

# GRADE LEVEL CONTENT EXPECTATIONS

# 4

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.

## 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 commitment 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.

## Elementary (K-4) Science Organizational Structure

Discipline 1 Science Processes	Discipline 2 Physical Science	Discipline 3 Life Science	Discipline 4 Earth Science
<b>Standards and Statements</b> <i>(and number of Content Expectations in each Statement)</i>			
<b>Inquiry Process (IP)</b> <b>Inquiry Analysis and Communication (IA)</b> <b>Reflection and Social Implications (RS)</b>	<b>Force and Motion (FM)</b> Position (2) Gravity (2) Force (8) Speed (3) <b>Energy (EN)</b> Forms of Energy (2) Light Properties (2) Sound (2) Energy and Temperature (3) Electrical Circuits (2) <b>Properties of Matter (PM)</b> Physical Properties (8) States of Matter (3) Magnets (4) Material Composition (1) Conductive and Reflective Properties (3) <b>Changes in Matter (CM)</b> Changes in State (1)	<b>Organization of Living Things (OL)</b> Life Requirements (6) Life Cycles (2) Structures and Functions (2) Classification (2) <b>Heredity (HE)</b> Observable Characteristics (3) <b>Evolution (EV)</b> Environmental Adaptation (2) Survival (2) <b>Ecosystems (EC)</b> Interactions (1) Changed Environment Effects (1)	<b>Earth Systems (ES)</b> Solar Energy (2) Weather (4) Weather Measurement (2) Natural Resources (4) Human Impact (2) <b>Solid Earth (SE)</b> Earth Materials (4) Surface Changes (2) Using Earth Materials (2) <b>Fluid Earth (FE)</b> Water (4) Water Movement (2) <b>Earth in Space and Time (ST)</b> Characteristics of Objects in the Sky (2) Patterns of Objects in the Sky (5) Fossils (2)

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

As students enter the fourth grade, they have developed their skills in observation, measurement, data collection and analysis, real-world application, and finally presentations of their findings to others. New science processes are not introduced at this level, but it is the intent of the expectations to provide content in which the students can practice and apply their inquiry skills as a process of testing their ideas and logically use evidence to formulate explanations.

### Physical Science: Energy, Properties of Matter, Changes in Matter

Students enter the fourth grade with prior knowledge regarding energy in the context of sound and light as examples of energy. Heat and electricity are introduced as additional forms of energy, as well as describing energy in terms of evidence of change or transfer. Students have intuitive notions that energy is necessary to get things done and that humans get energy from food. Children are not expected to understand the complex concept of energy at this level. By experimenting with light and sound (third grade) and heat, electricity and magnetism in fourth grade, students begin to recognize evidence of energy through observation and measurement of change. Through multiple experiences with simple electrical circuits, heat transfer, and magnetism, students make simple correlations and describe how heat is produced through electricity, identify conductors of heat and electricity, and explain the conditions necessary to make an electromagnet.

The content expectations for physical science conclude with the study of properties of matter that can be measured and observed, states of matter, and changes in states of matter through heating and cooling.

### **Life Science: Organization of Living Things, Evolution, and Ecosystems**

The role of different organisms and the flow of energy within an ecosystem is the main concept in fourth grade life science. Students explore the life requirements of living organisms and their source of energy for growth and repair. In their investigations, students study individual differences in organisms of the same kind and identify how those differences of organisms may give them an advantage for survival and reproduction. Students conclude their elementary life science exploration by investigating food chains or webs and how environmental changes can produce a change in the food web and species survival.

### **Earth Science: Earth in Space and Time**

The identification and comparison of common objects in the sky begins the study of Earth in space. Through long term observations of the sun and moon, students identify patterns in movement and collect data to summarize information regarding the orbit of the Earth around the sun, and the moon around the Earth. Models and activities provide the tools to demonstrate the orbits and explain the predictable cycle of one month in the phases of the moon, and day and night as the apparent movement of the sun and moon across the sky.

Students explore the history of the Earth through evidence from fossils and compare fossils of life forms with organisms that exist today.

The underlying theme within the physical, life, and Earth science is energy and specifically energy from the sun. Students can make connections between the heat and light energy from the sun and the dependency of all living things on the sun.

