LJ Group

Educational
Solutions

Living with Science Supporting Michigan Science Standards

CM504/A

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Contents

Section 1.

Michigan Science Standards

Science

Vision Statement

Science is a way of making sense of the natural world. Scientists seek to describe its complexity, to explain its systems and events, and to find the patterns that allow for predictions. Science is the basis for the design of technologies that solve real-world problems.

Not all students will become scientists or engineers. But science and technology occupy ever-expanding places in our everyday lives. As citizens, we are asked to make decisions about social issues that involve science and technology. As workers, we have occupations that increasingly involve science and technology. In the 21st century, adults will need to be comfortable and competent in a complex, scientific and technological world. Schools have the responsibility of preparing students for the future. Schools must prepare all students — regardless of their future aspirations — to be scientifically literate.

Therefore, all graduates of our schools should be:

- knowledgable about the important concepts and theories of the three major branches of scientific study: earth, life, and physical sciences;
- able to think scientifically and use scientific knowledge to make decisions about real–world problems;
- able to construct new knowledge for themselves through research, reading, and discussion;
- familiar with the natural world, and respectful of its unity, diversity, and fragility;
- able to make informed judgments on statements and debates claiming to have a scientific basis; and,
- able to reflect in an informed way on the role of science in human affairs.

To make this happen, education needs to:

1. emphasize understanding, not content coverage;
2. promote learning that is useful and relevant;
3. emphasize scientific literacy for ALL students; and,
4. promote interdisciplinary learning.

The "Michigan Content Standards and Benchmarks" describe three broad categories of activities that are common in scientifically literate individuals: **using** scientific knowledge; **constructing** new scientific knowledge, and **reflecting** on scientific knowledge. The content strands are directly related to these types of activities.

Overview of the Science Content Strands

Strand I. Constructing New Scientific Knowledge

*Scientifically literate students are learners as well as users of knowledge. With scientific literacy comes the ability to **ask questions** about the world that can be answered by using scientific knowledge and techniques. Scientifically literate students can also **develop solutions** to problems that they encounter or questions they ask. In developing solutions, scientifically literate students may use their own knowledge and reasoning abilities, seek out additional knowledge from other sources, and engage in empirical investigations of the real world. They can learn by **interpreting** text, graphs, tables, pictures, or other representations of scientific knowledge. Finally, scientifically literate students can remember key points and use sources of information to **reconstruct** previously learned knowledge, rather than try to remember every detail of what they study.*

Standard I.1 Constructing New Scientific Knowledge
All students will ask questions that help them learn about the world; design and conduct investigations using appropriate methodology and technology; learn from books and other sources of information; communicate their findings using appropriate technology; and reconstruct previously learned knowledge.

There is one standard under Constructing New Scientific Knowledge. This standard incorporates the ways that scientists and individuals investigate and learn about the world.

Strand II. Reflecting on Scientific Knowledge

*Scientifically literate students can also "step back" and analyze or reflect on their own knowledge. One important type of analysis is the **justification** of personal knowledge or beliefs using either theoretically or empirically based arguments. Scientifically literate students can also **show an appreciation** for scientific knowledge and the patterns that it reveals in the world; this often involves seeing **connections** among different areas of knowledge. They may be able to take a **historical and cultural perspective** on concepts and theories or to discuss institutional relationships among **science**, **technology**, and **society**. Finally, scientifically literate students can **describe the limitations** of their own knowledge and scientific knowledge in general.*

Standard II.1 Reflecting on Scientific Knowledge
All students will analyze claims for their scientific merit and explain how scientists decide what constitutes scientific knowledge; how science is related to other ways of knowing; how science and technology affect our society; and how people of diverse cultures have contributed to and influenced developments in science.

There is one standard under Reflecting on Scientific Knowledge. This standard incorporates the nature of the

scientific enterprise, its strengths, limitations, and connections to other ways of knowing.

Strand III. Using Scientific Knowledge in Life Science

*Scientifically literate students and adults can use their knowledge to understand the world around them and to guide their actions. Important types of activities that use scientific knowledge include **description** and **explanation** of real-world objects, systems, or events; **prediction** of future events or observations; and the **design** of systems or courses of action that enable people to adapt to and modify the world around them. In the life sciences, real-world contexts in which scientifically literate people use knowledge are often described in terms of **systems** and **subsystems**, such as cells, organisms, and ecosystems.*

There are five standards under Using Scientific Knowledge in Life Science:

Standard III.1 Cells

All students will apply an understanding of cells to the functioning of multicellular organisms; and explain how cells grow, develop and reproduce.

Cells are the basic living unit of which all organisms are composed.

Standard III.2 The Organization of Living Things

All students will use classification systems to describe groups of living things; compare and contrast differences in the life cycles of living things; investigate and explain how living things obtain and use energy; and analyze how parts of living things are adapted to carry out specific functions.

Organization of living things occurs both across species (as in taxonomic organizations) and within organisms (their structures and processes).

Standard III.3 Heredity

All students will investigate and explain how characteristics of living things are passed on through generations; explain why organisms within a species are different from one another; and explain how new traits can be established by changing or manipulating genes.

Heredity is the means by which traits are transmitted from one generation to the next.

Standard III.4 Evolution

All students will explain how scientists construct and scientifically test theories concerning the origin of life and evolution of species; compare ways that living organisms are adapted (suited) to survive and reproduce in their environments; and analyze how species change through time.

Evolution explains the diversity of living things and the changes seen in them over time.

Standard III.5 Ecosystems
All students will explain how parts of an ecosystem are related and how they interact; explain how energy is distributed to living things in an ecosystem; investigate and explain how communities of living things change over a period of time; describe how materials cycle through an ecosystem and get reused in the environment; and analyze how humans and the environment interact.

It is within ecosystems that communities of living things interact.

Strand IV. Using Scientific Knowledge in Physical Science

*In the physical sciences, the specification of real-world contexts often focuses on **phenomena**, such as motion, electromagnetic interactions, or physical, chemical, and nuclear changes in matter.*

Four standards are under the broad heading of Using Scientific Knowledge in Physical Science:

Standard IV.1 Matter and Energy
All students will measure and describe the things around us; explain what the world around us is made of; identify and describe forms of energy; and explain how electricity and magnetism interact with matter.

Matter and energy are the fundamental entities of the physical universe.

Standard IV.2 Changes in Matter
All students will investigate, describe and analyze ways in which matter changes; describe how living things and human technology change matter and transform energy; explain how visible changes in matter are related to atoms and molecules; and how changes in matter are related to changes in energy.

Physical, chemical, and nuclear interactions of matter and energy bring about all of the changes we observe in the physical world.

Standard IV.3 Motion of Objects
All students will describe how things around us move and explain why things move as they do; demonstrate and explain how we control the motions of objects; and relate motion to energy and energy conversions.

Motion of objects is accounted for by gravitational, electromagnetic, and nuclear forces.

Standard IV.4 Waves and Vibrations
All students will describe sounds and sound waves; explain shadows, color, and other light phenomena; measure and describe vibrations and waves; and explain how waves and vibrations transfer energy.

Sound, light, and electromagnetic waves are the means by which energy and information are propagated.

Strand V. Using Scientific Knowledge in Earth Science

*In the earth sciences, real-world contexts are often described in terms of **systems** and **subsystems**, such as atmospheric systems, crustal systems, solar systems, or galaxies, which are useful in explaining **phenomena,** including volcanic eruptions, earthquakes, thunderstorms, and eclipses.*

Four standards are under the broad heading of Using Scientific Knowledge in Earth Science:

Standard V.1 The Geosphere
All students will describe the earth's surface; describe and explain how the earth's features change over time; and analyze effects of technology on the earth's surface and resources.

The geosphere includes earth's surface and geological processes.

Standard V.2 The Hydrosphere
All students will demonstrate where water is found on earth; describe the characteristics of water and how water moves; and analyze the interaction of human activities with the hydrosphere.

The Hydrosphere includes all forms of water. Of particular interest in Michigan is the water environment in the Great Lakes region.

Standard V.3 The Atmosphere and Weather
All students will investigate and describe what makes up weather and how it changes from day to day, from season to season and over long periods of time; explain what causes different kinds of weather; and analyze the relationships between human activities and the atmosphere.

Weather is composed of patterns of moisture, temperature and pressure which move through the atmosphere.

Standard V.4 The Solar System, Galaxy and Universe
All students will compare and contrast our planet and sun to other planets and star systems; describe and explain how objects in the solar system move; explain scientific theories as to the origin of the solar system; and explain how we learn about the universe.

We learn about neighboring and remote celestial bodies through our observations and exploration of space.

Note: Essays associated with each of these standards can be found in the 1991 publication *Michigan Essential Goals and Objectives for Science Education*, available from The Center for Career and Technical Education at Michigan State University, (800) 292-1606. Each essay describes how learners encounter the standard in real-world contexts, key characteristics of scientifically literate performance of the standard, and how, with successful teaching, learners' performance of the standard becomes more sophisticated over time.

Michigan Curriculum Framework Science Benchmarks

Approved Summer, 2000

Note: Newly written narratives for the Benchmarks are found in the MI BIG document at www.misd.net/mibig

MI BIG Science is a series of 15 narratives and articulated strand maps (with submaps) written to the 15 strands of the Michigan Curriculum Framework, Science Standards and Benchmarks (June 2000 version). MI BIG Science is a new way of looking at the entire content strand.

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Constructing New Scientific Knowledge (C) I.1

Elementary	Middle School	High School
All students will ask questions that help them learn about the world:		
1. Generate questions about the world based on observation. *Key concepts:* Questions lead to action, including careful observation and testing; questions often begin with "What happens if…?" or "How do these two things differ?" *Real-world contexts:* Any in the sections on Using Scientific Knowledge.	1. Generate scientific questions about the world based on observation. *Key concepts:* Scientific questions can be answered by gathering and analyzing evidence about the world. *Real-world contexts:* Any in the sections on Using Scientific Knowledge.	1. Ask questions that can be investigated empirically. *Key concepts:* Questions often build on existing knowledge. *Real-world contexts:* Any in the sections on Using Scientific Knowledge.
All students will design and conduct investigations using appropriate methodology and technology:		
2. Develop solutions to problems through reasoning, observation, and investigations. *Key concepts:*(K-2) gather information, ask questions, think; (3-5) observe, predict, collect data, draw conclusions, conduct fair tests; prior knowledge. *Real-world contexts:* Any in the sections on Using Scientific Knowledge.	2. Design and conduct scientific investigations. *Key concepts:* The process of scientific investigations—test, fair test, hypothesis, theory, evidence, observations, measurements, data, conclusion. Forms for recording and reporting data—tables, graphs, journals. See C-I.1 m.3 (tools). *Real-world contexts:* Any in the sections on Using Scientific Knowledge; also, recognizing differences between observations and inferences; recording observations and measurements of everyday phenomena.	2. Design and conduct scientific investigations. *Key concepts:* Types of scientific knowledge—hypothesis, theory, observation, conclusion, law, data, generalization. Aspects of field research—hypothesis, design, observations, samples, analysis, conclusion. Aspects of experimental research—hypothesis, design, variable, experimental group, control group, prediction, analysis, conclusion. Investigations are based on questions about the world (see C-I.1 h.1). *Real-world contexts:* Any suggested in Using Scientific Knowledge benchmarks for which students would design and/or conduct investigations.

3. Manipulate simple devices that aid observation and data collection.

   Tools: Various data collection tools suitable for this level, such as hand lenses, wind direction indicators, grids for sampling areas of the sky or landscape.

   Real-world contexts: Any suggested in Using Scientific Knowledge benchmarks for which students would design and/or conduct investigations.

3. Use tools and equipment appropriate to scientific investigations.

   Tools: various data collection tools suitable for this level, including computers.

   Real-world contexts: Any suggested in Using Scientific Knowledge benchmarks for which students would design and/or conduct investigations.

4. Use simple measurement devices to make measurements in scientific investigations.

   Key concepts: Measurement units—milliliters, liters, teaspoon, tablespoon, ounce, cup, millimeter, centimeter, meter, gram.

   Measurement tools: Measuring cups and spoons, measuring tape, scale, thermometer, rulers, graduated cylinders.

   Real-world contexts: Making simple mixtures, such as food, play dough, papier mache; measuring height of a person, weight of a ball.

4. Use metric measurement devices to provide consistency in an investigation.

   Key concepts: Documentation—laboratory instructions. Measurement units—milliliters, liters, millimeter, centimeter, meter, gram.

   Measurement tools: Balancing devices, measuring tape, thermometer, graduated cylinder.

   Real-world contexts: Conducting investigations, following or altering laboratory instructions for mixing chemicals.

3. Recognize and explain the limitations of measuring devices.

   Key concepts: Uncertainty, error, range, tolerances, accuracy, precision.

   Tools: Balance, thermometer, measuring tape, ruler, graduated cylinder, electronic measuring devices.

   Real-world contexts: Experiments that use quantitative data; manufacturing systems where measurements are critical.

All students will learn from books and other sources of information:

5. Develop strategies and skills for information gathering and problem solving. *Tools:* Sources of information, such as reference books, trade books, magazines, web sites, other people's knowledge. *Real-world contexts:* Seeking help from or interviewing peers, adults, experts; using libraries, World Wide Web, CD-ROMs and other computer software, other resources.	5. Use sources of information in support of scientific investigations. *Tools:* Periodicals, reference books, trade books, web sites, computer software; forms for presenting scientific information, such as figures, tables, graphs. See R-II.1 m.1 (evaluate strengths/weaknesses of claims). *Real-world contexts:* Libraries, projects where research is needed.	4. Gather and synthesize information from books and other sources of information. *Key concepts:* Scientific journals, text- and computer-based reference materials. *Real-world contexts:* Libraries, technical reference books, Internet, computer software.

All students will communicate findings of investigations, using appropriate technology.

6. Construct charts and graphs and prepare summaries of observations. *Key concepts:* Increase, decrease, no change, bar graph, data table. *Tools:* Graph paper, rulers, crayons. *Real-world contexts*: Examples of bar charts like those found in a newspaper.	6. Write and follow procedures in the form of step-by-step instructions, formulas, flow diagrams, and sketches. *Key concepts:* Purpose, procedure, observation, conclusion, data. *Real-world contexts:* Listing or creating the directions for completing a task, reporting on investigations.	5. Discuss topics in groups by making clear presentations, restating or summarizing what others have said, asking for clarification or elaboration, taking alternative perspectives, and defending a position. *Key concepts:* Logical argument, summary, clarification, elaboration, alternative perspectives. *Real-world contexts:* Newspaper or magazine articles discussing a topic of social concern.

Reflecting on Scientific Knowledge (R) II.1

All students will analyze claims for their scientific merit and explain how scientists decide what constitutes scientific knowledge:

Elementary

1. Develop an awareness of the need for evidence in making decisions scientifically.

   Key concepts: (K-2) observations; (3-5) data, evidence, sample, fact, opinion.

   Real-world contexts: Deciding whether an explanation is supported by evidence in simple experiments, or relies on personal opinion.

Middle School

1. Evaluate the strengths and weaknesses of claims, arguments, or data.

   Key concepts: Aspects of arguments such as data, evidence, sampling, alternate explanation, conclusion; inference, observation.

