



# Grand Design for Ocean Education in the 21st Century:

Ocean Education Curriculum and Unit Plans



The Nippon Foundation







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# Introduction

Despite the fact that Japan has derived numerous benefits from the ocean and developed in close relation with it, experts in the ocean field regularly point out that the education on the ocean provided to our children, who are to assume responsibility for the next generation, is insufficient, particularly in the case of compulsory education. An overview of the state and practice of ocean education at schools around the country emphatically reveals that ocean education is not systematically practiced in any designated form in school education. Rather, the majority of examples stem from individuals or geographical areas, the result of personal enthusiasm of teachers or from regional concerns.

Meanwhile, the Basic Act on Ocean Policy was enacted in 2007, and the country is advancing initiatives in the 12 areas stipulated in the Basic Plan on Ocean Policy. One of these areas is “promotion of citizen understanding and human resource development related to the ocean”, whereby the country determined to promote education on the ocean in school education and social education.

However, from the standpoint of the educational administration that works within national educational policy based on the Fundamental Law of Education and the School Education Law, it is not easy for educators in actuality to accept reforms regardless of how ocean experts unilaterally assert the importance of ocean education. Classrooms today face issues such as growing demands on teachers and responses to increasing societal concerns. Additionally, research on educational approaches to ocean education has been nearly non-existent to present, and a detailed curriculum for educators to use as a reference has not been formulated.

Reflecting on this situation, our foundation implemented the “Investigative Research Project for Creation of National Educational Systems” based on a three-year plan from fiscal year 2008, in order to clarify the objectives and content of ocean education. The results have been compiled into this document, the “Grand Design for Ocean Education in the 21st Century: Ocean Education Curriculum and Unit Plans”. This three-part report is divided into primary school, junior high school, and high school sections, and lays out the shape of a consistent educational system on the ocean.

We hope that this report will be utilised as a starting point for debate on systematisation of ocean education in our country’s school education, and further will provide support for the actual practice of ocean education.

I would like to take this opportunity to express my sincere gratitude to the committee members who provided expert advice, to the investigative committee on curriculum that spent their holidays working, to the Nippon Foundation for its many years of understanding and support for the ocean education projects of this foundation, and to all involved.

Masahiro Akiyama, Chairman  
Ocean Policy Research Foundation

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# 1. The Present State of Oceans and the Importance of Ocean Education in School Education



## 1-1 . The present state of oceans

### 1) The importance of oceans to Japan

Oceans account for 97.5 percent of water on earth and occupy 70 percent of the earth's surface. They are the origin of all living things, including humans, and also wield considerable influence on the climate systems of the entire planet and play a major role in sustaining living things as the source of water circulation--from ocean to air, and on to forests, then rivers and back to the ocean. In the relatively stable environment provided by the oceans, humans have continued to prosper since their birth, and Japan has enjoyed the benefits of the oceans to their fullest extent as our country has developed.



Japan's territorial waters and economic exclusive zone

Data Source: Hydrographic and Oceanographic Department, Japan Coast Guard

Japan's territorial waters cover an area of 4.47 million km<sup>2</sup>, ranking 6th in the world in area (territorial waters including inland waters and exclusive economic zones). A variety of environments can be found from ice floes to coral reefs. Furthermore, an abundance of natural resources exists in offshore areas, such as diverse life forms, energy and minerals. We utilise the ocean in many ways: as a place to secure resources, of course, as a route of transportation to engage in trade with the world, as a natural barrier to protect the country from foreign invasion, and as a place for public recreation. Our country's society, economy and culture were built and have developed based on a strong connection to the ocean. At present, approximately 50 percent of the total population lives along the coasts, about 40 percent of animal protein intake comes from marine products, and 99 percent of import and export cargo is dependent on maritime transport.

Meanwhile, the tsunami caused by the Great East Japan Earthquake of 11 March 2011 exceeded all expected scenarios and in an instant stole away the precious lives of many as well as the local societies that had been established there. The tsunami also wreaked enormous damage on the marine environment of the coast, showing just what a threat the ocean can present. Japan, surrounded by the ocean, must fully recognise ocean-related threats, not merely from tsunamis, and based on this awareness build a society that coexists with the ocean.



## 2) Trends in international society involving the oceans

Mankind has until now lived with the belief that the oceans extending far outside narrow territorial waters are “free” to be developed or utilised by anyone, and have actively forged out into the oceans in search of potential new resources. In particular, progress in development of scientific technologies in recent years has led to increased movement capabilities in the oceans on the part of humans. In this context, coastal nations have expedited the enclosure of their coastal territories and resources, but this vigorous activity has in turn caused marine pollution, exhaustion of resources, and damage to the environment in various places around the world. As a consequence, the foundation of our existence is threatened.

Statistics and global ranking related to Japan’s oceans

Indicator	Area, etc. (global rank)
land area	approx. 380,000 km <sup>2</sup> (60th)
total length of coastlines	approx. 35,000 km <sup>2</sup> (6th)
territorial waters (including inland waters)	approx. 430,000 km <sup>2</sup>
contiguous waters	approx. 320,000 km <sup>2</sup>
territorial waters (including inland waters) and contiguous waters	approx. 740,000 km <sup>2</sup>
exclusive economic zones	approx. 4,050,000 km <sup>2</sup>
territorial waters (including inland waters) and exclusive economic zones	approx. 4,470,000 km <sup>2</sup> (6th)
national land and territorial waters (including inland waters) and exclusive economic zones	approx. 4,850,000 km <sup>2</sup> (9th)
number of islands	6,852
number of inhabited islands	421

However, in order to secure the water, food, resources and energy required by the world population, which is predicted to continue to increase, and to smoothly transport commodities, even further use of the oceans in the future is essential. In order to pass along the limited benefits of the oceans to the next generation, it is clear that the development, use and protection of the oceans must be comprehensively managed.

Comprehensive management of the oceans is not an issue for our country to deal with alone, but must be carried out through cooperation among all the countries on earth. As the oceans are filled with water, happenings that occur at sea are closely interrelated. An event that happens at one location crosses time and place to spread to and influence other areas in a variety of ways. For this reason, issues of marine spaces cannot be clearly distinguished as domestic and international, but rather are characterised by the fact that they must be dealt with from an international perspective at all times.

In the midst of such conditions and following nearly a half century of long debate, the United Nations Convention on the Law of the Sea at long last came into force in 1994. While this Convention, called the “Constitution for the Oceans”, recognises the sovereign rights and jurisdiction of the exclusive economic zones of coastal nations, it also sets forth a legal framework and rules to cover nearly all areas related to the oceans, such as obligating protection and preservation of marine environments.



Moreover, the Agenda 21 Plan of Action was adopted at the Rio Earth Summit in 1992. In Article 17, the details of a political framework for environmental protection of oceans and coastal areas and sustainable development and use were determined.

These agreements created an international framework and rules for engaging in development, utilisation, protection and management of the oceans. Now is the time for engaging in peaceful management of the ocean in its entirety through the cooperation of all countries, for the benefit of mankind and premised upon the management of extensive coastal areas by each country according to international agreements. In this way, the latter half of the 20th century represents a major period of transition as we shifted from the old principle of “freedom of the seas” to a new paradigm based on comprehensive management of the oceans.

Based on these developments, countries of the world have in recent years engaged with vigour in the comprehensive management of all ocean areas including coastal areas. They have drafted ocean policy to comprehensively manage the oceans, developed legal systems and have conducted reorganisation of their administrations and research organisations to implement these improvements, while enacting procedures to reflect the opinions of a broad range of users.

### **3) Ocean-related initiatives required from the education sector**

In order to promote the comprehensive management of oceans, human resources that possess a broad range of knowledge and abilities to address the various issues of the ocean are essential. Globally there is a pressing need to develop such human resources. On the one hand, enhancements of capacity through development of expert human resources such as administrators, officials, and researchers to conduct appropriate management in coastal nations, particularly those of high population density and pronounced environmental destruction, are important. However, raising awareness on the part of each individual citizen is also imperative. Ways to develop citizens that are aware of their relationship with the ocean and that possess the skills to take initiatives to engage in its protection, have become an issue.

The importance of education and awareness-raising activities for general citizens has been pointed out. In fact, governments and NGOs around the world have begun a variety of initiatives to spread education on the oceans, not only social education but within school education as well. A global ocean education network is currently being formed to link these various initiatives.

As such, the basic principles of the Basic Act on Ocean Policy enacted by Japan in April of 2007 were laid out to harmonize with of the development and use of the oceans with conservation of the marine environment” and “comprehensive governance of the ocean”. In addition, “enhancement of citizens' understanding of the oceans” was adopted as one of the basic policies. Article 28 of the Basic Act on Ocean Policy decrees that necessary measures are to be taken in order to promote education on the oceans in both school education and social education, to enable citizens at large to increase their



understanding and interest in the oceans. The article also states that plans should be devised to promote the development of human resources capable of addressing political issues related to the ocean at the university level.

Article 28 of the Basic Act on Ocean Policy

(Enhancement of Citizen's Understanding of the Oceans, etc.)

- (1) The State shall take necessary measures, in order that citizens shall have a better understanding of and deeper interests in the oceans, to promote school education and social education with regard to the oceans ...
- (2) The State shall take necessary measures to promote interdisciplinary education and research at universities and others, in order to nurture human resources with knowledge and capability required to meet the political issues appropriately with regard to the oceans.

In March of 2008, Japan's first Basic Plan on Ocean Policy was established based on the stipulations of the Basic Act on Ocean Policy. This plan states the following in Section 3, "Enhancement of Scientific Knowledge of the Sea" of Chapter 1 on "Basic Policy of Measures with Regard to the Sea":

Challenges to unknown domains of the sea...can prompt not only juveniles who will be responsible for the next generation but also the entire nation to deepen their understanding of and interest in the sea. Therefore, education and awareness-raising activities need to be enhanced so that juveniles who are to support the next generation can harbor dreams for the sea and spirits of challenge to the unknown.

Further, Part 2, "Efforts to Increase Understanding of the Sea among Juveniles Who Will Be Responsible for the Next Generation" of Section 12, "Enhancement of Citizen's Understanding of the Sea and Fostering of Human Resources" of Chapter 2, "Measures that the Government Should Take Comprehensively and Systematically with Regard to the Sea", states as follows:

School education and social education need to be enhanced so that the citizens, including juveniles who are responsible for the next generation, can deepen their correct knowledge and understanding of the sea. Regarding school education, based on the purport of the Basic Act on Ocean Policy, high school curriculum guideline for the subject "Fisheries" needs to be reviewed promptly and practical education should be promoted through on-site practices. More training vessels need be equipped and improved at high schools. Furthermore, efforts should be made to see to it that marine-related education is provided properly in classes of social studies and science at elementary schools, junior high schools and high schools and to disseminate marine education such as through introducing practical examples of marine-related education. The government should also provide support for citizens' learning activities concerning basic knowledge and various problems on the sea through promoting experience-oriented activities at fishing villages and ecotourism, and promote efforts by utilising natural science museums including aquariums.



These policies clearly state the nation's responsibility to take the necessary measures to promote education on the ocean in school education and social education. Based on the principles of the Basic Act on Ocean Policy, the country must further new ocean education from now on.

## 1-2. The present state of ocean education in primary and secondary education and related issues

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### 1) The present state of school education in Japan

The Fundamental Law of Education revised in December 2006 set concrete goals for education from the perspectives of personal independence, relationships with others and society, relationships with nature and the environment, and Japanese in international society, based on development with a balance among knowledge, virtue and the physical body. Accordingly, concrete educational objectives were set forth in the partial revision of the School Education Law announced in June 2007. Article 30, Section 2 states a clear definition of scholastic ability: "In order to foster a base for life-long learning, foundational knowledge and skills must be learned, and the cognitive ability, decision-making ability, power of expression and other abilities required to utilise these knowledge and skills to solve problems must be developed, with care given to cultivate the attitude to engage in autonomous learning".

Meanwhile, results of a nationwide survey on scholastic ability and the state of learning conducted in April of 2007, as well as the PISA (Programme for International Student Assessment) survey conducted in 2003, reveal that while a certain level of achievement has been reached overall in the acquisition of foundational and basic knowledge and skills, there are issues in responses to reading comprehension and written expression problems that test cognitive ability, decision-making ability and the power of expression. Further findings relate to the mental and physical state of school children. Issues related to physical strength were many, including weakened normative consciousness and unestablished daily living habits. The desire to learn was found to be low, and the number of school children apathetic or nervous about their futures were found to have increased. Meanwhile, the increasing number of school children who cannot form interpersonal relationships with friends or those around them was indicated as a problem.

In the midst of such conditions, primary and secondary education are called upon to foster the acquisition of foundational and basic knowledge and skills and the ability to utilise them, the autonomous will to learn and pursue studies on one's own, a sound mind and body, and the attitude to live together with others. Government curriculum guidelines revised in 2008 (hereby called the "new curriculum guidelines") were devised based on these trends, making improvements in each subject of study and reconsidering the relationship between subjects of study and periods for integrated study. They also stress language and experiential activities, as well as enriched moral education.

In particular, the objective of high school education, the latter secondary education that acts as a bridge between foundational education at the primary and secondary levels and specialised education



at the higher education level, was stipulated to be “to carry out high level general education and specialised education according to mental and physical development and course of future life above and beyond the foundational education given in junior high school” in Article 50 of the School Education Law. High school education is premised on acquisition of foundational and basic citizen education in mandatory education and is designed to further develop this foundation and link it to scholarly research and acquisition of skills. As such, aside from acquisition of the fundamental and basic knowledge and skills in each subject and course, importance is attached to learning activities that utilise such knowledge and skills. Importance is placed on a smooth and systematic transition between mandatory education and high school. Meanwhile, augmented instruction in moral education and physical education aimed at development of a sound mind and body are necessitated.

Meanwhile, expectations and demands on school education have expanded. As work at schools becomes more complex and varied, a reorganisation of the conditions of school education are demanded. Further, apart from school education, there is a need to examine methods of social education and education at home. In order to respond to the rapid changes occurring in our society, schools, communities and households must be called upon to work together to develop human resources. Human resources are required that can give full play to each person’s respective abilities and strengths, that can foster favorable relationships between people and the natural environment as the formants of sustainable societies, and that can contribute to the development of communities and society from an international perspective.

## **2) Relationships with the ocean and the importance of ocean education in primary and secondary education**

Japan is comprised of an archipelago and countless minor islands, and people live together in a strong relationship with the ocean. In the past, Japan’s youth grew up and learned within a concrete living relationship with the ocean as history and culture developed particular localities. However, at present this lively relationship with the ocean has lost its concreteness has become abstract for school children, intellectually, sensually and emotionally in both the environment in which they develop and in their school educations. For children in the sensitive stage of adolescence, getting close to the ocean and studying the nature, industry, history and culture of the ocean with all five senses have particular significance for their mental growth and for the future of local societies and Japanese society as a whole. To create the human resources to achieve the aim of the Basic Act on Ocean Policy, “to realise a new oceanic State in harmonisation of the peaceful and positive development and use of the oceans with the conservation of the marine environment, under the international cooperation”, primary and secondary education are designated as an extremely important forum and the role they are to play is large. Japan has newly set forth the aim of becoming an oceanic state in its Basic Act on Ocean Policy. Ways to foster a proper sense of being an ocean nation in the foundational education of citizens is a pressing issue. From this perspective, the acquisition in primary and secondary education of foundational knowledge on the oceans and the ability to



comprehensively understand and work to solve a variety of problems is essential.

Meanwhile, these abilities are consistent with the types of human resources primary and secondary education aim to achieve, which are the talent to create favorable relationships between people and the natural environment as the formants of sustainable societies, and the talent to contribute to the development of communities and society from an international perspective. Further deliberation on the significance and importance of actively including the ocean in the future of primary and secondary education is a must. The ocean as subject matter possesses both multidisciplinary and global elements. For this reason, ocean education is both possible and presents a proposal for a new education that questions the methods of human resource development of the next generation.

### **3) The present state and treatment of education on the ocean in primary and secondary education**

The curriculum guidelines set forth by the Ministry of Education, Culture, Sports, Science and Technology do not indicate any framework for the systematic study of the ocean. Furthermore, treatment of ocean-related content within various subjects is not covered systematically according to the definition of ocean education. Ocean-related content is covered in a portion of the topics in the area of vocational education, such as merchant shipping, marine industries, self-defense and maritime safety. However, treatment of the oceans within so-called general education only covers relevant items in a small fraction of social studies and science units.

Periods for integrated study, influenced by social trends critical of “pressure-free education”, are allotted a decreased amount of class hours in the new curriculum guidelines. Despite this fact, whereas to the present they were merely mentioned in the general provisions of the curriculum guidelines, they are now treated as a new independent subject, thus clarifying their place in the education process. While periods for integrated study are not the timeframe for study of the ocean, selection of learning materials, objectives, content and preparation of lesson plans are left to the discretion of each school. Thus, there are many instances of the ocean as subject matter in learning activities in schools along the coasts. Additionally, seaside school activities have been conducted as special activities. Nevertheless, these examples are either conducted within the limits of each subject or are dependent upon localities, and are not sufficient to be designated as ocean education based on the Basic Act on Ocean Policy.

Considering the present state of school education, establishing the new subject on “oceans” is hard to imagine. On the other hand, ocean education covers a broad range of areas from nature to society and culture. Given this fact, ocean education must be considered as a system for integrated education that horizontally connects existing subjects and thus promoted as such. However, the national government has so far not indicated a concrete stance on ocean-related education. Moreover, deliberation from the perspective of educational theory has not been carried out in the education departments of universities, educational research institutions or ocean-related institutes. For this

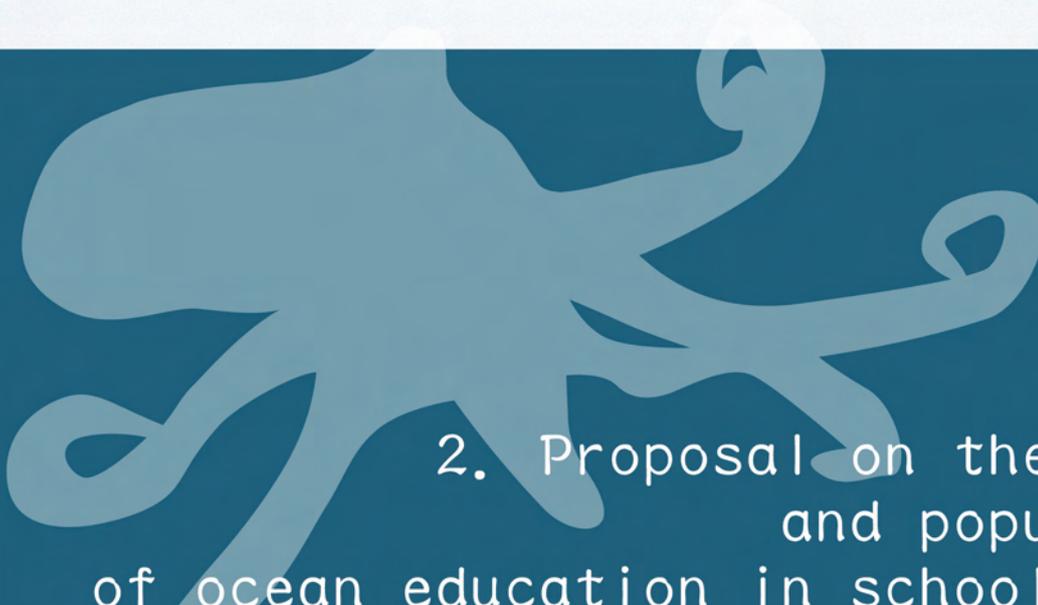


reason, clarification of the definition of new “ocean education” based on the principles of the Basic Act on Ocean Policy and the subsequent promotion of ocean education is necessary.

It is first essential that educational objectives and content be clarified for this promotion to ensue, and immediate development of a systematic curriculum is required. Pressing issues remain at the primary school, junior high school and high school levels, such as what type of educational content would foster the development of the necessary skills, nature and attitude, and how to set forth detailed content in accordance with the curriculum guidelines.







## 2. Proposal on the promotion and popularisation of ocean education in school education



Based on the background described above, the Ocean Policy Research Foundation launched the “Research committee on the promotion and popularisation of ocean education in primary education” (Chaired by Manabu Sato, Professor, Tokyo University and Chairman of the Japanese Educational Research Association at that time) in 2007, made up of experts in the fields of education and the ocean. The results have been compiled as the “Proposal on the promotion and popularisation of ocean education in primary schools” (hereafter hereby referred to as the “proposal”), which was submitted to the Minister of Education, Culture, Sports, Science and Technology via the Director-General of the Elementary and Secondary Education Bureau, and to the Minister for Ocean Policy via the Director-General of Headquarters for Ocean Policy in February 2008. The ideas of this proposal have been carried over to ocean education in junior high and high schools as well. The following is the “Proposal on the promotion and popularisation of ocean education in school education”, which covers, primary, junior high and high schools.

## **Proposal on the definition of ocean education**

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Endeavors should be made toward popularisation and promotion based on the following definition of ocean education.

### **Definition of ocean education**

“Humankind has received a great deal of benefit from the oceans, and yet our effect on the marine environment is not insignificant. The coexistence of the oceans and humankind is an important national issue. Ocean education enhances citizens’ understanding of the relationship between the ocean and humans, and aims to develop human resources that possess the knowledge, skills, cognitive ability, decision-making ability and power of expression to enable peaceful and sustainable development and use of the ocean and that seeks to protect the marine environment based on international understanding. In order to achieve these aims, ocean education promotes learning to become familiar with the ocean, to get to know the ocean, to protecting the ocean and utilize the ocean.”

## **Proposal for the popularisation and promotion of ocean education in school education**

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### **1) Basic approach**

Article 28 of the Basic Act on Ocean Policy calls for school education and social education to foster understanding of and interest in the ocean on the part of citizens in general, and requires universities to develop human resources that can respond to ocean-related policy issues. However, school education at present faces a mountain of issues. As far as human resource development at universities is concerned, the interdisciplinary education required for integrated initiatives in ocean-related issues is still in the early stages. However, the more a basic understanding of the ocean permeates among citizens, the more targets for the development of specialised human resources can be increased. Therefore, school education plays an extremely important role within ocean education as a whole. As such, it is proposed



that the five items below be deliberated on immediately and structures be built for the popularisation and promotion of ocean education.

## **2) Proposal**

### **1. Ocean-related educational content must be clarified**

The oceans offer a broad range of teaching materials that encompass natural and social phenomena as well as literary and artistic elements. In order to take advantage of this versatility, experiential activities based on interaction with nature and familiarisation with the ocean, in combination with investigative activities, can make up the basis for a cross-curricular approach that is ideal to cultivate overall cognitive ability and decision-making ability. In order to provide guidelines for schools on such an approach, detailed educational content and methods must be immediately clarified and made available.

### **2. A learning environment must be provided to popularise ocean education**

As direct mention of the ocean is limited in national curriculum guidelines, relevant content of the curriculum guidelines must be examined carefully and efforts to increase the ocean-related content of textbooks must be actively carried out. Peripheral materials such as supplementary teaching materials and study programmes must be enriched, and ocean education information networks utilising IT, as well as field locations where experiential learning can be safely conducted, must be prepared and made available.

### **3. External support systems must be enhanced to spread and strengthen ocean education**

A deeper understanding of content can be achieved with the participation of external groups in ocean education. For this reason, deliberation should be conducted on the formation of an external support system, based on an understanding of ocean education and the intent of schools, which effectively supports a portion of ocean education as required by each school. Specifically, areas for potential support by external organisations, including museums, aquariums, universities and research institutions, ocean-related groups, non-profit organisations, fishing cooperatives, chambers of commerce and ocean-related sectors such as marine transport, marine products and construction, should be organised and made explicit. Further, concerned government agencies and boards of education should recognise the importance of ocean education and create a support system for schools.

Additionally, it is important that external support not be implemented in single sessions, but as a continuing process. To do so, the creation of a framework to provide multi-faceted support for activities of external support organisations, including from a financial aspect, is required, such as utilisation of corporate social contribution activities or the establishment of an ocean education fund or an ocean education foundation.



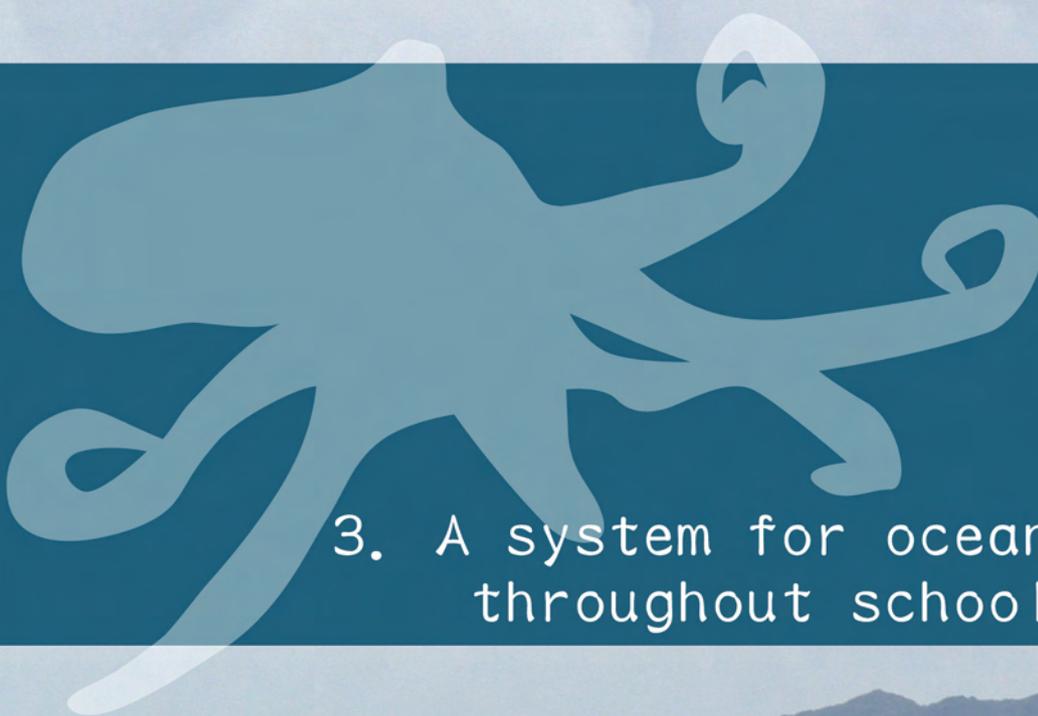
#### **4 . Human resources must be developed to take charge of ocean education**

Training and development of teachers is indispensable to the practice of ocean education. For this reason, the education system to develop teachers to take charge of ocean education must be improved. Ocean education for current teachers is also important, and opportunities to study the ocean must be set up in the form of teacher-training courses and training for current teachers. Additionally, it is necessary to expand the development of external human resources, such as ocean interpreters that possess expert knowledge on the ocean and travel to education sites to conduct ocean education in place of teachers.

#### **5 . Research on ocean education must be actively promoted**

As practical examples of ocean education within school education are still few in number, educational analysis of educational content and methods of instruction, as well as measurement of efficacy, is insufficient. Moreover, research on model curriculums has not yet begun. For this reason, research on ocean education should be conducted, and moreover improvements should be carried out in centres for research, such as universities that promote such research.





### 3. A system for ocean education throughout school education



## 3-1 . Objectives and structures for development

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### 1) Objective of development

Based on item one of the aforementioned proposal, “ocean-related educational content must be clarified”, this report was developed and prepared for the purpose of setting forth a concrete curriculum. Development is premised on the fact that promotion of ocean education in school education does not aim to create a new subject, but aims to create an integrated education system that horizontally links ocean-related content already covered in existing subjects.

### 2) Structures for development

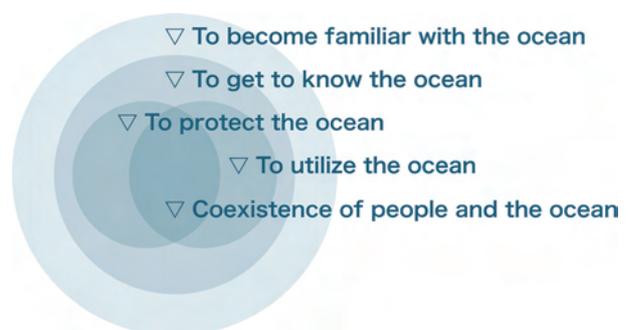
In the development process, first basic policy and methods were determined in the “Research committee on a system for ocean education in Japan”, comprised of education experts and ocean experts. Based on these, deliberations on detailed content and work on development and preparation were furthered in the “Investigative committee on ocean education curriculum” made up of teachers, education specialists and ocean-related researchers.

## 3-2 . The concept of ocean education in school education

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The concept of ocean education was established as follows aimed at developing human resources based on the principles of coexistence of humans and the oceans in the Basic Act on Ocean Policy, with the four categories set forth in the definition of ocean education as pillars, “to become familiar with the ocean”, “to get to know the ocean”, “to protect the ocean” and “to utilise the ocean”.

Conceptual diagram of ocean education in school education



#### To become familiar with the ocean:

Through a variety of experiential activities in the ocean’s natural abundance nature and the familiar local society, school children will develop a generous sensitivity toward the ocean and interest in the ocean, become familiar with the nature of the ocean and will voluntarily get involved with the ocean.

#### To get to know the ocean:

School children will take an interest in the close relationships between humans and the natural aspects and resources of the ocean and will engage voluntarily in investigations of these relationships.

#### To protect the ocean:

Through experience in investigative activities on the ocean’s environment and conservation activities,



school children will take the initiative to get involved in environmental protection of the oceans.

#### **To utilise the ocean:**

School children will comprehend marine products and resources, transport of people and goods using ships, and the links between people of the world that is provided by the ocean, and come to understand the importance of sustainable in these activities.

For the primary and junior high school versions, this report has opted to set forth in detail on “what, when and how to teach” in order to clarify ocean-related educational content as well as the types of abilities to be developed through content working within the new curriculum guidelines. Further, for the high school version, content builds on the base acquired in primary and junior high school and aims to develop human resources that possess the ability and knowledge to address more complex ocean issues. Modeling the characteristics of the high school education system which is subject-centred and has a broader range of course options for students, a set curriculum following a framework of guidelines by subject is not proposed. Rather, educational content is broadly set forth as “competencies” that are the abilities and attitudes to be fostered in ocean education and “contents”, which is the range of knowledge and skills to be learned in ocean education.

As such, a system for ocean education based on a consistent concept throughout primary, junior high and high school has been set forth.

