

[FEATURES 特集]

## JICA programs on Environmental Education in Kushiro

supported by

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### 釧路における JICA の環境教育プログラム

北海道教育大学環境教育情報センター

Program 11

Workshop: **Environmental Education in Japan**

#### The target of this study

- 1) Understanding the present situation and future direction of environmental education in Japan
- 2) Understanding examples of developing teaching materials and lessons for environmental education in Hokkaido
- 3) Understanding the meaning of developing teaching materials through an experiment that uses water, a familiar substance around us
- 4) Understanding teaching materials from Japan that Correspond to the contents of a science textbook from Egypt
- 5) Promoting a better understanding of each other by discussing science education and environmental education together

#### Key words

Environmental education

Developing teaching materials about the region's environment

Developing teaching materials using a substance around us

Comparison between nations regarding teaching materials

#### 1. Introduction

by Hidenori Ubukata (Science Education)

It is beyond doubt that from the end of the 20th century into the 21st century, environmental problems will become some of the most important problems in the world. Environmental problems emerged in Japan through litigation around the year 1970 involving diseases caused by environmental pollution. Since then, environmental education began to be provided at school with an emphasis on controlling pollution and the destruction of nature in

communities. Global environmental problems have also come to the fore since the latter half of the 1980s. As a result, environmental education has rapidly expanded in school education and social education.

To create a new environmental education program, Hokkaido University of Education-Kushiro Campus is conducting research on the global environment, regional natural environment and social environment, as well as developing contents of education and teaching materials. As the base for our activities, the Environmental Education Information Center affiliated with Hokkaido University of Education-Kushiro Campus was founded last year on the campus.

At the workshop held at Hokkaido University of Education-Kushiro Campus on the first day of this training program, two lectures and question and answer sessions will be presented in the morning. They are entitled "Characteristics of Environmental Education in Japan and Teaching Materials on Environmental Education in Hokkaido" and "Salmon Study and Environmental Education". The latter is an example of environmental education in a community. In the afternoon, two lectures and question and answer sessions entitled "An Experiment Using Water as a Material for Science Teaching" and "Teaching Materials in Japan that Correspond to Science Textbooks in Egypt" will be presented. And then an overall discussion about environmental education and the development of teaching materials for science education will be held.

#### 2. Characteristics of environmental education in Japan and teaching materials on environmental education in Hokkaido

by Nobuo Suzuki (Earth Science)

- 1) Framework of environmental education: Outline of the Ministry of Education's environmental education guidance materials
  - a. Basic concept
  - b. Guidance for each textbook and comprehensive instruction
  - c. Curriculum (course of study) developed through practice and the cooperation of all teachers
  - d. Environmental ethics and educational theories (forming views of nature, the world and life)
  - e. International view of global environmental problems
- 2) How to teach the relationships between lifestyle reform and environmental conservation
  - a. Saving energy
  - b. Recycling natural resources
  - c. Treating wastes
  - d. Efficiency of the environmental economy and risk management
  - e. Living environment (reconsidering food, clothing and shelter)
  - f. Urban environmental improvement, transportation facilities, and biosphere
  - g. Cultural reform of the psychological environment
  - h. Improving environmental education for lifelong learning
- 3) Responsibility of teacher-training colleges to improve environmental education teaching methods and the precursor development of teaching materials
  - a. Learning from historical changes in civilization, social structures and thoughts
  - b. Learning from communities of animals and plants: the diversity of living things and history of environmental changes in geology, topography and natural features
  - c. Field observation training experience and understanding nature
  - d. The creative role of natural conservation movements and a new conception of education
  - e. The cooperation between non-governmental organizations (NGOs) and environmental administrative agencies and criticism of environmental management supporting volunteers
  - f. Teaching environmental administrative policies and the legal system