   Real-world contexts: Deciding between alternate explanations or plans for solving problems; evaluating advertising claims or cases made by interest groups; evaluating sources of references.

2. Describe limitations in personal knowledge.

   Key concepts: Recognizing degrees of confidence in ideas or knowledge from different sources, evaluating dates and sources of references.

   Real-world contexts: Any in the sections on Using Scientific Knowledge.

High School

1. Justify plans or explanations on a theoretical or empirical basis.

   Key concepts: Aspects of logical argument, including evidence, fact, opinion, assumptions, claims, conclusions, observations.

   Real-world contexts: Any in the sections on Using Scientific Knowledge.

2. Describe some general limitations of scientific knowledge.

   Key concepts: Understanding of the general limits of science and scientific knowledge as constantly developing human enterprises; recognizing that arguments can have emotive, economic, and political dimensions as well as scientific.

   Real-world contexts: Any in the sections on Using Scientific Knowledge.

All students will show how science is related to other ways of knowing:

Elementary

2. Show how science concepts can be illustrated through creative expression such as language arts and fine arts.

   Key concepts: Poetry, expository work, painting, drawing, music, diagrams, graphs, charts.

   Real-world contexts: Explaining simple experiments using paintings and drawings; describing natural phenomena scientifically and poetically.

Middle School

3. Show how common themes of science, mathematics, and technology apply in real-world contexts.

   Thematic ideas: Systems-subsystems, feedback models, mathematical constancy, scale, conservation, structure, function, adaptation.

   Real-world contexts: Any in the sections on Using Scientific Knowledge.

High School

3. Show how common themes of science, mathematics, and technology apply in real-world contexts.

   Thematic ideas: Systems-subsystems, feedback models, mathematical constancy, scale, conservation, structure, function, adaptation.

   Real-world contexts: Any in the sections on Using Scientific Knowledge.

4. Discuss the historical development of key scientific concepts and principles.

   Key concepts: Historical, political, social, and economic factors influencing the development of science. See *Benchmarks for Science Literacy,* AAAS, Chapter 10.

   Real-world contexts: Historical development of key scientific theories.

All students will show how science and technology affect our society:

3. Describe ways in which technology is used in everyday life.

   Key concepts: Provide faster and farther transportation and communication, organize information and solves problems, save time.

   Real-world contexts: Cars, other machines, radios, telephones, computer games, calculators, appliances, e-mail, the World Wide Web.

4. Describe the advantages and risks of new technologies.

   Key concepts: Risk, benefit, side effect, advantage, disadvantage.

   Real-world contexts: Technological systems for manufacturing, transportation, energy distribution, housing, medicine (such as cloning, genetic engineering).

5. Explain the social and economic advantages and risks of new technology.

   Key concepts: Cost-benefit analysis; See LO h.5 (health technology), PME-IV.1 h.1 (household and agricultural materials, EG-V.1 h.4 (resource use), LEC-III.5 h.6 (effects of urban development and agriculture on ecosystems), EAW-V.3 h.4 (air pollution), EH-V.2 h.2 (water pollution.)

   Real-world contexts: Issues related to new technologies, including ones in health-care, transportation, communications, manufacturing, information and media.

4. Develop an awareness of and sensitivity to the natural world.

   Key concepts: Appreciation of the balance of nature and the effects organisms have on each other, including the effects humans have on the natural world.

   Real-world contexts: Any in the sections on Using Scientific Knowledge appropriate to elementary school.

5. Develop an awareness of and sensitivity to the natural world.

   Key concepts: Appreciation of the balance of nature and the effects organisms have on each other, including the effects humans have on the natural world.

   Real-world contexts: Any in the sections on Using Scientific Knowledge appropriate to middle school.

6. Develop an awareness of and sensitivity to the natural world.

   Key concepts: Appreciation of the balance of nature and the effects organisms have on each other, including the effects humans have on the natural world.

   Real-world contexts: Any in the sections on Using Scientific Knowledge appropriate to high school.

All students will show how people of diverse cultures have contributed to and influenced developments in science:

5. Develop an awareness of contributions made to science by people of diverse backgrounds and cultures.

   Key concepts: Scientific contributions made by people of diverse cultures and backgrounds.

   Real-world contexts: Any in the sections on Using Scientific Knowledge appropriate to this benchmark.

6. Recognize the contributions made in science by cultures and individuals of diverse backgrounds.

   Key concepts: Cultural contributions to science, contributions made by people of diverse backgrounds.

   Real-world contexts: Biographies of minority and female scientists; histories of cultural contributions to science.

7. Describe the historical, political, and social factors affecting developments in science.

   Key concepts: Historical, political, social, and economic factors influencing the development of science.

   Real-world contexts: The development of the sun-centered model of the solar system and political pressures on Galileo; the development of Darwin's theory of evolution by natural selection.

Cells (LC) III.1

All students will apply an understanding of cells to the functioning of multicellular organisms, including how cells grow, develop and reproduce:

Elementary	Middle School	High School
(No benchmark about cells at the elementary level)	1. Demonstrate evidence that all parts of living things are made of cells. *Key concepts:* Types of living things: plants, animals; parts of organisms: tissues, organs, organ systems; all functions of organisms are carried out by cells. See LC-III.1 m.2 for specific functions. *Tools*: Hand lens, microscope. *Real-world contexts:* Common plant or animal cells: Elodea leaf cells, onion skin cells, human cheek cells. Single-celled organisms: Paramecium.	1. Explain how multicellular organisms grow, based on how cells grow and reproduce. *Key concepts:* Specialized functions of cells—respiration (see LO h.3), protein synthesis, mitosis, meiosis (see LH-III.3 h.2). Basic molecules for cell growth—simple sugars, amino acids, fatty acids. Basic chemicals, molecules and atoms—water, minerals, carbohydrates, proteins, fats and lipids, nucleic acids; carbon, hydrogen, oxygen, nitrogen. Cells come only from other cells. See LO m.4 (digestion). *Real-world contexts:* The growth of plants and animals.
	2. Explain why and how selected specialized cells are needed by plants and animals. *Key concepts:* Specialized functions of cells—reproduction, photosynthesis, transport, movement, disease-fighting. See LO m.4 (systems and processes functioning to provide/remove materials to/from cells). *Real-world contexts:* Specialized animal cells: red blood cells, white blood cells, muscle cells, bone cells, nerve cells, egg/sperm cells; specialized plant cells—root cells, leaf cells, stem cells.	2. Compare and contrast ways in which selected cells are specialized to carry out particular life functions. *Key concepts:* Classifications of organisms by cell type—plant, animal, bacteria; selected specialized plant and animal cells—red blood cells, white blood cells, muscle cells, nerve cells, root cells, leaf cells, stem cells; cell parts used for classification — organelle, nucleus, cell wall, cell membrane; specialized functions — reproduction (see LC-III.1 h.1, LH-III.3 h.2), photosynthesis (see LO m.3), transport; cell shape. *Tools:* microscopes *Real-world contexts:* Reproduction, growth, response, movement, etc. of animals and plants. Functions of bacteria.

Organization of Living Things (LO) III.2

Elementary	Middle School	High School
All students will use classification systems to describe groups of living things:		
1. Explain characteristics and functions of observable body parts in a variety of animals. *Key concepts:* Observable characteristics—fur, scales, feathers, horns, claws, eyes, quills, beaks, teeth, skeleton, muscles, exoskeleton; functions—insulation, support, movement, food-getting, protection. *Real-world contexts:* Vertebrate and invertebrate animals, such as humans, cows, sparrows, goldfish, spiders, crayfish, insects.		
2. Compare and contrast (K-2) or classify (3-5) familiar organisms on the basis of observable physical characteristics. *Key concepts:* Plant and animal parts—backbone, skin, shell, limbs, roots, leaves, stems, flowers, feathers, scales. *Real-world contexts:* Animals that look similar—snakes, worms, millipedes; flowering and nonflowering plants; pine tree, oak tree, rose, algae.	1. Compare and classify organisms into major groups on the basis of their structure. *Key concepts:* Characteristics used for classification—vertebrates/ invertebrates, cold-blooded/warm-blooded, single-cell/multicellular, flowering/nonflowering; groups of vertebrates—mammals, birds, fish, reptiles, amphibians. *Observation tools*: Hand lens, microscope. *Real-world contexts:* Representative organisms, such as dog, worm, snake, Amoeba, geranium, bacterium, insect, mold.	1. Classify major groups of organisms to the kingdom level. *Key concepts:* Kingdom categories—protist, fungi, moneran, animal, plant. Characteristics for classification—cell wall, cell membrane, organelle, single-celled, multicellular. *Real-world contexts:* Common local representatives of each of the five major kingdoms—Paramecium, yeast, mushroom, bacteria, frog, geranium.

All students will compare and contrast differences in the life cycles of living things:

3. Describe life cycles of familiar organisms.

   Key concepts: Life cycle stages—egg, young, adult; seed, plant, flower, fruit; larva, pupa.

   Real-world contexts: Common plants and animals such as bean plants, apple trees, butterflies, grasshoppers frogs, birds.

2. Describe the life cycle of a flowering plant.

   Key concepts: Flowering plant parts and processes—roots, stems, leaves, flowers, fruits, seeds, embryo, pollen, ovary, egg cell, germination, fertilization.

   Tools: Microscope, hand lens.

   Real-world contexts: Common flowering plants, such as bean, tulip.

2. Describe the life cycle of an organism associated with human disease.

   Key concepts: Infection process—disease, parasite, carrier, host, infection.

   Tools: Microscope, hand lens.

   Real-world contexts: Life cycle of organism(s) associated with human disease(s), such as Lyme disease—tick, malaria—mosquito, parasites.

All students will investigate and explain how living things obtain and use energy:

4. Compare and contrast food, energy, and environmental needs of selected organisms.

   Key concepts: Life requirements—food, air, water, minerals, sunlight, space, habitat. See LEC-III.5 e.2.

   Real-world contexts: Germinating seeds, such as beans, corn; aquarium or terrarium life, such as guppy, goldfish, snail.

3. Describe evidence that plants make and store food.

   Key concepts: Process and products of food production and transport—photosynthesis, starch, sugar, oxygen, carbon dioxide, water. See LO m.4 (use of food for energy.)

   Real-world contexts: Plant food storage organs, such as potato, onion; starch storage in plants grown under different conditions.

3. Explain the process of food storage and food use in organisms.

   Key concepts: Cellular respiration, photosynthesis (see LO m.3), oxygen, sunlight, carbon dioxide, carbohydrate, fat, protein, minerals, water. See LC-III.1 h.1 (how organisms grow), LO-III.2 m.3 (how plants store food) LO-III.2 m.4 (how food and oxygen are distributed to cells), LEC-III.5 m.2 (the sun as the ultimate source of energy for organisms) and PCM-IV.2 m.3 (energy transformations).

   Real-world contexts: Food storage, such as maple tree—maple sap, potato—starch, honey bee—honey, cow—beef, milk. Weight gain and weight loss. Change in respiration rates with exercise.

All students will analyze how parts of living things are adapted to carry out specific functions:

5. Explain functions of selected seed plant parts.

   Key concepts: Plant parts—roots, stems, leaves, flowers, fruits, seeds.

   Real-world contexts: Common edible plant parts, such as bean, cauliflower, carrot, apple, tomato, spinach.

   (See LE-III.4 e.2 about functions of selected animal body parts.)

4. Explain how selected systems and processes work together in animals.

   Key concepts: Systems/Processes—digestion, circulation, respiration, endocrine, reproduction, skeletal, muscular, nervous, excretion, transport, growth, repair.

   Real-world contexts: Interrelations of body systems during selected activities, such as among skeletal, muscular, circulatory, and respiratory systems during physical exercise.

4. Explain how living things maintain a stable internal environment.

   Key concepts: Related systems/cells/ chemicals—excretory system, endocrine system, circulatory system, hormones, immune response, white blood cell, bacteria, virus. Factors/ mechanisms under control—temperature, disease/infection, homeostasis.

   Real-world contexts: Mechanisms for maintaining internal stability, such as body temperature, disease control.

5. Describe technology used in the prevention, diagnosis, and treatment of diseases and explain its function in terms of human body processes.

   Key concepts: Available technologies—sanitation, adequate food and water supplies, inoculation, antibodies, biochemistry, medicines, organ transplants. (See PWV-IV.4 h.4, ultrasound/x-ray.)

   Real-world contexts: Common contexts for these technologies—health maintenance and disease prevention activities, such as exercise and controlled diets; health monitoring activities, such as cholesterol and blood pressure checks and various tests for cancer.

Heredity (LH) III.3

Elementary	Middle School	High School
All students will investigate and explain how characteristics of living things are passed on through generations:		
1. Give evidence that characteristics are passed from parents to young. *Key concepts:* Characteristics—hair and feather color, eye color, leaf shape, flower structure. *Real-world contexts:* Example of mature and immature organisms, such as dogs/puppies, cats/kittens, maple trees/saplings, beans/seedlings.	1. Describe how the characteristics of living things are passed on through generations. *Key concepts:* Reproductive cells—egg, sperm. Chromosome, gene, hereditary information. *Real-world contexts:* Common traits controlled by a single gene pair, such as wrinkled or smooth seeds in a pea plant, color of horse hair; human traits such as tongue rolling.	1. Explain how characteristics of living things are passed on from generation to generation. *Key concepts:* Traits—dominant, recessive. Genetic material—gene pair, gene combination, gene sorting. *Real-world contexts:* Common contexts—inheritance of a human genetic disease/disorder, such as sickle cell anemia; a family tree focused on certain traits; examining animal or plant pedigrees.
All students will explain why organisms within a species are different from one another:		
(No corresponding benchmark at this level.)	2. Describe how heredity and environment may influence/determine characteristics of an organism. *Key concepts:* Traits—inherited, acquired. *Real-world contexts:* Data on heredity, such as identical twin studies, effects of introduced toxins, effects of natural selection, effects of controlled selection and breeding.	2. Describe how genetic material is passed from parent to young during sexual and asexual reproduction. *Key concepts:* Types of cell division—mitosis, meiosis. DNA replication, chromosome. Types of reproduction—sexual, asexual. Genetic variation. *Tools:* A-V media, diagrams showing DNA replication during cell division. *Real-world contexts:* Fruit flies, yeast, reproduction by spores, cloning.

All students will explain how new traits can be established by changing or manipulating genes:

(No corresponding benchmark at this level.)	(No corresponding benchmark at this level.)	3. Explain how new traits may arise in individuals through changes in genetic material (DNA). *Key concepts:* Genetic changes—variation, new gene combinations, mutation. Natural and human-produced sources of mutation—radiation, chemicals. See LE-III.4 m.2 (how new traits become established in populations.) *Real-world contexts:* Products of genetic engineering, such as medical advances—insulin, cancer drugs; agricultural related products, such as navel oranges, new flower colors, higher-yield grains; effects of natural and man-made contamination; examples of variations due to new gene combinations, such as hybrid organisms or new plant varieties resulting from multiple sets of genes.