### **3-3 . Approach to ocean education**

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#### **1) Primary school version**

Ocean education curriculum aimed at primary schools was prepared based on content flow charts made up of contents (from the viewpoint of structure of content areas) and sequence (special characteristics like development) and taking the definition and concepts of ocean education into consideration. With scope on the horizontal axis based on the four items of “to become familiar with the ocean”, “to get to know the ocean”, “to protect the ocean” and “to utilise the ocean”, and sequence as the vertical axis, divided into the three levels of “lower grades”, “middle grades” and “upper grades”.

Next, the content areas of ocean education feasible for implementation in primary school were selected following confirmation of content area for each subject set forth in the new curriculum guidelines and all ocean-related content in current textbooks. Educational content area is written out uniformly following the grammatical pattern of “to become aware of the subject matter, through concrete activities, and to develop the necessary abilities”, based on the new curriculum guidelines. Lastly, unit plans and syllabi were prepared in order that actual classes can be conducted on this content.



To become familiar with the ocean:

Through a variety of experiential activities in the ocean's abundant nature and the familiar local society, school children will develop a generous sensitivity toward the ocean and interest in the ocean, become familiar with the nature of the ocean and will voluntarily get involved with the ocean.

Through experience in investigative activities on the ocean's environment and conservation activities, school children will take the initiative to get involved in environmental protection of the oceans.

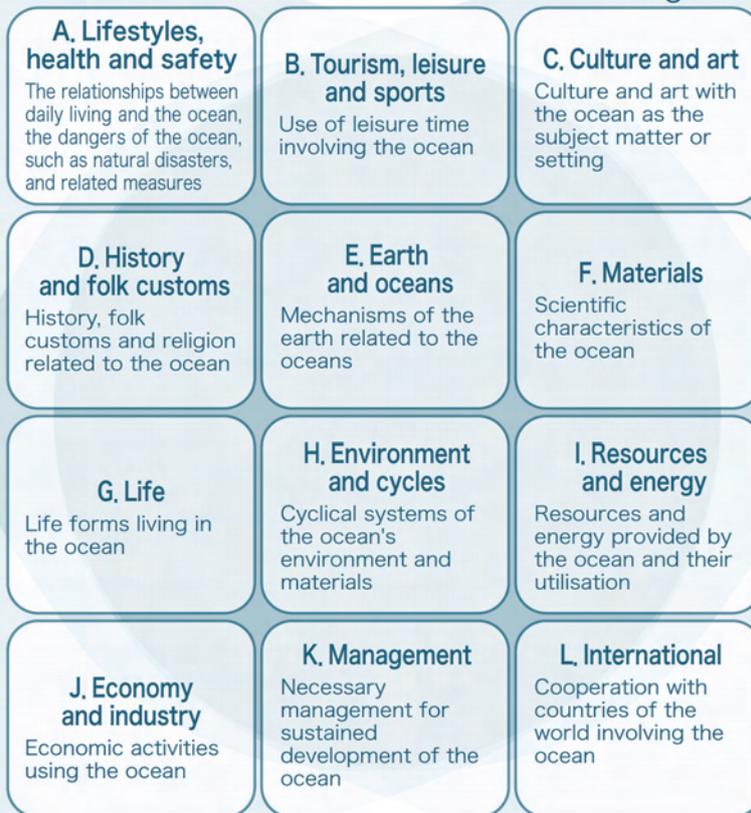
To protect the ocean:

To get to know the ocean:

School children will take an interest in the close relationships between humans and the nature and resources of the ocean and will engage voluntarily in investigations of these relationships.

School children will comprehend marine products and resources, transport of people and goods using ships, and the links between people of the world provided by the ocean, and understand the importance of sustainable use of these.

To utilise the ocean:



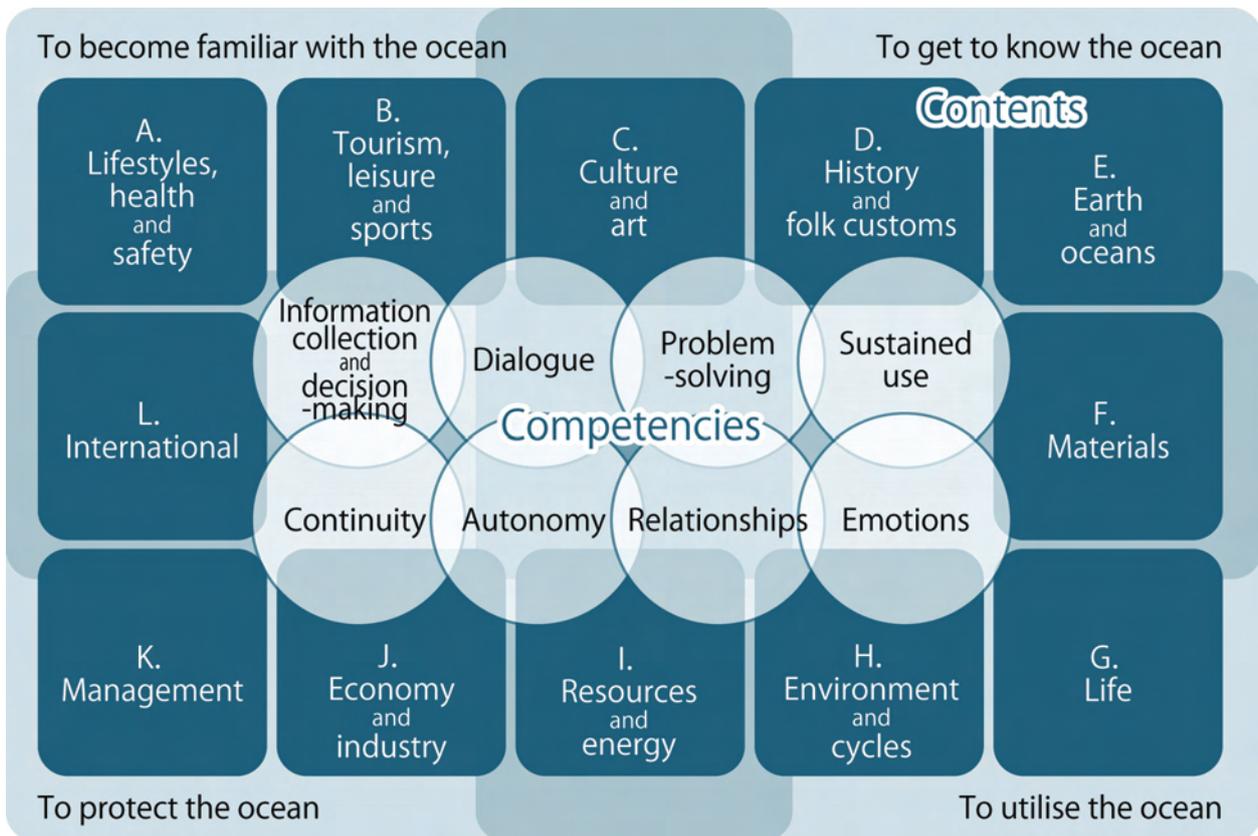
The concept of ocean education in school education and 12 areas

## 2) Junior high school version

The approach to preparation was the same as the primary school version. Further, sequence is divided into the three stages of “1st year”, “2nd year” and “3rd year”, with feasible learning content for all stages listed as “all years”. Meanwhile for contents, along with increasing fragmentation of content areas of study, one step is taken beyond the structure of content areas based on the four items of “to get familiar”, to “to know”, “to protect” and “to utilise” of the primary school version, i.e., to newly establish 12 fragmented areas as content areas. These 12 areas were formulated based on an analysis of the roles and functions that the ocean plays in the actual society in which humans live and within their daily lives. Specifically, the 12 areas are classified as “lifestyles, health and safety”, “tourism, leisure and sports”, “culture and art”, “history and folk customs”, “earth and oceans”, “materials”, “life”, “environment and cycles”, “resources and energy”, “economy and industry”, “management” and “international”.

Next, the content of ocean education at a feasible level for implementation in junior high school was selected following a check of content for each subject set forth in the new curriculum guidelines and ocean-related content in current textbooks. Educational content is written out uniformly following the grammatical pattern of “to become aware of the subject matter, through concrete activities, and



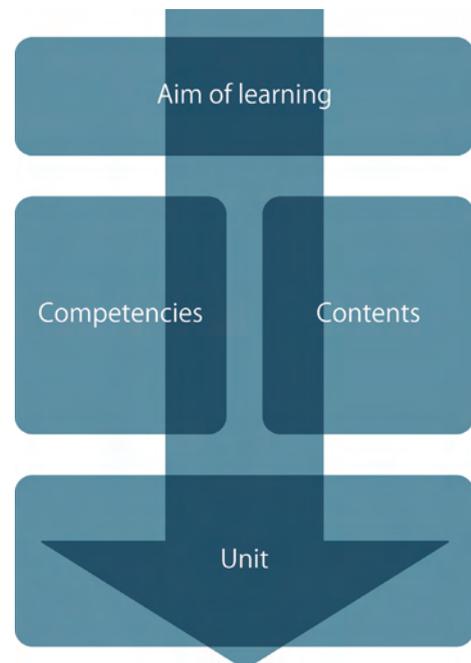


The concept of ocean education in high school education: competencies and contents

to develop the necessary abilities”, based on the new curriculum guidelines. Further, ocean-related content to be covered in the curriculum was made to comply with the items in the “Introduction to Ocean Issues (edited by the Ocean Policy Research Foundation)”, which was published as an introductory text on integrated ocean management for institutions of higher education, ensuring that educational content meets the requirements of the Basic Act on Ocean Policy.

### 3) High school version

In order to maintain consistency between primary and junior high school, the definition and concept of ocean education was given similar treatment. On the other hand, the interests, concerns and pathways of high school students are more diversified, and the expertise of teachers is also at a higher level. Thus, the high school curriculum differs from that of mandatory education and must maintain a balance between commonality and diversity. Accordingly, a fixed curriculum that follows the framework of the curriculum guidelines for each subject, like the one for primary and junior high schools that follows the form of “to become aware of the subject matter, through concrete activities,



Conceptual diagram of competencies and contents in units



and to develop the necessary abilities”, is not appropriate. Rather, the aforementioned “competencies”, or the abilities and attitudes to be fostered in ocean education, and “contents”, or the range of knowledge and skills to be learned in ocean education, have been set forth. There is no need to confine content to a curriculum; rather, the creation of detailed curriculums is left to the discretion of teachers. In so doing, the level of expertise is increased, and teachers are free to develop teaching at a certain level of knowledge without having to adhere to curriculum guidelines, as is characteristic of high school education. As such, it is also easier to reflect the ever-changing state of affairs in actual teaching.

“Competencies” were established with reference to various guidelines set forth by research institutions and the commissions of relevant government agencies. These include, “Education for Sustainable Development” (Ministry of Education, Culture, Sports, Science and Technology et al.), “The Power to Live and Scholastic Ability” (Ministry of Education, Culture, Sports, Science and Technology), “Human Power” (Cabinet Office), and “Basic Skills for Adults” (Ministry of Economy, Trade and Industry).

Contents were established with an effort to limit items to those that are particularly important to the various marine issues our country faces. Keywords were selected from several sources (listed below) that comprehensively cover ocean-related content, and the opinions of experts were taken into account to group and organise these keywords. Consistency was maintained with the methods of organisation in the primary school version of the four viewpoints of “to become familiar with the ocean”, “to get to know the ocean”, “to protect the ocean” and “to utilise the ocean”, as well as the method of organisation for the junior high version, which is the 12 content areas of “lifestyles, health and safety”, “tourism, leisure and sports”, “culture and art”, “history and folk customs”, “earth and oceans”, “materials”, “life”, “environment and cycles”, “resources and energy”, “economy and industry”, “management” and “international”.

“Introduction to Ocean Issues”, Hiroshi Terashima, Shin Kisugi, Isao Koike, edited by the Ocean Policy Research Foundation, Maruzen, 2007

“Ship & Ocean Newsletter”, Ocean Policy Research Foundation, 2000-2011

“Research on the Interdisciplinary Ocean Education of Universities” Report, The University of Tokyo Ocean Alliance, March 2010

“Research on Interdisciplinary Ocean Education”, The Research Society on Interdisciplinary Ocean Education, fiscal year 2010 report

## 3-4 . Usage

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### 1) To teachers

The primary and junior high versions were designed and developed based on the national curriculum guidelines. They are not intended to create a new subject on “oceans”, rather are premised on an



integrated educational system that laterally links the ocean-related content of existing subjects. Specifically, matters related to the ocean were extracted from each subject, moral education, foreign language activities, periods for integrated study and special activities, as set forth in the new curriculum guidelines, and systematically compiled. This curriculum is based on education content in adherence to the national curriculum guidelines and does not add new educational objectives or content. Learning in each subject is enhanced with the “ocean” as a focal point. The objective is to improve the knowledge, skills, cognitive ability, decision-making skills and power of expression of children, and there is no need to prepare them for “ocean education”. The curriculum is designed not only for teachers who would like to extensively utilise the ocean as teaching material in their classes, but is also applicable for teachers who would like to select and utilise only a part of this curriculum. The relation between each area of content of this curriculum and each subject of study is shown in a separate table.

In order to easily visualise units, all content is formatted uniformly following the “to become aware of the subject matter, through concrete activities, and to develop the necessary abilities” pattern of the national curriculum guidelines. Sample unit plans and lesson plans are provided as reference. Further, in order to conduct more effect learning through utilisation of the education resources provided by external organisations, an column outlining ideal “external cooperation” is provided in unit plans and lesson plans, and concrete forms of cooperation between schools and external organisations are shown as a reference.

Furthermore, reflecting the present state of junior high schools where different teachers teach each subject, the junior high school version gives more attention to showing in detail the treatment of the oceans in each subject. However, as ocean education calls for integrated thinking, cross-curricular “finishing units” that systematically combine content taught in each subject of the curriculum are also provided. Further, the content to be taught at the junior high school level and the skills to be acquired are clarified.

For the high school version, concrete examples of learning that combine competencies and contents are illustrated as a proposal for unit plans and lesson plans for a few subjects. These competencies and contents are not limited to ocean education at high schools, but are based on consistency with primary and junior high school versions. Thus, they can also be utilised as guidelines when considering ocean education at the primary and junior high levels. Additionally, content can be used as a reference for not only general courses, but also fisheries and ocean science courses as it is grounded in the content areas of interdisciplinary ocean education regarding which research is advanced in universities. However, as content follows ocean issues faced at present, it should be noted that content must be updated periodically.



## 2) To the external support organisations

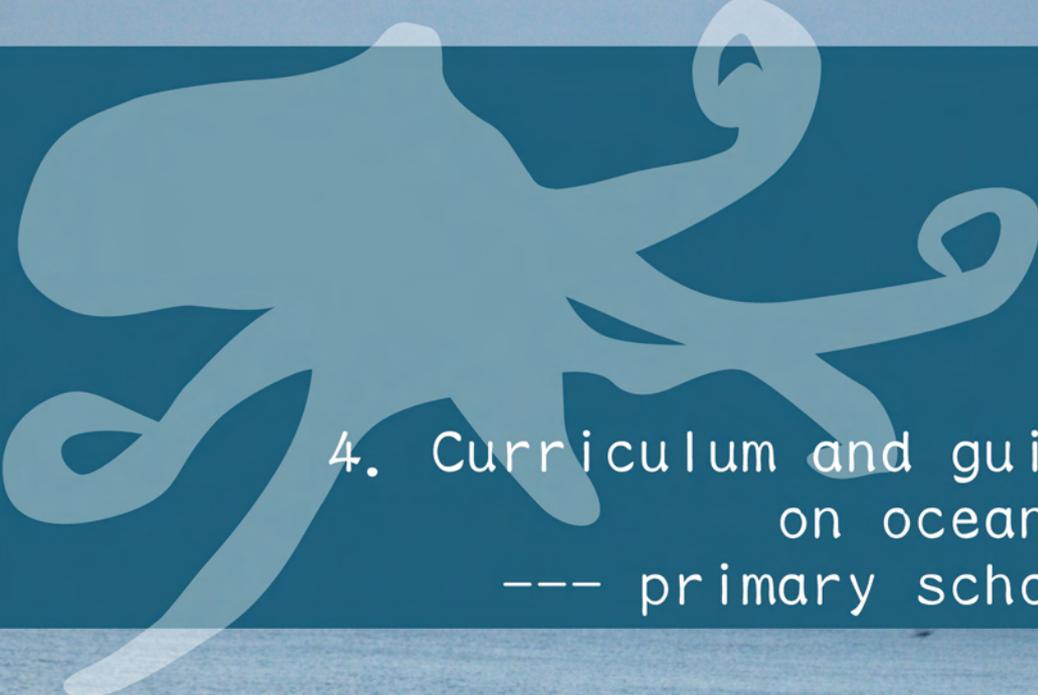
There are many organisations that conduct ocean-related education support all over the country, including museums, aquariums, universities, research institutes, private companies and non-profit organisations. They provide diverse content, including supplementary teaching materials, experiential programmes, guest teachers, and lending of equipment, constituting a beneficial component to education that cannot be achieved in classrooms alone. It goes without saying that such support from organisations external to schools is essential for the popularisation and promotion of ocean education.

Nevertheless, in order to practice ocean education within the framework of school education, it is necessary to work in compliance with the educational objectives and content required by school education, and for the content of external support to conform to the national curriculum guidelines. In other words, if content is in accordance with the curriculum guidelines, schools can use the educational resources of external organisations as “teaching materials”. For this reason, it is essential that both schools and external organisations share common content in ocean education.

This curriculum acts as a bridge between school teachers and staff of the external organisations that conduct educational support. This curriculum also is a proposal for detailed content of such cooperation.

In particular, external cooperation items shown in unit plans and lesson plans are an important part to understanding how the materials and programmes provided will be used, in what classes, and in what settings. One of the expectations for this curriculum is that the beneficial educational resources that lie outside schools will be further utilised, and that the distance between them and educational settings will be shortened.





4. Curriculum and guidance plan  
on ocean education  
--- primary school version



## 4-1 . Curriculum

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### 1) Objectives

To foster a generous sensibility toward the ocean and raise interest in the ocean through activities to get familiar with the abundant nature of the ocean, experiential activities to become aware of the links between the ocean and familiar aspects of communities, activities to study the ocean, and experience in activities to preserve the ocean. Also, to facilitate understanding of the relationships between the ocean and mankind, such as the marine environment, aquatic resources and transport by ships, as well as connections between the peoples of the world via the ocean, and to cultivate the nature, ability and attitude to become the builders of a sustainable society.

### 2) Objectives and content by school year

[Grades 1 and 2]

#### 1. Objectives

- (1) To become familiar with the nature of the ocean through playing at the seashore and contact with living things, and to enable to voluntarily get involved with the ocean.
- (2) To gain an interest in vessels of the ocean and the names of the ocean's living things, and to enable to engage voluntarily in investigation.
- (3) To become aware of the way the pollution of the ocean relates to our lifestyles and the seasons through seashore cleanup activities, and to enable to possess the desire to protect the nature of the ocean.
- (4) To participate in events related to the ocean, become aware of the daily lives and work of people in the community and the changes of season, and to enable to try to make contact with people whose lives are influenced by the ocean.

#### 2. Contents

##### A. To become familiar with the ocean (a. Walking on the seashore)

##### (1) Finding living things on the beach

To find living things on the beach, take an interest in the wonder of the ocean's living things, and enable students to voluntarily get involved with the ocean.

- a. To find and observe living things on sandy and rocky beaches.
- b. To become aware of the distinguishing characteristics of living things on sandy and rocky beaches.
- c. To take an interest in nature and to voluntarily get involved with it.

##### (2) Playing on a sandy beach

To experience fun and pleasant activities on sandy beaches through playing on a sandy beach, and to enable students to voluntarily get involved with the ocean.

- a. To play with the ocean's natural materials, such as sand, articles washed ashore and seaweed.



- b. To play among the natural phenomena of the ocean, such as waves, and the ebb and flow of tides.

### **(3) Drawing a picture of the ocean**

To take an interest in the size and beauty of the ocean through drawing pictures of the ocean, and to enable students to voluntarily get involved with the ocean.

- a. To observe the ocean and its variety of beauty according to seasons and time.
- b. To think of ways to express feelings about the ocean.
- c. To feel refreshed by contact with beauty.

## **A. To become familiar with the ocean (b. Exploring the seashore)**

### **(1) Creating art from articles washed ashore**

To make art using articles washed ashore and to enable students to think about the types, shapes and characteristics of items washed ashore.

- a. To think up and create art based on the shape and color of natural and artificial articles washed ashore, such as shells, drift wood and eroded glass.
- b. To enjoy creating art while remembering the scene and feelings of gathering the articles washed ashore at the ocean.
- c. To utilise the entire body to make items by lining articles up, connecting them and piling them up.
- d. To engage in expression by selecting favorite colors, making lots of shapes and having fun.

## **B. To get to know the ocean (a. Getting to know the ocean 's living things)**

### **(1) Learning the names of the ocean's living things**

To study the names of the living things of the ocean, understand that lots of living things exist, and enable students to gain familiarity with the ocean and to value it.

- a. Lots of living things are in the ocean.
- b. To take an interest in the distinguishing characteristics of living things, and to study their names.

## **B. To get to know the ocean (b. Studying the ocean 's vessels)**

### **(1) Studying the vessels that navigate the oceans**

To study vessels that navigate the oceans, to understand the situations of people who work on ships, and to enable students to gain familiarity with and attachment to the community in which one they live.

- a. There are lots of types of ships.
- b. There are lots of types of work on the oceans.
- c. The communities where we live have a variety of good qualities and distinguishing characteristics.



### C. To protect the ocean (a. Thinking about the lives of people and the ocean environment)

#### (1) Gathering refuse at the seashore.

To engage in activities to gather refuse at the seashore with people of the local communities, and to enable students to think about the connections between this refuse and our lifestyles and the seasons.

- a. The waste we throw away and waste from other countries is washed up at the seashore.
- b. A variety of people keep the seashores clean.
- c. Types and volume of waste differ by season.

### D. To utilise the ocean (a. Studying the connections in communities based on the ocean)

#### (1) Participating in events at the seashore

To participate in an event related to the ocean, and to enable students to think about the lifestyles and events of the community, the working people, and the variations of the four seasons.

- a. Our lifestyles are related to the people who live and work in our communities and to a variety of places.
- b. Observance of nature and activities related to seasons and community events show that aspects of our lifestyles change according to the variations of the four seasons and time of year.
- c. To get involved and have fun with familiar people through activities to communicate the events of our lifestyles and the community.

### [Grades 3 and 4]

#### 1. Objectives

- (1) To raise sea life, visit ocean-related facilities and experience boats to gain an interest in the habitat of sea life and the people who work at sea, and to enable students to voluntarily get involved with the ocean.
- (2) To take in interest in the different distinguishing characteristics and habitats of living things in the ocean, as well as ocean-related history and culture and their differences according to region, and to enable students to investigate while making comparisons.
- (3) To understand the conditions of the natural environment and the effects of our lifestyles on the natural environment through activities to preserve the environment of the ocean, and to enable students to voluntarily protect the nature of the ocean.
- (4) To know the ocean-related industries built upon the special characteristics of regions and that the various regions of Japan are connected by the ocean, and to enable to attempt to live with the sea.



## 2. Contents

### A. To become familiar with the ocean (b. Exploring the seashore)

#### (1) Raising living things of the ocean

To have concern for the life of creatures and their ocean habitats through activities in raising living things, and to enable students to voluntarily get involved with the ocean.

- a. Creatures have different colors, shapes and sizes.
- b. Creatures live in relation to their environments.
- c. To have concern for the changes and growth of creatures and to value their life.

#### (2) Visiting ocean-related facilities

To take an interest in ocean-related work and working people through visiting ocean-related facilities, and to enable students to get involved with the ocean.

- a. There are types of work related to production and sales related to the ocean, and these support our lifestyles.
- b. Related institutions cooperate with people in communities to work to prevent disasters and accidents.
- c. Relevant institutions have mutual partnerships and systems to react to emergencies.

### A. To become familiar with the ocean (c. Riding a boat)

#### (1) Riding and making different boats

To become aware of the fun and structure of boats through riding on and making boats, and to enable students to voluntarily get involved with the ocean.

- a. To become aware of the fun and characteristics of various boats.
- b. To take an interest in the skillful construction of floating boats.
- c. To have a goal and devise ways to make a boat from familiar materials.

### B. To get to know the ocean (c. Studying the living things of the sea)

#### (1) Studying living things in various places

To study the differences between living things in a variety of places and to enable students to understand the relationships between living things and their surrounding environments.

- a. Creatures have different colors, shapes and sizes.
- b. Creatures live according to their environments, including geographical features such as sand, rocks, coral reefs and ocean depth.

#### (2) Studying living things in the sea and in freshwater

To study the differences between living things in the ocean and in fresh water, and to enable students to understand the distinguishing characteristics of living things in the ocean and in fresh water.

- a. Types differ according to differences in living environments.
- b. There are similar fish, even though they live in different environments.



- c. There are living things that come and go between the ocean and rivers.

### **(3) Studying the appearance of living things by season**

To study the differences between living things by season and to enable students to understand the change of seasons and the manner of activity and growth of living things.

- a. The types and numbers of living things differ by season.
- b. The size of living things differs by season.
- c. There is a close relationship between the seasons and spawning season.
- d. There are best seasons for fish.

## **B. To get to know the ocean (d. Getting to know the nature of the ocean)**

### **(1) Studying the relationships among the oceans, rivers and mountains**

To study the relationships among the oceans, rivers and mountains, and to enable students to understand the cyclical system of water.

- a. Water evaporates from the water surface or the earth's surface, becomes vapor in the air, then the vapor in the air condenses to again become water.
- b. Water circulates from mountains to rivers to oceans to air as it changes its form.
- c. As water flows from mountains to river and oceans, soil and nutrients are carried along with it.

## **B. To get to know the ocean (e. Studying about ocean history)**

### **(1) Studying the traditions and culture closely related the ocean**

To study about the traditions and culture closely related to the ocean, and to enable to understand the work and labour of our forebears who devoted themselves to improving people's lifestyles.

- a. Distinctive localities and the lifestyles of people, such as the natural environment and traditional industries.
- b. Tools of the ocean related to lifestyles that remain from long ago, and the lives of people who used them.
- c. Cultural assets, yearly events, folk tales and folk songs related to the ocean that have been passed down by people.
- d. The wisdom and efforts of our forebears that have protected lives from natural disasters such as tsunami and storm tides.

## **C. To protect the ocean (a. Thinking about the lives of people and the ocean environment)**

### **(1) Getting involved in environmental preservation of the coast**

To engage in environmental preservation of the coast and to enable students to think about the conditions of the natural environment of the coasts, the effects our lifestyles have on the natural environment, and things we can do.



- a. The living things on the seashore live in close relation to their surrounding environment.
- b. Domestic wastewater and the way we discard waste affects living things at the seashore and the marine environment.
- c. To examine one's own present lifestyle and consider one's lifestyle in the future.

**(2) Expressing feelings about protecting the nature of the ocean**

To express feelings and the desire to protect the natural environment of the ocean in words, pictures and music, and to enable students to think about the present situation of the ocean and the connection between the ocean and themselves.

- a. To engage in expression, being aware of one's audience and by clarifying what one wants to communicate.
- b. The ocean environment has a wealth of nature and is constantly changing.
- c. There are relationships and connections between ourselves and the ocean.

**C. To protect the ocean (b. Studying the changes in environment and relationships between the ocean)**

**(1) Studying where articles washed ashore came from**

To engage in activities to gather and examine articles washed ashore, to become aware of the various countries and regions from which these articles are washed up on shore, and to enable students to think about the vastness of the ocean and relationships with foreign countries.

- a. Articles washed ashore are related to natural phenomena such as ocean currents and winds.
- b. Articles washed ashore are related to the characteristics of the land of Japan and the activities of neighboring countries, as well as activities at sea.

**D. To utilise the ocean (a. Studying the connections in communities based on the ocean)**

**(1) Studying the connections between various areas of Japan via ocean transportation**

To study about the connections between various areas of Japan via ocean transportation, and to enable students to think about the relationships among the geographical location of regions and the natural environment, the lifestyles of people, industries and relationships between various regions within Japan and foreign countries.

- a. The geographical formations of the coast in familiar regions and cities (wards, towns, villages), water depth, weather conditions, characteristics of ocean currents, land use, the location and role of harbors, transportation conditions, etc.
- b. The geographical location of one's own city (ward, town, village) within the prefecture, and of one's own prefecture within Japan; the names and locations of the 47 prefectures.
- c. The overall geographical formations of prefectures and whether they border the ocean, and the locations and roles of harbors.



- d. The lives of people in communities with harbors in one's prefecture.
- e. People's lifestyles and industries near the ocean, and the relationship between other areas of Japan and foreign countries via the ocean.

#### **D. To utilise the ocean (b. Studying the lifestyles of people who work at sea**

##### **(1) Studying about the industries of the ocean in the local area**

To study about the industries of the ocean in the local area and to enable students to understand the industries of the local area in which one lives.

- a. The characteristic geographical formations of familiar areas, land use, and geographical location.
- b. Ocean-related industries that support our lifestyles.

##### **(2) Learning about the marine industries in the local area**

To make a daily time schedule for a person participating in marine industries, to study about marine industries in the local area, and to enable students to think about production and sales and related operations.

- a. There is work related to production and sales in areas where fish and shellfish are caught or raised, and this work supports our lifestyles.
- b. To study the special characteristics of the work of catching and raising fish and shellfish seen in the production and sales of people in the local area.

### **[Grades 5 and 6]**

#### **1. Objectives**

- (1) To become familiar with the natural aspects and culture of the ocean, and to come into contact with diverse types of work related to the ocean through experiential activities in ocean-related work and touring facilities, and to enable students to voluntarily get involved with the ocean.
- (2) To take an interest in the ocean's biodiversity and ecosystems, as well as the ocean's history and culture, and to enable students to carry out investigations by making associations and measurements.
- (3) To study global-scale environmental issues and international initiatives, think about what one can do to preserve the environment of the ocean, and enable students to make efforts in a variety of ways.
- (4) To study the marine products industry, marine transport and marine resources of Japan, to enable students to understand the various roles and rules of the ocean that has supported the abundant lifestyles of people, and to work to utilise the ocean in cooperation with the other countries of the world.



## 2 Contents

### A To become familiar with the ocean (d. Going to a seaside school)

#### (1) Experiencing the ocean

To become aware of the pleasure of daily living in nature and group activities through seaside school activities, and to enable students to voluntarily get involved with the ocean.