- g. Understanding the relationships between regional environments and wide-area environments
- h. Confusion of environmental education science, environmental science, environmental information science, environmental study and environmental understanding
- 4) Natural environment of cool temperature and subarctic zones in Hokkaido
  - a. The relationship between geological history and the natural environment of Hokkaido (what is unique to Hokkaido?)
  - b. History of the development of Hokkaido; the decrease in virgin forests and forest vegetation conservation
    - a) Virgin nature, villages and mountains (mixed existence of paddy and dry fields and dairy farms)
    - b) Paddy field areas and river management
    - c) Large-scale pastures and changes in vegetation
    - d) A delicate balance between conservation and development of northern lowland marshy districts; issues of water areas
    - e) A comparison between temperate and subtropical zones and the greenhouse effect
  - c. Problems of northern regions
  - d. Kushiro, Nemuro, Tokachi, Abashiri and Soya cities in northern and eastern parts of Hokkaido
  - e. Environmental problems in the Kushiro district

### 3. "Salmon Study" and environmental education

by Yukio Takashima (School Education/Pedagogy)  
and Sachio Noro (Kunbetsu Junior High School)

Hokkaido, and particularly the Nemuro district in east Hokkaido, is well known as a salmon-producing region of Japan. Fixed shore net fishing, which is based on salmon egg collection, artificial fertilization, hatching, nurturing and fry release, has proven successful, and salmon production has increased remarkably. Many of the schools located in the fishery districts along the coast have correspondingly provided "fishery education" centered around the salmon culture fishery. However, since around the year 1980, environmental problems and environmental education have attracted public attention. Moreover, communities have undergone changes. As a result, new situations that cannot be coped with by traditional fishery education have developed, so we are facing a turning point. At present, it is expected that "salmon study" based on environmental education can be developed. The viewpoints

in this studying are first of all, "circulation" and next "looking at rivers as nodes of circulation". The main industries of the Nemuro district – which is blessed with natural forests, rivers and the ocean – are dairy farming and agriculture conducted on reclaimed pastureland and farming lands, forestry, fishing and sightseeing based on the ocean and its resources. The co-existence of nature and these industries has become a great issue for this district.

Next, I will introduce the studying of salmon conducted at primary and junior high schools in Shibetsu-cho, the home of the Shibetsu Salmon Museum.

- 1) "Salmon World" at Shibetsu
- 2) "Salmon studying" at Shibetsu Municipal Kunbetsu primary and junior high schools
  - a. Collecting salmon eggs, fertilizing them and nurturing young fish
  - b. Environmental research on salmon: investigations of rivers
  - b. "Salmon studying" by students and their studying demonstration
- 3) An experience of inspecting "salmon studying" at a primary school in Vernon City, British Columbia, Canada and the "98 Salmon Symposium at Shibetsu"

#### 4. An experiment using water as a material for science teaching

by Hiroshi Yahagi (Professor of Physics)

##### 1) Environmental education and water

One of today's most important issues is the conservation of the natural environment that places biosphere on the top. As an inorganic substance or substance related to life, water is directly related to environmental education and problems. Not only natural science education but also social science, Japanese language or even music education can use water as a theme for various teaching materials. For example, social science can take problems of water resources or agricultural water as a teaching material theme. Water, as a teaching material, penetrates almost every field of education. It can be said that "water" is an extremely important key word for environmental education.

##### 2) Water as a teaching material

Water has been utilized in teaching the concepts of mass, density, temperature and heat. Moreover, various contents dealing with water found in familiar situations, including climatic phenomena, are adopted as natural science themes in various parts of textbooks. However, as water is a substance so ubiquitous to our daily lives, those of us who study it scarcely regard it as a substance. Therefore, since 1993, I have been involved in planning a series of experiments for teaching the physical properties of water (as liquid, solid and gas). I have developed and demonstrated teaching programs with themes which include the ones shown below and also video teaching materials.

- a. Measuring water viscosity coefficients by means of a dropping method
- b. Developing frost columns
- c. Making ice lenses
- d. Stained glass made of ice
- e. Can coin batteries actually be used?
- f. Free-fall of water drops
- g. Is water viscous?
- h. A simple heater

##### 3) Two experiments for teaching

From the above eight experimental themes, I will introduce two of them—"Free-fall of water drops" and "Is water viscous?" The former experiment aims to analyze free-fall movement of waterdrops by measuring their falling time of them as they drop one by one from a syringe needle placed at several different heights. This is a favorite theme as a typical, familiar demonstration of movement and is almost always used for science education at universities as well as at junior and senior high schools. In addition to its value as a suitable teaching material for elementary physics, this free-fall phenomenon is regarded as important at every level of physics for junior and senior high schools as a means to trace the historical findings of Galileo Galilei. Here, this familiar phenomenon is taken as a gravity-related teaching material from a different angle. The latter experiment aims to demonstrate directly the temperature-dependency of the viscosity of water, which seems to have nothing to do with viscosity in our daily lives. Although this is a qualitative experiment, the method of dropping water through a pipe also constitutes a basis of a method that quantitatively determines

the temperature-dependency of viscosity coefficients. I would like to take this opportunity to demonstrate these experiments, which bear resemblance to dripping water that makes us think of raindrops.