Evolution (LE) III.4

Elementary	Middle School	High School
All students will explain how scientists construct and scientifically test theories concerning the origin of life and evolution of species:		
1. Explain how fossils provide evidence about the nature of ancient life. *Key concepts:* Types of evidence—fossil, extinct, ancient, modern life forms. See EG-V.1 e.4 (rocks and fossils provide evidence of history of the earth). *Real-world contexts:* Common contexts—plant and animal fossils, museum dioramas and paintings/drawings of ancient life and/or habitats.	1. Describe how scientific theory traces possible evolutionary relationships among present and past life forms. *Key concepts:* Selected evidence of common ancestry—geologic time, fossil, bone, embryo, limb. *Real-world contexts:* Fossils that show evidence of common ancestry, such as similarity of vertebrate limb bones, similarity of early vertebrate embryos, similarity of fossil bones to those of contemporary animals i.e., horse legs.	1. Describe what biologists consider to be evidence for human evolutionary relationships to selected animal groups. *Key concepts:* Common types of evidence used—hominid fossils, vestigial structures, DNA, protein structure. *Real-world contexts:* Skeletal comparisons, such as modern human to hominid fossils; anatomical and biochemical similarities of humans and other higher primates, such as blood proteins; similarity of early human embryo stages to those of other vertebrates; vestigial structures, such as appendix, tail bone.
All students will compare ways that living organisms are adapted (suited) to survive and reproduce in their environments and explain how species change through time:		
2. Explain how physical and behavioral characteristics of animals help them to survive in their environments. *Key concepts:* Characteristics—adaptation, instinct, learning, habit. Traits and their adaptive values—sharp teeth or claws for catching and killing prey, color for camouflage, behaviors. *Real-world contexts:* Common vertebrate adaptations, such as white polar bears, sharp claws and sharp canines for predators, changing colors of chameleon; behaviors, such as migration, communication of danger.	2. Explain how new traits might become established in a population and how species become extinct. *Key concepts:* Environmental change, variation in populations, reproductive success. *Real-world contexts:* Examples of inheritable and non-inheritable variations, such as white-eyed fruit fly or scars; examples of variations due to new gene combinations, such as hybrid organisms.	2. Explain how a new species or variety may originate through the evolutionary process of natural selection. *Key concepts:* Concept of species; how new species or varieties are established—natural selection, inheritable, non-inheritable characteristics, species variation. *Real-world contexts:* Contemporary examples of natural selection, such as bacteria resistance to antibiotics, insect resistance to pesticides; examples of artificial selection, such as agricultural selection to increase production, selecting desired traits for pets; historical examples of naïve explanations of evolution, such as the Lamarkian explanation of the evolution of the giraffe's long neck.

Ecosystems (LEC) III.5

Elementary	Middle School	High School
All students will explain how parts of an ecosystem are related and how they interact:		
1. Identify familiar organisms as part of a food chain or food web and describe their feeding relationships within the web. *Key concepts:* Producer, consumer, predator, prey, decomposer, habitat, community. *Real-world contexts:* Food chains and food webs involving organisms, such as rabbits, birds, snakes, grasshoppers, plants.	1. Describe common patterns of relationships among populations. *Key concepts:* Participants and relationships—predator, prey, parasite, competition, mutually beneficial. *Real-world contexts:* Relationships among plants and animals in an ecosystem—mutually helpful relationships, such as insects and flowering plants, birds eating fruit and spreading seeds; parasitic (harmful) relationships, such as humans and mosquitoes, trees and mistletoe; competitive relationships, including squirrels and seed-eating birds, weeds and garden plants.	1. Describe common ecological relationships between and among species and their environments. *Key concepts:* Competition, territory, carrying capacity, natural balance, population, dependence, survival; biotic, abiotic factors. *Real-world contexts:* Animals that live in packs or herds and plant colonies, such as—wolves, bison, lilies and other bulb plants, various forms of algae.
All students will explain how energy is distributed to living things in an ecosystem:		
2. Describe the basic requirements for all living things to maintain their existence. *Key concepts:* Needs of life—food, habitat, water, shelter, air, light, minerals. See LO-III.2 e.4. *Real-world contexts:* Selected ecosystems, such as an aquarium, rotting log, terrarium, backyard, local pond or wetland, wood lot.	2. Describe how organisms acquire energy directly or indirectly from sunlight. *Key concepts:* Sunlight, plants, food, photosynthesis, producers, consumers, food webs. See LO-III.2 m.3 (photosynthesis and food use). *Real-world contexts:* Selected food webs, including humans.	2. Explain how energy flows through familiar ecosystems. *Key concepts:* Participants and relationships—food chain, food web, energy pyramid, energy flow, producers, consumers, decomposers. See LO-III.2 m.3 (producers), PCM-IV.2 h.4 (conservation of energy). *Real-world contexts:* Energy pyramids for food webs in various ecosystems.

All students will investigate and explain how communities of living things change over a period of time:

3. Design systems that encourage growing of particular plants or animals.

   Key concepts: Needs of life—food, habitat, water, shelter, air, light, minerals.

   Real-world contexts: Ecosystems managed by humans, including farms, ranches, gardens, lawns, potted plants.

3. Predict the effects of changes in one population in a food web on other populations.

   Key concepts: Natural balance, population, dependence, survival, community, biodiversity, introduction of non-native species.

   Real-world contexts: Plants and animals in an ecosystem dependent upon each other for survival in selected ecosystems—see LEC-III.5 e.2; comparison of animals and plants found in polluted vs. nonpolluted water, urban vs. rural settings, rural vs. forest settings; zebra mussels introduced into the Great Lakes, gypsy moths defoliating trees.

4. Describe the likely succession of a given ecosystem over time.

   Key concepts: Succession, stages, climax community, pioneer.

   Real-world contexts: Process of gradual change in ecological systems, such as in ponds or abandoned farm fields.

3. Describe general factors regulating population size in ecosystems.

   Key concepts: Carrying capacity, competition, parasitism, predation, loss of habitat.

   Real-world contexts: Common factors that influence relationships, such as weather, disease, predation, migration.

4. Describe responses of an ecosystem to events that cause it to change.

   Key concepts: Succession, pioneer, climate/physical conditions, introduction of new/different species, elimination of existing species, biodiversity; cataclysmic changes.

   Real-world contexts: Climax forests comprised of maple, beech, or conifers; effects of urban sprawl or clear cutting forests; effects of cataclysmic changes such as the eruption of Mt. St. Helens.

All students will describe how materials cycle through an ecosystem and get reused in the environment:

(No corresponding benchmark at this level)	(No corresponding benchmark at this level)	5. Describe how carbon and soil nutrients cycle through selected ecosystems. *Key concepts:* Common nutrients/elements — nitrogen, sulfur, carbon, phosphorous. Inorganic compounds containing nutrients—soil minerals, carbon dioxide. Organic compounds in living communities—proteins, fats, carbohydrates. See LO-III.2 h.3 (cell respiration) and LO-III.2 m.3 (photosynthesis). *Real-world contexts:* Movement of food materials through various foodwebs, including decomposition.

All students will analyze how humans and the environment interact:

4. Describe positive and negative effects of humans on the environment.

   Key concepts: Human effects on the environment—garbage, habitat destruction, land management, renewable and non-renewable resources.

   Real-world contexts: Household wastes, school wastes, waste water treatment, habitat destruction due to community growth, reforestation projects, establishing parks or other green spaces, recycling.

5. Explain how humans use and benefit from plant and animal materials.

   Key concepts: Materials from plants, including—wood, paper, cotton, linen, starch, rubber, wax, and oils. Materials from animals, including leather, wool, fur, oils, wax.

   Real-world contexts: Human-made objects that incorporate plant and animal materials, including clothing, building materials, machines, and medicines.

6. Describe ways in which humans alter the environment.

   Key concepts: Agriculture, land use, renewable and non-renewable resource development, resource use, solid waste, toxic waste. Biodiversity. See EG-V.1 m.5, EH-V.2 m.3, EAW-V.3 m.4.

   Real-world contexts: Human activities, such as farming, pollution from manufacturing and other sources, hunting, habitat destruction, land development, reforestation, species reintroduction.

6. Explain the effects of agriculture and urban development on selected ecosystems.

   Key concepts: Common factors that influence ecosystems, such as pollution of ecosystems from fertilizer, insecticide, and other chemicals. Land management, biodiversity, sustainability. Loss of habitat. See PME-IV.1 h.1 (risk/benefit analysis), EH-V.2 h.2 (water pollution).

   Real-world contexts: Common factors that influence ecosystems, such as pollution of ecosystems from fertilizer, insecticide, and other chemicals.

Matter and Energy (PME) IV.1

Elementary	Middle School	High School

All students will measure and describe the things around us:

1. Classify common objects and substances according to observable attributes/properties.

   Key concepts: Texture—rough, smooth. Flexibility—rigid, stiff, firm, flexible, strong. Hardness. Smell—pleasant, unpleasant. States of matter—solid, liquid, gas. Magnetic properties—attract, repel, push, pull. Size—larger, smaller (K-2); length, width, height (3-5). Sink, float. Color—common color words. Shape—circle, square, triangle, rectangle, oval. Weight—heavy, light, heavier, lighter. See PWV-IV.4 e.4 (shadows: objects that let light pass through or block light); PME-IV.1 e.2 (materials that conduct electricity); C-I.1 e.4 (use measuring devices).

   Real-world contexts: Common objects, such as desks, coins, pencils, buildings, snowflakes; common substances, including—solids, such as copper, iron, wood, plastic, Styrofoam; liquids, such as water, alcohol, milk, juice; gases such as air, helium, water vapor.

2. Identify properties of materials which make them useful.

   Key concepts: Useful properties—unbreakable, water-proof, light-weight, conducts electricity (see PME-IV.1 e.4, electric circuits), conducts heat, attracted to a magnet, clear. See EG-V.1 e.4 (uses of earth materials).

   Real-world contexts: Appropriate selection of materials for a particular use, such as waterproof raincoat, cotton or wool for clothing, glass for windows, metal pan to conduct heat, copper wire to conduct electricity.

1. Describe and compare objects in terms of mass, volume, and density.

   Key concepts: Units of density—grams per cubic centimeter or grams per milliliter.

   Measurement tools: Balance, measuring cup or graduated cylinder, metric ruler. See C-I.1 m.4 (making measurements).

   Real-world contexts: Common objects and substances.

2. Explain when length, mass, weight, density, area, volume or temperature are appropriate to describe the properties of an object or substance.

   Key concepts: Appropriate metric (s.i.) units. See C-I.1 m.4 (use measuring devices).

   Measurement tools: Balances, spring scales, measuring cups or graduated cylinders, thermometers, metric ruler.

   Real-world contexts: Common substances such as those listed in PME-IV.1 e.1; hot and cold substances, such as ice, snow, cold water, hot water, steam, cold air, hot air.

1. Analyze properties of common household and agricultural materials in terms of risk/benefit balance.

   Key concepts: Risk/benefit analysis.

   Real-world contexts: Herbicides, refrigerants, fertilizers, detergents.

2. Identify properties of common families of elements.

   Key concepts: Properties—state, reactivity, metal/non-metal, conductivity.

   Tools: Various element samples.

   Real-world contexts: Highly reactive metals (such as potassium, sodium), less-reactive metals (such as calcium), highly reactive nonmetals (such as chlorine, fluorine, and oxygen), almost completely nonreactive gases (such as helium and neon); relationships on the Periodic Table of Elements.

All students will explain what the world around us is made of:

(No elementary benchmark about molecules or atoms)

3. Classify substances as elements, compounds, or mixtures and justify classifications in terms of atoms and molecules.

   Key concepts: Element, compound, mixture, molecule, atom. See PME-IV.1 m.4 (molecular structure of solids, liquids and gases).

   Real-world contexts: Common substances such as those listed above, including—elements, such as copper, aluminum, sulfur, helium, iron; compounds, such as water, salt, sugar, carbon dioxide; mixtures, such as soil, salt and pepper, salt water, air.

4. Describe the arrangement and motion of molecules in solids, liquids, and gases.

   Key concepts: Arrangement—regular pattern, random. Distance between molecules—closely packed, separated. Molecular motion—vibrating, bumping together, moving freely. (PCM-IV.2 m.4 addresses the molecular explanations of changes of state.)

   Real-world contexts: Common solids, liquids, and gases, such as those listed above.

3. Explain how elements differ, in terms of the structural parts and electrical charges of atoms.

   Key concepts: Parts of atoms—nucleus, electron cloud. Subatomic particles—proton, neutron, electron. Electrical charges—positive, negative, neutral. Each element has a unique number of protons. See PMO-IV.3 m.3 (electric force).

   Real-world contexts: All elements.

All students will identify and describe forms of energy:

3. Identify forms of energy associated with common phenomena.

   Key concepts: Heat, light, sound, food energy, energy of motion, electricity (see PCM-IV.2 e.1 about heat, PWV-IV.4 e.1-4 about light and sound, PME-IV.1 e.4 about electricity, LEC-III.5 e.2 about energy from food).

   Real-world contexts: Appropriate selection of energy and phenomena, such as appliances like a toaster or iron that use electricity, sun's heat to melt chocolate, water wheels, wind-up toys, warmth of sun on skin, windmills, music from guitar, simple electrical circuits with batteries, bulbs and bells.

(Benchmarks about energy are in other strands at the middle school level.)

(Benchmarks about energy are in other strands at the high school level.)

All students will explain how electricity (and magnetism; see PMO) interact with matter:

4. Construct simple, useful electrical circuits. (3-5)

   Key concepts and tools: Complete loop; batteries, bulbs, bells, motors, wires, electrical switches (see PME-IV.1 e.2, materials that conduct electricity).

   Real-world contexts: Flashlights, battery-powered toys.

5. Describe possible electrical hazards to be avoided at home and at school. (K-2)

   Key concepts: Shock, wall outlet, hazards; see PME-IV.1 e.3 (electrical energy).

   Real-world contexts: Electric outlets, power lines, frayed electric cords, electric appliances, lightning, hair dryers in sinks and tubs.

5. Construct simple circuits and explain how they work in terms of the flow of current.

   Key concepts and tools: Complete circuit, incomplete circuit, short circuit, current, conductors, non-conductors, batteries, household current, bulbs, bells, motors, electrical switches.

   Real-world contexts: Household wiring, electrical conductivity testing, electric appliances.

6. Investigate electrical devices and explain how they work, using instructions and appropriate safety precautions.

   Key concepts: Flow of electricity for energy or information transfer. Safety precautions for using electrical appliances; grounding. Documentation for toys and appliances—wiring diagrams, written instructions. (See PCM-IV.2 m.3, transformations of energy.)

   Real-world contexts: Situations requiring assembly, use, or repair of electrical toys, radios, or simple appliances, such as replacing batteries and bulbs; connecting electrical appliances, such as stereo systems, TV's and videocassette recorders, computers and computer components.

4. Explain how current is controlled in simple series and parallel circuits.

   Key concepts: Single path, multiple paths, switches, fuses, circuit breakers, power supply, batteries, household current, motors, bulbs, circuit diagrams.

   Real-world contexts: Basic household wiring, automobile wiring, flashlights, tree lights, power lines; electrical conductivity testing.

5. Describe how electric currents can be produced by interacting wires and magnets, and explain applications of this principle.

   Key concepts: Current flow and direction, magnetic fields. See PMO-IV.3 m.4 (magnetism from electricity).

   Real-world contexts: Generators, alternating current, direct current.