- a. To become familiar with the natural aspects and culture of the ocean in a living environment that differs from everyday life.
- b. To enjoy making dried fish, salt and gelidium jelly.
- c. To enjoy beach combing and crafts.
- d. To enjoy swimming in the ocean and marine sports.
- e. To become aware of the fun of cooperative group activities, and to form desirable human relationships.

### A. To become familiar with the ocean (e. Experiencing ocean-related work)

#### (1) Experiencing the work of fishermen

To experience the work of fishermen and take an interest in the jobs and trials of people who live and work dealing with nature, and to enable students to voluntarily get involved with the ocean.

- a. To become aware of the value of labour and the joys of production.
- b. To become aware of the schemes and efforts of people working in the fishing industry.
- c. The fishing industry supports the dietary lifestyles of citizens.

#### (2) Observing ocean-related work

To tour an ocean-related facility, gain a variety of knowledge about the ocean, and come to know various ocean-related jobs, and to enable students to voluntarily get involved with the ocean.

- a. To tour a fishing port, market and marine products research lab.
- b. To tour a facility of the coast guard or port authority.
- c. To tour an ocean-related museum, such as an aquarium.

#### (3) Experiencing ocean-related activities

To experience ocean-related activities, become aware of the importance of the thoughts and actions of people involved in ocean-related activities, and to enable students to voluntarily get involved with the ocean.

- a. To experience beach clean-up activities.
- b. To experience life-saving activities.
- c. To experience nature restoration volunteer activities.



## **B. To get to know the ocean (c. Studying the living things of the sea)**

### **(1) Studying the fish of the ocean**

To study the ocean's fish, and to enable students to understand the structure and workings of their bodies.

- a. Fish take in oxygen from sea water through their gills and release carbon dioxide into sea water.
- b. Food is digested and absorbed as it passes through the mouth, stomach and intestines, and what is not absorbed is excreted.
- c. Blood circulates the body due to operation of the heart, and carries nutrients, oxygen and carbon dioxide.
- d. Saltwater fish possess a mechanism to adjust the level of salt in their bodies while in sea water. Fish have a variety of distinguishing characteristics and mechanisms to respond to the environments they inhabit, such as species that store fat in air bladders and those without air bladders.

### **(2) Studying the plant life of the ocean**

To study the plant life of the ocean and enable students to understand the structure and workings of plant bodies.

- a. Among plants in the sea, there are plankton, algae and seaweed, which each have differing characteristics from plants on land.
- b. Plants of the ocean also engage in photosynthesis.
- c. The places where algae and seaweed grow are habitats for sea creatures.

### **(3) Studying the birth of sea creatures**

To study about the birth of sea creatures, and to enable students to understand about the birth and growth of animals.

- a. There are male and female fishes, and the appearance of eggs changes over time after they are laid.
- b. Fish survive by eating small organisms in the water.

## **B. To get to know the ocean (d. Getting to know the natural environment of the ocean)**

### **(1) Studying the relationships of sea life**

To study about the relationships of living things of the sea, and to enable students to understand that sea creatures are interdependent based on the food chain.

- a. Sea creatures share "eat and be eaten" type relationships.
- b. Sea creatures have symbiotic and parasitic relationships as they utilise each other.

## **B. To get to know the ocean (e. Studying about ocean history)**

### **(1) Studying about cultural exchange via the ocean**

To study about the history of cultural exchange via the ocean and enable to understand major



events in Japan's history, our ancestors who crossed the seas and culture.

- a. The works and labours of those who came before us, such as Ono no Imoko, Gyoki, Jianzhen, Francisco de Xavier, Perry and Katsu Kaishu.
- b. Culture, such as rice farming, religion, the written word, and firearms.

## **B. To get to know the ocean (f. Getting to know the situation of the ocean)**

### **(1) Studying about ocean currents, ebb and flow of tides and geographical formations of the ocean floor**

To study about the ocean currents, ebb and flow of tides, and the geographical formations of the ocean floor, to enable students to understand the influence of the large movements and formations of the ocean.

- a. Ocean currents and changes in water temperature are related to climates.
- b. Fishing grounds are formed according to ocean currents and the geographical formations of the ocean floor.
- c. The scale of the ebb and flow of tides changes with location and time of year.

## **C. To protect the ocean (a. Thinking about people's lifestyles and the environment of the ocean)**

### **(1) Studying about Japan's marine products industry and the marine environment**

To study about Japan's marine products industry, and to enable students to think about the relationships between Japan's fisheries resources and the marine environment.

- a. The marine products industry supports the dietary lifestyles of people in Japan, and some food is imported from foreign countries.
- b. Fisheries resources, distribution of marine products, production volume, and characteristics of the marine environment.
- c. Relationship between the marine products industry and the marine environment, and schemes and efforts to preserve the marine environment.

## **C. To protect the ocean (b. Studying the changes in the environment and relationships between the ocean)**

### **(1) Studying about global warming and changes in the ocean**

To study about global warming, changes in the ocean and their impacts, and to become aware of the fact that global warming is inextricably related to our lifestyles and the climate, and to enable to think about what one can do.

- a. Global warming is related to melting of ice at the north and south poles and glaciers.
- b. The issue of flooding and the rising sea level.
- c. El nino and La nina phenomena are related to changes in marine products industry resources.



## **(2) Studying about changes in the ocean's environment and the lives of animals**

To study about the relationship between the changes in the ocean's environment and the lives of animals, to become aware of the fact that the situation of animals changes according to the changing environment, and to enable students to think about involvement with the ocean (from the standpoint of nature preservation).

- a. Land reclamation, shore protection works, and ocean dumping and their influence on the ecosystem.
- b. Acidification of the ocean brought about by the increase in carbon dioxide yields influence on sea creatures.
- c. There are initiatives taking place toward environmental protection and restoration of nature.

## **(3) Studying about changes in the ocean's environment and the lives of people**

To study about the relationship between changes in the ocean's environment and the lives of people, to become aware of the fact that the lives of people near the ocean are changing according to the changing environment, and to enable students to think about involvement with the ocean.

- a. The structure of industry is changing, such as the decline in the fishing industry brought about by changes in the marine environment.
- b. The idea of ecotourism was born out of increased concern over changes in the marine environment.
- c. To rethink one's lifestyle and make an effort to lead an environmentally-friendly lifestyle.

## **C. To protect the ocean (c. Thinking about ocean-friendly living)**

### **(1) Studying about the influence people's lives on the oceans**

To study about marine pollution brought about by everyday lives and industrial activities, and to enable students to rethink lifestyles and habits to protect the ocean.

- a. The ocean's environment is polluted by drainage and waste water from our daily lives and industrial activities, including manufacturing, agriculture, aquaculture and mining.
- b. Public hazards caused by marine pollution have caused social problems.
- c. People work to protect the oceans by improving industrial activities and lifestyles.

## **D. To utilise the ocean (b. Studying the lifestyles of people who work at sea)**

### **(1) Studying the marine products industry of Japan**

To study about the marine products industry of Japan and to enable students to understand the distinguishing characteristics of the marine products industry in various areas of Japan and utilisation of the ocean.



- a. The location and territory of Japan, territorial waters and the continental shelf, units of measurement related to the ocean
- b. Fishing industry and major fishing ports in Japan
- c. Schemes and efforts of people working in the marine products industry
- d. Transport that connects fishing ports and places of consumption

## **(2) Studying about marine transport**

To study about the marine transport of Japan, and to enable students to understand the connections between people taking part in marine transport in various areas of Japan and the role of government agencies.

- a. Workings of transport that connects places of production with places of consumption
- b. Schemes and efforts of people working in marine transport
- c. Initiatives of government agencies in safe navigation and schemes and efforts of people involved in marine transport

## **D. To utilise the ocean (c. Studying about connections with the world via the ocean)**

### **(1) Studying the maritime transport of the world**

To study about the maritime transport of the world, and to enable students to understand links between people involved in marine transport in various areas of the world and the role of the United Nations.

- a. Maritime shipping can carry large volumes of goods at cheap costs.
- b. Efforts are being made to realise safe navigation led by the United Nations.
- c. International navigation has impacts on the environment.

### **(2) Studying about connections in the world and the workings of maritime transport**

To study about the connections in the world and the workings of maritime transport, and to enable students to think about how food, raw materials and products are conveyed by ship.

- a. Many foods and raw materials are imported from foreign countries.
- b. There are sea routes to convey items from places of production to places of consumption, and those who work to protect their safety.
- c. There are many types of ships and functions according to the items being conveyed.

## **D. To utilise the ocean (d. Studying about Ocean resources)**

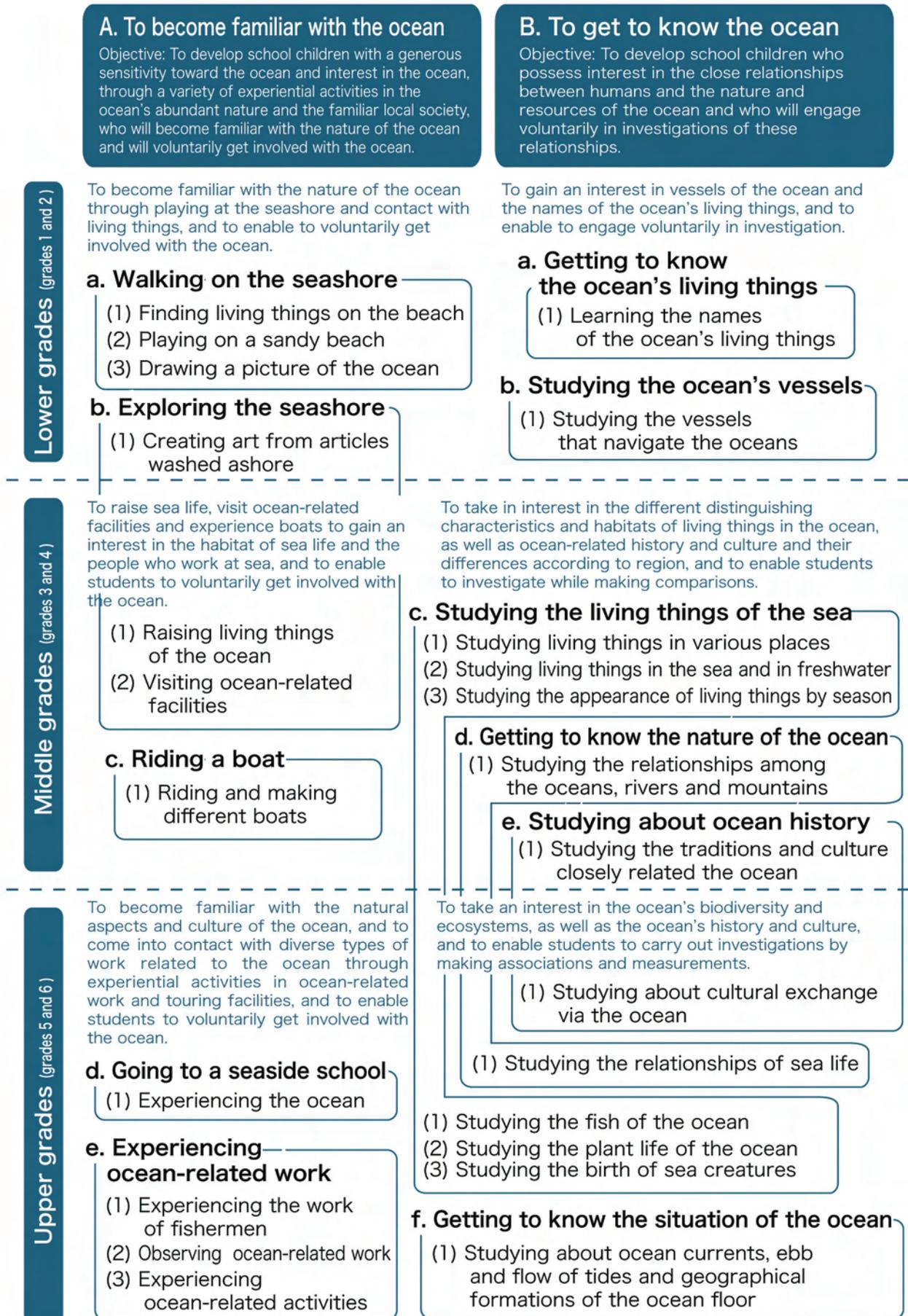
### **(1) Studying about energy development in Japan's oceans**

To study about energy development in Japan's oceans, and to enable students to think about effective utilisation.

- a. Power generation utilising wind power, wave power and temperature difference
- b. Utilisation of characteristics of mineral resources, such as methane hydrate and rare metals, for industry
- c. Use of deep ocean water for industry and daily life



### 3) Content flow chart



## C. To protect the ocean

Objective: To develop school children through experience in investigative activities on the ocean's environment and conservation activities, who will take the initiative to get involved in environmental protection of the oceans.

To become aware of the way the pollution of the ocean relates to our lifestyles and the seasons through seashore cleanup activities, and to enable to possess the desire to protect the nature of the ocean.

### a. Thinking about people's lifestyles and the environment of the ocean

- (1) Gathering refuse at the seashore

To understand the conditions of the natural environment and the effects of our lifestyles on the natural environment through activities to preserve the environment of the ocean, and to enable students to voluntarily protect the nature of the ocean.

- (1) Getting involved in environmental preservation of the coast
- (2) Expressing feelings about protecting the nature of the ocean

### b. Studying the changes in environment and relationships between the ocean

- (1) Studying where articles washed ashore came from

To study global-scale environmental issues and international initiatives, think about what one can do to preserve the environment of the ocean, and enable students to make efforts in a variety of ways.

- (1) Studying about global warming and changes in the ocean
- (2) Studying about changes in the ocean's environment and the lives of animals
- (3) Studying about changes in the ocean's environment and the lives of people

### c. Thinking about ocean-friendly living

- (1) Studying about the influence people's lives on the oceans

- (1) Studying about Japan's marine products industry and the marine environment

## D. To utilise the ocean

Objective: To develop school children who comprehend marine products and resources, transport of people and goods using ships, and the links between people of the world provided by the ocean, and who understand the importance of sustainable use of these.

To participate in events related to the ocean, become aware of the daily lives and work of people in the community and the changes of season, and to enable to try to make contact with people whose lives are influenced by the ocean.

### a. Studying the connections in communities based on the ocean

- (1) Participating in events at the seashore

To know the ocean-related industries built upon the special characteristics of regions and that the various regions of Japan are connected by the ocean, and to enable to attempt to live with the sea.

- (1) Studying the connections between various areas of Japan via ocean transportation

### b. Studying the lifestyles of people who work at sea

- (1) Studying about the industries of the ocean in the local area
- (2) Learning about the marine industry in the local area

To study the marine products industry, marine transport and marine resources of Japan, to enable students to understand the various roles and rules of the ocean that has supported the abundant lifestyles of people, and to work to utilise the ocean in cooperation with the other countries of the world.

- (1) Studying the marine products industry of Japan
- (2) Studying about marine transport

### c. Studying about connections with the world via the ocean

- (1) Studying the maritime transport of the world
- (2) Studying about connections in the world and the workings of maritime transport

### d. Studying about ocean resources

- (1) Studying about energy development in Japan's oceans



#### 4) Content flow chart by subject

The content flow chart indicates the relevant parts of the primary school national curriculum guides for each item of the curriculum content related to ocean education.

Lower grades(LG): grades 1(G1) and 2(G2)		Middle grades(MG): grades 3(G3) and 4(G4)	
<b>Japanese</b>			
<b>Daily Living</b>	G1/2-2-(3): People and places of living and working in the community LG-B-b-(1) Studying the vessels that navigate the oceans LG-C-a-(1) Gathering refuse at the seashore LG-D-a-(1) Participating in events at the seashore	<b>Social studies</b>	G3/4-2-A-(1)-b: To talk according to addressee and objective MG-C-a-(2) Expressing feelings about protecting the nature of the ocean
	G1/2-2-(5): Observation of nearby nature, Changing of seasons and daily living LG-A-a-(1) Finding living things on the beach LG-A-a-(3) Drawing a picture of the ocean LG-B-a-(1) Learning the names of the ocean's living things LG-C-a-(1) Gathering refuse at the seashore LG-D-a-(1) Participating in events at the seashore		G3/4-2-(1)-a: Location and work of public facilities, Characteristic places of the community MG-D-a-(1) Studying the connections between various areas of Japan via ocean transportation MG-D-b-(1) Studying about the industries of the ocean in the local area UG-A-e-(2) Observing ocean-related work
	G1/2-2-(6): Play using familiar nature and things LG-A-a-(2) Playing on a sandy beach LG-A-b-(1) Creating art from articles washed ashore		G3/4-2-(2)-a, b: Work in local production and sales MG-A-b-(2) Visiting ocean-related facilities MG-D-b-(1) Studying about the industries of the ocean in the local area MG-D-b-(2) Learning about the marine industries in the local area
	G1/2-2-(7): Places where grow, appearance of changes and growth LG-A-a-(1) Finding living things on the beach LG-B-a-(1) Learning the names of the ocean's living things MG-A-b-(1) Raising living things of the ocean		G3/4-2-(3)-a, b: Electricity and gas security UG-D-d-(1) Studying about energy development in Japan's oceans
	G1/2-2-(8): Communicating on lifestyles and local happenings LG-D-a-(1) Participating in events at the seashore		G3/4-2-(4)-a, b: Prevention of disasters and accidents, cooperation among relevant organisations MG-A-b-(2) Visiting ocean-related facilities
			G3/4-2-(5)-a, b, c: The lives of local people and the work of predecessors MG-B-e-(1) Studying the traditions and culture closely related to the ocean
			G3/4-2-(6)-a, b, c, d: Characteristics of prefectures, Major cities and their locations MG-D-a-(1) Studying the connections between various areas of Japan via ocean transportation UG-D-b-(1) Studying the marine products industry of Japan
			G3-2-B-(2): Observation of nearby nature MG-A-b-(1) Raising living things of the ocean MG-B-c-(1) Studying living things in various places MG-B-c-(2) Studying living things of the sea and freshwater MG-C-a-(1) Getting involved in environmental preservation of the coast
			G4-2-B-(2): Seasons and life forms-a, b MG-B-c-(3) Studying the appearance of living things by season
			G4-2-B-(3): The circumstances of nature MG-B-d-(1) Studying the relationships among the oceans, rivers and mountains
	G5-2-B-(2): The birth of animals-a MG-B-c-(3) Studying the appearance of living things by season		
<b>Music</b>			
<b>Art</b>	G1/2-2-A-(1)-a: Familiar natural items and artificial materials LG-A-b-(1) Creating art from articles washed ashore	<b>Science</b>	G3/4-2-A-(3)-a: Music-making activities MG-C-a-(2) Expressing feelings about protecting the nature of the ocean
	G1/2-2-A-(2)-a: Find something one wants to express and engage in expression LG-A-a-(3) Drawing a picture of the ocean		G3/2-2-A-(1)-a: Form an idea based on familiar materials and places MG-A-c-(1) Riding and making different boats
<b>Morality</b>	G1/2-3-(2): To become familiar with nearby nature LG-A-a-(1) Finding living things on the beach	<b>Art</b>	G3/4-2-A-(2)-c: Find something one wants to express and engage in expression MG-C-a-(2) Expressing feelings about protecting the nature of the ocean
	G1/2-3-(3): To come in contact with beautiful things and feel mentally refreshed LG-A-a-(3) Drawing a picture of the ocean		G3/4-3-(1): To value the living things LG-A-b-(1) Raising living things of the ocean
			G3/4-3-(3): A mind to be impressed by beautiful things MG-C-a-(2) Expressing feelings about protecting the nature of the ocean



Example: Daily Living G1/2-(6): Play using familiar nature and things

LG-A-a-(2) Playing on a sandy beach

The item, “LG-A-a-(2)Playing on a sandy beach” indicates relevance to “(6)” of the “grades 1 and 2” in the “Daily Living” in the primary school national curriculum guidelines. Following the colon “:”, a simple explanation of the corresponding item is added.

## Upper grades(UG): grades 5(G5) and 6(G6)

Social studies	<p>G5-2-(1)-a, b:The continents and oceans of the world and the geographical formations and climates of national land            MG-C-b-(1) Studying where articles washed ashore came from UG-D-b-(1) Studying the marine products industry of Japan            UG-B-f-(1) Studying about ocean currents, ebb and flow of tides and geographical formations of the ocean floor</p> <p>G5-2-(1)-c:Pollution            UG-C-c-(1) Studying about the influence people’s lives on the oceans</p> <p>G5-2-(1)-d:Prevention of natural disasters            MG-B-e-(1) Studying the traditions and culture closely related the ocean</p> <p>G5-2-(2)-a:Japan’s marine products industry, The schemes and efforts of people working in the food production industry            UG-A-e-(1) Experiencing the work of fishermen            UG-C-a-(1) Studying about Japan’s marine products industry and the marine environment            UG-C-b-(3) Studying about changes in the ocean’s environment and the lives of people</p> <p>G5-2-(2)-c:The schemes and efforts of people working in the food production industry, transport that links places of production and consumption            MG-D-b-(2) Learning about the marine industries in the local area            UG-D-b-(1) Studying the marine products industry of Japan UG-D-b-(2) Studying about marine transport            UG-D-c-(2) Studying about connections in the world and the workings of maritime transport</p> <p>G5-2-(3)-c:Trade and transport            UG-D-c-(1) Studying the maritime transport of the world            UG-D-c-(2) Studying about connections in the world and the workings of maritime transport</p> <p>G6-2-(1)-a, b, e, g:The history of Japan            UG-B-e-(1) Studying about cultural exchange via the ocean</p> <p>G6-2-(2)-a:The workings of national politics            UG-D-b-(2) Studying about marine transport</p> <p>G6-2-(3)-b:International exchange and international cooperation            UG-D-c-(1) Studying the maritime transport of the world</p> <p>3-1-(2): Utilisation of museum facilities            UG-A-e-(2) Observing ocean-related work</p> <p>G5-2-B-(2):The birth of animals-a,b            UG-B-c-(3) Studying the birth of sea creatures UG-B-d-(1) Studying the relationships of sea life</p>
Science	<p>G5-2-B-(4):Changes in weather            UG-B-f-(1) Studying about ocean currents, ebb and flow of tides and geographical formations of the ocean floor</p> <p>G6-2-A-(4):Utilisation of electricity-a, b, c, d            UG-D-d-(1) Studying about energy development in Japan’s oceans</p> <p>G6-2-B-(1):The structure and workings of the human body-a to d            UG-B-c-(1) Studying the fish of the ocean</p> <p>G6-2-B-(2):Plant nutrients and the path of water-a            UG-B-c-(2) Studying the plant life of the ocean</p> <p>G6-2-B-(3):Life forms and the environment            UG-B-d-(1) Studying the relationships of sea life            UG-C-b-(2) Studying about changes in the ocean’s environment and the lives of animals</p> <p>G6-2-B-(4):The structure of land and changes-a, b, c            UG-D-d-(1) Studying about energy development in Japan’s oceans</p>
Home making	<p>G5/6-2-B-(1)-a:The role of meals            UG-A-d-(1) Experiencing the ocean</p> <p>G5/6-2-D-(2)-a:One’s lifestyle and the immediate environment            MG-C-a-(1) Getting involved in environmental preservation of the coast            UG-C-b-(3) Studying about changes in the ocean’s environment and the lives of people            UG-C-c-(1) Studying about the influence people’s lives on the oceans</p>
Integrated study	<p>3-1-(5):Environment            UG-C-b-(1) Studying about global warming and changes in the ocean            UG-D-d-(1) Studying about energy development in Japan’s oceans</p> <p>3-2-(3):volunteer activities            UG-A-e-(3) Experiencing ocean-related activities</p> <p>3-2-(6):Utilisation of museum facilities            UG-A-e-(2) Observing ocean-related work</p> <p>teaching plan-1-(5):Environment            UG-C-b-(2) Studying about changes in the ocean’s environment and the lives of animals</p>
Morality	<p>G5/6-4-(4):The significance of work            UG-A-e-(1) Experiencing the work of fishermen</p>
Special activities	<p>2-school event-2-(4):Field trip and overnight group trip            UG-A-d-(1) Experiencing the ocean</p> <p>2-school event-2-(5): Labour production and service activities            UG-A-e-(1) Experiencing the work of fishermen UG-A-e-(3) Experiencing ocean-related activities</p>



## 4-2 . Proposal for unit plans and lesson plans

### 1) Unit name: “We love \_\_\_ beach park”

To become familiar with the ocean, grade 2, proposal by Kouji Shibata

【Unit Plan】 (8 hours)

#### 1 Aim of unit

To gain an interest in the mystery and wonder of sea creatures through finding them on the beach, playing on the beach, and utilising the facilities of seaside parks. Also, to experience fun and pleasant activities on sandy beaches, and to enable students to voluntarily get involved with the ocean.

#### 2 Unit teaching plan

Hours	Learning activities	External cooperation (reference)
2	<ul style="list-style-type: none"> <li>○To get to know the environment and living things of the field trip location, and to think about how to play there.</li> <li>• Let’s catch crabs and shellfish.</li> <li>• Let’s use sand to make a big castle together.</li> <li>○To discuss the aims of the field trip and precautionary points.</li> <li>• Let’s be careful the way we did on our town explorations.</li> <li>• Let’s think about getting hints from the “ocean teacher”.</li> </ul>	An administrator of the seaside park or aquarium staff member can go to the school to show and talk about photos of sea creatures that can actually be found and touched by children at the ocean, to raise interest in the field trip and give hints on setting aims.
5	<p>【To conduct field trip at an “ocean park”】</p> <ul style="list-style-type: none"> <li>○To listen to a talk about activities at the ocean from the people who administer the park.</li> <li>• Don’t catch shellfish or enter the water at your own discretion.</li> <li>• Now we know how to find them. Let’s try to find some now.</li> <li>○Core class hours Activities at the beach (1) “Finding living things”</li> <li>• So this is a sea anemone. I’ve never seen one before.</li> <li>• Move a rock and find a crab hiding.</li> <li>• The “ocean teacher” is good at finding shells.</li> <li>• You can find lots of things when you know how to look!</li> <li>○Activities at the beach (2) “Let’s play with sand”</li> <li>• I made a big face. I used seaweed for the hair.</li> <li>• We made a huge hill working together.</li> <li>• Water came out when I squeezed the sand. We made a bath.</li> <li>• The sandy beach is great for fun.</li> <li>• I found a rock that looks like a gem in the sand. I wonder what it is.</li> </ul>	<p>Administrator of seaside park explains about the safe use of facilities and differences between living things seen on sandy and rocky beaches.</p> <p>Staff of aquarium, or researcher or student acting as visiting teacher, engages in activities on the beach along with school children, and communicates detailed knowledge through experience to make children aware of the intrigue and wonder of the ocean’s living things.</p> <p>Administrators of the seaside park and staff of aquariums should be as brief as possible when talking about their thoughts and wishes for the ocean to the children they have gotten to know.</p>
1	<ul style="list-style-type: none"> <li>○Expressing and exchanging thoughts about the field trip in pictures and words.</li> <li>• Using shells and sea glass gathered to make a design on one’s picture.</li> <li>• That was a nice trip. I want to go with my family next time.</li> <li>• I want to go swimming once the beach is open for the season.</li> <li>• I want to write a letter to the “ocean teacher” to thank him/her.</li> </ul>	

Content of ocean education making up this unit

Lower grades-A-a-(1) Finding living things on the beach

To find living things on the beach, take an interest in the mystery and wonder of the ocean’s living things, and enable students to voluntarily get involved with the ocean.

a. To find and observe living things on sandy and rocky beaches.

b. To become aware of the distinguishing characteristics of living things on sandy and rocky beaches.

Lower grades-A-a-(2) Playing on a sandy beach

To experience fun and pleasant activities on sandy beaches through playing on a sandy beach, and to enable students to voluntarily get involved with the ocean.

a. To play with the ocean’s natural materials, such as sand, articles washed ashore and seaweed.

b. To play among the natural phenomena of the ocean, such as waves, and the ebb and flow of tides.



【Lesson plan】 (4-5 of 8 hours)

1 Aim of core class hours

To become aware of the mystery and wonder of the ocean's living things through activities looking for sea creatures on the beach.

2 Teaching plan of core class hours

Learning activities	External cooperation (reference)
<div data-bbox="215 450 885 533" style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">                     Utilising methods learned from the ocean teacher to find living things of the sea.                 </div> <ul style="list-style-type: none"> <li>○To divide into groups and walk along the beach, find living things and enjoy (take turns between rocky and sandy beaches).                         <ul style="list-style-type: none"> <li>《activities on the rocky beach》                                 <ul style="list-style-type: none"> <li>• It's true! When you move a rock, you find a crab hiding.</li> <li>• It's just as the "ocean teacher" said.</li> <li>• There are lots of little hermit crabs! There's one there, and here too!</li> <li>• Here's a hermit crab baby.</li> <li>• The "ocean teacher" told us that this is the season when babies increase.</li> </ul> </li> <li>《activities on the sandy beach》                                 <ul style="list-style-type: none"> <li>• The "ocean teacher" is good at finding shells.</li> <li>• There aren't many crabs here.</li> <li>• Must be because there aren't any places to hide.</li> <li>• Maybe they are over by that piece of concrete.</li> <li>• You can find lots of things when you know how to look!</li> </ul> </li> </ul> </li> <li>○Showing what was found and exchanging impressions.                         <ul style="list-style-type: none"> <li>• I found a colorful sea slug. The "ocean teacher" told me what it was. It was so pretty—I really liked it.</li> <li>• Wow! That looks like a gem!</li> <li>• I caught so many hermit crabs. But I'm going to put them back in the same place later.</li> <li>• Oh, the sign said to "release any babies smaller than 2 cm".</li> <li>• I figured out where crabs are.</li> <li>• There are so many living things in different places at the ocean.</li> <li>• I was so surprised at how many unbelievably beautiful sea creatures there are!</li> <li>• I wanted to keep looking for more!</li> </ul> </li> </ul>	<p>Staff of aquarium, or researchers and students acting as visiting teachers, engage in activities on the beach along with school children and communicate detailed knowledge through experience to make children aware of the mystery and wonder of the ocean's living things.</p> <ul style="list-style-type: none"> <li>* Detailed points: places to find, ways to find, origin of names, "eat and be eaten" relationships with other creatures, features of growth, features of movement, poisonous or not poisonous, edible or not, etc.</li> <li>* Ask questions to school children that say they want to take the creatures home to make them think about the difficulty of raising sea creatures and their propagation, so that the school children become able to decide for themselves to "let them go".</li> </ul> <p>Administrators of the seaside park and staff of aquariums should praise the children for realising problems associated with keeping creatures in captivity and propagation and be as brief as possible when talking about their thoughts and wishes for the ocean.</p>
<div data-bbox="172 1742 1422 1944" style="border: 1px solid black; padding: 5px;">                     Points to keep in mind                     <ul style="list-style-type: none"> <li>• When having the staff of the seaside park or museum curators teach students about the living things of the sea, it is important to become aware of their strengths and to build strong relationships. When trusting relationships are built, the messages on "we should value the ocean and its living things" are more readily taken to heart.</li> </ul> </div>	



## 2) Unit name: “Sea creatures research centre” (Studying the living things of the ocean)

To get to know the ocean, grade 3, proposal by Mika Yagi

【Unit plan】 (7 hours)

### 1 Aim of unit

To study the differences in living things in various places of the ocean, and to enable students to understand the relationships between living things and their surrounding environments.

