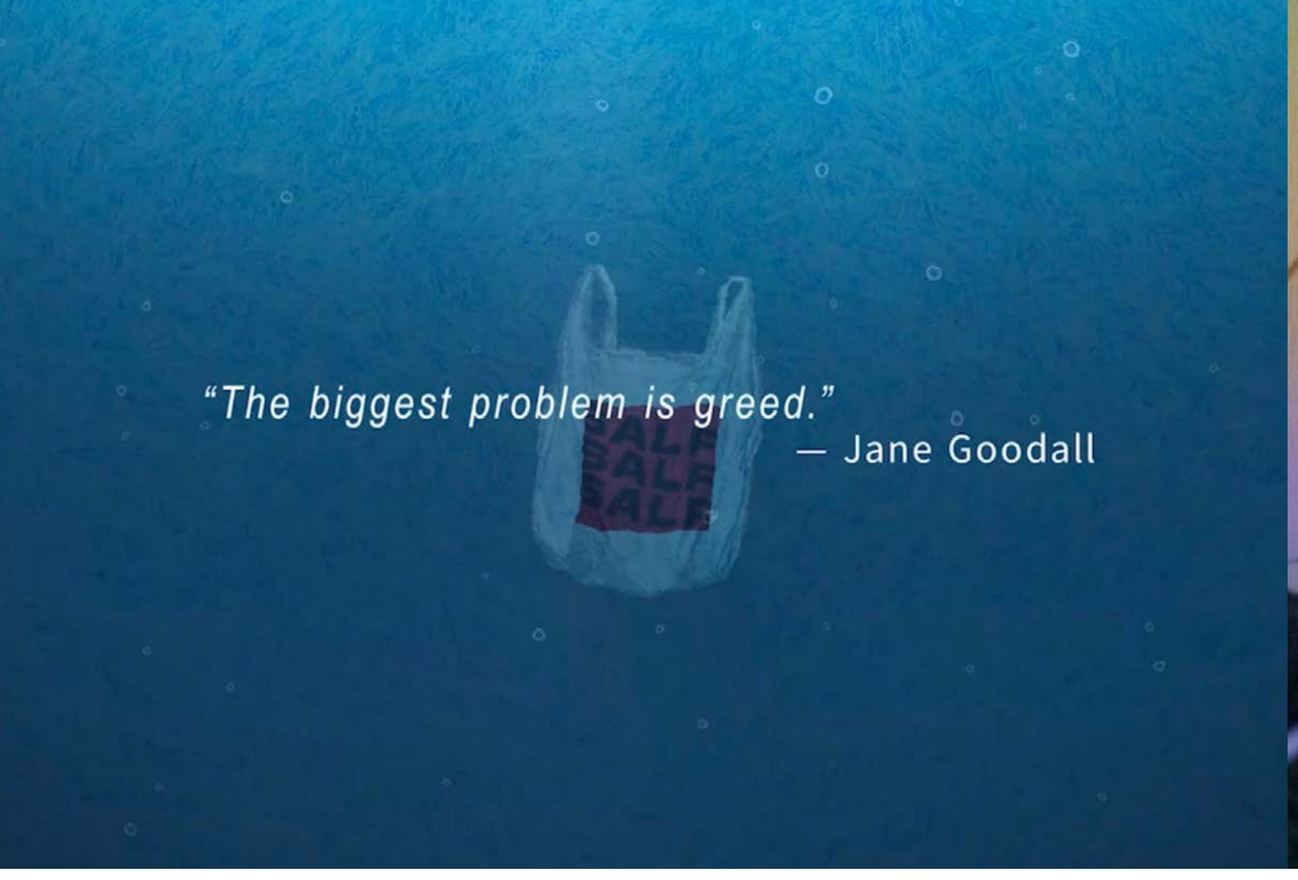
42. 水下無人載具
Unmanned Underwater Vehicles, UUV
43. 海廢缸
Marine debris device
44. 智能減碳船
Smart & Low-Carbon Ship
45. 殼
SHELL
46. 靠海吃海，生計漁業
Living off the sea, Artisanal fishing
47. OHI海洋健康指標
Ocean Health Index
48. 微型資料浮標
MANTA BUOY
49. 聖嬰與反聖嬰
El Niño and La Niña
50. 氣候遷徙
Climate Migration
51. 垂釣公民科學家
Fishing Citizen Scientist

58. 碳的終結者
Carbon Terminator
59. 許願樹
Wishing Tree
60. 海洋選歌 & 氣候選書
Oceanic Song Playlist & Climate Books Selection

1. 汪洋
Ocean
2. 新正常
New Normal
3. 永續的出入口
Portal to Sustainability

31. 山高水深
Ocean Deep Mountain High
32. 氣候鞭笞
Climate Whiplash

52. 極地建築
Polar Architecture
53. 聽覺海聲道
Hearing ocean soundways
54. 海洋記憶庫，漁業新聞167
Marine Memory, Fishing News 167
55. 座頭鯨之歌
Song of the Humpback Whale
56. 瓶中信
Letter in a Bottle
57. 冰山墳場
Iceberg Cemetery



汪洋

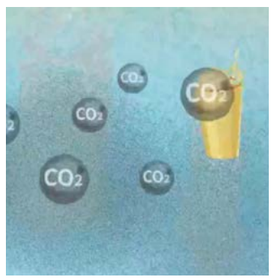
Ocean

本特展期勉與觀眾溝通：未來需要今天行動！
This special exhibition endeavors to communicates a simple message: we have to act now!

1

透過入口意象海平面上升動畫影片，描述我們人類迄今放肆消費與方便購物；無所節制導致碳足跡延續排放不止息，造成海洋母親酸化、暖化…而發出求救訊號！

This entrance sign is an animated film showing how sea levels have risen and describing how we humans have indulged in excessive consumption and convenience shopping. Our lack of restraint has swelled our carbon footprint, causing the Ocean Mother to acidify and warm up... and send out distress signals!



Protect the ocean, so you can “sea”.
(以 see 與 sea 的諧音，一語雙關表達：保護海洋，便能看見（與海合一）)
(Playing on the homophones “see” and “sea,” this pun conveys the idea that protecting the ocean allows us to see the sea)

“The biggest problem is greed.” ~Jane Goodall
（最大的問題是貪婪。……珍古德）

The health of our ocean is hanging in the balance. But the wonderful thing is that we have the power, and the knowledge, to change that. ~David Attenborough
（我們的海洋健康正處於臨界點，但令人欣慰的是，我們擁有改變現狀的力量與知識。~ 大衛・艾丁堡）

新正常

The New Normal

2

面對海洋暖化、酸化、塑化、優養化…，海洋與氣候的臨界點，我們需要：調適、增韌、逆轉與作出行動。
因為我們的想法、做法將會塑造出新正常的海洋未來式。

所謂新正常（新常態）是指社會或經濟在危機後的穩定狀態，而這狀態與危機前並不相同。例如新冠疫情後的疫後時代，便是「新正常」的例證，我們面對氣候變遷所帶來種種危機與衝擊，在不斷地解決問題、提出對策、付諸行動之間，最終將彼此連動、交相作用，進入氣候變遷後的未來新正常。

We confront ocean warming, acidification, plasticization, eutrophication…and ocean and climate tipping points. We must adapt and act to raise resilience and buck the trend.
What we think and do will shape the New Normal, as the ocean will…

The “new normal” refers to the stable state of society or the economy after a crisis, which is different from before. For example, the post-pandemic era following the COVID-19 pandemic is kind of “new normal.” As we confront the crises and impacts brought by climate change, we have to solve problems, develop strategies, and take action. Ultimately, we have to collaborate and synergize to handle the new normal of the post-climate change future.

永續的出入口

Portal to Sustainability

3

下一秒就是未來！未來沒有標準答案，但未來一定需要現在的行動！
在展覽主出入口，以全區 60 個關鍵思考展示配置圖，以及 2030SDGs 目標、2050NETZERO 關鍵戰略的對應 icon。仰視鯨魚裝置以大翅鯨的 bubble-net feeding 為靈感，每個氣泡象徵著 2030、2050 的目標。

如同 2030 聯合國 SDGs 的 17 項永發展核心目標，以及 2050 臺灣淨零排放 12 項關鍵戰略行動計畫等，總計 17+12=29 個氣泡，你我各都是一個氣泡，未來需要我們今天一起行動！

The future is a moment away! There’s no right answer except for taking action today!
At the entrance to the exhibition, there is a site map featuring 60 key considerations across the entire area, along with icons corresponding to the 2030 SDGs and the 2050 NET ZERO Key Strategic Action Plans. The overhead whale installation, inspired by the bubble-net feeding behavior of humpback whales. Each bubble symbolizes one of the 2030 and 2050 goals.

Adding the 17 Sustainable Development Goals of the 2030 United Nations Agenda to the 12 Key Strategic Action Plans for Taiwan’s 2050 Net-Zero emissions equals a total of 29 bubbles. Each of us is like one of those bubbles. The future needs us to coalesce now!

氣候情緒娃娃臉

Climate Emoticons

聯合國兒童基金會警告：98% 非洲兒童是最受到氣候變化影響的高危人群
UNICEF Warns: 98% of African Kids Most at Risk from Climate Change

4

國際知名保育專家珍古德博士 2025 年 6 月訪臺時直言：年輕人一出生就面對被大人搞砸的世界。恰巧呼應當代兒童，透過娃娃臉表情，對大人們呼求世代正義的疑惑！？
透過美術設計，各種兒童娃娃臉情緒表情，也比喻氣候變遷種種現象。

升溫、發燒、野火、暖化、強降雨、極端氣候、溫室氣體排放、海洋缺氧、酸化與優養化、洋流減弱、污染…，因為人類無止盡地取用與缺乏了解，我們的環境與海洋呈現負債狀態。

Dr. Jane Goodall, an internationally renowned conservationist, stated during her visit to Taiwan in June 2025: “Young people are born into a world that adults have ruined.” This resonates with contemporary children, who, through emoticons, express their confusion and appeals for intergenerational justice!
The artistic emoticons also metaphorically represent various aspects of climate change.

Rising temperatures, burning fevers, wildfires, warming, heavy rainfall, extreme weather, greenhouse gas emissions, ocean oxygen depletion, acidification and eutrophication, weakened ocean currents, pollution... Due to humanity’s endless exploitation and lack of understanding, our environment and oceans are indebted.

藍色經濟

Blue Economy

海洋是全球經濟的主要貢獻者
The oceans are a major contributor to the global economy.

5

本特展有個隱形世界輪廓，非洲尚比西河是人類起源地，本展參觀動線與人類遷徙路線不謀而合。儘管相對條件不佳，相反地，人口卻爆增突破 15 億，預測 2100 年更將翻倍，藍色經濟將會成為非洲改善經濟體質的一帖良方。

藍色經濟是永續使用海洋資源，帶來經濟成長、促進生活、福祉、就業的同時並兼顧海洋生態系健康。估計可為經濟貢獻 1.5 兆美元及 3,000 萬就業機會。聯合國非洲經濟委員會（UNECA）早定出藍色經濟戰略，而美國國家沿海海洋科學中心 (NCCOS) 將藍色經濟分海洋經濟、藍色經濟、新藍色經濟三階段逐步轉型。

This special exhibition traces the lineaments of the world. The Zambezi River in Africa is the origin of humanity, and the route you follow through the exhibition represents human migration routes. Despite relatively poor living conditions, the population has surged past 1.5 billion and is projected to double by 2100. The Blue Economy is a viable approach to treating Africa’s economic ills.

The Blue Economy involves the sustainable use of marine resources to drive economic growth, enhance living standards, promote well-being, and create jobs while maintaining the health of marine ecosystems. It is estimated to contribute 1.5 trillion dollars to the economy and generate 30 million jobs. The United Nations Economic Commission for Africa (UNECA) has already established a blue economy strategy, while the US National Centers for Coastal Ocean Science (NCCOS) has divided the blue economy into three phases of transformation: Marine Economy, Blue Economy, and New Blue Economy.

天氣＋時間＝氣候

Weather + Time = Climate

6

小時候課本裡寫著「雲腳長了毛，向西北飛奔，就知道颱風要來了…」。將每天的天氣逐一堆疊起來，有了長長的時間軸，天氣便累積成了氣候。也透過時間的長期觀測，氣候變遷已從渾然不知，變得顯而易見、人人有感。

以雲朵造型的大型裝置，內藏光源，環以霓虹燈字，簡明揭示天氣 + 時間 = 氣候，我們常仰望天空，看著天氣起居、作息，只要加上時間，便能看見氣候的面目。

As children, our textbooks taught us, “When the legs of the clouds grow hair and run northwest, we know a typhoon is on its way....” By stacking daily weather conditions over time, a long timeline is formed, and weather accumulates into climate. Through long-term observation, climate change has gone from obscure to increasingly evident and universally felt.

A large cloud-shaped installation, that is internally lit and and outlined in neon letters, simply shows that “weather plus time equals climate.” We often look up at the sky, observing the weather’s daily routine. Over time, we can see the true colors of climate.

不能沒有水

https://www.water.gov.tw/ch/Subject/Detail/3760?nodeId=4889

We Cannot Live Without Water

7

人體 7 成是水，水是生命之源，人不可一日無水。取材倉儲運輸液體常用的噸桶，給予觀者 1 噸水的具象體積量體，噸桶化作展示燈箱，作各種水量的換算式。

您珍惜水資源嗎？水對地球至關重要。水覆蓋地球 2/3，約 97% 鹹水，2% 冰凍水，只有 1% 淡水，而淡水正是人類所需的。我國保障民生基本生活用水：按每人每日 250 公升 (相當 417 瓶 600ml 罐裝水) 標準。另比較上方塑膠瓶裝水售價 20 元，面前這水箱體積 1 立方公尺（1,000 公升），即 1 度自來水費用約新臺幣 9 元，永續未來該選擇哪個 ?!

The human body is 70% water, and water is the source of life. Humans cannot survive for very long without water. Using an IBC (Intermediate Bulk Container), a container commonly used for liquid storage and shipping, the installation provides viewers with a tangible idea of one ton (1,000 liters) of water. The container is transformed into a light display, showcasing various volume conversion formulas.

Do you value water resources? Water is crucial to the Earth. Water covers two-thirds of the Earth’ s surface, but approximately 97% is salty, 2% is frozen, and only 1% is fresh—the very water humans need. Our country ensures basic domestic water supply: 250 liters of daily per capita water allocation (equivalent to 417 600ml bottles). Comparing the price of a plastic bottle of water at 20 NT dollars, the water tank in front of you has a volume of 1 cubic meter (1,000 liters), which is equivalent to approximately 9 NT dollars per cubic meter of tap water. Which should we choose for a sustainable future?

塑膠無所不在 & 無塑未來式

From Plastic is everywhere to a plastic-free future

8

塑膠製品因為輕便、耐用、成本低廉、防水、可塑性高等優勢，在現代生活中應用極廣。臺灣經濟研究院統計 2021 年塑膠製品製造業產值 3,173 億元，每年都有成長。而塑膠的過度使用及不易分解特性，讓無所不在的塑膠，帶來塑膠污染及塑膠微粒問題。

在日常生活中，我們早已無法迴避塑膠的存在，手搖飲料所附送的吸管、外賣食物的琳瑯滿目的塑膠湯匙…，塑膠工業產品幾乎全面取代容器，就連紡織衣物都是塑膠的舞臺。

Plastic is lightweight, durable, low-cost, water-resistant, and highly malleable. It is widely used in modern life. According to statistics from the Taiwan Institute of Economic Research, the output value of the plastics industry in 2021 was 317.3 billion NTDs, with steady annual growth. However, the excessive use of plastic and its non-biodegradable nature have led to a big problems: pollution, including microplastics.

In daily life, we can no longer avoid plastic. It’ s ubiquitous, in bubble tea straws, cutlery for take-out meals, containers of different shapes and sizes, and even textiles and clothing.