Changes in Matter (PCM) IV.2

Elementary	Middle School	High School

All students will investigate, describe and analyze ways in which matter changes:

1. Describe common physical changes in matter—size, shape; melting, freezing (K-2); dissolving, evaporating (3-5).

   Key concepts: States of matter—solid, liquid, gas. Changes in size and shape—bending, tearing, breaking. Processes that cause changes of state: heating, cooling. See EH-V.2 e.1 (water in three states).

   Real-world contexts: Changes in size or shape of familiar objects, such as making snowballs, breaking glass, crumbling cookies, making clay models, carving wood, breaking bones; changes in state of water or other substances, such as freezing of ice cream, or ponds, melting wax or steel, puddles drying up.

2. Prepare mixtures and separate them into their component parts.

   Key concepts: Mixture, solution. Separation techniques—(K-2) filtration, using sieves, using magnets, floating vs. sinking; (3-5) dissolving soluble substances, evaporating.

   Tools: Filter paper, funnels, magnets, sieves, beakers, solar stills.

   Real-world contexts: Mixtures of various kinds—salt and pepper, iron filings and sand, sand and sugar, rocks and wood chips, sand and gravel, sugar or salt solutions.

1. Describe common physical changes in matter: evaporation, condensation, sublimation, thermal expansion and contraction.

   Key concepts: States of matter—solid, liquid, gas. Processes that cause changes of state or thermal effects: heating, cooling. Boiling. Mass/weight remains constant during physical changes in closed systems.

   Real-world contexts: States of matter—solid, liquid, gas. Changes in state, such as water evaporating as clothes dry, condensation on cold window panes, disappearance of snow or dry ice without melting; expansion of bridges in hot weather, expansion and contraction of balloons with heating and cooling; solid air fresheners.

2. Describe common chemical changes in terms of properties of reactants and products.

   Key concepts: Common chemical changes—burning, rusting iron, formation of sugars during photosynthesis, acid reacting with metal and other substances. Mass/weight remains constant in closed systems.

   Real-world contexts: Chemical changes—burning, photosynthesis, digestion, corrosion, acid reactions, common household chemical reactions such as with alkaline drain cleaners.

(High school benchmarks related to changes in matter are in the next strand.)

All students will explain how visible changes in matter are related to atoms and molecules:

(There are no elementary benchmarks about atoms or molecules.)

3. Explain physical changes in terms of the arrangement and motion of atoms and molecules.

   Key concepts: Molecular descriptions of states of matter—see PME-IV.1 m.4. Changes in state of matter—melting, freezing, evaporation, condensation; thermal expansion and contraction (see PCM-IV.2 m.1). Speed of molecular motion—moving faster, slower, vibrate, rotate, unrestricted motion; change in speed of molecular motion with change in temperature.

   Real-world contexts: See examples of physical changes of matter, PCM-IV.2 e.1 and m.1.

1. Explain chemical changes in terms of the breaking of bonds and the rearrangement of atoms to form new substances.

   Key concepts: atom, molecule, ion, bond, reactant, product; conservation of mass; rate of reaction—temperature, surface area, concentration; specific chemical reactions—burning paper or wood, rusting iron, formation of sugars during photosynthesis. See PME-IV.1 h.3 (structure of the atom).

   Real-world contexts: Examples of chemical changes—See PCM-IV.2 m.2.

2. Explain why mass is conserved in physical and chemical changes.

   Key concepts: atom, molecule, mass.

   Real-world contexts: Common physical and chemical changes, including matter cycles in ecosystems.

3. Contrast nuclear fission, nuclear fusion, and natural radioactivity.

   Key concepts: Nucleus, nuclear change, force that hold nucleus together, nuclear energy. Stable and unstable isotopes. Properties—mass, element, radioactivity. See PME-IV.1 h.3 (structure of the atom).

   Real-world contexts: Nuclear power plants, nuclear energy from sun, natural radioactive decay, use of radiation and radioactive isotopes in medicine.

All students will explain how changes in matter are related to changes in energy and how living things and human technology change matter and transform energy.

(For a related elementary benchmark, see PCM-IV.2 e.1, heating and cooling cause melting and freezing.)

4. Describe common energy transformations in everyday situations.

   Key concepts: Forms of energy, including mechanical, heat, sound, light, electrical, magnetic, chemical, food energy. See PME-IV.1 m.5 (electricity in circuits), PCM-IV.2 m.1 (energy in changes of state). Total amount of energy remains constant in all transformations.

   Real-world contexts: Motors, generators, power plants, light bulbs, appliances, cars, radios, TV's, walking, playing a musical instrument, cooking food, batteries, body heat, photosynthesis (see LO-III.2 m.3, LEC-III.5 m.2).

4. Describe energy transformations involved in physical, chemical and nuclear changes, and contrast their relative magnitudes.

   Key concepts: Potential energy, kinetic energy, heat, light, electrical energy, chemical energy, sound; temperature changes. Original sources of energy: sun, radioactivity. Conservation of energy, conservation of mass/energy; $E=mc^2$. See PCM-IV.2 m.4 (common energy transformations), PCM-IV.2 h.3 (nuclear changes).

   Real-world contexts: Common physical, chemical and nuclear changes, including changes of state, burning, electrical decomposition of water, photosynthesis, cellular respiration, fireworks and dynamite, nuclear power, stars.

5. Explain changes in matter and energy involving heat transfer.

   Key concepts: Mechanisms of heat transfer — convection, conduction, radiation. Conservation of energy, efficiency. Changes in matter related to heat transfer—changes in temperature, volume, pressure. See PCM-IV.2 m.1 (thermal expansion), EAW-V.3 h.3 (convection).

   Real-world contexts: Convection currents, lake turnover, wind, hot frying pans, heating and cooling buildings, heat lamps, sunlight heating the earth, greenhouse effect, fires for warming.

Motion of Objects (PMO) IV.3

Elementary	Middle School	High School

All students will describe how things around us move, explain why things move as they do, and demonstrate and explain how we control the motions of objects:

1. Describe or compare motions of common objects in terms of speed and direction.

   Key concepts: Words—east, west, north, south, right, left, up, down. Speed words—fast, slow, faster, slower.

   Real-world contexts: Motions of familiar objects in two dimensions, including rolling or thrown balls, wheeled vehicles, sliding objects.

2. Explain how forces (pushes or pulls) are needed to speed up, slow down, stop, or change the direction of a moving object.

   Key concepts: Changes in motion—speeding up, slowing down, turning. Common forces—push, pull, friction, gravity. Size of change is related to strength of push or pull.

   Real-world contexts: Playing ball, moving chairs, sliding objects.

1. Qualitatively describe and compare motion in two dimensions.

   Key concepts: Two-dimensional motion—up, down, curved path. Speed, direction, change in speed, change in direction.

   Real-world contexts: Objects in motion, such as thrown balls, roller coasters, cars on hills, airplanes.

2. Relate motion of objects to unbalanced forces in two dimensions.

   Key concepts: Changes in motion and common forces—speeding up, slowing down, turning, push, pull, friction, gravity, magnets. Constant motion and balanced forces. Additional forces—attraction, repulsion, action/reaction pair (interaction force), buoyant force. Size of change is related to strength of unbalanced force and mass of object.

   Real-world contexts: Changing the direction—changing the direction of a billiard ball, bus turning a corner; changing the speed—car speeding up, a rolling ball slowing down, magnets changing the motion of objects, walking, swimming, jumping, rocket motion, objects resting on a table, tug-of-war.

3. Describe patterns of interaction of magnetic materials with other magnetic and non-magnetic materials.

   Key concepts: Magnetic poles, magnetic attraction and repulsion.

   Tools: Magnets, variety of magnetic and non-magnetic materials (K-2), magnetic compass (3-5).

   Real-world contexts: Common magnets, using a magnetic compass to find direction.

3. Describe the non-contact forces exerted by magnets, electrically charged objects, and gravity.

   Key concepts: Electrical charges and magnetic poles—north pole, south pole, positive charge, negative charge; mass, weight, gravitational pull. Charging by rubbing or touching, electric attraction and repulsion. Force depends on size of charges or masses, and decreases quickly with distance. See PMO-IV.3 m.2 (forces and motion), PME-IV.1 m.2 (weight and mass).

   Real-world contexts: Electrically charged or polarized objects, such as balloons rubbed on clothing, bits of paper, salt grains, static cling, magnets, magnetic materials, earth's gravitational pull on objects near its surface, sun's gravitation pull on solar system objects (see ES-V.4 m.2).

4. Use electric currents to create magnetic fields, and explain applications of this principle.

   Key concepts: Electric current, magnetic poles, magnetic fields. (See PME-IV.1 m.5, electric circuits.)

   Tools: Magnetic compass, battery, wire.

   Real-world contexts: Electromagnets, bells, speakers, motors, magnetic switches, Earth's magnetic field.

(A related benchmark about creating electrical currents from magnets is PME-IV.1 h.5.)

4. Identify and use simple machines and describe how they change effort.

   Key concepts: Inclined planes, levers, pulleys, wedges, wheel and axle; force, distance.

   Real-world contexts: Block and tackles, ramps, screwdrivers and screws, can openers, see-saws.

5. Manipulate simple mechanical devices and explain how their parts work together.

   Key concepts: Names and uses for parts of machines, such as levers, wheel and axles, pulleys, inclined planes, gears, screws, wedges.

   Real-world contexts: Simple mechanical devices, such as bicycles, bicycle pumps, pulleys, faucets, clothespins, can openers.

5. Design strategies for moving objects by application of forces, including the use of simple machines.

   Key concepts: Types of simple machines—lever, pulley, screw, inclined plane, wedge, wheel and axle, gear; direction change, force advantage, speed and distance advantage.

   Real-world contexts: Objects being moved by using simple machines, such as wagons on inclined planes, heavy objects moved by levers, seesaw, cutting with knives or axes.

1. Analyze patterns of force and motion in the operation of complex machines.

   Key concepts: Electrical and/or mechanical components of complex machines.

   Real-world contexts: Machines, such as bicycles, automobiles, pumps, electrical motors.

All students will relate motion to energy and energy conversions:

(No corresponding benchmark at this level.)

(No corresponding benchmark at this level.)

2. Explain energy conversions in moving objects and machines.

   Key concepts: Types of energy—electrical energy, kinetic energy, gravitational potential energy, potential energy in springs, chemical potential energy, heat energy, radiation. Energy transformations—see PCM-IV.2 m.4. Efficiency. See PME-IV.1 h.4 (conservation of energy) and PCM-IV.2 h.4 (energy in physical and chemical changes).

   Real-world contexts: Simple and complex machines, roller coasters, swings, pendulums, elevators, automobiles, fans, motors.

Waves and Vibrations (PWV) IV.4

Elementary	Middle School	High School

All students will describe sounds and sound waves:

Elementary

1. Describe sounds in terms of their properties.

   Key concepts: Properties: pitch—high, low. Loudness—loud, soft.

   Real-world contexts: Sound from common sources, such as musical instruments, radio, television, animal sounds, thunder, human voices.

2. Explain how sounds are made.

   Key concepts: Vibrations—fast, slow, large, small.

   Real-world contexts: Sounds from common sources, such as musical instruments, radio, television, animal sounds, thunder, human voices.

Middle School

1. Explain how sound travels through different media.

   Key concepts: Media—solids, liquids, gases. Vacuum.

   Real-world contexts: Sounds traveling through solids, such as glass windows, strings, the earth; sound traveling through liquids, such as dolphin and whale communication; sound traveling through gases, such as human hearing, sonic booms.

2. Explain how echoes occur and how they are used.

   Key concepts: Echo, sonar, reflection.

   Real-world contexts: Echoes in rooms—acoustics—and outdoors; practical uses of echoes, such as navigation by bats and dolphins, ultrasound imaging, sonar.

High School

1. Relate characteristics of sounds that we hear to properties of sound waves.

   Key concepts: Properties of sounds—pitch, volume. Characteristics of sound waves—frequency, amplitude, velocity.

   Real-world contexts: Common sounds that vary in pitch and volume—see PWV-IV.4 e.1.

All students will explain shadows, color, and other light phenomena:

3. Use prisms and filters with light sources to produce various colors of light.

   Key Concepts: White light is composed of different colors.

   Tools: Prisms, color filters, colored lights.

   Real-world contexts: Light from common sources, such as sun, stars, light bulb, colored lights, firefly, candle, flashlight, various prisms.

4. Explain how shadows are made.

   Key concepts: Shadow, blocked path, surface, object, light moves outward from source in straight lines.

   Real-world contexts: Shadows made on surfaces by putting objects in the path of light from common sources, including sunlight, light bulbs, projectors. Changes in size of shadows due to distance from object.

3. Explain how light is required to see objects.

   Key concepts: Light source, object, eye as a detector, illumination, path of light, reflection, absorption. See PWV-IV.4 m.2 (echo location).

   Real-world contexts: Seeing common objects in our environment; seeing "through" transparent media, such as windows, water; using flashlights to see in the dark.

4. Describe ways in which light interacts with matter.

   Key concepts: Reflection, refraction, absorption, transmission, scattering, medium, lens. Transmission of light—transparent, translucent, opaque.

   Real-world contexts: Objects that reflect or absorb light, including mirrors; media that transmit light such as clear and frosted glass, clear and cloudy water, clear and smoky air; objects that refract light, including lenses, prisms, and fiber optics; uses of lenses, such as eye, cameras, telescope, microscope, magnifying lens, for magnification and light-gathering.

2. Explain how we see colors of objects.

   Key concepts: Characteristics of light—brightness, amplitude, colors of spectrum (red, orange, yellow, green, blue, indigo, violet) wavelength, frequency (see PWV-IV.4 h.3). Ways that objects interact with light—emission, reflection, absorption, transmission, scattering (see PWV-IV.4 m.4).

   Real-world contexts: Colored light-reflecting objects, such as books, clothes, color photographs; colored light-transmitting objects, such as stained glass, cellophane; colored light-emitting objects, such as television, neon lights. Scattering of light by the atmosphere.

All students will measure and describe vibrations and waves:

5. Describe the motion of vibrating objects.

   Key concepts: Period, frequency, amplitude.

   Real-world contexts: Vibrating or oscillating objects, such as weights on springs, vocal cords, tuning forks, guitar strings.

3. Describe waves in terms of their properties.

   Key concepts: Mechanical waves, electromagnetic waves—see PWV-IV.4 h.4. Colors of light. Properties of waves—frequency, amplitude, wavelength, wave velocity, energy. Units of measurement—hertz or cycles per second, micrometers, meters, meters per second.

   Tools for making spectra: Prism, diffraction grating.

   Real-world contexts: Examples of mechanical and electromagnetic waves—see PWV-IV.4 h.4. Colors of light, frequencies of radio and TV transmission.

4. Describe different types of waves and their technological applications.

   Key concepts: Types of waves—mechanical: sound, ultrasound, water waves, shock wave; electromagnetic: radio waves, microwaves, radiant heat, infrared radiation, visible light, ultraviolet radiation, x-rays. Properties of waves—see PWV-IV.4 h.3. See PCM-IV.2 m.4 (energy transformations).