### 2 Unit teaching plan

Hours	Learning activities	External cooperation (reference)
3	<ul style="list-style-type: none"> <li>○ <b>Core class hours</b> To go to the ocean to look for living things.</li> <li>• To observe the living things found.                             <ul style="list-style-type: none"> <li>what color, shape, size?</li> <li>what kind of place were they found?</li> </ul> </li> <li>To observe from a certain viewpoint.</li> <li>• Sharing observation cards.                             <p>From the viewpoints of color, shape and location found, children can share what was the same, what was similar and what was different.</p> </li> <li>To divide into groups by similarities and differences.</li> <li>To listen to experts.</li> <li>“We want to learn more about the living things of the sea!”</li> </ul>	<p>Staff of aquarium, museum curators, administrators of seaside parks, and student researchers should engage in activities with school children, and point out different points for observation in detail, such as color, shape and size.</p> <p>Techniques for capturing distinguishing characteristics when drawing living things observed on cards should be taught.</p> <p>Photos of related creatures for cards divided up into similar types should be displayed as color, shape and location are introduced. Other living things that were not found or live in other places should also be introduced to raise interest.</p>
2 1 1	<ul style="list-style-type: none"> <li>○ To study about the living things of the ocean.</li> <li>• To take the opportunity to study about the living things observed using materials and encyclopedias to look for similarities and to study about various living things of the ocean.</li> <li>• To compile what was learned on a card.</li> <li>• To share cards with friends and discuss what was learned, and to pull one’s own ideas together.</li> <li>○ Listening to presentations at the “Sea creatures research centre”</li> <li>• Make cards into wall newspapers or albums.</li> <li>• To prepare presentations on what was learned.</li> <li>• To make presentations.</li> </ul>	<p>Materials and encyclopedias should be introduced prior to activity.</p> <p>Questions about things not understood or further information should be accepted by phone, fax or e-mail.</p> <p>Children should be praised and encouraged for their efforts and innovations.</p> <p>Further, information should be provided on living things in which the children might have a continued interest in the future.</p>

Content of ocean education making up this unit

Middle grades-B-b-(1) Studying living things in various places

To study the differences between living things in a variety of places, and to enable to understand the relationships between living things and their environments.

a. Living things have different colors, shapes and sizes.



【Lesson plan】 (1-2 of 7 hours)

1 Aim of core class hours

To study the differences in living things in various places, and to enable students to understand the relationships between living things and their environments.

2 Teaching plan of core class hours

Learning activities	External cooperation (reference)
<p>○To prepare for going to the ocean.</p> <ul style="list-style-type: none"> <li>• To prepare items to take.</li> <li>• To confirm safe behavior.</li> </ul> <p style="text-align: center;">&lt; Departure → arrival at ocean &gt;</p> <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p>Let's go find living things!</p> </div> <p>○To look for living things.</p> <ul style="list-style-type: none"> <li>• Let's have a look. "I see something!" "I'm going to catch it!"</li> <li>• To gather together. T: "What shape was it?" "Color?" "Where was it?"</li> <li>• To ask about the points to look at heard from the expert during observation. To understand that color, shape, size and location are points for observation.</li> <li>• To carefully observe. "I see a crab the same color as the rock!"</li> <li>• To gather. To report to each other on what living things were found.</li> </ul>	<p>To talk about ways of observation and useful tools for observation.</p> <p>* Tools: magnifying masks, glass-bottom boxes, spades, shovels</p> <p>By making color, shape, size and location points for observation, teach that associations can be made during observation between the environments where creatures live and their movements. Further, living things should be picked up and their color, shape, size and locations pointed out in detail.</p> <p>To provide information on living things not handled, similar types of living things that do not live in the location, and unusual living things, in order that children maintain a continued interest in the living things of the ocean after the activities.</p>
<p>Points to keep in mind</p> <ul style="list-style-type: none"> <li>• Make sure that the children can focus on the expert's observation activity. Make sure that the children understand that observations are being made based on points for observation, and that notes are being taken according to these points for observation. It is up to the teacher to see that the points for observation indicated by the external resource persons, such as color, shape, size and habitat, are understood by all members of the class. (Example: gather together in the middle of activities and confirm the points; tell children as they engage in activities together; set up a system for communication among students, etc.)</li> </ul>	



### 3) Unit name: “Studying about energy development in Japan’s oceans”

To protect the ocean, grade 6, proposal by Kazuhito Nakazawa

【Unit Plan】( 9 hours)

#### 1 Aim of unit

To study about energy development in Japan’s oceans and to enable students to think about effective utilisation.

#### 2 Unit teaching plan

Hours	Learning activities	External cooperation (reference)
2	<ul style="list-style-type: none"> <li>○ To think about our lifestyles and industries which have been dependent on energy development on land and the future of Japan and its scarcity of resources, and to think about various types of energy development in the oceans.</li> <li>• Japan has a scarcity of resources, so most of them are imported. But these resources are limited.</li> <li>• I didn’t know there were resources in the oceans.</li> </ul>	<p>Researchers from universities, the National Institute of Advanced Industrial Science and Technology and the Central Research Institute of Electric Power Industry to provide information on energy development in the ocean, mainly for the uses related to power generation, industry and daily living.</p>
4	<ul style="list-style-type: none"> <li>○ To look into marine resources and methods of effective utilisation in groups and to compile findings (newspapers, picture stories, PowerPoint, strips of paper, etc.)</li> <li>• Power generation is possible (wind power, wave power, pumping-up, temperature difference utilisation).</li> <li>• Methane hydrate, rare metals and deep ocean water are linked to development of industry.</li> <li>• Our lives are made richer by deep ocean water.</li> </ul>	<p>The above external resource persons will answer questions by telephone, fax or e-mail if the children run into trouble.</p>
2	<ul style="list-style-type: none"> <li>○ <b>Core class hours</b> To hold the “Presentations on energy development in the oceans” to present findings and listen to the findings of other groups.</li> <li>• The external resource teacher really knows a lot of technical things.</li> <li>• The ocean has amazing energy which is already being used effectively.</li> <li>• But there is still more that can be used.</li> </ul>	<p>Aside from the external resource persons listed above, persons from companies in the electronics and waste collection industries, as well as persons from marine products research labs should participate in the presentation session. Not only merits, but demerits such as damage to the environment, should be talked about. Issues with no immediate answers should be posed to children and the importance of making compromises (finding a balance) should be discussed.</p>
1	<ul style="list-style-type: none"> <li>○ To make a presentation and listen to the presentations of other groups and external teachers, then compile thoughts, areas for further study and future work into an essay.</li> <li>• We should value energy development in the oceans.</li> <li>• There is a close relationship between energy development in the oceans and our own lifestyles.</li> </ul>	<p>To read and comment on the essays written by children.</p>

Content of ocean education making up this unit

Higher grades-D-d-(1) Studying about energy development in Japan’s oceans

To study about energy development in Japan’s oceans and to enable students to think about effective utilisation.

- a. Power generation utilising wind power, wave power and temperature difference
- b. Utilisation of characteristics of mineral resources, such as methane hydrate and rare metals, for industry
- c. Use of deep ocean water for industry and daily life



【Lesson plan】 (7-8 of 9 hours)

1 Aim of core class hours

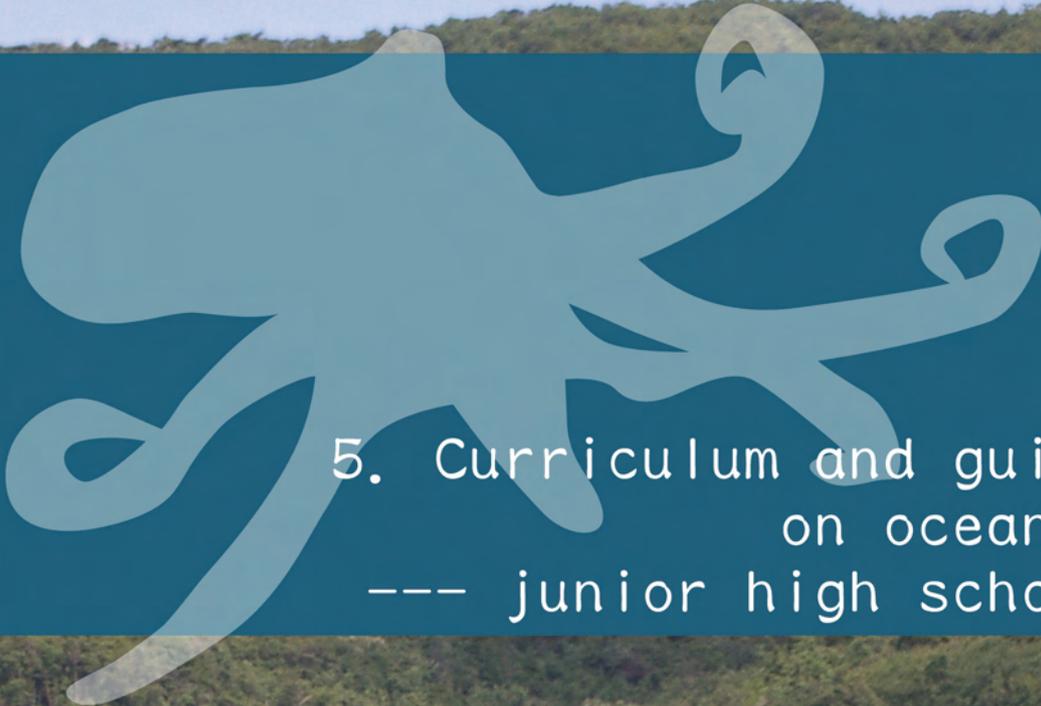
To get to know about various energy development in the oceans and methods of effective utilisation through the “Presentations on energy development in the oceans”, and to enable to have one’s own ideas about ways of using the oceans.

2 Teaching plan of core class hours

Learning activities	External cooperation (reference)
<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>For the “Presentations on energy development in the oceans”, children should use newspaper or picture story formats, PowerPoint, or strips of paper to make easy-to-understand presentations on their findings. They should listen to the findings of other groups and to the talk of the external teacher.</p> </div> <p>○To make presentations, listen to the presentations of other groups, and listen to the talk of the external teacher.</p> <ul style="list-style-type: none"> <li>• To take turns making presentations on the marine resources studied by one’s group through the last class and on methods of effective utilisation.</li> <li>• To listen to presentations on the findings of other groups.</li> <li>• To listen to the talk of the external teacher.</li> </ul> <p style="padding-left: 20px;">Power generation utilising wind power, wave power, pumping-up and temperature difference Utilisation of characteristics of mineral resources, such as methane hydrate and rare metals, for industry Use of deep ocean water for industry and daily life</p> <ul style="list-style-type: none"> <li>• To hear about not only good aspects, but also aspects such as environmental destruction, relationships with neighboring countries and environmental pollution, and to think about what one can do oneself.</li> </ul>	<p>Aside from researchers from universities, the National Institute of Advanced Industrial Science and Technology and the Central Research Institute of Electric Power Industry, people from companies in the electronics and waste collection industries, as well as people from marine products research labs, should participate in the presentation session.</p> <p>Along with praise of group presentations, supplementary explanations and advice, information on connections with actual everyday life, the latest methods of effective utilisation and prospects for the future should also be introduced.</p> <p>Not only merits, but demerits such as damage to the environment, should be talked about. Issues with no immediate answers should be posed to children and the importance of making compromises (finding a balance) should be discussed.</p> <p>The relationship with the possessions and economic zones of other countries, as well as the relationship with environmental pollution should also be discussed.</p>
<p>Points to keep in mind</p> <ul style="list-style-type: none"> <li>• Wave power and sea water pumping-up generation are covered in junior high school science textbooks. The teacher should design to add relevance.</li> <li>• External teachers should be informed of the content of presentations in advance so that they can make comments suited to presentation content.</li> <li>• External teachers should be asked to not to use specialised terms, and when used, should add an interpretation that can be understood by a sixth grader.</li> <li>• Students should be encouraged at every turn to see the relevance between their own lifestyles and the improvements to power generation, industry and daily lives due to development.</li> <li>• External resource persons should be requested to talk not only about a specific area of Japan, but also about relationships with other countries.</li> <li>• Both the merits and demerits of development should be talked about and children should be told of the importance of thinking for themselves what is best to do.</li> <li>• Children should be told that in the next class they will be compiling essays on their own presentations, those of other groups, thoughts on the talk from the external teacher, areas for desired further study, and efforts to make in the future.</li> </ul>	







5. Curriculum and guidance plan  
on ocean education  
--- junior high school version



## 5-1 . Curriculum

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### 1) Objectives

To foster a generous sensibility toward the ocean and raise interest in the ocean through activities to become familiar with the abundant nature of the ocean, experiential activities to become aware of the links between the ocean and familiar aspects of communities, activities to study the ocean, and experience in activities to preserve the ocean. Also, to facilitate understanding of the relationships between the ocean and mankind, such as the marine environment, aquatic resources and ship transport, as well as connections between the peoples of the world via the ocean, and to cultivate the nature, ability and attitudes necessary to become builders of a sustainable society.

### 2) Objectives and content areas by school year

[Years 1, 2 and 3]

#### 1. Objectives

- (1) To enjoy leisure activities at the ocean and express the riches of the sea in music and painting, to experience the appeal of the ocean, and to enable students to voluntarily get involved with the ocean.
- (2) To take an interest in the morphological and functional characteristics of marine life, the functions and role of the oceans and the history and folk customs of the oceans, and to enable students to engage in expression through analysis and interpretation.
- (3) Through thinking about protecting the marine environment and the balance of ecosystems, to enable students to make efforts with communities and societies to evade the crises faced by the oceans and pursue sustainable development.
- (4) To study about Japan's marine products industry, marine transport and energy development, to understand the distinguishing characteristics of the industries and resources of the sea that have contributed to the support and development of human lifestyles, to utilise the ocean in cooperation with the other countries of the world, and to enable students to utilise Japan's oceans.

#### 2. Content areas

##### 1) Year 1

##### A. Lifestyles, health and safety

##### (1) Relationships between prefectures and the ocean

To think about oceans from the perspectives of “natural environment”, “industry”, “environmental problems and environmental preservation”, and “connections with other regions” by engaging in activities to study Okinawa Prefecture with its strong ties to the ocean, and to enable students to augment understanding to include the relationships between the ocean and other prefectures.

- a. To become aware of the fact that from the perspective of the “natural environment”, Okinawa is surrounded by beautiful seas, including coral reefs.



- b. To become aware of the fact that from the perspective of “industry”, Okinawa is blessed by a variety of marine resources.
- c. To come to know that from the perspective of “industry”, the tourism industry that takes advantage of the ocean for marine sports is flourishing.
- d. To come to know that from the perspectives of “industry” and “environmental problems and environmental preservation”, decline of primary industries and destructive development have caused marine pollution problems such as red soil runoff.
- e. To come to know that from the perspective of “connections with other regions”, marine transportation is growing, including mainland routes and remote island routes.
- f. To make the best use of study activities on the relationship between Okinawa and the ocean to study about the relationships between the ocean and other prefectures from one’s own perspective.

## **(2) The danger of tsunamis**

In order to promote understanding on the dangers of tsunamis, to enable students to understand information communication networks and information ethics.

- a. To come to know the structure of computers and the basic system of information processing.
- b. To use a computer to predict tsunami, and to come to know how information is rapidly conveyed using communication networks.
- c. To come to know the responsibilities for tsunami information and to think about information ethics.
- d. To think about appropriate assessment and utilisation of technology related to tsunami information.

## **B. Tourism, leisure and sports**

### **(1) To swim in the nearby ocean**

To gain familiarity with the ocean in one’s region, to experience the fun and joy of actually swimming in the ocean, and to enable students to acquire swimming ability in the ocean and know-how and life-saving skills to prepare for emergencies.

- a. To set targets for oneself, such as long distances and time limits and to acquire the swimming ability necessary for swimming in the ocean.
- b. To actually swim in the ocean nearby and to personally experience the fun and joy of swimming in nature.
- c. To get involved at an ocean area, by, for example, games at the beach, such as beach flags, beach volleyball and beach soccer.
- d. To acquire life-saving skills in case there is an actual accident, such as how to swim fully clothed and life-saving techniques.



## C. Culture and art

### (1) To express the ocean as music

To think about one's own connections to the ocean, to conceptualise the "ocean" one wants to express and create music, and to search for ocean-related sounds, to share conceptions of the ocean, and to enable students to render these concepts in a musical performance.

- a. To become aware of the fact that the ocean offers diverse sounds, such as the sound of waves, the sound of wind, and sounds in the water.
- b. To come to know the fact that coral, shells and sand can become instruments and effectively make sounds.
- c. To expand one's image of the ocean to include a variety of ways to express the "ocean", such as its roughness or calmness.

### (2) Sketch of ocean scenery

To observe the scenery (or a visual image) of a port or beach, think about the way colors overlap and their shades, to express the "ocean" in one's own way, look at the works of peers, and to enable to students become aware of the interesting and good aspects of the ocean's scenery.

- a. To become aware of the fact that the shapes of nature near the ocean, such as waves and rocks, are interesting.
- b. To become aware of the fact that the ocean offers abundant materials to sketch, such as living things and articles washed ashore.
- c. To become aware of the fact that there are differences in hues of similar colors, such as the "blue" of the sky above the ocean or the "white" of waves and clouds.

### (3) To read writings related to the ocean

To read writings about the ocean and to enable students to improve reading ability.

- a. To accurately get the meaning of words and phrases in the readings and to understand them.
- b. To read a story about the ocean while paying attention to descriptions, including the unfolding of the setting and characters, and to enable students to think copiously about the main theme of the work.
- c. To read an essay about the ocean, to distinguish between the main parts and supplementary parts of the reading and between facts and opinions, and to interpret the author's intentions by summarising according to an aim or as needed and getting the gist of the reading.
- d. To grasp the views expressed in the reading and broaden one's own views and way of thinking.
- e. To acquire methods of collecting necessary information from books and readings, and to identify the information required according to one's purpose.



## D. History and folk customs

### (1) History of exchange via the ocean

To study about the history of exchange via the ocean, major events in Japan's history, and to enable students to understand about their ancestors who crossed the sea, their culture and happenings.

- a. To come to know the works and labours of people in the past, such as Ono no Imoko, Jianzhen, Francisco de Xavier, Perry and the Iwakura Mission.
- b. To study about culture, such as rice farming, Buddhism, the written word, firearms, Christianity, and printing techniques.
- c. To study about trade, such as the licensed trade with the Ming Dynasty, Nanban trade (trade with Spanish and Portuguese), and shogun-licensed trading ships.
- d. To understand warfare, such as the Battle of Baekgang, the Mongol invasions of Japan, Japanese pirates, the Imjin War, the attack of four-country fleet, the Sino-Japanese War, the Russo-Japanese War, and the Pacific War.

### (2) Ocean-related tradition and culture

To study about ocean-related tradition and culture, to think about the connections between predecessors and the ocean, to understand the significance and influence of culture in modern society, and to enable students to become aware of the importance of connections to the ocean in creation and inheritance of culture.

- a. To read the Records of Ancient Matters and Tosa Diaries and to study parts concerning the ocean.
- b. To study about traditional rituals involving the ocean and boats that have been passed down in various places.
- c. To study about ocean-related religion such as faith in sea gods.
- d. To study about regional traditional fishing culture, such as whaling and women shell divers.

## E. Earth and oceans

### (1) Investigation of coastal pollution

To collect materials on the particle size of sediment in order to study coastal pollution, to organise in a table or graph using a computer, and to enable students to interpret trends in the murkiness of the ocean focusing on representative values and dispersion of samples.

- a. To understand the necessity and meaning of histograms and representative values through studying about coastal pollution.
- b. To utilise a histogram and representative values to interpret trends in the murkiness of the ocean.

### (2) Water depth and water pressure

To become aware of the fact that water pressure becomes greater as water depth increases



through water pressure experiments, and to enable students to understand that water pressure depends on the weight of water.

- a. To come to know that water pressure of 1kg of force per 1cm<sup>2</sup> increases with every 10m increase in water depth.
- b. To become aware of the fact that the giant cusk-eel lives near depths of 8000m and can withstand pressure of 800kg of force per 1cm<sup>2</sup>.
- c. To come to know that when deep sea fish are suddenly pulled up, their air bladders swell making their eyes bulge out.
- d. To become aware of the fact that submarines are spindle-shaped or cigar-shaped taking account of water pressure and navigation.
- e. To understand that when the pressure of scuba oxygen cylinders becomes lower than the water pressure, air is no longer supplied by the cylinder.
- f. To become aware of the fact that water pressure-related expressions are seen in everyday life, such as the “10 bar water resistant” on watches.

### (3) The mechanisms of mirage and sonar

To enable students to reason about and sharpen their own ideas on the mirage phenomenon that occurs by light refraction, and sonar utilising the fact that sound travels well in the ocean.

- a. To conduct experiments on light reflection and refraction, to find the regularity in reflection and refraction of light on the boundary surface of material such as water and glass.
- b. To understand that a mirage is a phenomenon whereby one can see ships and scenery below the horizon, and that in order for a mirage to occur, warm air and cold air of differing densities must overlap.
- c. To become aware of the fact that the mirage that can be seen in Toyama bay occurs due to cold melt water running into the ocean from the north Alps and cooling lower air.
- d. To come to know that the speed by which sound is transmitted depends on the extent of density.
- e. To understand that in contrast to the speed by which sound travels in the air at approximately 340m per second, sound travels at a speed of approximately 1,513m in the greater density of the ocean.
- f. To learn that the fishing industry utilises underwater acoustic waves called sonar to detect schools of fish.
- g. To learn that whales are endowed with sonar ability and are able to converse with each other.

### (4) The mechanisms of earthquakes and tsunami

To understand the characteristics of tsunami from the relationship between ocean trench earthquakes and tsunami, to discuss ways to protect ourselves from tsunami, and to enable



students to make use of these ways in daily life.

- a. To learn that Japan is earthquake-prone and accounts for about 10 percent of earthquakes that occur globally.
- b. To come to know that the Japan Trench was formed in the place where the Pacific Plate subducts beneath the North American Plate and is 8,000m deep at its deepest part.
- c. To understand that the Sanriku offshore earthquake, the Miyagi Prefecture offshore earthquake and Eastern Chiba Prefecture offshore earthquake were ocean trench earthquakes that occurred in the Japan Trench, and that tsunamis sometimes accompany such earthquakes.
- d. To understand that the height of tsunami changes depending on the shape of the coast, and tends to be higher as water is shallower.
- e. To learn that the speed of tsunamis depends on water depth, and becomes quicker as depth increases and slower as water becomes shallower.
- f. To recognise that a variety of schemes and efforts must be made to protect ourselves from the damages of tsunami, and to make use of these in daily life.

## F. Materials

### (1) Density, convection and circulation of materials

To study and think about convection and circulation of materials based on one's own life experiences, and to understand that causes lie in the gap between density that arises from differences in temperature and differences in concentration.

- a. To become aware of the fact that the circulation of air for air-conditioning and convection based on the heating of miso soup is caused by density difference that occurs due to difference in temperature.
- b. To understand that the general circulation of the ocean occurs by changes in the ocean surface temperature and changes in sea water density due to evaporation and rainfall.

### (2) Components of sea water, solubility and salt

To conduct experiments to remove salt from sea water, to summarise processes and make associations with recrystallisation and salinity to understand that not only salt but calcium sulphate (gypsum) is also extracted.

- a. To become aware of the fact that various solutes are dissolved in sea water other than sodium chloride (salt).
- b. To understand that "magnesium chloride solution (nigari or bittern water)", "salt" and "calcium sulphate (gypsum)" can be removed from sea water utilising differences in temperature and solubility.

## G. Life

### (1) Photosynthesis on land and at sea

To understand that photosynthesis occurs in plants on land and plants in the ocean (seaweed



and phytoplankton), to discuss about environmental protection of the ocean, and to enable students to sharpen their own ideas.

- a. To observe the makeup of leaves, stems and roots of various plants, and discover the basic characteristics of the makeup of leaves, stems and roots based on records of these observations, and to correlate the results of experiments in photosynthesis, respiration and transpiration.
- b. To become aware of the fact that many plants (seaweeds and phytoplankton) inhabit the ocean as they do in lakes and marshes on land.
- c. To study the fact that plants in the ocean account for a larger portion of the photosynthesis that occurs on the whole earth than green plants on land.
- d. To come to know that there is no distinction between roots, stems and leaves for seaweeds such as kelp and wakame, and that they absorb water and nutrients throughout their bodies.

## **J. Economy and industry**

### **(1) Plans of convenient and safe ports**

To create a diagram with an outlook in mind and study the relationships of diagrams to augment understanding of two-dimensional diagrams through activities, to create plans for a port, and to enable students to logically contemplate and express their ideas.

- a. To understand basic methods of creating diagrams, such as the bisector of an angle, perpendicular bisector of a line segment and perpendicular lines, through creation of plans for a port, and to utilise these methods to prepare maritime routes.

### **(2) Relationships among the speed a ship travels, time and distance**

To find the two quantities of time and distance traveled from an event a) where a ship travels at a fixed speed, and to augment understanding on the relationship of proportion and inverse proportion through studying changes and adaptations in these quantities, and to enable students to discover, express and consider functional relations.

- a. To understand the functional relation of a ship traveling event.
- b. To understand the meaning of proportion and inverse proportion from a ship traveling event.
- c. To understand the meaning of coordinates.
- d. To express proportion and inverse proportion in tables, equations and graphs, and to understand the characteristics of each.
- e. To explain a ship traveling event using proportion and inverse proportion.

## **L. International**

### **(1) The oceans and continents of the world**

To enable students to become aware of the importance of the oceans by activities to study the oceans that account for 70 percent of the earth and the distribution of the continents.



- a. To study utilising a globe and world map.
- b. To know about the distribution of the oceans and continents.
- c. To study the names and locations of major countries, and to become aware that these countries are connected by the ocean.
- d. To personally realise that the majority of the earth is covered by oceans, and to understand their significance.

## **(2) The distinguishing characteristics of Japan, an island nation**

To enable students to think about the fact that Japan is blessed with exclusive economic zones, has a variety of marine resources and mineral resources, and to think about efforts and points of issue in securing these resources through activities to study the distinguishing characteristics of Japan as an island nation.

- a. To become aware of the fact that Japan is surrounded on all four sides by the ocean.
- b. Japan's exclusive economic zones are vaster than Japan's national land.
- c. To study the fact that Japan's exclusive economic zones are blessed with an abundance of marine resources.
- d. To study about expectations for the development of mineral resources in Japan's exclusive economic zones.
- e. To understand that shore protection works were conducted in Okinotorishima to protect the exclusive economic zone.
- f. To think about issues involving territory, such as the Northern Territories.

## **2) Year 2**

### **A. Lifestyles, health and safety**

#### **(1) Cooking seafood**

To enable students to understand dietary lifestyles using seafood and nutrition.

- a. To become aware of the nutritional components in seafood, and to think about healthy dietary lifestyles.
- b. To distinguish between good and bad from the perspective of freshness, quality and sanitation of seafood, and to be able to prepare food.
- c. To be able to prepare food that makes the most of fish caught locally and in season.

#### **(2) Relationship between depopulation countermeasures on remote islands and the ocean**

To enable to think about relationships with the ocean through activities to study about depopulation countermeasures on remote islands.

- a. To learn that the main industry of remote islands surrounded by the ocean is fishing, and that although indigenous fishing methods are being employed, hauls of fish are decreasing due to depopulation.



- b. To study about the fact that initiatives are being advanced to make the fishing industry flourish, such as devising a switch from “catching fish” to “raising fish”, and concentrating on seafood processing as a way to address depopulation.
- c. To think about the fact that measures to stimulate economies that make the best of the special characteristics of remote islands are being considered as a way to address depopulation.

## **B. Tourism, leisure and sports**

### **(1) To express the ocean in body movements**

To enable students to experience the fun and pleasure of moving one’s body, acquiring methods of expression suited to one’s aims, and to combine movements through expression of the ocean.

- a. To go look at the ocean, look at visual images of the ocean and conceive of an image of the ocean.
- b. To choose an ocean-related theme to express, and to engage in expression.
- c. To make changes in the movements expressed and combine different movements to make a coherent expression.
- d. To select an ocean-related traditional dance and come in contact with the meaning, culture and customs of the dance.

## **C. Culture and art**

### **(1) To sing about the ocean**

To listen to examples of the classic “Song of the Seashore”, to discuss thoughts and realisations on ocean scenery, to perceive the atmosphere and motif of the piece, and to enable students to sing about scenery.

- a. To become aware of the fact that the “Song of the Seashore” is a song about the scenery of the ocean that contains beautiful Japanese expressions.
- b. To think about the feelings put into the “Song of the Seashore” by its composer and vocally express a mental image of scenery.
- c. To know that there are choral songs related to the ocean, such as “Beyond the Horizon”, “The Sea in my Heart”, “Sky, Forest and Ocean”, and “The Sea is Space, Birds are Stars”, and to devise ways to sing and express being conscious of the role of the vocal part and the overall sound.

### **(2) Creation of a work of art using the ocean as material**

To think about the environment and the difference between natural things and artificial things when looking for ocean-related materials, and to enable students to create a work of art that makes the most of these materials.

- a. To find natural articles washed ashore on the beach, such as shells, coral and drift wood.



- b. To find articles washed ashore that are linked to environmental pollution, such as pet bottles, and to study about this problem.
- c. To become familiar with the ocean through beach combing and walking along the seashore.

## **E. Earth and oceans**

### **(1) The relationship between the ocean and weather**

To think and study about the climate of Japan based on one's own life experiences, and to enable students to understand that the climate is greatly affected by the oceans.

