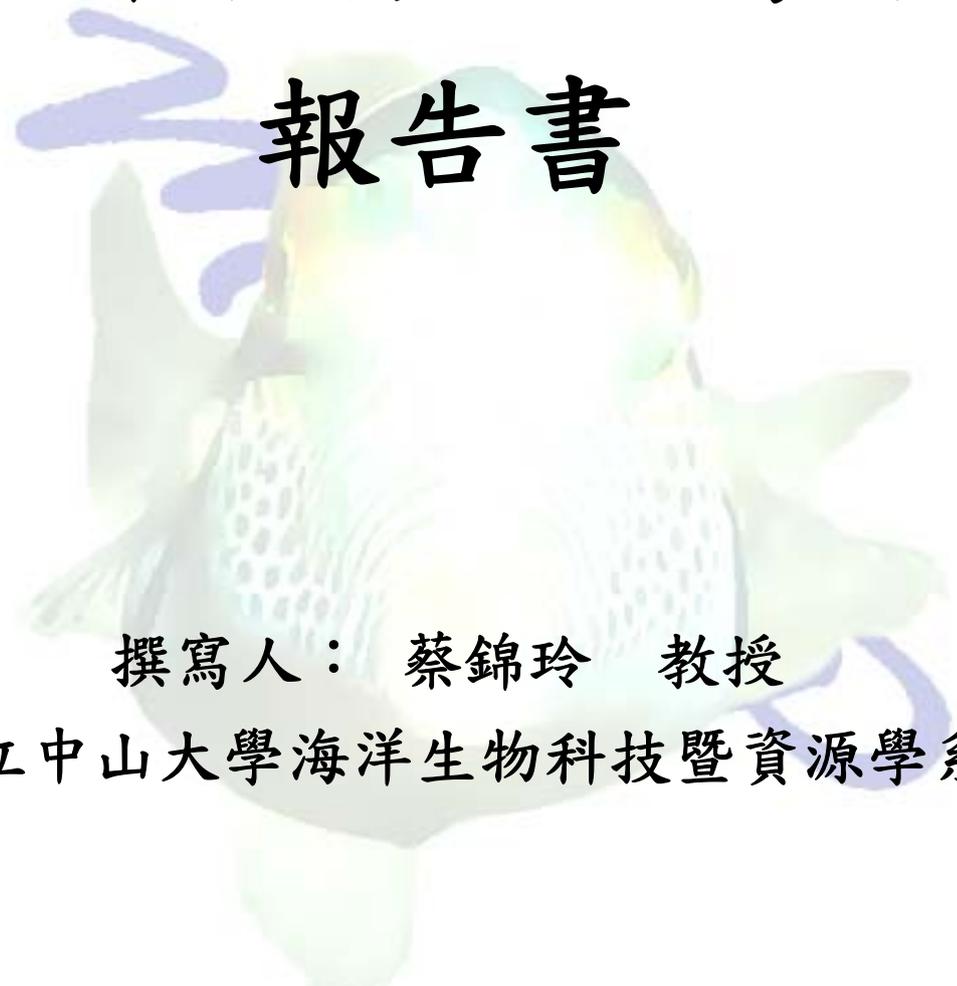


海洋教育出國考察 報告書



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國立中山大學海洋生物科技暨資源學系

教育部顧問室海洋教育先導型計畫辦公室

96年4月10日

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*未經教育部顧問室海洋教育先導型計畫辦公室之事先同意，任何人不得引註、使用或複製任何本報告書上所宣讀、發表、以及收錄於本報告書之資料。本報告書所有資料均受相關著作權法之保護。

壹、計畫緣起

2005 年 12 月依據教育部 杜部長指示，顧問室 黃副主任寬重召集、籌組海洋教育先導型計畫規劃團隊。2006 年 5 月教育部顧問室海洋教育先導型計畫中綱計畫規劃案正式建案，計畫主持人國立中山大學海洋生物科技暨資源學系蔡錦玲教授，規劃團隊成員國立台灣大學海洋研究所劉家瑄教授、國立成功大學黃煌輝副校長、國立台灣海洋大學李國添校長、中央研究院歷史語言研究所陳國棟研究員、中央研究院歐美研究所宋燕輝研究員，概涵海洋生物之生命科學及其相關科技產業、海洋系統基礎科學、海洋相關之工學及其相關科技產業、漁業資源及其相關產業、服務業、海洋文化、海洋法政事務，六大領域。海洋教育規劃團隊為完善規劃 97-100 年海洋教育先導型計畫，分別召開六場大型的討論會議(95 年 3 月 18 日“型塑擁抱變化的海洋教育”對話會議-與產業界、企業體、教育體系、社會教育體系，共三場次；95 年 7 月 27 日海洋教育全民教育對話會議、海洋教育專業教育對話會議、95 年 11 月 24 日 97-100 年海洋教育先導型計畫中綱計畫說明會)，展開與各級教育現場工作者及產業界對話會議，以瞭解現有狀況，廣納各界意見。

另，為瞭解國內、國外海洋教育相關發展資訊及相關資源分佈，在 97-100 年海洋教育先導型中程綱要計畫規劃案中，進

行海洋教育資訊蒐集並研析海洋教育相關資訊。為實地瞭解美國、日本在海洋教育發展的成功策略，做為我國發展海洋教育的參考，由海洋教育資訊團隊（國立自然科學工藝博物館趙世民、國立高雄大學生命科學系黃永森助理教授、國立中山大學海洋生物科技暨資源學系蔡錦玲教授）蒐集相關資訊研析後，擬定海洋教育國外考察行程，並經顧問室審議過後定案。考察結果作為 97-100 年海洋教育先導型計畫規劃之參考，並提供教育部全面推展海洋教育的參考。

貳、考察參訪單位

參訪日期	參訪單位	
02/01(星期四) 15:00	美國加州海岸委員會 California Coastal Commission (CCC) 45 Fremont Street, Suite 2000 San Francisco, CA 94105-2219 Tel: (415) 904-5200 Fax: (415) 904-5400	
02/02(星期五) 10:00	美國加州大學海洋理事會 University of California, Marine Council (UCMC) University of California, Office of the President Office of Research 1111 Franklin Street, 11th Street Oakland, CA 94607-5200	
02/02(星期五) 15:00	海洋尖端科技教育中心 Marine Advanced Technology Education Center (MATE) MATE Center Monterey Peninsula College 980 Fremont Street Monterey, CA 93940 Tel: (831) 645-1393 Fax: (831) 646-3080	
02/05 (星期一) 13:30 14:30	國立大學法人橫濱大學 橫濱市保土谷區常盤台 79-1	
02/06 (星期二) 10:00 12:00	獨立行政法人日本海洋研究開發機構 神奈川縣橫須賀市夏島町 2-15 本部事務局	
02/07 (星期三)	10:00 11:00	海洋政策研究財團 東京都港區虎之門 1-15-16 海洋船舶大樓 3 樓
	15:00 16:00	國立大學法人東京海洋大學 地址：東京都港區港南 4-5-7
	18:00	與文部省初等中等教育局視學官中谷三男（日本海洋教育史作者）等懇談餐會

02/08 (星期四) 13:30 15:30	筑波大學下田臨海實驗中心 静岡縣下田市五丁目 10-1
02/09 (星期五) 10:00 12:00	逗子開成中學・高校 神奈川縣逗子市新宿 2-5-1

參、考察參訪人員

參訪人員

國立中山大學海洋生物科技暨資源學系蔡錦玲教授、

國立台灣大學海洋研究所劉家瑄教授、

國立成功大學黃煌輝副校長、

國立台灣海洋大學李國添校長、

中央研究院歷史語言研究所陳國棟研究員、

中央研究院歐美研究所宋燕輝研究員。

肆、考察參訪報告

- 一、美國加州海岸委員會
(California Coastal Commission, CCC)
- 二、美國加州大學海洋理事會
(University of California Marine Council, UCMC)
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(Marine Advanced Technology Education Center, MATE)
- 四、國立大學法人橫濱大學-
海洋研究暨整合教育中心
(Center of Oceanic Studies and Integrated Education, COSIE)
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(Japan Agency for Marine-Earth Science Technology, JAMSTEC)
- 六、海洋政策研究財團
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- 七、國立大學法人東京海洋大學
(Tokyo University of Marine Science and Technology)
- 八、筑波大學下田臨海實驗中心
(Shimada Marine Research Center)
- 九、逗子開成中學・高校

一、美國加州海岸委員會 (California Coastal Commission, CCC)

地址： 45 Fremont Street, Suite 2000
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U.S.A.

接待人員： Ms. Vivian Matuk
Environmental Boating Program Coordinator
California Coastal Commission
TEL： 415-904-6905
FAX： 415-904-5216
E-MAIL： vmatuk@coastal.ca.gov

參訪日期： 2007年2月1日下午2:30

參訪影像紀錄：



參訪單位特色：

(一) 單位屬性

隸屬 California Department of Boating and Waterways 內的一個獨立單位。California Department of Boating and Waterways 是加州州政府負責加州 1100 哩海岸管理的機構。

(二) 經費來源

主要來自「California Whale License Plates Program」，由加州居民申請購買有鯨魚尾標誌的特殊車牌（以表示支持維護海洋環境）之所得。

(三) 目標任務

官方成立之獨立營運單位，做為州政府與民間連結的窗口，負責推展大眾教育（全民教育），增加民眾對海洋、海岸資源的瞭解與維護活動之參與。

(四) 目標推展策略

執行大眾教育計畫，Commission's Public Education program。主要策略：

1. 舉辦「淨灘」活動，由全民參與中，進行海洋教育，號召私人企業贊助全民清理海灘，另由「淨灘」活動之垃圾進行相關研究分析。
2. 實際執行海洋教育工作，設計一系列適用於幼稚園至 K-12 各級教育之海洋、海岸教學活動，並將相關科學知識印製成手冊，提供幼稚園至 K-12 各級學校教學使用，並舉辦教師研習營，教導種子教師使用這些教材。
3. 海洋教育資源之提供，設立資源網站 www.coastforyou.org，免費提供使用相關教育資源。
4. 舉辦以海洋、海岸為主題的藝術詩歌、繪圖比賽…等創作比賽，帶動全民對海洋的思考與關懷。
5. 服務學習會會員之招募，及會員必須參與五項以上之活動計畫，由全民參與海洋教育的推動。
6. 印製海報及 post-cards…等，以文宣進行海洋教育。

海洋教育推展策略特色：

1. California Coastal Commission 在推動海洋教育上的特色之一，是在州政府之下設立一個獨立的海岸委員會，藉由銷售汽車牌照取得大部分經費。
2. 在經費爭取上，California Coastal Commission 的 Grants Manager 和負責相關業務人員會負責開拓有潛力的經費來源。
3. 透過大眾參與方式強化海洋環境保護與資源利用的概念。作法是由下而上，將海洋的關懷融入民眾日常生活當中，並透過各種文宣資料和活動節目推廣海洋教育，強化對海洋的認識。
4. 由幼稚園至 12 年級生之非海洋專業教育及適合各年齡層之海洋普及教育，透過有計畫之年度活動計畫。
5. 網頁的設計使民眾可以上網取得相關教育資訊、視訊教材、教學指南、課程綱要、其就業機會資訊等。

值得學習、借鏡之海洋教育推展策略：

1. 官方成立之獨立營運單位，作為州政府與民間連結的窗口，以此推動教育。
2. 單位經費自籌，主要源自加州居民申請購買有鯨魚尾標誌的特殊車牌所得。
3. 激勵全民參與方式，由「淨灘」活動中進行海洋教育。
4. 競賽活動、文宣資料…。
5. 教育在美國是由州政府自主。加州州政府訂定有一個有關海洋教育的綱要，主要是提供 K-12 各級學校老師在教導學生有關海洋知識的依據，相關資料列述於後。有關高中以上的海洋教育主要是透過 California Sea Grants Program (係隸屬美國 National Sea Grant College Program 下之計畫) 推動。

加州之海洋教育課程綱要

There are 51 pages of science standards for California students. California content standards can be downloaded from this page: <http://www.cde.ca.gov/be/st/ss/>

The following are science standards I pulled out which specifically address oceans. There are of course many other standards which can be taught using oceans (including standards that would be best addressed using oceans and standards, such as the water cycle, in which oceans play an integral role), but the following standards *specifically* address oceans. These standards are required in California classrooms. There are fortunate high schools which also have classes devoted to marine science, marine biology, environmental science, and other topics. I would say that a minority of students have access to these classes, but I don't have any data on their prevalence.

Kindergarten Science

3. Earth is composed of land, air, and water. As a basis for understanding this concept:
 - a. *Students know* characteristics of mountains, rivers, oceans, valleys, deserts, and local landforms.

Third Grade Science

3. Adaptations in physical structure or behavior may improve an organism's chance for survival. As a basis for understanding this concept:
 - b. *Students know* examples of diverse life forms in different environments, such as oceans, deserts, tundra, forests, grasslands, and wetlands.

Fourth Grade Science

5. Waves, wind, water, and ice shape and reshape Earth's land surface. As a basis for understanding this concept:
 - c. *Students know* moving water erodes landforms, reshaping the land by taking it away from some places and depositing it as pebbles, sand, silt, and mud in other places (weathering, transport, and deposition).

Fifth Grade Science

3. Water on Earth moves between the oceans and land through the processes of evaporation and condensation. As a basis for understanding this concept:
 - a. *Students know* most of Earth's water is present as salt water in the oceans, which cover most of Earth's surface.

4. Energy from the Sun heats Earth unevenly, causing air movements that result in changing weather patterns. As a basis for understanding this concept:
 - b. *Students know* the influence that the ocean has on the weather and the role that the water cycle plays in weather patterns.

Sixth Grade Science

2. Topography is reshaped by the weathering of rock and soil and by the transportation and deposition of sediment. As a basis for understanding this concept:
 - c. *Students know* beaches are dynamic systems in which the sand is supplied by rivers and moved along the coast by the action of waves.
4. Many phenomena on Earth's surface are affected by the transfer of energy through radiation and convection currents. As a basis for understanding this concept:
 - a. *Students know* the sun is the major source of energy for phenomena on Earth's surface; it powers winds, ocean currents, and the water cycle.
 - d. *Students know* convection currents distribute heat in the atmosphere and oceans.

Ninth through 12th Grade Earth Sciences

3. Plate tectonics operating over geologic time has changed the patterns of land, sea, and mountains on Earth's surface. As the basis for understanding this concept:
 - a. *Students know* features of the ocean floor (magnetic patterns, age, and sea-floor topography) provide evidence of plate tectonics.
5. Heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents. As a basis for understanding this concept:
 - a. *Students know* how differential heating of Earth results in circulation patterns in the atmosphere and oceans that globally distribute the heat.
 - b. *Students know* the relationship between the rotation of Earth and the circular motions of ocean currents and air in pressure centers.
 - d. *Students know* properties of ocean water, such as temperature and salinity, can be used to explain the layered structure of the oceans, the generation of horizontal and vertical ocean currents, and the geographic distribution of marine organisms.
 - f. *Students know* the interaction of wind patterns, ocean currents, and mountain ranges results in the global pattern of latitudinal bands of rain forests and deserts.
 - g. *Students know* features of the ENSO (El Niño southern oscillation) cycle in terms of sea-surface and air temperature variations across the Pacific and some climatic results of this cycle.
7. Each element on Earth moves among reservoirs, which exist in the solid earth, in

oceans, in the atmosphere, and within and among organisms as part of biogeochemical cycles. As a basis for understanding this concept:

- b. *Students know* the global carbon cycle: the different physical and chemical forms of carbon in the atmosphere, oceans, biomass, fossil fuels, and the movement of carbon among these reservoirs.

二、美國加州大學海洋理事會 (University of California Marine Council, UCMC)

地址： University of California
Office of the President
1111 Franklin Street
Oakland, CA 94607-5200
U.S.A.

接待人員： Dr. Cathie Magowan

Director,
Science and Technology Program and Research
Initiatives

University of California

TEL： 510-987-0377

FAX： 510-987-9456

E-MAIL： cathie.magowan@ucop.edu

Ms. Ann Gilbert

Program Coordinator and Grants Administrator
UC Marine Council & Coastal Environmental Quality
Initiative

參訪日期： 2007年2月2日上午10:00

參訪影像紀錄：



參訪單位特色：

(一) 單位屬性

美國加州大學於 1999 年成立的「海洋理事會」，加州州立大學系統下之一級單位，屬科學與技術研究部門。

(二) 經費來源

美國 Sea Grant 及加州政府的資助。

<註>National Sea Grant College Program

National Sea Grant College Program 係屬美國聯邦政府，以統籌進行海洋相關研究計畫之推動、發展。

National Sea Grant 經費源自「美國國家海洋大氣局」

(National Oceanic & Atmospheric Administration, NOAA)，該基金於 1966 年 10 月 17 日創設，其資金主要源自美國國家大氣暨海洋局，各州輔以各州政府之經費，以及私人捐贈之資金。資金由上而下（由 National Sea Grant Funds、州政府經費及私人捐贈），研究議題由下而上（由學界共同討論、協調、整合，向 National Sea Grant Funds 提出申請計畫），能符合各州需求與國家發展利益。

美國「National Sea Grant College Program」資料，網址：

<http://www.seagrant.noaa.gov/>。

(三) 目標任務

負責協調整合加州各大學推展有關海洋政策、研究、教育、公共服務等事務決策與發展方向，並負責推展、執行加州海洋資源的管理工作。

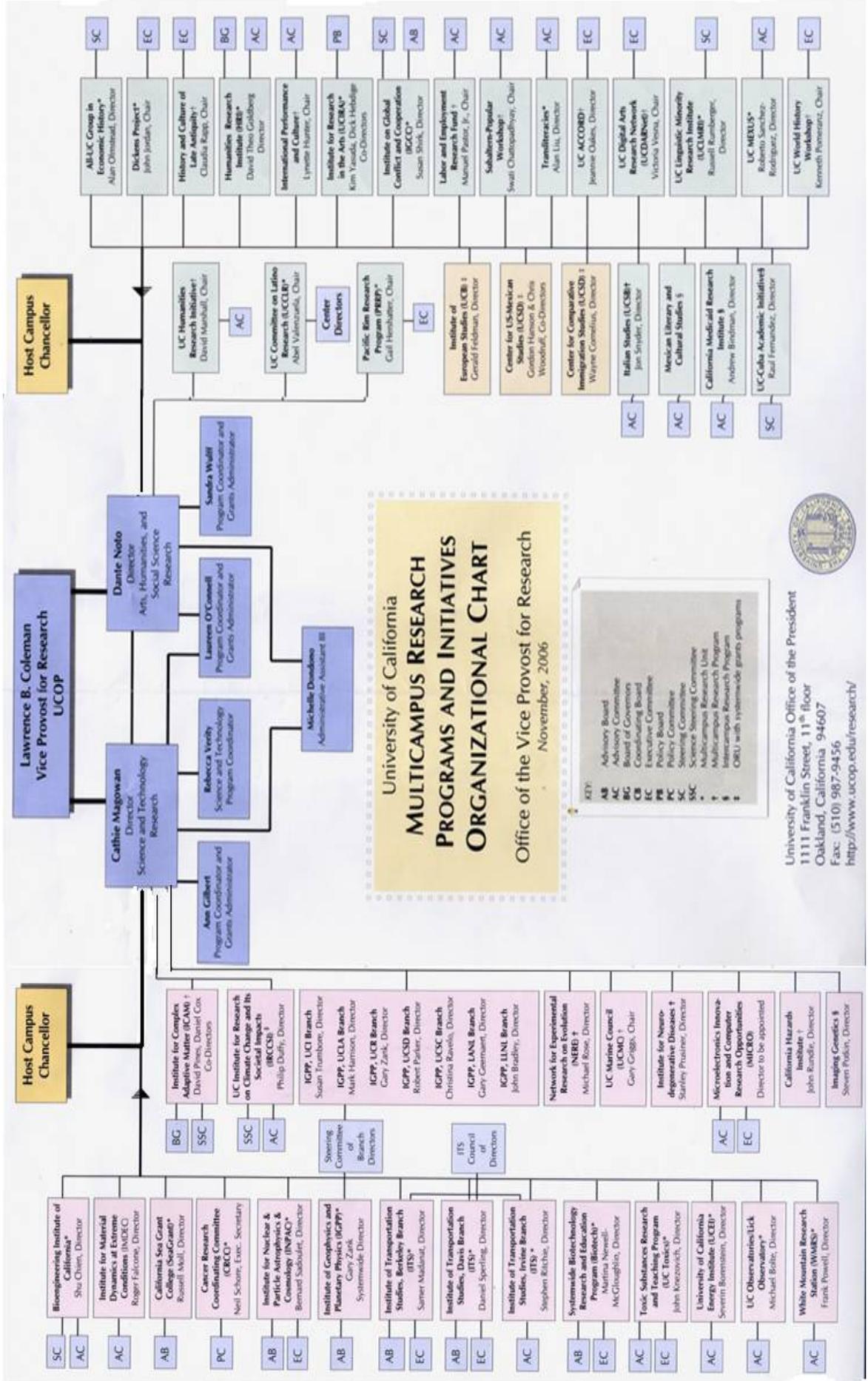
(四) 目標推展策略

1. UCMC 擔任學界與政府（州政府及聯邦政府）間的連結窗口，對下負責協調、控管學界（加州州立大學內部體系及加州各大學間）之教學、研究分工、整合發展，對上向州政府、聯邦政府提出海洋相關議題之建言。
2. 每年定期召開工作會報，舉辦專題研討會，以協調整合加州州立大學系統內部及加州各大學間之教學、研究之分工及資源之支援、整合。
3. 策略性爭取非教育體系之相關公、私有資源，共同