無塑未來式，未來食物超市

Plastic-Free Future Supermarket

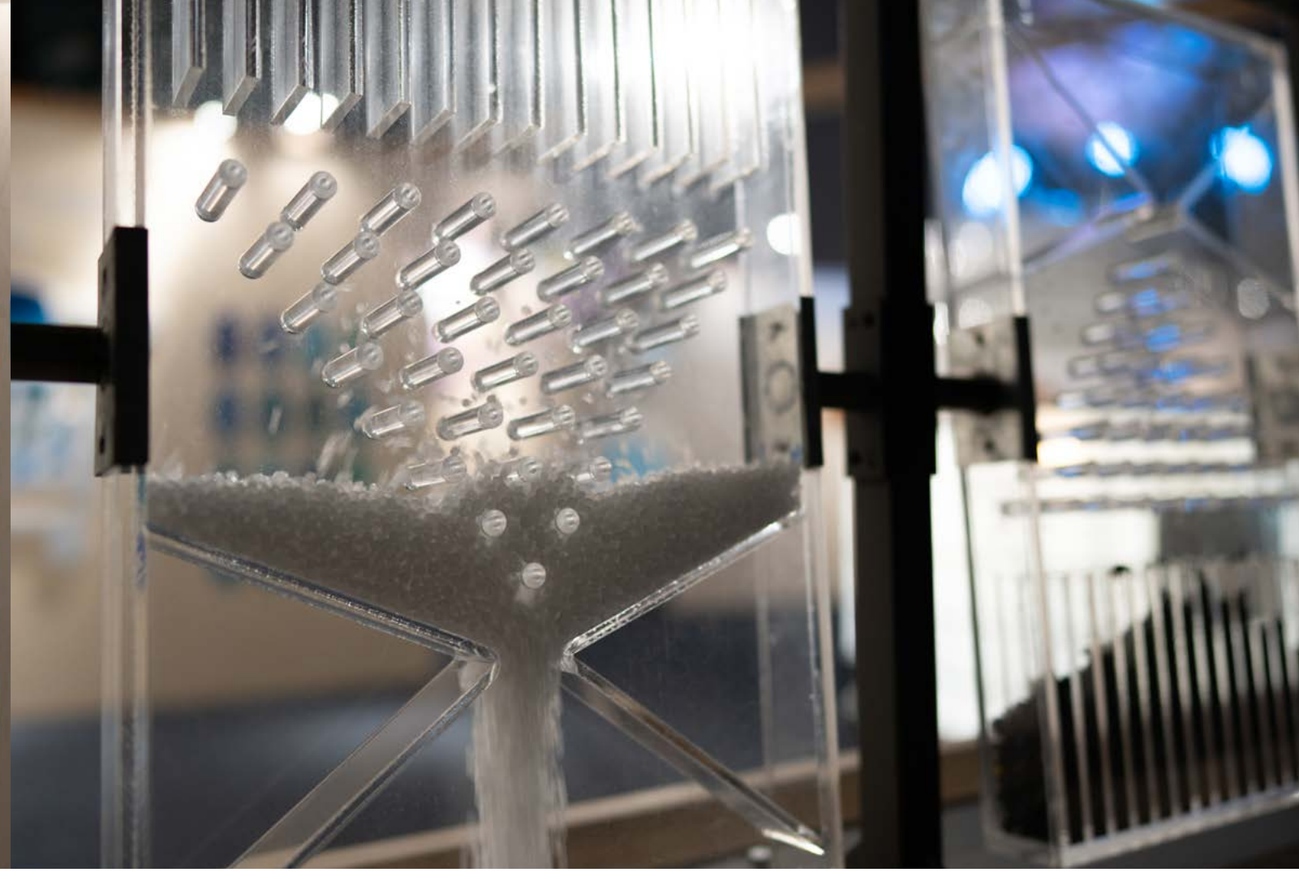
9

由 18 個國家組成的永續海洋經濟高層小組 (High Level Panel for a Sustainable Ocean Economy)，結合許多專家與研究人員，不斷探討海洋經濟與挑戰，該組織出版的第一本藍皮書便是《The Future of Food from the Sea》，主述海洋食物生產現狀和未來潛力，並如何透過海洋食物實現零飢餓，永續發展目標機會。

海洋食物能夠在永續糧食安全中發揮獨特作用，主要原因包括氣候變遷、飼料效率、生產潛力、營養、可獲取性等。未來食物的未來購物，似乎都有一些趨勢指標可循，如食物里程降低、過度包裝減少、性價比提高、對新鮮的要求提高…。

The High Level Panel for a Sustainable Ocean Economy, comprising 18 countries, brings together experts and researchers to continuously explore the challenges and opportunities of the ocean economy. The organization’s first blue book, titled “The Future of Food from the Sea,” outlines the current state and future potential of marine food production and how marine food can contribute to achieving zero hunger and without compromising sustainability.

Marine food can play a unique role in sustainable food security, primarily due to factors such as climate change, feed efficiency, production potential, nutrition, and accessibility. The future of grocery shopping is trending towards reduced food miles, decreased overpackaging, improved cost-effectiveness, and increased freshness.



塑膠微粒高頓板

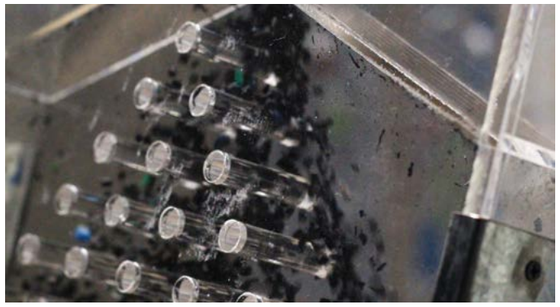
Microplastic Galton Board

10

Re，無塑金三角　Re- Plastic-Free Golden Triangle

微塑膠、塑膠微粒 (Microplastics) 係是直徑或長度小於 5mm 的塑膠碎片，它來自於各種塑膠產品分解、磨損，直接製造的小顆粒。塑膠微粒因為體積小而常被忽視，但它的污染問題早已浮上檯面、廣被討論，它不但存在空氣、水、土壤等環境中，甚至進入食物鏈中，對人體健康影響甚鉅。

展示中採取各種塑膠原料顆粒，雖微小但肉眼仍可見，並跳脫靜態展示，藉由大眾熟悉彈珠檯玩具，同時結合科學模型高頓板形式，同時有塑膠粒流動的真實聲響效果。



Microplastics are plastic fragments smaller than 5mm in diameter or length, originating from the wear and tear of various plastic products, as well as small particles that have been made that way. Microplastics have been overlooked but are now widely discussed. They exist in the air, water, soil, and other environments, and even enter the food chain, posing significant risks to human health.

The exhibition features different plastic raw material particles, which are small but still visible to the naked eye. It breaks away from static displays by incorporating a familiar Taiwan’s nightmarket pinball machine with a Galton Board model in which the plastic particles move to create a flowing sound.

嬰兒潮與玩具潮

The Baby Boom and the Toy Boom

11

每個小孩成長過程中，都有玩具陪伴，玩具產業的蓬勃，與戰後嬰兒潮有密切的關係，塑膠產業更加速了玩具的大暴發，琳瑯滿目令人眼花撩亂，不同年代的童年，各有不同玩具主角與主流，相同的是，這些玩具幾乎都是塑膠製品。玩具市場暢旺，也加速了上游塑膠產業的茁壯。

據研究統計，每個兒童平均擁有 300 件玩具，一天平均會玩 2 件，一件玩具受青睞壽命約 6 個月。這些遠離了童年的玩具，不只是美好童年的記憶，卻也是地球可觀塑膠廢棄物負擔。

Every child grows up with toys. The booming toy industry is closely tied to the post-war baby boom, and the plastic industry further accelerated the explosive growth of toys, creating a dazzling array of options. Different eras have their own iconic toys and trends, but one thing remains the same: nearly all these toys are made of plastic. The thriving toy market has also lifted the upstream plastic industry.

According to research statistics, each child averages 300 toys, plays with an average of 2 toys per day, and a toy’ s “attention lifespan” is approximately 6 months. These plastic toys, now distant from childhood, not only carry memories but also burden our planet.

海廢拉霸機

Marine Debris Slot Machine

12

海洋廢棄物又稱「海廢」，包括各種人造塑膠、玻璃、金屬…五花八門。海洋廢棄物不僅影響造成海洋生物誤食或被纏繞致死、影響食物鏈，也破壞海洋生態系統、生物棲地，甚至釋放有毒物質。

海廢影響海洋景觀，也加劇了海洋污染與氣候變遷。海洋無垠，讓海廢問題也沒有國界，而成了全球面臨嚴重的環境問題，主要以源頭減量、末端處理以及國際合作方式，一同面對一同解決海洋垃圾問題。

Marine debris, also known as “marine litter,” includes various man-made plastics, glass, metals, and many other items. Marine litter not only threatens marine life when it is ingested, or when creatures get caught in it, leading to injury or death. It also disrupts the food chain, damages marine ecosystems and habitats, and even releases toxins.

Marine debris affects marine landscapes and exacerbates marine pollution and climate change. The vastness of the ocean means that marine litter knows no borders, making it a severe global environmental problem. Solutions primarily involve upstream reduction, downstream processing, and international cooperation.

黃碳、綠碳、藍碳，碳安息

Yellow Carbon, Green Carbon, Blue Carbon, Carbon Sabbath

13

面對溫室氣體的元兇—二氧化碳，自然界有許多固碳高手，然而固碳還不夠，我們更希望這被固下來的碳，能就此安息、沈積（sink），永不再重出江湖、重返大氣中。

自然碳匯（Carbon Sink）最容易被理解便是綠碳，即森林碳匯；另而土壤中有機質與微生物也可儲存大量碳，是陸地生態系最大的碳庫—黃碳；而海洋包括紅樹林、海草床以及藻類等，更在自然碳匯中成為後起的明日之星—藍碳。

Facing the evil genius among greenhouse gases—carbon dioxide—there are many good sequestration agents in nature. However, sequestration alone is insufficient; we also hope that the sequestered carbon can rest in peace, never again to re-enter the atmosphere.

The most easily understood natural carbon sink is green carbon, i.e., forests. Additionally, organic matter and microorganisms in soil can store large amounts of carbon, making it the largest carbon reservoir in terrestrial ecosystems—yellow carbon. Meanwhile, marine ecosystems, including mangroves, seagrass beds, and algae, have emerged as rising stars—blue carbon.

藻 藍碳

Algae Blue Carbon

國立臺灣海洋大學海洋中心人工養殖海藻品種
The seaweed species for artificial culturing in NTOU.

14

因應國內 2050 淨零排放政策，在藍色碳匯研究上屢傳捷報，海洋委員會甫委請研究紅樹林與海草床生態服務的國立中興大學林幸助團隊，提出了紅樹林與海草床方法學，紅樹林可貢獻碳匯是森林的 2.5 倍，海草床與鹽沼則 1.5 倍。

而國立臺灣海洋大學在海藻生產力實驗中估計，每年每平方公尺種植溼重 10 公斤的海藻，則每公頃每年可額外貢獻 20 公噸當量二氧化碳。本展特別模擬海洋大學藻類保種中心，展示所育活藻，也是藍色碳匯的明日之星。

In response to Taiwan’s 2050 Net-Zero emissions policy, there have been encouraging developments in blue carbon research. The Ocean Affairs Council recently commissioned a research team led by Lin, Hsing-Juh from National Chung Hsing University to study the ecological services of mangroves and seagrass beds. The team found that mangroves can provide 2.5x more carbon storage than forests, while seagrass beds and salt marshes provide 1.5x more.

A team at National Taiwan Ocean University estimated that planting seaweed with a wet weight of 10 kilograms per square meter could contribute an additional 20 metric tons of carbon dioxide equivalents per hectare annually. This exhibition simulates the university’s algae conservation center, showcasing cultivated algae as a blue carbon sink.

提供單位：國立臺灣海洋大學海洋中心藻類實驗室、財團法人旭日教育基金會

Organization Name:Marine Algae Lab, Center of Excellence for the Oceans, National Taiwan Ocean University
Rising Sun Education Foundation

臺灣海洋能源發展潛力

Taiwan's Potential for Marine Energy Development

15

臺灣四面環海，道道地地的海洋國家，海洋資源蘊藏豐富，不只是漁業、生態資源，海洋能源將是未來開發方向之一，海洋能包括波浪能、海流能、潮汐能及溫差能，臺灣四周海域各有潛力。

目前國際上以潮汐能發電技術較為成熟並已商轉，其它形式發電技術仍屬新興發電技術，國家海洋研究院深入研究。考量臺灣四面環海的優越地理條件，可行的技術聚焦於長年穩定流經東部海域的黑潮所衍生之海流發電及波浪發電。

Taiwan is a true maritime nation, surrounded by the sea on all sides, with abundant marine resources. Beyond fisheries and ecological resources, marine energy is a future development direction. Marine energy includes wave energy, current energy, tidal energy, and thermal differential energy, with significant energy generation potential all around.

Currently, tidal energy generation technology is the most mature and has already been commercialized internationally. Other technologies are still emerging, and the National Academy of Marine Research is conducting in-depth research. Considering Taiwan's advantageous geographical conditions—it is an island, after all—feasible technologies include ocean current power generation and wave power generation derived from the Kuroshio Current, which flows steadily off the east coast year-round.

浮游式黑潮發電渦輪機

Floating Kuroshio Turbine

16

2050 淨零排放的關鍵戰略中，能源轉型是四大策略之一，開發海洋能源早已如火如荼進行中。經濟部也定出海洋能政策目標，2030 年完成設置 0.1MW ～ 1MW 示範發電機組；2035 年設置 1 ～ 10MW 商業運轉發電機組；2050 年達成目標裝置容量 1.3 ～ 7.5GW。

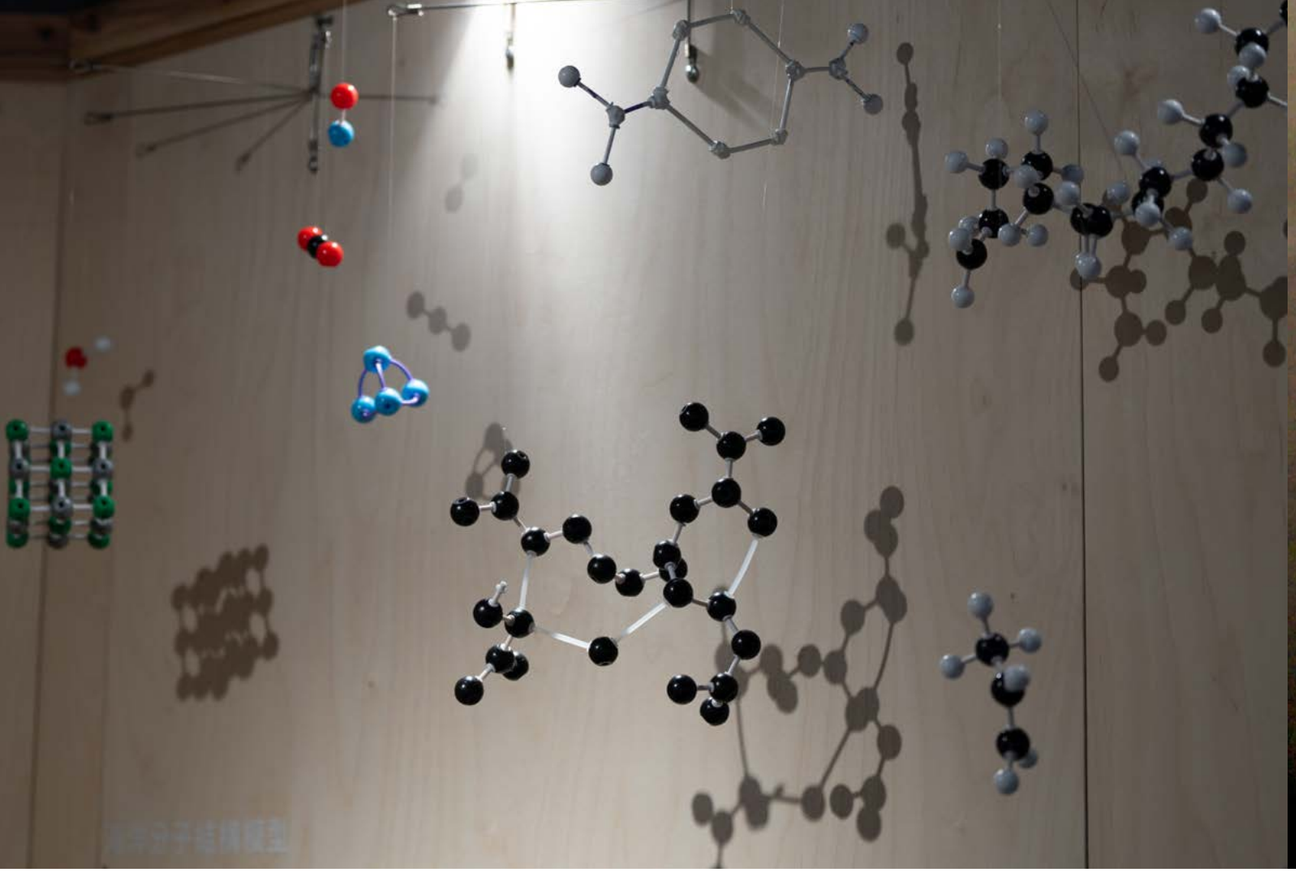
這組浮游式黑潮發電機以 500KW 為目標，從 800W 模型機實驗開始做起，進而 10KW 發電機組，並將單轉子結合成為雙轉子 20KW，在水深 70 公尺處長期錨碇測試發電上岸，再進入示範電廠階段任務。

In the key strategic plan for achieving Net-Zero emissions by 2050, energy transition is one of the four major strategies, and the development of marine energy is already underway. The Ministry of Economic Affairs has also set policy goals for marine energy: by 2030, complete the installation of demonstration power generation units with a capacity of 0.1 MW to 1 MW; by 2035, install commercial-scale power generation units with a capacity of 1 MW to 10 MW; and by 2050, achieve a target installed capacity of 1.3 GW to 7.5 GW.

This Floating Kuroshio Turbine targets 500 kW, starting with an experimental 800 W model, then progressing to a 10 kW generator unit, and combining single rotors into a dual-rotor 20 kW system for long-term testing anchored at a depth of 70 meters, followed by the demonstration power plant phase.

提供單位：國立臺灣大學工程科學及海洋工程學系

Organization Name:Department of Engineering Science and Ocean Engineering, National Taiwan University

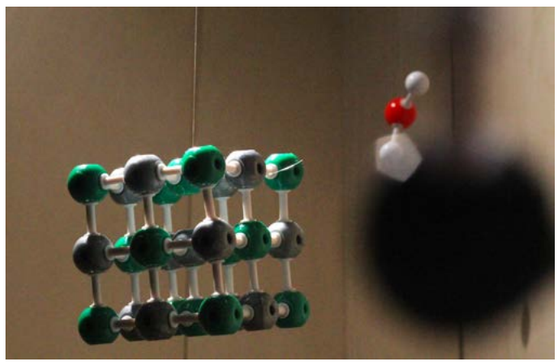


海洋分子結構

Marine Molecular Structure

17

分子（molecule）是能保持物質固有化學性質且能獨立存在的最小中性粒子。分子結構可以是艱深的專業，也可以平易如樂高玩具，本展示便以分子結構透過光的投影，在牆上映出美麗的影像，以間接簡易表達海洋的種種污染，尤其是海洋酸化與優養化及微塑料等海洋污染，透過分子結構帶來的化學意象，讓人聯想二氧化碳帶來酸化，氮磷造成優養化，以及更複雜結構的塑料。



A molecule is the smallest neutral particle that can maintain the inherent chemical properties of a substance independently. Molecular structure can be a complex field of study or as simple as LEGO toys. This exhibition projects molecular structures on the wall to convey various forms of marine pollution, particularly ocean acidification, eutrophication, and microplastics. Through the chemical imagery evoked by molecular structures, viewers can associate carbon dioxide with acidification, nitrogen and phosphorus with eutrophication, and more complex structures with plastic pollution.

