SIXTH GRADE SCIENCE

GRADE LEVEL CONTENT EXPECTATIONS

6 SCIENCE

v.1.09

Welcome to Michigan's K-7 Grade Level Content Expectations

SCIENCE PROCESSES

PHYSICAL SCIENCE

LIFE SCIENCE

EARTH SCIENCE

Purpose & Overview

In 2004, the Michigan Department of Education embraced the challenge of creating Grade Level Content Expectations in response to the Federal No Child Left Behind Act of 2001. This act mandated the existence of a set of comprehensive state grade level assessments in mathematics and English language arts that are designed based on rigorous grade level content. In addition, assessments for science in elementary, middle, and high school were required. To provide greater clarity for what students are expected to know and be able to do by the end of each grade, expectations for each grade level have been developed for science.

In this global economy, it is essential that Michigan students possess personal, social, occupational, civic, and quantitative literacy. Mastery of the knowledge and essential skills defined in Michigan's Grade Level Content Expectations will increase students' ability to be successful academically, and contribute to the future businesses that employ them and the communities in which they choose to live.

Reflecting best practices and current research, the Grade Level Content Expectations provide a set of clear and rigorous expectations for all students, and provide teachers with clearly defined statements of what students should know and be able to do as they progress through school.

Development

In developing these expectations, the K-7 Scholar Work Group depended heavily on the *Science Framework for the 2009 National Assessment of Educational Progress* (National Assessment Governing Board, 2006) which has been the gold standard for the high school content expectations. Additionally, the *National Science Education Standards* (National Research Council, 1996), the Michigan Curriculum Framework in Science (2000 version), and the *Atlas for Science Literacy,* Volumes One (AAAS, 2001) and Two (AAAS, 2007), were all continually consulted for developmental guidance. As a further resource for research on learning progressions and curricular designs, *Taking Science to School: Learning and Teaching Science in Grades K-8* (National Research Council, 2007) was extensively utilized. The following statement from this resource was a guiding principle:

"The next generation of science standards and curricula at the national and state levels should be centered on a few core ideas and should expand on them each year, at increasing levels of complexity, across grades K-8. Today's standards are still too broad, resulting in superficial coverage of science that fails to link concepts or develop them over successive grades."

Michigan's K-7 Scholar Work Group executed the intent of this statement in the development of "the core ideas of science...the big picture" in this document.

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Curriculum

Using this document as a focal point in the school improvement process, schools and districts can generate conversations among stakeholders concerning current policies and practices to consider ways to improve and enhance student achievement. Together, stakeholders can use these expectations to guide curricular and instructional decisions, identify professional development needs, and assess student achievement.

Assessment

The Science Grade Level Content Expectations document is intended to be a curricular guide with the expectations written to convey expected performances by students. Science will continue to be assessed in grades five and eight for the Michigan Educational Assessment Program (MEAP) and MI-Access.

Preparing Students for Academic Success

In the hands of teachers, the Grade Level Content Expectations are converted into exciting and engaging learning for Michigan's students. As educators use these expectations, it is critical to keep in mind that content knowledge alone is not sufficient for academic success. Students must also generate questions, conduct investigations, and develop solutions to problems through reasoning and observation. They need to analyze and present their findings which lead to future questions, research, and investigations. Students apply knowledge in new situations, to solve problems by generating new ideas, and to make connections between what they learn in class to the world around them.

Through the collaborative efforts of Michigan educators and creation of professional learning communities, we can enable our young people to attain the highest standards, and thereby open doors for them to have fulfilling and successful lives.

Understanding the Organizational Structure

The science expectations in this document are organized into disciplines, standards, content statements, and specific content expectations. The content statements in each science standard are broader, more conceptual groupings. The skills and content addressed in these expectations will, in practice, be woven together into a coherent, science curriculum.

To allow for ease in referencing expectations, each expectation has been coded with a discipline, standard, grade-level, and content statement/expectation number.

For example, **P.FM.02.34** indicates:

P - Physical Science Discipline

FM-Force and Motion Standard

02-Second Grade

34-Fourth Expectation in the Third Content Statement

Content statements are written and coded for Elementary and Middle School Grade Spans. Not all content expectations for the content statement will be found in each grade.

Why Create a 1.09 Version of the Expectations?

The Office of School Improvement is committed to creating the best possible product for educators. This committment served as the impetus for revision of the 12.07 edition. This new version, v.1.09, refines and clarifies the original expectations, while preserving their essence and original intent and reflects the feedback from educators across the state during the past year.