### **5. Teaching materials in Japan that correspond to the contents of a science textbook in Egypt**

by Shiro Kuragano (Education/Pedagogy)

For reference for constructing a curriculum that corresponds to the following sections in "SCIENCE and LIFE", a science textbook for primary education in Egypt, I have examined the possibility of arranging several teaching materials used in Japan according to the textbook. As each section of the textbook has subsections, I have also adopted subsections that correspond to them.

I have tried to arrange teaching materials based on current textbooks in Japan, without thinking of changing the arrangement of the whole structure of units.

(The fourth grade)

- (1) Animals and plants in our environment
- (2) The matter around us
- (3) Man and the universe
- (4) Life on earth

(The fifth grade)

- (1) Food and organisms
- (2) The structure of living organisms
- (3) Matter
- (4) Energy
- (5) Magnetism and electricity

#### 1) Examining process

As we have no teaching materials that accurately correspond to the contents of the textbook from Egypt, I have selected those which are as similar as possible in their contents, from among rough plans prepared by my office and especially from among teaching materials prepared by the Hypothetical Experiment Teaching Method Studying Workshop, and

arranged them in a proper order. In so doing, I have selected teaching materials that contain a single experiment which has not yet been fully developed for a class lesson. Moreover, I plan to select some scientific reading matter (scientific picture books) that is applicable as teaching material, though this work has not progressed yet.

#### 2) Dealing with selected teaching materials

It will be difficult to adopt the selected teaching materials and experiments as they are to the textbooks in Egypt. However, it is thought that the thoughts and viewpoints underlying these materials as well as their composition method will be utilized as a reference when a new curriculum is prepared in Egypt. In this case, it will be necessary to select appropriate equipment for the experiments.

I have also found through this work of teaching material selection that there are some fields in which there are few teaching materials equivalent to those used in Egypt. Moreover, we have yet to solve the problem of how to deal with those themes about which children have to investigate for themselves.

However, when developing a curriculum corresponding to teaching materials used in Japan, I think that the concepts of rules, and images and viewpoints of nature underlying these materials become very important. Therefore, it is likely that a poor curriculum will be created if teaching materials in Japan are introduced to a foreign nation without suitable adaptations.

#### 3) A new image of education in Japan

Present-day Japan attaches importance not only to knowledge and understanding but also to the interests, willingness and behavior of students. Moreover, a five-days-a-week system will be completely introduced in Japanese schools in the near future. Therefore, the necessity of comprehensive study is being emphasized. This will present a big challenge not only to Egypt, but also to teacher training in Japan.

**Program 12**

Visiting a Public Primary School and Museum:

**Shibecha Municipal Shibecha Primary School Shibetsu Salmon Museum**

by Shiro Kuragano (School Education/Pedagogy)

**The target of this study**

- 1) Understanding the value of teaching material development by looking at environmental education practiced at a primary school
- 2) Understanding the role of field trip-educational facilities and human resources by visiting the Shibetsu Salmon Museum

**Key words**

Environmental education

Using the community for teaching materials

Field trip education, Museum

On the second day of teacher-training at Kushiro, in order to inspect the present situation of environmental education practiced in a community, we will visit Shibecha Municipal Shibecha Primary School and observe class lessons. We will see that by practicing not only a fixed curriculum but also a flexible curriculum corresponding to the real situation of a community, it is possible to develop a creative study program in which children participate. After that, we will go to the Shibetsu Salmon Museum to look at exhibits related to salmon and hear explanations about them, so we can understand the present situation of field trip education.