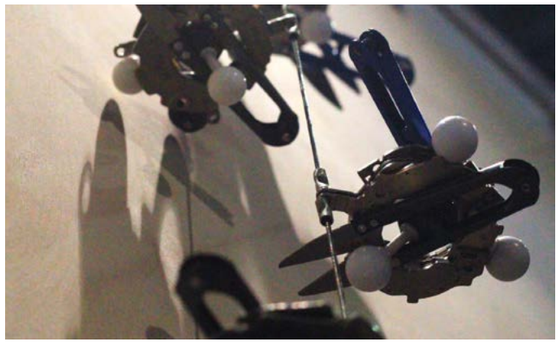
去碳燃氫

Turquoise Hydrogen

18

在能源轉型的賽道上，不只在海洋能源開發，中央研究院也投入「去碳燃氫」技術研發，透過裂解，將甲烷中的碳鍵打斷，分離出固化的碳以及可燃的氫。這項技術成果也臺電合作進行燃氣機組混氫發電，為降低發電碳排再邁前一步。

展示主要係透過分子結構模型中，如何將一個碳原子與四個氫原子的鍵結打斷，同一科學原理，看似簡單的化學式，卻有千百條技術通道與關卡，等待科學家的靈光乍現。



In the race to the energy transition, Academia Sinica is involved in marine energy generation development and in the research and development of “turquoise hydrogen” technology, also called methane pyrolysis. This technology decomposes methane into solid carbon and combustible hydrogen. This achievement has been applied with Taiwan Power Company in turbines that can burn hydrogen-gas blends, taking another step toward reducing carbon emissions in this sector.

The demonstration primarily showcases how to break the bonds between one carbon atom and four hydrogen atoms in a model of methane, CH4. While the underlying scientific principle may seem straightforward, the seemingly simple chemical formula involves numerous technical difficulties for scientists to overcome.

懸賞溫室氣體

Greenhouse Gases Wanted, Dead or Alive

19

日本《海賊王》（ONE PIECE）不論是漫畫或動畫、電影，都造成轟動，光是漫畫便銷售超過 5 億冊，其中海賊王的通緝懸賞海報，也成了懸賞告示的經典格式。許多電影中的懸賞畫面與情節，成為本展品的靈感，而受到通緝的，被視為全球公敵的，不正是這些闖下大禍、十惡不赦的溫室氣體，將它們的特徵、罪行一一描繪，貼滿了公告牆。

The Japanese manga, anime, and film series One Piece caused a sensation, with over 500 million copies sold. The wanted posters for the characters are classic. Such posters and plots in films have become one of our inspirations for this exhibition, where bounties are placed on global evils, none other than greenhouse gases that are so harmful and unforgivable. Their guilty “faces” and traits are meticulously depicted and described, then plastered across bulletin boards.

抱卵母蟹

Egg-bearing Crabs

公民參與　Citizen Participation

20

包括基隆在內的臺灣北海岸，是蟹類重要產地，萬里更以蟹為地方特色與物產，漁市場攤架上各類生鮮活蟹令人食指大動，但夾帶其中許多抱卵母蟹，卻也令有識之士認有不妥，於是在政府公共政策網路參與平臺上提案，並引起了熱烈討論，該案經名開多次相關單位會議後，促成了修法，將禁捕期期從 3 個月延長為 5 個月。這是公民參與政策的鮮活案例。

The northern coast of Taiwan, including Keelung, is an important crab-producing area. Wanli is particularly known for its crabs as a local specialty. The fresh live crabs on display at the fish market stalls are tempting, but among them are many egg-bearing crabs, which just isn’t right. Sensible citizens have proposed a solution on the government’s public policy online participation platform (https://join.gov.tw), sparking a heated debate. After multiple meetings with relevant agencies, the proposal led to a legislative amendment extending the annual fishing ban from three months to five months. This is a fresh, live example of citizen participation in policy-making.

熱浪

Heatwave

21

https://wmo.int/publication-series/state-of-global-climate-2024
https://tccip.ncdr.nat.gov.tw/km_news_one.aspx?kid=20220209213834#!
https://www.bbcearth.com/news/saving-coral

熱浪是天氣在某段時間內持續出現異常高溫，並可能伴隨較高的空氣濕度。
世界氣象組織（WMO）定義，熱浪是連續 5 天最高氣溫，皆超過該地區平均最高氣溫 5° C 以上。全球各地每年紛傳熱浪事件。

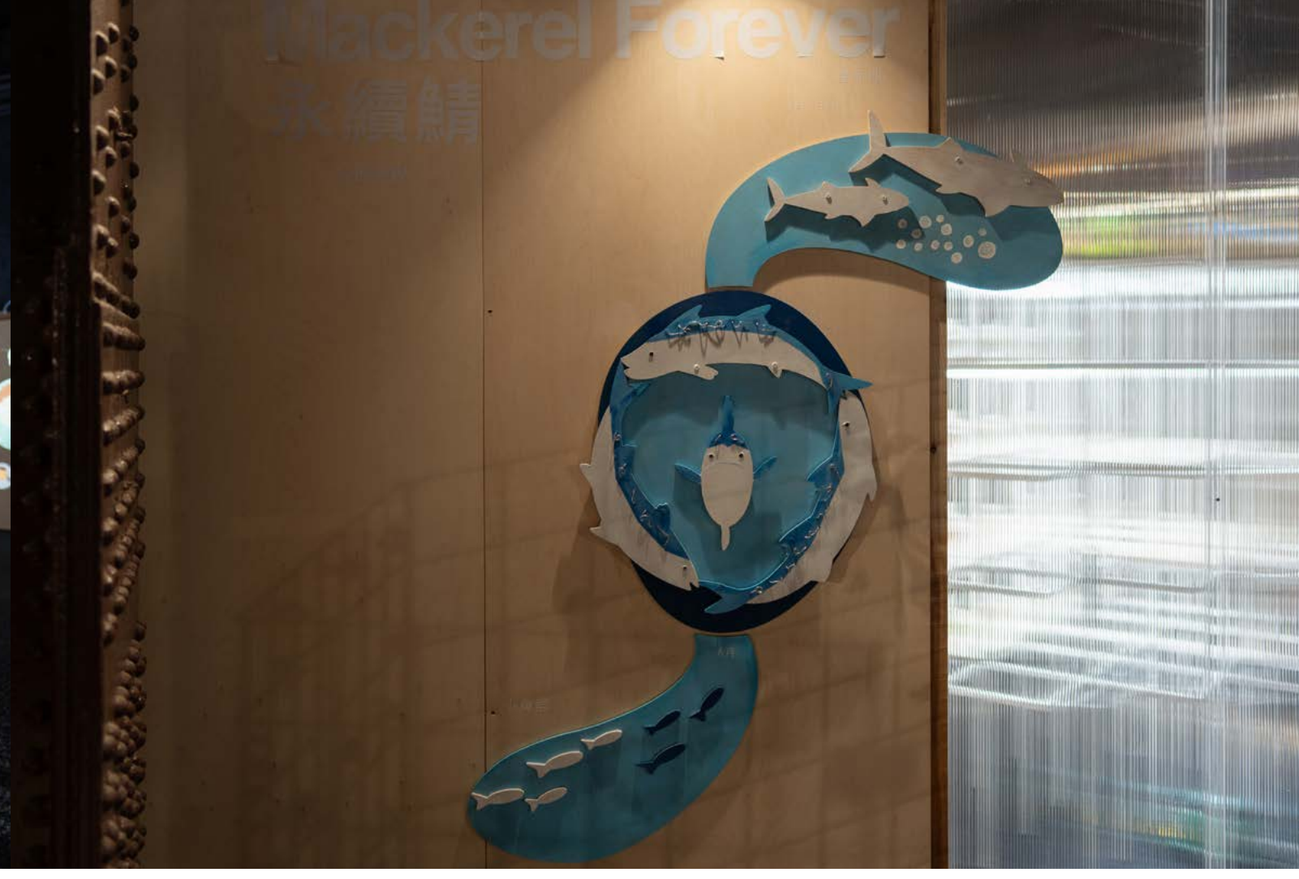
聯合國政府間氣候變遷專門委員會 2018 年報告預測：全球暖化 1.5° C 將導致全球 70% 至 90% 的珊瑚礁消失。聯合國世界氣象組織 2025 年《2024 年全球氣候狀況報告》證實：2024 年可能是第一個氣溫比 1850-1900 年平均值高出 1.5° C 以上的年份，這將是 175 年來觀測記錄中最熱的一年。科學家 2022 年研究發表：全球升溫 1.5°C熱浪，將使 99% 的珊瑚礁受害面臨消失的命運。

珊瑚礁的大災難：人類能做些什麼 - BBC 英倫網

A heatwave is a period of abnormally high temperatures over a certain period, often accompanied by high humidity. The World Meteorological Organization (WMO) defines a heatwave as five consecutive days with maximum temperatures exceeding the average maximum temperature for the region by more than 5° C. Heatwave events are reported annually across the globe.

The Intergovernmental Panel on Climate Change (IPCC) reported in 2018 that global warming of 1.5 ° C could lead to the disappearance of 70% to 90% of the world’s coral reefs. The WMO’s “State of the Global Climate 2024 ” report stated that 2024 “was likely the first calendar year to be more than 1.5 ° C above the pre-industrial era, with a global mean near-surface temperature of 1.55 ± 0.13 ° C above the 1850-1900 average. This is the warmest year in the 175-year observational record.” A 2022 study by scientists found that a 1.5 ° C global temperature rise could result in the destruction of 99% of coral reefs and the extinction of coral species.

The Coral Reef Catastrophe: What Can Humans Do? (Saving Coral, BBC EARTH)



永續鯖

Mackerel Forever

https://www.fa.gov.tw/view.php?theme=Announcement_Info&subtheme=&id=360

22

公民參與　Citizen Participation

鯖魚是臺灣漁業的主力漁獲、代表魚種，沿近海漁業最重要的魚種，產量居首。然而鯖魚越捕越少、魚體越來越小，卻是不爭的事實，面對氣候變、海水升溫、漁獲不穩等因素，漁民表決通過願意接受更嚴格的永續漁業管理，在產官學的合作下，更定出 2024 年漁獲總量為 9 萬公噸及配額，這數字也是科學家長期投入監測與計算，認為是大海母親的可再生能力。

公告 113 年度東北海區鯖鰺漁業總容許漁獲量 (農業部漁業署)

Mackerel is the main catch and representative species of Taiwan’s fishing industry, and the most important species in coastal fisheries, with the highest production volume. However, the fact that mackerel populations are declining and fish sizes are shrinking is undeniable. In the face of factors such as climate change, ocean warming, and fluctuating catches, fishermen have voted to accept stricter sustainable fisheries management. Through collaboration between government, industry, and academia, a total catch quota of 90,000 metric tons for 2024 has been established. This figure is also based on long-term monitoring and calculations by scientists and believed to be sustainable, within the ocean’s capacity for renewal.

Notice on the Total Allowable Catch for Mackerel and Horse Mackerel Fisheries in the Northeast Sea Area for 2024 (Ministry of Agriculture, Fisheries Bureau).

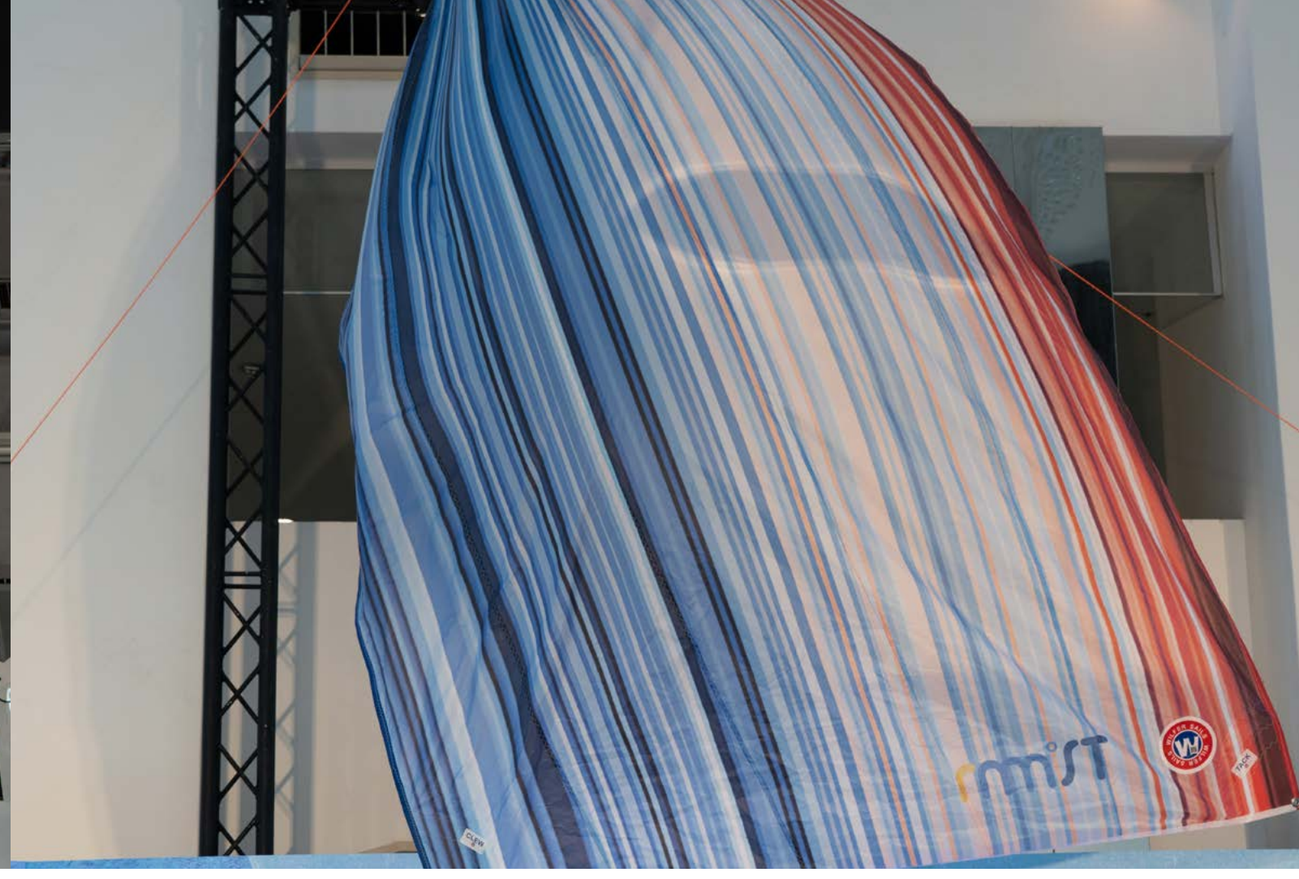
海洋六大汙染

The Six Major Forms of Marine Pollution

23

海洋污染可以分為六大面向，包括塑膠污染、營養物質污染、非點源污染、光污染、噪音污染、工業污染，其中更以塑膠污染最為大眾所熟悉，但除了棘手的塑膠污染問題，還有其它污染被忽略，都是扼殺海洋的殺手，而我們不經意地便成火幫兇。本特展廳過去為北火電廠鍋爐室，挑高空間與巨大的花樑鋼構，以污染海洋的廢棄物創作妝點呈現不同海洋污染。

There are six types of marine pollution: plastic pollution, nutrient pollution, non-point source pollution, light pollution, noise pollution, and industrial pollution. Among these, plastic pollution is best known. Other forms of pollution are often overlooked, yet they are equally deadly to the ocean. Unwittingly, we have become accomplices in this destruction. This exhibition hall was formerly the boiler room of the North Thermal Power Plant, featuring a high ceiling and massive steel trusses with decorations made out of marine litter to showcase different forms of pollution.



氣候條紋船帆

https://showyourstripes.info/

Climate Stripes Sail

24

英國雷丁大學氣候學家愛德華・霍金斯（Edward Hawkins）發明了溫度條紋圖，他將各國 1970 年至 2000 年的平均氣溫定為標準，在 2.6 個標準差範圍內依顏色變化，視覺化顯現示 1901-2020 年的溫度條紋。臺灣也有自己的溫度條紋圖，過去 20 年來一路紅通通，都是暖化、氣候變遷的證據。愛德華曾將氣候條紋應用於船帆，並行駛於西北航道上，本展也秀出了屬於臺灣的溫度條紋，並製成球帆，期有一天也能出海揚帆。

Edward Hawkins, a climatologist at the University of Reading in the UK, invented warming stripes to visualize climate change data. He set the average temperature of each country from 1970 to 2000 as the baseline and used color changes within a 2.6 standard deviation range to visually represent the temperature in stripes from 1901 to 2020. Taiwan also has its own temperature stripes, which have been consistently red over the past 20 years, serving as reminders of global warming. Hawkins once applied climate stripes to a sail on a boat he sailed through the Northwest Passage. This exhibition also showcases Taiwan’s climate stripes on a spinnaker sail, with the hope that one day it too can set sail.

