Space Education Activities in the Young Astronauts Club
Space Education Mutually Connecting Time, Space, and Life

By Toshiaki Takemae, Yuu Teraura and Kunika Teraura

Young Astronauts Club-Japan Yokohama Chapter, Yokohama, Japan

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The activities of the Yokohama Chapter of Young Astronauts Club-Japan are introduced as an example of space education. The main theme of the workshop is atmosphere of the earth. In the workshop, they learned of the history of the earth, compared the earth with other planets, studied the material cycle, and gained a good feel for the course of the earth up to the present. The workshop shows that thinking “on a universe scale,” the most essential characteristic of space education activities, produces great educational effects.

Key Words: Space Education, Young Astronauts Club, Yokohama Chapter

1. Introduction

The Yokohama Chapter of the Young Astronauts Club-Japan (YAC) was established in February 1988, and has continually developed its activities over twenty years, conducting experiments making handicrafts, and conducting other activities through holding regular monthly meetings.

In October 2008, children participated in a workshop under the main theme of the atmosphere of the earth. In the workshop, they learned of the history of the earth, compared the earth with other planets, studied the material cycle, and gained a good feel for the course of the earth up to the present. Making connections between study items, though each of which is covered by school education, and thinking “on a universe scale” can broaden and deepen educational activities.

Environmental issues are discussed at every opportunity these days, but it is inadequate to simply feel pity for animals or to practice easy ecological activities. It is essential to consider matters from a comprehensive viewpoint, including time, space, matter, and life up to the present existence of the children themselves, as well as all human beings. Such consideration is made possible by “widening one’s vision to the universe.”

The following activities of the Yokohama Chapter show that thinking “on a universe scale,” the most essential characteristic of space education activities, produces great educational effects.

2. Contents of a Regular Meeting

2.1. Comparison of the atmospheres of planets

The meeting began with the story of space, which was suitable for YAC. While looking at pictures of astronauts working outside a space station, the children confirmed that space suits are necessary for the astronauts to carry out activities outside the space station. It was also confirmed that particularly, air of a pressure of (approximately) one atmosphere is necessary.

The earth has much oxygen, and the space suits secure the environment of the earth. The question is whether, similar to earth, the neighboring planets of the earth also have much oxygen.

Based on this question, a quiz was given to compare the main constituents of the atmospheres of different planets.

![Fig. 1. Main atmospheric constituents of different planets.](Explanatory materials used for the regular meeting)

The children understood afresh that the atmospheric constitutions of Venus and that of Mars are nearly the same, and on both planets, carbon dioxide (CO₂) constitutes nearly the whole atmosphere. On the other hand, the children understood that as for the atmosphere of the earth, the proportion of CO₂ is extremely low and oxygen constitutes a certain proportion.

2.2. History (Changes) of the atmosphere of the earth

Next, the lecturer explained that the proportion of CO₂ in the atmosphere of the earth had not been low when the earth was born; on the contrary, CO₂ had accounted for
approximately 96% of the atmosphere. This was the same as the atmospheres of Venus and Mars.

Through taking a quiz, the children studied the history of the atmosphere of the earth or the changes of the atmosphere from the original constituents, which were nearly the same as the atmospheres of Venus and Mars, to the present constituents.

The history of the earth is roughly divided into the following five stages.

(i) The primitive earth collided with small celestial bodies and was covered with a sea of magma.

(ii) In the course of time, the collisions with the small celestial bodies ceased, the surface of the earth cooled down, vapor changed into water and fell down as rain, and the sea was created.

(iii) Life was born in the sea and oxygen came to be produced by organisms that photosynthesize (cyanobacteria, etc.).

(iv) Meanwhile, CO₂ dissolved in the seawater was taken by organisms with a calcareous shell, such as coral organisms, and the shells formed into limestone. The quantity of CO₂ in the atmosphere had thus been decreased.

(v) Magnificent limestone caves are examples of the transformation of the limestone earth, which are now shown to us.

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**2.3. Gaining a sense of the history of the earth through taking a quiz**

The children took a quiz on when crucial events had occurred so that they could really appreciate the changes of the atmosphere of the earth over a long period. The children extended a tape measure having a length of five meters and considered a 4.6 meter length of it to represent the age of the earth of 4.6 billion years. They were given flags on which various events were written, such as the birth of the sea, the origin of photosynthetic organism (the generation of oxygen), the luxuriant growth of coral, the prosperity of dinosaurs, and the birth of human beings. They placed each flag at a length on the tape measure representing the time they thought the event had occurred.

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**Fig. 3.** Placing flags on a tape measure 4.6 meters long with guesses about the times when crucial historic events occurred on the earth.

When flags were put at their correct places, the children seemed surprised to really gain a sense of the time scale. They had had unclear ideas about the time when the crucial events had occurred and the period when the crucial states had continued, although they had understood the contents of the crucial events and states through explanation.

The following are the children’s representative impressions.

- I was surprised to know that the constituents of the atmosphere had changed over a very long time since very early days.
- It has been an unexpectedly short time since dinosaurs died out.
- The history of human beings is very short (five millimeters on the tape measure), and my history (the age of the child) is too short to perceive.