Middle School (5-7) Science Organizational Structure

Discipline 1 Science Processes	Discipline 2 Physical Science	Discipline 3 Life Science	Discipline 4 Earth Science
Standards and Statements *(and number of Content Expectations in each Statement)*			
Inquiry Process (IP) **Inquiry Analysis and Communication (IA)** **Reflection and Social Implications (RS)**	**Force and Motion (FM)** Force Interactions (2) Force (4) Speed (3) **Energy (EN)** Kinetic and Potential Energy (2) Waves and Energy (3) Energy Transfer (3) Solar Energy Effects (2) **Properties of Matter (PM)** Chemical Properties (1) Elements and Compounds (4) **Changes in Matter (CM)** Changes in State (2) Chemical Changes (3)	**Organization of Living Things (OL)** Cell Functions (4) Growth and Development (2) Animal Systems (2) Producers, Consumers, and Decomposers (2) Photosynthesis (3) **Heredity (HE)** Inherited and Acquired Traits (2) Reproduction (2) **Evolution (EV)** Species Adaptation and Survival (4) Relationships Among Organisms (1) **Ecosystems (EC)** Interactions of Organisms (1) Relationships of Organisms (3) Biotic and Abiotic Factors (2) Environmental Impact of Organisms (2)	**Earth Systems (ES)** Solar Energy (3) Human Consequences (2) Seasons (2) Weather and Climate (4) Water Cycle (2) **Solid Earth (SE)** Soil (4) Rock Formation (1) Plate Tectonics (3) Magnetic Field of Earth (2) **Fluid Earth (FE)** Atmosphere (2) **Earth in Space and Time (ST)** Solar System (1) Solar System Motion (5) Fossils (1) Geologic Time (2)

Science Processes: Inquiry Process, Inquiry Analysis and Communication, Reflection, and Social Implications

Sixth grade students have had multiple experiences in science inquiry, practice in investigating a question, and the selection of a variety of resources for information gathering and problem solving. Through the grade level science processes, students gain a greater understanding of the nature and structure of scientific knowledge and the process of its development. Throughout the middle school years, students should be provided with the opportunity to engage in full inquiry experiences that include raising a question based on observations, data sets, and/or research, designing an investigation, gathering information through observation and data collection, analyzing and evaluating information, engaging in science discourse, and formally presenting their findings. Sixth grade students need guidance and practice in the identification of variables and controlling more than one variable in an investigation. They need clarification in recognizing the difference between a scientific explanation and evidence.

With appropriate guidance and experiences, sixth grade students can recognize science as a means of gathering information and confirming or challenging their current beliefs about the natural world, the effect humans and other organisms have on the natural world, and begin to design solutions through science and technology to world challenges.

Physical Science: Energy and Changes in Matter

Students enter the sixth grade with the knowledge of different forms of energy (sound, light, heat, electrical, and magnetic). They have had the opportunity to explore properties of sound and light, observe heat transfer, construct a simple circuit, observe the interaction between magnetic and non-magnetic material, and finally make an electro-magnetic motor. Sixth grade students deepen their understanding of energy through investigations into kinetic and potential energy and the demonstration of the transformation of kinetic energy. Through the investigation of energy transfer by radiation, conduction, or convection, students are introduced to the concept that energy can be transferred while no energy is lost or gained. Students begin to see the connections among light, heat, sound, electricity, and magnetism. They gain an understanding that energy is an important property of substances and that most changes observed involve an energy transfer. Students will understand energy by observing multiple forms of energy transfer and begin to dispel the misconception that energy is linked to fuel or something that is stored, ready to use, and gets consumed.

Sixth grade students also build on their understanding of changes in matter by exploring states in terms of the arrangement and motion of atoms and molecules. They are given the opportunity to design investigations that provide evidence that mass is conserved as it changes from state to state.

Life Science: Organization of Living Things and Ecosystems

The study of life science in the elementary curriculum has introduced students to roles organisms play in a food web, their needs to survive, and the physical and behavioral characteristics that help them survive. The elementary student has a beginning understanding of the dependency of organisms on one another and balance in an ecosystem's food web. Sixth grade students build on their prior knowledge by exploring classifications of organisms based on their source of energy (producers, consumers, and decomposers) and distinguish between ways in which organisms obtain energy. The study of ecosystems at this level includes interactions of organisms within populations, communities, and ecosystems including examples in the Great Lakes region. Students recognize patterns in ecosystems and broaden their understanding from the way one species lives in an environment to how populations and communities interact. They explore how populations can be mutually beneficial and how that relationship can lead to interdependency.

The final course of study in ecosystems for the sixth grader includes biotic and abiotic factors in an ecosystem that influence change. Included is the consequence of overpopulation of a species, including humans. Students explore how humans affect change, purposefully and accidentally, and recognize possible consequences for activity and development.