#ShowYourStripes

冰芯的氣候密碼

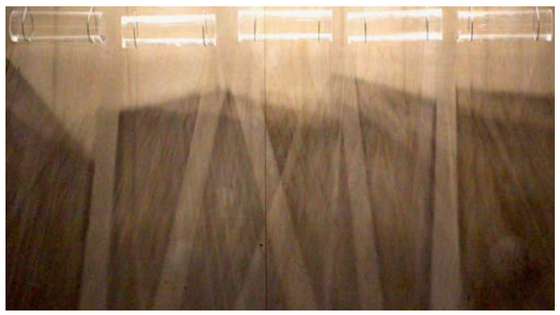
The Climate Code in Ice Cores

https://nsidc.org/learn/ask-scientist/core-climate-history

25

早在 2015 年便啟動 EastGRIP 計畫（The East Greenland Ice-core Project），目標要在格陵蘭東北部冰流（Ice Stream）上，鑽出深達 2,650 公尺的冰芯，就像地質鑽探取得岩心，科學家在格陵蘭冰原鑽取「冰芯」。

冰原的冰是逐年累積了數萬年，冰是水的一種形式，透露氧同位素分析，便可以解讀萬年的氣候史。本展取冰芯外形，以柱狀透明管體模擬，管中帶有少許液體流動、盪漾，顯示出多變漣漪，藉此遙想冰芯暗藏的氣候密碼。



As early as 2015, the EastGRIP project (East Greenland Ice-Core Project) was launched with the goal of drilling through the Northeast Greenland Ice Stream (NGIS) to retrieve a 2,650 meter long ice core, similar to geological drilling for rock cores.

The ice in the sheet has accumulated over tens of thousands of years. Oxygen isotope analysis of the water in different levels of ice can reveal the climate history of thousands of years. This exhibition simulates an ice core in a transparent tube. The tube contains a small amount of flowing liquid, showing ever-changing ripples that evoke the climate code hidden within the ice core.

What do ice cores reveal about the past? | National Snow and Ice Data Center

The BLOOP

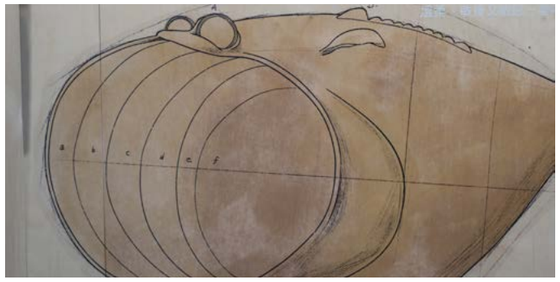
The BLOOP

https://www.youtube.com/watch?v=5EiGIaMbGnM
https://oceanservice.noaa.gov/facts/bloop.html

26

The Bloop 是美國國家海洋暨大氣總署 (NOAA) 太平洋海洋環境實驗室 (PMEL) 於 1997 年夏天，在南太平洋偵測到的超低頻深海聲音，此聲音震驚了科學界，當時研究人員認為，可能來自一個非常龐大的海洋生物，歷經 8 年持續監聽紀錄探索研究，終在 2005 年確認，這低頻深海怪聲是冰山從南極冰川上裂開、脫落所發出的聲響。

不過 BLOOP 聲音引發許多想像力奔馳，本展也藉由聲音，發想 BLOOP 深海龐大未知海洋生物造型，作為本展吉祥物與角色扮演應用。



The BLOOP was an ultra-low-frequency deep-sea sound detected by the Pacific Marine Environmental Laboratory (PMEL) of the U.S. National Oceanic and Atmospheric Administration (NOAA) in the South Pacific during the summer of 1997. This sound shocked the scientific community, as researchers initially speculated it might originate from an extremely large marine organism. After eight years of continuous monitoring, recording, and research, it was finally confirmed in 2005 that the strange high-amplitude sound was caused by an iceberg calving from an Antarctic glacier.

But the BLOOP sound got people thinking. This exhibition also uses sound to conceptualize the shape of a massive, unknown underwater creature as the exhibition’ s mascot and for role-playing.

海洋生態系指標物種

Marine Ecosystem Indicator Species

27

海洋健康指標中，多項都與生態有關，除了涵蓋棲地與物種兩面向構成的生物多樣性外，更有在地意識項下，特別舉出標誌物種。標誌物種（iconic species）指的是在公眾心中具有高知名度、象徵性，常被用來代表特定地區或生態系，或與文化連結以及促進保育意識、議題的物種。在陸地上，臺灣黑熊、黑長尾雉、藍腹鷴…都堪稱是臺灣的指標物種，而海洋的標誌物種則因多元棲地而異。

Many marine health indicators are ecological. In addition to biodiversity, which encompasses both habitat and wildlife, there are also “iconic species.” Highly recognizable and symbolic in the public eye, such species often represent specific regions or ecosystems. Such species are often linked to culture and used to promote conservation awareness. On land, Taiwan black bears, Mikado pheasants, and Swinhoe’s pheasants … are all iconic species, while marine iconic species vary due to diverse habitats.

本產品含衛星成分

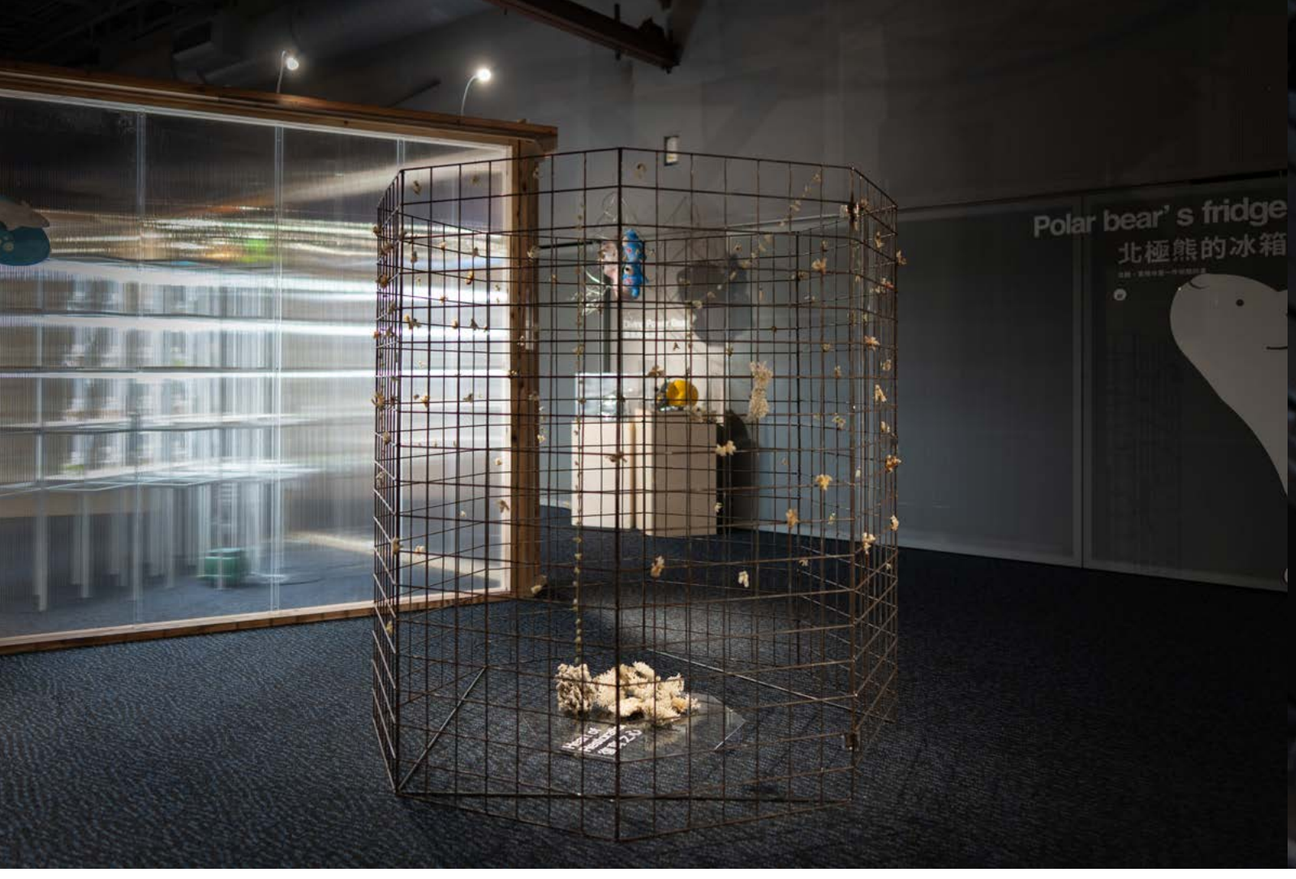
https://money.udn.com/money/story/5629/7800986

This product contains satellite components.

28

我們只有一顆地球，當然也只有一個太空。目前被送上太空中人造衛星約有 16,990 顆，仍在太空中 11,500 顆，其中還在運作約 9,000 顆。我們可以不了解衛星科技，但我們卻沈浸在享受衛星應用於生活所帶來的各種便利。如果衛星是一種成分，我們生活用品中含衛星成分的比例正在節節升高，你可以輕易指出如飛機、船舶、電話、無人機、SNG 車、智慧手錶、智慧手機…，你將赫然發現衛星不只在遙遠的太空，更貼身近在每天的生活裡。

We have only one Earth, and of course, only one space. Currently, there are around 16,990 man-made satellites in space, with 11,500 still in orbit, of which about 9,000 are operational. We may not understand satellite technologies, but we are immersed in the various conveniences they bring. If satellites were an ingredient, we use so much we’d have to call it a staple. For example, airplanes, ships, phones, drones, SNG vehicles, smartwatches, and smartphones all depend on satellites…. Satellites are not only in distant space but also part of our daily lives.



復育之心

https://www.bbc.com/ukchina/trad/vert-earth-47890492

The Heart of Restoration

29

珊瑚復育是水下的手工藝

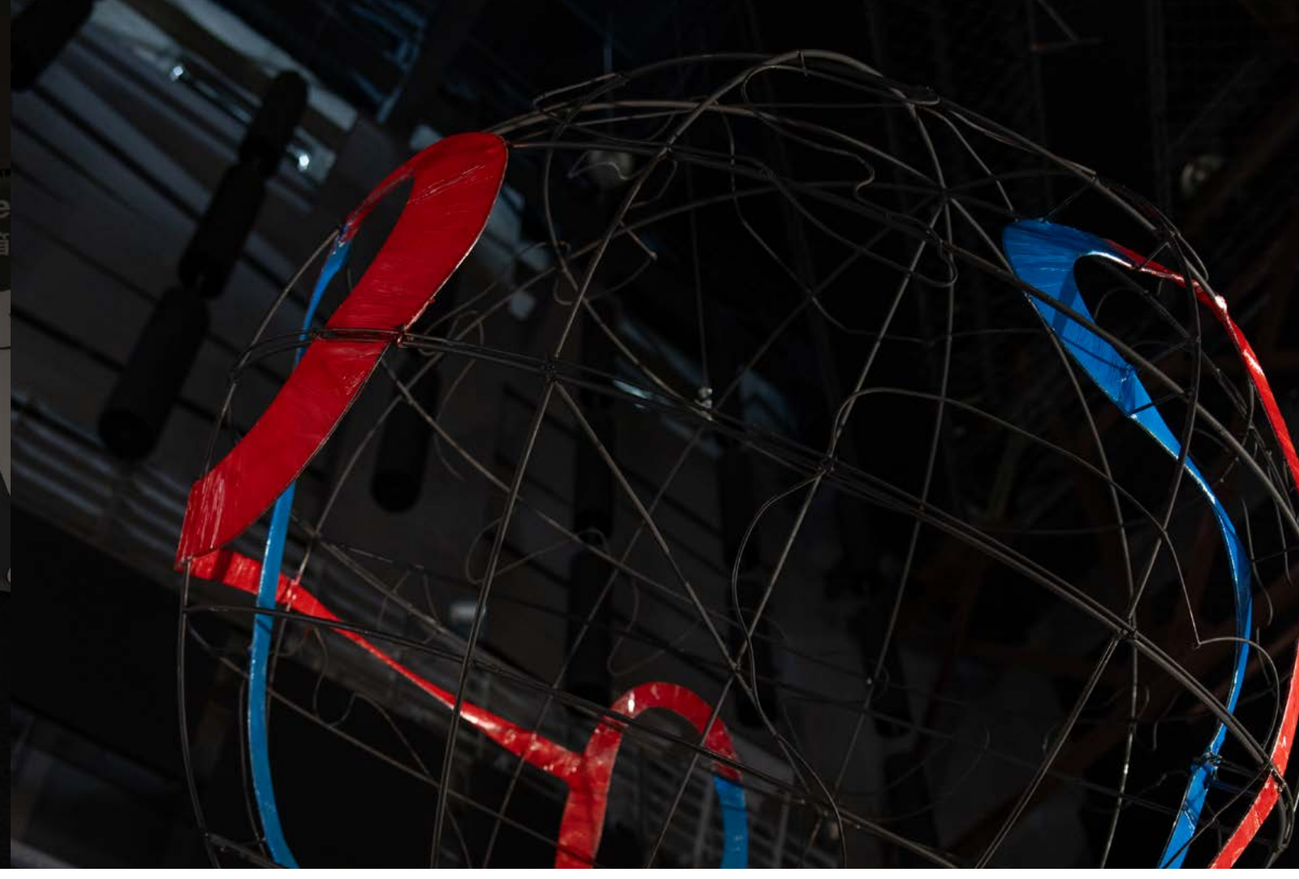
珊瑚礁雖面積不大，只占全球海洋面積 1%，但卻是超過 1/4 海洋生物賴以為生的棲地，生物多樣性極高，被稱為「海洋雨林」。當珊瑚礁災難：我們能做什麼？德國建築師德國建築師沃夫・希柏茲（Wolf Hilbertz）於 1976 年發明 BioRock 人工珊瑚礁，將金屬通過微弱電流，促使海水中的礦物質析出沈澱，加速珊瑚沉降、生長、癒合、存活，以及抵抗高溫、沉積物和污染等環境壓力的能力。

珊瑚礁的大災難：人類能做些什麼 - BBC 英倫網

Coral reefs, though small in area—accounting for only 1% of the ocean surface—serve as habitats for over a quarter of all marine life, boasting extremely high biodiversity and earning the nickname “marine rainforests.” When coral reefs are on the rocks, what can we do? German architect Wolf Hilbertz invented the BioRock artificial coral reef in 1976. By applying a weak electric current to metal, minerals in seawater precipitate, accelerating coral settlement, growth, healing, survival, and resistance to environmental stresses such as high temperatures, sedimentation, and pollution.

The Coral Reef Crisis: What Can Humans Do? (Saving Coral, BBC EARTH)

提供單位：國立海洋科技博物館
Organization Name:National Museum of Marine Science and Technology



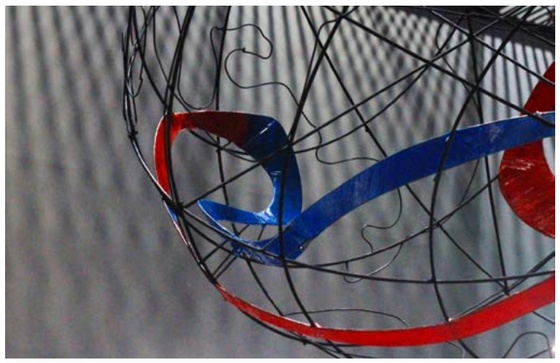
AMOC 大西洋經向翻轉環流

https://news.pts.org.tw/article/648392

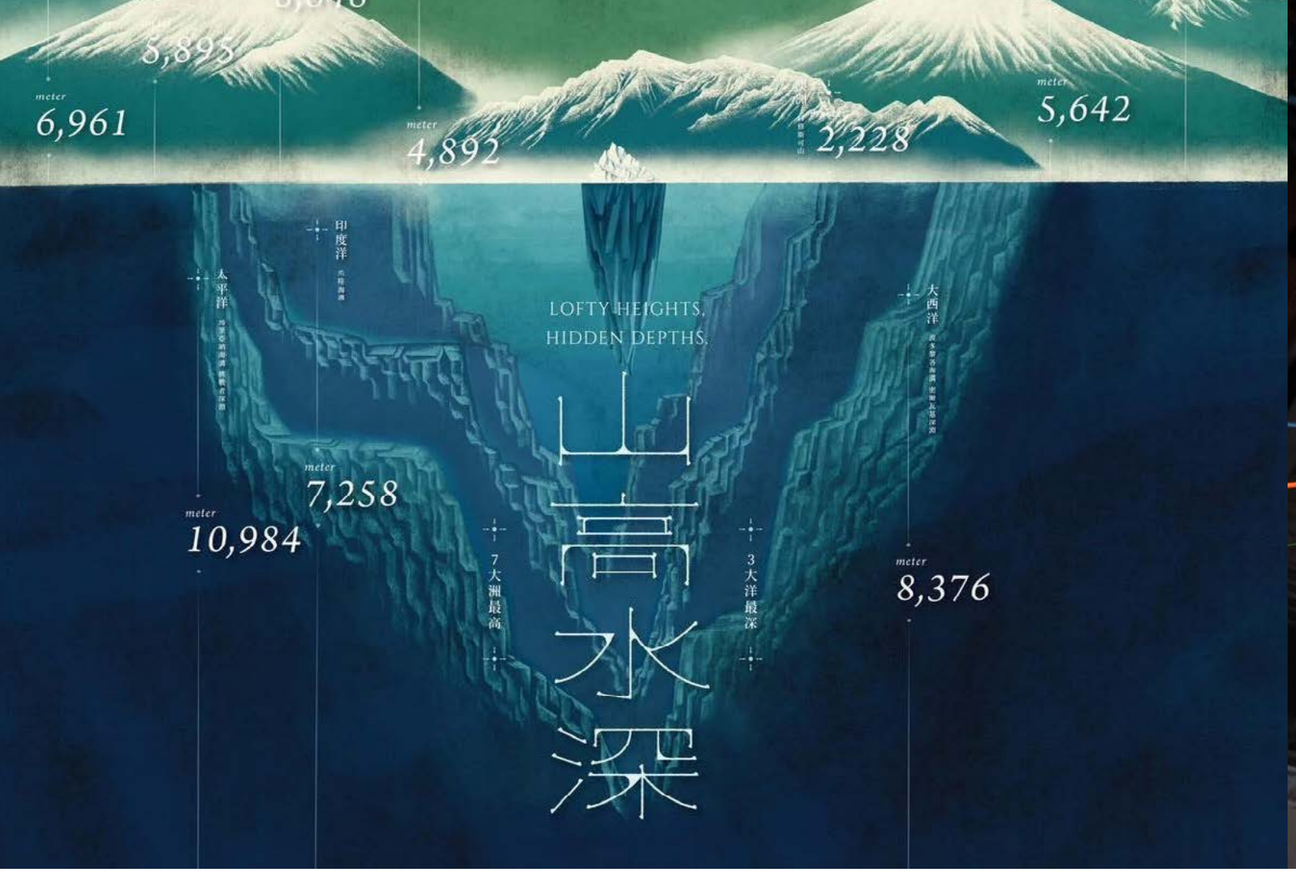
AMOC (Atlantic Meridional Overturning Circulation)

30

海洋有許多大大小小洋流，影響著全球氣候和生態系統，而大西洋經向翻轉環流 AMOC 更由多道洋流共同組成的複雜系統，AMOC 每秒可移動 17,000,000 立方公尺的海水，任何一立方公尺海水將會花 1,000 年才能繞 AMOC 一圈，AMOC 自 1955 年到 1994 年保持穩定、一致，但過去 20 年間強度和速度有所下降。有觀察顯示，2023 年預估 AMOC 崩潰最有可能發生在 2057 年左右，至 2095 年間崩潰的可能性為 95%。



The ocean is home to numerous currents that influence global climate and local ecosystems. The Atlantic Meridional Overturning Circulation (AMOC) is a complex system composed of multiple currents. The AMOC moves 17M cubic meters of seawater per second, and it takes a thousand years for a single cubic meter of seawater to complete one cycle through the AMOC. The AMOC remained stable and consistent from 1955 to 1994, but its strength and speed have declined over the past 20 years. Observations suggest that the AMOC is most likely to collapse around 2057, with a 95% probability of collapse by 2095.



