Standards for the Preparation of Teachers

Integrated Science-Elementary (DI)

Adopted by the Michigan State Board of Education
August 8, 2002

Standards for the Preparation of Teachers of Integrated Science (Elementary)

DI Endorsement

Preface

Development of the Proposal

Over the last several years, a referent group of professional educators developed a proposal to adopt standards for the preparation of integrated science teachers. These standards align with standards developed by the National Science Teachers Association and the Michigan Curriculum Framework for science education.

An elementary integrated science endorsement prepares candidates to teach integrated science in grades K-5, and also to teach biology, chemistry, physics, and earth/space science in grades 6-8, in courses designed to meet the Michigan Curriculum Framework science standards. The preparation of integrated science teachers includes courses of study in each of the three major categories of science identified in the Michigan Curriculum Framework: Life Sciences, Physical Science, and Earth/Space Science. The Elementary Integrated Science Endorsement requires either a group major with a minimum of 36 semester hours distributed among the three major categories for a balance of credits across the areas, or a group minor with a minimum of 24 semester hours among the three major categories. Candidates who apply for the DI endorsement (elementary) must pass the Michigan Test for Teacher Certification integrated science test at the elementary level for their elementary certificate.

To provide information and gather feedback on the proposal, a copy was also forwarded to selected groups/organizations, all Michigan teacher preparation institutions, and a random sample of intermediate and local school districts for review and comment. As presented in this document, the standards reflect the feedback received.

State Board adoption of these standards typically leads to the creation of a new certification test for teachers prepared to teach elementary integrated science. Test development for a new Michigan Test for Teacher Certification in elementary integrated science will be scheduled according to the recommendation of the Standing Technical Advisory Council.

Approval of Programs

Teacher preparation institutions that wish to continue to offer programs to prepare elementary integrated science teachers are required to submit an application for program approval that demonstrates how the new standards are met throughout the proposed curriculum. The programs must be re-approved to show compliance with the new standards. Following initial approval, the teacher preparation

program will be reviewed every five years through the Periodic Review/Program Evaluation process.

Submit a narrative that explains how this program:

- uses the Michigan Curriculum Framework K-12 Science Content Standards and Benchmarks as the critical foundation for teacher preparation, ensuring that elementary integrated science teachers have the content knowledge and the ability to teach this curriculum; and
- develops an understanding of the interconnectedness of all science, along with major unifying themes, and relates this understanding to the teaching of science; and
- prepares candidates to understand and teach biology, chemistry, physics, and earth/space science as integrated content.

Levels of Proficiency:

A– Awareness

The integrated science teacher recognizes/recalls the existence of diff erent aspects of integrated science and related teaching strategies.

B – Basic Understanding

The integrated science teacher articulates knowledge about integrated science and related instructional and assessment strategies. The integrated science teacher demonstrates proficiency in using the knowledge at a fundamental level of competence acceptable for teaching.

C – Comprehensive Understanding

The integrated science teacher is able to apply broad, in-depth knowledge of the different aspects of integrated science in a variety of settings. (This level is not intended to reflect mastery; all teachers are expected to be lifelong learners.)

The preparation of elementary integrated science teachers will enable them to:

1.0 understand and develop the major concepts and principles of biology, chemistry, earth/space science, and physics, which may include such topics as the following:

- 1.1 Cellular Function, including
  - 1.1.1 cell theory (B)
  - 1.1.2 cell types (B)
  - 1.1.3 cell structure and function (C)
  - 1.1.4 protein synthesis (A)
  - 1.1.5 cell division (mitosis & meiosis) (A)
- 1.2 Organization of Living Things, including
  - 1.2.1 life cycles (including sexual and asexual reproduction) (C)
  - 1.2.2 living and non-living (C)
  - 1.2.3 systems (C)

1.2.4 classification (B)
1.2.5 growth and development (embryology, etc.) (A)
1.2.6 photosynthesis (B)
1.2.7 cellular respiration (B)

1.3 Concepts of Heredity, including
1.3.1 Mendelian genetics (B)
1.3.2 traits passed from one generation to the next (C)
1.3.3 molecular genetics (structure of DNA) (A)
1.3.4 modern genetics (electrophoresis, genetic engineering, DNA fingerprinting, etc.) (A)
1.3.5 environmental effects on heredity (B)

1.4 Evolutionary Change, including
1.4.1 diversity/speciation (A)
1.4.2 theory of evolution (adaptation, variation, and natural selection and relationships between species, including human) (B)
1.4.3 fossils/ancient life (B)
1.4.4 extinction (B)

1.5 Ecological Systems, including
1.5.1 community relationships, including predator/prey and symbiosis (C)
1.5.2 population (A)
1.5.3 transfer of energy (food chains/webs) (C)
1.5.4 biogeochemical cycles (B)
1.5.5 human impact (B)

1.6 Human Biology, including
1.6.1 anatomy and physiology (B)
1.6.2 disease and immunology (A)
1.6.3 health habits (B)
1.6.4 resource management (C)
1.6.5 human population growth and diversity (B)

1.7 Earth/Space Science, including
1.7.1 lithosphere and historical geology (B)
1.7.2 hydrosphere (C)
1.7.3 atmosphere, weather, climate (C)
1.7.4 astronomy (B)

1.8 Chemistry and Physics: Major Concepts and Principles of Physics and Chemistry
1.8.1 Inorganic Chemistry, including
1.8.1.1 atomic/molecular structure and bonding (B)

1.8.1.2 stoichiometry (B)
1.8.1.3 gas laws (B)
1.8.1.4 states of matter (C)
1.8.1.5 equilibria (A)
1.8.1.6 acid-bases (B)
1.8.1.7 electrochemistry (A)
1.8.1.8 nomenclature (A)
1.8.1.9 qualitative analysis (A)

1.8.2 Physics, including
1.8.2.1 mechanics (B)
1.8.2.2 electricity and magnetism (B)
1.8.2.3 thermodynamics (A)
1.8.2.4 waves, vibrations, and optics (B)

The preparation of elementary integrated science teachers will enable them to:

2.0 apply mathematics, including statistics, to investigations in the sciences, including the analysis of data;
3.0 relate the study of science to contemporary, historical, technological, and societal issues; in particular, relate the concepts of science to current controversies such as cloning, genetically-modified food, the use of energy, exploitation of resources, global changes, and medical research, as well as other issues;
4.0 locate appropriate resources, design and conduct inquiry-based open-ended scientific investigations, interpret findings, communicate results, and make judgments based on evidence;
5.0 construct new knowledge for themselves through research, reading and discussion, and reflect in an informed way on the role of science in human affairs;
6.0 understand and promote the maintenance of a safe science classroom as identified by the Council of State Science Supervisors, including the ethical and appropriate use and care for living organisms and scientific equipment, and the safe storage, use, and disposal of chemicals;
7.0 demonstrate competence in the practice of teaching as defined within the Entry Level Standards for Michigan Teachers;
8.0 create and maintain an educational environment in which conceptual understanding will occur for all science students;
9.0 develop an understanding and appreciation for the nature of scientific inquiry; and
10.0 demonstrate competence in the practice of teaching through investigative experiences and by demonstrating the application of the scientific process and in assessing student learning through multiple processes.