推展海洋科技相關研究及資源管理之執行方案。

4. UCMC 負責 National Sea Grant College Program 在加州的協調、整合、執行與控管，並在加州政府經費支持下，進行加州海岸環境分析、研究與監測之計畫，提出維護加州海岸永續發展之法案。
5. 研究生獎學金之獎勵策略。
針對政策性目標之研究議題提供獎學金，以培育標的性人才。
6. 加州大學研究教學領域分野與組織架構，表列於後，提供參考。加州大學特色之一是華人貿易史的研究。台灣在相關研究可尋求與加州大學的合作。

加州大學研究教學領域分野與組織架構



海洋教育推展策略特色：

加州大學體系主要以 California Sea Grant College Program 推動與海洋相關之高階專業人才培育，以協調整合訂定加州大學內部及加州各大學間之研究發展方向，申請 Sea Grant 計畫，經由研究計畫之執行，訓練海洋領域之大學和研究生，以及培養未來之海洋研究和教育人才。加州大學設立「海洋理事會」作為政府與學界的聯結窗口，向下整合學界能量，負責加州大學內部及加州各大學間之整合、協調，向上則負責執行官方所賦予之海岸環境相關研究，並向政府提出海洋相關議題之建議。

值得學習、借鏡之海洋教育推展策略：

1. 非官方之整合、協調單位進行學界間、學界與政府間、學界與私人財團間之連結單位，是為此良性運作之關鍵；
2. Sea Grant 的運作模式，進行區域性分工、整合，共同擬定研究優先項目，並由各校競爭申請計畫。以研究帶動高階人才培育的發展，具整合、協調、決策機制之設計與運作，California Sea Grant College Program 之運作方式，值得學習。
3. 政策性標的人才培育之獎勵策略，經由研究參與培育高階人才。

三、海洋尖端科技教育中心 (Marine Advanced Technology Education Center, MATE)

地址：MATE Center
Monterey Peninsula College,
980 Fremont Street
Monterey, CA 93940
U.S.A.

接待人員：Ms. Deidre Sullivan
Curriculum & Industry Manager
Marine Advanced Technology Education Center
TEL：831-646-3081
FAX：831-646-3080
E-MAIL：deidres@marinetech.org
URL：<http://www.marinetech.org>

參訪日期：2007年2月2日下午3:00

參訪影像紀錄：



參訪單位特色：

(一) 單位屬性

美國國家科學基金 (National Science Foundation, NSF) 下設 11 個尖端科技教育中心 (Advanced Technology Education Centers), Marine Advanced Technology Education Center (MATE) 為其中之一。設置於 Monterey Peninsula College (社區大學) 內。

(二) 經費來源

創立資金源自美國國家科學基金會 (National Science Foundation), 目前, 則 35% 經費來自加州政府, 65% 來自 MATE 自籌款。

(三) 目標任務

提升海洋科技教育, 增加海洋科技高階專業人才培育, 建立高階人才培育與產業之良性關係, 及提升就業所需能力, 以產業導引人才培育, 瞭解人才市場需求, 協助培育符合需求之人才。

(四) 目標推展策略

1. 針對國小、國中、高中學生分級設計研習課程並長年例行性舉辦之。
2. 成為大學、高中、小各級學校、非教育組織、機構、研究機構、學界之夥伴單位。
3. 開設實習訓練班和暑期特別班, 進行專業與實務人才訓練培育課程。
4. 與產業界密切交流, 確定海洋業者之人才需求, 研擬海洋產業綱要, 作為課程設計之參考依據; 因應科技、產業發展需求, 制定新的課程, 不斷地更新既有課程; 建立產業界與學界之伙伴關係; 擔任產業界與學界間之聯結窗口, 提供機會, 增加產、學聯繫、互動。
5. 建立海洋產業人力需求之相關資料庫, 網址: <http://marinetech.org/sitemap.php>, 作為資訊平台。
6. 舉辦國際性 Remotely Operated Vehicle (ROV) 之比賽。

海洋教育推展策略特色：

1. 對 K-12、大學、專業、非專業分類設計課程，並以長年例行性舉辦研習營。
2. 與產業界保持密切關切，掌握產業發展與人才需求資訊，並提供大眾。
3. 科學技術實務訓練為職前教育平台。
4. 單位自籌營運。

值得學習、借鏡之海洋教育推展策略：

1. 職業綱要之訂定，海洋產業人力需求之調查；資料、資訊蒐集，建立全面完整的海洋人才資訊網，掌握產業現況與發展脈動，成為職場需求資訊平台界面，是為學界、產業界之聯絡窗口。
2. 課程之更新與新課程之設計。
3. 以科技創作（ROV 比賽）誘導海洋科技教育，提供在職者產業相關之專業科技教育。促進人才投入及現有人才之素質提升為其兩大重點策略。

四、國立大學法人橫濱大學－
海洋研究暨整合教育中心
(Center of Oceanic Studies and Integrated ducation, COSIE)

地址： 79-1 Tokiwadai,
Hodogayaku, Yokohama City
240-8501, Japan

接待人員： 來生新
橫濱國立大學理事副學長
TEL: 045-339-3003
FAX: 045-339-3009
E-MAIL: skisugi@ynu.ac.jp

角洋一
橫濱國立大學教授
(社)日本船舶海洋工學會 副會長、東部支部長
TEL: 045-339-4091
FAX: 045-339-4099
E-MAIL: sumi@structlab.shp.ynu.ac.jp

菊池知彥
橫濱國立大學教授 農學博士
TEL：045-339-3413
FAX：045-339-3413
E-MAIL： kikuchi@edhs.ynu.ac.jp

平山次清
橫濱國立大學教授
TEL：045-339-4093
FAX：045-339-4099
E-MAIL： hirayama@ynu.ac.jp
URL： <http://www.seakeeping.shp.ynu.ac.jp/>

參訪日期：2007年2月5日下午1:30

參訪影像紀錄：



參訪單位特色：

(一) 單位屬性

國立大學法人，由神奈川師範學校、橫濱高等工業學校、橫濱高等商業學校合併、升格而來。在校內跨學院成立「海洋研究暨整合教育中心（Center of Oceanic Studies and Integrated Education, COSIE）」。

(二) 經費來源

日本文部科學省及校方。

(三) 目標任務

進行海洋和海岸治理和管理的科技整合性教育，培育熟悉國內、外海洋及海岸治理與管理體系及相關業務之作業流程及策略性規劃人才。

(四) 目標推展策略

1. 由校方成立 COSIE，由 COSIE 納編各學院老師（目前約 45 名）進入 COSIE 體系，共同設計、規劃並執行「跨領域之整合性海洋、海岸治理暨管理之碩

- 士課程」，部分經費源自日本文部科學省支助，並篩選學生進入學程修習。
2. 以「教學合作」推動校內之「研究合作」。
 3. COSIE 開設之學程亦提供政府官員及非校內學生之修習。極力建立官-學關係，增加校方對政策面的影響力。
 4. 擔任產業界、民間團體的諮詢服務平台，並舉辦推廣性演講，以教育一般民眾。
 5. 推動國際性聯盟活動，主導成立「國際海港城市大學聯盟」(Port-City University League)。國際海港城市大學聯盟係由七個國家(印度、中國、英國、加拿大、日本、越南、巴西)，八所大學(University of Southampton、Yokohama National University、Indian Institute of Technology Madras、Hochi Minh City University of Technology、Yokohama City University、The University of British Columbia、Shanghai Jiao Tong University、University of Sao Paulo)組成。

海洋教育推展策略特色：

此校之特色是成立跨學院之「海洋研究暨整合教育中心」(COSIE)，整合師資，進行課程設計規劃，積極進行有關海洋與海岸治理與管理之跨學科整合性教育，提供給全校研究生。另，以演講系列推動海洋教育。透過組織港市大學聯盟，舉辦國際研討會加強國際合作與交流。

值得學習、借鏡之海洋教育推展策略：

1. 校方主動成立跨學院之整合性海洋教育中心，負責師資納編、整合及課程規劃、設計，跨領域人才培育。跨學科教育整合之努力與實際作法。
2. 以「教學合作」作為「研究合作」之基礎。
3. 國際性聯盟及會議、演講之推展。

五、獨立行政法人日本海洋研究開發機構 (Japan Agency for Marine-Earth Science Technology, JAMSTEC)

地址：2-15 Natsushima-cho
Yokosuka Kanagawa,
237-0061, Japan

接待人員：末廣潔

海洋研究開發機構理事

TEL：046-867-9000

FAX：046-867-9005

E-MAIL：suyehiro@jamstec.go.jp

URL：<http://www.jamstec.go.jp/>

北シ尺一宏

海洋研究開發機構特別參事

TEL：046-867-9191

FAX：046-867-9195

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URL：<http://www.jamstec.go.jp/>

鷺尾幸久

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TEL：046-867-9220

FAX：046-867-9195

E-MAIL：washioy@jamstec.go.jp

URL：<http://www.jamstec.go.jp/>

渡邊曜子

海洋研究開發機構經營企畫室國際課課員

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FAX：046-867-9195

E-MAIL：ywatanabe@jamstec.go.jp

URL：<http://www.jamstec.go.jp/>

參訪日期：2007年2月6日上午10:00

参访影像纪录：



A collage of informational panels and diagrams about the 'Kaiyoh' ROV series. The top-left panel, titled '「かいこう ビークル」', compares three models: 「かいこう」 (11000m), 「かいこう7000」 (7000m), and 「かいこう7000 II」 (7000m). Below this is a table with specifications:

	「かいこう」 11000m級無人探査機	「かいこう7000」 7000m級無人探査機	「かいこう7000 II」 7000m級無人探査機
空中重量	5.7 t	2.9 t	3.5 t
容積	5660 L	2890 L	3580 L

The top-right panel, titled '10,000m級無人探査機「かいこう」の実績', lists various missions and achievements. The middle-right panel, titled '「かいこう7000 II」試験搭載', shows images of the ROV in operation. The bottom-left panel is a detailed cutaway diagram of the ROV with various components labeled. The bottom-right panel is a timeline titled '「かいこう7000」年表'.

參訪單位特色：

(一) 單位屬性

獨立行政法人，源自 1971 年設立之「日本海洋科學與技術中心」(Japan Marine Science and Technology Center)，2004 年重組改為「獨立行政法人日本海洋研究開發機構」，其單位組織架構圖示於後。

(二) 經費來源

日本政府資金投入創立後，獨立營運。

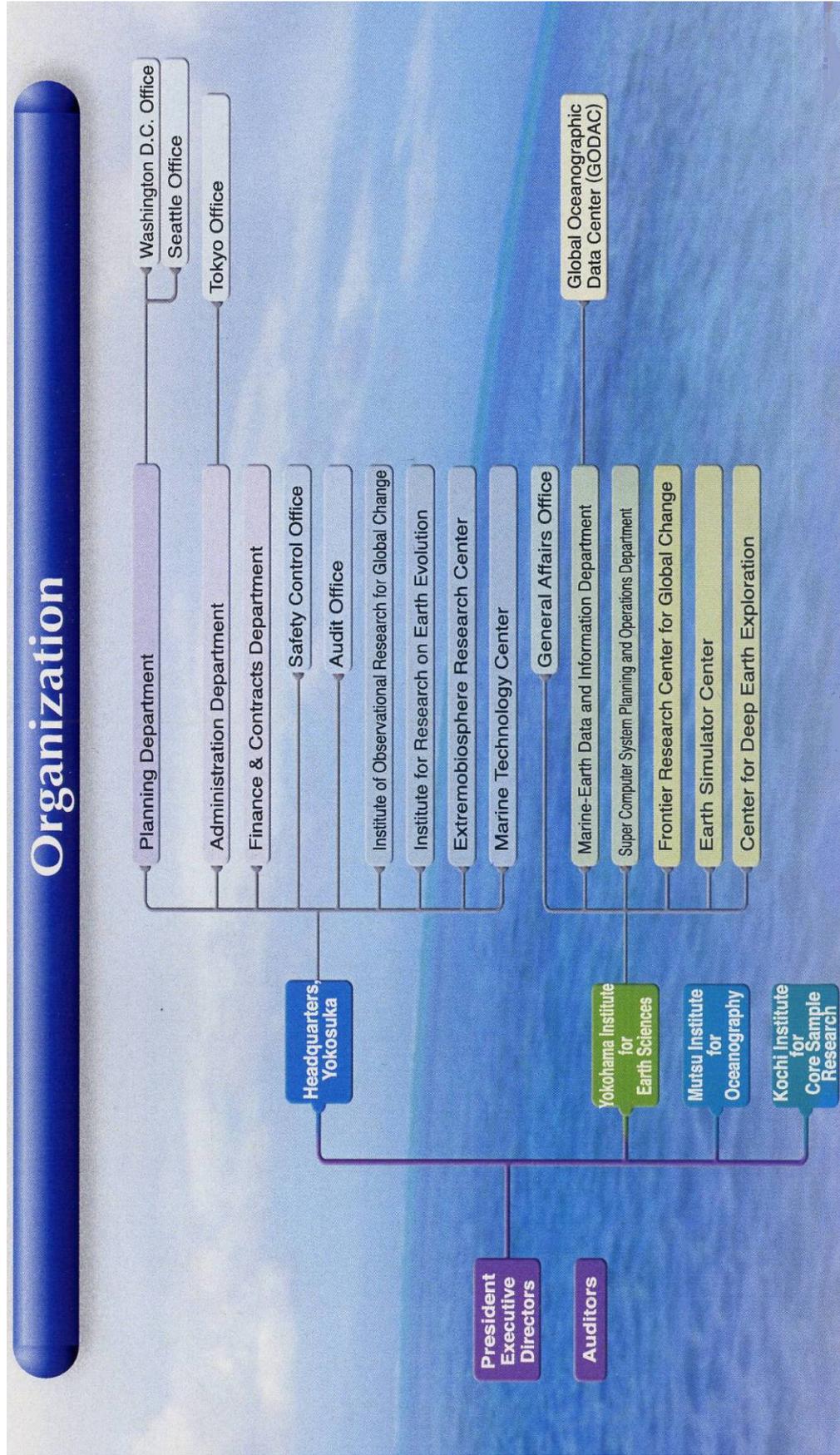
(三) 目標任務

海洋-地球科學及技術相關之基礎研究與產業研發。

(四) 目標推展策略

1. 執行海洋科技研發計畫，為日本海洋科技研發平台。
2. 設定研發標的，資源集中投入為其重要發展策略。
研發標的之擬定採由上而下決策機制，其「中程發展計畫」，圖示於後。
3. 營運策略是建立「學-研-產」合作機制，其原則為「至學界吸收人才，強化自我研究、研發能量，以研發成果技轉產業，以研發技轉獲利永續營運單位」。
4. 建立美國、加拿大、歐洲、蘇俄…等密切的研究合作關係，在亞洲區域，更與台灣（海科中心）、東南亞各國進行實質研究合作，以日本出發，進行區域性整合，進而參與國際競爭，領航國際為其主要策略。
5. 海洋科技教育之執行策略有三，
 - 一、JAMSTEC 研究人員至大學院校兼課，
 - 二、對學校公開徵求研究計畫，接受學生至 JAMSTEC 進行論文相關之研究，由此培育高階海洋科技專業人才，
 - 三、設計各級程度之研習營課程，並定期舉辦研習營；設立相關博物館提供各級學校（國小、國中、高中、大學）及一民眾之參訪，進行相關科教活動，設計海洋相關活動、科教影片之製作誘導全民對海洋之關心與思考。如對新建之研究船的命名“地球”，即緣自小學生命名活動而來。

獨立行政法人日本海洋研究開發機構單位組織架構



獨立行政法人日本海洋研究開發機構單位組織架構圖



海洋教育推展策略特色：

以其研究設施、研究成果，實質提供並進行海洋尖端科技教育，並以活動激發民眾，尤其小學生對海洋的熱情。

值得學習、借鏡之海洋教育推展策略：

1. 充分的經費投資，法人化的營運模式，「學-研-產」各界能量的吸收、整合、強化，提供 JAMSTEC 自我之發展。
2. 標的目標「由上而下」的訂定中、長程發展目標後，集中投資的研發；以回饋社會的理念，開創國家利益。
3. 人才培育策略，以課程研習營及關懷日本海洋相關事務活動之舉辦，誘導年輕學子（中小學生）的投入，以研究參與培育高科技產業人才。

六、海洋政策研究財團 (Ocean Policy Research Foundation, OPRF)

地址：東京都港區虎之門 1-15-16
海洋船舶大樓 3 樓，日本國

接待人員：寺島紘士

海洋政策研究財團常務理事

TEL：03-3502-1834

FAX：03-3502-2033

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菅原善則

海洋政策研究財團

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田中祐美子

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日野明日香

海洋政策研究財團研究員

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URL：<http://www.sof.or.jp>

參訪日期：2007 年 2 月 7 日上午 10:00

參訪影像紀錄：



參訪單位特色：

(一) 單位屬性

海洋政策研究財團 (Policy Research Foundation, OPRF) 2005 年成立，係屬日本民間財團法人機構，其前身為 1975 年設立之「財團法人日本造船振興財團」。

(二) 經費來源

民間財團組織

(三) 目標任務

以非官方組織作為政府與教育工作者之聯結窗口，組織成員為退休官員、教授與教育工作者，整合全國教師能量與民間教育資源，聯合學界、民間組織落實執行。另，針對海洋政策、海上交通安全保障、海岸管理、海洋環境、海洋產業、海洋教育之海洋相關議題調查之研究、分析，並與國際合作等，進行由社會科學乃至自然科學進行研究，進一步，依據研析結果，擬定策略規劃，提出具體方案，向政府提出建言。

(四) 目標推展策略

精確、嚴謹的研析後，規劃系統性解決方案，與執行策略，之後具體推動實踐。

以海洋教育的普及及推動之研析與策略規劃為例

1. 第一階段(2002-2004年)教育現場之問題調查，傾聽教師之意見，教育現場之參與瞭解。
2. 第二階段(2005-2007年)規劃設計海洋教育推展方案。與教師共同研究規劃推展方案，參考讀本之製作、提供；教育相關工作者之聯繫網的建議。
(http://www.sof.or.jp/ocean/edu/act/class_sup/20040612.html)
3. 訂定執行目標-增進孩子對海洋的關心。
4. 執行推展業務：擬定主題，以區域性之教員研習會，每年例行性地推展教員研修活動，及學生之課外學習活動。
5. 教育資源之建構與提供：由大學老師及 OPRF 研究員協同小學老師，針對單一主題(諸如海洋教育學會合作翻車魚)一起撰寫適合國小一至六年級所需之教材讀本，並與專業教師規劃專業學程，諸如海洋管理碩士課程，提供學校參考。