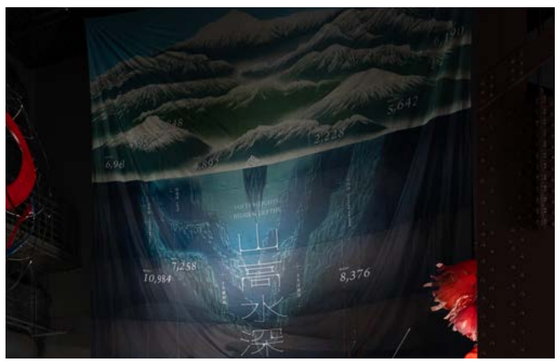
山高水深

River Deep, Mountain High

31

臺灣水準原點就位於海科館北部濱海公路旁（臺 2 線 70K）。以陸地觀點，它是所有高程的參考原點，以海拔論高度，地圖上有等高線圖，海圖上便是等深線圖。生活在陸地的我們，世界各洲之顛早有人攀登；然而各大洋中的深淵勝過高山，每往下潛 10 公尺，壓力便增加 1 大氣壓（atm），人早已上太空，但對於內太空，深淵仍是人類未及之境。

Serving as a reference point for all elevations, the Taiwan Geodetic Datum is located alongside the northern coastal highway (Taiwan Highway 2, kilometer 70) near the National Museum of Marine Science & Technology. Maps feature contour lines, while nautical charts use bathymetric lines. While we who live on land have already climbed the peaks of every continent, the abysses of the oceans surpass even the highest mountains. For every 10 meters of descent, pressure increases by 1 atmosphere (atm). Humans have already ventured into outer space, but inner space remains underexplored.



氣候鞭答

Weather Whiplash

https://www.weforum.org/stories/2025/03/climate-whiplash-air-quality-urban-transformation/

32

氣候鞭答 (Weather Whiplash) 是氣候在極端乾旱和極端降雨之間，快速且劇烈的波動，就像被鞭子抽打一樣。在氣候變遷下，這現象變得頻繁且強烈，導致嚴重自然災害如野火、洪水和乾旱。

UCLA 氣候科學家史溫（Daniel Swain）以「膨脹的大氣海綿」描述此現象，也就是大氣在雨季吸收更多水分，導致洪水，而旱季則從土壤和植物中奪走水分。史溫指出「氣溫每升高 1° C，大氣就會蒸發、吸收和釋放額外 7% 的水」，如此更進一步惡化了氣候災害。本展品靈感源自碼頭繫纜樁，樁上繫滿了纜繩，並受到各方力量的拉扯，藉此隱喻我們所處之地正受到極端、反覆的折磨、拉扯。

Weather whiplash refers to rapid swings in weather between extreme drought and rainfall, akin to being struck by a whip. Climate change has made such swings more frequent and intense, leading to severe natural disasters such as wildfires, floods, and droughts.

UCLA climate scientist Daniel Swain describes this phenomenon as an “expanding atmospheric sponge effect,” where the atmosphere absorbs more moisture during the rainy season, causing floods and then draws moisture from the soil and plants during the dry season. Swain notes that “with every degree of warming the atmosphere is able to evaporate, absorb and release 7% more water,” further exacerbating climate disasters. This exhibit draws inspiration from a mooring post, with ropes tied to it that pull it in all directions, symbolizing the extreme and relentless pressures and stresses our environment is enduring.

潛水的北火熊

Diving Power Bear

33

海洋維繫著人類和地球上所有生命，儘管我們完全仰賴海洋，但探索過的海洋部分卻僅約 10%，我們對浩瀚海洋知之甚少。縱使海洋兇險，也從未讓人的探索、研究卻步，器材、設備不斷日新月異，讓我們的好奇心可達到更深的海底。

海洋科技博物館典藏的深海作業頭盔，既是文物也是現行水下作業現役的頭盔，仿如電影變形金剛中的大黃蜂，讓深海潛水人員有著英雄般的身影，在水底執行著不同的艱鉅任務。
本展也為海洋科技博物館的吉祥物「北火熊」也配上潛水頭盔，海洋探索出任務。

The ocean sustains humanity and all life on Earth. Despite our complete reliance on the ocean, only about 10% of it has been explored, leaving us with limited knowledge of its vastness. Despite its dangers, the ocean has never deterred human exploration and research. With constantly evolving equipment and technology, our curiosity can now probe deeper.

The deep-sea diving helmet in the collection of the National Museum of Marine Science & Technology in Keelung may be a historical artifact, but it’s still dive-ready. Donning the helmet, which looks like Bumblebee from the Transformers movies, would turn any diver into a superhero, ready to tackle any underwater challenge.

This exhibition also features the museum’s mascot, the “Power Bear,” wearing a diving helmet, ready for ocean exploration missions.

提供單位：國立海洋科技博物館

Organization Name:National Museum of Marine Science and Technology

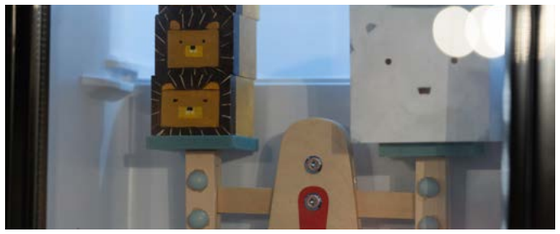
北極熊的冰箱

The Polar Bear’s Refrigerator

34

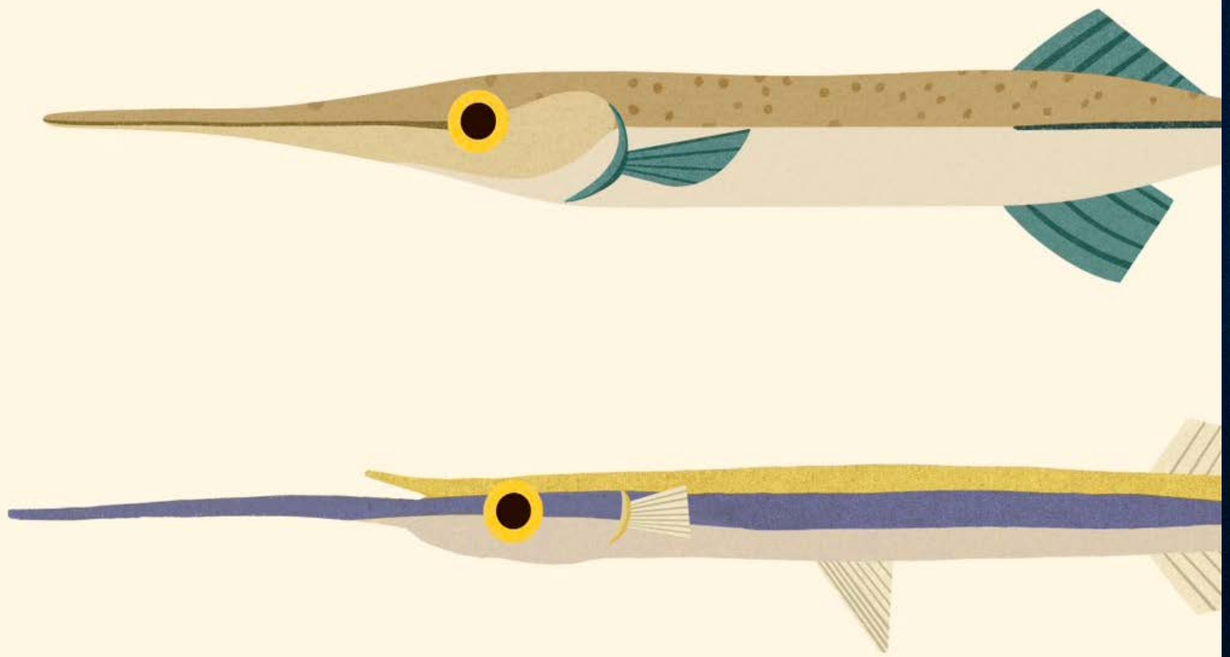
北極熊是地球上唯一依賴海洋生態系生存的熊科動物，同時被歸類為海洋哺乳類動物，一生多生活在北冰洋的海冰上。本展以冰箱作為展箱，呼應北極熊所處低溫環境，分別呈現北極熊各種特性。

北極熊屬獨居性動物，活動範圍直徑 150~300 公里，四肢著地肩高 1.5 公尺，站立身高可達 3 公尺，體重可達 800 公斤。短距奔跑時速可達 40 公里，游泳時速約 9 公里。環斑海豹、髯海豹是牠的主食，一身狩獵技能，但成功率卻不到 2%，氣候變遷帶來海冰消褪、覓食困難…，都讓北極熊面臨空前危機。



Polar bears are the only bear species on Earth that rely on marine ecosystems for survival and are classified as marine mammals. They spend most of their lives on the ice of the Arctic Ocean. This exhibition uses a refrigerator to evoke the polar bear’s frigid environment, showcasing various characteristics of polar bears.

Polar bears are solitary animals with a range of 150–300 kilometers. They stand 1.5 meters tall on all fours and can reach 3 meters in height standing on their hind legs. They weigh up to 800 kilograms. They can sprint up to 40 kilometers per hour and swim at approximately 9 kilometers per hour on the hunt for ringed seals and bearded seals. They possess exceptional hunting skills, but their success rate is less than 2%. Climate change has led to an unprecedented crisis: the retreat of sea ice makes it harder for polar bears to find food.



鱵半ㄎ

Halfbeaks

35

美國國家科學院院士彼得・雷文（Peter Raven）不斷呼籲「全球物種正以每年消失 1,000 種的速度滅絕」。俗稱「水針」的鱵科魚類，兩種鱵一個滅絕，一個被新發現，都是海洋的現在進行式。臺灣下鱵是美國魚類學家布魯斯・科萊特（Bruce Collette）在 1986 年所正式發表的新種，標本散藏於國外多所博物館，魚標本分別於 1908、1943、1956、1969 年，由淡水河的挖仔尾以及基隆河下游的士林一帶所採到，顯示當年數量不少。然而中央研究院幾年調查，卻始終沒有發現，推測可能已經滅絕。臺灣下鱵是在被分類學家發現和證實牠是新種之前，就已經在地球上消失了。

相對於臺灣下鱵的消失，德國漢堡自然博物館中有一不明魚類標本，標記採於 1907 年，採集地為「Takao，Formosa」（打狗，高雄舊稱），牽起了臺德雙方攜手合作，2023 年在嘉義再度發現此魚，並命名為新種「打狗異鱵鱵」。

Peter Raven of the National Academy of Sciences has repeatedly warned that “species are now disappearing at thousands of times the historical rate.” The halfbeak family, commonly known as “water needles” in Chinese, has seen the discovery of one species to replace another that has gone extinct, reflecting the current state of the ocean. The Taiwanese halfbeak was formally described by American ichthyologist Bruce Collette in 1986. Specimens are scattered across numerous museums abroad, with fish specimens collected in 1908, 1943, 1956, and 1969, from the Waziwei area of the Tamsui River, and the Shilin stretch of the Keelung River, right before it pours into the Tamsui, indicating that their numbers were once significant. However, despite several years of surveys by the Academia Sinica, no live individuals have been found, leading to the conclusion that they may have already gone extinct. The Taiwanese halfbeak disappeared from Earth before it was classified and confirmed as a new species by taxonomists.

In contrast to the disappearance of the Taiwanese halfbeak, an unidentified fish specimen at the Hamburg Natural History Museum, labelled as collected in 1907 from “Takao, Formosa” (Takao being the former name of Kaohsiung), has fostered collaboration between Taiwanese and German researchers. In 2023, the fish was rediscovered in Chiayi and named “Takao river garfish.”

https://www.endangered.org/campaigns/wild-success-endangered-species-act-at-40/peter-h-raven/

冰山一角

The Tip of the Iceberg

36

冰山多為純水結冰形成，冰的密度約為 917kg/ m^3，而海水的密度約為 1,025kg/ m^3，依照阿基米得定律我們可以知道，自由漂浮的冰山約有 90% 體積沉在海水表面下，因此看著浮在水面上形狀，並猜不出水下的形狀，這也是為何有「冰山一角」成語一說。

本展以密集塑帶作為人在海面下的換位視角，透過水下的視角，才能看到一隅冰山下的實際全貌。展品也視作提醒參觀者海冰正在融化的訊息。

Icebergs are primarily formed from pure water, with a density of approximately 917 kg/m^3, while seawater has a density of ~1025 kg/m^3. According to Archimedes’ principle, we can determine that ~90% of a freely floating iceberg is submerged beneath the water’s surface. What you see above the water does not predict what exists below. This is the origin of the idiom “the tip of the iceberg.”

This exhibition uses densely packed plastic cords to represent an underwater perspective, for only under water is the full extent of an iceberg visible. The exhibition also serves as a reminder to visitors about the melting of sea ice.

豆丁海馬蒙太奇

Pygmy Seahorse Montage

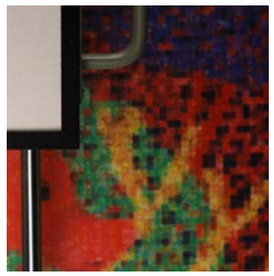
37

蒙太奇（Montage）源自法語組、裝配之意，也成為一種電影剪輯技巧，將一系列短暫、不同角度、不同地點拍攝畫面，創作構思組接在一起，產生出新意義與情感。電影「楚門的世界」海報便是蒙太奇的應用案例。

豆丁海馬全世界已知有 7 種，而臺灣海域被記錄便多達 5 種，豆丁海馬身形極迷你，尋找它簡直如真實版的大海撈針。而臺灣有如此傲人豆丁海馬密度，科學家有如此的發現，當然非靠一己之力，而是仰賴所有潛人水下記錄彙集，又一次公民科學家力量的展現。

Originating from a French word meaning “assembly,” montage is a film editing technique that combines a series of brief shots from different angles and locations to create new meanings and emotions. The poster for *The Truman Show* is a photomosaic, a sort of montage of the film.

There are seven known species of pygmy seahorses worldwide, with five recorded in Taiwanese waters. Pygmy seahorses are so tiny locating one is like looking for a needle in a haystack. We know of the high density of pygmy seahorses around Taiwan due to the efforts of the divers who documented them, once again showcasing the power of citizen science.



