

10. Development of Revolutionary Teaching Materials and Aids based on Systems Science in order to Popularize Integrated Science in Upper Secondary Schools

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(1) Purpose and Aim of Study

To date, integrated science textbooks have consisted merely of basic content from physics, chemistry, biology, and earth science textbooks presented discretely, rather than being compiled on the basis of principles and philosophies for the cultivation of integrated outlooks on science. We now need to raise basic scientific knowledge and literacy among the general public, boost the number of students with a liking for science, and develop an integrated approach to science education founded in specific principles and philosophies not present in science education to date.

There are two objectives to this study, both oriented to the cultivation of integrated science outlooks and approaches. One is to develop new teaching materials (textbooks) in integrated science founded on the principles and philosophies of systems science; the other is to develop a revolutionary integrated science curriculum based on systems science.

(2) Outline of Research Results

In order to cultivate integrated science outlooks and approaches, we developed seven new teaching materials for integrated science founded on the principles and philosophies of systems science, two integrated science teaching materials centered on conventional subject areas (biology, physics and chemistry), and two teaching materials in integrated science based on new concepts. This involved the following specific projects.

- Development of integrated science teaching materials centered on systems science
 - Integrated Science: “Science with a focus on human relationships and systems”
 - Integrated Science: “Global biosphere environmental systems science”

- Supplementary Reader in Integrated Science: “Important concept formation processes in ecological science”
 - Integrated Science textbook: “Earth systems education”
- Development of systems science-based integrated science on specific themes
 - Integrated Science: “Natural disasters—using science for disaster prevention and disaster mitigation”
 - “Integrating science through water”
- Development of integrated science teaching materials centered on conventional subject areas
 - “We all live together” (integrated science centered on biology)
 - Integrated science for use by teachers with backgrounds in physics and chemistry (integrated science centered on physics and chemistry)
- Development of integrated science teaching materials founded on new perspectives and concepts
 - New integrated science teaching materials based on four key concepts: Elements and Hierarchies, Preservation and Change, Rhythms and Cycles, Heat and Energy
- Testing of integrated science textbooks constituting the five approaches of Accumulating, Tracking, Regulating, Spiraling, and Engineering
- Development of integrated science textbooks constituting the five approaches of Disaster Prevention, Food, Health, Lifestyle, and Environment
- Development of teaching practice on methods for investigating nature
 - Basic approaches and worksheets for organizing investigations into nature
- Development of teaching materials for observation and experiments
 - Upper secondary school biology teaching materials on plant germination using amylase test strips and urinary sugar test strips.

- Developed and implemented a revolutionary integrated science curriculum based on earth systems education and founded in an elementary systems science test of glucose concentration in buckwheat seeds germinated using urinary sugar test strips.
- Developed and implemented a curricular unit on volcanoes in Earth Science I that had been reorganized on the basis of earth systems education founded in systems science.
- Organized a school-set subject “Global Environment” on the basis of earth systems education founded in systems science, and developed and implemented a curriculum for it.
- Developed and implemented an Earth Science I weather curriculum that had been reorganized on the basis of earth systems education founded in systems science.