- a. To study about the fact that seasonal rain fronts are formed by two large air masses that develop at sea called the Okhotsk-sea air mass (cold air mass) and the Ogasawara air mass (warm air mass).
- b. To become aware of the fact that the heavy snowfall on the Sea of Japan side of the country in winter is made up of the moisture of the Sea of Japan carried by seasonal winds created by the Siberian air mass and high pressure systems.
- c. To learn that typhoons originate in tropical zones and develop by the energy given off when water vapour evaporated from the warmed sea surface condenses at high altitudes.
- d. To think about the fact that the El nino phenomenon (rising sea water temperature) and the La nina phenomenon (lowering sea water temperature) have considerable influence on the climate of Japan and the global climate.

## **G. Life**

### **(1) Wonderful living things of the ocean**

To study and observe the morphological and functional characteristics of wonderful marine life, and to enable students to make associations with living environments and sharpen their ideas.

- a. To study about the fact that living things in the ocean have morphological and functional characteristics suited to their living environments, in the same manner as living things on land.
- b. To become aware of the fact that sea squirts, sea urchins, sea anemone and coral are animals.

### **(2) Biodiversity and evolution in the oceans**

To study about the diverse living things of the ocean, make comparisons with fossils, and to enable students to augment their understanding of diversity and evolution.

- a. To study about the fact that there are a variety of environments in the ocean and a variety of living things suited to these environments.
- b. To understand that there is a morphological and functional continuity between the living things of the past seen in fossils and living things that exist at present, and that living things born at sea have evolved over long periods of time.



### **(3) To write a report on their study of marine life**

To take an interest in and study the distinguishing characteristics of the ecosystem of a chosen marine life form, and to enable students to write a report on this marine life form based on information collected.

- a. To clarify one's own viewpoint and the facts and matters one wants to relate, and to devise the structure of the report.
- b. To write, including explanations and concrete examples, and to devise descriptions so that facts, matters, opinions and feelings are effectively related to one's audience.

## **H. Environment and cycles**

### **(1) Forests, rivers and ocean**

To understand that our own lifestyles are connected to the sea via forests and rivers, to think about better local environments, and to enable students to work to achieve a sustainable society.

- a. To understand that the rainwater soaked up by forests and river water eventually arrive at the ocean, and that our immediate environment is linked to the ocean.
- b. To think about the connections between the ocean and the local environment from multiple facets and angles, and to possess an awareness of issues from study of Iwate Prefecture's "The sea is the lover of the forest tree planting ceremony" and the marine protection initiatives of various groups and non-profit organisations.
- c. To utilise books, the internet and museums in the process of problem-solving and investigation activities, and to investigate an issue by directly talking to people. Additionally, to actually go to local forests, rivers and the ocean and engage in experiential learning, such as field study and observation, and joint study with others.
- d. To hold an exchange session according to the actual conditions of the school and class based on matters investigated both individually and in groups, and to communicate ideas to each other. Additionally, if an approach to work toward realising a sustainable society and improvement of the global environment is agreed upon at the exchange session, to translate into action.

### **(2) To write an opinion statement about the ocean's environmental problems**

To know the actual situation of the oceans, and to enable students to compile their opinions in written form on a portion of environmental problems.

- a. To choose an issue from ocean-related environmental problems and to collect materials in different ways and compile one's ideas
- b. To write, including explanations and concrete examples, and to devise descriptions so that facts, matters, opinions and feelings are effectively related to one's audience.



## J. Economy and industry

### (1) Japan's maritime transport

To study about maritime transport of Japan's people and goods, and to enable to understand that the maritime transportation network is closely related to connecting various areas of Japan and Japan and the world.

- a. To study about Japan's major ports and their function.
- b. To think about the advantages of maritime transport.
- c. To study about the changes in industry and changes in volume of goods transported domestically and internationally.
- d. To understand major marine transportation networks and changes in people lifestyles b).

### (2) Graph of ocean liner operation

To find two quantities from an ocean liner operation event and through studying changes and adaptations in these quantities, to enable students to understand that time and distance have a linear functional relationship.

- a. To find two quantities of time and distance concerning an ocean liner operation event and to come to know that they have a linear functional relationship.
- b. To understand and make mutual associations from a graph showing the operation of ocean liners between tables, equations and graphs.
- c. To consider a linear equation with two unknowns as a formula to express function and to find the times and locations ocean liners will meet from a graph of ocean liner operation.
- d. To use linear function to interpret and explain the relationship shown by operation of ocean liners.

### (3) Japan's marine products industry

To study about Japan's marine products industry, and to enable students to understand the distinguishing characteristics of the marine products industry of various areas of Japan and utilisation of the ocean.

- a. To learn the units involved in Japan's location and territory, territorial waters and continental shelf, ocean current and ocean.
- b. To study the relationship between ocean currents and fishing grounds and Japan's major fishing ports.
- c. To study about changes in the marine products industry and imports and exports, such as the decline of deep sea and off-shore fishing industries and the promotion of mariculture and aquaculture industries.
- d. To understand problem points involving the marine products industry, such as relationships with other countries, lack of successors, ensuring of safe bait, overfishing and illegal fishing and inter-market competition.



#### **(4) Ocean-related work**

To understand the connections between people and nature, society and the ocean, based on personal experience and to feel close to the ocean through experiencing careers related to the ocean.

- a. To study about ocean-related work, such as the marine products industry, shipbuilding, marine transport, distribution, leisure, maritime safety, museums and aquariums and ocean research.
- b. To engage in workplace experience according to the actual conditions of the region.
- c. To think about one's own way of life by comparing it with that of people involved in ocean-related work.

### **K. Management**

#### **(1) Coastal development and environmental preservation**

To enable students to become aware of the necessity of balance between development and environmental preservation through activities to study development and environmental protection involving tidal flats, wetlands and coral reefs.

- a. To study the fact that the recuperative power and balance of nature have been destroyed, tidal flats, wetlands and coral reefs have been lost, and the ecosystems of the ocean and rivers have been disturbed due to modification of nature such as land reclamation.
- b. To learn that the importance of environmental preservation has led to environmental preservation movements, such as the movement to register with the Ramsar Convention and the National Trust movement.
- c. To think about the fact that because tidal flats, wetlands and coral reefs are important as the breeding grounds and living environments of sea creatures, and are meanwhile also important as places of development in the lifestyles of people, it is necessary to strive to achieve harmony.

### **L. International**

#### **(1) Relationships with other countries and the ocean**

To think about relationships with the ocean from the perspectives of “natural environment”, “resources” and “industry” through activities to study Norway and its strong relationship to the ocean, and to enable students to augment their understanding to include the relationships between other countries and the ocean.

- a. To become aware of the fact that from the perspective of “natural environment”, Norway is located on the North Atlantic Ocean and numerous fjords have developed along the coastline.
- b. To become aware of the fact that from the perspective of “resources”, oil drilling in the North Sea supports the economy, and that water resources are abundant and hydroelectric power generation is actively practiced.



- c. To learn that from an “industry” perspective, the fishing and mining industries are flourishing, and that in particular a great amount of Norwegian salmon and Atlantic mackerel are exported to Japan.
- d. To learn that from an “industry” perspective, industries related to maritime transport and the North Sea oil fields, such as shipbuilding, marine fashion and marine survey equipment, are flourishing.
- e. To make the best use of study activities on the relationship between Norway and the ocean and to study about the relationships between the ocean and other countries from one’s own perspective.

### 3) Year 3

#### A. Lifestyles, health and safety

##### (1) Disasters at sea and seaside safety administration

To enable students to augment their understanding of ocean-related natural disasters and injuries.

- a. To learn about ocean-related natural disasters such as typhoons, floods, storm tides and tsunami.
- b. To learn about injuries due to natural disasters and injuries that arise from secondary disasters.
- c. To learn ways of being ready and preparing for natural disasters, how to safely evacuate and prevent worsening of injuries, and ways of first aid treatment.
- d. To learn that there are injuries caused by marine life such as shells and jellyfish.
- e. To learn ways of readying and preparing for activities on the seashore and first aid treatment.

#### E. Earth and oceans

##### (1) The height of waves and energy

To find two quantities from an event related to wave height and energy, and through studying changes and adaptations in these quantities, to understand the function  $y=ax^2$ , and enable students to discover, express and think about functional relationships.

- a. To come to know that there is a  $y=ax^2$  relationship between wave height and energy.
- b. To understand and make mutual associations from tables, equations and graphs on the relationship between wave height and energy.
- c. To explain the extent to which energy differs based on wave height shown in weather reports using  $y=ax^2$ .
- d. To understand that there are functional relationships in a variety of events.

##### (2) Movement of celestial bodies and our lifestyles

To make associations between and think about movement of celestial bodies and our lifestyles, such as the fact that tides are caused by the gravitational force of the moon on the earth,



and the influence of moonlight on fishing.

- a. To understand that high tides and low tides happen as a result of the positional relationship of the sun and earth.
- b. Understand that high tides and low tides each occur twice a day.
- c. To come to know that the sea level of the Ariake Sea fluctuates by 4.5m, and that at the Amazon River, a large-scale counter-current flow occurs in a river called the Pororoca during high tide.
- d. To think about the fact that tidal flats cultivate diverse living things and are formed by low tides.
- e. To come to know that moonlight is a hindrance to night fishing, such as squid fishing, and that the volume of haul decreases.

## **F. Materials**

### **(1) Sea water as ion material**

To enable students to engage in exploratory study and augment their thinking about the characteristics of sea water as an electrolyte solution and ions by engaging in experiments on the electrification and electrolysis of a variety of electrolyte solutions, including sodium hydroxide.

- a. To understand that sea water is an electrolyte solution, has various ions dissolved in it and conducts electricity well.
- b. To learn that because sea water conducts electricity well, it can be dangerous in the case of lightning strikes, and to apply this to one's lifestyle.

## **G. Life**

### **(1) The growth and proliferation of ocean life forms**

To study and observe the growth and proliferation of ocean life forms, and to enable students to conduct exploratory studies on the distinguishing characteristics of ocean life forms.

- a. To come to know that sea squirts, sea urchins, jellyfish and sunfish go through dramatic transformations from larval stage to adulthood based on cell division and morphological change.
- b. To learn that in harsh environments where meeting a male is difficult, female hammerhead sharks are known to engage in parthenogenesis.
- c. To study about the many monoecious creatures that live at sea, such as sea slugs and sea squirts.

### **(2) Estimating population of marine animals**

To extract samples from a population and study trends in samples through activities to estimate the population of marine animals, and to enable students to understand interpretations of population trends.



- a. To attach markers to marine animals and to release, recapture and investigate after a certain period of time, and to understand that population can be estimated from the ratio of animals with markers on them.
- b. To conduct a sample survey to estimate the population of marine animals, and to understand and explain trends in populations.
- c. To understand the importance and meaning of sample surveys through activities to estimate the population of marine animals.

## H. Environment and cycles

### (1) The food chain of the ocean and the balance of ecosystems

To understand the food chain in the ocean, discuss with one another about noteworthy matters related to maintaining the balance of ecosystems, and enable students to sharpen their own ideas.

- a. To know that as there is a food chain on land, there is a food chain in the ocean that includes producers, primary consumers and secondary consumers.
- b. To think about the close relationships between the balance of the ocean's ecosystems and our lifestyles.
- c. To understand that there is strong connection between changes in the environment involving ocean life forms and the workings of our lifestyles, that causes a disruption of the balance of the ocean's ecosystems.

### (2) A message from the ocean

To possess one's own message to relate to other people on protecting the ocean of Japan in the future, to create an art work to make the message stronger, and to enable students to express their message clearly.

- a. To learn that there are a variety of issues related to the present state of the ocean, including environmental issues.
- b. To include tangible objects and examples related to the ocean in one's creation of art work.
- c. To relate a message on the ocean to peers and local people via art work.

### (3) Crises faced by the ocean and what we can do

To look at the various crises the ocean faces today, reflect on our own lifestyles, propose simple efforts that can be made, and foster attitudes encouraging ocean preservation.

- a. To study about the red soil runoff into the ocean caused by numerous land development projects in Okinawa, the fact that coral bleaching is progressing along with rising sea water temperatures, and the fact that forest preservation, activities to remove starfish, and transplanting and planting of coral are being conducted to preserve coral.



- b. To learn that sandy beaches where horseshoe crabs can lay eggs are decreasing in the Seto Inland Sea due to landfills in bays and land reclamation works, and the fact that they are on the verge of extinction because the area is no longer suitable for egg-laying due to waves caused by the navigation of large ships.
- c. To think about forestation activities taking place along coasts to create a more abundant ocean environment and the links between forests, rivers and the ocean.
- d. To study about the fact that many volunteer groups are active and have had successes in environmental preservation of the ocean.

#### **(4) Panel discussion on ocean environmental issues**

To deepen thinking on the ideal future state of the oceans through developing one's own opinions on environmental issues and holding a panel discussion.

- a. To select a topic from social life, to organise and compile ideas on one's experiences and knowledge, to effectively use words and phrases, and to give a convincing talk utilising materials.
- b. To talk according to the situation and the bearing of one's audience, and to appropriately utilise respectful language.

### **I. Resources and energy**

#### **(1) The bounty and disasters of the ocean**

To enable students to understand our relationships with the ocean, such as the fact that it is the source of life, that it holds various marine resources such as marine products, mineral resources and energy resources, and that we receive many benefits from the ocean, but at the same time to understand that the ocean also presents many dangers.

- a. To know that no other planets aside from earth have been discovered that are blessed with water.
- b. To become aware that Japan is blessed with marine resources.
- c. To think about the fact that the water indispensable to our lives is provided within a large-scale cycle, and that the greater part of this is moisture evaporated in the ocean.
- d. To understand the occurrence of tsunami due to earthquakes, immense damage and dangers due to the high waves of typhoons and strong winds, and to learn that a variety of measures and initiatives are being carried out to protect people.

#### **(2) Energy development in Japan's oceans**

To study about energy development in Japan's oceans and enable students to think about effective utilisation.

- a. To study about the fact that abundant deposits of methane hydrate, which gives off less carbon dioxide emissions than petroleum or coal and is effective for global warming mitigation, are thought to exist in Japan.



- b. To learn that there are a variety of issues concerning extraction of methane hydrate, such as extraction techniques and the potential for the collapse of underground structures after the methane hydrate is removed.
- c. To understand that renewable energies of the ocean attracting attention as next-generation clean energy include wave power, tidal power, temperature difference, offshore wind power, and tidal current power, and that the energy gained from power generation based on these energy resources fluctuates greatly according to the natural environment of installation locations and weather conditions.
- d. To learn that sailboats and yachts gain their propulsive force from converting wind into kinetic energy, and that attempts are being made to utilise this technology for large-scale ships.
- e. To understand that speeds above wind speed can be reached by racing yachts of today when wind direction and wind speed conditions are right based on improvement in scientific techniques.

## **J. Economy and industry**

### **(1) Technological innovation of ships**

To study about technologies utilised in maritime transport, and to enable students to understand the progress and history of these technologies.

- a. To learn that ship size is increasing and ships are becoming more energy efficient as initiatives to develop industry and protect the environment take place.
- b. To come into contact with the history and people instrumental in the progress made in shipbuilding technology, and to think about that way of life.

### **(2) Museums**

To visit museums or companies related to the ocean, such as aquariums, ocean centres and shipbuilding companies, and to enable students to understand ocean-related learning and initiatives through interaction with the staff.

- a. To study ocean-related museums and companies, and to come to know ocean-related learning, initiatives and research findings.
- b. To actually visit a museum, such as an aquarium or research facility, to personally experience the attraction and function of that facility.

## **K. Management**

### **(1) Ocean-related laws**

To study about ocean-related laws, and to enable students to understand about laws that reflect the wishes of the local residents and are linked to revitalisation of localities.

- a. To come to know laws for protection of the ocean.
- b. To come to know laws concerning utilisation of the ocean.



## (2) The future of Japan's oceans

To explore an issue that needs to be solved through activities studying the future of Japan's ocean from one's own perspective, and to enable students to compile their own ideas from the perspective of forming a sustainable society.

- a. To study about Japan's territorial waters and economic zones, such as the Northern Territories, Takeshima, the Senkaku Islands, and Okinotorishima.
- b. To study about the marine environment, such as marine pollution, rising sea level due to global warming, deforestation and topsoil runoff.
- c. To understand marine resources, such as economic zones and securing of resources and declining haul due to overfishing.
- d. To think about the Basic Act on Ocean Policy and our future efforts

## (3) Symposium on future ocean utilisation

To develop one's opinions on ocean utilisation, and to enable students to deepen their ideas on the future ideal utilisation of the ocean through holding a symposium.

- a. To evaluate the content areas and expressions heard, to improve one's own mindset and way of thinking and to make use of these in expression.
- b. To share opinions with others and to persuade others on social living topics.

## (4) To hold a sea conference

To think about better ways to utilise the ocean according to the actual conditions of localities through exchanges between schools and communities located on the same rivers or seashores, or even through exchanges between distant schools or communities, and to enable students to translate ideas into action aimed at improvement of the global environment.

- a. For schools utilising the same river at upstream, midstream and downstream locations and schools near the ocean and far from the ocean to share initiatives in the environment or concerning aspects of various rivers or seashores.
  1. Schools or localities visited during seaside school or field trips
  2. Schools or localities where ocean visibility is high and the ocean is a habitat for coral, such as Okinawa.
  3. Schools or localities in various situations in Japan and around the world, such as industrial regions and Tuvalu.
- b. To devise methods of interaction according to the actual situations of schools, such as letters, e-mail and internet television.
- c. To translate efforts based on interaction into feasible actions in each community aimed at realisation of a sustainable society and improvement of the global environment. Additionally, to plan further exchanges between schools based on these results.



## L. International

### (1) To read materials on the ocean written in English

To read marine literature or material on various ocean issues written in English, to give students an international understanding from a broad perspective and understanding on global-scale environmental issues, to raise self-awareness as a person living in international society and in a global environment, and to enable students to communicate in English or Japanese.

- a. To read marine literature written in English.
- b. To read material written in English on international ocean issues such as whaling.
- c. To read works about Japan written in English as seen from other countries, and to increase understanding of Japan.
- d. To communicate one's ideas in written English.

## 4) All years

### A. Lifestyles and health

#### (1) Experiencing daily life at sea

To personally experience the fun of daily life in nature and group activities through trips and group overnight events such as post-admission orientations, school building, seaside school and field trips.

- a. To come into contact with persons living at sea and come to know the connections between people and the ocean.
- b. To enjoy activities at sea, such as swimming in the ocean, snorkeling, and sea kayaking and to experience the good aspects of nature.
- c. To experience work at sea, such as dragnets and fishing experience.
- d. To foster ideal human relationships with peers and people who live at sea through these experiences.
- e. To give thanks to people involved with the ocean, and to interact with them through thank you letters, reporting on learning achievements.

## H. Environment and cycles

### (1) Activities to protect the ocean

To help each other in groups to think about a better ocean environment through student council and class activities, and to enable students to engage in volunteer activities.

- a. To learn about community initiatives to protect the environment.
- b. To actually participate in volunteer activities to protect the ocean environment.
- c. To communicate one's activities to protect the environment of the ocean to other grades, schools and communities, and to educate others to make the activities grow larger.



### 3) Content flow chart

		To become familiar with the ocean			To get to know the ocean		
		A. Lifestyles, health and safety	B. Tourism, leisure and sports	C. Culture and art	D. History and folk customs	E. Earth and oceans	F. Materials
Year 1	(1) Relationships between prefectures and the ocean Social studies	(1) To swim in the nearby ocean HP	(1) To express the ocean as music Music	(1) History of exchange via the ocean Social studies	(1) Investigation of coastal pollution Mathematics	(1) Density, convection and circulation of materials Science	
	(2) The danger of tsunamis IH		(2) Sketch of ocean scenery Art	(2) Ocean-related tradition and culture Social studies	(2) Water depth and water pressure Science	(2) Components of sea water, solubility and salt Science	
			(3) To read writings related to the ocean JL		(3) The mechanisms of mirage and sonar Science		
Year 2	(1) Cooking seafood IH	(1) To express the ocean in body movements HP	(1) To sing about the ocean Music		(1) The relationship between the ocean and weather Science		
	(2) Relationship between depopulation countermeasures on remote islands and the ocean Social studies		(2) Creation of a work of art using the ocean as material Art				
Year 3	(1) Disasters at sea and seaside safety administration HP				(1) The height of waves and energy Mathematics	(1) Sea water as ion material Science	
					(2) Movement of celestial bodies and our lifestyles Science		
All years	(1) Experiencing daily life at sea SA						

JL: Japanese language  
 IH: Industrial arts and homemaking  
 HP: Health and physical education  
 FL: Foreign language  
 PI: Periods for integrated study  
 SA: Special activities



To protect the ocean		To utilise the ocean			
G. Life	H. Environment and cycles	I. Resources and energy	J. Economy and industry	K. Management	L. International
(1) Photosynthesis on land and at sea Science			(1) Plans of convenient and safe ports Mathematics		(1) The oceans and continents of the world Social studies
			(2) Relationships among the speed a ship travels, time and distance Mathematics		(2) The distinguishing characteristics of Japan, an island nation Social studies
(1) Wonderful living things of the ocean Science	(1) Forests, rivers and ocean PI		(1) Japan's maritime transport Social studies	(1) Coastal development and environmental preservation Social studies	(1) Relationships with other countries and the ocean Social studies
(2) Biodiversity and evolution in the oceans Science	(2) To write an opinion statement about the ocean's environmental problems JL		(2) Graph of ocean liner operation Social studies		
(3) To write a report on their study of marine life JL			(3) Japan's marine products industry Social studies		
			(4) Ocean-related work PI		
(1) The growth and proliferation of ocean life forms Science	(1) The food chain of the ocean and the balance of ecosystems Science	(1) The bounty and disasters of the ocean Science	(1) Technological innovation of ships IH	(1) Ocean-related laws Social studies	(1) To read materials on the ocean written in English FL
(2) Estimating population of marine animals Mathematics	(2) A message from the ocean Art	(2) Energy development in Japan's oceans Social studies	(2) Museums PI	(2) The future of Japan's oceans Social studies	
	(3) Crises faced by the ocean and what we can do Science			(3) Symposium on future ocean utilisation JL	
	(4) Panel discussion on ocean environmental issues JL			(4) To hold a sea conference PI	
	(1) Activities to protect the ocean SA				

Year 1

Year 2

Year 3

All years



#### 4) Content flow chart by subject

	Year 1 (Y1)	Year 2 (Y2)
<b>JL</b>	Y1-C-(1) Reading ability [Traditional linguistic culture and characteristics of Japanese language] 3-1-(5) Various writings 3-3-(2) Perspectives of teaching materials C-(3) To read writings related to the ocean	Y2-B-(1)-a Problems and materials 3-3-(2) Perspectives of materials G-(3) To write a report on their study of marine life H-(2) To write an opinion statement about the ocean's environmental problems
<b>Social studies</b>	Geography-(1)-a Makeup of the world's regions L-(1) The oceans and continents of the world Geography-(2)-a Makeup of Japan's regions L-(2) The distinguishing characteristics of Japan, an island nation Geography-(2)-b Regional characteristics of Japan compared to the world Geography-(2)-c The various regions of Japan A-(1) Relationships between prefectures and the ocean History-(1) Interpretation of history D-(1) History of exchange via the ocean Citizen-(1)-a The modern society and culture we live in D-(2) Ocean-related tradition and culture	Geography-(1)-d Investigation on the world's various regions L-(1) Relationships with other countries and the ocean Geography-(2)-b Regional characteristics of Japan compared to the world J-(1) Japan's maritime transport J-(3) Japan's marine products industry K-(1) Coastal development and environmental preservation Geography-(2)-c The various regions of Japan A-(2) Relationship between depopulation countermeasures on remote islands and the ocean
<b>Mathematics</b>	Y1-B-(1) Drawing figures J-(1) Plans of convenient and safe ports Y1-C-(1) Proportion and inverse proportion J-(2) Relationships among the speed a ship travels, time and distance Y1-D-(1) Histograms E-(1) Investigation of coastal pollution	Y2-C-(1) Linear function J-(2) Graph of ocean liner operation
<b>Science</b>	Area1-(1)-a Light and sound E-(3) The mechanisms of mirage and sonar Area1-(1)-b Power and pressure E-(2) Water depth and water pressure Area1-(2)-a The form of materials F-(1) Density, convection and circulation of materials Area1-(2)-b Aqueous solutions F-(2) Components of sea water, solubility and salt Area2-(2)-a Volcanoes and earthquakes E-(4) The mechanisms of earthquakes and tsunami Area2-(1)-b The structure and workings of plant life bodies Area2-(1)-c plant cousins G-(1) Photosynthesis on land and at sea	Area2-(3)-c Animal cousins G-(1) Wonderful living things of the ocean Area2-(3)-d Changes and evolving of life forms G-(2) Biodiversity and evolution in the oceans Area2-(4)-c Japan's climate E-(1) The relationship between the ocean and weather
<b>M</b>	Y1-A-(2) Activities with musical instruments Y1-A-(3)-b Creative activities C-(1) To express the ocean as music	Y2/3-A-(1) Choral activities C-(1) To sing about the ocean
<b>A</b>	Y1-A-(1) Expression in pictures and sculptures C-(2) Sketch of ocean scenery	Y2/3-A-(3) Expressing ideas and plans C-(2) Creation of a work of art using the ocean as material
<b>HP</b>	Physical ed.-Y1/2-D Swimming B-(1) To swim in the nearby ocean	Physical ed.-Y1/2-G Dance B-(1) To express the ocean in body movements
<b>IH</b>	Technology-D Information technologies(1)(3) A-(2) The danger of tsunamis	Home-making-B Dietary lifestyles and independence A-(1) Cooking seafood
	JL: Japanese language M: Music A: Art HP: Health and physical education IH: Industrial arts and home-making IN: Integrated	 All content  H-(1) Forests, rivers and ocean J-(4) Ocean-related work



Example: citizen-(4) Various issues in the international community and us

I-(2) Energy development in Japan's oceans

Pillar: The above shows that the item "(2) Energy development in Japan's oceans" of the content areas of "I. Environment and energy" is relevant to the "(4) Various issues in the international society and us" item of "citizen areas" of "social studies" of the junior high school national curriculum standards. Furthermore, due to space restrictions, portions of the curriculum guidelines content have been abbreviated.

## Year 3(Y3)

## All years

Y3-A-(1) Speaking and listening

H-(4) Panel discussion on ocean environmental issues

K-(3) Symposium on future ocean utilisation

Citizen-(3) Politics and us

K-(1) Ocean-related laws

Citizen-(4) Various issues in the international community and us

I-(2) Energy development in Japan's oceans

K-(2) The future of Japan's oceans

Y3-C-(1)  $y=ax^2$

E-(1) The height of waves and energy

Y3-D-(1) Populations and samples

G-(2) Estimating population of marine animals

Area1-(6)-a Aqueous solutions and ions

F-(1) Sea water as ion material

Area2-(5)-a Growth and Propagation of life forms

G-(1) The growth and proliferation of ocean life forms

Area2-(6)-b The solar system and stars

E-(2) Movement of celestial bodies and our lifestyles

I-(1) The bounty and disasters of the ocean

Area2-(7)-a Life forms and environment

H-(1) The food chain of the ocean and the balance of ecosystems

H-(3) Crises faced by the ocean and what we can do

Area2-(7)-b The bounty and disasters of nature

I-(1) The bounty and disasters of the ocean

Area2-(7)-c Preservation of the natural environment and utilisation of scientific technology

H-(3) Crises faced by the ocean and what we can do

Y2/3-A-(2) Aims and functions, design and handicrafts

H-(2) A message from the ocean

Insurance-(3) Preventing bodily injuries

A-(1) Disasters at sea and seaside safety administration

Technology-A-(1) Lifestyles and technology in industry

J-(1) Technological innovation of ships

English-3-(2)-c International understanding

L-(1) To read materials on the ocean written in English

All content

J-(2) Museums K-(4) To hold a sea conference

### Special activities

School-(4) Trip and overnight group event

A-(1) Experiencing daily life at sea

Class-(2)-f Volunteer activities

Student council-(5) Volunteer activities

Events-(5) Labor production and service events

H-(1) Activities to protect the ocean



## 5-2. Proposal for unit plans and lesson plans

### 1) Unit name: “Studying about Okinawa Prefecture”

Year 1, A. Lifestyles, health and safety (1) Relationships between prefectures and the ocean, proposal by Takayuki Narita

【Unit plan】 (6 hours)

#### 1 Aim of unit

To think about the connections between Okinawa and the ocean from the perspectives of “natural environment”, “industry”, “environmental problems and environmental preservation”, and “connections with other regions” by engaging in activities to study about Okinawa Prefecture.

#### 2 Unit teaching plan

Hours	Learning activities	External cooperation (reference)
1	<ul style="list-style-type: none"> <li>○To look at and taste actual pineapples and sugar cane, talk about where they were grown, take an interest in Okinawa Prefecture and communicate with each other what has been learned.</li> <li>• I've heard that Okinawa has sugar cane.</li> <li>• Okinawa makes me think of blue skies.</li> <li>○To think about perspectives for studying about Okinawa.</li> <li>• The perspective of nature and the abundant ocean</li> <li>• The perspective of industry such as tourism because many people take trips there</li> <li>• The perspective of environment as coral reefs are decreasing</li> <li>• The perspective of connections to other communities and modes of transportation to remote islands</li> <li>• The perspective of culture such as Eisa dance and dragon boat race festivals.</li> </ul>	Merchants in Okinawa Prefecture (of specialty products such as pineapples and sugar cane) Akajima Marine Science Laboratory (AMSL) Website of Okinawa Prefecture Various guidebooks Shops that sell Okinawan specialty products (sea grapes, salt, star sand, sea snakes)
3	<ul style="list-style-type: none"> <li>○To study and communicate about Okinawa Prefecture from each perspective.</li> <li>• Mangroves seen in the subtropics and tropics and coral reefs have developed. (nature)</li> <li>• It's surrounded by the ocean. (nature)</li> <li>• Okinawa is in the path of typhoons and many pass through every year. (nature)</li> <li>• Marine leisure using the ocean is popular. (industry)</li> <li>• Okinawa offers environmentally-friendly eco-tours as well. (industry)</li> <li>• Marine product resources are abundant because it's surrounded by water. (industry)</li> <li>• The Uminchu festival prays for a good haul and safe navigation. (culture)</li> <li>• There are environmental problems like red soil runoff and disappearance of coral reefs. (environment)</li> <li>• You can see coral and dugongs at the Churaumi Aquarium. (living things)</li> <li>• Okinawa has lots of remote islands so there is a lot of air and marine transportation. (connections)</li> </ul>	Okinawa travel agents (materials on eco-tours and marine sports) Marine Science Department of the University of the Ryukyus Churaumi Aquarium Mangroves and environmental tours National Institute for Japanese Islands (SHIMADAS) <a href="http://www.nijinet.or.jp">www.nijinet.or.jp</a> Weather Association, local meteorological observatories WWF
2	<ul style="list-style-type: none"> <li>○<b>Core class hours</b> Compiling viewpoints on connections with the ocean using “ocean” as a keyword.</li> <li>• To organise information on connections with the ocean, and to make presentations on what was found out, what was realised and what was felt in order to make associations and think about the facts studied.</li> </ul>	Eco-tourism companies, environmental protection groups in Okinawa, fishing cooperatives and tourism division can utilise letters, telephone and e-mail to respond to questions.