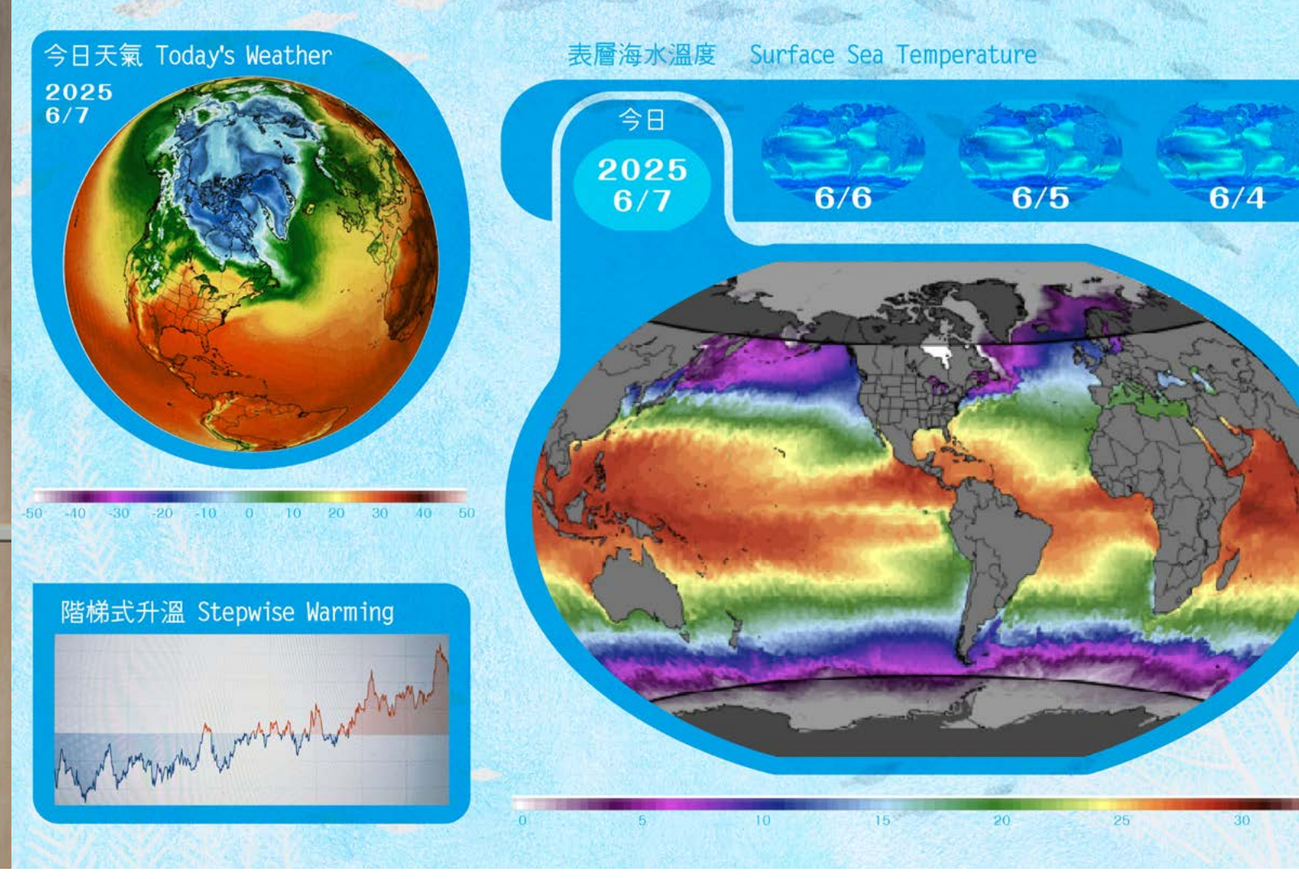
沒有等一下

No Time to Wait

38

「等一下」是我們常掛在嘴邊的口頭禪，但也真實反映出每個人心中優先順序，不是當務之急之事，那就等一下吧。本展品不論以倒數或累計鐘的概念以營造時間的急迫感，傳達地球與海洋的種種警訊，正以每秒驚人的數目持續發生著，進而喚起人們不要再有「等一下」的磋跎心態，因為地球已經沒有等一下了。

“It can wait” is a phrase we often use to signal our priorities. If it’s not urgent, then it can wait. This exhibit uses the concept of a countdown to create a sense of urgency. It also conveys the various warnings from land and sea, which are occurring at an astonishing rate, every second. It aims to awaken people out of an “It can wait” mentality, because the Earth no longer has time to wait.



鯨豚的內在外在

The Inner and Outer Worlds of Cetaceans

39

與人類同是哺乳類動物，鯨豚不是魚，而是生活在海洋的哺乳類動物。

臺灣海域鯨豚超過 30 種，佔全球種類的 1/3，小小臺灣海域有此佔比，何其驕傲、何其不易。鯨魚，幫助地球降溫？大型鯨魚在漫長的一生中，體內累積大量碳匯，當死去便沉入海底封存，平均可吸收 33 噸二氧化碳。當鯨魚到海面上換氣呼吸，隨著排便富含鐵、氮元素也成為海洋浮游植物完美的養分來源，而海洋浮游植物則貢獻地球至少 50% 的氧氣，並吸收全球 40% 的二氧化碳排放量。

不論海洋保育、鯨豚研究等，不非只限科學領域，科學研究成果普及與資訊共享，更能擴大大眾對海洋的觀注。展示鯨豚的外觀特徵以及骨骼結構，讓參觀者有了動物醫生的角色扮演感。

Like humans, cetaceans are mammals, not fish.

Taiwan’s waters are home to over 30 species of whales and dolphins, accounting for one-third of the world’s cetaceans. Such a high proportion is truly a source of pride. What? Whales help cool the Earth? Large whales accumulate a significant amount of carbon in their bodies over their long lives. When they die, they sink to the ocean floor, each sequestering an average of 33 tons of carbon dioxide. Still alive, when they surface to breathe and defecate after feeding, they release a lot of iron and nitrogen. These are the perfect nutrients for phytoplankton, which contribute at least 50% of Earth’s oxygen production and absorb 40% of global carbon dioxide emissions.

Whether it’s marine conservation or cetacean research, the results are not just for the scientific community. The dissemination of scientific research findings and information sharing can further expand public awareness of the ocean. The displays of the physical characteristics and skeletal structures of cetaceans allow visitors to feel like they’re playing the role of an animal doctor.

氣候預估

Climate Projections

40

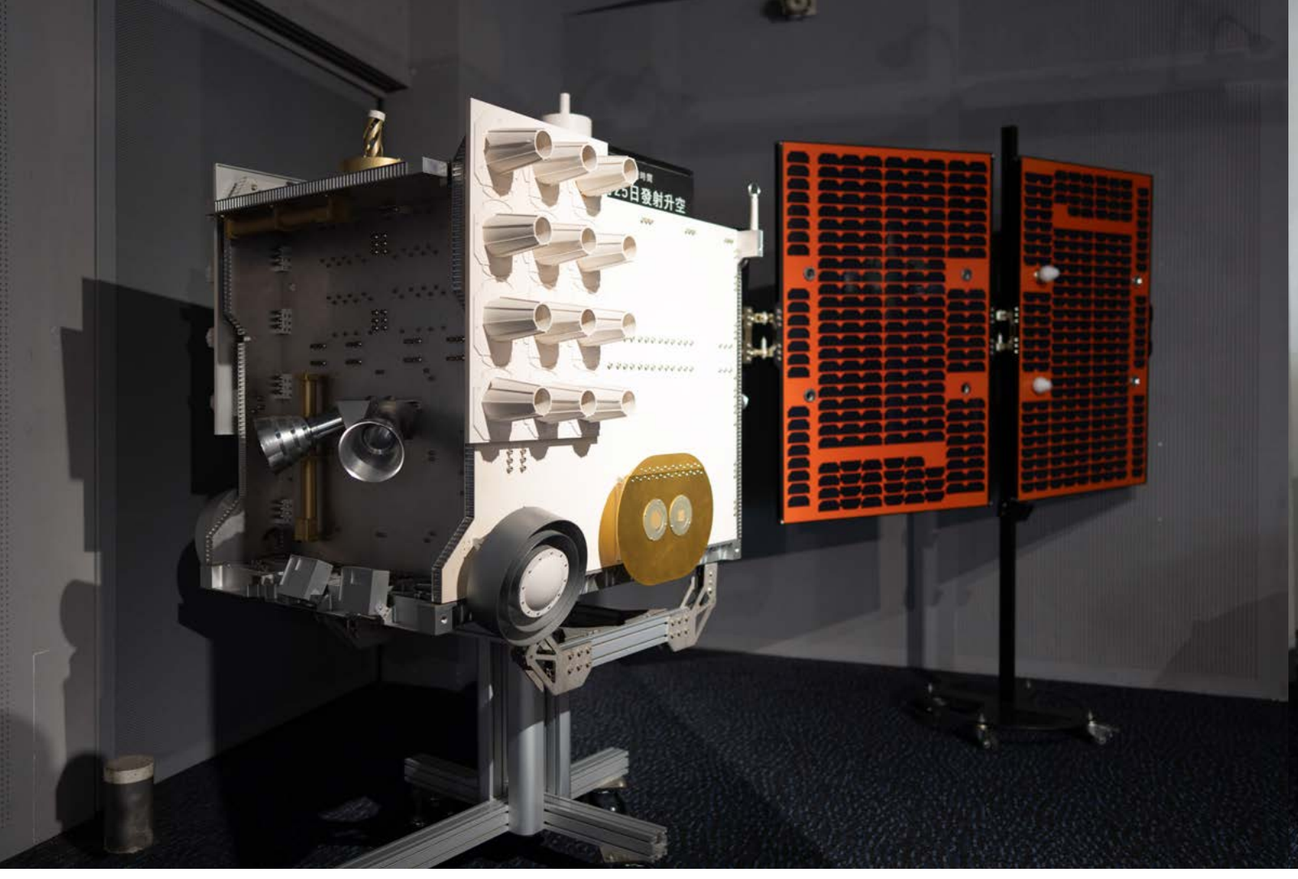
https://climatereanalyzer.org/
https://www.ipcc.ch/report/sixth-assessment-report-cycle/

海洋熱浪階梯式升溫！聯合國政府間氣候變化專門委員會 2023 年報告：極端天氣事件頻率與強度，將隨全球氣溫升高而顯著增加。要完全避免升溫 1.5° C 有其可能：全球需要在 2030 年前將溫室氣體排放量減少 50%，並在 2050 年達到 100% 淨零排放。

由美國國家科學基金會、緬因大學及氣候變遷研究所所支持開發的 Climate reanalyzer 讓氣候與天氣預報模式可視化，讓我們以全球的視角，來看待每日地球上各種可視化的氣候資訊，本展顯示每日海面溫度 SST 等資訊，讓人切身有感今天海面溫度的全球現況。

Ocean heatwaves are escalating! According to the 2023 report by the Intergovernmental Panel on Climate Change (IPCC), the frequency and intensity of extreme weather events will significantly increase as global temperatures rise. Avoiding a 1.5 ° C temperature rise is still possible: global greenhouse gas emissions must be reduced by 50% by 2030, to reach 100% Net-Zero emissions by 2050.

Developed with support from the National Science Foundation, the University of Maine, and the Climate Change Institute, the Climate Reanalyzer visualizes climate and weather forecast models, allowing us to view daily climate information from around the globe. This exhibition displays daily sea surface temperature (SST) data from the seven seas.



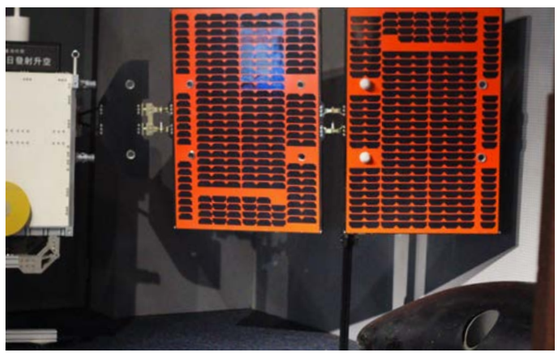
福爾摩沙衛星七號

https://www.tasa.org.tw/zh-TW/missions/detail/FORMOSAT-7

Formosat-7

41

臺灣自民國 1991 年開始推動太空計畫，第一顆人造衛星福爾摩沙一號，1999 年發射升空，揭開臺灣人造衛星序幕，如今福衛一號 2004 年退役；福衛二號也在 2016 年除役；福衛三號在 2020 年功能身退。第 4 枚福爾摩沙衛星五號（福衛五號）在 2017 年升空；福衛七號則在 2019 年升空。本展為 TASA 的福衛七號模型，福衛七號星系共有 6 枚衛星，由火箭發射到 720 公里高空，最終布署在 520-550 公里上空的氣象衛星。



Taiwan launched its space program in 1991. The first satellite, Formosat-1, was launched in 1999, and retired in 2004, followed by Formosat-2 in 2016 and Formosat-3 in 2020. Formosat-5 was launched in 2017, and Formosat-7 in 2019. This exhibition features Formosat-7, a constellation of six satellites, rocket-launched to an altitude of 720 kilometers and ultimately deployed for meteorological monitoring at an altitude of 520-550 kilometers.

提供單位：TASA 國家太空中心 Taiwan Space Agency

Organization Name: TASA 國家太空中心 Taiwan Space Agency

水下無人載具

Unmanned Underwater Vehicles

42

為了探索深海洋，水下無人載具彌補了人的有限，不需人在載具內駕駛或操控機器，大大減少了風險成本，藉由電纜、無線電波或聲波直接遙控水下載具或電腦軟體硬體自主操控。比起時下成熟且熱門無人機，水下無人載具需要克服的障礙更困難且複雜，在深海水壓、能見度、通訊、海流、地形等考驗下，都讓任務所取得的資料倍顯難能可貴。本展早期水下無人載具，早有仿生概念，彷彿是條鯨鯊的流線形。

To explore the deep ocean, underwater drones compensate for human limitations by eliminating the need for human drivers or operators, significantly reducing risk and costs. Such drones can be remotely controlled via cables, radio waves, or sonar, or allowed to operate autonomously. Compared to aerial drones, which are backed by a now-mature technology, underwater drones face far more challenging and complex obstacles. Under the harsh conditions of deep-sea water pressure, low visibility, communication challenges, ocean currents, and complex terrain, the data obtained from drones is all the more valuable. This exhibition features an early underwater drone with biomimetic design, resembling the streamlined shape of a whale shark.

提供單位：國立海洋科技博物館

Organization Name:National Museum of Marine Science and Technology

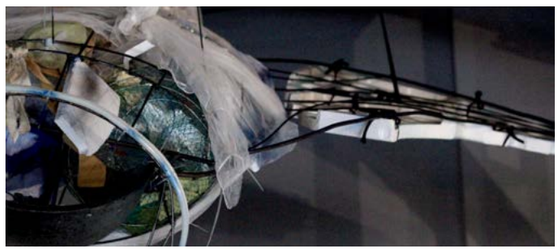
海廢魟

Marine Debris Manta Rays

43

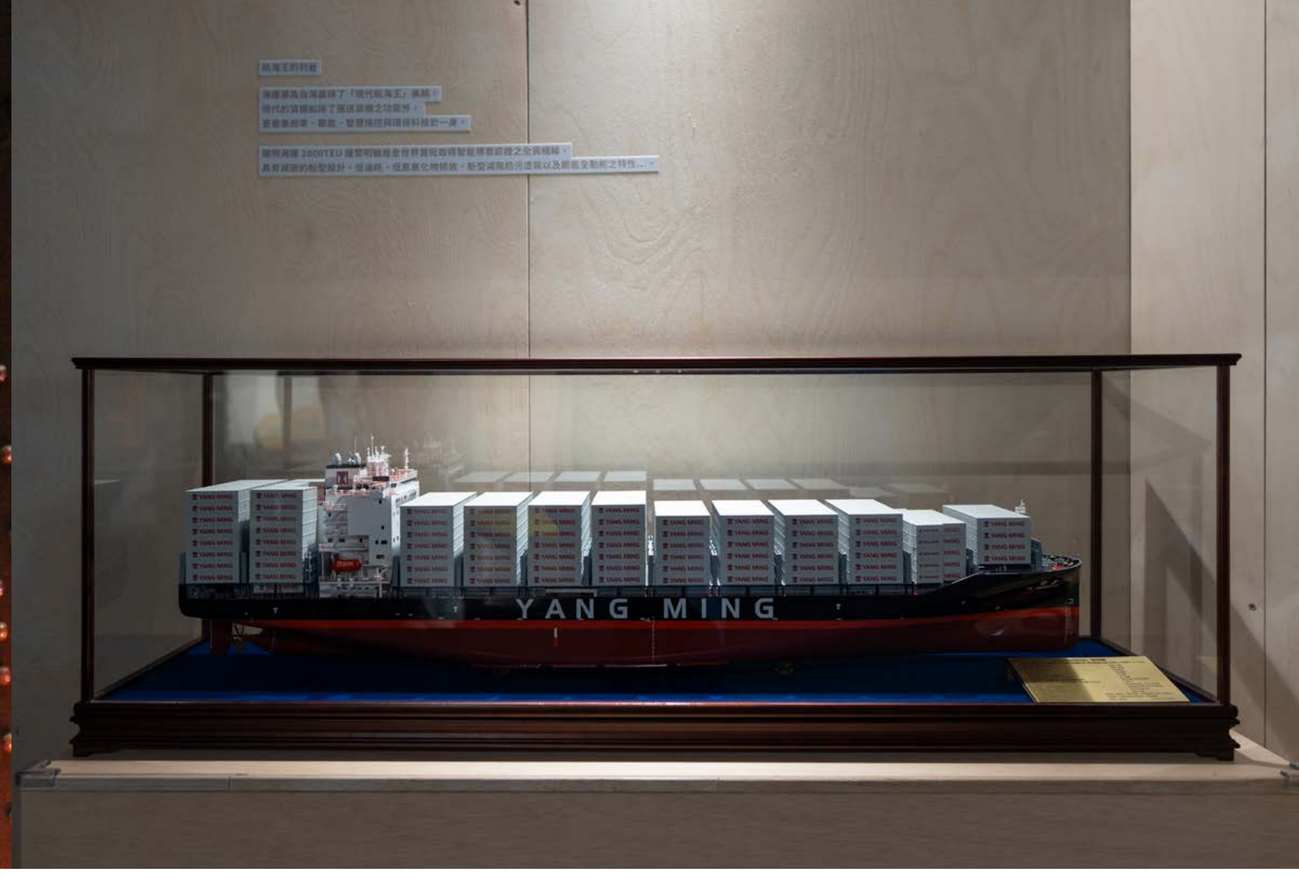
鬼蝠魟許多潛水人夢寐以求希望相遇的明星海洋生物，魟魚在動畫電影裡更成了海洋世界裡接送小朋友上下學的校車巴士。

所謂的鬼蝠魟共有兩種，屬前口蝠鱝屬包括「雙吻前口蝠鱝」（Manta birostris）及「阿氏前口蝠鱝」（Manta alfredi），漁民稱牠飛魴仔。鬼蝠魟常雌雄偕行、卵胎生、10 年才達性成熟，一次一胎，世界自然保育聯盟（IUCN）將兩種蝠魟列為易危（Vulnerable，VU）物種，惟 IUCN 的保育等級並無實質上之法律效力。



Manta rays are stars of the deep that many divers dream of encountering. In animated films, manta rays have even become marine school buses.