Earth Science: Solid Earth, Earth in Space and Time

Sixth grade students develop a deeper understanding of the Earth through the exploration of the rock cycle, phenomena that shape the Earth, and Earth's history. In the elementary curriculum, students observed a variety of Earth materials and identified different properties that help sustain life. Sixth grade students explore the formation and weathering of rocks and how different soil types are formed. Their knowledge continues through study of movement of lithospheric plates, major geological events, and layers of the Earth. Students are introduced to the concept of the Earth as a magnet.

The Earth science curriculum includes a deeper exploration into rocks, rock layers, and fossils. They provide evidence of the history of the Earth and are used to measure geologic time. Fossils provide evidence of how life and environmental conditions have changed over long periods of time.

The concept of energy in the sixth grade curriculum is integral throughout the study in physical, life, and Earth science. Students gain a deeper understanding of the concept when encouraged to apply what they know about energy transfer to energy in ecosystems and the rapid and gradual changes on Earth.

Sixth Grade Science Standards, Statements, and Expectations

Note: *The number in parentheses represents the number of expectations..*

Discipline 1: Science Processes (S)

Standard: Inquiry Process (IP)
1 Statement (6)

Standard: Inquiry Analysis and Communication (IA)
1 Statement (5)

Standard: Reflection and Social Implications (RS)
1 Statement (9)

Discipline 2: Physical Science (P)

Standard: **Energy (EN)**
Kinetic and Potential Energy (2)
Energy Transfer (2)

Standard: **Changes in Matter (CM)**
Changes in State (2)

Discipline 3: Life Science (L)

Standard: Organization of Living Things (OL)
Producers, Consumers, and Decomposers (2)

Standard: Ecosystems (EC)
Interactions of Organisms (1)
Relationships of Organisms (3)
Biotic and Abiotic Factors (2)
Environmental Impact of Organisms (2)

Discipline 4: Earth Science (E)

Standard: Solid Earth (SE)
Soil (4)
Rock Formation (1)
Plate Tectonics (3)
Magnetic Field of Earth (2)

Standard: **Earth in Space and Time (ST)**
Fossils (1)
Geologic Time (2)

SCIENCE PROCESSES

Inquiry Process

K-7 Standard S.IP: *Develop an understanding that scientific inquiry and reasoning involves observing, questioning, investigating, recording, and developing solutions to problems.*

S.IP.M.1 Inquiry involves generating questions, conducting investigations, and developing solutions to problems through reasoning and observation.

S.IP.06.11 Generate scientific questions based on observations, investigations, and research.
S.IP.06.12 Design and conduct scientific investigations.
S.IP.06.13 Use tools and equipment (spring scales, stop watches, meter sticks and tapes, models, hand lens, thermometer, models, sieves, microscopes) appropriate to scientific investigations.
S.IP.06.14 Use metric measurement devices in an investigation.
S.IP.06.15 Construct charts and graphs from data and observations.
S.IP.06.16 Identify patterns in data.

Inquiry Analysis and Communication

K-7 Standard S.IA: *Develop an understanding that scientific inquiry and investigations require analysis and communication of findings, using appropriate technology.*

S.IA.M.1 Inquiry includes an analysis and presentation of findings that lead to future questions, research, and investigations.

S.IA.06.11 Analyze information from data tables and graphs to answer scientific questions.
S.IA.06.12 Evaluate data, claims, and personal knowledge through collaborative science discourse.
S.IA.06.13 Communicate and defend findings of observations and investigations using evidence.
S.IA.06.14 Draw conclusions from sets of data from multiple trials of a scientific investigation.
S.IA.06.15 Use multiple sources of information to evaluate strengths and weaknesses of claims, arguments, or data.

Reflection and Social Implications

K-7 Standard S.RS: *Develop an understanding that claims and evidence for their scientific merit should be analyzed. Understand how scientists decide what constitutes scientific knowledge. Develop an understanding of the importance of reflection on scientific knowledge and its application to new situations to better understand the role of science in society and technology.*

S.RS.M.1 Reflecting on knowledge is the application of scientific knowledge to new and different situations. Reflecting on knowledge requires careful analysis of evidence that guides decision-making and the application of science throughout history and within society.

S.RS.06.11 Evaluate the strengths and weaknesses of claims, arguments, and data.
S.RS.06.12 Describe limitations in personal and scientific knowledge.
S.RS.06.13 Identify the need for evidence in making scientific decisions.
S.RS.06.14 Evaluate scientific explanations based on current evidence and scientific principles.
S.RS.06.15 Demonstrate scientific concepts through various illustrations, performances, models, exhibits, and activities.
S.RS.06.16 Design solutions to problems using technology.
S.RS.06.17 Describe the effect humans and other organisms have on the balance of the natural world.
S.RS.06.18 Describe what science and technology can and cannot reasonably contribute to society.
S.RS.06.19 Describe how science and technology have advanced because of the contributions of many people throughout history and across cultures.