#### Content areas of ocean education making up this unit

Year 1 A. Lifestyles, health and safety (1) Relationships between prefectures and the ocean

To think about oceans from the perspectives of “natural environment”, “industry”, “environmental problems and environmental preservation”, and “connections with other regions” by engaging in activities to study Okinawa Prefecture with its strong ties to the ocean, and to enable students to augment understanding to include the relationships between the ocean and other prefectures.

- a. To become aware of the fact that from the perspective of “natural environment”, Okinawa is surrounded by beautiful sea including coral reefs.
- b. To become aware of the fact that from the perspective of “industry”, Okinawa is blessed by a variety of marine resources.
- c. To come to know that from the perspective of “industry”, the tourism industry that takes advantage of the ocean for marine sports is flourishing.
- d. To come to know that from the perspectives of “industry” and “environmental problems and environmental preservation”, decline of primary industries and destructive development have caused marine pollution problems such as red soil runoff.
- e. To come to know that from the perspective of “connections with other regions”, marine transportation is growing, including mainland routes and remote island routes.
- f. To make the best use of study activities on the relationship between Okinawa and the ocean to study about the relationships between the ocean and other prefectures from one's own perspective.



【Lesson plan】 (5-6 of 6 hours)

1 Aim of core class hours

To become aware of the strong connections between the lifestyles of the people of Okinawa and the ocean through activities to think about these connections, and to enable students to think about the importance of the ocean.

2 Teaching plan of core class hours

Learning activities	External cooperation (reference)
<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">                     Compiling various viewpoints on the relationship between Okinawa and the ocean.                 </div> <p>○To present findings on Okinawa Prefecture compiled as “connections to the ocean”. (on two pages of open notebook)</p> <p>&lt; Industry and the ocean &gt;</p> <ul style="list-style-type: none"> <li>• Okinawa is in the path of the Kuroshio current, and tuna fishing has flourished for ages.</li> <li>• Many tourists visit Okinawa, surrounded by beautiful seas, every year, and the tourism industry is flourishing.</li> </ul> <p>&lt; Nature and the ocean &gt;</p> <ul style="list-style-type: none"> <li>• There are beautiful white sand beaches.</li> <li>• There are beautiful coral reefs in Okinawa’s oceans.</li> </ul> <p>&lt; Transportation and the ocean &gt;</p> <ul style="list-style-type: none"> <li>• Okinawa has many remote islands, and thus sea routes are developed as a mode of transportation.</li> </ul> <p>&lt; Culture and the ocean &gt;</p> <ul style="list-style-type: none"> <li>• There is a dragon boat race to pray for safety at sea and abundant fishing.</li> </ul> <p>&lt; Environment and the ocean &gt;</p> <ul style="list-style-type: none"> <li>• Red soil runoff is an issue.</li> <li>• Disappearance of coral reefs is an issue.</li> </ul> <p>&lt; Each perspective and the ocean &gt;</p> <ul style="list-style-type: none"> <li>• It is thought that development of leisure to promote the tourism industry has resulted in red soil runoff.</li> <li>• Initiatives in “eco-tours” are taking place to allow people to enjoy sightseeing while protecting Okinawa’s environment.</li> <li>• Culture related to wishing for abundant fishing has remained as Okinawa has been a good place for fishing since long ago.</li> </ul> <p>○To write about feelings through activities to compile information on “Okinawa and the ocean”.</p> <ul style="list-style-type: none"> <li>• Protection + utilisation of the ocean is linked to development in Okinawa.</li> <li>• Destruction of the environment for people’s convenience should not be allowed.</li> <li>• Language activities: To send a message to a relevant group linking to introductory essays.</li> </ul>	<p>To effectively utilise various photo materials.</p> <ul style="list-style-type: none"> <li>• tuna fishing</li> <li>• coasts</li> <li>• coral reefs</li> <li>• sightseeing boats</li> <li>• underwater hikes</li> <li>• dragon boat races</li> <li>• red soil runoff</li> <li>• eco-tours</li> </ul> <p style="text-align: right;">etc.</p> <p>To have persons from the Environmental Preservation Division of Okinawa Prefecture and WWF introduce their initiatives to make students conscious of actual trends in environmental preservation.</p> <p>To have persons from related groups read the introductory essays and evaluate interpretations of relationships between the ocean and lifestyles and the environment.</p>
<p>Points to keep in mind</p> <ul style="list-style-type: none"> <li>• Children should grasp that relationships with the ocean can be viewed from multiple perspectives, not a single point of view. Accordingly, they will more strongly feel the need to protect the ocean.</li> <li>• Advice should be given so that materials are not simply cut and pasted, but that information is compiled as the relationships with the ocean are clarified.</li> </ul>	



## 2) Unit name: “Writing a report on study of the ocean’s living things”

Year 2, G. Life (3) To write a report on study of marine life, proposal by Taishi Kato

【Unit plan】 Unit plan (5 hours)

### 1 Aim of unit

To take an interest in and study the distinguishing characteristics of the ecosystem of a chosen marine life form, and to enable students to write a report on this marine life form based on information collected.

### 2 Unit teaching plan

Hours	Learning activities	External cooperation (reference)
1	<ul style="list-style-type: none"> <li>○To encounter the assigned work of the unit and issues that run throughout unit and to have an overview of the unit.</li> <li>• To confirm the issues that run throughout the unit and the type of writing that will be dealt with in the unit.</li> <li>• To come to know the ecosystem of the whale, a marine life form.</li> <li>• I had no idea that the ancestors of whales lived on land. I read a few books on whales and dolphins in my first year, but there is still a lot to learn. I’d like to learn more about the living things of the ocean which is the origin of life.</li> </ul>	<p>“Ocean Trivia”, Ocean Policy Research Foundation and The Oceanographic Society of Japan</p> <p>Staff of aquariums, such as one with coelacanths (Aquamarine Fukushima), and jellyfish (Kamo Aquarium, Tsuruoka), can give talks on the intrigue of ecosystems using visual aids to raise the interest of students in marine life forms.</p>
2	<ul style="list-style-type: none"> <li>○To choose a marine life form to study and collect information from the Internet and books.</li> <li>○To make a memo on structure</li> <li>• To organise information collected into lists and narrow down the main focus of the report on the life form.</li> <li>• To write a list of one’s own ideas and thoughts on what was found out.</li> <li>• To make multiple drafts.</li> <li>• I realised that I still don’t know a lot of things about eels, like where they are born and how they grow. I’d like to report on the wonders of the eel’s ecosystem to everyone.</li> </ul>	<p>Places for information collection</p> <p>Museums</p> <p>The Ocean Consultation Room of the Hydrographic and Oceanographic Department of the Japan Coast Guard</p> <p>Japan Agency for Marine-Earth Science and Technology (JAMSTEC)</p> <p><a href="http://www.jamstec.go.jp/j/kids/">http://www.jamstec.go.jp/j/kids/</a></p> <p>Ministry of the Environment Photo Library</p> <p><a href="http://www.env.go.jp/guide/video/library/list_pic.php">http://www.env.go.jp/guide/video/library/list_pic.php</a></p> <p>Let’s Study the Ocean Classroom of the Oceanographic Society of Japan</p> <p><a href="http://coast14.iic.hokudai.ac.jp/osj/">http://coast14.iic.hokudai.ac.jp/osj/</a></p> <p>“Living at 3,472m ocean depths”, Four years of records on the Nankai Trough off Muroto</p> <p><a href="http://www.kagakueizo.org/2009/04/post-116.html">http://www.kagakueizo.org/2009/04/post-116.html</a></p>
2	<ul style="list-style-type: none"> <li>○To convert memos into a composition.</li> <li>• To write about 300 characters.</li> <li>• To keep a dictionary at hand and use it as necessary while writing.</li> <li>• To separate writing on facts that were looked up and thought about these facts.</li> <li>○Core class hours To divide into small groups, mutually evaluate writing, and make revisions.</li> <li>○To compile a collection of the reports of the class and read the writings of peers.</li> <li>○To reflect on the unit.</li> </ul>	<p>The guest marine biologist researcher can read the reports of students and evaluate them from the following angles.</p> <ul style="list-style-type: none"> <li>• Are items that deserve special mention included in the content areas?</li> <li>• Are facts and thoughts written separately, and is the report organised?</li> </ul>
<p>Content areas of ocean education making up this unit</p> <p>Year 2 G. Life (3) To write a report on study of marine life</p> <p>To take an interest in and study the distinguishing characteristics of the ecosystem of a chosen marine life form, and to enable students to write a report on this marine life form based on information collected.</p> <p>a. To clarify one’s own viewpoint and the facts and matters one wants to relate, and to devise the structure of the report.</p> <p>b. To write including explanations and concrete examples and to devise descriptions so that facts, matters, opinions and feelings are effectively related to one’s audience.</p>		



**【Lesson plan】 (5 of 5 hours)**

**1 Aim of core class hours**

To review written reports and mutually evaluate them, focusing on making them easier to read and writing facts and opinions separately, and to enable students to make revisions.

**2 Teaching plan of core class hours**

Learning activities	External cooperation (reference)
<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">                     Engaging in mutual evaluation focusing on writing facts and opinions separately.                 </div> <ul style="list-style-type: none"> <li>○To reread one’s composition to confirm that matters learned are communicated and written concisely.                         <ul style="list-style-type: none"> <li>• To confirm there are no mistakes or awkward sentences.</li> </ul> </li> <li>○To form small groups of four to share writings with each other and engage in mutual evaluation.                         <ul style="list-style-type: none"> <li>• To write on a comment sheet about the good aspects and aspects to be corrected of the report read.</li> <li>• After checking each other’s work, to engage in verbal exchange on points for revision on each person’s work in succession.</li> </ul> </li> <li>○To revise one’s work based on peers’ comments and write up points for improvement in a list.                         <ul style="list-style-type: none"> <li>• To make the final copy.</li> </ul> </li> <li>○To reflect on core class hours.                         <ul style="list-style-type: none"> <li>• To reflect on what was learned from peers and in the whole unit, and to write about reflections on study content areas and thoughts on the unit.</li> </ul> </li> </ul> <p>• In this unit, we wrote reports on the ecosystems of marine life forms while writing facts and opinions separately. I was writing sentences where the subject and predicate did not match. I’ll be more careful in the future to write concisely. Also, I learned a lot about the ecosystems of other marine life forms from reading the reports of my friends. I think the ocean is a treasure chest of mysteries.</p>	<p>The guest marine biologist researcher (graduate school student or researcher in marine biology) can read the reports of students and evaluate from the following angles while interpreting affirmatively as much as possible.</p> <ul style="list-style-type: none"> <li>• Are items that deserve special mention for each marine life form (matters that must be covered to introduce the life form) included in the content areas?</li> <li>• Are facts and thoughts written separately, and is the report well organised?</li> </ul> <p>The marine biologist researcher can provide supplementary explanations if necessary on the ecosystems and distinguishing characteristics of the marine life forms not covered in student reports to arouse the interest and concern of students.</p>
<p>Points to keep in mind</p> <ul style="list-style-type: none"> <li>• To confirm that students are gaining the ability to write compositions based on information collected on marine life forms, 1) with structures that differentiate between facts and thoughts, and 2) to compose while clarifying which parts are central opinions and to find ways to develop logic.</li> </ul>	



### 3) Unit name: The ocean and resource and energy issues of the 21<sup>st</sup> century

Year 3, I. Resources and energy (2), Energy development in Japan's oceans, proposal by Takayuki Narita

【Unit plan】 (6 hours)

#### 1 Aim of unit

To study about energy development in Japan's oceans and enable students to think about effective utilisation and future energy issues.

#### 2 Unit teaching plan

Hours	Learning activities	External resources (reference)
2	<ul style="list-style-type: none"> <li>○To come to know about the state of supply and demand of energy resources in Japan and the reserves of major resources.</li> <li>• The reserves and deposits of fossil fuels like petroleum and coal are distorted.</li> <li>• Developed countries consume a massive amount of energy.</li> <li>○To think about the potential of energy development utilising the ocean from the perspective of Japan as a maritime nation with scarce resources.</li> <li>• I've heard of wave power generation.</li> <li>• If we can utilise the ocean, it would be friendlier to the environment.</li> </ul>	<p>University researchers and persons from the New Energy and Industrial Technology Development Organisation (NEDO) can provide (send) materials on the potential for ocean energy development.</p> <p>Japan Oil, Gas and Metals National Corporation (JOGMEC)</p> <p>Methane hydrate</p> <p>Kids page of the Research Consortium for Methane Hydrate Resources in Japan <a href="http://www.mh21japan.gr.jp/">http://www.mh21japan.gr.jp/</a></p> <p>National Institute of Advanced Industrial Science and Technology (AIST)</p> <p>Artificial methane hydrate</p> <p>National Maritime Research Institute</p> <p>Shipbuilding related research institutes (Mitsubishi Heavy Industries, etc.)</p>
2	<ul style="list-style-type: none"> <li>○To study about new energy development and resources in the ocean.</li> <li>• Many types of power generation (offshore wind power, wave power, tidal power, temperature difference, and tidal current power) have been developed.</li> <li>• There is methane hydrate around Japan that can be utilised.</li> <li>• Development of seafloor hydrothermal deposits is about to be started.</li> </ul>	<p>The above external resource persons can use telephone, fax and e-mail to receive and respond to questions.</p>
2	<ul style="list-style-type: none"> <li>○<b>Core class hours</b> To communicate what was learned on "energy development in the oceans". Language activity: symposium</li> <li>• Energy development at sea is more advanced than I thought.</li> <li>• The ocean has the potential to provide energy for Japan in the future.</li> <li>• Development is being carried out based on the country's "Basic Act on Ocean Policy" and "Basic Plan on Ocean Policy".</li> </ul>	<p>The above external resource persons will participate as much as possible and talk about the latest information and the potential of the ocean.</p> <p>Not only merits, but demerits should also be covered. Information should be provided to draw attention to issues related to implementation and relationships to environmental protection.</p>

Content areas of ocean education making up this unit

Year 3 I. Resources and energy (2) Energy development in Japan's oceans

To study about energy development in Japan's oceans and enable students to think about effective utilisation.

- a. To study about the fact that abundant deposits of methane hydrate, that causes less carbon dioxide emissions than petroleum or coal and is effective for global warming mitigation, are thought to exist in Japan.
- b. To come to know that there are a variety of issues concerning extraction of methane hydrate, such as extraction techniques and the potential for the collapse of underground structures after methane hydrate is removed.
- c. To understand that renewable energies of the ocean attracting attention as next-generation clean energy include wave power, tidal power, temperature difference, offshore wind power, and tidal current power, and that the energy gained from power generation based on these energy resources fluctuates greatly according to the natural environment of installation locations and weather conditions.
- d. To learn that sailboats and yachts gain their propulsive force from converting wind into kinetic energy, and that attempts are being made to utilise this technology for large-scale ships.
- e. To understand that speeds above wind speed can be reached by racing yachts of today when wind direction and wind speed conditions are right based on improvement in scientific techniques.



**【Lesson plan】 (4-5 of 8 hours)**

**1 Aim of core class hours**

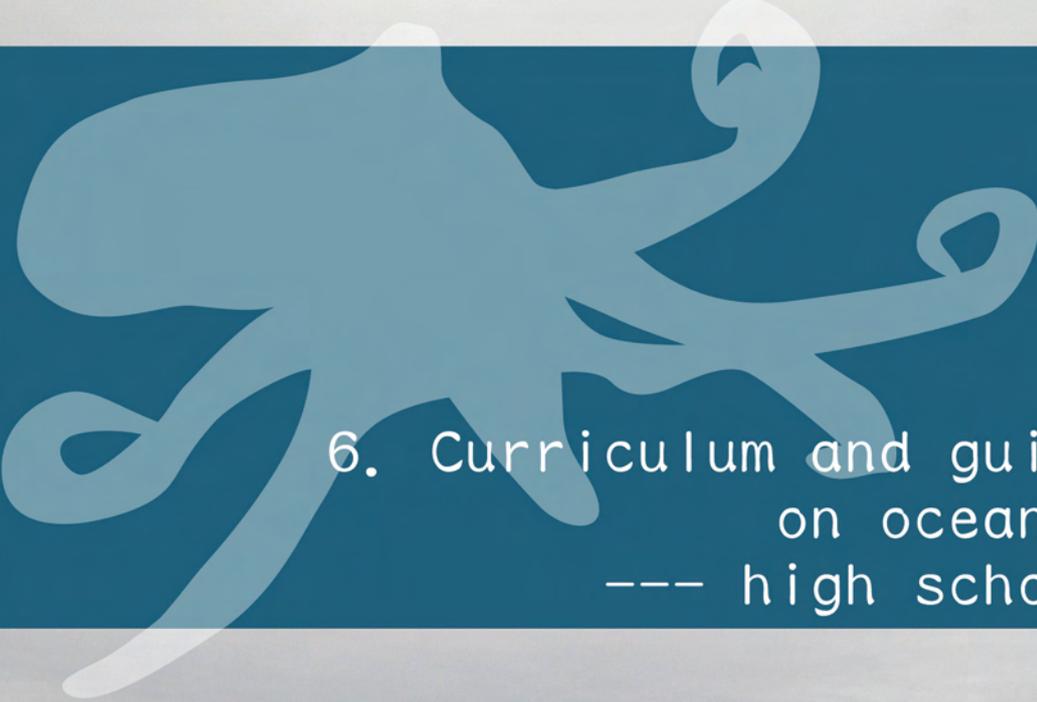
To learn about various energy development in the oceans and effective ways of utilisation through activities to communicate on energy development in the ocean, and to enable students to have their own ideas on ways of using the oceans.

**2 Teaching plan of core class hours**

Learning activities	External cooperation (reference)
<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>To communicate what was learned on “energy development in the oceans”.</p> </div> <ul style="list-style-type: none"> <li>○To present what was learned in “energy development in the oceans” and listen to the talk of external teachers.               <ul style="list-style-type: none"> <li>&lt;Power generation &gt;                   <ul style="list-style-type: none"> <li>• Development of power generation utilising wind power, wave power, tidal power and temperature difference is being advanced.</li> </ul> </li> <li>&lt;Methane hydrate &gt;                   <ul style="list-style-type: none"> <li>• Methane hydrate is friendlier to the environment as carbon dioxide emissions when burned are half that of petroleum and coal.</li> <li>• Methane hydrate is in the sediment of the ocean floor.</li> </ul> </li> <li>&lt;Seafloor hydrothermal deposits &gt;                   <ul style="list-style-type: none"> <li>• The potential exists to gain metal resources from seafloor hydrothermal deposits.</li> </ul> </li> </ul> </li> <li>○To hold a symposium on “Future potential for ocean energies” and to communicate thoughts based on discussions.               <ul style="list-style-type: none"> <li>• Language activity: symposium</li> <li>• This is an issue that must be thought about from both “development” and “marine environmental preservation” perspectives.</li> <li>• For Japan, that is surrounded by ocean on all four sides, the potential for energy security will expand if oceans can be utilised.</li> <li>• We should think about effects on marine life forms.</li> <li>• Because we cannot continue to depend on limited resources, I think energy development utilising the ocean is bound to become more important in the future.</li> </ul> </li> </ul>	<p>University researchers and persons from the New Energy and Industrial Technology Development Organisation (NEDO) will participate as much as possible and give advice and supplementary explanations as appropriate.</p> <p>Efforts should be made to utilise visual aids such as diagrams and PowerPoint to make technical content easy to understand.</p> <p>Explanations should not be one-sided, but should be designed to bring out the ideas of students through exchange of questions.</p> <p>Not only merits, but demerits should also be related as information that can be used for students to think about the future potentials of ocean energies.</p> <p>The relationship with the possessions and economic zones of other countries, as well as the relationship with environmental pollution, should also be communicated to make students aware of the viewpoint of cooperation with other countries.</p> <p>External resource persons can participate as commentators and provide technical advice as appropriate to students (the class delivery programme of the University of Tokyo Ocean Alliance, The Japan Society of Naval Architects and Ocean Engineers)</p> <p>Panelists can create opportunities to think about energy according to the regions where they live (characteristics such as strong winds or strong currents).</p>
<p><b>Points to keep in mind</b></p> <ul style="list-style-type: none"> <li>• It is best to try to find relevance with study related to energy development in “science” and “industrial arts and homemaking” subjects.</li> <li>• A prior meeting with the external resource person should be carefully conducted. It should be confirmed that the guest lecturer will not give a one-sided talk, but should ask questions of the students to bring out their ideas and correct misconceptions. Important! The students play the leading parts and their strengths should be brought out.</li> <li>• Methods should be devised to provide materials, make a blackboard plan or conduct class so that students become aware of aspects of both “development” and “environmental preservation”.</li> <li>• It is best to not only become aware of the present situation, but to become aware of connections to one’s own future lifestyle.</li> </ul>	







## 6. Curriculum and guidance plan on ocean education --- high school version



## 6-1 . Curriculum

### 1) Competencies

<p>The ability to collect appropriate information on the ocean and to comprehensively make decisions [ information collection and decision-making ]</p>	<p>To appropriately acquire necessary information from multiple resources on the intricately related various events and issues of the ocean, and to perform a many-sided and comprehensive analysis of these from a broad bird's-eye perspective, to understand the interrelationships and spread of people, societies and nature, and to develop the ability to make decisions logically, rationally and equitably.</p>
<p>The ability to understand others and express oneself in order to engage in smooth communication with others at various settings of the ocean [ dialogue ]</p>	<p>To simply explain and express one's own knowledge and ideas to others while understanding and respecting the ideas of others in various ocean-related settings where a variety of parties come together, and to develop the ability to actively expand connections with others.</p>
<p>The ability to solve problems while attempting to coordinate among persons involved in the various issues of the ocean [ problem-solving ]</p>	<p>To discover peaceful measures based on one's own ideas to respond to various ocean issues in which a variety of parties are involved, while understanding and respecting the standpoints and ways of thinking of others involved, and to develop the ability to execute.</p>
<p>The ability to continually utilise the bounty of the oceans [ sustained use ]</p>	<p>To develop the ability to utilise the bounty of the ocean, including bioresources, mineral resources, beautiful scenery and nature experiences, for the development of modern society, without forfeiting benefits to future generations.</p>
<p>The attitude to become familiar with and value the ocean [ emotions ]</p>	<p>To develop the attitude to voluntarily and actively come into contact with the ocean, become familiar with the ocean, sense the magnificence and blessings of the ocean, and to value the ocean.</p>
<p>The attitude to respect the connections between time and space with the ocean in mind [ relationships ]</p>	<p>To understand connections not only between oneself and familiar individuals and groups, but also one's connections with the world via the ocean, and to develop the attitude to think from an international perspective. To study the history and culture of the ocean, and to develop the attitude to make associations between one's actions and various events in order to realise coexistence of humans and the oceans across future generations.</p>
<p>The positive attitude to take responsible action on the various issues of the ocean [ autonomy ]</p>	<p>To understand connections between one's actions and other matters, to feel responsible for those actions, and to develop the attitude to exhibit leadership and to take positive action related to utilisation, management and preservation of the ocean. To develop an attitude of curiosity about various things, persevere, and continually challenge oneself.</p>
<p>The attitude to continually learn ocean-related knowledge and skills to be able to respond to changing societies, looking to the future [ continuity ]</p>	<p>To develop the attitudes and skills necessary to envision a future society for oneself and others, and to try to voluntarily and continually acquire information on various knowledge and skills related to the ocean, and on a variety of economic activities and careers performed at sea.</p>



### 3) Contents

Area of learning	Target of learning	Study matters	Study items	Explanation of study items	Keywords
	The people, things and facts that students will investigate to strengthen connections	Items shown analytically and in further depth for students to learn based on connections with individual targets of learning	Detailed targets of learning	Explanation of study items	Important words and phrases for learning of study items
A L i f e s t y l e s · h e a l t h a n d s a f e t y	Things related to everyday life and involving the ocean, such as food, clothing and shelter, health, safety and disaster prevention, etc.	Relationship between our daily lives and mental and physical health and the bounty of the oceans	Marine products	To come to know seafood products and commodities and to think about the relationship of these to the producing area and the importance of these to everyday life.	Marine seafoods, processed sea foods, fishing industry, fishermen, specialty products, biological material, protein source, preserved foods, traditional foods, local production for local consumption
			Maritime transport	To come to know use of the ocean for maritime transport such as for the transport of food, resources and energy, as well as the distinguishing characteristics and importance of this use.	Maritime transport industry, maritime transportation, sea route, control, navigation aid, marine chart, harbour, remote island sea route, school boat
			Comfort	To come to know the comfort of interacting with the ocean and issues faced by modern society.	Scenery, whistling sand, water park, strong south winds in spring, thalassotherapy, dolphin therapy, regarding the seashore as dangerous, turning away from fish, scenery degradation, coastal erosion, aging and depopulation in fishing villages, community revitalisation of fishing ports and fishing villages
		Danger of accidents at sea and the importance of countermeasures	Accidents	To come to know about shipwrecks and grounding accidents, and accidents during swimming at sea.	Maritime accident, ships run aground, ship fire, whale collision accident, rip current, dangerous life forms
			Emergency preparedness	To come to know rules for safety and accident prevention, as well as response after accidents.	Maritime rescue, maritime rescue unit, maritime disaster prevention training, coast guard, 118 emergency number, Umizaru, risk management, swimming clothed, life jacket, maritime weather forecast
		The threat of tsunamis and storm tide disasters and the importance of countermeasures and community building	Disasters	To come to know about storm tides and tsunamis, coastal erosion and ocean-related disasters.	High tide, high waves, tsunamis, coastal erosion, chopping waves, typhoon, heavy rain, flood
			Disaster preparedness	To come to know how to prepare for disasters and how to respond after disasters.	Embankment/breakwater/shore protection, wave dissipation blocks, risk quantification, hazard map, water damage simulation system, tsunami and high tide reporting network, earthquake prediction, ocean-going experience for emergency use, disaster mutual aid agreement, reconstruction assistance, volunteer
The importance of and issues related to public awareness campaigns for the general public and foundational	Education	To learn about the present state of ocean education and think about the need for initiatives in the future.	Ocean education, periods for integrated study, nature experience learning, Jack T. Moyer, community-based learning materials, Marine Day, museum, regarding the seashore as dangerous, turning away from fish		
B · T o u r i s m · l e i s u r e a n d s p o r t s	Use of leisure time and sports related to the ocean, etc.	Types and attraction of tourism, leisure and sports at the ocean, and related industries	Sports	To come to know the types of marine sports, rules and use of equipment, and also to feel the attraction to these sports through actual experience.	Snorkeling, scuba diving, long-distance swimming, yachting, sea kayaking, water skiing, wakeboarding, surfing, body boarding, wind surfing, beach volleyball, triathlon, parasailing
			Leisure	To come to know a variety of play and leisure facilities of the ocean, and to feel the fun and wonder of the ocean.	Swimming in the ocean, playing in sand, playing on rocky beaches, shell gathering at low tide, beach seine, sudate fishing, fishing, cruise ship, motor boat, water craft, fish arena, sea stations, sand steam bath
			Tourism	To research a tourist area facing the ocean, and to come to know the beauty of the ocean and the diversity of seaside towns in Japan through actually visiting them.	Ocean-related world heritage sites (Shiretoko, Yakushima, Ogasawara), coral reef, Three Views of Japan, Ine boat house, whale watching, aquarium
		Initiatives and issues in coordination of use for the enjoyment of marine leisure activities	Problems	To come to know that changes in ocean surface use due to diversification of marine leisure has caused problems, such as various conflicts of interest and an increase in accidents.	Noise, exhaust gas, abandoned boat, reckless driving, off-road vehicles, beach vegetation, divers and the fishing industry, sport fishing boats and the fishing industry
			Solutions	To pay attention to ocean surface use other than for leisure, and come to know initiatives in coordination of complicated interests surrounding the ocean.	Switch to four cycle engine, FRP scrapped vessel disposal technology, public marina development, car restrictions for beaches, diving fishing fee, fishing port utilisation adjustment project
		Initiatives related to education for the enjoyment of safe marine leisure activities and laws and frameworks related to use of leisure time	Initiatives	To study the dangers of marine leisure, think about ways and measures to safely enjoy marine leisure, and to put them into practice.	Water safety Japan, Umimori (ocean protection group), leisure white papers
			Laws	To study the rules to safely enjoy marine leisure and other related laws.	Boat license, water craft license, comprehensive resort areas development law (resort law), harvesting sea creatures and relevant laws
Frameworks	To study about social frameworks aimed at popularisation of safe marine leisure, and to understand significance and issues.		Maritime rescue unit, life-saving, Japanese Red Cross, water safety act, Blue Feather Fund, B&G Foundation, Japan Marine Recreation Association		