   Real-world contexts: Examples of mechanical waves—sound, ultrasound, ocean waves, wave tanks, earthquakes, seismic waves; examples of electromagnetic waves, such as light—see above, radio and television signals, heat lamps, microwave transmitters, radar, ultraviolet radiation in sunlight, X-ray machines, CAT-scans, gamma rays from radioactive decay.

All students will explain how waves and vibrations transfer energy:

(No elementary benchmark for this strand.)	6. Explain how mechanical waves transfer energy. Key concepts: Sound energy, absorption, transmission, reflection; media—air, solids, water. (See PME-IV.1 m.6, electrical circuits transfer electrical energy.) Real-world contexts: Waves in slinkies and long springs, sound waves, water waves, earthquakes.	(No high school benchmark for this strand.)

Geosphere (EG) V.1

Elementary	Middle School	High School

All students will describe the earth's surface:

1. Describe major features of the earth's surface.

   Key concepts: Types of landforms—mountains, plains, valleys; bodies of water—rivers, oceans, lakes (see EH-V.2 e.2); deserts.

   Real-world contexts: Examples of Michigan surface features, such as hills, valleys, rivers, waterfalls, Great Lakes; pictures of global land features, including mountains, deserts.

2. Recognize and describe different types of earth materials.

   Key concepts: Materials—mineral, rock, boulder, gravel, sand, clay, soil.

   Tools: Hand lens.

   Real-world contexts: Samples of natural earth materials, such as rocks, sand, soil, ores.

1. Describe and identify surface features using maps.

   Key concepts: Landforms—plains, deserts, plateaus, basin, Great Lakes, rivers, continental divide, mountains, mountain range, or mountain chain.

   Tools: Maps—relief, topographic, elevation.

   Real-world contexts: Maps showing continental and regional surface features, such as the Great Lakes or local topography.

(No high school benchmark for this strand.)

All students will describe and explain how the earth's features change over time:

3. Describe natural changes in the earth's surface.

   Key concepts: Causes of changes—volcanoes, earthquakes, erosion (water, wind, gravity, glaciers). Results of change—valleys, hills, lakes, widened rivers, mountains, cracks, movement of earth materials (boulders, gravel, sand, clay).

   Real-world contexts: Places around the school where erosion has occurred, such as gullies formed in down-hill gravel areas, cracks in asphalt. Places beyond the school where changes have occurred, such as volcanic mountains, shorelines, landslides, sand dunes, slopes, river valleys.

2. Explain how rocks are formed.

   Key concepts: Rock cycle processes—melting and cooling (igneous rocks); heat and pressure (metamorphic rocks); cementing and crystallization of sediments (sedimentary rocks). Minerals. Heat source is interior of earth. Materials—silt, clay, gravel, sand, rock, lava, magma, remains of living things (bones, shells, plants).

   Real-world contexts: Physical environments where rocks are being formed: volcanoes; depositional environments, such as ocean floor, deltas, beaches, swamps; metamorphic environments deep within the earth's crust.

3. Explain how rocks are broken down, how soil is formed and how surface features change.

   Key concepts: Chemical and mechanical weathering; erosion by glaciers, water, wind and downslope movement; decomposition, humus.

   Real-world contexts: Regions in Michigan where erosion by wind, water, or glaciers may have occurred, such as river valleys, gullies, shoreline of Great Lakes; chemical weathering from acid rain, formation of caves, caverns and sink holes; physical weathering, frost action such as potholes and cracks in sidewalks; plant roots by bacteria, fungi, worms, rodents, other animals.

1. Explain the surface features of the Great Lakes region using Ice Age theory.

   Key concepts: Glacial processes—climate change, snow changing to ice, pressure, moving (advance, retreat), melting; deposits; features—hills, lakes, Great Lakes. See EAW-V.3 h.1 (long-term climate change.)

   Tools: Relief map, topographic map, elevation map.

   Real-world contexts: Examples in Michigan of glacial formations, such as moraines, kettles, drumlins.

2. Use the plate tectonics theory to explain features of the earth's surface and geological phenomena and describe evidence for the plate tectonics theory.

   Key concepts: Earth composition—crust, mantle: upper part is able to flow very slowly; core: interior at high temperature and pressure (see ES-V.4 h.3.) Forces—tension, compression shearing. Plates—continental crust, oceanic crust. Features—faults, trenches, mid-ocean ridges, folded mountains, hot spots, volcanoes. Related actions—earthquakes (see PWV-IV.4 m.6), volcanic activity, seafloor spreading, mountain building, convection in mantle. Evidence of "continental drift"—physical fit of continents, fossil evidence, measurements of movement, rock layer sequences, glacial evidence. See Reflecting on Scientific Knowledge benchmarks related to evidence and theory.

   Real-world contexts: Recent patterns of earthquake and volcanic activities; maps showing the direction of movement of major plates and associated earthquake and volcanic activity; compressional boundaries: folded mountains, thrust faults, trenches, lines of volcanoes (e.g. Pacific "ring of fire"); tensional boundaries: mid-ocean ridges, rift valleys; shearing boundaries: lateral movement producing faults (e.g. San Andreas Fault).

4. Explain how rocks and fossils are used to understand the history of the earth.

   Key concepts: Fossils, extinct plants and animals, ages of fossils, rock layers. See LE-III.4 e.1 (ancient life.)

   Real-world contexts: Fossils found in gravel, mines, quarries, beaches (Petosky stones), museum displays; Michigan examples of layered rocks; specific examples of extinct plants and animals, such as dinosaurs.

4. Explain how rocks and fossils are used to understand the age and geological history of the earth.

   Key concepts: Fossils, extinct plants and animals, ages of fossils, rock layers, timelines, relative dating.

   Real-world contexts: Fossils found in gravel, mines and quarries, museum displays; places where rock layers are visible, such as Pictured Rocks, quarries, Grand Canyon, road cuts; Michigan fossils, such as trilobites, brachiopods, Petosky stones; specific examples of extinct plants and animals, such as dinosaurs.

All students will analyze effects of technology on the earth's surface and resources:

5. Describe uses of materials taken from the earth.

   Key concepts: Transportation, building materials, energy, water (see EH-V.2 e.3.)

   Real-world contexts: Examples of uses of earth materials, such as gravel into concrete for walls, gypsum into drywall, sand into glass for windows, road salt, ores into metal for chairs, oil into gasoline for cars, coal burned to produce electricity, water for hydroelectric power. Samples of manufactured materials, such as concrete, drywall, asphalt, iron and steel.

6. Demonstrate ways to conserve natural resources and reduce pollution through reduction, reuse, and recycling of manufactured materials.

   Key concepts: Materials that can be recycled—paper, metal, glass, plastic. Conservation and anti-pollution activities—reduce, reuse, recycle.

   Real-world contexts: Collections of recyclable materials, plans for recycling at home and school, composting, ways of reusing or reducing the use of paper.

5. Explain how technology changes the surface of the earth.

   Key concepts: Types of human activities—surface mining, construction and urban development, farming, dams, landfills, restoring natural areas.

   Real-world contexts: Local example of surface changes due to human activities listed in the Key concepts above; local examples of negative consequences of these changes, such as groundwater pollution, destruction of habitat and scenic land, reduction of arable land; local examples of positive consequences, such as soil conservation, reforestation, restoring wetlands.

3. Explain how common objects are made from earth materials and why earth materials are conserved and recycled.

   Key concepts: Valuable materials—minerals, metallic ores, iron, copper, aluminum, fuels. Types of resources—renewable, nonrenewable. Conservation, limits, recycling, costs for developing more remote supplies. Manufacturing, refining, mining. Recycling processes—melting, shredding, dissolving.

   Real-world contexts: Manufacturing processes—steel mills, auto assembly lines, paper making; local recycling center for materials, such as glass, plastic, aluminum, steel cans, motor oil; examples of technical and social means for slowing the depletion of earth's resources, such as developing more fuel-efficient cars and mandating their use; disposal in landfills and incinerators.

4. Evaluate alternative long range plans for resource use and by-product disposal in terms of environmental and economic impact.

   Key concepts: Understanding of limitations of knowledge and technology (see R-II.1 h.2), side effects of resource use (see PME-IV.1 h.1, risk/benefit analysis). Also see R-II.1 h.5 (new technologies), EAW-V.3 h.4 (air pollution),

   Real-world contexts: Industries for mining, energy production, manufacturing, transportation, housing. Resources including fossil fuels, metals, wood, water. Pollution prevention and events, such as catalytic converters, Love Canal, Superfund waste sites.

Hydrosphere (EH) V.2

Elementary	Middle School	High School
All students will describe the characteristics of water and demonstrate where water is found on earth:		
1. Describe how water exists on earth in three states. *Key concepts:* Liquid (K-2)—visible, flowing, melting, dew. Solid (K-2)—hard, visible, freezing, ice. Gas (3-5)—invisible, water vapor, moisture, evaporating. See PCM-IV.2 e.1. *Real-world contexts:* Examples of water in each state, including dew, rain, snow, ice, evidence of moisture in the air, such as "fog" on cold bathroom mirrors; examples of melting, freezing, and evaporating.	1. Use maps of the earth to locate water in its various forms and describe conditions under which they exist. *Key concepts:* Liquid water forms—lakes, rivers, oceans, springs. Frozen water forms—continental glacier, valley glacier, snow on mountains, polar cap. Gaseous water in atmosphere. Tools: Relief and elevation maps; satellite images *Real-world contexts:* Local lakes, rivers, streams, ponds, springs; examples of frozen water, including snow, glaciers, icebergs, polar regions, frozen Great Lakes shorelines.	(No high school benchmark for this strand.)
All students will describe how water moves:		
2. Trace the path that rain water follows after it falls. *Key concepts:* Precipitation—see EAW-V.3 e.1. Flow—downhill, to rivers, into the ground. Bodies of water—streams, rivers, lakes, oceans. See EG-V.1 e.1 (earth features). *Real-world contexts:* Examples of water flowing locally, including gutters, drains, streams, wetlands.	2. Describe how surface water in Michigan reaches the ocean and returns. *Key concepts:* Water path—run-off, creeks, streams, wetlands, rivers, Great Lakes. Sources—snow melt, rain fall. Gravity. Water cycle—see EAW-V.3 m.3. (See EH-V.2 m.3 about groundwater.) *Real-world contexts:* Maps showing streams, lakes, rivers, oceans; examples of motions of rivers and lakes; investigations of rivers and lake temperatures; saltiness of ocean.	1. Identify and describe regional watersheds. *Key concepts:* drainage basins, divides, reservoirs, tributaries, run-off. *Tools:* maps *Real-world contexts:* Local and regional watersheds, Great Lakes Basin, Continental Divide; planning water management, evaluating potential disposal sites, analyzing pollution events which concern both surface and ground water.

All students will analyze the interaction of human activities with the hydrosphere:

3. Identify sources of water and its uses.

   Key concepts: Water sources—wells, springs, Great Lakes, rivers. Household uses—drinking, cleaning, food preparation. Public uses—generate electricity, recreation, irrigation, transportation, industry.

   Real-world contexts: Examples of local sources of drinking water, including wells, rivers, lakes. Examples of local occasions when water is used, including car wash, swimming, fire hydrants, drinking, food preparation, cleaning, watering lawn, bathing, fishing, boating, shipping on the Great Lakes.

3. Explain how water exists below the earth's surface and how it is replenished.

   Key concepts: Ground water—water table, spring, porous, saturate, filtration. Sources—snow melt, rain fall.

   Real-world contexts: Examples of groundwater, including springs, wells, water soaking into the ground.

4. Describe the origins of pollution in the hydrosphere.

   Key concepts: Sources of pollution—sewage, household dumping, industrial wastes, agricultural run-off. See EG-V.1 m.5, LEC-III.5 m.6.

   Real-world contexts: Examples of polluted water; examples of occasions when water supply is restricted, such as during droughts.

2. Describe how human activities affect the quality of water in the hydrosphere.

   Key concepts: Human activities—agriculture, fishing, manufacturing, energy production. Quantity of water—rate of use, urbanization. Oceans—oil spills, garbage, global warming, marine life. Fresh water pollution—industrial waste disposal, agricultural run-off, herbicides, pesticides, sewage, acid rain, nutrient levels. Ground water—landfills, leaching, disposal of toxic wastes. Purification technology—filtering, chlorination. Limits to natural resources.

   Real-world contexts: Examples of local and regional human activities that have measurable effects on water, including farming, industry, sewage disposal, toxic waste disposal.

Atmosphere and Weather (EAW) V.3

Elementary	Middle School	High School

All students will investigate and describe what makes up weather and how it changes from day to day, from season to season and over long periods of time:

Elementary

1. Describe weather conditions.

   Key concepts: Atmosphere is a blanket of air around the earth, air is a substance; see PME-IV.1 e.1 (attributes of substances). Air has temperature—cold, hot, warm, cool. Cloud cover—cloudy, partly cloudy; foggy. Precipitation—rain, snow, hail, freezing rain. Wind—breezy, windy, calm. Severe weather— thunderstorms, lightning, tornadoes, high winds, blizzards.

   Tools: Thermometer, wind sock, rain gauge.

   Real-world contexts: Daily changes in weather; examples of severe weather.

2. Describe seasonal changes in Michigan's weather.

   Key concepts: Seasons and types of weather—fall, cool nights and warm days; winter—snowy and constantly cold, getting dark early in the evening; spring—warmer days, often rainy with thunderstorms; summer—hot days and warm nights, daylight lasting until late in the evening.

   Real-world contexts: Examples of visible seasonal changes in nature.

Middle School

1. Explain patterns of changing weather and how they are measured.

   Key concepts: Weather patterns—cold front, warm front, stationary front, air mass, humidity.

   Tools: Thermometer, rain gauge, wind direction indicator, anemometer, weather maps, satellite weather images.

   Real-world contexts: Sudden temperature and cloud formation changes; records, charts, and graphs of weather changes over periods of days; lake effect snow.

High School

1. Explain how interactions of the atmosphere, hydrosphere and geosphere create climates and how climates change over time.

   Key concepts: Average yearly temperatures; ice ages, volcanic dust in atmosphere, greenhouse effect, global air circulation, effects of latitude, effects of landforms, ocean currents.

   Real-world contexts: Causes of short-term climate changes, such as catastrophic volcanic eruptions and impact of solar system objects; evidence of long-term climate changes, such as ice ages, global warming. El Nino, La Nina.

All students will explain what causes different kinds of weather:

(No elementary benchmark for this strand.)

2. Describe the composition and characteristics of the atmosphere.

   Key concepts: Composition—air, molecules, gas, water vapor, dust particles, ozone. Characteristics—air pressure and temperature changes with altitude, humidity.

   Real-world contexts: Examples of characteristics of the atmosphere, including pressurized cabins in airplanes, demonstrations of air pressure; examples of air-borne particulates, such as smoke, dust, pollen, bacteria; effects of humidity, such as condensation, dew on surfaces, comfort level of humans.

3. Explain the behavior of water in the atmosphere.

   Key concepts: Water cycle—evaporation, water vapor, warm air rises, cooling, condensation, clouds. Precipitation—rain, snow, hail, sleet, freezing rain. Relative humidity, dew point, fog. See PCM-IV.2 m.1 (changes of state), EH-V.2 m.2 (water on the earth's surface).

   Real-world contexts: Aspects of the water cycle in weather, including clouds, fog, precipitation, evaporating puddles, flooding, droughts.

