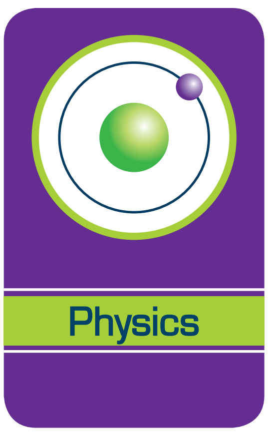
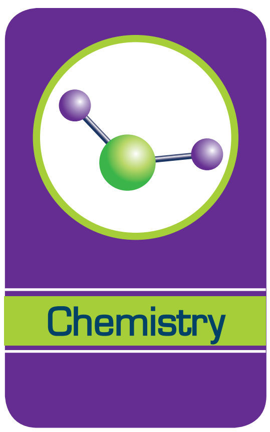
High School Science Priority Expectations in Michigan: Preparing for the Next Generation of Science Standards

A Collaboration to Encourage "State of the Art" Practice in Science Education, in an Era of High Stakes Accountability

Based on the MDE Science Companion Document





ISD/ESA Collaborative Priority Expectation Partners

Allegan AESA
Alpena-Montmorency-Alcona ESD
Bay-Arenac ISD
Branch ISD
Calhoun ISD
Charlevoix-Emmet ISD
Cheboygan-Otsego-Presque Isle ESD
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Clinton County RESA
C.O.O.R. ISD
Eaton ISD
Genesee ISD
Gratiott Isabella RESD
Huron ISD
Ingham ISD
Ionia County ISD
Iosco RESA
Kalamazoo RESA
Kent ISD
Lewis Cass ISD
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Macomb ISD
Manistee ISD
Mason-Lake ISD
Mecosta-Osceola ISD
Midland County ESA
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Newaygo County RESA
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Van Buren ISD
Washtenaw ISD
Wayne RESA
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Table of Contents

Overview of the Science Priority Expectations Document

WHY ANOTHER DOCUMENT ABOUT MICHIGAN SCIENCE STANDARDS?

In recent years, Michigan educators of all subjects have been grappling with the challenges of revising district programs in response to new state standards and assessment designs. Despite clear and well supported recommendations to identify and focus deeply on fewer core concepts in science, Michigan's new standards are numerous and vast in breadth. As a consequence, the imposing enormity of the content expectation obscures critical interrelationships among important core concepts. It promotes an erroneous impression that science literacy is about mastery of a dizzying array of facts and proficiency in discrete skills disconnected from science content. There are exemplary educators, proficient in highly effective instructional practices who are dismayed that they face the difficult trade-off between covering all science content expectations in the standards and teaching in a manner that is known to be effective and inspiring. Also, the incentives that result from common interpretations of our accountability systems (Michigan Merit Exam (MME) and high school graduation requirements) have locked the very aims of our science programs in an outdated mode: emphasizing vast content coverage.

In order to best assure quality educational programming, numerous districts and ISDs had independently embarked upon efforts **to identify the content expectations that are recognized as most important, and therefore deserving of an enhanced focus**. Despite the fact that purposes varied to some degree, it was recognized that a collaborative endeavor would be greatly preferable to several efforts that inevitably would produce different lists of expectations to emphasize. Therefore, a statewide ISD collaboration was initiated and has committed to producing this document. The effort has been encouraged by Michigan's state Superintendent Flanagan who also echoed the sentiments of the ISD collaboration in a June 2009 memo by saying that the high school content expectations…

"…should not be viewed as a list of items that must be checked off one by one. With only so many instructional hours available each year, we know that there is no way for schools to cover in depth every HSCE, nor should districts make that attempt."

WHAT PRINCIPLES GUIDED THE DESIGN OF THE PRIORITY EXPECTATIONS DOCUMENT?