**Program 13**

Excursion:

**Natural Study in a Community and Teaching Material Development****The target of this study**

- 1) Understanding that the earth's activities can be comprehended through the field study of topographical features within a district
- 2) Observing forests and wetlands and the living things therein, and understanding how they are utilized for environmental education

**Key words**

Natural environment

Using regional characteristics for teaching materials

Environmental education

**1. Objectives of the excursion**

by Hidenori Ubukata (Science Education) and  
Yoshihiko Sugiyama (Mathematics Education)

For education in the fields of earth science and biology, using the nature of a region for teaching materials is extremely important. Making the most of the natural characteristics of the region, Hokkaido University of Education-Kushiro Campus is actively involved in scientific research on volcanoes and wetlands as well as in developing teaching materials. On the last day of this training program in Kushiro, we will take an excursion to the area from Kawayu to Kushiro Marsh (Kushiro-Shitsugen) in order to conduct *field observations* on

(1) volcanic topography and activity, (2) forests and wetlands and (3) the ecology of freshwater crawfish. We will also hear explanations of their value for education and points to be considered in using them as teaching materials from professionals in each field.

What we learn from this field study may not be adopted without modification to education in Egypt. But the policy of letting students conduct research by themselves on the regional environment through field practice and graduation studies, and letting them utilize what they have learned through their studies in actual school education when they become teachers, may be useful to teacher training in Egypt.

## 2. Understanding volcanic activity through volcanic topography

by Toshihiko Ito (Earth Science)

There are 86 active volcanos in Japan. Because of them, Japan is blessed with wonderful mountain scenery, hot springs and mineral resources among others. On the other hand, Japan has also suffered disasters caused by volcanic eruptions. At present, 19 volcanic mountains are designated as dangerous by the Meteorological Agency and put under constant surveillance.

On the excursion from Kawayu to Kushiro Marsh, we will tour Iou-zan (Mt. Iou), the Kussharo Caldera and Mashu-ko (Lake Mashu) in that order. On this occasion, we will be able to (1) see actual volcanic activity (e.g., fumarolic gases), (2) understand the relationship between the chemical ingredients of magma and the shapes of volcanoes, (3) inquire about the history of volcanic activities and (4) imagine the destructive force of volcanic activity.

### 1) Iou-zan (Mt. Iou)

Iou-zan is lavadome-shaped. This volcano was formed by the activities of high-viscosity magma, which contains lots of silica. As the lava does not easily flow, mountains of this type become dome-shaped. Looking at the fractures in the rocks made of this lava, it can be understood that they contain a lot of silica. The crater at the top, which is called "A Bear Trap", was made several hundred years ago by steam explosions that blew off the side of the mountain. The volcano is still active. The name of Iou-zan (the Japanese

"Iou" means "sulfur" and "zan" means a "mountain") is derived from the fact that sulfur was mined here from 1876 to around 1945. The ruins of the digging operation still remain on one side of the mountain. The mountain is called "Atosanupuri" in the Ainu language, which means a "naked mountain".

By the way, coal mining in Kushiro developed in its early days to provide fuels for the steam locomotives that carried sulfur ore excavated here to the refinery at Shibechea.

### 2) Kussharo Caldera

Kussharo-ko (Lake Kushiro), which is peanut-shaped, was made by the accumulation of water in a crater. The collapsed ground had been round in its original shape, but its eastern part was buried by later volcanic activities. It is called a collapsed caldera of craterlake type. How long did it take for volcanic activity to form this caldera?

The erupted ash from this caldera reached far as the Sea of Okhotsk (Abashiri City), the Nemuro-kaikyo (Nemuro Straits) and the Pacific Ocean (Kushiro City). This fact alone is enough to imagine how destructive the eruptions were. Age determination of the welded tuff, which is the oldest among the erupted matters, tells us that the eruptions occurred about 340,000 years ago. Carbon dating of the rocks carried by pyroclastic flows that occurred during the last years of the caldera's formation (and which can be observed in the city of Kushiro) shows that the eruptions broke out about 30,000 years ago. It indicates that the biggest caldera (of a craterlake shape) in the world was formed by long, intermittent volcanic activities that lasted approximately 300,000 years. The Wakoto Peninsula was formed when the central cone was connected to the shore of the lake by a sand bar. The central cone was formed by eruptions that broke out along cracks in the caldera.