## Fourth 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 (7)

### Discipline 2: Physical Science (P)

#### Standard: Energy (EN)

Forms of Energy (1)

Energy and Temperature (3)

Electrical Circuits (2)

#### Standard: Properties of Matter (PM)

Physical Properties (3)

States of Matter (1)

Magnets (2)

Conductive and Reflective Properties (1)

#### Standard: Changes in Matter (CM)

Changes in State (1)

### Discipline 3: Life Science (L)

#### Standard: Organization of Living Things (OL)

Life Requirements (2)

#### Standard: Evolution (EV)

Survival (2)

#### Standard: Ecosystems (EC)

Interactions (1)

Changed Environment Effects (1)

### Discipline 4: Earth Science (E)

#### Standard: Earth in Space and Time (ST)

Characteristics of Objects in the Sky (2)

Patterns of Objects in the Sky (5)

Fossils (2)

## SCIENCE PROCESSES Inquiry Process

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**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.E.1 Inquiry involves generating questions, conducting investigations, and developing solutions to problems through reasoning and observation.**

**S.IP.04.11** Make purposeful observation of the natural world using the appropriate senses.

**S.IP.04.12** Generate questions based on observations.

**S.IP.04.13** Plan and conduct simple and fair investigations.

**S.IP.04.14** Manipulate simple tools that aid observation and data collection (for example: hand lens, balance, ruler, meter stick, measuring cup, thermometer, spring scale, stop watch/timer, graduated cylinder/beaker).

**S.IP.04.15** Make accurate measurements with appropriate units (millimeters centimeters, meters, milliliters, liters, Celsius, grams, seconds, minutes) for the measurement tool.

**S.IP.04.16** Construct simple charts and graphs from data and observations.

### **Inquiry Analysis and Communication**

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

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

**S.IA.04.11** Summarize information from charts and graphs to answer scientific questions.

**S.IA.04.12** Share ideas about science through purposeful conversation in collaborative groups.

**S.IA.04.13** Communicate and present findings of observations and investigations.

**S.IA.04.14** Develop research strategies and skills for information gathering and problem solving.

**S.IA.04.15** Compare and contrast sets of data from multiple trials of a science investigation to explain reasons for differences.

### **Reflection and Social Implications**

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**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.E.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.04.11** Demonstrate scientific concepts through various illustrations, performances, models, exhibits, and activities.

**S.RS.04.14** Use data/samples as evidence to separate fact from opinion.

**S.RS.04.15** Use evidence when communicating scientific ideas.

**S.RS.04.16** Identify technology used in everyday life.

**S.RS.04.17** Identify current problems that may be solved through the use of technology.

**S.RS.04.18** Describe the effect humans and other organisms have on the balance of the natural world.

**S.RS.04.19** Describe how people have contributed to science 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.E.1 Forms of Energy- Heat, electricity, light, and sound are forms of energy.**

**P.EN.04.12** Identify heat and electricity as forms of energy.

**P.EN.E.4 Energy and Temperature- Increasing the temperature of any substance requires the addition of energy.**

**P.EN.04.41** Demonstrate how temperature can be increased in a substance by adding energy.

**P.EN.04.42** Describe heat as the energy produced when substances burn, certain kinds of materials rub against each other, and when electricity flows through wire.

**P.EN.04.43** Describe how heat is produced through electricity, rubbing, and burning.

**P.EN.E.5 Electrical Circuits- Electrical circuits transfer electrical energy and produce magnetic fields.**

**P.EN.04.51** Demonstrate how electrical energy is transferred and changed through the use of a simple circuit. \*

**P.EN.04.52** Demonstrate magnetic effects in a simple electric circuit. \*

**Properties of Matter**

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***K-7 Standard P.PM:*** *Develop an understanding that all matter has observable attributes with physical and chemical properties that are described, measured, and compared. Understand that states of matter exist as solid, liquid, or gas; and have physical and chemical properties. Understand all matter is composed of combinations of elements, which are organized by common attributes and characteristics on the Periodic Table. Understand that substances can be classified as mixtures or compounds and according to their physical and chemical properties.*

**P.PM.E.1 Physical Properties- All objects and substances have physical properties that can be measured.**

**P.PM.04.16** Measure the weight (spring scale) and mass (balances in grams or kilograms) of objects.

**P.PM.04.17** Measure volumes of liquids in milliliters and liters. \*

**P.PM.E.2 States of Matter- Matter exists in several different states: solids, liquids, and gases. Each state of matter has unique physical properties. Gases are easily compressed, but liquids and solids do not compress easily. Solids have their own particular shapes, but liquids and gases take the shape of the container.**