2. Describe patterns of air movement in the atmosphere and how they affect weather conditions.

   Key concepts: Air movement—air masses, fronts, pressure systems, prevailing winds, jet stream.

   Real-world contexts: Reports of local weather patterns influenced by the jet stream and prevailing winds.

3. Explain and predict general weather patterns and storms.

   Key concepts: Weather patterns—cold front, warm front, stationary front, air mass, high and low pressure systems. Storms—thunderstorms, lightning and thunder, tornadoes, hurricanes, winds, blizzards. Buoyancy, thermal expansion, convection. See PCM-IV.2 m.1 (thermal expansion) and PME-IV.1 m.1 (density).

   Tools: Weather maps, thermometer, hygrometer, barometer, anemometer, wind vane, rain gauge, satellite and radar monitoring (see PWV-IV.4 h.4).

   Real-world contexts: Observable daily weather patterns; examples of weather reports from TV, radio, newspapers, including representations on weather maps. Reports of local weather patterns influenced by the jet stream and prevailing winds.

All students will analyze the relationships between human activities and the atmosphere:

3. Explain appropriate safety precautions during severe weather.

   Key concepts: Safety precautions—safe locations, sirens, radio broadcasts, severe weather watch and warning.

   Real-world contexts: Examples of local severe weather, including thunderstorms, tornadoes and blizzards, examples of local community safety precautions, including weather bulletins and tornado sirens.

4. Describe health effects of polluted air.

   Key concepts: Effects—breathing difficulties, irritated eyes. Sources—car exhaust, industrial emissions. Acid rain.

   Real-world contexts: Locations and times where air quality is poor; local sources of potential air pollution; ozone warnings.

4. Explain the impact of human activities on the atmosphere and explain ways that individuals and society can reduce pollution.

   Key concepts: Air pollution—car exhaust, industrial emissions, smog. Related effects—breathing problems, acid rain, global warming, deforestation, ozone depletion. See EG-V.1 h.4 (resource use).

   Real-world contexts: Examples of human activities that affect the atmosphere, including use of aerosol spray cans, discharge from smoke stacks, car exhaust, burning leaves and wood in stoves and fireplaces, climate change, global warming; actions, including turning off lights, turning down heat, tuning-up cars, filling tires, driving at a consistent speed, mandating higher fuel efficiencies, energy savings from recycling.

Solar System, Galaxy and Universe (ES) V.4

Elementary	Middle School	High School

All students will compare and contrast our planet and sun to other planets and star systems.

1. Compare and contrast characteristics of the sun, moon and earth.

   Key concepts: Planet, star, sphere, space, solar system, larger/smaller, closer/farther, heat, light.

   Real-world contexts: Observations of the moon, earth, and safe observations of the sun.

1. Compare the earth to other planets and moons in terms of supporting life.

   Key concepts: Surface conditions—gravity, atmospheres, temperature. Relative distances, relative sizes. Sun produces the light and heat for each planet. Molecules necessary to support life—water, oxygen, nitrogen, carbon; see LC-III.1 m.2 (cell processes), LO-III.2 m.3 (photosynthesis), LEC-III.5 m.2 (light needed for energy).

   Real-world contexts: Examples of local and extreme conditions on earth vs. conditions on other planets; exploration of planets and their satellites.

1. Compare our sun to other stars.

   Key concepts: Temperatures, colors, sizes, apparent and absolute brightness; double stars.

   Real-world contexts: Observing color and brightness of stars, observing double stars.

All students will describe and explain how objects in the solar system move.

2. Describe the motion of the earth around the sun and the moon around the earth.

   Key concepts: Spin, orbit, length of day, nighttime, month, year, observed movement of the sun and stars across the sky, observed movement of the moon from day to day, calendar.

   Real-world contexts: Outdoor observing of the sun's and star's motions during the night and moon's motions over several days.

2. Describe, compare, and explain the motions of solar system objects.

   Key concepts: Orbit, rotation (spin), axis, gravity, planets, moons, comets, asteroids, seasons. Tilt of the earth on its axis, direct/indirect rays. See PMO-IV.3 m.2 (force and change in motion) and PMO-IV.3 m.3 (gravity).

   Real-world contexts: Observations of comet motion over days and weeks, length of day and year on planets, changes in length of daylight and height of sun in sky; changes in daily temperature patterns; summer and winter solstices, spring and fall equinoxes.

3. Describe and explain common observations of the night skies.

   Key concepts: Perceived and actual movement of the moon and planets across the sky, moon phases, eclipses, stars and constellations, planets, Milky Way, comets, comet tails, meteors. Sun is light source for all solar system objects (except meteors; friction with atmosphere), emitted light, reflected light (see PWV-IV.4 m.3 and m.4.)

   Real-world contexts: Outdoor observing of the skies, using telescopes and binoculars when available, as well as "naked-eye" viewing; viewing with robotic telescopes via the World Wide Web; telescopic and spacecraft-based photos of planets, moons, and comets; news reports of planetary and lunar exploration.

2. Describe the position and motion of our solar system in our galaxy and the overall scale, structure and age of the universe.

   Key concepts: Stars, galaxies, Milky Way, spiral structure, speed of light, light year, travel times, big bang, red shift.

   Tools: Telescopes, binoculars, *spectroscopes*

   Real-world contexts: Observations of other stars, star clusters, nebulas, and galaxies, observations of other potential planetary systems, accounts of possible travel to other star systems.

All students will explain scientific theories as to the origin of the solar system

(No elementary benchmark for this strand.)	(No middle school benchmark for this strand.)	3. Explain how stars and planetary systems form and how stars produce energy. *Key concepts:* Processes of formation—coalescence from clouds of dust and gases by gravity; explosions of stars producing heavy elements; hydrogen, helium. Production of energy—fusion, radiation. Planetary systems may form during this process—heavy and light elements, hot interiors of earth-like planets. Age of the solar system. *Real-world contexts:* Nebulas considered to be star-forming regions, supernovas, nuclear fusion research.

All students will explain how we learn about the universe.

(No elementary benchmark for this strand.)	(No middle school benchmark for this strand.)	4. Explain how technology and scientific inquiry have helped us learn about the universe. *Key concepts:* Information—radiant energy, radio waves, light, spectra, color of stars, moon and meteor samples. Devices—radio, optical and other types of telescopes, space probes, satellites, computer imaging/modeling (see PWV-IV.4 h.4.) Problems for investigation—geology and weather of planets and moons, origins, extraterrestrial life. *Real-world contexts:* Histories of discoveries, stories of exploration, visits to observatories and planetariums; videos showing space exploration; samples of space materials, including moon rocks and meteorites; remote sensing data; SETI—Search for Extraterrestrial Life.

Section 2.

Michigan School District Science Scores

Michigan State to District 5th Grade Science Statistics

	% Level 1	% Level 2	% Level 3	% Level 4	% Passing (L1 + L2)
Michigan State Performance	27.9	45.3	22.3	4.5	73.2
District Name	% Level 1	% Level 2	% Level 3	% Level 4	% Passing (L1 + L2)
NORTHRIDGE ACADEMY	2.3	2.3	32.6	62.8	4.6
CHANDLER PARK ACADEMY	0.0	5.0	80.0	15.0	5.0
BENTON HARBOR CHARTER SCHOOL	0.0	8.5	53.2	38.3	8.5
MI EARLY ELEM CENTER	0.0	9.1	63.6	27.3	9.1
FRANCIS REH PUBLIC SCHOOL ACADEMY	0.0	12.5	62.5	25.0	12.5
ALLEN ACADEMY	0.0	12.7	58.2	29.1	12.7
DETROIT ADVANTAGE ACADEMY	1.9	12.1	48.6	37.4	14.0
PIERRE TOUSSAINT ACADEMY	0.0	15.8	52.6	31.6	15.8
INKSTER PUBLIC SCHOOLS	0.8	15.8	43.6	39.8	16.6
COMMONWEALTH COMMUNITY DEVELOPMENT ACAD	1.7	16.9	57.6	23.7	18.6
CENTER FOR LEARNING AND CREATIVITY	0.0	20.0	53.3	26.7	20.0
TRI VALLEY ACADEMY	4.3	17.4	52.2	26.1	21.7
PLYMOUTH EDUCATIONAL CENTER	4.1	18.6	54.6	22.7	22.7
ACADEMY OF OAK PARK	5.2	17.7	63.5	13.5	22.9
HOPE ACADEMY	1.5	21.5	46.2	30.8	23.0
DEARBORN ACADEMY	3.9	19.6	56.9	19.6	23.5
CENTER ACADEMY	2.6	21.1	47.4	28.9	23.7
HIGHLAND PARK CITY SCHOOLS	0.7	23.3	48.1	27.8	24.0
WEST VILLAGE ACADEMY	4.1	20.4	53.1	22.4	24.5
KALAMAZOO ADVANTAGE ACADEMY	0.0	26.3	47.4	26.3	26.3
TIMBUKTU ACADEMY OF SCI AND TECH	7.7	19.2	50.0	23.1	26.9
WARRENDALE CHARTER ACADEMY	2.7	24.3	52.7	20.3	27.0
LINDEN CHARTER ACADEMY	1.3	26.0	53.2	19.5	27.3
CESAR CHAVEZ ACADEMY	1.3	26.3	46.1	26.3	27.6
BUENA VISTA SCHOOL DISTRICT	1.8	26.5	56.6	15.0	28.3
WOODWARD ACADEMY	2.4	26.5	43.4	27.7	28.9
BEECHER COMMUNITY SD	5.8	23.8	48.3	22.1	29.6

CAPITAL AREA ACADEMY	13.8	17.2	65.5	3.4	31.0
MOSAICA ACADEMY OF SAGINAW	0.0	31.7	56.1	12.2	31.7
STAR INTERNATIONAL ACADEMY	8.2	24.5	51.0	16.3	32.7
INTERNATIONAL ACADEMY OF FLINT	4.7	28.1	31.3	35.9	32.8
DETROIT ACADEMY OF ARTS AND SCIENCES	4.1	28.8	50.0	17.1	32.9
YMCA SERVICE LEARNING ACADEMY	4.2	28.8	55.1	11.9	33.0
AISHA SHULE/W.E.B. DUBOIS PREPARATORY	0.0	33.3	44.4	22.2	33.3
SAUK TRAIL ACADEMY	0.0	33.3	53.3	13.3	33.3
ROSS HILL ACADEMY	0.0	33.3	54.5	12.1	33.3
EL-HAJJ MALIK ELL SHABAZZ ACADEMY	6.7	26.7	46.7	20.0	33.4
GEORGE WASHINGTON CARVER ACADEMY	4.2	29.6	43.7	22.5	33.8
HAMTRAMCK PUBLIC SCHOOLS	8.6	25.5	45.2	20.7	34.1
BEACON INTERNATIONAL ACADEMY	0.0	34.8	43.5	21.7	34.8
CENTRAL ACADEMY	5.0	30.0	55.0	10.0	35.0
MUSKEGON HEIGHTS PUBLIC SCHOOLS	4.0	31.3	48.5	16.2	35.3
KING ACADEMY	0.0	35.3	64.7	0.0	35.3
THOMAS-GIST ACADEMY	0.0	36.7	40.0	23.3	36.7
GEORGE CROCKETT ACADEMY	2.3	34.9	55.8	7.0	37.2
HOPE OF DETROIT ACADEMY	0.0	37.5	43.8	18.8	37.5
SANKOFA SHULE ACADEMY	6.3	31.3	50.0	12.5	37.6
BALDWIN COMMUNITY SCHOOLS	7.5	30.2	41.5	20.8	37.7
QUESTAR ACADEMY	7.7	30.8	61.5	0.0	38.5
OLD REDFORD ACADEMY	2.0	36.7	61.2	0.0	38.7
DOVE ACADEMY OF DETROIT	5.6	33.3	61.1	0.0	38.9
THRESHOLD ACADEMY	7.1	32.1	53.6	7.1	39.2
TIMBERLAND ACADEMY	9.1	31.8	50.0	9.1	40.9
WILLIAM C ABNEY ACADEMY	0.0	41.2	58.8	0.0	41.2
SUMMIT ACADEMY NORTH	6.3	35.0	43.8	15.0	41.3
ECORSE PUBLIC SCHOOL DIST	3.7	38.5	50.5	7.3	42.2
METRO CHARTER ACADEMY	3.3	39.3	47.5	9.8	42.6
FLINT COMMUNITY SCHOOL DISTRICT	10.7	32.0	43.0	14.4	42.7
GAUDIOR ACADEMY	9.5	33.3	42.9	14.3	42.8
NSOROMA INSTITUTE	3.6	39.3	46.4	10.7	42.9
WESTWOOD HEIGHTS SCH DIST	8.7	34.8	40.2	16.3	43.5
CONNER CREEK ACADEMY EAST	8.3	35.4	37.5	18.8	43.7
GRAND RAPIDS PUBLIC SCHOOLS	10.3	34.1	41.5	14.0	44.4
MICHIGAN AUTOMOTIVE ACADEMY	6.8	38.6	43.2	11.4	45.4

OAK PARK SCHOOLS	6.9	39.1	44.6	9.4	46.0
WALDEN GREEN DAY SCHOOL	15.4	30.8	46.2	7.7	46.2
BENTON HARBOR AREA SCHOOLS	6.8	39.4	46.0	7.8	46.2
PONTIAC CITY SCHOOL DISTRICT	11.3	35.0	42.0	11.7	46.3
CONNER CREEK ACADEMY	1.7	44.8	31.0	22.4	46.5
WESTWOOD COMMUNITY SCHOOLS	4.9	41.7	41.7	11.8	46.6
ACADEMY OF FLINT	15.0	31.7	45.0	8.3	46.7
DETROIT PUBLIC SCHOOLS	10.9	36.1	38.6	14.4	47.0
COVERT PUBLIC SCHOOLS	9.8	37.3	51.0	2.0	47.1
ACADEMY OF WESTLAND	6.3	41.7	33.3	18.8	48.0
MARVIN L WINANS ACADEMY/PERFORMING ARTS	4.2	43.8	37.5	14.6	48.0
RIDGE PARK CHARTER ACADEMY	15.4	33.3	43.6	7.7	48.7
CHERRY HILL PERFORMING ARTS	5.4	43.5	34.8	16.3	48.9
RIVER ROUGE SCHOOL DISTRICT	16.9	32.9	35.2	15.0	49.8
DISCOVERY ELEMENTARY SCHOOL	16.7	33.3	41.7	8.3	50.0
CARROLLTON SCHOOL DISTRICT	10.4	39.6	43.8	6.3	50.0
WALTER FRENCH ACADEMY	10.0	40.0	40.0	10.0	50.0
NATAKI TALIBAH SCHOOLHOUSE OF DETROIT	6.0	44.0	48.0	2.0	50.0
LITCHFIELD COMMUNITY SCHOOLS	5.6	44.4	36.1	13.9	50.0
ACADEMY OF LATHRUP VILLAGE	2.6	48.7	46.2	2.6	51.3
PONTIAC PUBLIC SCHOOL ACADEMY	9.1	42.4	36.4	12.1	51.5
KALAMAZOO CITY SCHOOL DIST	17.9	33.7	36.9	11.5	51.6
MUSKEGON CITY SCHOOL DIST	12.1	39.9	40.3	7.6	52.0
EDISON PUBLIC SCHOOL ACADEMY	7.7	45.3	35.0	12.0	53.0
TEKONSHA COMMUNITY SCHOOLS	15.6	37.5	40.6	6.3	53.1
BATTLE CREEK PUBLIC SCHOOLS	12.5	40.7	37.4	9.4	53.2
BURR OAK COMM SCHOOL DIST	6.7	46.7	46.7	0.0	53.4
WALTON CHARTER ACADEMY	14.1	39.4	38.0	8.5	53.5
SUMMIT ACADEMY	7.1	46.4	33.9	12.5	53.5
BAY COUNTY PSA	12.5	41.7	37.5	8.3	54.2
GRATTAN ACADEMY	27.3	27.3	18.2	27.3	54.6
HOLTON PUBLIC SCHOOLS	8.6	46.2	36.6	8.6	54.8
SAGINAW CITY SCHOOL DISTRICT	10.8	44.1	39.8	5.3	54.9
FREESOIL COMMUNITY SCH DIST	0.0	55.0	40.0	5.0	55.0
THE MOREY CHARTER SCHOOL	23.7	31.6	34.2	10.5	55.3
COLIN POWELL ACADEMY	11.6	44.2	44.2	0.0	55.8
WEST MICHIGAN ACADEMY OF ENVIR SCI	4.9	51.2	34.1	9.8	56.1