### 3) Mashu-ko (Lake Mashu)

Mashu-ko is also a caldera lake. Our bus will drive along the side of this stratovolcano up to the top, where the lake is. (At its deepest point, the lake is 211.4 meters deep.) It is a caldera lake of crater lake type, which appeared due to a collapse that was caused about 7,000 years ago by volcanic activity, which began near the somma located in the east of the Kussharo Caldera and caused large-scale pyroclastic flows. The small island (called "Kamuisshu") in the center is the

central cone. Although it is only 25 meters above the water surface, it is a perfect volcano with a height of 230 meters from the lake bottom and a base diameter of 1 km. The height of the lake surface above sea level is 351 meters, which is nearly constant throughout the year. Owing to a permeable layer of rock running just above the surface, the height (depth) is kept constant. Moreover, there are no rivers running out of the lake, although there are several springs around the caldera. The data on transparency once showed the best value in the world (41.6 m in 1931). According to an investigation conducted in 1978, it was 34.8 meters. One-fourth of the eastern part of the caldera was buried by a series of volcanic activities that created Mashu-dake (Kamuinupuri) on the other side. The crater that can be seen was made about 1,000 years ago when volcanic eruptions occurred.

### 3. Forests and marshes in the eastern part of Hokkaido and environmental education

by Fusayuki Kanda (Biology)

The natural environment in the eastern part of Hokkaido, which is among the best natural environments in Japan, is full of diversity, including marshes, volcanoes, mountainous areas and seaside grasslands. Accordingly, the vegetation also shows diversity. Because one of the most important factors of the environmental education is to get close to nature, the natural environment in eastern Hokkaido can provide one of the best regions for such education. Various educational programs have been carried out here in this part of Hokkaido, including Kushiro Marsh.

#### 1) Kushiro Marsh

Hokkaido has 80% of the total marshland area in Japan. Most of this marshland is distributed around the eastern part of Hokkaido. Kushiro Marsh is the largest, with an area of about 20,000 hectares. This marsh became the first Ramsar Convention registered marsh in Japan in 1980. The vegetation here shows the great difference between the fen, where the water table is comparatively high, and the raised bog, where the water table is comparatively low. The vegetation in the fen is mainly composed of reeds and sedges, while the bog is composed of Labrador teas (*Ledum palstre* var. *diversipolosum*), crowberries (*Empetrum nigrum* var.

*japonisum*) and peat moss (*Sphagnum* spp.). The latter area also has alder forests.

#### 2) Marshes adjacent to Kushiro Marsh

The eastern part of Hokkaido has several other marshes that spread out adjacent to Kushiro Marsh. Just east of the marsh, there is a marsh that developed along the Bekambeushi River. Near the seaside of Hamanaka-cho lies Kiritappu Marsh. This marshland has boreal plants such as *Polemonium caeruleum* var. *laxiflorum* and *Caldamine platensis*, which indicates that it has some plants in common with northern regions such as the Kuril Islands, Kamchatka Peninsula, Siberia and Alaska. They also became registered marshes at the Ramsar Convention held in Kushiro in 1993.

#### 3) Forests

As a whole, Hokkaido can be classified as a cool temperature zone. Regarding vegetation, forests of deciduous, broadleaf trees — including *Quercus mongolica* var. *glosseserrata*, *Acer mono* and *Betula platyphylla* var. *japonica* — are widely distributed in mountainous areas. In the part of the eastern Hokkaido where the climate is cooler, needle-leaf trees such as *Picea jezoensis* and *Abies sachalinensis* are also mixed. Here needle- and broadleaf-mixed-forests are formed. In the mountain areas such as Oakan-dake and Meakan-dake, needle- and broadleaf- mixed-forests are generally seen up to several hundred meters above sea level. From 1,200 meters above sea level up to the mountain tops, forests of *Betula ermani* appear followed by *Pinus pumila* belts, so that alpine zones are formed. In the alpine zones, typical alpine plants can be seen, including Labrador teas (*Ledum palstre* var. *diversipolosum*), crowberries (*Empetrum nigrum* var. *japonisum*) and *Potentilla miyabei*. In Iou-zan — an active volcano in Kawayu — creeping pines (*Pinus pumila*) and Labrador teas have developed special communities due to the emission of sulfur gases, though the mountain is not high.