海洋教育推展策略特色：

以非官方之組織，實質影響政策，並執行海洋教育。其執行策略，是直接進入教育現場進行調查、研究、分析、瞭解實際需求、問題後，規劃解決方案，經由現場教育者直接參與規劃、設計教材，並教育教師、激發老師、學生對海洋的關懷並執行。

值得學習、借鏡之海洋教育推展策略：

1. 成立非官方之獨立機構(或團體)，以客觀立場，有規劃、有系統、逐步的進行海洋相關議題，諸如：海洋教育，之調查、研究、分析，進一步，進行相關策略規劃，向政府提呈建言，具國家政策影響力。
2. 以調查、研究、分析為基礎，擬定相對推展方案，並落實執行，其成功關鍵為單位成員之組成為官方退休人員及教育人員，及研究部門之編制，其論述具公信力、影響力。
3. 以研析數據之成果為基礎，進行策略規劃；提呈建言，建立對政府政策方向的影响力；以教育現場工作者落實其規劃。以聯結現場教育工作者，落實其論述之執行。

4. OPRF 為非官方之民間組織，以整合民間教育工作者能量及教育資源，經由教育工作者落實執行，諸如與日本海洋教育學會合作並整合大學及國小各年級老師撰寫”翻車魚”，提供各年級學生、教師使用。另，OPRF 與現場教育工作者研析、提擬之海洋教育各級分配表，國小三、四、五、六年級分別表列於后。另，OPRF 與大學教授，本次參訪單位之一的橫濱大學副校長來生新教授亦參與其中，研擬並落實推動之海洋法政相關學程，亦表列於后。

海洋教育國小三年級課表表 — 海洋政策研究財團研擬

● 單元配列表 小學校 3 學年

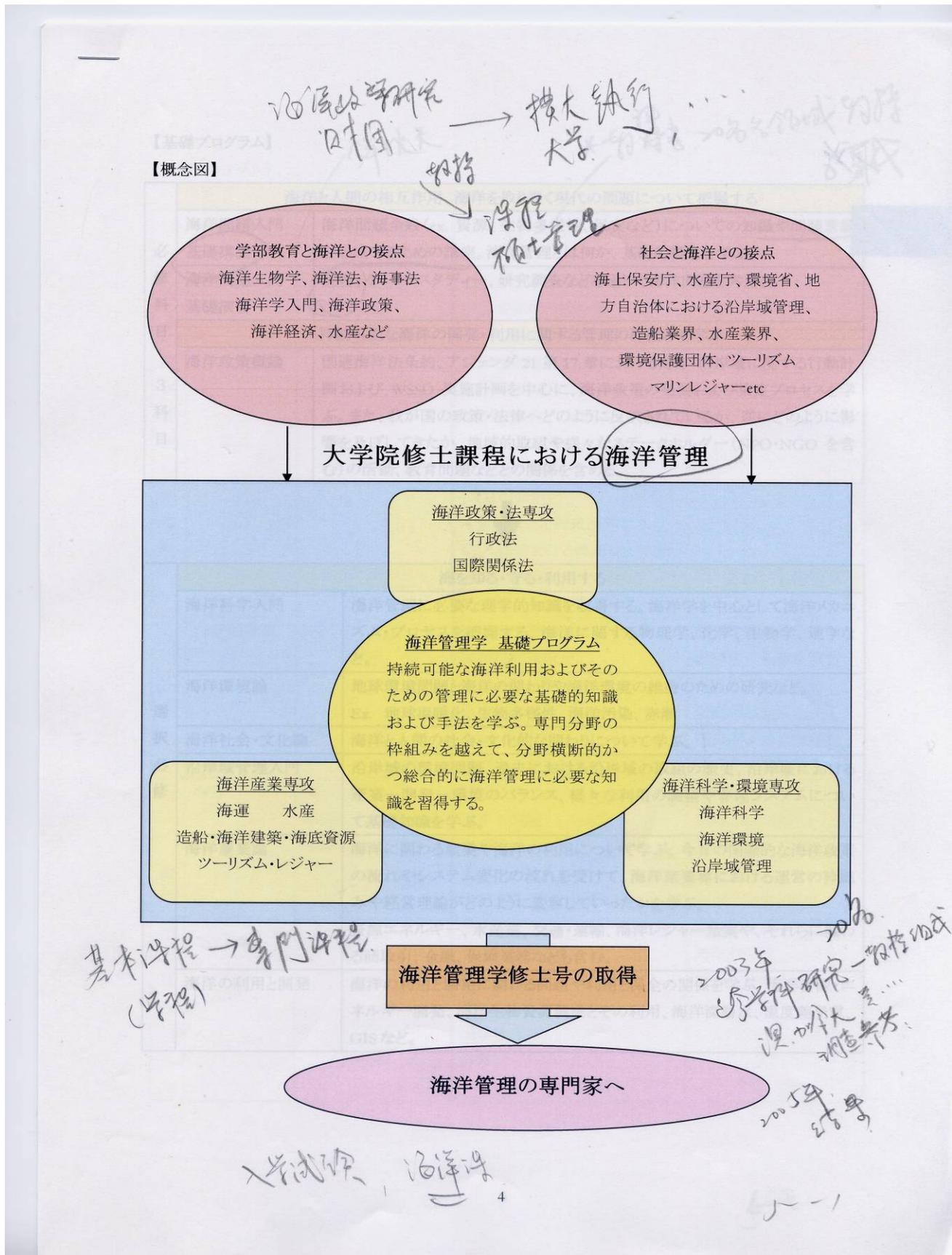
	4月	5月	6月	7月	8月	9月	10月	11月	12月	1月	2月	3月
國語 (25)	場面の様子を思い浮かべながら声に出して読もう (11) 「新しい年のラッパ」 「どきん」 「夕日が背中をおしてくる」	自分を紹介するスピーチをしよう (6) 招待状を書こう (4)	段落ごとに内容をとらえながら読もう (10) 「自然のかくし絵」	物語のあらすじを考えながら読もう (7) 「ゆうすけ村の小さな歌」	16	中心をはっきりさせて説明しよう (13) 「私のお城にのり場所」	世界の民謡を読もう (13) 「木蘭にさくら」	いろいろなお祭りについて調べよう (17) 「福引のお祭り」	伝えたいことをはっきりさせて書こう (11) 「私の研究レポート」	よりよい暮らしについて話し合おう (14) 「音楽の仲間」	中心となる人物の気持ちを考えてよう (15) 「カーカスのライオン」	想像したことを書こう (12) 「もしもの国」 「行ってみよう」
音楽 (60)	みんなで歌って音楽はかま 「歌え手のひら」 「楽器の重なり」 「茶湯み」	楽器とともだち 「かりかりわいわれ」 「ゆかいなまきば」 「おねがい」 「おはるゼンラント」	漢字の組み立てと意味を考えよう (3)	出来事つたえよう (4)	体で音楽 「イルカはさんばらこ」	音と音を合わせると 「らまき」 「うちゅうらの黒猫が」 「すぐきまの力」 「リブ」 「ガクゴトはる馬車」	想像を広げて (3)	漢字の表す意味を考えよう (3)	音で表すと 「字相聞の歌」	曲の感じを生かして 「崖の上」	楽しい音楽会 「はるがらんでいる」 「太平洋がわらわら」	
社会 (70)	私の町、みんなの町 (22) 「学校のまわり」 「町のようす」	18	わたしの研究 (1)	わたしの研究 (1)	わたしの研究 (1)	わたしの研究 (1)	花と雲を調べよう (3)	日向と日陰を比べよう (8)	光を当てよう (8)	明かりをつけよう (8)	じしゃくにつけよう (11)	つくって遊ぼう (7)
理科 (70)	植物を育てよう (3)	チョウを育てよう (7)	植物の体を調べよう (4)	昆虫を調べよう (6)	38	あれもこれももうつけるよ (4)	うぶい、これも顔に見えるよ (4)	だんだん段ボール (2)	集まってへんしーん (4)	粘土は銃くよ広がるよ (2)	ゆめの中で宇宙へ行こう (8)	ゆらゆらころころ (8)
図画工作 (60)	かけっこ・リレー (4)	鉄棒 (5)	リズムダンス (6)	バスケットボール (9)	力試し (2)	水泳 (10)	かけっこ・ハードル (5)	ベースボール (7)	マット (5)	蹴り箱 (2)	かけ足 (3)	蹴り箱 (4)
体育 (90)	かけ算 (7)	時ごとく時間 (8)	わり算 (12)	水のかさの測り方と表し方 (8)	足し算と引き算の筆算 (8)	暗算 (2)	かけ算 (7)	サッカー (7)	用具 (3)	箱の形 (6)	そろばん (2)	3年の復習 (4)
算数 (60)	1	26	28	34	41	41	健康な生活 (4)	大きな数のしくみ (8)	かけ算の筆算 (14)	重さの測り方と表し方 (10)	かけ算の筆算 (10)	3

海洋教育國小四年級課表 — 海洋政策研究財團研擬

● 單元配列表 小學校 4 學年

	4月	5月	6月	7月	8月	9月	10月	11月	12月	1月	2月	3月	
國語 (23)	人物の気持ちを 感じながら声に出 して読もう (11) 【おむすびの巻】「おむすび」	出来事を紹介する スピーチをしよう (6)	段落と段落の結び つきを考えながら 読もう (10) 【おむすびの巻】 「おむすび」	物語の盛り上がり を考えながら読もう (7) 【おむすびの巻】 「おむすび」	筋道を立てて説 明しよう (12) 【おむすびの巻】 「おむすび」	愛の心を描いた 物語を読もう (13) 【おむすびの巻】 「おむすび」	いろいろな環境を 守る工夫について 調べよう (16) 【おむすびの巻】 「おむすび」	中心をはっきりさ せて書こう (13) 【おむすびの巻】 「おむすび」	暮らしの中の世界 について話し合おう (12) 【おむすびの巻】 「おむすび」	人物の気持ちの移 り変わりを考えよ う (10) 【おむすびの巻】 「おむすび」	伝えたいことを選 んで書こう (10) 【おむすびの巻】 「おむすび」		
音楽 (6)	みんなで歌って音楽な かま 【世界の子どもたちが】「さくらさくら」 【みんなの木の実】「あめつばき」	楽器とともだち 【サイクリングやホホ】「歌と夢と」【月の夜】【フ】											
社会 (8)	住みよい暮らしをつくる (26) 【ゴミの分別と利用】「来た道から」												
理科 (9)	あたたかくな ると (7)	電気のほたら き (12)	暑くなる と (6)	月の動き (4)	わたしの研究 (1)								
図工 (6)	空気がいっぱい こめて (2)	ぱっくりひらいた ら (6)	わたしの○○○ (6)	大好きな仲間ま れ (6)									
体育 (9)	かけっこ・リ レー (4)	力試し (2)	リズムダンス (6)	バスケットポ ール (9)	水泳 (10)								
算数 (1)	大きい数の仕 組み (8)	円と球 (9)	わり算の筆算 1 (17)	折れ線グラフ (8)	整理の仕方 (5)								
道徳 (3)													

海洋法政相關學程設計—日本海洋政策研究財團研擬



【基礎プログラム】

海休

* 印 海 休 あり 領域 研究

海洋と人間の相互作用、海洋を取り巻く現代の問題について把握する		
必修科目	海洋問題入門 基礎講義	海洋問題全般(ex. 資源、生物多様性、保安など)についての知識や問題意識を形成するための講座。海洋管理とは何か、基礎的概念を学ぶ。
	海洋問題入門 基礎演習	実習、ケース・スタディー、研究調査などを通じて海洋問題を考える。
持続可能な海洋の開発・利用に関する管理の枠組みを学ぶ		
3科目	海洋政策概論	国連海洋法条約、アジェンダ 21 第 17 章における海洋・沿岸域に関する行動計画および WSSD 実施計画を中心に、海洋政策の発展および策定プロセスを学ぶ。また、我が国の政策・法律へどのように反映されているか、逆にどのように影響を及ぼしてきたか、地域的取組や様々なステークホルダー(NPO・NGO を含む)の活動、教育問題などとの関係を含める。



海を知る・守る・利用する		
選択必修	海洋科学入門	海洋管理に必要な学理的知識を取得する。海洋学を中心として海洋メカニズム・プロセスを把握する。海洋に関する物理学、化学、生物学、地学など。
	海洋環境論	地球環境問題と海洋の関わりや海洋環境の維持のための研究など。 Ex. 地球温暖化、生物多様性、海洋汚染、赤潮
	海洋社会・文化論	海洋と人間の社会・文化的な関わりについて学ぶ。
	沿岸域管理入門	沿岸域の環境問題、過去における沿岸域の取組の歴史、沿岸域における産業－開発－環境のバランス、様々な利用の調整や管理システムについて基礎知識を学ぶ。
	海洋産業論	海洋に関わる産業や海洋の利用について学ぶ。今日の国際的な海洋政策の流れやシステム変化の流れを受けて、海洋産業界における運営の枠組みや経営理論がどのように変容していったかを学ぶ。 資源エネルギー、水産業、交通・運輸、海洋レジャー産業や、それらに関わる商取引、金融、保険業務なども含む。
	海洋の利用と開発	海洋の利用と開発に関わる問題や利用と保全の関係を学ぶ。海洋資源・エネルギー開発、海洋生物資源開発とその利用、海洋深層水、温度差発電、GIS など。

4-12

【応用プログラム】

専門分野(専攻)		選択必修 (基礎プログラムから選択)	主要科目	関連科目
海洋政策・法専攻	行政法的側面	沿岸域管理入門 海洋産業論 海洋の利用と開発	沿岸域管理法総論 沿岸域管理の政治学 沿岸域管理の私法基礎理論 沿岸域管理と行政活動法1 (沿岸域管理行政法総論1) 沿岸域管理と行政活動法2 (沿岸域管理行政法総論2) 沿岸域管理と行政活動法3 (環境の保全) 沿岸域管理と行政活動法3 (沿岸域における諸活動と行政) 漁業と法制度 沿岸域管理と公有水面埋立法	必修(最低2科目)
	国際関係法		海洋管轄権論 海洋法実施政策 海洋紛争解決手続 海洋法 海商・保険法 海洋管理総合講座	海洋管轄権論演習 海洋法実施政策演習 海洋紛争解決演習 船舶通航制度論 国際海運取引制度論 海底資源開発制度
海洋産業専攻	海運	海洋産業論 海洋社会文化論 沿岸域管理入門	海運経済学 海事産業論 海事法	貨物輸送管理 造船と船舶設計 海洋技術入門
	海洋科学	海洋科学入門 海洋環境論 沿岸域管理入門	海運マーケティング 供給連鎖管理と国際物流 港湾論 海運政策と海運史 財務管理 運送契約と海上保険 海事情報論 海事コンサルティング	海事行政 海洋の利用と開発 海洋環境論 海洋科学論 調査方法論

専門分野(専攻)		選択必修 (基礎プログラムから選択)	主要科目	関連科目
海洋科学 海洋産業専攻	水産 (生物資源含む)	選択必修6科目から いずれか3科目	漁業生産システム学 資源生物学 資源管理学 漁場形成論 海洋植物学 海洋動物学 魚類学 水産養殖学 水族増殖学 栄養化学 食機能学 食品安全学 食品プロセス工学 食品流通学 水産経営・経済学 水産関係法規	※将来の目標に合わせて、他の専攻分野で開講される科目から選択必修(最低2科目)
	海洋建築・ 海底資源		海洋開発論 海洋環境工学 海洋計測工学 海洋構造物工学 船体運動工学 海洋エネルギー論	海洋産業論 海洋数値解析 海洋計測実習 海洋構造物工学演習 海洋制御工学 海洋エネルギー工学
	ツーリズム・ レジャー			
海洋科学・ 環境専攻	海洋科学	海洋科学入門 海洋環境論 沿岸域管理入門	海洋・地球システム形成史 海洋物理環境概論 海洋物質循環概論 海洋生態系概論 海洋環境計測・解析法 沿岸海洋学 陸域・沿岸域相互作用論	大気・海洋相互作用 数値海洋学 海洋化学概論 海洋生物適応論 沿岸生物資源学 海岸域保全学 水環境学 人為汚染化合物循環論

専門分野(専攻)		選択必修 (基礎プログラムから選択)	主要科目	関連科目
海洋科学・環境専攻	海洋環境	海洋科学入門 海洋環境論 沿岸域管理入門	海洋物理学 海洋化学 地球物理学 海洋地学 海洋物理学実習 海洋化学実習 1 海洋化学実習 2 海洋地学実習 海洋プランクトン学 海洋ネクトン学 海洋ベントス学 海洋生物多様性学 海洋生物生理学 海洋生物学実習1 海洋生物学実習2 海洋生物学実習3	保全生物学 森里海連環学 珊瑚礁学 海洋法 国際法 海洋関連国内法 環境経済学
	沿岸域管理		環境アセスメント1 環境アセスメント2 数値モデル解析1 数値モデル解析2 沿岸生態学1 GIS 入門 沿岸生態学2	危機管理学

七、國立大學法人東京海洋大學 (Tokyo University of Marine Science and Technology)