PHYSICAL SCIENCE | Energy

K-7 Standard P.EN: *Develop an understanding that there are many forms of energy (such as heat, light, sound, and electrical) and that energy is transferable by convection, conduction, or radiation. Understand energy can be in motion, called kinetic; or it can be stored, called potential. Develop an understanding that as temperature increases, more energy is added to a system. Understand nuclear reactions in the sun produce light and heat for the Earth.*

P.EN.M.1 Kinetic and Potential Energy- Objects and substances in motion have kinetic energy. Objects and substances may have potential energy due to their relative positions in a system. Gravitational, elastic, and chemical energy are all forms of potential energy.

P.EN.06.11 Identify kinetic or potential energy in everyday situations (for example: stretched rubber band, objects in motion, ball on a hill, food energy).
P.EN.06.12 Demonstrate the transformation between potential and kinetic energy in simple mechanical systems (for example: roller coasters, pendulums).

P.EN.M.4 Energy Transfer- Energy is transferred from a source to a receiver by radiation, conduction, and convection. When energy is transferred from one system to another, the quantity of energy before the transfer is equal to the quantity of energy after the transfer. *

P.EN.06.41 Explain how different forms of energy can be transferred from one place to another by radiation, conduction, or convection.

P.EN.06.42 Illustrate how energy can be transferred while no energy is lost or gained in the transfer.

Changes in Matter

K-7 Standard P.CM: *Develop an understanding of changes in the state of matter in terms of heating and cooling, and in terms of arrangement and relative motion of atoms and molecules. Understand the differences between physical and chemical changes. Develop an understanding of the conservation of mass. Develop an understanding of products and reactants in a chemical change.*

P.CM.M.1 Changes in State- Matter changing from state to state can be explained by using models which show that matter is composed of tiny particles in motion. When changes of state occur, the atoms and/or molecules are not changed in structure. When the changes in state occur, mass is conserved because matter is not created or destroyed.

P.CM.06.11 Describe and illustrate changes in state, in terms of the arrangement and relative motion of the atoms or molecules.

P.CM.06.12 Explain how mass is conserved as a substance changes from state to state in a closed system. *

LIFE SCIENCE

Organization of Living Things

K-7 Standard L.OL: *Develop an understanding that plants and animals (including humans) have basic requirements for maintaining life which include the need for air, water, and a source of energy. Understand that all life forms can be classified as producers, consumers, or decomposers as they are all part of a global food chain where food/energy is supplied by plants which need light to produce food/energy. Develop an understanding that plants and animals can be classified by observable traits and physical characteristics. Understand that all living organisms are composed of cells and they exhibit cell growth and division. Understand that all plants and animals have a definite life cycle, body parts, and systems to perform specific life functions.*

* Revised expectations marked by an asterisk.

L.OL.M.5 Producers, Consumers, and Decomposers – Producers are mainly green plants that obtain energy from the sun by the process of photosynthesis. All animals, including humans, are consumers that meet their energy needs by eating other organisms or their products. Consumers break down the structures of the organisms they eat to make the materials they need to grow and function. Decomposers, including bacteria and fungi, use dead organisms or their products to meet their energy needs. *

L.OL.06.51 Classify producers, consumers, and decomposers based on their source of food (the source of energy and building materials). *

L.OL.06.52 Distinguish between the ways in which consumers and decomposers obtain energy.

Ecosystems

K-7 Standard L.EC: *Develop an understanding of the interdependence of the variety of populations, communities and ecosystems, including those in the Great Lakes region. Develop an understanding of different types of interdependence and that biotic (living) and abiotic (non-living) factors affect the balance of an ecosystem. Understand that all organisms cause changes, some detrimental and others beneficial, in the environment where they live.*

L.EC.M.1 Interactions of Organisms- Organisms of one species form a population. Populations of different organisms interact and form communities. Living communities and nonliving factors that interact with them form ecosystems.

L.EC.06.11 Identify and describe examples of populations, communities, and ecosystems including the Great Lakes region. *

L.EC.M.2 Relationships of Organisms- Two types of organisms may interact with one another in several ways: they may be in a producer/consumer, predator/prey, or parasite/host relationship. Some organisms may scavenge or decompose another. Relationships may be competitive or mutually beneficial. Some species have become so adapted to each other that neither could survive without the other.