MESICK CONSOLIDATED SCH DIST	12.7	43.7	31.0	12.7	56.4
SPRINGPORT PUBLIC SCHOOLS	11.8	45.2	40.9	2.2	57.0
TAHQUAMENON AREA SCHOOLS	14.1	43.6	37.2	5.1	57.7
BOYNE FALLS PUBLIC SCHOOL	10.5	47.4	31.6	10.5	57.9
MAYVILLE COMMUNITY SCH DIST	6.6	51.6	34.1	7.7	58.2
HURON ACADEMY	8.7	50.0	37.0	4.3	58.7
ARBOR ACADEMY	17.6	41.2	35.3	5.9	58.8
WILLOW RUN COMMUNITY SCHOOLS	15.8	43.3	37.2	3.7	59.1
JACKSON PUBLIC SCHOOLS	20.6	38.6	33.1	7.7	59.2
DECATUR PUBLIC SCHOOLS	7.9	51.3	30.3	10.5	59.2
PONTIAC ACADEMY OF EXCELLENCE	10.8	48.6	35.1	5.4	59.4
KALKASKA PUBLIC SCHOOLS	17.4	42.6	33.9	6.1	60.0
WALKERVILLE PUBLIC SCHOOLS	8.0	52.0	32.0	8.0	60.0
HARTFORD PUBLIC SCHOOL DIST	25.0	35.2	34.1	5.7	60.2
FENNVILLE PUBLIC SCHOOLS	17.4	43.0	35.5	4.1	60.4
MID MICHIGAN PUBLIC SCHOOL ACADEMY	15.8	44.7	34.2	5.3	60.5
MONTROSE COMMUNITY SCHOOLS	11.8	48.7	32.8	6.7	60.5
MICHIGAN CENTER SCHOOL DIST	9.3	51.4	38.3	0.9	60.7
EDISON OAKLAND ACADEMY	17.9	42.9	31.0	8.3	60.8
BRONSON COMMUNITY SCHOOLS	9.8	51.0	30.4	8.8	60.8
VISTA CHARTER ACADEMY	15.2	45.7	34.8	4.3	60.9
POSEN CONS SCHOOL DISTRICT	22.2	38.9	33.3	5.6	61.1
ALBION PUBLIC SCHOOLS	21.7	39.5	34.9	3.9	61.2
WALDRON AREA SCHOOLS	9.7	51.6	35.5	3.2	61.3
NEW HAVEN COMMUNITY SCHOOLS	11.4	50.0	28.6	10.0	61.4
GRAND BLANC ACADEMY	21.4	40.5	31.0	7.1	61.9
DELTON KELLOGG SCHOOLS	19.0	43.0	34.2	3.8	62.0
ACADEMY OF SOUTHFIELD	17.9	44.6	33.9	3.6	62.5
WHITTEMORE PRESCOTT AREA S/D	29.0	33.6	27.1	10.3	62.6
GALESBURG AUGUSTA COMM SCHS	20.2	42.4	34.3	3.0	62.6
LANSING SCHOOL DISTRICT	15.5	47.1	32.9	4.5	62.6
BELDING AREA SCHOOL DISTRICT	16.5	46.3	34.1	3.0	62.8
NORTH SAGINAW CHARTER ACADEMY	24.6	38.6	33.3	3.5	63.2
MACOMB INTERMEDIATE S/D	5.3	57.9	31.6	5.3	63.2
CARSON CITY-CRYSTAL AREA SCHOOLS	14.7	48.6	34.9	1.8	63.3
JONESVILLE COMMUNITY SCHOOLS	17.2	46.2	25.8	10.8	63.4
OAKLAND INTERNATIONAL ACADEMY	18.2	45.5	27.3	9.1	63.7

CREATIVE MONTESSORI ACADEMY	18.2	45.5	30.3	6.1	63.7
AKRON FAIRGROVE SCHOOLS	15.2	48.5	24.2	12.1	63.7
TAYLOR SCHOOL DISTRICT	23.1	40.7	31.6	4.7	63.8
ATLANTA COMMUNITY SCHOOLS	19.4	44.4	25.0	11.1	63.8
MT MORRIS CONSOLIDATED SCHS	17.1	46.8	30.6	5.6	63.9
CARSONVILLE-PORT SANILAC S/D	5.6	58.3	30.6	5.6	63.9
ATHENS AREA SCHOOLS	9.3	54.7	32.0	4.0	64.0
ROMULUS COMMUNITY SCHOOLS	15.3	48.9	30.6	5.1	64.2
MADISON PUBLIC SCHOOLS	13.3	51.0	35.7	0.0	64.3
MOUNT CLEMENS COMMUNITY SCHOOLS	16.6	47.8	27.8	7.8	64.4
WOODLAND PARK ACADEMY	22.6	41.9	22.6	12.9	64.5
WHITMORE LAKE PUBLIC SCHOOLS	15.1	49.5	31.2	4.3	64.6
NEW BRANCHES SCHOOL	23.5	41.2	29.4	5.9	64.7
BRIDGEPORT SPAULDING C S D	15.9	48.8	29.0	6.3	64.7
EAST JACKSON COMMUNITY SCHOOLS	25.0	40.6	31.3	3.1	65.6
UNION CITY COMMUNITY SCHOOLS	13.3	52.4	27.6	6.7	65.7
COUNTRYSIDE CHARTER SCHOOL	13.6	52.3	22.7	11.4	65.9
HARRISON COMMUNITY SCHOOLS	25.5	40.5	30.1	3.9	66.0
RUDYARD AREA SCHOOLS	18.3	47.7	32.1	1.8	66.0
MASON CONSOLIDATED	17.2	49.0	29.7	4.1	66.2
BRECKENRIDGE COMMUNITY SCHOOLS	11.7	54.5	27.3	6.5	66.2
MAPLE VALLEY PUBLIC SCHOOLS	13.9	52.6	29.9	3.6	66.5
BEAL CITY SCHOOL	22.2	44.4	33.3	0.0	66.6
GRASS LAKE COMMUNITY SCHOOLS	13.6	53.0	31.8	1.5	66.6
BENTLEY COMMUNITY SCHOOL DISTRICT	20.6	46.1	26.5	6.9	66.7
ADRIAN PUBLIC SCHOOLS	19.8	46.9	28.7	4.6	66.7
ISLAND CITY ACADEMY	16.7	50.0	25.0	8.3	66.7
NAH TAH WAHSH PSA	0.0	66.7	26.7	6.7	66.7
SCHOOL DISTRICT OF YPSILANTI	20.0	46.8	27.1	6.2	66.8
NORTHWEST COMMUNITY SCHOOLS	17.2	49.8	30.2	2.8	67.0
GENESEE SCHOOL DISTRICT	16.4	50.7	28.4	4.5	67.1
FOWLERVILLE COMMUNITY SCHS	17.9	49.3	31.4	1.5	67.2
CAMDEN FRONTIER SCHOOLS	12.1	55.2	27.6	5.2	67.3
MARLETTE COMMUNITY SCHOOLS	23.8	43.6	29.7	3.0	67.4
CENTRAL MONTCALM PUBLIC SCHOOL	17.0	50.6	30.7	1.7	67.6
EVART PUBLIC SCHOOLS	16.1	51.6	26.9	5.4	67.7
CRESTWOOD SCHOOL DISTRICT	17.8	50.0	28.4	3.8	67.8

FOREST AREA COMMUNITY SCHOOLS	11.1	56.9	27.8	4.2	68.0
BUCHANAN COMMUNITY SCHOOL DISTRICT	25.2	42.9	29.3	2.7	68.1
FERNDALE CITY SCHOOL DISTRICT	22.8	45.3	27.7	4.2	68.1
ONTONAGON AREA SCHOOLS	27.3	40.9	29.5	2.3	68.2
COLEMAN COMMUNITY SCH DIST	25.3	42.9	29.7	2.2	68.2
LINCOLN CONSOLIDATED SCHOOLS	17.8	50.4	29.2	2.5	68.2
CASSOPOLIS PUBLIC SCHOOLS	21.4	47.0	30.8	0.9	68.4
WYOMING PUBLIC SCHOOLS	20.6	47.8	29.6	1.9	68.4
CONCORD ACADEMY-BOYNE	15.8	52.6	31.6	0.0	68.4
HOUGHTON LAKE COMMUNITY SCHOOLS	11.8	56.6	29.6	2.0	68.4
COLOMA COMMUNITY SCHOOLS	22.7	46.0	27.6	3.7	68.7
HEMLOCK PUBLIC SCHOOLS	21.7	47.0	31.3	0.0	68.7
NEW BEDFORD ACADEMY	18.8	50.0	6.3	25.0	68.8
ACADEMY OF DETROIT WEST	22.2	46.7	28.9	2.2	68.9
WINDEMERE PARK CHARTER ACADEMY	20.0	48.9	26.7	4.4	68.9
RAVENNA PUBLIC SCHOOLS	19.0	50.0	27.4	3.6	69.0
PITTSFORD AREA SCHOOLS	14.5	54.5	27.3	3.6	69.0
VAN DYKE PUBLIC SCHOOLS	21.9	47.3	28.0	2.9	69.2
DEERFIELD PUBLIC SCHOOLS	23.1	46.2	30.8	0.0	69.3
CONSTANTINE PUBLIC SCH DIST	19.4	50.0	28.2	2.4	69.4
HALE AREA SCHOOLS	16.9	52.5	30.5	0.0	69.4
NILES COMMUNITY SCHOOLS	26.2	43.3	26.2	4.3	69.5
SUPERIOR CENTRAL SCHOOL DISTRICT	21.7	47.8	30.4	0.0	69.5
BURTON GLEN CHARTER ACADEMY	15.2	54.3	23.9	6.5	69.5
EAST JORDAN PUBLIC SCHOOLS	15.2	54.3	23.9	6.5	69.5
ST LOUIS PUBLIC SCHOOLS	21.0	48.6	24.8	5.7	69.6
NEWAYGO PUBLIC SCHOOL DIST	18.0	51.6	29.2	1.2	69.6
BULLOCK CREEK SCHOOL DISTRICT	26.3	43.4	27.4	2.9	69.7
PARAGON CHARTER ACADEMY	16.1	53.6	23.2	7.1	69.7
SOUTH REDFORD SCHOOL DIST	18.1	51.7	27.2	3.0	69.8
ENDEAVOR CHARTER ACADEMY	27.4	42.5	26.0	4.1	69.9
REED CITY AREA PUBLIC SCHOOLS	21.6	48.3	26.1	4.0	69.9
MONTABELLA COMMUNITY SCHOOLS	21.4	48.5	30.1	0.0	69.9
PORT HOPE COMMUNITY SCHOOLS	20.0	50.0	30.0	0.0	70.0
BELLEVUE COMMUNITY SCHOOL DISTRICT	23.9	46.3	22.4	7.5	70.2
OAKRIDGE PUBLIC SCHOOLS	16.0	54.5	27.6	1.9	70.5
MARION PUBLIC SCHOOLS	22.1	48.5	23.5	5.9	70.6

NORTH DICKINSON COUNTY SCHOOL DIST	14.7	55.9	26.5	2.9	70.6
ARENAC EASTERN SCHOOL DIST	16.1	54.8	29.0	0.0	70.9
LINCOLN PARK PUBLIC SCHOOLS	19.3	51.8	26.2	2.7	71.1
WEST MICHIGAN ACADEMY FOR ARTS AND ACAD	31.4	40.0	25.7	2.9	71.4
DEARBORN HEIGHTS SCHOOL DIST #7	28.1	43.3	23.5	5.1	71.4
LES CHENEAUX COMMUNITY SCHOOLS	26.2	45.2	23.8	4.8	71.4
REETHS PUFFER SCHOOLS	22.1	49.3	27.4	1.2	71.4
COLDWATER COMMUNITY SCHOOLS	22.4	49.1	25.0	3.4	71.5
HOLLAND CITY SCHOOL DISTRICT	28.9	42.7	24.3	4.1	71.6
BARAGA AREA SCHOOL DISTRICT	4.3	67.4	26.1	2.2	71.7
SOUTH HAVEN PUBLIC SCHOOLS	26.5	45.3	26.5	1.8	71.8
VASSAR PUBLIC SCHOOLS	14.5	57.3	25.0	3.2	71.8
DEARBORN CITY SCHOOL DISTRICT	29.0	43.0	24.7	3.3	72.0
FOWLER PUBLIC SCHOOLS	28.0	44.0	28.0	0.0	72.0
HARBOR BEACH COMMUNITY SCHOOL	26.0	46.0	26.0	2.0	72.0
ATHERTON COMM SCHOOL DIST	24.4	47.6	20.7	7.3	72.0
VOYAGEUR ACADEMY	0.0	72.0	28.0	0.0	72.0
WEST BRANCH-ROSE CITY AREA SCHOOLS	20.6	51.5	26.0	2.0	72.1
READING COMMUNITY SCHOOLS	15.1	57.0	27.9	0.0	72.1
BESSEMER AREA SCHOOL DISTRICT	27.8	44.4	27.8	0.0	72.2
MONROE PUBLIC SCHOOLS	21.1	51.1	26.6	1.3	72.2
HAZEL PARK SCHOOL DISTRICT	20.7	51.5	23.6	4.3	72.2
MELVINDALE-NORTHERN ALLEN PARK	26.8	45.5	25.3	2.5	72.3
WAYNE WESTLAND COMMUNITY SCHOOLS	21.3	51.0	25.9	1.8	72.3
GODWIN HEIGHTS PUBLIC SCHOOLS	24.4	48.1	20.5	7.1	72.5
LAKEVIEW SCHOOL DISTRICT	24.3	48.2	23.9	3.5	72.5
STURGIS SCHOOL DISTRICT	23.3	49.3	22.5	4.8	72.6
SAULT STE MARIE AREA PUBLIC SCH	20.1	52.5	25.5	2.0	72.6
NORTH BRANCH AREA SCHOOLS	20.5	52.2	23.4	3.9	72.7
GARDEN CITY SCHOOL DISTRICT	24.6	48.2	21.5	5.7	72.8
CLINTONDALE COMMUNITY SCHOOLS	19.1	53.8	24.6	2.5	72.9
CENTREVILLE PUBLIC SCHOOLS	28.6	44.4	25.4	1.6	73.0
HOLLY ACADEMY	19.2	53.8	23.1	3.8	73.0
OSCODA AREA SCHOOLS	21.8	51.3	21.8	5.1	73.1
BENDLE PUBLIC SCHOOLS	39.3	33.9	23.2	3.6	73.2
ST IGNACE AREA SCHOOL DISTRICT	28.6	44.6	25.0	1.8	73.2
MICHIGAN DEPARTMENT OF TREASURY	27.9	45.3	22.3	4.5	73.2