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參訪日期：2007年2月7日下午3:00

參訪影像紀錄：



參訪單位特色：

(一) 單位屬性

國立大學法人，為東京水產大學與東京商船大學於 2003 年合併而成。東京海洋大學之演進，圖示於后。

(二) 經費來源

政府及自籌。

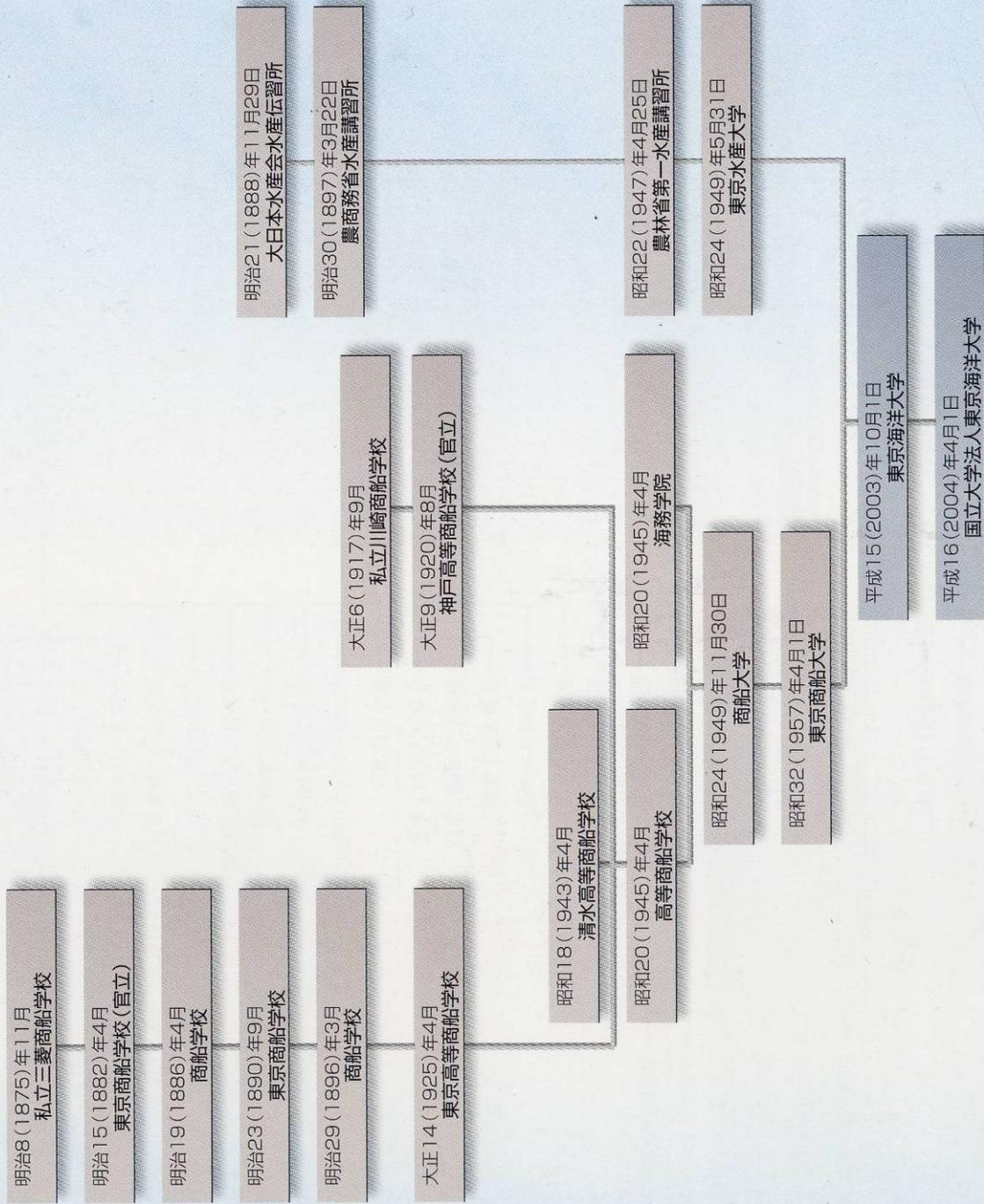
(三) 目標任務

以「知海」、「守海」、「利用海」為基本理念，培育海洋相關之「產、官、學」決策領導人才。

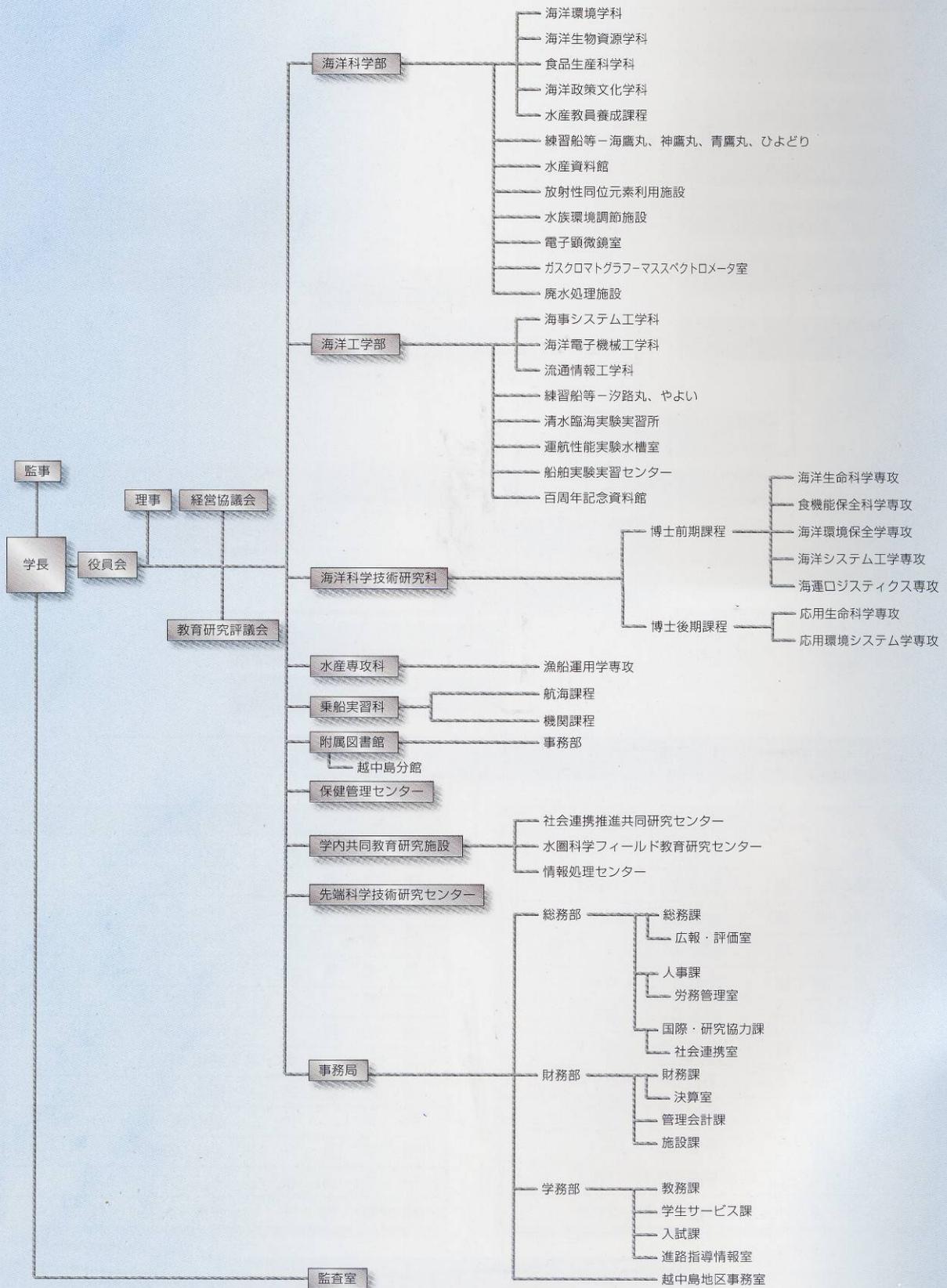
為達成目標任務，東京海洋大學建構對應性之組織架構圖示於后。及其擬定之相對貢獻目標圖示於后。

國立大學法人東京海大演進圖

沿革圖



機構図

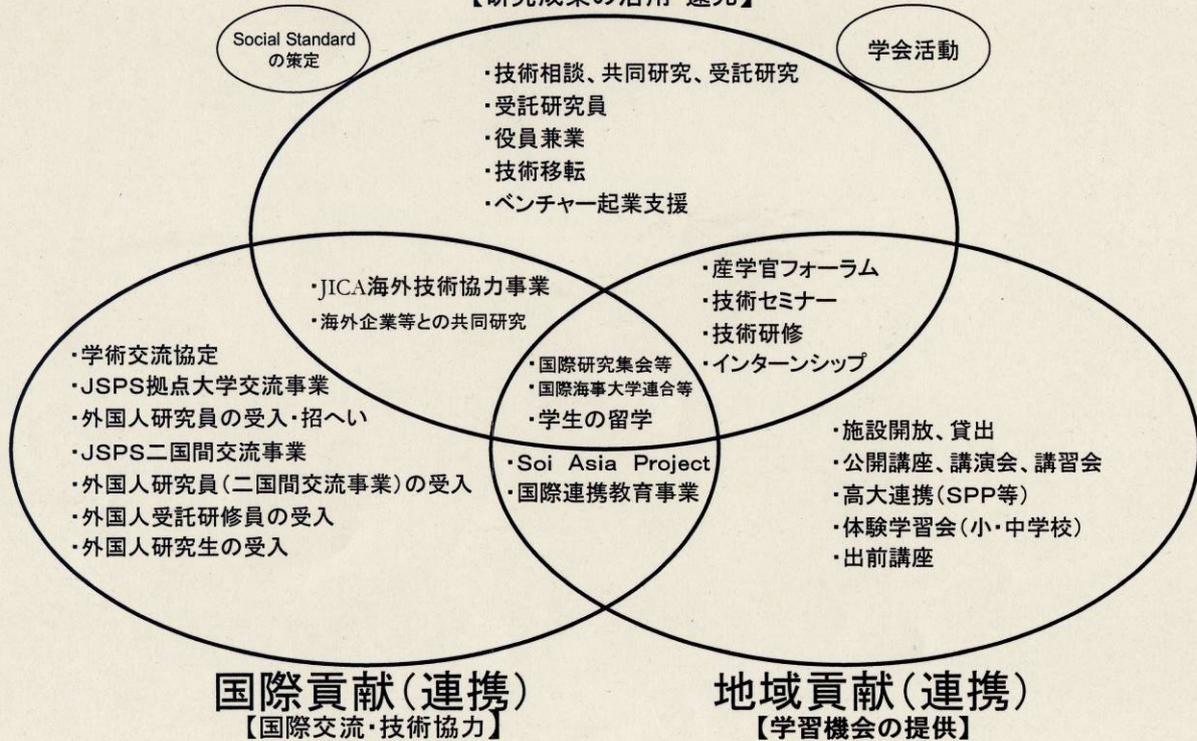


東京海洋大學之社會貢獻目標

東京海洋大学の社会貢献

— 理念を追求する中から生まれる「知」を社会に還元 —

産学官連携 【研究成果の活用・還元】



(四) 目標推展策略

1. 嚴謹地研析學校特性，具體擬定學校的發展目標與策略，架構發展骨幹基架
2. 因應產業開發系統之改變，以校內學程 (program) 調整教學，導引教學方向 (諸如：食品流通的安全管理 program、海事英語學習、評價 program 的開發)。資料附加於后。
3. 積極推動「產-研-學合作關係」，設立「知的財產本部」，導引智財權相關管理、應用，設立「海的相談室」對外招攬社會連攜推進共同研究的中心 (目前在東大校內有兩個由私人企業經費資助、研究合作的研究中心)，由地區性開始進行產學連攜活動 (與橫濱市、川崎市、八戶、桃子氣仙沼大島之產業結盟)。「知的財團本部」、「海的相談室」之相關資料陳列於后。
4. 優秀人才的引入，由民間捐贈資金聘請講座優秀人才，迅速累積學術研究與產業研發能量。
5. 由國小、國中、高中開始又人才的投入海洋專業，小學、中學舉辦體驗學習會，由高校開始培育人才，與高中結盟，誘導進入海洋專業領域。

東京海洋大學獲得日本文部省之 good przctice (GP)學程計畫

○ 文部科学省現代GP

現代GPとは「現代的教育ニーズ取組支援プログラム」の略。各大学などが取り組んでいる教育プロジェクトの中から、今の社会に求められる政策課題やテーマに即した優秀なものが選ばれています。

● 海事英語学習・評価プログラムの開発

〔2005年度採択〕

本学は、海事・海洋英語教育の世界拠点をめざす試みの第一歩として『体験型海事英語プログラム』、『海事英語検定試験』、『海事・海洋英語データベース』の3本柱からなる「海事英語学習・評価プログラム」の開発に着手。海運界に携わる優秀な人材を育成し、世界の船舶職員養成機関、さらに広くは海事・海洋科学に携わる人々に貢献することを目標としています。

● 食品流通の安全管理プログラム

〔2004年度〕

食の安全性への関心が高まっている中、食品流通の安全管理・リスク管理に関わる専門的技術者の養成が急務となっています。そこで本学では「食品流通の安全管理システム 専門技術者養成コース」を創設。学部の4年間・大学院の2年間の高度な専門教育を一貫させ、食品の生産、加工、流通、消費からなる食品流通を体系的に学ぶカリキュラムを設置しました。

國立大學法人東京海洋大學自日本文部省獲得 之魅力教育計畫

○ 魅力ある大学院教育イニシアティブ

文部科学省が大学院充実のために特に選定した19課題の一つである、「海洋観測・生物資源調査の実践強化」プログラムの推進しています(2006年度採択)。これは練習船を有する本学の特徴を活かし、また、各専攻の教員の協働体制の組織化を図ることで、より高度なカリキュラムの充実を実現。世界の海洋で活躍する乗船技術者・研究者の養成をめざしています。

國立法人東京海洋大學之「知的財團本部」組織圖



國立大學法人東京海洋大學之「海的相談室」

- ◆ 誰に聞いたらいいのだろうか？
- ◆ どこまで頼めるのだろうか？
- ◆ きちんと話を聞いてもらえるのだろうか？
- ◆ 契約・費用・秘密保持などはどうなっているのだろうか？
- ◆ 本当に実用化に結びつくのだろうか？ etc...

このような不安を解消し、
皆様の問題解決のお手伝いをさせていただきます。

東京海洋大学 社会連携推進共同研究センターは皆様にとっての

「海の相談室」です



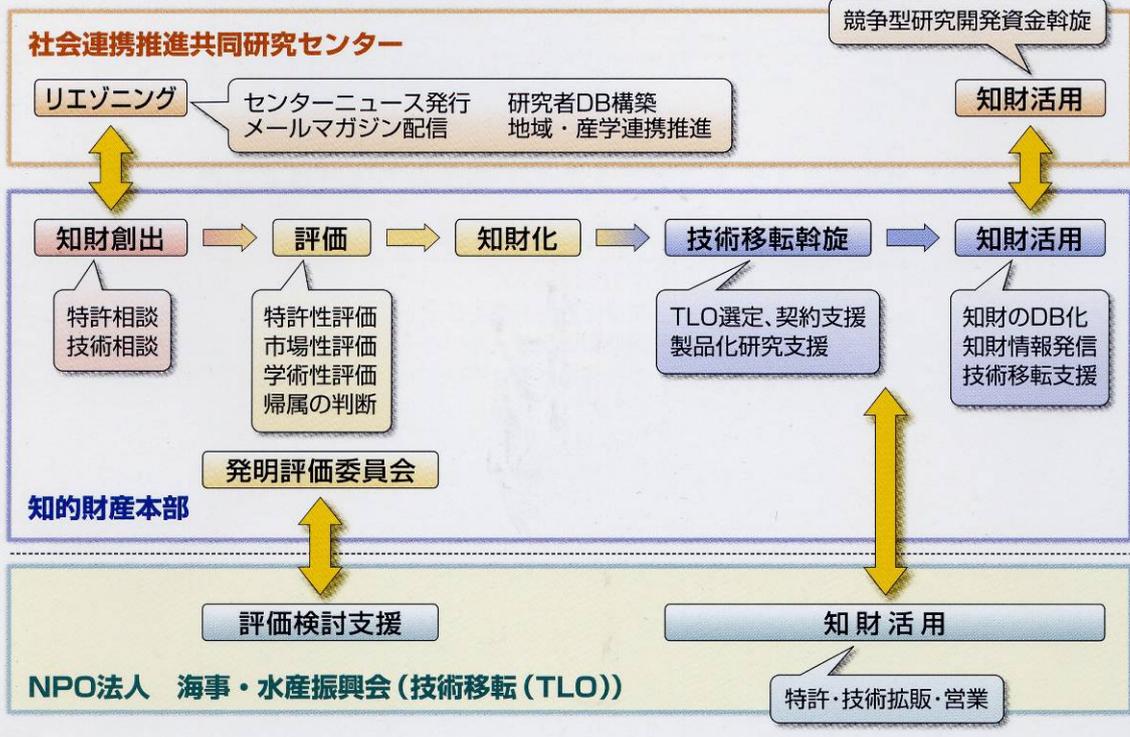
東京海洋大学
社会連携推進共同研究センター
まずはセンターで受け止めドリルします。

國立大學法人東京海洋大學之 智慧財產權相關產業研究、研發之流通營運流程

業務と知財の流れ

<主な業務> 社会連携推進共同研究センターと、TLO機能を持つNPO法人 海事・水産振興会と連携して下記を行います。

1. 研究成果の特許化相談
2. 知財戦略策定、知財創出、管理、運用の企画立案、推進
3. 発明の市場性評価、市場性向上のための検討、想定移転先の開拓
4. 発明の特許性評価、特許性向上のための検討
5. 知財創出のための教育・啓蒙活動
6. 知財創出のための研究者ヒアリング、知財データベース作成
7. 特許をベースにした外部資金導入検討



國立法人東京海洋大學與產業界、民間之連結體系



海洋教育推展策略特色：

「培育產、官、學領導人才」的原則下，推展下列工作：

1. 人才的納編縱向舉辦國小、國中、體驗研習會，與高校結盟，誘導進入海洋專業領域；在校內推展學程，導引教學，並注重實務訓練課程。
2. 公職人員考試之資料蒐集與鼓勵。
3. 產學合作研究機制。NPO 法人—海事、水產振興會為其產學合作之重要界面。

值得學習、借鏡之海洋教育推展策略：

1. 建立學校基礎資料，並掌握學校本身及人類科技、人文變動的脈動，進行研析，由此規劃學校發展方向與執行策略。
2. 策略性的誘導國小、國中、高中生進入海洋專業。
3. 培養公職人員，藉此使東京海洋大學的影響力經由官方切入，主導國家發展方向。
4. 建構健全、完善的產學合作體系。以法人單位 NPO 法人—海事、水產振興會為其與產業界/企業體之聯結界面，在校內設立「海的相談室」，作為對外之聯結窗口。
5. 悲觀的說，假如我們沒有能力找出台灣海洋相關系所院校的方向，就努力研究、瞭解日東京海洋大學的發展規劃與發展方向，做為我們發展的依據。

八、筑波大學下田臨海實驗中心 (Shimada Marine Research Center)

地址：静岡縣下田市五丁目 10-1，日本國

接待人員：稻葉一男

下田臨海實驗中心主任

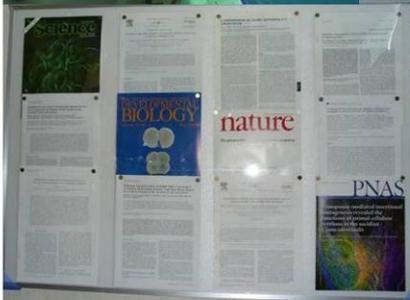
TEL：0558-23-6357(直通)、0558-22-1317(代表)

FAX：0558-22-0346

E-MAIL：inaba@kurofuno.shimoda.tsukuba.ac.jp

參訪日期：2007年2月8日下午1:30

參訪影像紀錄：



參訪單位特色：

(一) 單位屬性

源自 1933 年東京文理科大學創設的附屬設施，曾為東京教育大學理學部附屬臨海實驗所，自 1976 年開始為國立大學法人筑波大學附設之下田臨海實驗中心。

(二) 經費來源

筑波大學及日本文部科學省

(三) 目標任務

海洋生物之分子層次至生態系層次之基礎研究及相關科技教育之執行。「對生命的理解與建構認知海洋生物價值的社會」為目標。

(四) 目標推展策略

1. Marine Research Center 目標的擬定，目標對應性設施之建構。
2. 研究的目標的鎖定，並與國際合作執行（與澳洲、美國合作海鞘基因體解碼已完成）。考量單位資源與優勢，選定研究標的，研究體系以三角椎模式，教授（中心主任）一名、講師二名、技術人員數名，共同針對「海鞘的發育」，進行單一主題研究（論文已在 Nature 發表）。
3. 教育執行策略
日本國內目前共有 21 個 Marine Research Center，經費源自日本文部科學省與校方，研究與教育為其職責。開放對全國大學院、校生之課程開授及實習。對高中開設研習課程，對國小、國中學生舉辦自然觀察會。自行設計適合各級學生之課程內容，並設置研習營所需之住宿設施。

海洋教育推展策略特色：

依據下田臨海實驗中心海域資源特性，選取研究標的，並以研究主題為其科教主軸，由研究人員自行設計教案，並執行長年例行性舉辦之學生分級研習營。

值得學習、借鏡之海洋教育推展策略：

1. 日本國內，各大學由文部科學省補助設立附屬於大學之 Marine Research Center，目前只有 21 個表列於後。中心責任為研究，並以研究成果為基礎，進行教育活動，其運作模式是定期召開 Marine Research Center 中心主任會議，協調以各中心之地理特性、優勢、分工、整合，鎖定各自研究發展標的，及研究、教育的交流與成效評估。
2. 著重研究，研究成果用於科學教育。