Area of learning	Target of learning	Study matters	Study items	Explanation of study items	Keywords
C · C u l t u r e a n d a r t	Music, art, literature, traditional handicrafts and folklore and cultural assets related to the ocean, etc.	Art and music with the ocean as its subject and the wonder of this artistic expression	Music	To come to know songs about ocean scenery and music about the ocean.	Singing, We are Children of the Sea, Southern All Stars, TUBE, Ichiro Toba, THE BOOM
			Art	To come to know about paintings of the ocean and art related to the ocean.	Ukiyoe, Hokusai Katsushika, Hiroshige Utagawa, modern art and the Seto Inland Sea
		Practices of old and the characteristics and oral tradition of customs, including religious ones, food culture and tangible and intangible cultural assets	Folk customs	To come to know ocean-related legends, practices and customs.	Lady Otohime, Urashima Taro, Mazu goddess, monstrous being, folk tale, religious belief, myth, Okinawan culture, Umisachihiko and Yamasachihiko, Ebisu faith
			Food culture	To come to know ocean-related food culture, such as traditional marine food products.	Salt pan, Edo-style, eel, memorial monument, shio no michi/konbu no michi (salt/kelp paths), mackerel street/yellowtail street, tub-turned boat, female and male divers, house boats
			Performing arts	To come to know plays set at the ocean and ocean-related performing arts.	Noh, Kabuki, puppet theatre, hula dance
			Handicrafts	To come to know ocean-related handicrafts, such as those that use materials from the ocean.	Traditional handicraft, tortoiseshell, coral, pearl, Japanese-style ship, shipwright, utase boat, skill succession, beach combing, sand craft, shell craft
			Cultural assets	To come to know tangible and intangible cultural assets, such as underwater heritage.	Marine cultural assets, world natural heritage, ocean floor heritage/underwater cultural heritage, ocean floor heritage database, underwater archaeology, Itsukushima Shrine, Silk Road of the sea, Daruma Daishi monk, Shiwaku culture, Seto inland water transport, sunken ship
			The interest of ocean-related literature and film	Literature	To come to know ocean-related literature, such as novels set at sea.
		Popular culture		To come to know ocean-related films, manga and documentaries.	The Silent World, Blue Planet, Oceans, Titanic, Jane Inamura, Point Break, Le Grand Bleu, Umizaru
		D · H i s t o r y	Past events, wars, natural disasters, accidents and historical turning points related to the oceans and development in coastal regions, etc.	The history of the progression of human beings into the oceans and their efforts	World's progression in the oceans
Japan's progression in the oceans	To come to know about Japan's progression in the world following the closed nation policy and opening of the country that originated in trade with the continent of old.				Ancient trade, Jomon transport, dugout canoe, envoy to Sui dynasty China, envoy to Tang Dynasty China, Ennin, Japanese pirates and naval forces, Francisco de Xavier, Tensho young envoys to Europe, shogun-licensed trading/shogun-licensed trading ships, higaki and taru cargo vessels, Daikokuya Kodayu, Wakamiya-maru, kitamaebune cargo ships, Tadataka Ino, John Mung, Ryuma Sakamoto, Joseph Heco
Conflict such as wars that happened at sea, historical turning points and their historical backgrounds	World wars and incidents		To come to know the history of battles fought at sea.	Treaty of Tordesillas, Treaty of Saragossa, The Battle of Trafalgar, Battle of Tsushima, Pacific War, Battle of Midway, Spratly Islands issue, cod wars	
	Japan's wars and incidents		To come to learn about battles in Japan and overseas that occurred at sea and incidents significant to Japan	Setouchi naval forces, ban on piracy, Imjin War, shogunate naval governor/Keizo Yatabori, national isolation and the opening of the country, black ships, Ertugrul shipwreck, Ehime-maru incident, Tajima incident	
Catastrophic natural disasters and large scale accidents that happened at sea	World disasters		To come to know ocean-related major disasters and accidents that occurred outside Japan.	Sinking of Titanic, Torrey Canyon disaster, Sumatra earthquake and tsunami, hurricane Katrina	
	Japan's disasters		To come to know ocean-related major disasters and accidents that occurred in Japan.	Sanriku earthquake, Meiji-sanriku earthquake, Toya-maru accident, Ise Bay typhoon, Hokkaido Okushiri tsunami, Nakhodka incident, Great East Japan earthquake	



Area of learning	Target of learning	Study matters	Study items	Explanation of study items	Keywords
E · E a r t h  a n d  o c e a n s	Physics, earth science and geography related to the ocean	Mechanisms of the ocean and ocean currents and the relationships between climate, weather and human lifestyles	Cycles	To study about water that travels from ocean to forests and rivers and back to the ocean again, or the circulation of moving substances that accompany this water.	Stable isotope, carbon stable isotope ratio (12C/13C), nitrogen stable isotope ratio (14N/15N), fulvic acid iron, detritus food chain, smolting fish, fish ascent
			Climate	To study the mechanisms of the ocean and ocean currents and the special qualities of sea water, and to understand that the existence of the ocean is closely related to weather.	Kuroshio current, Oyashio current, various currents such as the equatorial current, Kuroshio meander, Coriolis, wind driven circulation, seasonal winds, pressure gradient, water temperature (saline) distribution, water temperature (saline) thermocline, oceanic climate, inland climate, climate change, climatic change, surface current, deep circulation, deep ocean general circulation
			Weather	To study various weather phenomena in the ocean and understand the interrelationships between the ocean and people, such as are related to fisheries and ship navigation.	Westerlies, trade wind, ocean waves, hurricane, typhoon, monsoon, tropical cyclone, El Nino, La Nina, Indian Ocean Dipole, hydrographic conditions
		The diversity of ocean floor geographical formations and types of sediment, and the formation processes and dynamism of the history of the earth	Geographical features	To study the structure of basic ocean floor geographical formations, such as seamounts, the continental shelf and ocean trenches, and to comprehensively understand the origin of and changes in topography.	Continental shelf, continental shelf slope, continental rise, seamount, seamount chain, submarine canyon, ocean trench, ocean basin, sea knoll, mid-ocean ridge, trough, back-arc basin, island arc, hot spot, guyot
			Earth's crust	To study the movement pattern of plates formed at the mid-oceanic ridge as they are swallowed into ocean trenches, and to understand the dynamic aspects of the earth's interior.	Pacific plate, Philippine Sea plate, North American plate, Eurasian plate, mantle convection, divergent boundary, convergent boundary
			Sediment	To study about the production, transport and deposition of ocean sediment, and to understand the cycle of substances in the ocean.	Clay, silt, mud, sand, stones, foraminifer, coccolith, carbonate, radiolarian, diatom, silicate, turbidite, submarine fan, white cliff
			History of the earth	To take a general view of 4.6 billion years of the earth's history and to understand the role of the ocean in this history.	Glacial period, inter-glacial period, Milankovitch cycle, Wilson cycle, Tethys Sea, snowball earth, Cambrian period, Permian period, origin of life
			Geography	To become familiar with representative ocean areas, gulfs, straits and peninsulas, both domestically and overseas, and to acquire a special and distance-oriented perception of natural and social conditions.	Pacific Ocean, Sea of Japan, Yellow Sea, East China Sea, Sea of Okhotsk, Bay of Bengal, Gulf of Mexico, Persian Gulf, Gulf of Guinea, Malacca Strait, Drake Passage, Bering Strait, Tsugaru Peninsula, Kii Peninsula, Shiretoko Peninsula, Osumi Peninsula, Ashizuri Cape
			Observation methods and prediction methods to study the physical processes of the oceans	Observation	To study representative methods of observation to get to know the dynamism of the earth and oceans, and to think about the role of marine science in the past and future.
		Forecasting		To take a general view of prediction technology for changes in the earth and oceans, and to come to know the frontline of marine science.	Ocean circulation model, ecosystem model, earth simulator
F · M a t e r i a l s	Scientific characteristics of the ocean, such as components and chemical composition of sea water, the ocean floor and the atmosphere	Sea water	To study about substances contained in sea water and their distribution, as well as the mechanisms of chemical changes such as photosynthesis and eutrophication.	Water, fluid, surface water, deep water, organism, salt, saline concentration, nutrient salt (nitrate, phosphate, silicate), dissolved matter in sea water (sodium chloride, magnesium chloride, etc.), bromine, iodine, aluminum, photosynthesis, eutrophication	
		Ocean floor	To study the distinguishing characteristics of crustal material and chemical components of the ocean floor, and chemical changes taking place near cold seeps and hydrothermal vents.	Iron, manganese, aluminum, methane gas, rare metals, methane hydrate, oceanic ridge, magma, cold seepage, hydrothermal vent	
		Atmosphere	To understand the substances that make up of the atmosphere, chemical composition and chemical changes from the relationship with the oceans.	Nitrogen, oxygen, carbon dioxide, aerosol, precipitation, dustfall, nitrogen oxide, sulphur oxide, acid rain	
G · L i f e	The life forms and ecosystems of the ocean, etc.	Classification	To study basic classification systems of life forms, and to come to know that the majority of organism groups exist in the ocean and the marine life forms that represent each classification group.	Eukaryote, true bacteria, archaeobacteria (large domain), sponge, cnidarian, mollusk, annelid, arthropod, vertebrate (phylum), crustacean, bivalve, gastropod, cartilaginous fish, bony fish, calyptogena, tubeworm, coral, dugong, horseshoe crab, minke whale, eelgrass, sargassum, arame, ecklonia cava	
		Ecology	To study the diverse ecosystems of marine life forms and to come to know classification methods based on ecosystems and representative species.	Benthic organism (benthos), plankton, nekton, neuston, nanobenthos, meiobenthos, macrobenthos, megabenthos (plankton too), sessile species, mobile species, herbivorous, carnivorous, omnivorous, filtration-eating, detritus-eating, producer, consumer, decomposer	
	The diversity and wonder of ecosystems, including marine life forms	Ecosystems	To study the diversity of marine ecosystems, such as tidal flats, seaweed beds, the open sea and deep sea, and to understand the functions and connections of these ecosystems.	Foreshore tidal flat, estuary tidal flat, sand tidal flat, mud tidal flat, seaweed bed, algae bed, rockyshore, sea tide, sargassum bed, sand and mud zones, HCLN sea area, upwelling area, hydrothermal area, abyssal plain, seamount	



Area of learning	Target of learning	Study matters	Study items	Explanation of study items	Keywords
H · E n v i r o n m e n t	Issues related to the marine environment and required activities	Changes in the marine environment that occur on a global scale and the impacts on human activity that accompany them, as well as foundational concepts and the importance of initiatives toward problem-solving and conservation	Ocean warming	To come to know the impacts of climate change due to warming of the oceans and alleviation of rising temperatures on land due to heat absorption of the oceans.	Global environmental change, global warming, climate change, ocean temperature rise, carbon-free societies, underwater CO2 sequestration
			Rising sea level	To understand the causes of the rising ocean surface, such as the melting of ice and expansion of sea water due to global warming. Further, to study about impacts, such as diminishing land and damages from storm tides and tsunamis.	Rising sea level, sea ice melting, damages from tsunamis/high tides/high waves, small island nations, inundated land, height above sea level, groundwater flooding, diminishing arctic ice
			Ocean acidification	To study the mechanisms of acidification of the oceans due to increase of carbon dioxide concentrations and to understand the impact on marine life forms.	Global warming, rising carbon dioxide concentration, calcium carbonate, phytoplankton, loss of coral reefs, biomineralisation, foraminifer, shellfish
			Diminishing biodiversity	To understand the distinguishing characteristics of marine biodiversity and related functions and mechanisms, and the reasons behind diminishing biodiversity, such as overfishing, pollution and changes in the environment, and to study about initiatives in Japan and abroad to preserve biodiversity.	Ecosystem service, diminishing tidal flats and coral reefs, marine sanctuary, biodiversity conservation strategy, exotic life forms, endangered species, laws related to the preservation and management of living marine resources
			Diminishing arctic sea ice	To understand the reasons for diminishing arctic sea ice, such as global warming, as well as impacts on climate change, and to study the impacts on politics and the economy, such as development of new sea routes and development of undersea resources.	Global warming, albedo variation, acceleration of warming, arctic passage, seabed resources, ice algae
			Marine pollution caused by ships	To study about environmental pollutants that originate from navigation of ships, such as oil, exhaust gas and ballast water.	Toxic liquid substance, ballast water, ocean dumping, exhaust gas, TBT (organotin), FRP boats, ship scrapping, asbestos, ship-fouling organism, ballast water management system, International Convention for the Control and Management of Ships' Ballast Water and Sediments
		Changes in the marine environment that occur transnationally and the impacts on human activity that accompany them, as well as foundational concepts and the importance of initiatives toward problem-solving and conservation	Marine waste	To study about the types of marine waste and emitters, as well as impacts on the oceans.	Waste of the fisheries industry, medical waste, radioactive waste, illegal dumping, damage to fisheries
			Floating refuse and refuse washed ashore	To understand the characteristics of floating refuse and refuse washed ashore, damage to life forms and impacts on environmental pollution levels, as well as initiatives such as coastal clean-ups and specification of emitters.	Illegal dumping, styrofoam, plastic, fishnets, lighters, cigarettes and medical waste, municipal management, clean-ups
		Changes in the marine environment that occur locally and the impacts on human activity that accompany them, as well as foundational concepts and the importance of initiatives toward problem-solving and conservation	Mass collection of sea sand	To comprehend the history and present state of mass collection of sea sand, understand the impacts on marine resources and the natural environment, and study about initiatives toward solutions.	Construction aggregate, land reclamation, Seto Inland Sea, water depth change, sand attachment to seaweeds, ban on collection of beach gravel, dredging of sea basins
			Changes in coastlines	To study about changes in the coastlines, including natural causes like waves and tides, as well as artificial causes such as land reclamation and harbor development, and to understand impacts.	Land reclamation, gulf development, erosion, artificial shore protection, diminishing seaweed beds and tidal flats, estuary weir, diminishing sediment supply, diminishing sandy beaches, tidal current change, coasts in harmony with nature
			Regeneration of seaweed beds and tidal flats	To understand the function of seaweed beds and tidal flats and to study the reasons for diminishing seaweed beds and tidal flats, such as land reclamation, and to learn about initiatives in regeneration.	Seaweed beds, tidal flats, submarine forest, spawning, water purification, land reclamation, shell gathering at low tide, tidal flat reclamation, Zostera bed reclamation, sargassum regeneration, wakame cultivation, red soil runoff prevention measures, forestation activities, fish shelter forest, protected water surfaces
			Red tides and blue tides	To understand the causes of red tides and blue tides, such as household and factory wastewater, and to study about the distinguishing characteristics and impacts of each.	Domestic wastewater, agricultural wastewater, industrial wastewater, waste oil, phytoplankton outbreaks, anoxic water mass, sulphur, polysulfide ions, shellfish poison, HAB (toxic algal bloom), eutrophication, closed water areas, nutrient salt, wastewater regulation, sewage treatment, water purification
			Stranding	To understand the meaning of stranding, and to understand countermeasures, treatment methods and the responsibility of local governments.	Dolphin, whale, stranding, drifting ashore, mass stranding, straying into rivers, surviving population, municipal treatment, surfer, volunteer
			Coastal zone pollution	To understand that land is the main source of pollutants and impacts on sea water, marine life forms and marine ecosystems.	Dioxin, PCB, heavy metals, nutrient salt, plastic, ecological concentration
			Oil spill issues	To study the impacts on marine ecosystems of oil spills, responses, and major oil spills of the past.	Oil spills, response period, response methods, response costs, running aground of Exxon Valdez, Nakhodka oil spill, Gulf of Mexico oil spill, Philippine oil spill, Gulf War, oil ball, creation of international regime, double hull tanker



Area of learning	Target of learning	Study matters	Study items	Explanation of study items	Keywords
I . R e s o u r c e s a n d e n e r g y	Marine product resources, mineral resources and energy related to the ocean and their uses	Methods to obtain marine life forms and management methods	Life forms	To study about methods of utilisation of marine living resources and representative target species, and to think about initiatives for sustainable development and coordination of interests.	Resource management fisheries, adaptive management, highly migratory species, mariculture, developing fisheries, make-and-raise fisheries, dragnet fishing, trawl, longline fishing, drift net fishing, gill net fishing, fixed net, floating offshore reefs, IUU fishing, TAC system, overfishing, ghost fishing, by-catch, fish dumping, fisheries regulation, closed season for fishing, no-fishing zone, fishing method regulation, size regulation
		Marine minerals and methods to develop them, industries and frameworks	Minerals	To comprehensively study marine mineral resources and the important issues involved in their development. To think about coordination of interests and international cooperation.	Manganese nodule, manganese crust, seafloor hydrothermal deposit, black ore seafloor hydrothermal deposit, rare metals, rare earths, copper, platinum, mining, ore dressing, retrieving ore, smelting, Okinawa Trough, Izena, Iheya, Myojin knoll, Suioy seamount
		Marine energy and methods to develop it, and industries	Energy	To study renewable energies and non-renewable energies that can be obtained at sea and to think about future issues, sustainable development and coordination of interests.	Offshore wind power generation, tidal current (ocean current) power generation, tidal power generation, Rance Tidal Power Station, OTEC (ocean thermal energy conversion), Uehara cycle, natural gas, submarine oil field, methane hydrate, oil spill
		Domestic and international frameworks for development of the ocean and its bounty in harmony with the environment	General	To study in general about marine resources and to understand the issues, initiatives, institutions, and international and domestic frameworks involved.	FAO, International Seabed Authority, IWC, International Maritime Organisation, Organisation for Economic Cooperation and Development, International Energy Agency, International Institute for Mining Technology, Japan Oil, Gas and Metals National Corporation, Japan Agency for Marine-Earth Science and Technology, National Institute of Advanced Industrial Science and Technology, New Energy and Industrial Technology Development Organisation, Research Consortium for Methane Hydrate Resources
J . E c o n o m i c a n d i n d u s t r y	Economic activities utilising the ocean, including shipbuilding, use of the sea surface, marine transport, and offshore structures	Distinguishing characteristics of the marine products industry, the issues of overfishing and depopulation of fishing villages and remote islands, and the efforts of people	Representative fishing methods	To study about the form and fishing methods of fisheries and to understand the history of marine product technology development and changes in the marine product industry.	Coastal fisheries, deep sea fisheries, offshore fisheries, aquaculture, roundhaul net fisheries, dragnet fisheries, longline fisheries, mariculture, whaling, fish finders
			Issues	To research the causes of diminishing marine resources and the declining marine products industry, and to think about the nature of a future sustainable marine products industry.	Overfishing, by-catch, immature fish fishing, illegal/unreported/unregulated fisheries (IUU fisheries), marine products distribution, sluggish fish prices, resource management, maximum sustainable yield, no-fishing zones, highly migratory fish species, sea surface farming and water pollution, sea cucumber battles, depopulation of fishing villages, aging fishing villages, fisheries compensation
		Distinguishing characteristics of the marine transport industry, its connection to daily life and related issues	Types of ships	To come to know various types of ships used for various purposes.	Fishing boat, passenger boat, ferry, container ship, car carrier, LPG ship, ore carrier, tanker, research vessel, deep earth exploration ship, tug boat, training ship, yacht, pleasure boat, sightseeing boat, Japanese pleasure boat
			Structure and issues of coastal shipping	To come to know the importance of ship transport in domestic distribution and the problems facing coastal shipping, such as reducing numbers of sailors and cabotage, and to think about the nature of future distribution.	Hull adjustment, scrap and build policy, aging and decreasing number of sailors, modal shift, shared building system, cabotage, coastal shipping temporary measures
			Structure and issues of open sea shipping	To come to know the present state of intense international competition and structural issues such as flag-of-convenience ships and reduced numbers of Japanese sailors, and to think about the future of Japan's commercial fleet that supports our lives.	Freedom of the sea principle, flag-of-convenience ship, substandard ship, port state control, sea route, Panama Suez Canal, shipping conference, cargo sharing, standard tonnage tax, Japanese merchant fleet, AIS, piracy, Strait of Malacca, reduced number of Japanese sailors, quality shipping, maritime cluster
		Distinguishing characteristics of the shipbuilding industry, ship technology and related issues	Shipbuilding industry	To research the history of shipbuilding and the processes of development, to come to know the differences with other industries and distinguishing characteristics, and to think about the future shipbuilding industry.	Shipyard, dock, goliath crane, assembly industry, labour intensive industry, shipboard industry, class of ship, mega-float, launching ceremony, welding
			Environmental technology	To research the impacts of ship navigation on the global environment, and to come to know the international regulations and technological development taking place to prevent these impacts.	Super eco-ship, non-ballast ship, ship recycling, FRR disposal, ship bottom paint
		Knowledge in engineering and civil engineering applied to ocean development and its uses	Harbor technology	To research the types and functions of harbors, and to come to know their development and maintenance and operation, as well as initiatives taking place in environmental measures.	Designated major port, regional port, hub port, port and harbor law, sea coast law, coastal engineering, breakwater, shore protection
			Ocean civil engineering	To research marine and coastal development and the history of coastal protection, to come to know various marine civil engineering technologies developed to present, and to understand the impacts on the surrounding environment.	Coastal erosion, artificial beach nourishment, sand bypass, headland, coastal conservation basic plan, tetrapod, platform, undersea tunnel, bridges, submarine pipeline, submarine cable
			Offshore development	To research offshore development and to understand various methods of use, such as offshore power generation and ocean fertilisation technology based on artificial spring tides of deep ocean water.	Offshore wind power generation, wave power generation, ocean thermal energy conversion, offshore LNG terminal, ocean tsunami measurement, artificial spring tide, ocean fertilisation, deep ocean water
			Conflicts of interest	To research conflicts of interest between the natural environment and industry involving development of the ocean, and to come to know initiatives toward solutions.	Marine products and tourism, energy development, port and harbor development and conservation, mine leisure industry, cruise industry



Area of learning	Target of learning	Study matters	Study items	Explanation of study items	Keywords
K · M a n a g e m e n t	Domestic legal systems and mechanisms related to the management necessary for continued maintenance and development of the ocean	The concepts of sustainable development, safety and security, improvement of scientific knowledge, integrated management and international cooperation advocated in the Basic Act on Ocean Policy, and related institutions, management schemes, frameworks, legislation and approaches	Development and use of marine resources	To study about domestic and international legal frameworks, cooperation frameworks and cooperation schemes related to management of marine resource preservation and promotion of development of energy and mineral resources.	Fishing rights, total allowable catch (TAC), total allowable effort (TAE), local sea, petroleum, natural gas, methane hydrate, seafloor hydrothermal deposit, cobalt rich crust
			Preservation of the marine environment	To study about domestic and international legal frameworks, cooperation frameworks and cooperation schemes related to ensuring biodiversity, reducing environmental burdens, and promotion of continued research on marine environment preservation.	Biodiversity national strategy, marine biodiversity conservation strategy, NOWPAP (North-west Pacific Action Plan), ecosystem approach, MPA (marine reserve)
			Exclusive economic zones	To study about smooth promotion of development of exclusive economic zones, promotion of deliberate development of marine resources, research, investigations and the present state of domestic and international agreements.	Maritime areas under national jurisdiction, development/utilisation/conservation, coastal authority, continental shelf extension measures, continental shelf extension research, territorial waters, inland water, closed water areas, marine ledger, territorial sea law, laws concerning exercise of sovereign rights in exclusive economic zones
			Maritime transport	To understand domestic and international initiatives and legal frameworks related to international competition, securing of Japanese ships and Japanese sailors, development and securing of sailors, base maintenance and improvement of quality of open sea navigation.	Ocean-going transport enterprises, Japanese-flagged ship, labour environment of sailors, container shipping, gulf function, base maintenance
			Marine safety	To study cooperation schemes of various countries concerning maintenance of order in nearby ocean areas as well as agreements related to safety of ocean transportation. To understand countermeasures for natural disasters that originate at sea.	Act on Preventing Collisions at Sea, Maritime Traffic Safety Act, Shipping Act, Ship Act, maritime law, piracy, ship collisions, unidentified ship, smuggling ship, armed robbery, sea lane, maritime self-defense force
			Oceanic survey	To study steady implementation of marine research, collection and organisation of foundation information, total management and provision of information, and domestic and international initiatives concerning international cooperation.	Facilities/equipment/analytic technology, sea chart, hazard map, harbor map, fishery zone, nature park zone chart, argo programme, Global Earth Observation System of Systems, IODP (Integrated Ocean Drilling Programme)
			Marine science technology	To study initiatives in foundational research, promotion of mission-oriented research, improvement of research bases and augmentation of partnerships, as related to marine science technology.	Ship, supercomputer, foundational research, mission-oriented research and development, science and technology basic plan, marine science and technology innovation system
			Marine industries and international competitiveness	To study initiatives in augmentation of management bases, creation of new marine industries, and perception of trends as related to international competition in marine industries.	World Trade Organisation (WTO), Economic Partnership Agreement (EPA), joint ownership of ships, grouping of management bodies, stabilisation of marine products, integration and simplification of fisheries law, genetic resources, promotion of new industry
			Integrated management of coastal zones	To study initiatives aimed at problem-solving concerning integral management of land and water areas, coordination of use for coastal areas, and creation of partnerships schemes for cooperation, as related to integrated management of coastal areas.	Comprehensive coastal management, mineral management, integrated management of rivers and oceans, comprehensive management of ocean and land areas, stakeholder, consensus forming
			Preservation of remote islands	To study initiatives aimed at securing ocean safety, development and utilisation of ocean resources, protection of the natural environment and community independent development, as related to protection, management and revitalisation of remote islands.	Support for sea rescue activities, exotic species, management of pollution originating on land, improvement in transportation infrastructure, improvement in gulf coast conservation facilities, construction of communication networks, lifestyles of remote island residents, promotion of industry
			International partnerships and international cooperation	To study formation of order and international partnerships and cooperation for development in the ocean, and the frameworks, monitoring organisations and cooperation programmes of these, and to understand initiatives aimed at various solutions.	Conflict resolution, marine resource management, environmental protection, marine security, marine technology, energy security, anti-terrorist measures, International Convention for the Control and Management of Ships' Ballast Water and Sediments, closed water area measures, anti-titanium measures, disaster prevention/sea rescue support
			Promotion of citizen understanding and human resource development	To understand initiatives aimed at raising citizen awareness, increasing understanding of the next generation, international efforts in human resource development, methods of spreading public awareness, and human resource development.	Marine Day, Marine Month, marine leisure, recreation, eco-tourism, grand design, interdisciplinary ocean education, oceanic state, internship, marine industry high school



Area of learning	Target of learning	Study matters	Study items	Explanation of study items	Keywords
L · I n t e r n a t i o n a l	International initiatives and issues faced in cooperation with other countries of the world concerning the ocean	International issues related to navigation, safety, fisheries, mining and territorial issues, and the frameworks, approaches and initiatives in marine management by international organisations toward their solutions	International issues	To give attention to various problems occurring in the world's oceans, and to understand international initiatives aimed at addressing their backgrounds and providing solutions.	Piracy, IUU fishing, ocean boundary demarcation, innocent passage, rising sea level, marine pollution
			Territory and territorial waters	To understand types of territorial waters and thought on their definitions, as well as the rights and obligations of coastal nations.	Territorial waters, contiguous waters, exclusive economic zone, continental shelf, open sea, inland sea, archipelagic waters, international strait, designated sea area (international strait), base line, international canal, Commission on the Limits of the Continental Shelf
			International frameworks	To come to know that there are various treaties and international agreements related to use and management of oceans.	United Nations Convention on the Law of the Sea (UNCLOS), Agenda 21, IMO treaty (MARPOL treaty, SOLAS treaty, etc.), Convention on Biological Diversity, UN high seas fisheries agreement, responsible fisheries, International Whaling Commission, Washington Convention
			International institutions	To come to know how a variety of international organisations, including the United Nations, play a role in creation and maintenance of order in the world's oceans.	United Nations, International Maritime Organisation (IMO), International Hydrographic Organisation (IHO), UN Food and Agriculture Organisation (FAO), United Nations Environment Programme (UNEP), United Nations Development Programme (UNDP), UNESCO Intergovernmental Oceanographic Commission (IOC), International Whaling Commission (IWC), International Tribunal for the Law of the Sea (ITLOS), Commission on the Limits of the Continental Shelf (CLCS), International Seabed Authority (ISA), International Committee Conservation of Atlantic Tunas (ICCAT)
		Administration of each country related to marine management	Legislation	To research laws and policy related to the oceans of various countries and to understand each country's approach to the ocean and differences in utilisation and management efforts.	Ocean-related laws of each country, basic plan, ocean policy, compliance with international treaties
		Frameworks and schemes for multilateral cooperation	Multilateral issues	To research examples of disputes related to the ocean between neighboring coastal nations, and to think about methods to solve them from multiple perspectives.	Ocean areas of conflict, marine refuse, radioactive contamination, marine naming, territorial issues, sea area under agency supervision, Senkaku Islands, Takeshima, Okinotorishima, Northern Territories, southern bluefin tuna incident
Multilateral frameworks for cooperation	To study about ocean management initiatives based on coastal nation cooperation, and to think about integrated ocean management and multilateral cooperation.		Partnerships in Environmental Management for the Seas of East Asia (PEMSEA), North-west Pacific Action Plan (NOWPAP), management organisation for regional fisheries, Arctic Council, Small Island Developing States (SIDS)		



## 6-2. Proposal for unit plans and lesson plans

Unit name : Natural disasters and the oceans

1. Subject/course  
covered by this unit:

Marine science (school-designated  
course, “Marine science foundations”)

Author: Akira Mizuno

2. Unit objective and aim:

To understand the foundations of natural disasters and preservation of the marine environment, to eagerly investigate these, and to develop an attitude to work to prevent disasters.

3. Corresponding portion of the national curriculum guidelines:

The high school national curriculum guidelines contain a unit on “disaster prevention”, but not on “tsunami”. Therefore, this unit can be covered by the school-designated subject, “marine science”. Provide potential corresponding portions to cover “tsunami ” from the “science” part of the high school national curriculum guidelines.

“ Science and human lifestyles” Content (2) Science in human lifestyles, d. science of space and earth, (b) Observation of nearby nature and natural disasters

“ Earth science foundations” Content (2) The changing earth, d. The global environment

4. Teaching materials central to this unit:

Natural disasters and the oceans are inextricably related. Here, abnormal weather and tsunami should be covered to increase disaster prevention awareness. Abnormal weather should cover severe rain storms, droughts and cool summers. As abnormalities in sea water temperature are one cause, the mechanisms and methods of measurement of El Niño phenomena and the Indian Ocean Dipole, as well as the effect of these phenomena on weather and disasters in various regions of the world, should be studied.

For tsunamis, earthquakes and the mechanisms that generate them, propagation velocity, amplification due to topography, the state of disasters in Japan and the world in recent years, and evacuation methods should be covered to increase disaster prevention awareness.

Further, other natural disaster, such as typhoons and storm tide, should be covered.