There are two species of manta rays, both belonging to family Myliobatidae: the giant manta ray (Manta birostris) and the dwarf manta ray (Manta alfredi). Fishermen refer to them as “flying John Dorys.” Manta rays travel in pairs, with females reaching sexual maturity at 10 years old. They’re ovoviviparous, meaning that the egg hatches inside the mother, who gives birth to a single pup. The International Union for Conservation of Nature (IUCN) has listed both species as Vulnerable (VU), but the IUCN conservation status is not legally enforceable.



智能減碳船

Smart Ships

44

海運為臺灣贏得「航海王」的美稱，從大航海時代一路航向現代。古老的順風、順水、順流航海秘訣從未改變，而現代貨櫃船整合效率、節能、智慧與環保科技於一身。

陽明海運 2,800 TEU 級「聚明輪」為全球首批取得智能標章認證的全貨櫃輪，包括低碳船型設計、節能油耗、降低氮氧化物排放、全動舵節能系統等，甚至船身塗層都是新型減阻防污塗料，樣樣都是當代綠色科技的結晶。航海王的利器正隨著時代日新月異，考慮更多對海洋友善的細節。

Maritime transport has earned Taiwan the nickname “King of the Seas,” from the Age of Exploration to the modern era. The ancient secrets of sailing with the wind, water, and currents have never changed, while modern container ships integrate efficiency, energy conservation, intelligence, and green technologies.

Yang Ming Marine Transport’s 2,800 TEU-class “YM Credential” is one of the world’s first fully containerized ships to obtain the Smart Mark certification, featuring low-carbon ship design, energy-efficient fuel consumption, reduced nitrogen oxide emissions, and a full-motion rudder energy-saving system. Even the ship’s hull coating uses new low-drag anti-fouling paint, all of which showcase contemporary green technology. The King of the Seas is evolving with the times, incorporating more ocean-friendly details.

提供單位：陽明海運股份有限公司
Organization Name:YangMing Marine Transport Corp.

殼

Shells

45

臺灣海域可見 5 種海龜，包括綠蠵龜 (Chelonia mydas)、赤蠵龜 (Caretta caretta)、玳瑁 (Eretmochelys imbricata)、欖蠵龜 (Lepidochelys olivacea) 及革龜 (Dermochelys coriacea)，雖然過去也有赤蠵龜上岸產卵記錄，但如今只有綠蠵龜還會上岸產卵。

然而海龜性別卻是溫度所決定，氣候變遷帶來暖化，直接衝擊海龜族群性別均衡，溫度一升高，雌龜比例大增，太多雌龜、太少雄龜，將讓海龜世代傳續亮起紅燈。

海龜的性別仰賴環境「溫度決定系統」，關鍵溫度約為 29°C，低於攝氏 27.7°C會孵出雄海龜，高於 31°C則會孵出雌海龜。愈接近「關鍵溫度」孵出雌雄比例越相等。

Five species of sea turtle can be found in Taiwanese waters, including the green sea turtle (Chelonia mydas), loggerhead sea turtle (Caretta caretta), hawksbill sea turtle (Eretmochelys imbricata), olive ridley sea turtle (*Lepidochelys* olivacea), and leatherback sea turtle (Dermochelys coriacea). While there have been records of loggerheads coming ashore to lay eggs in the past, only green sea turtles still do so today.

The sex of sea turtles is temperature dependent. Climate change-induced warming directly impacts the sex balance of sea turtle populations. As temperatures rise, the proportion of female turtles increases significantly. An excess of female turtles and a shortage of male turtles threaten the future of sea turtle populations.

Sea turtle gender depends on the environmental “thermostat,” with a critical temperature of approximately 29 ° C. Temperatures below 27.7 ° C result in mostly male hatchlings, while temperatures above 31 ° C result in mostly female hatchlings. The closer the temperature is to the critical temperature, the more balanced the ratio will be.

提供單位：國立海洋科技博物館
Organization Name:National Museum of Marine Science and Technology

https://www.facebook.com/photo.php?fbid=3494519743946117&id=2318252258239544&set=a.2324050000993103

靠海吃海，生計漁業

Living off the Sea: Subsistence Fishing

46

倚靠海洋的無垠廣闊與海水的浮力，海洋生物的噸位，比陸地動物大上許多，藍鯨可重達 190 噸，世界最大漁船超過 17,000 噸，工業捕魚、工廠級捕鯨船以及足以摧毀生態系平衡的破壞性漁業（底拖網、流刺網）是漁業資源枯竭主因之一。

海洋的未來正在阻止過漁及彌補造成的惡果。聯合國海洋大會以 2022 年為國際手工漁業跟水產養殖年；聯合國農糧組織也宣告，使用更少的能源資源、較小的漁船、更短的捕撈作業時間、離岸更近，也離周遭的漁獲消費社群更近，將是海洋的未來方向。

發起臺灣海鮮選擇指南的邵廣昭教授，鼓吹「留影不留魚」觀念外，也提出「魚沒有更年期」，打破「抓大放小」舊有觀念，讓保育觀更有未來感。

Taking advantage of the vastness of the ocean and the buoyancy of seawater, marine organisms are much larger in tonnage than land animals. Blue whales can weigh up to 190 tons, and the world’s largest fishing vessels exceed 17,000 tons. Industrial fishing, factory-scale whaling ships, and destructive fishing practices (bottom trawling, drift nets) that disrupt ecological balance are major causes of fish resource depletion.

The future of the ocean lies in preventing overfishing and addressing its consequences. The United Nations Ocean Conference designated 2022 as the International Year of Artisanal Fisheries and Aquaculture; the United Nations Food and Agriculture Organization has outlined related approaches to marine conservation: using less energy, making short fishing trips, close to shore, and mainly for local consumption.

Professor Shao Kuang-Tsao has been trying to modernize marine conservation in Taiwan. He initiated the Taiwan Seafood Choice Guide, advocated “taking a photo, not a fish,” and challenged the outdated notion that “catching the big and releasing the small” is adequate for fish conservation. After all, fish don’t experience menopause and can bear young into old age.

https://fishdb.sinica.edu.tw/eng/seafoodguide.php

OHI 海洋健康指標

Ocean Health Index (OHI)

https://oceanhealthindex.org/

47

您知道海洋也有健康檢查報告嗎 ?! 查詢看看我國 2012~2024 年 OHI 指標分數，即代表海洋調適與韌性狀態，如同人類經過 COVID19 疫情，是否仍具備免疫能力呢 ?!

海洋健康指數是一個海洋健康評估系統，針對全球 220 個專屬經濟海域所提供的生態系統服務進行評分。相較於其它有關於海洋健康的評估系統，多以生態為切入，OHI 不僅關注海洋生態健康，更納入經濟和社會效益，強調海洋與人類福祉結合的可持續發展性。

OHI 共有 10 項指標，臺灣 2024 年 OHI 得分為 69 分，與全球得分相同。

Did you know that the ocean also gets a check-up? Check the OHI scores for Taiwan from 2012 to 2024, which represent the ocean’s adaptation and resilience status. Just like humans after the COVID-19 pandemic, does the ocean still have immunity?

The OHI is an ocean health assessment system that scores the ecosystem services provided by 220 exclusive economic zones worldwide. Unlike other marine health assessment systems that primarily focus on ecology, the OHI not only addresses marine ecological health but also incorporates economic and social benefits, emphasizing that human well-being depends on the sustainable development of marine ecosystems.

The OHI comprises 10 indicators. Taiwan’s 2024 OHI score is 69 points, matching the global average.

微型資料浮標

Micro Data Buoys

https://www.namr.gov.tw/ch/home.jsp?id=36&parentpath=0,6&mcustomize=news_view.jsp&dataserno=202109010001

48

2021 年，由國立中央大學自主研發微型「海洋資料浮標」，正式在北極展開冒險探測之旅，這也是我國首次在北極，運用科學研究調查快速融冰現象。這項計畫由國家海洋研究院與國立中央大學地球科學院、波蘭哥白尼大學三方進行北極海洋科學國際合作研究，所蒐集到的海面微型浮標即時觀測資料，將應用於研究北極洋流、海表溫及波浪對北極融冰影響等海洋重要議題研究。

計畫地位於格陵蘭海北側佛拉姆海峽 (Fram Strait)，以田字形方式投放 8 顆海面微型浮球，將隨著西斯匹次卑爾根流 (West Spitsbergen Current)，為北大西洋暖流分支) 往北漂流進入北冰洋。

In 2021, National Central University developed a miniature “marine data buoy,” which officially embarked on an exploratory mission in the Arctic. This marks Taiwan’s first scientific investigation of rapid ice melting. This project is an international research collaboration between the National Academy of Marine Research, the Department of Earth Sciences at National Central University, and Nicolaus Copernicus University in Poland. The real-time observational data collected from the buoy will be applied to critical marine issues such as Arctic Ocean currents, sea surface temperature, and the impact of waves on Arctic ice melt.

The project is located in the Fram Strait north of the Greenland Sea, where eight buoys will be deployed in a grid pattern. These buoys will drift northward along the West Spitsbergen Current (a branch of the North Atlantic Warm Current) into the Arctic Ocean.

提供單位：中央大學
Organization Name:National Central University

聖嬰與反聖嬰

El Niño and La Niña (Anti-El Niño)

49

南美洲秘魯西岸的東太平洋，每隔幾年的聖誕節前後，總出現海水異常升溫當地居民聯想到了耶穌誕生，稱它 El Niño（基督之子）。
氣象學家研究後對這種每隔 2-7 年，赤道東太平洋海水異常增溫現象，通稱為「聖嬰」現象，它又與大氣中的南方振盪 (Southern Oscillation) 有高度相似性，印證聖嬰同時在海洋、大氣連動，它有個更完整全名 El Niño Southern Oscillation，簡稱 ENSO。

而當地海水會異常升溫，有時也會異常變冷，科學家便給她取名 La Niña（西班牙文「女孩」之意），便是我們習稱的「反聖嬰」現象。聖嬰並非兩極正反，更像男嬰、女嬰角色。

Every few years around Christmas, the eastern Pacific off the west coast of Peru, experiences abnormal warming. Local residents associated it with the birth of Jesus and called it El Niño, the Christ Child.
After studying this phenomenon, meteorologists adopted “El Niño” to describe abnormally warm sea surface temperatures in the eastern equatorial Pacific Ocean, which occur every 2 to 7 years. This phenomenon is highly similar to the Southern Oscillation in the atmosphere, confirming that El Niño is a complex phenomenon of sea and air. It has a more complete name, El Niño Southern Oscillation (ENSO).

Sea temperatures can also be abnormally low, a circumstance that scientists refer to as La Niña (Spanish for “the girl”) or the “anti-El Niño” phenomenon. But they’re not two extremes, just different in personality, like baby boys and girls

氣候遷徙

Climate Migration

https://www.theguardian.com/science/2023/jul/27/scientists-july-world-hottest-month-record-climate-temperatures

50

由於氣候變遷改變了環境，讓原本宜居的居住地或棲地條件不再，人們或動物被迫遷徙，尋找新的安身立命地。世界銀行也預測，2050 年，氣候變遷將牽動全球 2.16 億人在國境內遷徙，2030 年遷徙潮便會出現。

從全球暖化、沸騰 (global boiling)、極端氣候到氣候變遷，不斷有許多新名詞被提出，如氣候鞭笞、氣候遷徙…等皆因氣候變遷而生。氣候遷徙因造成許多因環境改變而產的環境難民，氣候遷徙不只牽動人的遷徙，也造成生態系改變牽動的動物牽徙。

As climate change alters the environment, making previously habitable places uninhabitable, people and animals are forced to migrate in search of new places to settle. The World Bank predicts that by 2050, climate change will drive 216 million people to migrate within their own countries, with a migration wave expected to emerge by 2030.

Numerous neologisms have appeared due to climate change, such as global warming, global boiling, extreme weather, climate whiplash, climate migration, and environmental refugees. Climate migration involves animals that are forced to move due to ecological alteration, too.

垂釣公民科學家

https://iocean.oca.gov.tw/oca_oceanconservation/public/Marine_Fishing_v2.aspx

Fishing Citizen Scientists

51

臺灣海釣人口約 80 萬人，釣客也可以是公民科學家，讓垂釣可以更友善海洋，不但自主負起安全，也兼顧環境維護與資源永續任務。垂釣公民科學家竿前那一條釣線，宛如伸入海中的調查線索，而每一次揚竿，都是統計資料庫的數據累積。

海洋委員會海洋保育署 2018 年建立 iOcean 海洋保育網，以及公民科學家垂釣回報平臺，並逐步精進至 2021 年建立 AI 魚種辨識功能，近年垂釣回報資料累積已相當可觀，全臺垂釣活動最常見魚種也在本展示露出！

There are approximately 800,000 fisherfolk in Taiwan, and they can also be citizen scientists, helping to make fishing more ocean-friendly. They not only take responsibility for their own safety but also consider environmental protection and resource sustainability. The angler’s fishing line is like a probe that is cast into the sea; and each time the rod is raised, it adds data to the base.

The Ocean Conservation Administration established the iOcean Marine Conservation Network and the Citizen Scientist Fishing Reporting Platform in 2018. Since 2021 functionality has been enhanced with AI fish species identification. Since then, a substantial number of observations have been recorded. The most common species that have been recorded by fisherfolk citizen scientists are also featured in this exhibition!

極地建築

https://www.bas.ac.uk/polar-operations/sites-and-facilities/facility/halley/

Polar Architecture

52

哈雷研究站（Halley Research Station），是英國設立的南極科學考察站，位於布倫特冰架上，第一代在 1956 年建成，臭氧破洞便是 1985 年在哈雷研究站首次發現。

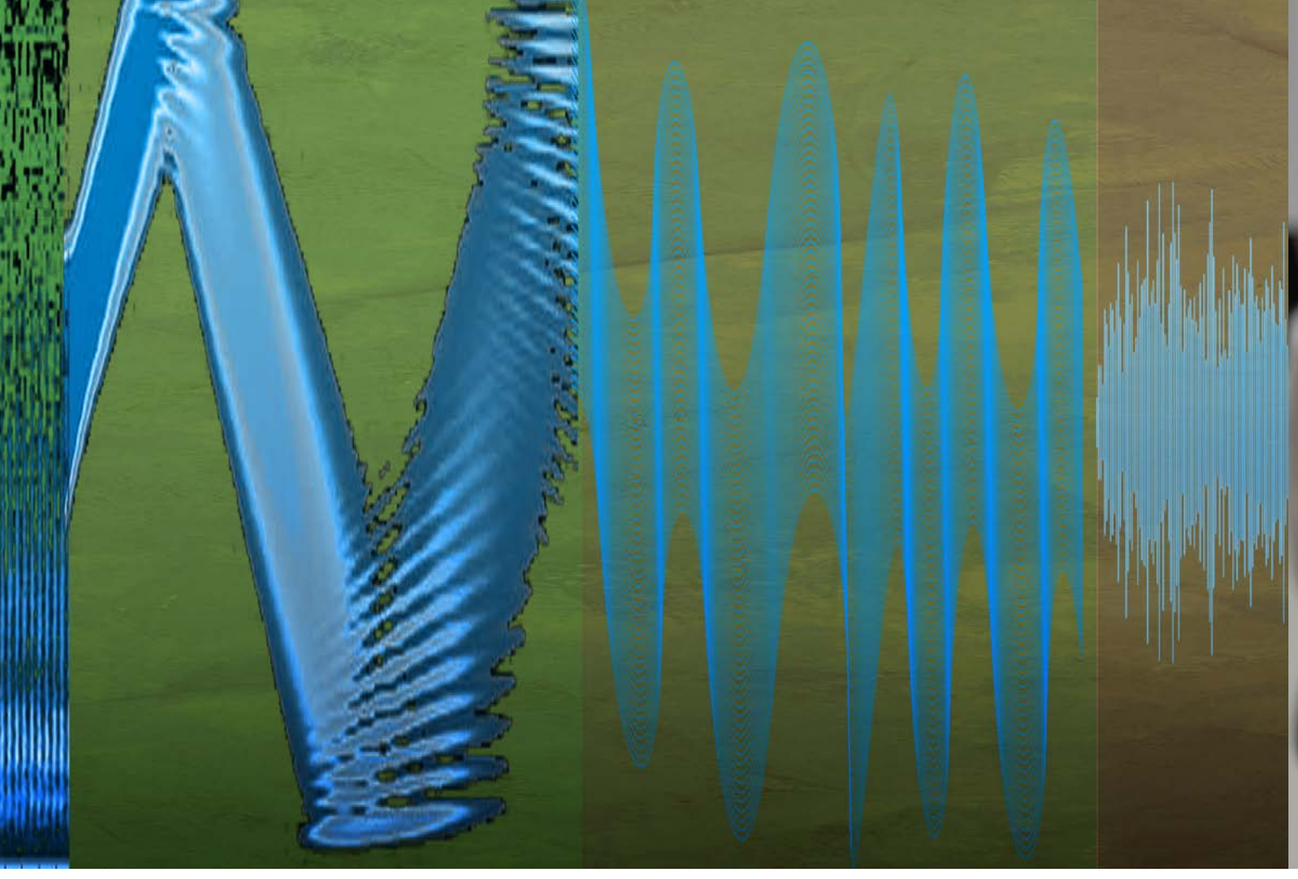
哈雷六號從 2012 年起開始啟用，由 8 個模塊化建築組成，各模塊配備液壓腿和雪橇，以便用拖車隊拉著搬遷，以避開不斷擴大的冰架裂縫，這座屢獲殊榮的創新研究站，為科學家提供最先進的實驗室和宿舍，南極是世界最寒冷、風最大、最乾燥的地方，但也不能阻擋設計師將現代建築美學帶到這裡。

當時的探險隊負責人威廉・布魯斯（William Speirs Bruce）以愛丁堡氣象學家 Robert Traill Omond 名字為這座建築命名，稱它為 Omond House。

The Halley Research Station is located on the Brent Ice Shelf, Antarctica. It was first built by the British in 1956, and the ozone hole was first discovered there in 1985.