日本大學附設海洋研究中心(Marine Research Center)分布圖



九、逗子開成中學・高校

地址：神奈川縣逗子市新宿2丁目5番1號，日本國

接待人員：橫山春夫

逗子開成中學・高校校長

TEL：046-871-2062

FAX：046-873-8459

E-MAIL：<http://www.zushi-kaisei.ac.jp/>

高橋純

逗子開成中學・高校教頭

TEL：046-871-2062

FAX：046-873-8459

E-MAIL：takahashi-j@zushi-kaisei.ac.jp

URL：<http://www.zushi-kaisei.ac.jp/>

小西信行

逗子開成中學・高校廣報部長

TEL：046-871-2062

FAX：046-873-8459

E-MAIL：konishi@zushi-kaisei.ac.jp

URL：<http://www.zushi-kaisei.ac.jp/>

參訪日期：2007年2月9日上午10:00

參訪影像紀錄：





參訪單位特色：

(一) 單位屬性

私人財團所設，1903年時為東京的「開成中學校」的分校，1909年獨立為「逗子開成中學校」；濱臨太平洋，為六年一貫教育，含國中、高中部門。校名源自易經之「開物成語」，校徽為櫻花和日本劍的組合，意味著「知力、心身的調和、發達」，表現日本忍者智慧與精神。

(二) 經費來源

私人財團

(三) 目標任務

高知識、多元表現，身心健康、自主、自律、國際化、資訊社會適應力，其教育目標表列於後。

日本國逗子開成中學・高校教育目標

■ 教育目標

1. 高い学力と多彩な表現力

楽しく充実した授業により、高度な学力と知的探求心を育成するとともに、総合学習や土曜講座等により、様々な表現力を身につけます。

2. 豊かな心と逞しい体

道徳教育や映像教育により、豊かな人間性を育むと同時に、ヨット帆走や遠泳などの海洋教育によって強く健康な身体を育成します。

3. 自主の精神と自律の意思

生徒主体の各種行事を通して自主性の大切さを学び、生徒会・クラブ活動等に参加することによって、自律的な行動意識を高めてゆきます。

4. 国際・情報化社会への適応力

海外への研修旅行や留学によって国際感覚を身につけるとともに、コンピュータ利用の学習により情報処理能力を養成します。

(四) 目標推展策略

- 一、針對各級教育階段分別訂定學生養成標的目標的訂定，依據標的目標擬定教學略，規劃需求課程，並由教師自行設計教案。其相關資料表列於後。
 1. 以有趣、充實的授課，達成知識求知慾的養成目標；以組合學習和週末講座達成多元教育。
 2. 以道德教育、映象教育，培育豐裕的人性關懷，以帆船、長泳的海洋教育培育健康、毅力。
 3. 自主、自律的養成，導生會、俱樂部活動之參與。
 4. 國外研修旅行、電腦資訊應用能力、國際化、資訊化社會適應力之培養。
- 二、海洋教育之重視，以帆船製作、帆船運動培養群體性、自主性、體魄與體力。群體生活、凝聚群體共同價值的空間設計與活動設計，如住宿、共浴、帆船製作、下水儀式…。帆船製作講義摘要表列於後。
- 三、文化教育的重視，日本文化的導入、融入式教育。重視人文教育，由「人間學」、「道德」之授課可見一斑。「人間學」及「道德」課程時程表表列於後。

日本國逗子開成中學・高校分級目標

大学進学に向けて

本校では中・高6年間を3つのステージに分け、大学進学に向けた学習指導・進学指導を行っています

第1ステージ:中1・2 →「基礎学力の定着」

第2ステージ:中3・高1 →「大学進学への意識・動機づけ」

第3ステージ:高2・3 →「志望大学受験への準備時間」

日本國逗子開成中學・高校之國中、高中六年課程規劃：

教科別6年間スケジュール

	中1	中2	中3	高1	高2	高3
英語	中学範囲		高校範囲		大学入試演習	
	英会話			選択英会話		
	AVC (コンピュータによる授業)					
数学	中学範囲		高校範囲			大学入試演習
国語	中学範囲		高校範囲			大学入試演習
	現代文					
	古文・漢文					
社会	地理	歴史	公民	倫理	日本史・世界史	日本史・世界史・政経 (私立文系1科目選択)
				政経		日本史・世界史・倫理・政経 (国公立理系1科目・文系1~2科目選択)
理科	生物	物理	化学	化学・生物	化学・生物 (文系選択)	化学・生物 (国公立文系選択)
	地学	化学	地球と環境	物理	化学・生物・物理 (理系2科目選択)	化学・生物・物理 (理系2科目選択)
保健体育	集団行動・スポーツテスト・陸上・水泳・球技・持久走					
	保健 (心身健康・事故と病気の予防)			保健 (健康と環境・救急法・講義と実演)		
芸術	美術			平面・立体・音楽・	○集中講義 (抽象について)	
	音楽			パフォーマンス (1科目選択)	○終了課題	

日本國逗子開成中學・高校之帆船製作講義範例

■ヨット製作の工程

1 部品組み立て

- バドル、淦くみ接着
- トランサム接着
- Mフレーム接着
- プラム船首接着
- センタートランク接着
- ラダーヘッド、センターボード接着
- ティラー接着

2 部品仕上げ

- ラダープレート、センターボード磨き
- フレームパテ埋め
- 磨き作業 (Mフレーム磨き残し)

3 部品塗装

- ニス塗り1回目
- ニス磨き
- ニス塗り2回目
- ニス磨き
- ニス塗り3回目
- センター、ラダーニス塗り

4 船体組み立て

- ストリンガー切断
- キー/ストリンガー/ガノネル入り
- 外板張り
- 防舷材取り付け
- ニー取り付け

5 船体仕上げ・塗装

- ハルパテ埋め
- ハルパテ磨き
- 防舷材ニーパテ埋め
- ハル下塗り磨き
- コックピット下塗り磨き
- Name入れ

6 船装品取り付け

- ビンドル、UPバック取り付け
- 金具取り付け
(アイプレート/アイボトル/スイベルなど)

ヨット製作と海洋講義

中1の10月から3月にかけて、ヨット製作と講義が行われます。生徒たちはグループを作って共同作業で製作を進めていきます。1つのクラスだけではなく、複数のクラスのメンバーが同じ艇を交代で製作します。

完成したヨットは5月中旬の進水式にてシャンパンがかけられ、逗子湾に船出します。船のへりには担当した生徒の名前が書き記されており、生徒たちは自分の手で作った船が自由に逗子湾を進むのをうれしそうに眺めています。

また製作作業と平行して、海洋に関する講義も行われます。この講義を通して、生徒たちはヨットに関する基礎知識を学んだり、現在世界の海が抱える環境問題などについて考える機会を持つことができます。

■海洋教育講義内容

ヨットはなぜ走るのか
(帆走理論) → 自然科学の視点

ロープワーク
(実技基礎) → 生活の智恵と技術

海上での安全
(安全確保) → 命・責任・協力

今世界の海で
(環境問題) → グローバルな視点

日本國逗子開成中學・高校之「人間學」學習時程表

総合的な学習

生徒たちが新しいグローバル社会で活躍するのに必要な力をつけることを目的とした学習プログラムです。

[人間学]

中1 広げる 人間関係を通じて学ぶ人間学

HR単位で人間関係をほぐし、人と関わることの楽しさを味わい、コミュニケーションスキルを学ぶ。「見る力」「聞く力」「話す力」を高めるトレーニングを行う。

中2 究める 人間の営みについて探究する人間学

本校教員が総力をあげて作成した『世界が抱える100の問題』（総合学習『人間学』テキスト、2005年4月発行）を用い、現代社会が抱える様々な問題への興味・関心を広げるとともに、「意見を持つ」訓練を行う。

中3 卒業発表 表現を生きる力に結ぶ人間学

義務教育・中学卒業を機に、自分が一番興味あるテーマを徹底的に研究し、発表する。ジャンルごとに分かれ、指導教官のもと1年かけて研究成果をまとめる。学年末に「卒業発表」を行う。

高1 進路探究 生き方を探る人間学

クエストエデュケーションプログラム（提供：教育と探求社）に参加し、実在する企業でのインターンシップを教室で体験することで、実際の企業活動に触れながら課題解決力を身につけ、自らの進路についても考える。

高2 進路探究 異文化に触れ生き方を考える人間学

選択制での海外を含む「研究旅行」と事前・事後学習、および大学見学・オープンキャンパスへの参加などを通して進路について具体的に考える。研究旅行では、自己を見つめ直し、探究心を深める。

日本國逗子開成中學・高校之「道德」學習時程表

道 德

逗子開成では、様々な機会をとらえて生徒に日ごろの生活態度を見直させ、規範意識を持たせ、実践する力を育てています。特に中学1～3年では、年間に渡って計画的に、道德の授業を行っています。

<2005年度の実施例>

中1

「中学生としての自覚を持つ」
「学校生活におけるルール・マナーについて」
「理想のクラスとは」
「迷惑メールの影響」
「いじめ」
「開成祭に向けてクラスの団結を図るには」
「万引き」

中2

「中学2年生としての自覚」
「家庭内のルール・クラス内のルール」
「校内での所持品の扱い」
「登下校のマナー」
「たばこ、薬物」
「インターネット利用のマナー」

中3

「中学最高学年の心構え」
「ニュージーランド研修に向けて
(日本と異なる文化・規則・ルール)」
「たばこ、お酒」
「進路について」
「高校生に向けての心構え」

海洋教育推展策略特色：

以帆船、長泳培養健康、毅力、獨立自主面對問題、解決問題的能力。

值得學習、借鏡之海洋教育推展策略：

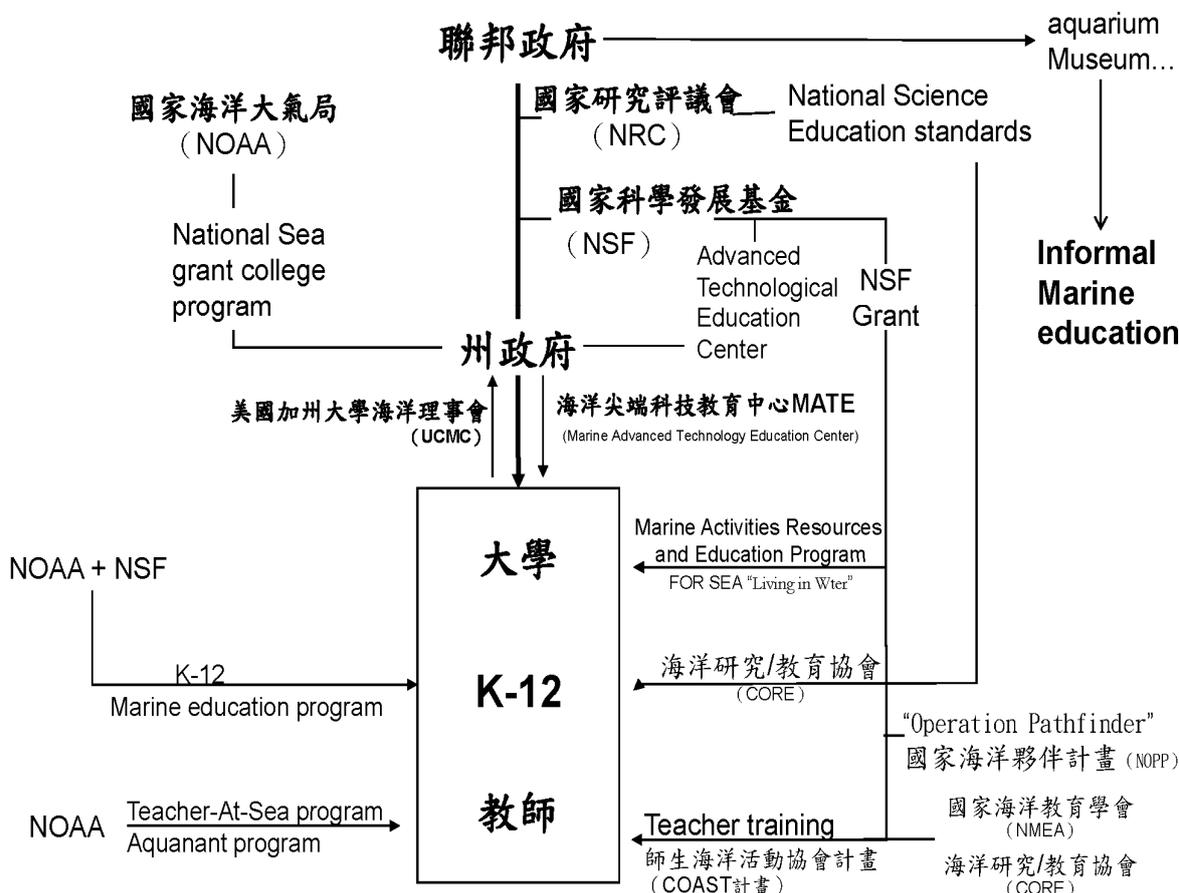
1. 對各級教育階段，學生養成目標標的的訂定，依據標的目標定教學策略，規劃需求課程，由教師自行設計教案。
2. 文化教育的重視，日本文化的導入、融入式教育。
3. 群體生活、凝聚群體共同價值的空間設計與活動設計，如住宿共浴、帆船製作、下水儀式…。
4. 特殊課程
總和學習，「人間學」其授課規劃，
另有情操教育，含
「朝的讀書」-早上先有十分鐘讀書時間
「道德教育」-表列如後
「映畫鑑賞」-觀賞優質電影後，撰寫評析報告。
5. 將學校的精神與發展歷史寫成書。溶入國家人文、科技、文化發展軌跡的陳述，型塑學校的精神象徵。

伍、美國海洋教育推展體系

美國海洋教育推展體系

教育係由州政府自主，具各州特異性。僅就全國性海洋教育推動體系，圖列如後。

美國海洋教育推動體系概念圖



<註>：

1. NSF grant, NSF has funded projects to encourage ocean science study by ethnic minorities as well. An example is a summer program between Harbor Branch Oceanographic Institution and Savannah State University. This provides research and ship-board opportunities for both faculty and students from Savannah State. Under an NSF grant, three curriculum projects spanning K-12 have been refined and enhanced. They will become available soon on two multimedia compact discs. The discs will contain all the text and graphics from the three projects. The three are the Marine Activities Resources and Education program, FOR SEA (developed by the Marine Science Center at Poulsbo, WA), and 'Living in Water,' an aquatic science curriculum for grades 5-7 developed at the National Aquarium, Baltimore.

2. COAST Consortium for Oceanographic Activities for Students and Teachers

CORE Consortium for Ocean Research and Education

NMEA National Marine Educators Association

NOAA National Oceanic and Atmospheric Administration

NOPP National Ocean Partnership Program

NRC National Research Council

NSF National Science Foundation

美國海洋教育推動體系特點概述

- 一、經費之整合：聯邦→州→民間，成立獨立單位負責整合。
教師能量整合：成立「協會」負責整合。
「經費、能量」整併至正規教育體系。
- 二、政府經費補助「協會」執行教育計畫。
- 三、由「美國國家科學發展基金」創立尖端科技教育中心，海洋尖端科技教育中心（Marine advanced technology education center, MATE）為其中之一，其職責為輔助正規教育體系。
- 四、分級規劃 K-12 學生課程，設計、重視教師培訓，均由國家經費支持，委由學校、水族館、或協會執行。
- 五、National Sea Grant College Program，研究議題「由下而上」協調、整合，是高等教育體系，專業人才培育的重要機制。協調整合界面的成立為其重要執行策略，以加州為例、「加州大學海洋理事會」是為學界與政府的聯結界面。
- 六、國防創造產業發展，產業締造人才需求面，人才需求導引人才培育。

<註>1998 年美國海洋教育總覽於後。

1998 年美國海洋教育總覽

1998 Year of the Ocean

MARINE EDUCATION, U.S.A.: AN OVERVIEW

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This Year of the Ocean document was prepared as a background discussion paper and does not necessarily reflect the policies of the U.S. Government or the U.S. Government agencies that participated in its preparation.

INTRODUCTION

This document provides an overview of marine education in the United States in 1997. For the purposes of this report, marine education refers to the education related to the ocean, coastal waters, and the Great Lakes. Aquatic education is a broader term that includes all inland waters (rivers, lakes, and wetlands). Environmental education is another term broader than marine education. These are not directly covered by this report. Formal marine education is carried out at schools, colleges and universities. Informal marine education occurs in the media, at public aquaria, and by various public and private agencies and organizations.

The Advisory Committee on Protection of the Sea's May 1997 report of the Oceans and Security Conference, includes the "Potomac Declaration: Towards Enhanced Ocean Security into the Third Millennium." :

Recognizing that:

Continuing intensification of human activity in coastal and marine areas will adversely affect marine and coastal ecosystems world-wide and threatens the well-being of the human population. The natural resource base of world fisheries is threatened by overexploitation, habitat degradation, introduction of alien species and loss of biological diversity. Human security is threatened by unsustainable food production, increased public health hazard and unemployment, which may contribute to escalating human conflicts. Humans themselves have entered into conflict with the very environment that supports them. It is vital to take immediate action to strengthen environmental security if global human security is to be sustained;

Climate change threatens to affect ocean levels and temperature, the land and peoples living in low elevation coastal regions, and species dependent on ocean and land touched by oceans. The oceans play an essential role in the planet's climate, though the mechanisms are poorly understood; and

Sustainable development, including conservation of the marine environment, can actually increase environmental, food and economic security and therefore provide a foundation for political security.

Recommendation 10 from the Oceans and Security Conference states:

"Concerted national and international efforts should be undertaken to introduce

environmental studies into all levels of formal school curricula at a global level, in order to eliminate environmental illiteracy, increase environmental awareness, and promote deeper environmental ethics. Up-to-date scientific knowledge about the oceans should be popularized and disseminated to the public through both formal education and creative communication channels such as arts, music, and multi-media. In support of this effort, the year 2000 should be declared as the “Year of Environmental Awareness” by the UN General Assembly at its forthcoming Special Session.”

HISTORICAL BACKGROUND

It is only fitting that any discussion of marine education in the United States begin with a recognition of the contribution that Benjamin Franklin made as the publisher of the first chart of the Gulf Stream in 1770. In order to speed up the delivery of mail and goods from America to Europe, he urged that ships stay in the Gulf Stream to take advantage of the current. Based on measurements of temperature he took in his Atlantic crossings in 1775, 1776 and 1785, he advocated using regular temperature readings to ensure that the ship remained in the relatively warmer waters of the Gulf Stream. Franklin’s cousin, Captain Timothy Folger of Nantucket, Massachusetts, provided essential information about the Gulf Stream and assisted in making the first chart. Folger was an experienced whaling ship captain who was familiar with the North Atlantic Ocean.

In 1838, the first American scientific voyage of discovery was launched. The United States Exploring Expedition, under the leadership of U.S. Navy Lieutenant Charles Wilkes, was a four-year expedition which resulted in a final report of 19 volumes of maps, text, and illustrations, including 241 new maps and charts.

Earlier, on August 13, 1825, Midshipman Matthew Fontaine Maury had been assigned to the USN Frigate, *Brandywine*, whose first duty assignment was to return General Lafayette to France following the mourning of the simultaneous deaths of Thomas Jefferson and John Adams on July 4, 1825. Maury kept a diary of his observations at sea, and his recordkeeping expanded in 1831 when he became sailing master of the *Falmouth*. On October 17, 1839, Maury was thrown from a stagecoach in an accident and sustained multiple injuries that precluded his return to sea. Fortuitously, Maury was reassigned as Superintendent of the U.S. Navy Depot of Charts and Instruments, later to become Superintendent of the U.S. Naval Observatory. In these new positions, he assiduously collected information from ships’ logs. His first oceanography book, *The Physical Geography of the Sea*, was published in 1854 and was followed by seven revisions. The book was both popular and influential and is an important milestone in the history of marine education in America.

Two other popular books written in the 19th century by Americans also contributed to

the public's knowledge about the sea. *Two Years Before the Mast*, by Richard Henry Dana, documented his voyage around Cape Horn from New England to California. It provided the public with a true, first hand account of shipboard life and waves and weather across more than 100 degrees of latitude in two oceans. The other book, Herman Melville's *Moby Dick*, while a novel, described many aspects of the life of a whaler and much information about whales and other sea life. Both books were important early sources of information for the public about the sea.

