

## ASTRONOMY EDUCATION IN KOREAN EARTH SCIENCE CURRICULUM: FROM ELEMENTARY SCHOOL TO COLLEGE

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### ABSTRACT

We introduce the National Science Curriculum issued by the Education Ministry in Korea. Astronomy should be given and taught as compulsory courses in **Nature** of elementary school, **Science** of middle school, **General Science** of high school, and as elective courses in **Earth Science I, II**. Astronomy concepts have been designed in spiral pattern. College levels of astronomy have been given as majoring in astronomy course, cultivating one for earth science pre-teacher students and cultural subjects for non-major students

### I. INTRODUCTION

Here we want to introduce an astronomy education in Korea based upon the science curriculum issued by the Education Ministry in our government. We now use the 6th curriculum that the science curriculum just follows. The Education Ministry now prepares for revising a new curriculum which will go into effect 3 years later as the 7th curriculum (Education Ministry, 1995).

Main ideas of the 7th curriculum should include the objectives of the educational reforms, issued by the Educational Reform Committee, that is, the consultative body of the President in Korea. Especially, all of the science programs from kindergarten to high school should be developed gradually by achievement levels of students and/or learners (KARSE, 1996). This emphasizes the learner's view, activity, experience and so on, not the teacher's. The only function of teachers gradually changes teaching students to helping and/or guiding them to learn. In addition, under the new curriculum, textbook becomes one of the important references for the students to learn. The students should learn science through their experiences, activities, thinking processes and so on. Here I use a term **science**, which includes the scientific concept, process skill, methodology, attitude, creativeness, determination of social issue and so on.

It is much better to introduce the new science curriculum, but it is now developing by the Education Ministry. All schools make use of the 6th curriculum as a national standard. All teachers from elementary to high school should follow it to prepare for their instructional manuals and teach the students and to issue the textbooks adopted to each class of each school. Here we introduced the science education program in the 6th science curriculum and its characteristics, goals and contents which are basically emphasized. We discuss scopes and sequences of each school levels in the concepts, mostly in astronomy concepts. Afterward, we deal with the astronomy education in college.

### II. ASTRONOMY EDUCATION FROM ELEMENTARY SCHOOL TO HIGH SCHOOL

#### (a) Characteristics

In school science, it is important for students to understand basic scientific knowledge, develop creative thinking ability and rational decision-making ability, and cultivate attitude and ability to solve problems scientifically occurring daily life by giving students experiences to investigate surrounding matters and natural phenomena with interest and concern. To accomplish this mission, Korean science curriculum consists of not only scientific inquiry processes and scientific knowledge but also relationships among science and technology, science and society, and the value and morality of science (KEDI, 1993).

Korean science curriculum is controlled by the Education Ministry that we have a written science curriculum. We also have authorized science textbooks which are **Nature** in elementary school, **Science** in middle school, **General Science** and **Physics I, II, Chemistry I, II, Biology I, II, Earth Science I, II** in high school. The science curriculum also gives the credit allotments for science subjects in each school level (Table 1).

Earth science curriculum including astronomy takes an important part in Korean science education. Earth science is integrated with other science at the subjects of **Nature, Science** and **General Science**. **Earth Science I, II** in high school deal widely with the knowledge and inquiry of earth science. Astronomy and other earth science, therefore, are required to be taught and learned with **spiral** type in their concepts (Y.R. Lee and S.U. Choe, 1995).

#### (b) Goals

The goals for school science in the 7th science curriculum is the meaningful to student's individual life (Education Ministry, 1995). Now, in the 6th science curriculum, we have adopted future-oriented following goals in each school (KEDI, 1993).

##### Elementary School

To help children have interests and curiosity for nat-

**Table 1.** Credit allotments for science in each school level(Education Ministry, 1992a,b,c)

Subjects	Grade	Credit <sup>1</sup>
Nature	3	3
	4	4
	5	4
	6	4
Science	1	4
	2	4
	3	4
General Science	1	8
Physics I	2-3 <sup>2</sup>	4
Chemistry I		4
Biology I		4
Earth Science I		4
Physics II	2-3 <sup>3</sup>	8
Chemistry II		8
Biology II		8
Earth Science II		8

<sup>1</sup> 1 credit : 40 minutes learning time per week in elementary school, 45 minutes in middle school, 50 minutes in high school.

<sup>2</sup> Physics I, Chemistry I, Biology I and Earth Science I are the elective subjects for humanities and social science track students.

<sup>3</sup> Physics II, Chemistry II, Biology II and Earth Science II are the elective subjects for natural science track students.

ural phenomena, and bring up the creative problem solving abilities by experiencing basic inquiry methods and scientific knowledges.

a. To help children bring up basic methods to inquire natural phenomena and utilize them in the problem solving process.

b. To help children understand basic facts and concepts about natural phenomena and apply the acquired concepts to explain natural phenomena or events.

c. To help children have interests and curiosity in natural phenomena and inquiry of science, and raise scientific attitude.

d. To help children understand that science affect to the development of technology and has deep relationship with our lives.