#### 5. Competencies to be fostered in this unit (abilities and attitudes)

- The ability to collect appropriate information on the ocean and to comprehensively make decisions [ information collection and decision-making ]
- The ability to solve problems while attempting to coordinate among persons involved in the various issues of the ocean [ problem-solving ]
- The positive attitude to take responsible action on the various issues of the ocean [ autonomy ]
- The attitude to continually learn ocean-related knowledge and skills to be able to respond to changing societies, looking to the future [ continuity ]

#### 6. Contents covered in this unit (knowledge and skills)

- A. Lifestyles, health and safety; tsunamis and storm tides
- E. Earth and oceans; El Nino, the Indian Ocean Dipole, sea water temperature, air-sea interaction, typhoons, waves
- H. Environment; global warming and climate change, rising sea level, rising sea water temperature

#### 7. Points to keep in mind for this unit (distinguishing characteristics of the learning process of this unit, relevance to other subjects, development of learning activities with external cooperation, etc.):

Learning on natural disasters and the oceans will increase disaster prevention awareness. This unit should cover the causes, process of generation, observation methods and circumstances of disasters of abnormal weather and tsunami, as well as ways to protect oneself and disaster preparedness measures. The circumstances of past disasters can be used as concrete examples of the causes, process of generation and observation methods of abnormal weather and tsunami, using audiovisual equipment such as slides or projectors to make concepts easy to visualise and augment understanding.

Furthermore, in order to increase disaster prevention awareness, students should investigate the circumstances of disasters in Japan and the world in recent years, as well as the disaster prevention measures of the communities they live in, using the Internet and books.

In “Science and human lifestyles”, students can gain knowledge on disaster prevention. In “Earth science foundations”, students can gain knowledge on the relationship between the natural environment and human lifestyles, including an understanding of the natural environment, and its benefits and disasters. In “Earth science”, students can gain knowledge on sea water movement and circulation, tides and waves.

Japan Agency for Marine-Earth Science and Technology: <http://www.jamstec.go.jp/j/>

Japan Meteorological Agency: <http://www.jma.go.jp/>



8. Unit teaching plan (total 4 hours)

Hours	Study topic	Main learning activities	Points to keep in mind
2	Abnormal weather	<ul style="list-style-type: none"> <li>• To apprehend the types of abnormal weather and to understand causes, process of generation and observation methods.</li> <li>• To apprehend the circumstances of past disasters and to understand disaster prevention measures.</li> </ul> <p>A . Lifestyles, health and safety E . Earth and oceans H . Environment and cycles</p>	<ul style="list-style-type: none"> <li>• The causes and process of generation of abnormal weather should be explained using graphic representations.</li> <li>• Concrete examples of disasters and observation methods should be explained using audio-visual equipment, such as slides.</li> </ul> <p>[ information collection and decision-making ][ problem-solving ] [ positivity ][ continuity ]</p>
2	Tsunami and disasters <b>Core class</b> <b>hour</b>	<ul style="list-style-type: none"> <li>• To investigate the circumstances of disasters in Japan and the world, as well as the disaster prevention measures of one 's community, using the Internet and books.</li> <li>• To understand earthquakes and the process of generation of tsunami, propagation velocity and amplification due to topography.</li> </ul> <p>A . Lifestyles, health and safety E . Earth and oceans</p>	<ul style="list-style-type: none"> <li>• Students should investigate the circumstances of disasters in Japan and the world, as well as the disaster prevention measures of one 's community, using the Internet and books.</li> <li>• Earthquakes and the process of generation of tsunami, propagation velocity and amplification due to topography should be explained using graphic representations.</li> </ul> <p>[ information collection and decision-making ][ problem-solving ] [ positivity ][ continuity ]</p>



## 9. Lesson development plan

### 9-1. Content and aim of core class hour (4/4 hours):

To come to know the circumstances of tsunami-related disasters and the process of generation of tsunami, and to foster the attitude to eagerly work to prevent disasters.

### 9-2. Teaching plan of core class hour:

	Learning activities/content	Instruction	Assessment/points to note
Introduction (10 minutes)	<ul style="list-style-type: none"> <li>Recall Internet research in previous classes on the circumstances of tsunami disasters in Japan and the world.</li> </ul>	<ul style="list-style-type: none"> <li>Have a few students present on Internet research of previous classes on the circumstances of tsunami disasters in Japan and the world.</li> </ul>	<ul style="list-style-type: none"> <li>Are students actively engaged in presentations?</li> </ul>
Development (30 minutes)	<ul style="list-style-type: none"> <li>Think about regions with many tsunami disasters and their characteristics.</li> <li>Apprehend the mechanisms of ocean trench earthquakes.</li> <li>Apprehend the process of generation of earthquakes and tsunami and propagation velocity.</li> <li>Think about the fact that the size of tsunami changes according to geographical features.</li> <li>Apprehend that the size of a tsunami is amplified by geographical features.</li> <li>Recall the disaster prevention measures of the community researched in previous classes.</li> <li>Apprehend tsunami evacuation methods.</li> </ul>	<ul style="list-style-type: none"> <li>Ask questions about regions with many tsunami disasters and their characteristics to facilitate thinking.</li> <li>Facilitate understanding on the mechanisms of ocean trench earthquakes by making illustrations.</li> <li>Explain the process of generation of earthquakes and tsunami and propagation velocity through illustrations.</li> <li>To facilitate thinking on the fact that tsunami change size according to geographical features.</li> <li>Facilitate understanding using illustrations on the fact that the size of a tsunami is amplified by geographical features.</li> <li>Have a few students present on the disaster prevention measures of the community researched in previous classes.</li> <li>Facilitate understanding on tsunami evacuation methods.</li> </ul>	<ul style="list-style-type: none"> <li>Concrete examples of the causes, process of generation and observation methods of abnormal weather and tsunami should be provided by showing the circumstances of past disasters utilising audio-visual equipment such as slides or projectors.</li> <li>Do students understand the regions with many tsunami disasters, the mechanisms of generation of ocean trench earthquakes, the process of generation of tsunami, propagation velocity, amplification of tsunami due to geographical features, and tsunami evacuation methods?</li> </ul>
Wrap-up (10 minutes)	<ul style="list-style-type: none"> <li>Review tsunami disasters and understand disaster prevention measures.</li> </ul>	<ul style="list-style-type: none"> <li>Review tsunami disasters and facilitate understanding on disaster prevention measures.</li> </ul>	<ul style="list-style-type: none"> <li>Are students actively attempting to engage in disaster prevention measures?</li> </ul>



## Unit name : Human activities and marine pollution

1. Subject/course  
covered by this unit:

Contemporary society

Author: Eri Ota

2. Unit objective and aim:

To come to know the relationships between the present state of marine pollution and the lives of human beings through inquiry into the connections between marine pollution and people within global environmental issues, and to think about improvement measures, as well as attempt to continually protect the abundant marine environment.

3. Corresponding portion of the national curriculum guidelines:

Content (1) Our challenges in modern living  
Treatment of content (b) Global environmental issues

4. Teaching materials central to this unit:

Marine pollution is recognised as one of nine environmental issues, which include (1) global warming, (2) ozone layer depletion, (3) diminishing tropical forests, (4) pollution in developing countries, (5) acid rain, (6) desertification, (7) diminishing biodiversity, (8) marine pollution, and (9) transboundary movement of toxic waste. The causes of marine pollution are inextricably linked to socio-economic activities. Not only is the influence of these activities widespread and long-term, but also highly relevant to other global environmental issues. Students should comprehend the present state of pollution, understand the interrelationships between marine pollution and human activities, recognise the present state of both domestic and overseas initiatives and measures for marine preservation, and think about issues that require action on the part of individuals and society.



## 5. Competencies to be fostered in this unit (abilities and attitudes)

- The ability to collect appropriate information on the ocean and to comprehensively make decisions [ information collection and decision-making ]
- The attitude to respect the connections between time and space with the ocean in mind [ relationships ]
- The ability to understand others and express oneself in order to engage in smooth communication with others at various settings of the ocean [ dialogue ]
- The ability to solve problems while attempting to coordinate among persons involved in the various issues of the ocean [ problem-solving ]
- The positive attitude to take responsible action on the various issues of the ocean [ autonomy ]
- The attitude to continually learn ocean-related knowledge and skills to be able to respond to changing societies, looking to the future [ continuity ]

## 6. Contents covered in this unit (knowledge and skills)

- E. Earth and oceans; oceanic general circulation, air-sea interaction
- H. Environment; ocean refuse, oil spills, domestic wastewater and eutrophication, Minamata disease, environmental ethics
- I. Resources and energy; off-shore oil fields, mineral resources
- J. Economy and industry; marine transport industry, cruise industry, marine leisure industry economy and environmental problems
- L. International; International Convention on the Law of the Sea, local marine management initiatives, earth summit, world summit on sustainable development, International Maritime Organisation, environmental policy

## 7. Points to keep in mind for this unit (distinguishing characteristics of the learning process of this unit, relevance to other subjects, development of learning activities with external cooperation, etc.):

In this unit, students will study the topic of marine pollution to learn about the interrelationships of global environmental issues and the connections between human activities and the natural environment. For this reason, concrete examples of the present state of problems, causes and results, impacts and measures for improvement, such as current events and links to everyday life, should be used to facilitate understanding on the relevance of one's life to marine pollution and concrete action to solve problems. Use of video materials and pictures will give a more vivid impression, and teachers should aim to develop the ability to solve problems within relationships with others through group work.

Further, students can gain detailed information on marine pollutants in chemistry classes, learn about domestic and overseas initiatives in political economy classes, and come to understand impacts on biodiversity in biology class, and so on. Instruction with awareness of the relevance of this unit to other subjects and courses will contribute to learning activities that allow students to grasp the big picture of marine pollution issues.

Act Pertaining to the Prevention of Marine Pollution and Maritime Disaster:

<http://law.e-gov.go.jp/htmlldata/S45/S45H0136.html>

History of the establishment of the act:

[http://www.mlit.go.jp/sogoseisaku/ocean\\_policy/sosei\\_ocean\\_tk\\_000004.html](http://www.mlit.go.jp/sogoseisaku/ocean_policy/sosei_ocean_tk_000004.html)

Kanagawa Coastal Environmental Foundation (<http://bikazaidan.main.jp/>)

The above can be used to introduce local beach clean-up initiatives.



## 8. Unit teaching plan (total 7 hours)

Hours	Study topic	Main learning activities	Points to keep in mind
1	What are global environmental issues?	<ul style="list-style-type: none"> <li>• Prompt students to speak about what types of global environmental issues exist.</li> <li>• Explain the nine major global environmental issues.</li> </ul> <p>H. Environment and cycles</p>	<ul style="list-style-type: none"> <li>• Students should understand each individual global environmental issue and the interrelationships among them [ information collection and decision-making ]</li> <li>• Environmental white papers should be cited.</li> </ul>
1	Getting to know the present state of marine pollution	<ul style="list-style-type: none"> <li>• Demonstrate pollution from oil, hazardous substances and toxic substances.</li> <li>• Demonstrate damages from floating refuse or refuse washed ashore.</li> <li>• Human beings have for a long time treated the expansive ocean as a disposal site for unwanted things. Explain the background of marine pollution that has resulted in the occurrence of various marine pollution problems today. H. Environment and cycles</li> </ul>	<ul style="list-style-type: none"> <li>• Students should have a comprehensive understanding of the causes of marine pollution. [ information collection and decision-making ]</li> <li>• Audiovisual materials, such as video and photos, should be used to make an impact on students.</li> </ul>
2	Considering the causes and impacts of marine pollution	<p>To think about the causes of marine pollution:</p> <ul style="list-style-type: none"> <li>• Prompt students to speak about the kinds of causes of marine pollution. E. Earth and oceans H. Environment and cycles ; I. Resources and energy; J. Economy and industry</li> </ul> <p>Reference: pollution from land (factory wastewater, domestic wastewater); exploration for seabed resources; coastal development; runoff of pollutants; waste disposal; pollution from ships; pollution via the atmosphere; tanker accidents; war</p> <p>To think about the impacts of marine pollution:</p> <ul style="list-style-type: none"> <li>• Prompt students to speak about the kinds of impacts that result from marine pollution. H. Environment and cycles</li> </ul> <p>Reference: deterioration of water quality; loss of biodiversity; damages to health; damages to fishing industry</p>	<ul style="list-style-type: none"> <li>• Students should understand the interrelationships between human activities and the causes and impacts of marine pollution. [ relationships ]</li> <li>• UN Convention on the Law of the Sea should be cited.</li> <li>• Students should be encouraged to observe articles washed ashore at a nearby shore.</li> <li>• The songs of Tousei Shimazaki are a good example to use.</li> <li>• The film Message in a Bottle is a good example to use.</li> <li>• Damages from tankers in recent years (Gulf of Mexico oil spill, Exxon Valdez oil spill) should be used as examples.</li> </ul>
1	Discussing marine pollution and our lifestyles	<p><b>Core class hour</b> Students should discuss the interrelationships between marine pollution and their own lifestyles in groups and indicate solutions to problems. H. Environment and cycles</p>	<ul style="list-style-type: none"> <li>• Students should understand the mechanisms involved in the connections between their daily lives and the causes and results of marine pollution. [ dialogue ]</li> <li>• Students should discuss what efforts they can make to address marine pollution. [ problem-solving ]</li> <li>• Familiar problems should be used as examples to foster a sense of ownership of marine pollution problems.</li> </ul>
2	Organising our ideas on improving marine pollution	<ul style="list-style-type: none"> <li>• Prompt students to share content discussed in groups and to speak about what they can do.</li> <li>• Provide a summary of domestic and overseas laws (International Convention on the Law of the Sea, London Convention, Marine Pollution Prevention Law, etc.), and prompt setting of future research topics. L. International</li> </ul>	<ul style="list-style-type: none"> <li>• Students should be encouraged to put problem-solving efforts into practice based on content discussed in the last class session. [ positivity ]</li> <li>• A micro and macro perspective on marine pollution and lifestyles should be fostered so that students are able to apply the awareness and knowledge gained in class in their everyday lives. [ continuity ]</li> </ul>



## 9 . Lesson development plan

### 9-1 . Content and aim of core class hour (5/7 hours):

To understand the relevance between one's daily life and the causes and results of ocean pollution, as well as to examine methods of problem-solving and foster a sense of responsibility for one's actions.

### 9-2 . Teaching plan of core class hour:

	Learning activities/content	Instruction	Assessment/points to note
Introduction (5 minutes)	1 .Go back over the causes and impacts of marine pollution to review previous class sessions.	<ul style="list-style-type: none"> <li>• Provide examples of familiar problems to facilitate understanding of the mechanisms involved in the connections between students' daily lives and the causes and results of marine pollution and to foster a sense of ownership of marine pollution problems.</li> </ul>	<ul style="list-style-type: none"> <li>• Students should discuss on marine pollution and their lifestyles, as well as solutions to address these.</li> <li>• Students should indicate a concrete plan for their own action and efforts to address marine pollution.</li> </ul>
Development (40 minutes)	<p>2 .Discuss in groups the relationships between marine pollution and our lifestyles, as well as solutions.</p> <p>Examples of discussion topics:</p> <ul style="list-style-type: none"> <li>• Where do oil and hazardous substances come from, and why do we need them?</li> <li>• Where does floating refuse come from? Why does it float into certain regions?</li> <li>• What types of domestic wastewater are there?</li> </ul> <p>3 .Students should indicate a concrete plan for their own actions and efforts to address marine pollution.</p>	<ul style="list-style-type: none"> <li>• Confirm that the problem of marine pollution is one that accompanies necessary activities, such as our lifestyles and convenience, demand for energy, sanitation and industrial activities.</li> </ul>	<ul style="list-style-type: none"> <li>• Teachers should devise to develop a story to show the cause and effect relationship between causes and results using the KJ method, or other methods.</li> <li>• Are students able to explain their own opinions?</li> <li>• Do students understand that their own opinions differ from those of others?</li> <li>• Are students aware of the fact that the standpoint of each constituent is different?</li> <li>• Do students feel responsible for their actions and pollution?</li> <li>• Are proposals to solve problems appropriate?</li> </ul>
Wrap-up (5 minutes)	4 . Facilitate understanding on sustainable use of the oceans in the future by presenting an image of preservation of ecosystems and the beauty of the ocean aimed at environmental improvement of the oceans.	Show students pictures of the beautiful ocean and living things.	<ul style="list-style-type: none"> <li>• Do students have the intent to take concrete action?</li> <li>• Do students have the intent to develop and continue their learning?</li> </ul>



## Unit name : Classification and phylogeny of organisms

1. Subject/course  
covered by this unit:

Biology II

Author: Ayako Hino

2. Unit objective and aim:

To inquire into the classification and phylogeny of organisms through observation and experiments and to increase concern for nature and the spirit of enquiry. To apprehend the diversity of animals and plants and to acquire a point of view and opinion on classification. To augment understanding of the basic concepts related to classification and phylogeny of organisms, and to develop a scientific outlook on nature.

3. Corresponding portion of the national curriculum guidelines:

(2) Classification and evolution of organisms

To inquire through observation and experiments into the classification and phylogeny of organisms, and the processes and mechanisms of evolution in order to apprehend the diversity of plants and animals and historical changes and to discover a point of view and opinion on classification and evolution.

a. Classification and phylogeny of organisms

(a) Classification of organisms

(b) Phylogeny of organisms

4. Teaching materials central to this unit:

Utilise living things that students know, such as familiar animals and plants, including agricultural products, fish and shellfish, garden plants and pets. Help students to apprehend the deciding factors of form and nature for classification by actually observing and dissecting.

The ocean is a place inhabited by a wide variety of taxonomic groups of organisms, and it provides good teaching materials for this unit. If the high school is in an area where trips to the ocean can be made, gathering and observation of organisms at rocky beaches or tidal flats is recommended.

For schools where trips to the ocean are not possible, teaching materials that allow for virtual experiences, such as photos or specimens of organisms available on the websites of the National Museum of Nature and Science and universities, can be utilised to learn about the phyla of various organisms.

5. Competencies to be fostered in this unit (abilities and attitudes)

- The ability to collect appropriate information on the ocean and to comprehensively make decisions [ information collection and decision-making ]
- The ability to understand others and express oneself in order to engage in smooth communication with others at various settings of the ocean [ dialogue ]
- The ability to solve problems while attempting to coordinate among persons involved in the various issues of the ocean [ problem-solving ]
- The ability to continually utilise the bounty of the oceans [ sustained use ]
- The attitude to become familiar with and value the ocean [ emotions ]
- The attitude to respect the connections between time and space with the ocean in mind [ relationships ]
- The positive attitude to take responsible action on the various issues of the ocean [ autonomy ]
- The attitude to continually learn ocean-related knowledge and skills to be able to respond to changing societies, looking to the future [ continuity ]



## 6. Contents covered in this unit (knowledge and skills)

- E. Earth and oceans; seashore, tidal flats, seaweed bed, tides
- G. Life; classification
- H. Environment; exotic species
- I. Resources and energy; marine product resources
- J. Economy and industry; fisheries, marine products processing
- K. Management; fishing rights, protection of marine resources

## 7. Points to keep in mind for this unit (distinguishing characteristics of the learning process of this unit, relevance to other subjects, development of learning activities with external cooperation, etc.):

Special features of the learning process of this unit: Examples of as many familiar living things as possible, including food such as agricultural products and seafood, garden plants, and pets, should be given to students to help them understand classification and phylogeny. However, these are only a small fraction of the diverse life forms on earth. Students should study about the diverse taxonomic groups of organisms of the ocean, seaweeds, and life forms on rocky beaches.

Listing of organism names makes the study of classification and phylogeny dull. Photos and specimens should be observed and dissected to augment understanding. Activities to look up information in encyclopedias and on the Internet should be utilised.

While it is meaningful to study many taxonomic groups and their distinguishing characteristics, another method is to select one kingdom and phylum or division as a topic, and then study classification methods and cladistic classification methods.

For relevance to other subjects and the teaching materials of other subjects, efforts should be made to not only become familiar with the ocean through swimming and leisure, but to understand that the ocean is the habitat of diverse life forms. It is interesting to attempt to classify life forms that appear in the previously studied General Science A/B and Biology I, as well as those that appeared in homemaking and other textbooks. In health and physical education, students learn about the human skeleton and muscles. Relevance can be shown to augment understanding of homology of the skeletons of vertebrate. Additionally, bacteria and viruses are covered by items on disease and infectious disease.

Connections with communities and human connections

Fisherman's unions must be contacted before observation and collection of life forms on rocky beaches and tidal flats. Special consideration is required to avoid disturbing the environment or removing too many life forms of the ocean, which are marine resources. Consideration must be given to the ebb and flow of tides, and observation should be conducted based upon confirmation of evacuation routes for large numbers of people in the case of a disaster.

External organisations for cooperation, such as research institutes and aquariums, and literature and websites for reference

Photos on websites and specimens on loan of the National Museum of Nature and Science and universities can be utilised. Teaching materials that allow for virtual experience can be utilised. Tours of aquariums, zoos and botanical gardens, as well as participation in ocean observation events held by museums and marine biological stations are also recommended.

National Museum of Nature and Science

Digital learning content "Virtual Observation of Animals on Rocky Beaches"

<http://www.kahaku.go.jp/exhibitions/vm/iso/index.html>

Events <http://www.kahaku.go.jp/event/index.php>

Japan's seaweed [http://www.tbg.kahaku.go.jp/research/database/seaweedworld/c/top\\_list\\_C.html](http://www.tbg.kahaku.go.jp/research/database/seaweedworld/c/top_list_C.html)

Worksheets [http://www.kahaku.go.jp/education/work\\_sheet/pdf\\_2009/1f-3-2.pdf](http://www.kahaku.go.jp/education/work_sheet/pdf_2009/1f-3-2.pdf)

Chiba University, Encyclopedia of seaweed and algae specimens

<http://www-es.s.chiba-u.ac.jp/kominato/choshi/algae/index.html>

Okuno Karuta (cards) store "vegetable cards"

Misaki Marine Biological Station website "Virtual nature observation"

<http://www2.mmb.s.u-tokyo.ac.jp/hiroba/kansatsukai/index2.html>



## 8. Unit teaching plan (total 12 hours)

Hours	Study topic	Main learning activities	Points to keep in mind
4	Diversity and classification of organisms (Classifying organisms)	<ul style="list-style-type: none"> <li>To know the difference between artificial and natural classification. Classification such as beneficial insect and harmful insect are artificial. Natural classification shows phylogenetic relationships. Exercise: "Vegetable cards" game. Students should understand the difference between practical classification methods such as root vegetables and leafy vegetables, and classification methods that reflect phylogenetic relationships and attach importance to form and nature, such as the structure of flowers.</li> <li>Methods of classification (looking up scientific names) Following explanation of kingdom classifications, levels of classification, scientific names (binomial nomenclature), species (Linnaean taxonomy) and Japanese names, students should look up the scientific names of familiar animals and plants.</li> <li>Students should think about homology and analogy, adaptation and evolution while making a skeleton specimen from chicken wings, and coloring a skeleton diagram of a vertebrate animal.</li> <li>Students should observe several varieties of garden plants and sort out the differences in form and nature to think about phylogenetic relationships.</li> </ul>	<ul style="list-style-type: none"> <li>Arouse student interest in classification by introducing the Japanese names of pets like dogs and cats, types of agricultural products, cultivated plants and garden plants [Life]</li> <li>Utilise encyclopedias and the Internet. [Information collection and decision-making]</li> <li>Visits to the phylogeny area of the Global gallery of the National Museum of Nature and Science and other various museums are recommended. The National Museum of Nature and Science offers study sheets for tours. [Information collection and decision-making]</li> <li>The current curriculum guidelines cover 2 kingdom and 5 kingdom theories. These are kingdom classifications based on diversity of species. The next revision will cover three domains based on diversity of genes. [Life]</li> </ul>
4	Classification and phylogeny of plants (Classifying plants and sorting out phylogenetic relationships)	<ul style="list-style-type: none"> <li>Classification of photosynthetic plants. Give examples of organisms that photosynthesise in the same manner as terrestrial plants and chlorophytes, and classify by photosynthetic pigment type.</li> <li>Classification of terrestrial plants. Students should engage in comparative observation of plants on school grounds and garden plants. In the process of writing the names of each part on sketches, students should learn about aspects of form and nature that are clues for classification.</li> <li>Through observation of the sporophytes and gametophytes of mosses and ferns, students learn about the life cycle and alternation of generations.</li> <li>Classification of fungi and bacteria. Students should look up and classify various kinds of fungi and bacteria, such as those manufactured for food and medicines, and those related to health and illness. Exercise: testing for coliform bacteria, and observation of aspergillus, yeast and lactic acid bacteria.</li> </ul>	<ul style="list-style-type: none"> <li>Students should be made aware that not only chlorophytes, but also cyanobacteria, chemosynthetic bacteria, photosynthetic bacteria and algae are photosynthetic plants (primary producers). [Life]</li> <li>If possible, students should collect seaweed. [Erotions] [Sustainable use] Fisherman's unions must be contacted. [Dialogue] Heed must be given to safety related to earthquakes and tsunami. [Information collection and decision-making] Seaweeds that are foods can also be used for classification. There are websites with plenty of photos of seaweeds, such as the websites of the National Museum of Nature and Science and Chiba University. [Information collection and decision-making]</li> <li>Junior high school does not cover plants that do not flower. Biology I does not cover mosses and ferns, so this is the first time students will study them. [Life]</li> <li>Facilitate understanding through use of actual specimens and photos of diverse fungi and bacteria. [Life]</li> </ul>
4	Classification and phylogeny of animals (Classifying animals and sorting out phylogenetic relationships)	<ul style="list-style-type: none"> <li><b>Core class hour</b> Students should study broadly each phylum of animal through classification of animals on rocky beaches. Students should write the names of animals observed by animal phylum on their worksheets. Relevant points should be summarised on the necessary tides for observing animals at rocky beaches, the intertidal zone, tide pools, observation tools, observation methods and points of caution. Most schools cannot actually visit the ocean. Illustrations in textbooks, as well as the "Virtual Observation of Animals on Rocky Beaches" on the website of the National Museum of Nature and Science can be utilised to provide students with a simulation experience.</li> <li>Students should sort out and classify a variety of animals, paying attention to order, tissue, somites and motile organs.</li> <li>Experiments and observation: Students should dissect any materials they can get from food shops or fishing shops to learn about the form and nature that are clues to classification, order and organs.</li> <li>From the forming of blastopores, and the formation of orders, students should think about family relationships based on inter-animal history.</li> </ul>	<ul style="list-style-type: none"> <li>If possible, conduct observation at a rocky beach. [Erotions] [Sustainable use] Fisherman's unions must be contacted. [Dialogue] Heed must be given to safety related to earthquakes and tsunami. [Information collection and decision-making]</li> <li>Students can study photos of ocean life forms and classification on the websites of science museums, aquariums and marine biological stations. [Information collection and decision-making]</li> <li>There are relatively inexpensive materials appropriate for observation and dissection that are easy to obtain, such as squid, shrimp and crayfish for invertebrates and mackerel, dried sardines, chicken wings and hearts, and pig eyeballs, hearts and livers for vertebrates. [Life]</li> </ul>



## 9. Lesson development plan

### 9-1. Content and aim of core class hour (9/12 hours):

To study methods of observing organisms on rocky beaches where animals from a wide range of animal phyla can be observed. To look up representative animals for each animal phylum. For schools that cannot actually visit the ocean to experience observation of animals on rocky beaches, to virtually use the Internet to collect information.

### 9-2. Teaching plan of core class hour:

	Learning activities/content	Instruction	Assessment/points to note
Introduction (5 minutes)	<ul style="list-style-type: none"> <li>Have students take turns giving examples of familiar species of animals, while the teacher organises them into the animal phyla where they belong on the blackboard.</li> </ul>	<ul style="list-style-type: none"> <li>Most of the animals we interact with regularly are vertebrate phyla. Students are inclined to give vertebrate mammals as answers. Provide hints to make them aware that there are many other kinds of animals.</li> <li>Move to the computer lab and inform students that today they will engage in virtual observation of animals on rocky beaches.</li> </ul>	<ul style="list-style-type: none"> <li>Can students give examples of a variety of animals?</li> <li>Introduce the fact that there are animals from many animal phyla in the ocean.</li> <li>Coordinate use of the computer lab with other subjects. The core class hour can be out of sequence within the unit teaching plan.</li> </ul>
Development (40 minutes)	<ul style="list-style-type: none"> <li>Move to the computer lab and have each student connect to the Internet.</li> <li>Students should look at the "Virtual Observation of Animals on Rocky Beaches" digital learning content of the National Museum of Nature and Science website and write the names of 2 to 3 species for each animal phylum on their worksheets.</li> <li>(If time allows), relevant points should be summarised on the necessary tides for observing animals at rocky beaches, the intertidal zone, tide pools, observation tools, observation methods and points of caution.</li> </ul>	<ul style="list-style-type: none"> <li>After starting up computers and accessing websites, the teacher should go through once while explaining, after which everyone should slowly engage in the activity.</li> <li>Worksheets should be passed out and filled in.</li> </ul>	<ul style="list-style-type: none"> <li>Do students have interest and do they take the initiative in looking up each animal phylum? Can they summarise points of caution for rocky beach observation?</li> <li>Circulate around desks while students work and provide assistance as necessary. There will be differences from person to person in operation of the machines.</li> <li>On the museum website "List of animals on rocky beaches", multiple animals are listed in group names such as relatives of the sea slug, relatives of fish... when you click on the photo, the animal phylum and family name are indicated in the explanation that appears.</li> </ul>
Wrap-up (5 minutes)	<ul style="list-style-type: none"> <li>Students should take turns giving the names of representative species observed during the core class hour, about one species for each animal phylum, and confirm together.</li> <li>In a similar manner, cautionary points for rocky beach observation should be confirmed.</li> <li>(advanced notice) In the next class, you will explain the distinguishing characteristics of the animal phylum, including the deciding factors used for classification based on the animal phyla observed today, such as the skeleton and muscle attachment points, order and tissue, somites and motile organs. Further, you should think about phylogeny from the phylogenetic relationships of animal phyla of today.</li> </ul>	<ul style="list-style-type: none"> <li>Progress will vary by student. Work should be gone over to confirm and blanks filled in. Uncompleted portions should be assigned as homework.</li> <li>The worksheets of the core class hour will assist in study of classification and phylogeny in subsequent classes.</li> <li>If possible, interest in rocky beaches when visiting beaches for leisure should be encouraged.</li> <li>Everyone should confirm that computers have been shut down.</li> </ul>	<ul style="list-style-type: none"> <li>Do students understand the diversity of ocean animals? Do they understand the distinguishing characteristics of each phylum?</li> <li>Did students patiently look for and find animals for all animal phyla?</li> <li>Do students understand points of caution regarding tides and rocky beaches, and do they have interest in actually going to rocky beaches?</li> </ul> <p>As it takes time to move to the computer lab and access websites, it is advisable to combine two continuous class hours, such as the core class hour and classification of animals, or the phylogeny of animals.</p>









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