Science teachers in New England began receiving the first summer training in marine biology in the late 1870s under the leadership of Harvard University's famous naturalist, Alexander Agassiz. In addition to having founded the Museum of Comparative Zoology at Harvard, he was also the founder of the first U.S. marine station, the Anderson School of Natural History on Penikese Island, Buzzard's Bay, Massachusetts. There, the teachers, who were all women, stayed in a dormitory at Woods Hole, Massachusetts, and studied local marine life while learning new techniques using microscopes and dissection instruments. This represented a new, hands-on approach for pre-college education. Indeed, the study of science was just being introduced in schools at this time.

Scripps Institution of Oceanography was founded in 1903 and became a part of the University of California, Los Angeles in 1912. During the first half of the 20th century, virtually all the U.S. oceanographers were trained at this institute. It remains a cornerstone of leadership and research in the oceanographic community and in higher education. Woods Hole Oceanographic Institution was originally a marine biological laboratory and did not offer graduate degrees until the post-World War II era. In fact, the other leading institutions of higher education in oceanography did not play a significant role until after World War II.

World War II was a major milestone in marine science and education. Of course, many people went to sea for the first time. Sea warfare, especially submarines and aircraft carriers, created new strategic ocean-related needs. In 1942, the last single volume (1,087 pages) was published containing everything known about oceanography, *The Oceans*, by H.U. Sverdrup, Martin W. Johnson, and Richard H. Fleming. The field of oceanography has grown geometrically since then.

The deep dives by Andreas Rechnitzer, Don Walsh (both U.S. Navy) and Jacques Piccard in the bathyscaph, Trieste, captured the American pride in 1959 and 1960 after the cultural shock of Sputnik in 1958. These dives, the first television shows by Jacques Cousteau, and the emerging theory of plate tectonics raised the awareness level of the American public. A new exploratory submarine, Alvin, was launched. Amidst the excitement, many new ideas emerged. Three had special significance for marine science and education. One was the theory of plate tectonics, which forced a rewriting of textbooks at all levels, and a new general understanding

of why earthquakes occur and why they occur where they do. A second idea came from Dr. Carl Hubbs at Scripps Institution of Oceanography. He thought a facility that would bring people in proximity to whales could prove educational. Thus, the idea for Sea World came to fruition with private sector support. Third, Dr. Athelstan Spilhaus, an eminent scientist, thought that the United States should enact a Sea Grant Act patterned after the Land Grant Act but focused on the sea. With support from the new Dean of the School of Oceanography at the University of Rhode Island, John Knauss, Senator Claiborne Pell, and many others, the Sea Grant Act was enacted in 1966.

The period of 1969-1974 was a time for a call to action in the environmental arena.. It was during this time that the Environmental Science and Services Administration, later to become the National Oceanic and Atmospheric Administration (NOAA), was established. Notable legislation enacted included: the Endangered Species Act, the Marine Mammal Protection Act; the National Coastal Zone Management Act; the Marine Protection, Research and Sanctuaries Act; the Federal Water Pollution Control Act; and the Clean Air Act. It was also during this period that the U.S. Environmental Protection Administration (EPA) was created. President Richard M. Nixon supported the initiation of the UN Law of the Sea deliberations and set the agenda for them. He also supported the UN Resolution on Prevention and Control of Marine Pollution. From this brief summary of events during his administration, it is possible that history may come to view President Nixon as one of the greatest “environmental presidents.” .

For marine education in the 1970s, the resonant call to action produced multiple responses. New aquaria were built and Sea World expanded. Ocean-related television programs proliferated, with those featuring the prominent oceanographic explorer, Jacques Cousteau, being among the most notable. The National Marine Educators Association was established in 1976. The National Sea Grant College Program funded many initiatives in K-12 curriculum development. Interest and excitement peaked in 1977 with the discovery of the Galapagos deep sea hot springs and their associated chemosynthesis-based food web.

The stage is now set for a look at the current state of marine education.

INFORMAL MARINE EDUCATION

SeaWeb

“SeaWeb” was established in 1996 by the Pew Charitable Trusts to provide information about the ocean and ocean-related issues to the public. It is a multi-media educational organization designed to make the public more aware of the ocean and ocean life. It does no

lobbying. One of SeaWeb's first endeavors was to contract with The Mellman Group to carry out a national survey of public attitudes towards, and knowledge about, the ocean, ocean life, and ocean-related issues.

The results of the SeaWeb survey provide a promising picture on the level of awareness and importance of marine issues to the public. The most startling finding was that people (72 percent) believe that ocean exploration is a higher priority than space exploration. Many people (87 percent) consider the ocean to be important to them. Most people (67 percent) believe the ocean is in trouble. A majority (58 percent) believe the condition of the oceans has deteriorated in the past few years, and many (87 percent) see the destruction of the ocean as a threat to their quality of life. A large majority of the people in this survey (82 percent) attributed the deterioration and threats to the ocean to human activity. Although Americans generally want less government in their lives, 85 percent would like the federal government to do more to help protect the ocean. Finally, when asked the question, "Which messenger of information about the environment do you trust a great deal?", people chose *National Geographic Magazine* (68 percent), Jacques Cousteau (63 percent), zoos and aquaria (51 percent), and NOAA (49 percent). Prominent elected officials, regardless of party, were very low on this list.

The SeaWeb survey establishes the importance of the ocean to the American public and the readiness of the public to take action to remedy ocean-related issues. As one of its educational activities, SeaWeb has begun publishing a monthly, "Ocean Update," focusing on current issues and providing contacts for further information (website address: www.seaweb.org). SeaWeb also sponsors a 90-second "Ocean Report" on National Public Radio and Voice of America with Sylvia Earle.

Aquaria

Aquaria, maritime science centers, and museums are currently a major source of informal marine education for the public. At this time, there are twenty-seven aquaria around the country, some for-profit, some for nonprofit. Education is a fundamental goal for all of them. Most aquaria have extensive educational outreach programs for school children and children in other groups (Scouts, Boy/Girls Clubs, etc). The outreach programs include escorted tours at the aquarium, classroom visits by aquarium staff, books, tapes, and curriculum materials.

Some of the best known of these facilities are Sea World, Monterey Aquarium, Waikiki Aquarium, the National Aquarium at Baltimore, the New England Aquarium, the Miami Sea Aquarium, and the Chicago Aquarium. In 1998, a new Maritime Discovery Center will open in Seattle. In 1999, a new aquarium will open in Charleston, South Carolina, and another in

Long Beach, California, in 2000. New facilities are in the planning stage in Erie, Pennsylvania, and Denver, Colorado. These facilities are extremely popular and annually host millions of people to whom they provide high quality marine education opportunities. This approach to providing marine education is highly successful. It could possibly be improved by cooperative input from federal agencies as is now being initiated through Coastal America, a federal, multi-agency consortium.

Media

As indicated by the SeaWeb survey, the national media have an excellent reputation with respect to informing the public about the ocean. Most notable is the National Geographic Society. This organization's magazine has a large public circulation, is relatively inexpensive, and is in most school libraries. A notable example is the *National Geographic* issue of November, 1995, whose theme is "Exploring the Ocean's Bounty: Diminishing Returns." Other efforts by the Society in partnership with IBM have produced state-of-the-art CD-ROMs on marine life. It is widely recognized that the Society's television specials are high quality and popular, which explains why they are often shown on PBS-TV pledge nights. The National Geographic Society plans a one hour special for the Year of the Ocean to be shown on NBC-TV in 1998.

Everyone will miss Jacques Cousteau and he can never be replaced. His role in providing marine education for the world public is unmatched and unique. He has left a legacy of books and television programs for the continued benefit of the public. Some other individuals have made important contributions to informal marine education. In the 1950s, Thor Heyerdahl captured the attention of the world with his ocean voyages, books, and films. Currently, Robert Ballard, through his JASON project, has reached many people—especially young people. He has collaborated with the National Geographic Society in producing television specials. Another prominent spokesperson is Sylvia Earle, who serves on the Board of Directors for SeaWeb and has served as Chief Scientist for NOAA.

A recent spokesperson for the ocean, Jane Lubchenko, has gained prominence as President of American Association for the Advancement of Science. As a marine biologist studying coastal, rocky-shore ecology, she has raised the knowledge and awareness of many about the vulnerability of the coastal zone to human impacts.

There have been many modern books that have made major contributions to the understanding of the sea by the public. Rachel Carson's books, *The Sea Around Us* and *Under the Sea Wind*, were both best sellers and have served to educate and heighten the awareness of the public about the sea since their publication thirty years ago. A recent best seller, *The Perfect Storm*, by Sebastian Junger, gives a riveting account of men and women at sea

struggling against the sea and weather. This nonfiction account of three storms coalescing off New England in October, 1991, is an excellent source of information about the sea.

Newspapers and national magazines are increasing their coverage of environmental issues, including the ocean. Global warming is a high-profile international issue which now has frequent and comprehensive coverage. The predicted El Nino, 1997-98, has received similar coverage. Many scientists have been quoted and the media has made a significant effort to educate the public about the science involved. Many elements of the national media have increased their coverage of such ocean-related issues as global climate change, El Nino, and fisheries. Occasional disasters, such as Hurricane Andrew and the Exxon Valdez oil spill, have also led to expanded media coverage of the ocean and subsequent education of the public.

Federal Agencies

Identifying the federal agencies involved in informal marine education is not entirely straightforward. Determining how much these agencies spend on informal education is an impossible task. The problem is that many agencies have a general responsibility for education with no specific staff educators or budget. To a large extent, responsibility lies in a public affairs office, as in the case of the U.S. Coast Guard. Then too, it also depends on the definition of informal marine education. For example, if one includes boater education, The U.S. Coast Guard plays a large role. For this report, agencies with a budget and legislative mandate for informal marine education will be highlighted.

In the National Oceanic and Atmospheric Administration (NOAA) of the Department of Commerce, programs in three offices have specific informal marine education responsibilities. Obviously, the National Weather Service is a major provider. With more than 50 percent of the nation's population living within 100 miles of the coast, information about weather, tides, and waves along the coast is of continuing interest to the public. The National Weather Service maintains local forecast offices, provides information on the Weather Channel and other broadcast outlets for television and radio, and has special severe storm watch centers. The National Weather Service does an outstanding job of meeting its informal marine education responsibilities.

The National Sea Grant College Program in NOAA's Oceanic and Atmospheric Research Division supports informal education through its local programs in 30 coastal and Great Lake states and Puerto Rico. In Fiscal Year 1997, Sea Grant funds six special informal education projects for \$486,000. Most of its activities in this area are carried out by marine educators and marine advisors through local marine extension programs. The activities are diverse and range from teacher workshops to boater education and safe handling of seafood. Some of the

activities are community-based efforts such as beach clean-ups. Others are national in scope such as MarinaNet, which provides information and education to marina owners and operators, and the Hazard Analysis and Critical Control Point system, which provides Food and Drug Administration-approved safe handling techniques to people in the seafood industry. Testimony in Congress at the recent Sea Grant reauthorization hearings and a recent study by the National Research Council endorse the success and high quality of these efforts.

The National Marine Sanctuaries Program and the National Estuarine Research Reserves System in NOAA's National Ocean Service also have informal marine education responsibilities. One of their mandates is "resource protection through enhanced public awareness, understanding, appreciation, and wise use of the coastal and marine environments." There are presently 12 sanctuaries and 22 estuarine reserves. Sanctuaries has been granted special authority to organize "friends" groups to help support local sanctuaries. Sanctuaries and Reserves both have education visitor centers for the public and school children. They provide supplemental school curricular activities, sponsor nature walks, and publish informative newsletters. These activities are limited in scope but highly successful and effective at their local sites.

Coastal America is a partnership of representatives of eleven federal agencies including NOAA, the Environmental Protection Agency, the U.S. Navy, the U.S. Army Corps of Engineers, and the Department of the Interior. Their activity in informal marine education is to designate Coastal Ecosystem Learning Centers at various aquaria and to provide appropriate enrichment materials from each participating agency at the Centers. This is a new effort and only five learning centers, such as at the New England Aquarium, are functioning. It shows great potential for disseminating materials from diverse agencies. Also, Coastal America offers an opportunity to coordinate informal marine education activities among the partnering agencies.

The Smithsonian Institution has a long record of high quality informal education. Each of the Smithsonian museums has its own education program. None of the museums is specifically marine oriented, although the Museum of Natural History has many marine exhibits including special displays, and a traveling exhibit and documentary movie for "1997, International Year of the Coral Reef." Their outreach effort on coral reefs has reached millions of Americans during the past year. Their magazine, *The Smithsonian*, sometimes carries marine-related articles and has substantial public circulation. The Smithsonian also has another traveling exhibit called "Project Ocean Planet Awareness."

The U.S. Coast Guard, as previously mentioned, has a significant and important role in informal marine education. The principal responsibility rests in the Office of Navigation, Safety and Waterway Services. The specific responsibilities include enforcement of federal

laws and regulations (and dissemination of knowledge about them), supervision of local Coast Guard Auxiliary operations, establishment of pleasure craft safety standards, administration of public education and training programs (especially regarding handling of all vessels and pollution control), and liaison with other organizations and state and local agencies concerned with boating safety and water pollution. The Boating Education Branch administers an extensive public information program which includes distributing literature, offering courses, and making announcements for the media. Recreational boating represents a \$20 billion dollar industry in the United States with a 10 percent annual growth rate. The main problem for the USCG is its multiple responsibilities. It does an outstanding job with limited resources.

The Department of the Interior's National Park Service, through some of its parks, monuments, and national seashores, maintains site specific programs in informal marine education. There are visitor centers at each of these sites with educational exhibits, special programs, nature hikes, and book stores. The National Park Service has a World Wide Web site called The Learning Place (<http://www.nps.gov/interp/learn.htm>) with many educational materials, especially for teachers.

The U.S. Environmental Protection Agency (EPA) provides and supports a wide array of marine education mechanisms that reach targeted technical audiences, children, the general public, and industry groups. EPA's Marine Debris Curriculum, available in both English and Spanish, provides lesson plans and activities to help teach grade school students about marine debris, where it comes from, how it can harm the environment, and what they can do to help reduce the amount of debris entering marine waters. The National Estuary Program contains a public outreach and education component, and all 28 estuary programs around the country include a Citizens Advisory Committee to educate citizens about threats to their estuaries and involve them in devising solutions to those threats. Numerous training courses are offered to EPA constituent groups on topics such as coastal resource protection at the local level, consensus-building for watershed planning, and volunteer monitoring in estuarine waters. Technology transfer is also emphasized in many of EPA's ocean and coastal programs such as an effort underway in the wider Caribbean to share low-cost methods for managing land-based sources of marine pollution, and EPA's support of the *Coastlines* newsletter to provide local communities with a source of applied coastal management techniques and contacts to protect their coastal watersheds.

K-12 MARINE EDUCATION

National Standards

The *National Science Education Standards* by the National Research Council (National Academy Press, Washington, DC, 1996) contain almost no mention of the ocean.¹ There is no mention of the oceans or life in the sea in the major sections on Physical Science, Life Science, Science and Technology, Science in Personal and Social Perspectives, or History and Nature of Science. The citations above are in Earth and Space Science. Inferred references can be found in the citations regarding water, although a knowledgeable person would need to point these out. In the references to fossils, evolution and biological diversity, the ocean connection is never explicit. The words “ocean,” “sea,” “marine,” or even “water,” do not appear in the index. This omission is appalling. Of course, no oceanographers were on the consulting advisory panel. There is a crucial need for an addendum to the *National Science Education Standards* detailing how the ocean fits in with the cited standards.

Admiral (ret.) James Watkins, President of the Consortium for Ocean Research and Education (CORE), recognized this omission and pointed out that, in fact, the ocean sciences comprise “one perfect implementation mechanism to meet national standards.” In his address to the National Marine Educators Association conference in Chicago, August 1997, he said, “The so-called content standards of the *National Science Education Standards* include categories, each of which I will discuss in conjunction with utilizing ocean sciences as the ideal implementing tool.” To this end, Admiral Watkins remarked on the following categories:

Unifying Concepts and Processes in Science. “The science of biochemistry, which is one of the most interdisciplinary fields ever developed, was invented by marine scientists in order to understand the global carbon budget and its role in controlling climate.”

Science as Inquiry. “Ocean science is still a science of untold discoveries. Each research cruise raises as many new questions as it answers old ones. Some refer to oceans as the last frontier here on earth.”

Physical Science. “Study of the sea covers every aspect of physics, from the classical dynamics of wave theory, to the most fundamental aspects of high energy physics

¹ Here are the only citations: (1) page 159, “ocean floors are the tops of thin oceanic plates,” “...to change continuously earth’s crust, oceans, atmosphere...”; (2) page 160, “Water evaporates...collects in lakes, oceans, soil...”, “Oceans have a major effect on climate, because water in the oceans holds a large amount of heat.” (3) page 189, “This energy transfer is influenced by...static conditions such as the position of mountain ranges and oceans.”

related to how sea water interacts with deep undersea muons and neutrinos. It is these studies which will feed into our understanding of such seemingly unrelated subjects as nuclear fusion as an energy source.”

Life Science. “The ocean holds the key to the origins of life, as shown in the chemosynthetic behavior of deep-sea vent biota. How can life exist in the absence of sunlight, and often in hostile environments prohibitive to their counterparts with which we are familiar in shallower waters?”

Earth and Space Science. “Even a subject as seemingly remote as the study of asteroids is now being addressed through analysis of deep-sea cores where sediments have revealed the clues to the extinction of dinosaurs 65 million years ago.”

Science and Technology. “Every aspect of technology, including communications, advanced materials, information technology, and sensor design, is critical to ocean sciences, and made even more difficult by the forces of the operating environment. Arguably, in many aspects, deep ocean research is more technologically challenging than studying rocks on Mars.”

History and Nature of Science. “The history of oceanography is one of basic research feeding immediately into societal needs -- defense and fisheries are the classic examples, but new issues such as coastal hazard mitigation and sustainable development of mineral resources will demand even stronger ties between the social sciences and ocean sciences.”

Textbooks

None of the major publishers of public school textbooks publishes one on oceanography, marine science, or marine biology for the K-12 portion of formal education. Many publishers have sections of Earth Science textbooks that relate to the oceans. Most are compendia of facts or concepts about the ocean such as tides and plate tectonics, which tend to be complicated. The coverage of other topics in the ocean sciences is sparse. The authors and editors of these volumes appear to have little knowledge about the oceans except what they may have read in a college textbook. They also seem unaware that many children in the United States have been to the ocean often; after all, 50 percent live within 100 miles of the shore. Many children thus have an experiential base to build on. There is a major need for a national conference/workshop to educate the authors and editors of the major textbook publishing companies about the ocean and how this knowledge can be infused into the K-12 science and social science curriculum.

Curricula

While textbooks in marine education are scarce and inadequate for K-12 education, the same cannot be said for available curricula. The Consortium for Ocean Research and Education (CORE) is compiling an inventory of K-12 marine education programs. This is due to be published in 1998 and will provide much needed information on a national basis.

Federal agencies, especially Sea Grant and the National Science Foundation (NSF), have funded the development of marine science curricula for K-12 use. Some of these have been in use for several years by many teachers, and have been cited for excellence by various organizations such as the National Science Teachers Association (NSTA) and the U.S. Department of Education.

The Hawaii Marine Science Studies program was developed by the Curriculum Research and Development Group at the University of Hawaii. It is designed as a one or two year integrated science program for grades 9-14. It is a hands-on, multidisciplinary program with a marine theme that integrates science, technology, and environmental studies. The Fluid Earth portion has units on waves and beaches, physical oceanography, chemical oceanography, and transportation. The Living Ocean portion deals with fish, invertebrates, plants, and ecology. This is not a Hawaiian-only program. The program has been reviewed by at least 50 marine scientists and tested in the classroom by over 400 teachers to date. Clearly, this is a high quality program that fits a new niche in grades 9-12, namely, a two-year "integrated science" course for all students. This type of course is especially applicable in California where the State Science Framework calls for some physical, life, and earth sciences in each science course.