**Table 2.** The astronomy contents in the science curriculum(KEDI, 1993)

Elementary School	
Grade	Content (Nature)
5th	<b>Rotation of the earth</b> diurnal motion of the sun change of day and night <b>Revolution of the earth</b> seasonal change of constellation <b>Revolution of the moon</b> the phase of the moon <b>Family of solar system</b> the sun's shape and size relative comparison of distance and size of planets <b>Exploration of space</b> telescope, space probe
6th	<b>Change of seasons and the earth's revolution</b> seasonal change of living things seasonal change of air temperature seasonal change of day and night the sun's altitude the meridian sun shadow length solar radiant energy
Middle School	
Grade	Content (Science)
3rd	<b>Size of the earth, sun, and moon</b> <b>Motion of the earth</b> <b>Motion of the moon</b> <b>Characteristics of planets</b> <b>Motion of planets</b> <b>The solar system</b> <b>The distance of stars</b> <b>Brightness of stars</b> <b>Color and size of stars</b> Clusters Nebulae <b>Milky way and galaxy</b> <b>Universe</b>
High School	
Grade	Content (General Science)
1st	<b>Constitution of the solar system</b> <b>Characteristics of planets</b> <b>Constellation</b> <b>Motion of planets</b> <b>Galaxy and other galaxies</b>

Table 2. Continued

Grade	Content (Earth Science I)
2nd or 3rd	<p><b>Solar Energy</b>  <b>World-view on the universe</b>  <b>The solar system</b>                      constitution and exploration  <b>Stars</b>                      physical properties                      HR diagram                      birth and evolution  <b>Our galaxy</b>                      constitution and structure  <b>Other galaxies</b>                      shape and classification  <b>Expansion of the universe</b></p>
Grade	Content (Earth Science II)
2nd or 3rd	<p><b>Coordinate system</b>  <b>The earth</b>                      rotation and it's evidence                      revolution and it's evidence                      seasons  <b>Time and calender</b>  <b>The solar system</b>                      constitution and origin                      motions of planets  <b>Planets</b>                      motion and physical properties  <b>The sun</b>                      physical properties and structure                      energy source  <b>Stars</b>                      physical properties and structure                      parallax and distance                      spectrum, energy source, composition                      HR diagram  <b>Stellar evolution</b>  <b>Our galaxy</b>                      constiution and distribution  <b>Other galaxies</b>                      characteristics and distribution  <b>The cosmic evolution</b>                      origin                      background radiation  <b>Evolution of the universe</b></p>

**Middle School**

To help students have the abilities to solve problems creatively through comprehension of scientific facts, principles, laws and theories, and using the basic scientific methods and processes.

- a. To acquire scientific inquiry process, and apply them to solve real life problems.
- b. To comprehend elementary scientific knowledge, and apply them to explain natural phenomena.
- c. To stimulate learning motivation and interest in science, and to cultivate positive attitude toward science and science learning.

Table 3. Curriculum of the majoring in astronomy course(department of astronomy in SNU : SNU, 1993)

Grade	Subjects
1st	<p>General astronomy I,II                      General astronomy lab I,II</p>
2nd	<p>Solar system astronomy and lab                      Stellar astronomy and lab                      Mechanics                      Differential equation                      Mathematical physics</p>
3rd	<p>Galaxy and universe                      Astronomical observation I,II                      Introduction to astrophysics I                      Astronomical dynamics and lab                      Ast. spectroscopy and lab                      Galactic astronomy</p>
4th	<p>Introduction to astrophysics II, III                      Variable stars and binaries and lab                      Stellar structure and evolution                      Physics of the ISM and lab                      Introduction to radio astronomy                      Introduction to geodesy                      High energy astronomy                      Orbital theory                      Supervised reading and research</p>

d. To realize the effects of science on the development of technology and progress of society.

**High School**

To help students raise interests and curiosity for natural phenomena, and have right point of view on nature by helping them to acquire scientific knowledge and inquiry methods.

- a. To understand basic science concepts systematically through inquiring natural phenomena and things, and to apply them to explaining natural phenomena.
- b. To improve abilities to inquire nature scientifically and utilize them in solving problems.
- c. To increase interests and curiosity for natural phenomena and science learning, and forster scientific attitudes.
- d. To understand that concepts in science are developing continuously.
- e. To recognize the effects of science on technological developments and social progresses.

**(c) Contents**

Science contents in the science curriculum has two categories : Knowledge and Inquiry.