**P.PM.04.23** Compare and contrast the states (solids, liquids, gases) of matter.

**P.PM.E.3 Magnets- Magnets can repel or attract other magnets. Magnets can also attract magnetic objects. Magnets can attract and repel at a distance. \***

**P.PM.04.33** Demonstrate magnetic field by observing the patterns formed with iron filings using a variety of magnets.

**P.PM.04.34** Demonstrate that non-magnetic objects are affected by the strength of the magnet and the distance away from the magnet.

\* Revised expectations marked by an astrisk.

**P.PM.E.5 Conductive and Reflective Properties- Objects vary to the extent they absorb and reflect light energy and conduct heat and electricity.**

**P.PM.04.53** Identify objects that are good conductors or poor conductors of heat and electricity.

### **Changes in Matter**

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***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.E.1 Changes in State- Matter can be changed from one state (liquid, solid, gas) to another and then back again. Heating and cooling may cause changes in state. \***

**P.CM.04.11** Explain how matter can change from one state (liquid, solid, gas) to another by heating and cooling.

## **LIFE SCIENCE**

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### **Organization of Living Things**

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***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.*

**L.OL.E.1 Life Requirements- Organisms have basic needs. Animals and plants need air, water, and food. Plants also require light. Plants and animals use food as a source of energy and as a source of building material for growth and repair.**

**L.OL.04.15** Determine that plants require air, water, light, and a source of energy and building material for growth and repair.

**L.OL.04.16** Determine that animals require air, water, and a source of energy and building material for growth and repair.

\* Revised expectations marked by an astrisk.

## Evolution

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***K-7 Standard L.EV:*** Develop an understanding that plants and animals have observable parts and characteristics that help them survive and flourish in their environments. Understand that fossils provide evidence that life forms have changed over time and were influenced by changes in environmental conditions. Understand that life forms either change (evolve) over time or risk extinction due to environmental changes and describe how scientists identify the relatedness of various organisms based on similarities in anatomical features.

**L.EV.E.2 Survival- Individuals of the same kind differ in their characteristics, and sometimes the differences give individuals an advantage in surviving and reproducing.**

**L.EV.04.21** Identify individual differences (color, leg length, size, wing size, ;eaf shape) in organisms of the same kind. \*

**L.EV.04.22** Identify how variations in physical characteristics of individual organisms give them an advantage for survival and reproduction.

## Ecosystems

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***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.E.1 Interactions- Organisms interact in various ways including providing food and shelter to one another. Some interactions are helpful; others are harmful to the organism and other organisms.**

**L.EC.04.11** Identify organisms as part of a food chain or food web.

***L.EC.E.2 Changed Environment Effects- When the environment changes, some plants and animals survive to reproduce; others die or move to new locations.***

**L.EC.04.21** Explain how environmental changes can produce a change in the food web.

\* Revised expectations marked by an asterisk.

**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.E.1 Characteristics of Objects in the Sky- Common objects in the sky have observable characteristics.**

**E.ST.04.11** Identify the sun and moon as common objects in the sky. \*

**E.ST.04.12** Compare and contrast the characteristics of the sun, moon and Earth, including relative distances and abilities to support life.

**E.ST.E.2 Patterns of Objects in the Sky- Common objects in the sky have predictable patterns of movement. \***

**E.ST.04.21** Describe the orbit of the Earth around the sun as it defines a year.

**E.ST.04.22** Explain that the spin of the Earth creates day and night.

**E.ST.04.23** Describe the motion of the moon around the Earth.

**E.ST.04.24** Explain how the visible shape of the moon follows a predictable cycle which takes approximately one month.

**E.ST.04.25** Describe the apparent movement of the sun and moon across the sky through day/night and the seasons.

**E.ST.E.3 Fossils- Fossils provide evidence about the plants and animals that lived long ago and the nature of the environment at that time.**

**E.ST.04.31** Explain how fossils provide evidence of the history of the Earth.

**E.ST.04.32** Compare and contrast life forms found in fossils and organisms that exist today.

\* Revised expectations marked by an asterisk.