At the Lawrence Hall of Science, University of California, Berkeley, the Marine Activities Resources and Education program is a comprehensive ocean exploration program developed for K-8 (elementary and middle schools) . This program devotes the attention of an entire student body of a school to the ocean for a week. Students read books and stories about the ocean, create ocean-related art, listen to music about the sea, and study ocean-related topics in mathematics, science, and social science. There are special programs for teachers, parents, and even the community. This program provides a short but intense and comprehensive approach to marine education, not just to marine science education.

A new international environmental curriculum is underway that has the endorsement of the Clinton/Gore Administration. Called "Global Learning and Observations to Benefit the Environment (GLOBE)," its focus was on making measurements and observations related to lakes, rivers, and weather. Recently, GLOBE is expanding to include coastal waters.

Students make measurements and observations based on a GLOBE protocol and share data via the Internet. To date, more than 3,000 schools in 50 countries are participating.

Under an NSF grant, three curriculum projects spanning K-12 have been refined and enhanced. They will become available soon on two multimedia compact discs. The discs will contain all the text and graphics from the three projects. The three are the Marine Activities Resources and Education program, FOR SEA (developed by the Marine Science Center at Poulsbo, WA), and "Living in Water," an aquatic science curriculum for grades 5-7 developed at the National Aquarium, Baltimore.

"Oceanic Education Activities for Great Lake Schools" was developed at Ohio State University under the leadership of Dr. Rosanne Fortner. These are activities that are designed to take a concept or idea from the existing school curriculum and develop it into an oceanic and Great Lakes context using teaching approaches and materials appropriate for grades 5-9. Dr. Fortner has also developed "Great Lakes Instructional Materials for the Changing Earth System." The topics include fisheries, shipping, pollution, biodiversity, climate, and estuaries (wetlands). These were developed mainly with Sea Grant funding.

In 1998, CORE is sponsoring a national "Ocean Sciences Bowl" along with CORE member institutions and the National Marine Educators Association (NMEA). This will be the first time a national high school competition on the ocean is held. Awards will include scholarships, research cruise participation, visits to ocean research laboratories, computer hardware and software, and laboratory supplies and equipment. The grand prize will be a trip to the International Year of the Ocean celebration at EXPO '98 in Lisbon, Portugal. This bowl will be modeled after the National Science Bowl, now in its seventh year. There will be regional competitions (16) followed by a final competition in Washington, D.C., during Earth Week in April, 1998. It is expected that teams from up to 500 high schools will compete. Funding is provided by NSF, NASA, NOAA, U.S. Navy, and other agencies, and private sources. This competition should provide national visibility for the ocean sciences and be highly motivational for students. It is great to see such cooperation between ocean science-related agencies.

A "new kid on the block," the National Ocean Partnership Program (NOPP) has recently appeared on the marine science education scene. Following a very short notice and limited Internet announcement, this program has nonetheless already funded five K-12 ocean-related projects that may prove to have major national impact potential. These are as follows:

- “The Bridge: A Marine Education Clearinghouse” is a project to provide teachers access to the multiplicity of marine-related educational and curriculum materials or, at least, annotated reviews of commercial materials. This is an update and extension of a Sea Grant-funded project begun over 15 years ago at the Virginia Institute of Marine Sciences. “The Bridge” will be developed in consultation with the National Marine Educators Association and will be linked to NMEA on the Internet.
- “JASON IX” will continue under the leadership of Dr. Robert Ballard. This is an ocean exploration project which links Dr. Ballard in a submersible, usually Alvin, to students at remote, scattered sights via telecommunication/satellite. This is a real-time, live, exciting experience for students and teachers (and sometimes Dr. Ballard!).
- “COAST: Consortium for Oceanographic Activities for Students and Teachers” builds on the past five years experiences of “Operation Pathfinder,” the Sea Grant initiated teacher training workshops. It also will extend Operation Pathfinder to high school teachers and pre-service teachers in training at the college level. As with Operation Pathfinder, a shipboard, at-sea experience for teachers is included.
- “Bringing the Ocean into the Pre-college Classroom Through Field Investigations at a National Underwater Laboratory” will be carried out through Rutgers University and NOAA. There is presently a shallow water laboratory located offshore of New Jersey doing comprehensive ocean data monitoring. The experimental project will be linked to classrooms enabling students not only to learn about the nearshore marine environment, but also to appreciate the technical problems inherent in real-time ocean monitoring in the environment.
- The University of South Florida will extend its “Project Oceanography” live via educational television to middle school science students. In Fall, 1997, seven weeks are devoted to coral reefs and seven weeks to plankton. NOPP is joined in supporting this project by National Geographic Society and five private sector corporations (Honeywell, K-Mart, Northern Trust Bank, TASA Graphic Arts, and Time-Warner Communications).

Sea Grant has funded fifteen K-12 education projects for 1996-97 at fifteen different educational institutions from Hawaii to Maine to Puerto Rico. These projects are for teacher training, curriculum development, and student field experiences. They include Operation Pathfinder, which will be publishing 50 activities of its “best of the best” designed for middle school students by the teacher participants.

The Environmental Protection Agency is funding a compilation of 50 coral reef education activities for middle school teachers. This effort will employ both English and Spanish editors. The activities are compiled by Dr. Sharon Walker, Gulf Coast Research Laboratory, Biloxi, Mississippi. Teacher workshops will be held in Humacao, Puerto Rico, in summer, 1998, in conjunction with the annual conference of the National Marine Educators Association.

In an innovative new program being developed currently with funding from NOAA's Oceanic and Atmospheric Research Division, real-time oceanographic data will be accompanied by lesson plans and instructions for using the data through OAR's home page on the WWW.

Teacher Training

The National Science Foundation has funded summer institutes and other programs to train teachers in marine education. In fact, the author directed the first summer institute in oceanography for teachers in 1972-73. NSF has recently been funding the "Maury Project" at the U.S. Naval Academy. This teacher training project was originally a partnership between the Naval Academy, and the American Meteorological Society. With its early success, sponsorship has grown and now includes the U.S. Naval Meteorology and Oceanography Command, the Office of Naval Research, and NOAA's National Environmental Satellite, Data, and Information Service, and NOAA's National Ocean Service. This project concentrates on physical oceanography in a two-week summer workshop including laboratory and ship-board experiences. To date, 76 teachers have been trained and each summer 25 more are expected to be trained. After attending, teachers are expected to become "peer trainers" to conduct local workshops for teachers in physical oceanography. This has been a highly successful program that deals with a topic rarely or poorly covered in K-12 curricula.

Sea Grant initiated a teacher- training program called "Operation Pathfinder," now in its fifth year under the leadership of Dr. Sharon Walker at the Scott Marine Education Center and Aquarium in Biloxi, MS. The project name derives from the USN survey ship Pathfinder. Two week summer workshops are held regionally for elementary and middle school teachers. In 1997, six were held in Connecticut, North Carolina, Mississippi, California, Minnesota, and Ponape Island (Mariannas). The following agencies were co-sponsors with Sea Grant: NOAA's National Environmental Satellite, Data and Information Service, Office of Naval Research, U.S. Naval Meteorology and Oceanography Command, and the Department of the Interior. Teachers were trained in oceanography and coastal processes. They also had a shipboard at-sea experience. About 300 teachers have been trained to date. "Operation Pathfinder" was the basis for an expanded teacher training program called "COAST," which has been funded by the previously mentioned NOPP.

NOAA maintains a “Teacher-At-Sea” program. Teachers are invited to participate in fishery cruises under the research program of the National Marine Fisheries Service. As many as 40 teachers participate annually. The National Undersea Research Program in NOAA funds an “Aquanaut Program” which allows some teachers and students to go to sea to use remotely operated vehicles in research projects. The U.S. Navy and the National Geographic Society run Project Marco Polo which enables middle school teachers and students to go to sea on a Navy oceanographic ship.

Nationally, pre-service teaching and teacher credential programs rarely provide any special instruction in oceanography. Some universities offer oceanography or ocean-related courses as electives for those planning to teach. Teaching methods courses frequently provide information about water, but rarely about the ocean specifically. Some colleges that train teachers in dissection techniques do use fish as a vertebrate example; more generally however, teacher training at universities ignores areas that pertain to the ocean. One noteworthy exception is Oregon State University, which offers an MS degree in science education with marine emphasis for teachers. The teachers go to Newport, Oregon, and take courses every summer for three years at the Mark Hatfield Marine Science Center. This is the only degree program in marine education in the United States and it graduates about five students per year while maintaining enrollment at fifteen students.

CORE led an education workshop on ocean sciences and K-12 education in 1996 sponsored by NSF. The participants included ocean scientists, classroom and informal science education experts, and leaders in science education. The participants agreed on the following general conclusion:

“...the workshop participants strongly support the theme that the ocean agencies present outstanding opportunities and untapped resources for K-12 education, and that oceanographic processes and features are ideally suited for constructing and demonstrating knowledge and science-based skills in the fundamental principles of science across all disciplines, including the social sciences, and over a wide range of levels of sophistication. The challenge is for the ocean sciences research community and K-12 educators to reach out and develop partnerships (both formal and informal) to, over the long term, mutually develop new ways to infuse the ocean sciences into K-12 education at all levels and throughout the curriculum.”

The CORE report recommended urgent action in these priority areas:

1. Develop a formal umbrella partnership directed at ocean sciences and K-12 education reform with professional societies and associations which share similar

goals and concerns. These include, but are not limited to: the American Association for the Advancement of Science (including Project 2061), the National Science Teachers Association, the National Marine Educators Association, the Association of Science-Technology Centers, the Association of Zoos and Aquariums, The American Geophysical Union, and The Oceanography Society. The basic purposes of these partnerships should be to:

- a. facilitate implementation of the recommendations in this report;
 - b. ensure the highest standards of quality are met throughout this process;
 - c. foster the development of standards for ocean science literacy;
 - d. enhance visibility of ocean sciences in educational reform;
 - e. explore new linkages between ocean sciences and education communities.
2. Develop, publish and disseminate “Standards for Oceans/Ocean Science Literacy.” In other words, what are the basic knowledge components (by discipline, such as physics and by topic, such as ocean currents) that should be understood by students at different grade levels (K-4, 5-8, 9-12) and which can be explored and tested through grade appropriate inquiry-base study? At the adult level, what should a science literate person know about the oceans and their influence on global environment and impact (both now and likely in the future) on the global economy?
 3. Issue a policy statement strongly endorsing the need for pre-college outreach on the part of ocean science researchers. Federal agencies concerned with the support of ocean sciences should advocate pre-college outreach by ocean science researchers and include outreach as an evaluation criterion in the review of research proposals by these agencies. Strong endorsement by funding agencies of the need and value of pre-college outreach is particularly necessary in order to change the reward system (tenure) for younger faculty at academic institutions.
 4. Prepare a thorough inventory of existing K-12 ocean sciences programs and curricula. Initial focus should be placed on gathering information on pre-college outreach programs conducted by universities. The inventory should then be expanded to include other sites and locations through the assistance of the education societies including the AAAS, the National Marine Educators Association and the National Science Teachers Association. This inventory should be made available in readily usable format to classroom teachers and informal science educators. In addition, working with scientists and K-12 educators, standards or guidelines which could be used by teachers and educators to judge the

quality, currency, and utility of existing K-12 ocean science education programs should be developed.

Another recommendation called for CORE to expand and enhance its current home page on the World Wide Web (<http://core.cast.msstate.edu>) to include information on K-12 programs and opportunities. This home page should also “point” to those other home pages in the ocean sciences research community which include K-12 information. The CORE Home Page will also be the site for the maintenance and display of an inventory of current K-12 programs, particularly those involving and impacting teachers.

Consistent with these urgent needs for action, the universities should encourage and provide incentives for faculty members to engage in K-12 outreach to teachers and students. These activities could include, but are certainly not limited to: working with teachers in nearby schools to help incorporate ocean sciences research into classrooms; designing and delivering outreach skills-training to faculty and scientists; providing opportunities for field trips and research internships for teachers and their students; mentoring and counseling both teachers and students, etc.

The CORE/NSF workshop participants also made general recommendations for the improvement of K-12 marine education:

1. Creation of a national program of summer research internships for K-12 teachers at oceanographic institution research sites.
2. Development of a model pre-service ocean sciences course for use in pre-service K-12 math/science teacher education.
3. Continued support for K-12 curriculum development.
4. Increased teacher and student participation through technology in ocean sciences data collection and analysis.

The National Marine Educators Association has provided leadership for some 20 years, and has kept marine education “alive and kicking” through a network of educators and a professional journal. The organization has a membership of just over 1,000 teachers and informal educators. It is not a grant receiving institution, nor does it have political clout in Washington, DC. CORE could provide the clout and grant attracting ability to expand and improve K-12 marine education.

Federal granting agencies such as Sea Grant, NSF, and the Department of Education

need to maintain and expand where feasible their support for K-12 marine education.

HIGHER EDUCATION

Thirty- six universities or consortia offer a graduate degree (MS/Ph.D.) in a marine related field in the United States. Some of the consortia (e.g., Dauphin Island) consist of several universities. About 650 Ph.D. degrees are granted annually. These figures come from the Marine Technology Society (MTS) publication, “Education and Training Programs in Oceanography and Related Fields” (1995). NSF annually supports about 500 graduate students in ocean sciences research. Sea Grant supports another 250 graduate students (personal communications).

Again, based on figures from the MTS directory, about 200 BA/BS degrees are earned annually in marine-related areas and about 1,100 MA/MS degrees are earned. The purpose of the MTS directory was not to collect this data; however, there was a line for respondees to report “Number of Degrees Granted.” Not all universities reported, so the numbers are less than the actual number of degrees granted. On the other hand, the reported degrees are in “Oceanography Related Fields,” which would indicate that the numbers probably exceed the marine science or oceanography degrees earned at reporting universities. In any case, this provides a general sense of university output in the field. Some figures are startling: Coastal Carolina University has an undergraduate Marine Science major with 400 students! The University of Miami and the University of Rhode Island do not report degrees granted.

According to a survey by CORE of alumni of U.S. marine science and policy graduate institutions, there were only 157 MS degrees and 309 Ph.D. degrees granted in 1994. This represents a much narrower survey of marine science than the MTS Directory uses and is based on graduates of the major ocean research institutions.

The California Sea Grant College Program publishes a “Directory of Academic Marine Programs” (1993, 3rd edition). There are ten programs at two-year colleges. There are 38 four-year colleges with oceanography or marine-related programs. Most are, for example, biology (with marine emphasis). The University of Southern California offers both an MS and Ph.D. in ocean sciences. The University of San Diego and Humboldt State University offer a BS in marine science and oceanography, respectively. The U.S. Naval Postgraduate School offers a Ph.D. in oceanography. The University of California, Berkeley offers a Ph.D. in ocean engineering. The University of California at Santa Barbara offers both the MS and Ph.D. in ocean engineering. Scripps Institution of Oceanography offers both an MS and a Ph.D. in applied ocean sciences, biological oceanography, geological, sciences, geophysics, marine biology, geochemistry, marine chemistry, and physical oceanography.

In discussions with experts in these fields, a need exists for trained graduates in maritime law, marine affairs, seafood technology, recreation, and naval architecture that are not being met. Marine recreation, for example, is now a \$17 billion industry in California. Based on the MTS Directory and additional personal communications, national needs are similar to those in California. In recognition of these needs, new graduate programs in marine affairs are emerging.

The strength of marine higher education in California and the nation lies in the research training area for the basic sciences. There is no question that the United States has the best marine research and training in the sciences available in the world. The number of graduating trained researchers certainly meets or exceeds the needs of the nation at this time. The main support comes from NSF, Sea Grant and the U.S. Navy.

In addition to grant support of graduate students in research, there are Fellows and Internship programs supported by NSF, Sea Grant, AAAS and the U.S. Navy. The Knauss Sea Grant Fellows program provides Washington, D.C.-based experience in both the executive and legislative branches of government for about 24 graduate students per year. This kind of practical training enhances the university experience. Sea Grant is beginning an Industrial Fellows program which will place graduate students in private industry. This program should be expanded.

One of findings made by Dr. Andreas Rechnitzer's in California in 1969 persists. That is, graduate students are mainly prepared to be research professors at graduate research institutions. The reality is that the majority of MS and Ph.D. graduates in ocean sciences will find employment in government agencies and private industry. University faculty and placement offices need to be more aware of this reality and help students prepare better for this eventuality.

There are eight maritime academies or institutes in the United States. The U.S. Merchant Marine Academy at King's Point, New York, is the only federal academy. Six are state-run (New York, California, Massachusetts, Maine, Texas, and Michigan). The Maritime Institute of Technology and Graduate Studies (MITGS) is the training arm of the International Organization of Masters, Mates and Pilots at Linthicum, Maryland. These are all high quality institutions that maintain a tradition of training U.S. merchant mariners. Most have from three to six hundred students. The MITGS trains about 1,400 working professionals annually in specialized courses for upgrading and modernization. With a relatively small fleet of non-military U.S. flag ships, these institutions meet the current U.S. need.

The U.S. government also supports the U.S. Naval Academy and the U.S. Coast Guard Academy, both of which maintain high quality undergraduate level programs in ocean-related

studies. These institutions meet the current U.S. needs.

ETHNIC MINORITIES

The ocean sciences community continues to have extremely low numbers of people from ethnic minorities. This means that all universities, government agencies, and private industries dependent on graduating students are affected.

At NOAA, each line office (National Weather Service, Oceanic and Atmospheric Research, etc.) has a program to encourage participation and professional training of ethnic minorities. The Sea Grant program, for example, has granted \$50,000 per year for three years to five “historically black colleges and universities” to develop and encourage undergraduate participation and studies in ocean sciences. NOAA’s total annual investment is about \$1.5 million. Unfortunately, there is no coordination of the program in NOAA.

The U.S. Navy probably has the best record for recruiting ethnic minorities into the ocean sciences by virtue of its overall record in this area.

NSF has funded projects to encourage ocean science study by ethnic minorities as well. An example is a summer program between Harbor Branch Oceanographic Institution and Savannah State University. This provides research and ship-board opportunities for both faculty and students from Savannah State.

NOAA is also supporting an Earth Systems Science curriculum at Clark Atlanta University which includes an agreement with Oklahoma University leading to a BS in Earth Systems Science and an MS in Meteorology. Students spend three years at Clark Atlanta and two years at Oklahoma.

There is no clear answer to the glaring problem of low numbers of people from ethnic minorities in the ocean sciences community. Surely more intra- and inter-agency coordination would help matters. Universities and K-12 educators also need to direct more attention to this matter and must shoulder some of the blame for the present condition. New ideas in this regard are urgently needed.

CAREER OPPORTUNITIES

Too often, ocean scientists advise students only about careers in research. High school students receive little information about ocean related careers. The best job opportunities

today are in marine recreation and tourism. In California alone, it has already been noted that this is a \$17 billion per year industry. There are a few good publications that provide information about marine careers. Sea Grant has a recent publication, *Marine Science Careers: A Sea Grant Guide to Ocean Opportunities*. This can be obtained from Woods Hole Oceanographic Institution Sea Grant Program, 193 Oyster Pond Road, Woods Hole, MA 02543-1525. A good source for information about ocean-related careers other than the sciences is *Opportunities in Marine and Maritime Careers* by William Ray Heitzmann (VGM Career Horizons, 4255 West Tonky Avenue, Lincolnwood, IL 60645). Additional resources include the organizations and publications listed below:

Publications:

Careers in Oceanography and Marine-Related Fields. The Oceanography Society, 4052 Timber Ridge Drive, Virginia Beach, VA 23455, (804)464-0131, fax: (804)464-1759, e-mail: jrhodes@ccpo.odu.edu.

Education and Training Programs in Oceanography and Related Fields. Available from the Marine Technology Society, 1828 L Street, NW, Suite 906, Washington, D.C. 20036-5104, (202)775-5966, fax: (202)429-9417.