**2.4. Circulation of CO₂ and the crisis of coral**

After the quizzes, the children learned that limestone dissolves in water and crystallizes again into stalactites. The remaining water, rich in CO₂ due to the dissolved limestone,
forms a river, and flows into the sea before long. CO₂ on the earth circulates from the sea, through rock and rivers, and again to the sea over a long period in various forms.

Meanwhile, human beings have continually emitted CO₂ in a drastic way. The children were surprised at the extreme discord between the slow changes of the earth itself and the rapid changes caused by human activities. The children seemed to be more surprised at this fact than they were when they used the tape measure.

In addition, the children learned that coral, which played an important role in changing CO₂ into limestone, is recently faced with the crisis of extinction or coral bleaching.

3. Children’s Impressions and Thoughts

Children’s impressions and thoughts are written below, based on the worksheets used in the regular meeting and the questionnaires they filled out after the meeting.

3.1. Increase in the volume of CO₂ caused by human beings

- I think it is not good because the cycle of the earth will be disturbed. (Male third grader of an elementary school)
- I cannot accept it because it will damage the established cycle of the earth. (Male fourth grader of an elementary school)
- It is terrible because the whole surface of the earth might be covered with the sea. (Female sixth grader of an elementary school)
- It is inevitable. It is the result of human beings’ halfway civilization. (Female second grader of a junior high school)
- In a sense, nature may be restored if human beings become extinct. Even though human beings continue emitting CO₂ and exterminate themselves, the extinction of the human beings will be unrelated to the existence of the earth. (Female second grader of a senior high school)

Most children have negative thoughts of the increase in CO₂.

As children grow older, they think more about human activities and existence.

3.2. Measures to tackle global warming

- Reduce the volume of waste (Female third grader of an elementary school)
- Take eco-friendly action at every opportunity. Use a bicycle to go to nearby stores (Male third grader of an elementary school)
- Reduce CO₂ emissions (Male fourth grader of an elementary school)
- Take eco-friendly action. Follow the 3R principle in disposing of waste (Male fourth grader of an elementary school)
- Take eco-friendly action. Conserve energy and resources (electricity, tap water, etc.) (Female sixth grader of an elementary school)
- Recycle PET bottles and other used products in a step-by-step fashion, although what I can do is only a trifle (Female second grader of a junior high school)
- Use hybrid vehicles in place of conventional vehicles, and do not use bioethanol. Promote self-sufficiency by growing vegetables in the kitchen garden (Female second grader of a senior high school)

The children thought out the measures they could put into practice in their daily lives.

3.3. The ideal earth in the future

- Place full of flowers (Female third grader of an elementary school)
- The rich earth, where a variety of living things exist (Male
The earth, which is clean. (Male third grader of an elementary school)

The earth, where the natural environment is restored and well preserved. (Male fourth grader of an elementary school)

The earth, where the natural environment is fully preserved. (Female sixth grader of an elementary school)

I feel miserable about my incompetence to create an ideal future. (Female second grader of a junior high school)

The earth, where most people have hopes. (Female second grader of a senior high school)

The children not only thought about people’s lives but also became aware of the value of plants, other living things, and the rich natural environment, and wanted to contribute to their protection.

3.4. Findings at the regular meeting

Role of coral in the sea. (Female third grader of an elementary school)

Fact that coral is on the verge of extinction. (Male third grader of an elementary school)

Process through which the atmosphere was formed. (Male third grader of an elementary school)

Fact that the process of global warming is beyond my expectations. (Male fourth grader of an elementary school)

Fact that dinosaurs became extinct for a shorter period than I expected. (Male fourth grader of an elementary school)

Global environmental problems. (Female sixth grader of an elementary school)

Fact that the history of human beings is short. (Female second grader of a junior high school)

Process of a decrease in the volume of CO\textsubscript{2} in the atmosphere. (Female second grader of a senior high school)

Younger children seemed to be surprised to know that coral plays an important role in reducing the volume of CO\textsubscript{2} in the atmosphere and that coral faces a crisis. The quiz concerning the history of the earth using the tape measure was an effective means, because all the children really gained a sense of the time scale with surprise.

4. Conclusion

The activities of the Yokohama Chapter of YAC were introduced as an example of space education. All the experiments carried out in this regular meeting are generally conducted in school education and science classes. To connect these experiments with each other and understand matters comprehensively, thinking “on a universe scale” is significantly effective.

Although the children’s impressions and thoughts were not fully drawn out by the questionnaires, leaders who had direct contact with the children, felt that the children thought about various matters seriously. In other words, everybody accepts the idea that the conservation of the global environment is important, but the children, going deep into the subject, became aware of the “need” for conservation.

Based on present knowledge, the earth is the only place in the universe, including Venus and Mars, which has liquid water and life. Although the life of a person is too short to indicate on the tape measure, the person is a result of long history, and matter has connected and will connect with other matter, and life has connected and will connect with other life.

The children could understand the above through the space education, and became aware of a “valuable feeling” that they were required to strive for global environmental conservation.

References

1) URL of YAC : http://www.yac-j.or.jp/ 
   URL of the Yokohama Chapter : http://www.yacyokohama.org/