The Knowledge and Inquiry from elementary school

**Table 4.** Curriculum of the cultivating for earth science[astronomy] teacher course (department of earth science, college of education, SNU : SNU, 1993)

Grade	Subjects
2nd	Solid earth science and lab I,II Solid earth geophysics and lab I,II <b>Astronomy and lab I,II</b> Applied calculus Introduction to mechanics Introduction to electromagnetism Physical chemistry
3rd	Atmospheric science and lab I,II Oceanography and lab I,II <b>Observational astronomy</b> Physical meteorology Environmental earth science Geothermodynamics Science education theory
4th	<b>Basic astrophysics</b> Earth material and lab Historical geology Seismology Geochemistry Synoptic meteorological analysis Statistical meteorology Physical oceanography Field works in earth science Earth science education theory Earth science education study Science Teaching Material

to high school can provide students with good science experience. Many science teacher and educator in Korea appreciate the importance of teaching and learning science in the context of human experience. So, the role of earth and space science education is increasingly emphasized.

**Knowledge** means basic science concepts such as **material, motion, force, energy, life, earth and environment**. Especially, Earth Science I, II in high school have a set of earth science knowledge : **matter of the crust and it's change, the atmosphere and the ocean, the universe, the past and future of the earth**(in Earth science I), and **the earth, matter of the crust and its change, history of the earth, atmospheric circulation and weather change, oceans and ocean currents, solar system, star and the universe, environments and resources**(in Earth Science II).

**Inquiry** means students-oriented science activities which focus on the scientific inquiring skill and process. Inquiry involves the followings : **observation, classification, measurement, communication, prediction, using models, data collection and treatment, data interpretation, experiment, manipu-**

**Table 5.** Astronomy-related subjects in the cultural education course in SNU(SNU, 1993 ; 1995 ; 1996)

Astronomy-related lectures in the cultural education course, SNU
Astronomy and lab I,II Astronomy and lab Earth Science and lab Astronomy Universe, matter and physics Evolution of the Univers Man and Universe Investigation the earth
Lectures opened up in the 1st term, 1996. SNU
Astronomy and lab I (27) <sup>1</sup> Astronomy and lab (150) Earth Science and lab (257) Evolution of the Univers (353) Man and Universe (150)

<sup>1</sup> ( ) indicates the number of students enrolled in each lectures

### lation of apparatus, investigation and discussion.

The astronomy contents in the science curriculum is presented from elementary to high school(Table 2).

### III. ASTRONOMY EDUCATION IN COLLEGE LEVEL

Astronomy education in college can be classified into three types ; majoring in astronomy course, cultivating course for astronomy teachers, and cultural education course involving astronomy-related lectures.

#### (a) Majoring in astronomy course

As of 1994, there are 127 universities (national or public 25, private 102) and 4,408 departments in Korea, and a sort of departments amounts to 524. There are only 7 universities setting up the majoring in astronomy course which are divided into two types ; One is the integrated type whose curriculum is consists of astronomy and atmospheric science or other earth science, and the other is only for astronomy(Korean University Yearbook, 1994).

The curricula of the majoring in astronomy courses vary in degree with the characteristics of the university and the departments. An example of the department of astronomy in Seoul National University(SNU) can be shown in Table 3.

#### (b) Cultivating course for astronomy teachers

In the middle and high school, astronomy is taught as a independent unit or integrated content in the sci-

ence subjects of Science, General Science, Earth Science. So, the cultivating course for science teachers is managed for the purpose of cultivating teachers who can teach Science, General science and Earth Science(H.B. Kim et.al., 1994). Specially, astronomical subjects are opened up in the department of earth science and the majoring in earth science course of the department of science education in college of education.

There are 10 universities in Korea setting up the cultivating course for earth science[astronomy] teacher(H.B. Kim et.al., 1994). Pre-earth science teachers should complete regular courses of astronomy such as **Astronomy and Lab, Observational Astronomy and Astrophysics**(Table 4).

(c) **Cultural Education Course**

The most of universities setting up the majoring in astronomy course open up the astronomy-related lectures in the cultural education course for the students who do not major in astronomy.

For example in SNU, 1993, there are 9 astronomy-related lectures of the total 435 ones in the cultural education course given to students. In the first term, 1996, 937 students in SNU attended 5 astronomy-related lectures(Table 5).

**IV. CONCLUSION**

We have the National Science Curriculum issued by the Education Ministry with which teachers from elementary to high schools should prepare for their teaching materials and textbooks should be written.

Nature in Elementary school, Science in middle school, and General Science in high school are given to be required to students as compulsory courses, but Physics I, II, Chemistry I, II, Biology I, II, Earth Science I, II in high school are given as a elective courses.

In the science programs from elementary to high schools, astronomy is taught not much in 5-6th grades of elementary school, 3rd grade of middle school, 1st grade of in high school in compulsory courses, and 2-3 grades of high school in elective Earth Science I, II.

Astronomy concepts are spirally constructed in order to cultivative the students be a world-citizen with science.

We can classify the astronomy education at the college level in Korea into 3 type : majoring in astronomy, cultivating earth science teachers for astronomy education and cultural education course for non-major students. Many student are very interested in astronomy, but we have to indicate that few student want to study it as a major as those in the most of countries in the world.

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