Strategies for Pursuing a Career in Marine Mammal Science. Allen Press, P.O. Box 1897, Lawrence, KS 66044-8897, 800/627-0629.

Taking the Initiative: Report on a Leadership Conference for Women in Science and Technology. Available from the Association for Women in Science, 1522 K Street, NW, Suite 820, Washington, D.C., 20005, (202)408-0742, fax:(202)408-8321, e-mail:awis@digex.net.

Careers in Oceanography. Neritic Enterprises, PO Box 5485, Santa Barbara, CA 93108.

There is a need to communicate information about marine careers to high school guidance counselors. California Sea Grant sends its Directory of Marine Programs to every counselor in the state. NOAA, the U.S. Navy, and/or CORE should consider buying a booth at the national conference of career and guidance counselors.

CONCLUSIONS

Informal marine education is extensive and growing in the United States. The media has improved its coverage in both extent and quality over the past 25 years. There are many aquaria and similar institutions available for public viewing and education. These institutions

have extensive and usually high quality education programs. SeaWeb has begun a worthy program of raising the awareness of the public about ocean issues. The U.S. Congress has also shown new interest about ocean issues and policy after a 25-year hiatus. Government agencies are extensively involved in a wide range of informal marine education endeavors and maintain a high level of quality.

K-12 marine education appears to lag other aspects of marine education. There are a few curricular programs and materials that are available from aquaria and government agencies. Science textbooks have little coverage of the ocean. Teacher training in marine education is almost non-existent in universities. Several government agencies have in-service teacher training programs. The new NRC *National Science Education Standards* ignore the ocean.

Higher education is a bright spot in marine education. Graduate programs are high quality and produce adequate members of scientists to meet national needs with the exception of marine affairs (social sciences). Marine affairs is of growing importance to the nation and there is a need to develop new graduate degree programs. Maritime academies meet the national needs at this time considering the low availability of jobs in the merchant sector. NSF and Sea Grant are the main supporters of ocean science graduate students.

Ethnic minorities while under-represented in science are even more under-represented in the ocean sciences. Women are generally represented in oceanography similar to their representation in other sciences.

There are some publications available for career opportunities in the ocean sciences. Students at all levels are poorly informed about the range of careers available in the ocean sciences. The best job opportunities lie in the area of marine recreation and tourism.

OPTIONS FOR CONSIDERATION

- Provide leadership and visibility for marine education;
- Seek new international/national advocates for marine education;
- Coordinate efforts and new ideas to promote diversity of people in marine education;
- Increase public awareness of ocean issues;
- Educate the public regarding the role of the ocean in global climate;
- Coordinate marine education support by federal agencies;
- Revise/amend the *National Science Education Standards* (National Research Council) to infuse ocean sciences;

- Fund and organize a national conference/workshop to educate K-12 textbook authors and editors about the oceans;
- Support CORE and National Ocean Partnership Program;
- Make real-time oceanography accessible and useful for teachers and students;
- Encourage more university programs in marine affairs, law, coastal engineering, and ports and harbor management and planning;
- Improve career education information about ocean-related employment at all levels of education;
- Provide marine career information to career and guidance counselors.

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LIST OF ACRONYMS

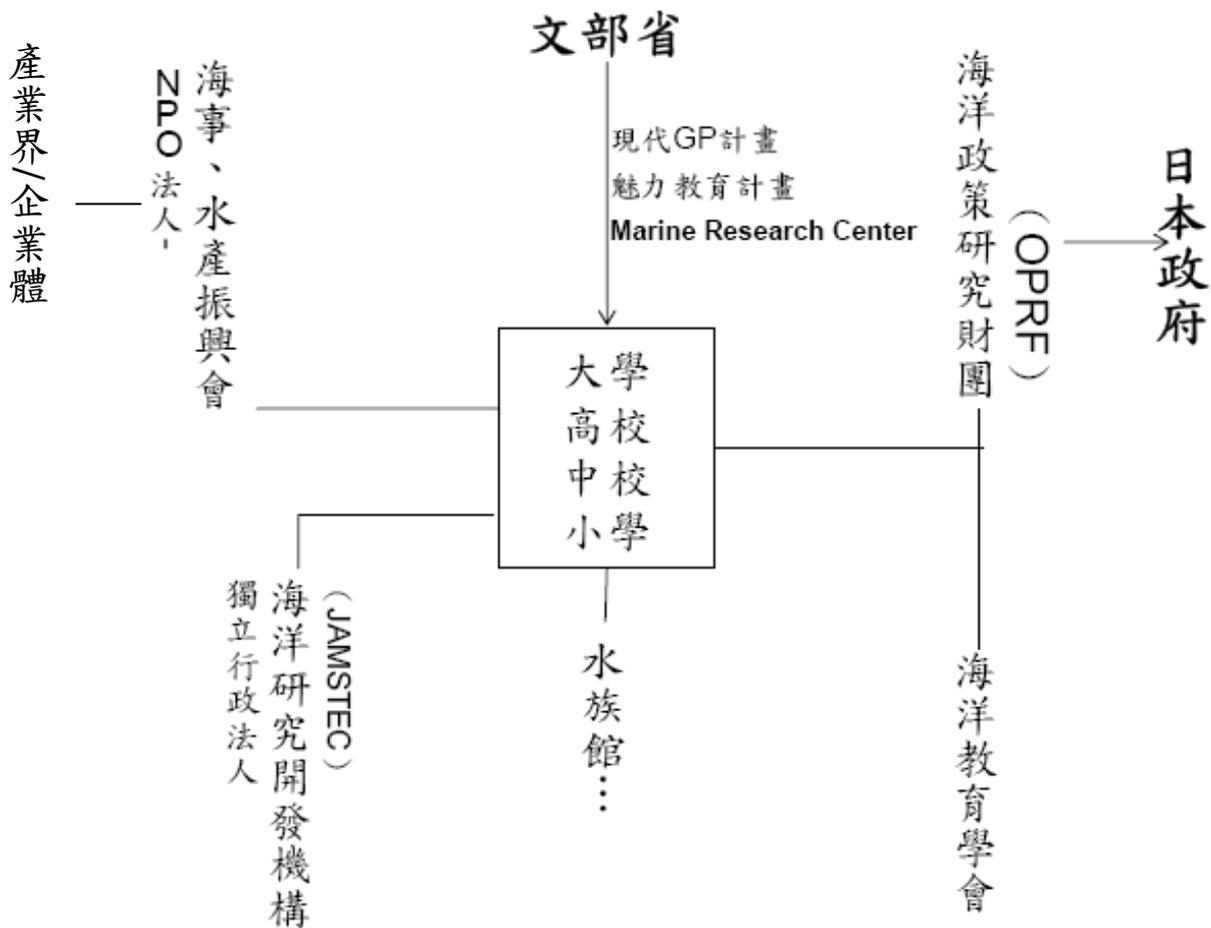
COAST	Consortium for Oceanographic Activities for Students and Teachers
CORE	Consortium for Ocean Research and Education
GLOBE	Global Learning and Observations to Benefit the Environment
MTS	Marine Technology Society
NASA	National Aeronautics and Space Administration
NMEA	National Marine Educators Association
NOAA	National Oceanic and Atmospheric Administration
NOPP	National Ocean Partnership Program
NRC	National Research Council
NSF	National Science Foundation
UN	United Nations
USCG	United States Coast Guard
USN	United States Navy

陸、日本海洋教育推展體系

日本海洋教育推展體系

大學教育係由文部科學省負責，採大學自主，以大學法人營運；高中、國中、國小由地方政府掌管。日本之海洋教育推展體系概念圖如後。

日本海洋教育推動體系概念圖



日本海洋教育推動體系特點概述

- 一、經費之整合：？
教師能量整合：海洋政策研究財團、海洋教育學會…。
- 二、文部省，「由上而下」推動因應產業開發系統轉型需求及因應全球科技、人文、社會變遷之學程，諸如現代 GP、及魅力教育，資料於後。
- 三、「NPO 法人—海事、水產協會」是學界與產業界的聯結窗口；「海洋政策研究財團」是學界/教育界與政府的聯結窗口；「海洋政策研究財團」也是整合民間資源提供正規教育體系推展海洋教育，是民間與政府的聯結窗口。
- 四、由民間(海洋政策研究財團)研擬推動分級課程計畫。
- 五、政府投資補助大學設立海洋研究中心 (Marine Research Center)，全國有 21 個〉資料於後。研究、教育為其職責。以其研究成果辦理分級之長年例行性研習營課程，以補助正規教育體系。
- 六、經濟需求，開創產業締造經濟；產業體系導引人才需求面，人才培育策略回應產業開發體系之轉型、培育人才開創產業為其重要策略。

日本國文部省魅力教育計畫—I

ホーム >> 事業案内 >> 「魅力ある大学院教育」イニシアティブ >> 概要

「魅力ある大学院教育」イニシアティブ

Initiatives for Attractive Education in Graduate Schools

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▶ 委員会委員等名簿

▶ 審査結果・リンク集

▶ 申請状況

概要

〔目的〕

今後の大学院は、①大学院教育の実質化(教育の課程の組織的展開の強化)、②国際的な通用性・信頼性の向上を通じ、世界規模での競争力の強化を図ることを重要な視点として、教育研究機能の強化を推進していくことが求められています。

「魅力ある大学院教育」イニシアティブは、現代社会の新たなニーズに応えられる創造性豊かな若手研究者の養成機能の強化を図るため、大学院における意欲的かつ独創的な研究者養成に関する教育取組に対し重点的な支援を行うことにより、大学院教育の実質化(教育の課程の組織的展開の強化)を推進することを目的としています。

また、採択された取組を広く社会に情報提供することで、今後の大学院教育の改善に活用します。

〔公募の概要〕

- 背景：「新時代の大学院教育—国際的に魅力ある大学院教育の構築に向けて—」(平成17年9月5日中央教育審議会答申)を踏まえて実施
- 公募対象：一定の学問分野のまとまりを有する専攻又は専攻の組合せ(原則として、博士課程を置く専攻(研究者養成を目的とする修士課程を置く専攻についても申請可))
- 申請者：研究科長が学長を通じて申請
- 申請内容：大学全体としての位置付け、課程の目的・役割、具体的な計画、終了後の継続性などについて申請
- 取組期間：2年間
- 公募範囲：すべての学問分野を対象とし、公募は「人社系」・「理工農系」・「医療系」に区分
- 採択件数：40件程度(各分野10～20件程度)
- 取組規模：取組規模は年度毎に1億円を上限とし、国から補助金を支出する額は1件当たり年間5千万円程度を上限とする(2年間継続的に交付、18年度予算額(継続含む)：4.2億円)

日本國文部省魅力教育計畫—II

1. 平成18年度「魅力ある大学院教育」イニシアティブ申請・採択状況一覧

区分	人 社 系				理 工 農 系				医 療 系				総 計			
	申請数		採択課題数		申請数		採択課題数		申請数		採択課題数		申請数		採択課題数	
	大学数	件数	大学数	件数	大学数	件数	大学数	件数	大学数	件数	大学数	件数	大学数	件数	大学数	件数
国立大学	24	32	9	10	50	109	15	17	31	40	7	7	66	181	24	34
公立大学	6	6	1	1	4	9	0	0	7	10	1	1	14	25	2	2
私立大学	26	31	5	5	21	21	2	2	10	10	3	3	49	62	9	10
合 計	56	69	15	16	75	139	17	19	48	60	11	11	129	268	35	46

※大学数の合計は、1大学で複数分野(系)への申請があるため、各系の合計数と総計欄の数値は一致しない。

日本國文部省魅力教育計畫—III

3. 平成18年度「魅力ある大学院教育」イニシアティブ 分野別採択課題一覧

【理工農系】

整理番号	教育プログラム名	大学名	主たる研究科・専攻名	取組実施担当者名
e001	高邁なる大志を抱いたT型化学者養成	北海道大学	理学研究科化学専攻	鈴木 孝紀
e002	食の安全に関わる高度専門家庭教育プログラム	帯広畜産大学	畜産学研究科畜産衛生学専攻	宮本 明夫
e003	実践IT力を備えた高度情報学人材育成	筑波大学	システム情報工学研究科コンピュータサイエンス専攻	田中 二郎
e004	国際的リーダーシップをもつ物理学者の養成	東京工業大学	理工学研究科基礎物理学専攻	細谷 暁夫
e005	メカノインフォマティクス・カデット教育	電気通信大学	電気通信学研究科知能機械工学専攻	松野 文俊
e006	海洋観測・生物資源調査の実践教育の強化	東京海洋大学	海洋科学技術研究科応用環境システム学専攻、海洋環境保全学専攻	安田 明生
e007	一貫コース型3Gマインド先導的研究者養成	長岡技術科学大学	工学研究科材料工学専攻、材料開発工学専攻	西口 郁三
e008	シミュレーション科学を支える高度人材育成	京都大学	情報学研究科数理工学専攻	中村 佳正
e009	生命科学キャリアディベロップメント	京都大学	生命科学研究科高次生命科学専攻	石川 冬木
e010	生命先端工学国際創造教育プログラム	大阪大学	工学研究科生命先端工学専攻	福住 俊一
e011	先端通信エキスパート養成プログラム	大阪大学	工学研究科電気電子情報工学専攻	河崎 善一郎
e012	先端科学技術の芽を生み出す女性研究者育成	奈良女子大学	人間文化研究科物理科学専攻、複合現象科学専攻	岩淵 修一
e013	物質科学の先端融合領域を担う研究者の育成	奈良先端科学技術大学院大学	物質創成科学研究科物質創成科学専攻	片岡 幹雄
e014	先端基礎科学開拓研究者育成プログラム	岡山大学	自然科学研究科数理物理学専攻、先端基礎科学専攻	原田 勲
e015	世界戦略的フードサイエンス教育	九州大学	生物資源環境科学府生物機能科学専攻	今泉 勝己
e016	出稽古修行型の分野横断研鑽システム	九州工業大学	生命体工学研究科脳情報専攻	古川 徹生
e017	異分野融合能力をもつ未来開拓型人材育成	熊本大学	自然科学研究科複合新領域科学専攻	安部 眞一
e018	専門英語の積極的導入による先端的工学教育	豊田工業大学	工学研究科先端工学専攻	鈴木 孝雄
e019	「資源循環総合演習」による実践的環境教育	福岡大学	工学研究科資源循環・環境工学専攻、エネルギー・環境システム工学専攻	松藤 康司

日本國文部省

現代 GP 計畫—I

文部科学省

Ministry of Education, Culture, Sports, Science and Technology

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② 大学教育の充実—Good Practice—

文部科学省では、国公立大学を通じて、学生教育の質の向上などの大学教育改革の取組を選定し、財政的なサポートや幅広い情報提供を行い、各大学などでの教育改革の取組を促進するため、「特色ある大学教育支援プログラム(特色GP)」及び「現代的教育ニーズ取組支援プログラム(現代GP)」を実施しています。

② 新着情報

- 1月30日平成19年度「特色ある大学教育支援プログラム」及び「現代的教育ニーズ取組支援プログラム」公募要領等説明会の開催について
- 1月29日特色GP・現代GPのイベント情報を追加しました。(2月分)
- 1月27日「大学改革GPナビ—Good Practice—」について(第40号)発信
- 1月17日現代的教育ニーズ取組選定委員会の開催について

② お知らせ

- ・平成17年度現代GPフォーラムの報告
- ・平成18年度「現代的教育ニーズ取組支援プログラム」の選定結果について
- ・平成18年度「特色ある大学教育支援プログラム」の選定状況について

国公立大学を通じた大学教育改革の支援

GP以外にも、高等教育局では、国公立大学を通じて大学の教育改革の取組を支援しています。

(高等教育局大学振興課大学改革推進室)

(お問い合わせ先)

文部科学省高等教育局大学振興課
大学改革推進室

電話: 03-5253-4111(代表)(内線3319、3321)

FAX: 03-6734-3387

e-mail: daikaika@mext.go.jp

現代GP計畫—II

文部科学省

Ministry of Education, Culture, Sports, Science and Technology

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 - ・選定事例紹介
- ②大学改革への財政支援—大学改革推進等補助金—

○現代的教育ニーズ取組支援プログラム(現代GP)

「現代的教育ニーズ取組支援プログラム」では、各種審議会からの提言などを踏まえ、社会的要請の強い政策課題(地域活性化への貢献、知的財産関連教育など)に関するテーマを設定し、これに対して各大学、短期大学、高等専門学校が計画している取組の中から、国公私を通じて優れた取組を選び、サポートします。また、選ばれた取組を社会に広く情報提供し、高等教育全体の活性化を促しています。

○平成19年度「特色ある大学教育支援プログラム」及び「現代的教育ニーズ取組支援プログラム」公募要領等説明会の開催について

○平成18年度「大学教育改革プログラム合同フォーラム」の開催について

○平成18年度「現代的教育ニーズ取組支援プログラム」の選定結果について

平成16年度から平成18年度までで282件の優れた取組を選定しました。(平成16年度86件、平成17年度84件、平成18年度112件)
→審査の流れと選定結果についてはこちらをご覧ください。

平成19年度の公募について
[現代的教育ニーズ取組選定委員会]
開催案内: 第1回

平成18年度の公募について
[現代的教育ニーズ取組選定委員会]
開催案内: 第1回 第2回 第3回 第4回
議事次第・配付資料: 第1回 第2回 第3回 第4回
委員名簿: 選定委員会
平成18年度面接審査実施要項

平成18年度の公募テーマ
・地域活性化への貢献(地 地域活性化への貢献(広域型)元型)
・知的財産関連教育の推進・持続可能な社会につながる環境教育の推進
・実践的総合キャリア教育・ニーズに基づく人材育成を目指したe-Learning Programの開発

日本大學附設海洋研究中心(Marine Research Center)分布圖



<註> 2004 年日本海洋教育機構一覽表

大學 (教育部)	大學校 (直屬政府機構)	高等專 科學校	高校
商船學部 2	海上保安大學校 1	商船 5	水產、海洋高校 48
水產學部 5 (國立 4 私立 1)	水產大學校 1		海上技術學校 5
水產學科 10 (私立 3)	防衛大學校 1		海上保安學校 1
海洋學部 1	海土技術短期大學 2		
短期大學 1			

柒、美國、日本、台灣海洋
教育推展體系比較

美、日、台海洋教育策略需求比較

		美國	日本	台灣	
共同點		教師；教材；博物館功能不彰 人材 / 產業聯結性不佳；人才投入海洋專業意願不高 一步一腳印、穩紮穩打，台灣？			
相異點	推展動力	政府 → 民間	民間 → 政府	政府 → 民間	
	發展標的	國防 環境	產業 國防 環境	? (產業) (環境)	
	推展策略	教材	分級建構	分級建構	分級建構 (中綱計畫)
		教師	教師研習課程	教師研習課程	分級教師培育課程 (中綱計畫)
		推展體系	海洋尖端科技教育中心 (MATE) <small>(創立經費源自國家科學發展基金)</small>	Marine Research Center、 <small>(經費源自日本文部科學省及校方)</small> JAMSTEC、OPRF	? (海生館、海科館、國研院)
	發展經費	Top-down <small>(National Sea Grant College Program)</small>	Top-down	? (Top-down)	
發展議題	Bottom-up	Top-down	? (Top-down)		

捌、政策建議

政策建議

- 一、與國科會、國家實驗研究院攜手共同發展海洋教育。
- 二、強化海洋相關社教館所體質，並責成其擔負海洋相關之社會教育及中等學校相關之彈性課程。建立海洋相關部屬館所長年例行性、分別針對國小、國中、高中、大學生舉辦知識性研習營之運作機制，如同美國之 MATE、日本之 Marine Research Center 之教育功能運作模式。
- 三、一步一腳印，紮實地架構海洋教育的骨幹與基架，締造發展能量。
 1. 建構完整之教育體系，即建構健全之正規教育體系與輔助正規教育之體系。
 2. 嚴謹地、科學性的研析作業後，擬定推動目標、規劃對應性推展策略，並落實執行；強化研究、逐步分級建構教材；有系統、有品管的培訓教師…。