In keeping with research, national leadership in science education and modern, high quality curriculum design these documents are meant to encourage a deep treatment of a limited number of important big ideas and core concepts, explored in a manner that promotes an understanding of the nature of science and the proficiencies that are central to the scientific enterprise. It built in large part on the structure of the science companion documents because they are widely disseminated and utilized. To emphasize the critical interrelationships and intended prominence of big ideas, core concepts and student inquiry, the actual list of priority expectations are located at the bottom of each unit. The prominent and close positioning of the big ideas, core concepts and student inquiry is meant to bring a teacher's focus to the intrinsic interrelationship of these elements of our standards. The graphic organizer ties them together in a single display. This approach provides an intellectual organizational structure (or framing) of the standards which provides invaluable guidance in how ideas are related and how to integrate the practices of science with the overriding big ideas and important core concepts.

The criteria to select the priority expectations were developed to serve these principles.

Which HSCEs should be priorities? Those that:

- best point to central ideas of the discipline (big ideas and core concepts)
- lend themselves to rich student investigations
- readily connect to critical societal concerns

Which HSCEs should not be priorities? Those that are:

- redundant with other, better worded HSCE's
- arbitrary, specific tasks (i.e., reads like a NAEP expectation)
- not strongly connected to core concepts
- overly esoteric, as though part of a bachelor of science program in a science major

These criteria served the process well and interestingly revealed that many decisions were made on the basis of redundancy where one selected expectation sufficiently captured the essence of others or where the expectation was an application of an understanding or concept. Additionally, in depth study of the recommended priority expectations will result in an understanding of the non priority expectations related to that unit.

How should the new high school priority expectations document be used?

1. To assure quality, 'state-of-the-art' science curriculum and instruction

By focusing on fewer, more important science concepts teachers can afford more time to teach in a manner known to be effective and meaningful for students. Curriculum built to provide students well-structured opportunities to investigate scientific questions and embark on problem-solving endeavors puts core knowledge to use and develops proficiencies central to science. These proficiencies happen to largely overlap with the College Readiness Standards of the ACT and most iterations of currently touted 21st Century Skills necessary for individual success in a globally competitive economy.

New insights on learning call for the integration of writing, collaborative discourse and structured activities that reveal frameworks of knowledge and self-reflection on thinking. With a limited focus on more important content as suggested in this document, science teachers will be able to utilize the strategies critical for promoting student success and enthusiasm for science.

2. To define course graduation credit in a deliberate and informed way

Properly interpreted, Michigan's high school graduation requirements do not have to thwart 'state-of-the-art' instructional practice in science. While legislation directs districts to base high school credit on proficiencies of the high school content expectations, school districts retain the prerogative to make choices on what central ideas in our standards are emphasized and which ones ought to be de-emphasized. Also, districts still possess the authority to determine how proficiency is defined and what proficiencies warrant the granting of credit. Courses defined around proficiencies related to fewer, more important core concepts and skills will more likely meet the aims of their design. Such a basis for district decisions will be a great improvement over what can be capricious reasons, (such as a surprisingly early arrival of the end of a year).

3. To improve the reliability of assessments

The best way to give teachers, students and parents more accurate and actionable feedback is to bear down on a limited set of important core concepts and proficiencies with a number of assessment items of varying difficulty and type. This document can make this possible by providing a foundation for refining the focus of district, building and classroom assessments. Assessments that target the most critical outcomes of a strong science program will encourage instructional decisions that support those aims. Rather than targeting each and every high school content expectation, assessments can focus on those that serve the core concepts and student proficiencies that best support the big idea of each unit.

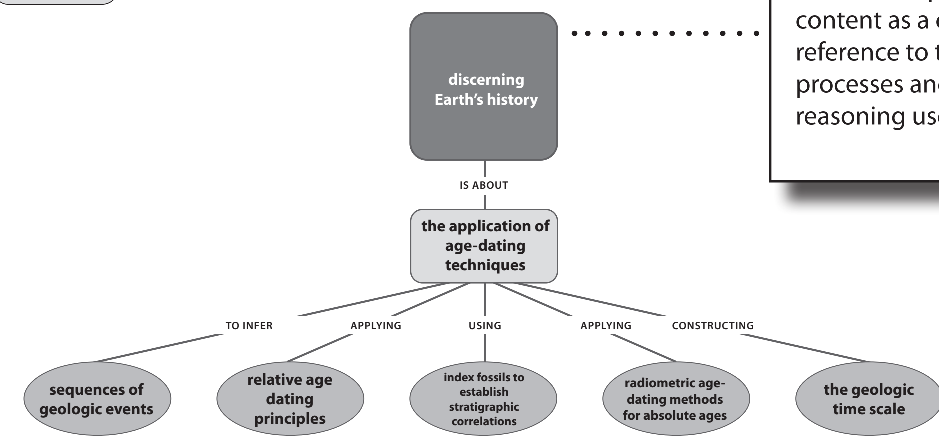
4. To better prepare students for the MME