L.EC.06.21 Describe common patterns of relationships between and among populations (competition, parasitism, symbiosis, predator/prey).

L.EC.06.22 Explain how two populations of organisms can be mutually beneficial and how that can lead to interdependency.

L.EC.06.23 Predict how changes in one population might affect other populations based upon their relationships in the food web.

* Revised expectations marked by an asterisk.

L.EC.M.3 Biotic and Abiotic Factors- The number of organisms and populations an ecosystem can support depends on the biotic (living) resources available and abiotic (nonliving) factors, such as quality of light and water, range of temperatures, and soil composition.

L.EC.06.31 Identify the living (biotic) and nonliving (abiotic) components of an ecosystem.

L.EC.06.32 Identify the factors in an ecosystem that influence changes in population size.

L.EC.M.4 Environmental Impact of Organisms- All organisms (including humans) cause change in the environment where they live. Some of the changes are harmful to the organism or other organisms, whereas others are helpful.

L.EC.06.41 Describe how human beings are part of the ecosystem of the Earth and that human activity can purposefully, or accidentally, alter the balance in ecosystems.

L.EC.06.42 Predict possible consequences of overpopulation of organisms, including humans, (for example: species extinction, resource depletion, climate change, pollution).

EARTH SCIENCE — Solid Earth

K-7 Standard E.SE: *Develop an understanding of the properties of Earth materials and how those properties make materials useful. Understand gradual and rapid changes in Earth materials and features of the surface of Earth. Understand magnetic properties of Earth.*

E.SE.M.1 Soil- Soils consist of weathered rocks and decomposed organic materials from dead plants, animals, and bacteria. Soils are often found in layers with each having a different chemical composition and texture.

E.SE.06.11 Explain how physical and chemical weathering lead to erosion and the formation of soils and sediments.

E.SE.06.12 Explain how waves, wind, water, and glacier movement, shape and reshape the land surface of the Earth by eroding rock in some areas and depositing sediments in other areas.

E.SE.06.13 Describe how soil is a mixture made up of weather eroded rock and decomposed organic material.

E.SE.06.14 Compare different soil samples based on particle size and texture.

E.SE.M.4 Rock Formation- Rocks and rock formations bear evidence of the minerals, materials, temperature/pressure conditions, and forces that created them.

E.SE.06.41 Compare and contrast the formation of rock types (igneous, metamorphic, and sedimentary) and demonstrate the similarities and differences using the rock cycle model.

E.SE.M.5 Plate Tectonics- The lithospheric plates of the Earth constantly move, resulting in major geological events, such as earthquakes, volcanic eruptions, and mountain building.

E.SE.06.51 Explain plate tectonic movement and how the lithospheric plates move centimeters each year.

E.SE.06.52 Demonstrate how major geological events (earthquakes, volcanic eruptions, mountain building) result from these plate motions.

E.SE.06.53 Describe layers of the Earth as a lithosphere (crust and upper mantle), convecting mantle, and dense metallic core.

E.SE.M.6 Magnetic Field of Earth- Earth as a whole has a magnetic field that is detectable at the surface with a compass.

E.SE.06.61 Describe the Earth as a magnet and compare the magnetic properties of the Earth to that of a natural or manufactured magnet. *

E.SE.06.62 Explain how a compass works using the magnetic field of the Earth, and how a compass is used for navigation on land and sea.

Earth in Space and Time

K-7 Standard E.ST: *Develop an understanding that the sun is the central and largest body in the solar system and that Earth and other objects in the sky move in a regular and predictable motion around the sun. Understand that those motions explain the day, year, moon phases, eclipses and the appearance of motion of objects across the sky. Understand that gravity is the force that keeps the planets in orbit around the sun and governs motion in the solar system. Develop an understanding that fossils and layers of Earth provide evidence of the history of Earth's life forms, changes over long periods of time, and theories regarding Earth's history and continental drift.*

E.ST.M.3 Fossils- Fossils provide important evidence of how life and environmental conditions have changed in a given location.

E.ST.06.31 Explain how rocks and fossils are used to understand the age and geological history of the Earth (timelines and relative dating, rock layers).

* Revised expectations marked by an asterisk.

E.ST.M.4 Geologic Time- Earth processes seen today (erosion, mountain building, and glacier movement) make possible the measurement of geologic time through methods such as observing rock sequences and using fossils to correlate the sequences at various locations.

E.ST.06.41 Explain how Earth processes (erosion, mountain building, and glacier movement) are used for the measurement of geologic time through observing rock layers.

E.ST.06.42 Describe how fossils provide important evidence of how life and environmental conditions have changed.