The station is now in its sixth iteration. The award-winning Halley VI has been operational since 2012. It consists of eight pods, each equipped with hydraulic legs and skies to enable relocation by special vehicles to avoid a widening crack in the ice shelf. Inside, it provides scientists with state-of-the-art laboratories and accommodations. Antarctica is the coldest, windiest, and driest place on Earth, yet this has not deterred designers from bringing modern architectural aesthetics.

The expedition leader, William Speirs Bruce, named the main building after Edinburgh meteorologist Robert Traill Omond, calling it Omond House.



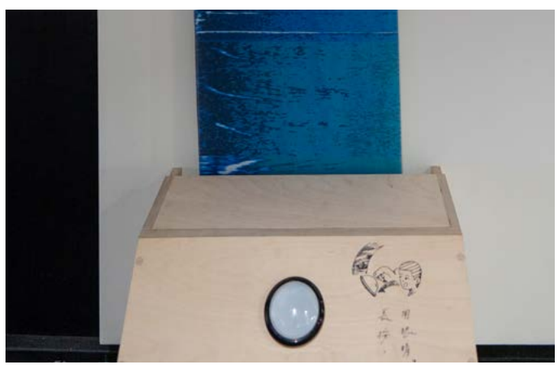
聽覺海聲道

Auditory Sound Channel

53

聲音是聽覺感受，但如果將聲音用看的，將聲波視覺化，是否帶來另種感官的體驗，聽覺海聲道仿如一部聲波的印表機，將 Bloop 海洋怪聲、海洋環境中水下聲學、海洋哺乳類、棕色噪音、以聲音傳導為海洋量體溫、鯨魚叫聲、海浪聲波…，任何有關海的聲音，在眼下都有不同風景。

Sound is auditory, but what if it could be seen? What if sound waves were visualized? Would this create a different sensory experience? The Auditory Sea Channel is like a sound wave printer, visualizing Bloop’s roar, underwater acoustics in marine environments, marine mammals, brown noise, sound-based ocean temperature measurement, whale calls, and sound “waves.” A variety of marine sounds appear like landscapes before your eyes.



海洋記憶庫，漁業新聞 167

https://www.cwa.gov.tw/V8/C/L/Fishery_index.html

Ocean Memory Bank, 167 Fisheries Weather Report

54

臺灣雖為海島國家、海洋國家，但因過去歷史緣故，作家廖鴻基感慨說，我們是集體背對海洋的國家，對陸地思維的我們來說，海洋總是陌生、令人生畏，直到政府推動「向海致敬」海洋開放政策，彷彿國人對海洋的啟蒙運動。

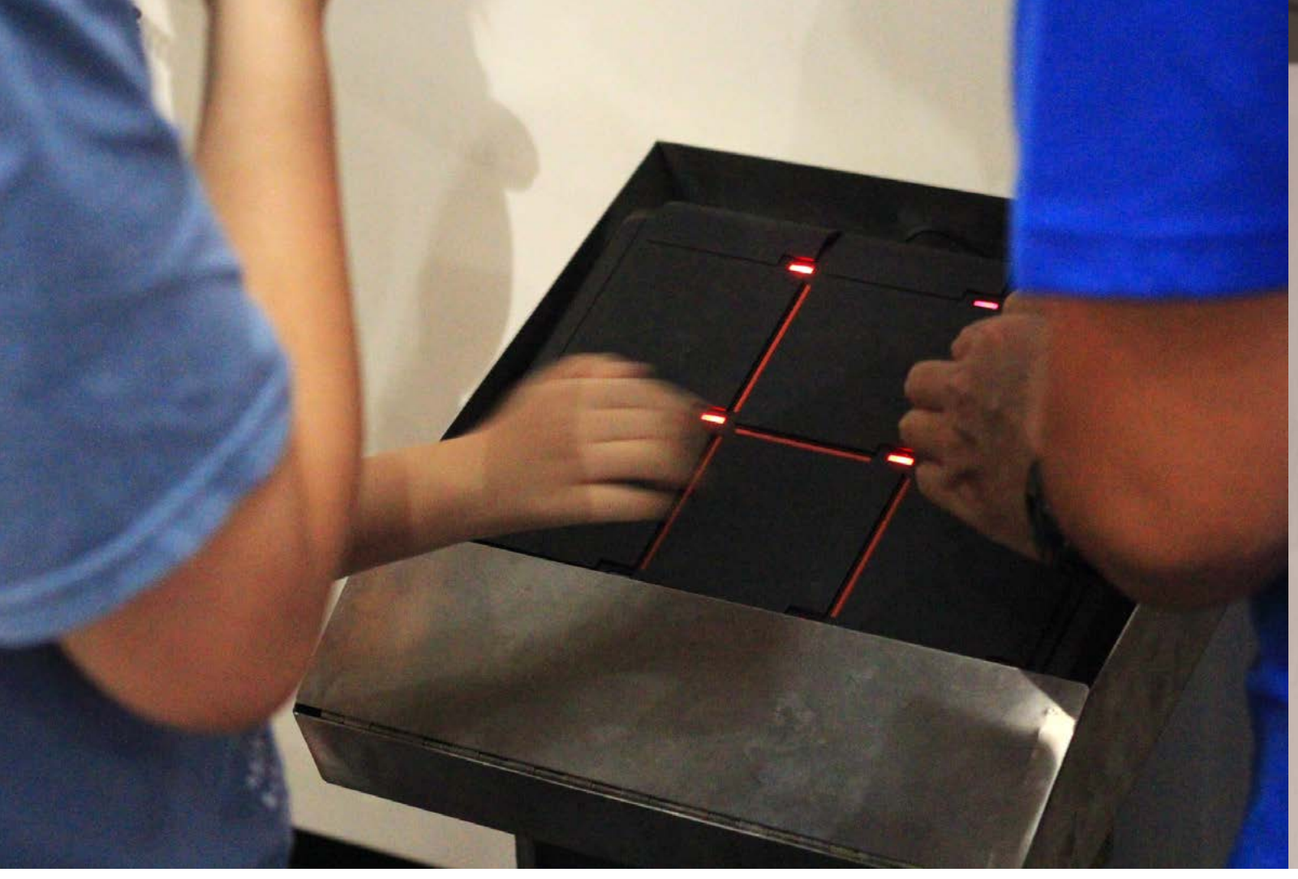
海洋的神秘，過去有個管道可以稍填補國人對海洋的好奇，那便是漁業氣象播報，平易流利的臺語，幽遠地訴說著聽眾所不解的海面、海域，更想像大湧是何等驚濤駭浪，大湧之上還有猛湧…。

本展以經驗播音員，重錄漁業氣象播報，重溫人聲的溫暖，並深覺是臺語教材，也是近海海象的第一線描述。

Although Taiwan is an island state, and a maritime nation, for historical reasons, lamented writer Liao Hung-Chi, we are a nation that has collectively turned its back on the ocean. For those of us with a land-based mindset, the ocean has always been strange and stern. It wasn’t until the government promoted the marine openness policy that we started paying homage to the sea. It seemed almost like enlightenment.

The mystery of the ocean was once partially addressed through fishery weather reports, delivered in colloquial Taiwanese, which described the distant sea conditions to listeners, evoking images of towering waves and even more formidable surges...

This exhibition features rerecorded fishery weather reports by an experienced broadcaster. With the warmth of the human voice, the reports serve both as Taiwanese language learning materials and firsthand accounts of near-shore sea conditions.



座頭鯨之歌

https://archive.org/details/songsofhumpbackw00payn/01_Side_1.mp3

The Song of the Humpback Whale

55

《傾聽地球之聲》作者大衛・喬治・哈思克筆下的鯨魚歌聲令人神往，抹香鯨用連串喀嗒聲彼此溝通，有時像咿呀響的舊鏈條，也像節拍器嗒嗒響，一整群聚在一起時，又像幾十隻發狂啄木鳥又敲又啄；小鬚鯨叫聲柔軟有彈性，自帶回音，時而顫動，時而重擊，時而彈撥，有如打擊樂；北大西洋露脊鯨悶哼聲，也會發出像大口徑來福槍般的「槍聲」；灰鯨震顫的牢騷，像鬱悶的公牛或發狠咆哮的貓咪…座頭鯨節奏、頻率、韻律和音色，與人類的語言和音樂有足夠的共通點，牠們的叫聲能引發移情作用。鯨聲音檔內建於打擊板上，打擊敲響自己的鯨之歌。

David George Haskell’s evocations of whale songs in Sounds Wild and Broken are enchanting. “Sperm whales use streams and clusters of clicks both to communicate with one another and to explore their world through echolocation. They creak like old door hinges, clack like metronomes, and, when gathered in groups, hammer and peck like dozens of frenzied woodpeckers. …. Minke whales boing, pulse, thump, and twang, their calls rubbery and percussive. …. The North Atlantic right whales’ groans sound … [like] ‘gunshot,’ like a large-caliber rifle. The gray whales’ wavering complaints are croaks and bellows like those of distressed bulls or fierce growling cats…. The tempo, frequencies, cadences, and timbres of the humpback whales’ sounds overlap enough with those of human speech and music that their sounds evoke empathy.”
In this exhibition, a digital percussion board plays their songs.

瓶中信

Message in a Bottle

56

面對無垠的大海，你會向它傾吐什麼心事？面對不可測的大海，你會請它代捎什麼信息？給一個不可預期、不特定的收信人，將一紙信封入玻璃瓶中，投入大海，接下來便是充滿想像的期待…。這是最早最原始的人與海的互動。

最早瓶中信歷史約在西元前 300 年，是古希臘哲學家泰奧弗拉斯托斯（Theophrastus）實驗地中海跟大西洋是否相連，後來瓶中信應用廣泛，實驗、訊息傳遞、求救、立據、祈福等有多種功能與寓意。

What secrets would you confide in the boundless, unpredictable ocean? What message would you ask it to deliver? Place a letter for an unknown recipient in a glass bottle and toss it into the sea—what follows is a world of anticipation…. This is the earliest and most primitive form of human interaction with the sea.

The earliest recorded message in a bottle dates back to around 300 BCE, when the ancient Greek philosopher Theophrastus conducted an experiment to determine whether the Mediterranean Sea and the Atlantic Ocean were connected. Later, messages in bottles were widely used for various purposes, not just experimentation but also corroboration as well as message transmission, sending distress signals and offering blessings.

冰山墳場

Iceberg Graveyard

https://www.bbc.com/zhongwen/trad/science-68777025
https://usicecenter.gov/Products/AntarcIcebergs

57

全球最大的冰山 A23a，現今 2025 年 6 月測得面積約 2,800 平方公里，超過北北基 3 縣市大小，1986 年已脫離南極海岸線，30 多年像一座靜止的「冰島」困在海底泥沼。直到 2020 年，因氣候變遷冰山逐漸融化，重新浮起開始移動漂流旅行 (平均厚度超過 280 公尺)，受到風、洋流與漩渦的相互作用，決定漂流路線向北帶往溫暖的水域，最終都會經過南大西洋位處洋流路徑上的南喬治亞島，也是許多冰山的葬身之地。

The world’s largest iceberg, A23a, currently measures approximately 2,800 square kilometers, larger than the Taipei-Keelung metropolitan area. It calved from the Antarctic coastline in 1986 and was trapped in the seabed mud for over 30 years, like an “ice island.” In 2020, due to climate change, the iceberg had melted enough to start drifting again, with an average thickness of more than 280 meters! Influenced by wind, ocean currents, and eddies, it drifted north toward warmer waters. Ultimately, it will pass through the South Atlantic, following currents to its final resting place, an iceberg graveyard near South Georgia Island.

碳的終結者

The Carbon Terminator

58

在海洋未來式特展動線的終點，企圖誘發參觀一些行動的想像力，假如我是一個碳的終結者，我要如何養成、訓練自己成為一個效率、精準、具行動力與判斷力的戰士，本站可以自由選擇 5 個方案，得出終結者的戰鬥能力指標。49 個方案、5 個選擇，可以得出非常多樣的結果，帶來遊戲感與使命感及樂趣。

The final stop of The Ocean Will… is intended is to get you thinking about taking action, by asking: If I were a Carbon Terminator, how would I train myself into a warrior, effective and decisive? At this stop, you choose your own Terminator with any five options out of forty-nine and see how powerful you are. That’s a lot of possibilities for fun and games, and a sense of mission.

許願樹

The Wishing Tree

59

面對未來許多不可期，人們都需要許願，在生日時許下願望、在聖誕前夕向聖誕老人許願、在一株許願樹上掛上寫著心願的小紙條、在無人的地方，只有你與自然獨處之時…

人們需要許願，許願可以讓人更確立目標、增加動力、表達情感，同時在心理上得到滿足與希望，甚至對願望的實現更具信心海洋未來式以海扇造型作為海洋的許願樹，珊瑚貼標可以寫上心願，如復育種珊瑚般的形式，許個心願，埋一顆行動的種子。

Confronting an uncertain future, people need to make wishes—on birthdays, to Santa Claus before Christmas, by hanging notes on a wishing tree, or in a secluded place where you are alone with nature...

People make wishes. Wishing helps clarify goals, boost motivation, express emotions, and provide psychological fulfillment and hope, even fostering greater confidence in the realization of the wish. The Ocean Will exhibition uses a branched sea fan shape as the ocean’s wishing tree, with coral tags where wishes can be written, where hopes can grow like a replanted coral sprout. So come make a wish and plant a seed of action!

海洋選歌 & 氣候選書

Ocean-themed songs & climate-themed books

60

不論是 Sailing 英國老歌
One ocean-themed song is the British golden oldie “Sailing,”
I am sailing, I am sailing, home again ‘cross the sea.
I am sailing, stormy waters, to be near you, to be free.

還是鄭華娟《漂泊的心停泊在基隆港》，陳建年《海洋》、電影《碧海藍天》配樂，海洋是靈感的寶藏庫，永遠取不盡、用不竭，因為海洋，所以啟迪了創作，因為海洋的深奧，我們知之甚微，所以選了有關海洋的書，開卷讓人更知海洋更近海洋，更懂海洋。

Others are by famous Taiwanese singers, “A Wandering Heart Anchors in Keelung Port” by Cheng Hua-juan or “Ocean” by Chen Jien-nien. The ocean is also an endless treasure trove of inspiration, never to be exhausted, in the soundtrack of the French movie *Le Grand Bleu*. The ocean not only inspires our minds with its breadth; it also humbles us with its depth. That’s why we have chosen a selection of books about the ocean, to help readers get to know it better.

氣候選書

海洋選歌

海洋 / 氣候 / 環境
播放清單（Suno）

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/ 新正常特展 /

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氣候選書

海洋選歌

海洋 / 氣候 / 環境 播放清單（Suno）

一起動手做～～

小提醒：可先用相機拍下此圖，邊看邊折

memo 把今天的心得 寫下來...畫出來...

1.娃娃臉

如果海洋也有情緒，面對人類應該會？

- 覺得沮喪
- 充滿希望
- 生氣忽怒
- 包容接納
- 拒絕往來

2.天氣＋時間＝氣候

你感覺到氣候變遷了嗎？因為？

- 有，因每年開冷氣時間一直提前
- 沒有，因為我還受得了
- 有，因為覺得冰涼的海水變暖了
- 有，覺得天氣變化多端
- 沒有，沒有影響

3.碳終結者

碳是溫室效應、地球發燒的主嫌，我要成為一名

- 專業補碳的賞金獵人
- 固碳科學家
- 海藻的養殖專家
- 減碳生活家

4.無塑未來式

塑膠真的無所不在，你有好幾個RE法寶，最常用哪些？

- REthink
- RECycle
- REpair
- REfuse
- REdesign
- REcover

5.玩具潮

數一下！你共有多少玩具？

- 10以下
- 10-30個
- 30個以上

再回想一下，它們的材質大多是？

- 塑膠類
- 紙類
- 木質類
- 金屬類

6.北極熊的冰箱

最深深吸引你的北極熊魅力是？

- 可愛
- 速度
- 狩獵技巧
- 感同身受面臨的處境

7.沒有等一下

過漁是我們捕撈超過了大海母親的再生能力，我可以？

- 不消費
- 聰明消費
- 投入修改法令
- 調整吃魚習慣
- 影響力，帶來改變

8.藍色碳匯

海洋藍色碳匯，我是個支持者

- 投一票給紅樹林
- 投一票給藻礁
- 投一票給海草床
- 投一票給巨藻

9.復育之心

不斷聽到珊瑚白化的壞消息，我想要

- 學習珊瑚復育
- 培育耐熱珊瑚、超級珊瑚
- 成為珊瑚園丁
- 阻止海水升溫

10.太平洋經向翻轉環流

黑潮是台灣最熟悉的洋流，你還認識哪一道洋流

- 親潮
- 赤道逆流
- 北大西洋暖流
- 挪威洋流
- 大西洋經向翻轉洋流

11.韌性海洋

韌性是面對衝擊的承受力，以及衝擊過後的回復能力

你覺得你對什麼最具韌性？

- 天氣變化
- 氣溫
- 缺水
- 飢餓

12.海聲道

海洋是活的，當然有聲音，你聽過的聲音有

- 海浪
- 海風
- 鯨豚
- 漁船引擎
- BLOOP

海洋 100 補完計劃

100 unisea re discovery project

引導性問題式內文＋電池儲能＋延伸閱讀的連結針對展區內 12 大重點進行補完
因為「海洋未來式，新正常特展」的出發點希望可以創造改變與作出氣候行動的動機補完了一個 氣候 / 環境 / 海洋人所需的動機
補完計劃的內文文稿、電池儲能電池 % 數與延伸閱讀