By far, most points earned on the MME come from the ACT portion. For an individual student, the ACT score is in fact more personally important than the MME score as a whole. Because the ACT is based on College Readiness Standards, students who score well are highly proficient at interpreting scientific data, parsing and evaluating scientific experiments and arguments and reading and interpreting advanced text that describes scientific investigations. The education that prepares students for these challenges is one that involves them both directly and reflectively in scientific investigations. That is exactly the kind of science programming these documents are trying to encourage. By focusing on the fewer more important scientific concepts and big ideas, classroom time can be dedicated to the writing, discussion, analysis and reflection necessary to develop these advanced skills. By suggesting that students engage these ideas through investigation and experimentation these documents encourage a practice that will enable students to draw from more relevant and personal experiences when demonstrating their competencies on the ACT portion of the MME.

Title:
The units and their titles are those of the MDE Companion.

Unit 5

Discerning Earth's History



Big Picture Graphic:
This area depicts the unit content as a concept map with reference to the disciplinary processes and patterns of reasoning used in science.

Big Idea

The application of age-dating techniques provides evidence for a 4.6 billion year old Earth and allows for the interpretation of Earth history and biological evolution, which has been the basis of the design and refinement of the geologic time scale.

Core Concepts

- Gradual and catastrophic change has occurred over the vastness of geologic time (and our lifespans).
- Relative age-dating techniques are used to discern sequencing of geologic events.
- Isotopic age-dating techniques are used to deduce absolute ages of materials and place them within Earth history.

Inquiry, Reflection and Social Implications

E 1.1C Conduct scientific investigations
E 1.1g Critique reasoning based on evidence
Students use relative and absolute age dating techniques to construct a well reasoned geologic history of an area.

E1.2i Explain progressions of ideas
Students explain how the invention and improvement of technology in addition to emerging geologic data aids in the continual refinement of the geologic time scale.

E1.2k Analyze how science and society interact
Students relate the effects of the discovery that Earth is ancient to the science of biology and major elements of society.

...ative • **High School Earth Science Priority Expectations**

Big Idea and Core Concepts:
This area describes the central, big ideas and core concepts of the unit. They should be learned in depth as the focus of instruction and assessment.

Inquiry, Reflection and Social Implications:
This area identifies the HSCE's from Standard 1 that are well served by the content of the unit. It includes some excellent suggestions of ways to engage students in the practices of science as they relate to the unit content. The inquiry HSCE's should be part of the instructional design in all of the units.

Unit 5

Content Expectations *(Priority Expectations are highlighted in gray.)*

E5.3B	**Describe the process of radioactive decay and explain how radioactive elements are used to date the rocks that contain them.**
E5.3C	**Relate major events in the history of the Earth to the geologic time scale, including formation of the Earth, formation of an oxygen atmosphere, rise of life, Cretaceous-Tertiary (K-T) and Permian extinctions, and Pleistocene ice age.**
E5.3D	**Describe how index fossils can be used to determine time sequence.**
E5.3e	Determine the approximate age of a sample, when given the half-life of a radioactive substance (in graph or tabular form) along with the ratio of daughter to parent substances present in the sample.
E5.3f	Explain why C-14 can be used to date a 40,000 year old tree but U-Pb cannot.
E5.3g	**Identify a sequence of geologic events using relative age-dating principles.**

ISD/RESA/RESD Collaborative • **High School Earth Science Priority Expectations** | **103**

Content Expectations:
All of the content expectations of the MDE Companion Document are listed in this area. The "Priority Expectations" are identified by bolding the text. These should be the focus of instruction and assessment, as depicted by the "Big Ideas" and "Core Concepts."