#### 4) Sand dunes

In the coastal area of eastern Hokkaido, which faces the Pacific Ocean, there are several sand dunes and rocky places. In the dunes, dune-specific plants such as *Rosa rugosa* and *Elymus mollis* are growing. Shore terraces can be found along the coast near Nemuro. The upper part of the terrace

located in Ochiishi contains a marsh, where a unique forest of *Picea glehnii* has developed. *Rhododendron parvifolium* growing naturally here cannot be seen in other parts of Japan. In Shunkunitai, located in the joint part of the Nemuro Peninsula, a very unique plant community has formed on the dune along the coast, including a forest of spruces (*Picea glehnii*). Moreover, a saltmarsh spreads near the coast, where plants peculiar to this type of marsh, such as *Salicornia europaea*, *Troglochin maritimum* and *Potentilla egedei* var. *groenlandica*, have established communities.

#### 4. Value of crayfish living in eastern Hokkaido as teaching materials

by Shin-ichi Hiruta (Biology)

##### 1) Three species of crayfish inhabiting Hokkaido

The following three species of crayfish inhabit Hokkaido: native Japanese crayfish (*Cambaroides japonicus*), signal crayfish (*Pacifastacus leniusculus*), and red swamp crayfish (*Procambarus clarkii*) which live in places with high water temperatures. The latter two species were imported from North America. Although the native species used to be widely distributed and seen everywhere in Hokkaido, its habitat has rapidly decreased, and it is now rarely found. The natural environments of clean streams and lakes with lots of springs—which provide habitat for the native species—have been reduced. The first signal crayfish were released in Lake Mashu in 1930. A total of 476 were released. They came from the Columbia River valley near the Pacific coast of the U.S., where the climate is cold. The Ministry of Agriculture and Forestry imported them, hoping to introduce important aquatic animals to Japan. The signal crayfish and native Japanese crayfish are the two most commonly seen crayfish in eastern Hokkaido.

##### 2) Imported signal crayfish and native Japanese crayfish

Signal crayfish already have a wide distribution. For example, they can be seen in the Kushiro River, Old Kushiro River, Beppo River, Ninishibetsu River, Kan River, in the Setsuri River running through the central part of Kushiro Marsh, in water channels in the south along the bank extending from Onnenai, Lake Shirarutoro, Lake Toro and Takkobu Pond. On the other hand, it has been verified that native Japanese crayfish live only in limited places where there is enough spring water percolating from hills around the

Kushiro Marsh. Different from signal crayfish, they live in habitats that are not easily found by human beings, because they can live with a small amount of flowing water. So it is difficult to verify their existence. However, they have disappeared at least from around the places where human beings live. The major reason for their disappearance is the alteration or disappearance of their habitats. In addition to this, signal crayfish are involved in their disappearance in eastern Hokkaido.

##### 3) Crayfish, biodiversity and environmental education

Excepting bivalves, crayfish are the biggest mobile invertebrate animals in the fresh water ecosystem. They are recognized as a "keystone species" for the environment. "Keystone species" means a species that has a great effect on the diversity of species in an ecosystem. Whether a keystone species lives or not in an ecosystem greatly affects the composition of other species in the system. Native Japanese crayfish are a species that have contributed to the diversity of nature in Hokkaido. Therefore, to maintain biodiversity, it is essential that we make every effort not to deprive them of their habitats. On the other hand, signal crayfish, a species which is not native to the region, have already spread widely in eastern Hokkaido and are greatly influencing the environment. They have replaced native Japanese crayfish in several places, and are further widening their habitat into surrounding areas. How should we deal with this fact? As it is almost impossible to remove them completely, so we have to think of measures to decrease their numbers and contain them within eastern Hokkaido. Moreover, we have to make efforts to inform the public about native Japanese crayfish and signal crayfish, so they will be interested in them and have accurate knowledge about them.

On the second day of teacher-training at Kushiro, in order to inspect the present situation of environmental education practiced in a community, we will visit Shibechea Municipal Shibechea Primary School and observe class lessons. We will see that by practicing not only a fixed curriculum but also a flexible curriculum corresponding to the real situation of a community, it is possible to develop a creative study program in which children participate. After that, we will go to the Shibetsu Salmon Museum to look at exhibits related to salmon and hear explanations about them, so we can understand the present situation of field trip education.