YALE PUBLIC SCHOOLS	24.4	48.8	23.2	3.6	73.2
SOUTH LAKE SCHOOLS	26.1	47.2	25.5	1.2	73.3
OWEN-GAGE COMMUNITY SCHOOLS	20.0	53.3	23.3	3.3	73.3
MORRICE AREA SCHOOLS	36.7	36.7	15.0	11.7	73.4
EWEN TROUTCREEK CONS SD	28.9	44.7	26.3	0.0	73.6
NORTH HURON SCHOOL DISTRICT	28.9	44.7	26.3	0.0	73.6
SOUTHFIELD PUBLIC SCHOOLS	23.9	49.7	23.6	2.9	73.6
BLOOMINGDALE PUBLIC SCH DIST	19.8	53.8	25.3	1.1	73.6
BANGOR PUBLIC SCHOOLS	14.2	59.4	20.8	5.7	73.6
CRAWFORD AUSABLE SCHOOLS	19.8	53.9	24.0	2.4	73.7
STEPHENSON AREA PUBLIC SCHS	24.6	49.2	23.1	3.1	73.8
EATON RAPIDS PUBLIC SCHOOLS	21.1	52.8	23.6	2.4	73.9
GREAT LAKES ACADEMY	17.4	56.5	19.6	6.5	73.9
LAKEVIEW COMMUNITY SCHOOLS	28.0	46.0	24.7	1.3	74.0
STANDISH STERLING COMMUNITY SD	27.3	46.7	21.8	4.2	74.0
BUCKLEY COMM SCHOOL DISTRICT	25.9	48.1	25.9	0.0	74.0
BAY CITY SCHOOL DISTRICT	24.5	49.5	22.7	3.3	74.0
VANDERCOOK LAKE PUBLIC SCHOOLS	23.1	50.9	25.0	0.9	74.0
BERRIEN SPRINGS PUBLIC SCHOOLS	29.5	44.6	22.3	3.6	74.1
ALMA PUBLIC SCHOOLS	20.8	53.3	23.9	2.0	74.1
SAND CREEK COMMUNITY SCHOOLS	18.5	55.6	21.0	4.9	74.1
LESLIE PUBLIC SCHOOLS	30.4	43.8	24.1	1.8	74.2
GREENVILLE PUBLIC SCHOOLS	24.5	49.7	23.2	2.6	74.2
FULTON SCHOOLS	21.2	53.0	22.7	3.0	74.2
MORENCI AREA SCHOOLS	25.6	48.7	21.8	3.8	74.3
GLADWIN COMMUNITY SCHOOLS	22.6	51.8	23.4	2.2	74.4
WHITEHALL SCHOOL DISTRICT	32.6	41.9	23.8	1.7	74.5
ALMONT COMMUNITY SCHOOLS	26.4	48.1	22.5	3.1	74.5
BLISSFIELD COMMUNITY SCHOOLS	24.5	50.0	24.5	1.0	74.5
WATERVLIET PUBLIC SCHOOLS	24.5	50.0	24.5	0.9	74.5
CARMAN-AINSWORTH SCHOOLS	27.9	46.7	22.2	3.2	74.6
MANTON CONSOLIDATED SCHOOLS	16.9	57.7	21.1	4.2	74.6
LAWTON COMMUNITY SCHOOL DISTRICT	30.5	44.2	22.1	3.2	74.7
QUINCY COMMUNITY SCHOOLS	24.3	50.4	23.5	1.7	74.7
ST CHARLES COMMUNITY SCHOOLS	23.2	51.5	24.2	1.0	74.7
PUBLIC SCHOOLS OF CALUMET	31.9	42.9	21.8	3.4	74.8
BOYNE CITY PUBLIC SCHOOL DISTRICT	20.9	53.9	24.3	0.9	74.8

BATH COMMUNITY SCHOOLS	34.2	40.8	25.0	0.0	75.0
ALLEGAN PUBLIC SCHOOLS	25.9	49.1	22.7	2.3	75.0
ANN ARBOR LEARNING COMMUNITY	25.0	50.0	25.0	0.0	75.0
LANDMARK ACADEMY	20.8	54.2	20.8	4.2	75.0
PENTWATER PUBLIC SCHOOL DIST	20.8	54.2	20.8	4.2	75.0
VESTABURG COMMUNITY SCHOOLS	15.6	59.4	25.0	0.0	75.0
MORAN TOWNSHIP SCHOOL DIST	12.5	62.5	25.0	0.0	75.0
COMSTOCK PUBLIC SCHOOLS	25.2	50.0	22.5	2.3	75.2
OLIVET COMMUNITY SCHOOLS	20.6	54.6	24.7	0.0	75.2
LAWRENCE PUBLIC SCHOOL DIST	47.8	27.5	17.4	7.2	75.3
VANDERBILT CHARTER ACADEMY	18.4	57.1	22.4	2.0	75.5
HARPER CREEK COMMUNITY SCHOOLS	27.7	47.9	22.3	2.1	75.6
INLAND LAKES SCHOOLS	27.0	48.6	17.6	6.8	75.6
HESPERIA COMMUNITY SCHOOL DISTRICT	23.2	52.4	22.0	2.4	75.6
GALIEN TOWNSHIP SCHOOL DIST	24.2	51.5	21.2	3.0	75.7
FITZGERALD PUBLIC SCHOOLS	40.2	35.6	21.9	2.3	75.8
SHEPHERD PUBLIC SCHOOL DISTRICT	27.4	48.4	23.4	0.8	75.8
WHITE CLOUD PUBLIC SCHOOLS	19.4	56.5	21.3	2.8	75.9
MANCELONA PUBLIC SCHOOLS	26.6	49.4	21.5	2.5	76.0
HART PUBLIC SCHOOLS	25.0	51.0	23.1	1.0	76.0
WAVERLY COMMUNITY SCHOOLS	23.6	52.4	19.1	4.9	76.0
LAKEVILLE COMM SCHOOL DIST	19.5	56.5	22.1	1.9	76.0
NORTH CENTRAL AREA SCHOOLS	42.1	34.2	23.7	0.0	76.3
GRANT PUBLIC SCHOOL DISTRICT	29.5	46.8	21.4	2.3	76.3
GAYLORD COMMUNITY SCHOOLS	25.3	51.0	21.0	2.7	76.3
WHITEFORD AGR SCHOOL DIST	19.6	56.9	23.5	0.0	76.5
FRANKFORT-ELBERTA AREA SCHOOLS	34.0	42.6	21.3	2.1	76.6
MARCELLUS COMMUNITY SCHOOLS	26.7	50.0	21.7	1.7	76.7
RICHMOND COMMUNITY SCHOOLS	20.4	56.3	21.1	2.1	76.7
NORTH ADAMS-JEROME PUBLIC SCHOOLS	10.0	66.7	23.3	0.0	76.7
REDFORD UNION SCHOOL DISTRICT #1	25.5	51.3	21.7	1.5	76.8
CHASSELL TWP SCHOOL DISTRICT	42.3	34.6	19.2	3.8	76.9
VAN BUREN PUBLIC SCHOOLS	33.9	43.0	20.9	2.3	76.9
REESE PUBLIC SCHOOLS	29.2	47.7	23.1	0.0	76.9
TRI COUNTY AREA SCHOOLS	24.1	52.8	22.6	0.5	76.9
STANTON TWP SCHOOL DISTRICT	23.1	53.8	23.1	0.0	76.9
ALBA PUBLIC SCHOOLS	38.5	38.5	23.1	0.0	77.0

REPUBLIC MICHIGAMME SCHOOLS	30.8	46.2	23.1	0.0	77.0
BRANDYWINE PUBLIC SCH DIST	23.0	54.1	20.5	2.5	77.1
AIRPORT COMMUNITY SCH DIST	28.5	48.7	20.9	1.9	77.2
ONAWAY AREA COMM SCHOOL DIST	26.3	50.9	15.8	7.0	77.2
PERRY PUBLIC SCHOOL DISTRICT	19.7	57.5	22.0	0.8	77.2
GRAND TRAVERSE ACADEMY	13.6	63.6	22.7	0.0	77.2
MIO AUSABLE SCHOOL	29.0	48.4	19.4	3.2	77.4
CLARE PUBLIC SCHOOLS	25.0	52.4	20.2	2.4	77.4
HILLSDALE COMM PUBLIC SCHS	28.2	49.3	21.1	1.4	77.5
CLARENCEVILLE SCHOOL DIST	25.4	52.1	21.1	1.4	77.5
OWOSSO PUBLIC SCHOOLS	24.1	53.4	20.4	2.0	77.5
DUNDEE COMMUNITY SCHOOLS	13.5	64.0	20.7	1.8	77.5
FREMONT PUBLIC SCHOOLS	24.1	53.5	20.6	1.8	77.6
NORTHPORT PUBLIC SCHOOL DIST	38.9	38.9	22.2	0.0	77.8
MILAN AREA SCHOOLS	28.7	49.1	19.9	2.3	77.8
WHITE PIGEON COMM SCH DIST	28.4	49.4	17.3	4.9	77.8
PORT HURON AREA SCHOOL DIST	25.7	52.1	20.4	1.8	77.8
MADISON SCHOOL DISTRICT	22.2	55.6	22.2	0.0	77.8
CLIO AREA SCHOOL DISTRICT	25.8	52.1	19.5	2.6	77.9
DECKERVILLE COMM SCHOOL DIST	23.5	54.4	20.6	1.5	77.9
SUMMERFIELD SCHOOL DISTRICT	22.0	55.9	18.6	3.4	77.9
LAKE LINDEN HUBBELL SCH DIST	31.7	46.3	22.0	0.0	78.0
DURAND AREA SCHOOLS	25.0	53.0	20.7	1.2	78.0
ONSTED COMMUNITY SCHOOLS	13.5	64.5	20.6	1.3	78.0
ITHACA PUBLIC SCHOOLS	28.5	49.6	22.0	0.0	78.1
L'ANSE AREA SCHOOLS	12.5	65.6	21.9	0.0	78.1
NORTH MUSKEGON PUBLIC SCHS	43.8	34.4	21.9	0.0	78.2
KENT CITY COMMUNITY SCHOOLS	33.0	45.5	19.3	2.3	78.5
WOODHAVEN-BROWNSTOWN SCHOOL DISTRICT	27.9	50.6	20.2	1.3	78.5
RENAISSANCE PUBLIC SCHOOL ACADEMY	21.4	57.1	14.3	7.1	78.5
WATERSMEET TWP SCHOOL DIST	21.4	57.1	21.4	0.0	78.5
AU GRES SIMS SCHOOL DISTRICT	26.2	52.4	21.4	0.0	78.6
MORLEY STANWOOD COMMUNITY SCHOOLS	25.0	53.6	21.4	0.0	78.6
PICKFORD PUBLIC SCHOOLS	25.0	53.6	21.4	0.0	78.6
CHARLOTTE PUBLIC SCHOOLS	23.8	54.8	19.0	2.4	78.6
FRUITPORT COMMUNITY SCHOOLS	33.9	44.9	18.4	2.9	78.8
EAGLE CREST CHARTER ACADEMY	33.3	45.5	18.2	3.0	78.8

ORCHARD VIEW SCHOOLS	27.1	51.7	19.3	1.9	78.8
WHITE PINE ACADEMY	42.1	36.8	21.1	0.0	78.9
GERRISH HIGGINS SCHOOL DISTRICT	16.7	62.2	18.6	2.6	78.9
WEST OTTAWA PUBLIC SCH DIST	33.1	45.9	18.9	2.1	79.0
MENDON COMMUNITY SCHOOL DIST	29.0	50.0	21.0	0.0	79.0
ZEELAND PUBLIC SCHOOLS	28.4	50.6	20.0	1.0	79.0
A G B U ALEX AND MARIE MANOOGIAN SCH	33.3	45.8	20.8	0.0	79.1
PARAMOUNT CHARTER ACADEMY	28.4	50.7	19.4	1.5	79.1
NAPOLEON COMMUNITY SCHOOLS	32.8	46.4	18.4	2.4	79.2
MARSHALL ACADEMY	29.2	50.0	16.7	4.2	79.2
WEST IRON COUNTY SCHOOL DISTRICT	23.2	56.1	20.7	0.0	79.3
MARTIN PUBLIC SCHOOLS	17.0	62.3	20.8	0.0	79.3
LAKE FENTON SCHOOLS	36.4	43.0	18.2	2.5	79.4
HANOVER HORTON SCHOOLS	34.6	44.9	19.6	0.9	79.5
KENTWOOD PUBLIC SCHOOLS	31.8	47.8	17.2	3.1	79.6
EAST CHINA SCHOOLS	27.3	52.3	19.2	1.2	79.6
UBLY COMMUNITY SCHOOLS	23.4	56.3	17.2	3.1	79.7
CEDAR SPRINGS PUBLIC SCHOOLS	35.5	44.4	18.3	1.8	79.9
CARNEY NADEAU PUBLIC SCHOOLS	50.0	30.0	20.0	0.0	80.0
TRAVERSE BAY COMMUNITY SCHOOL	40.0	40.0	20.0	0.0	80.0
ROMEO COMMUNITY SCHOOLS	31.3	48.7	18.1	1.9	80.0
MERIDIAN PUBLIC SCHOOLS	27.7	52.3	16.2	3.8	80.0
MANCHESTER COMMUNITY SCHOOLS	22.2	57.8	20.0	0.0	80.0
MARTIN LUTHER KING JR EDUCATION CENTER	20.0	60.0	10.0	10.0	80.0
HILLMAN COMMUNITY SCHOOLS	17.8	62.2	20.0	0.0	80.0
HOMER COMMUNITY SCHOOLS	15.6	64.4	16.7	3.3	80.0
PELLSTON PUBLIC SCHOOLS	15.0	65.0	20.0	0.0	80.0
PENNFIELD SCHOOL DISTRICT	27.7	52.5	19.9	0.0	80.2
ALLEN PARK PUBLIC SCHOOLS	31.7	48.6	18.1	1.5	80.3
EAU CLAIRE PUBLIC SCHOOLS	23.2	57.1	19.6	0.0	80.3
PINE RIVER AREA SCHOOLS	40.2	40.2	17.5	2.1	80.4
HUDSON AREA SCHOOLS	28.9	51.5	17.5	2.1	80.4
HOPKINS PUBLIC SCHOOLS	26.2	54.4	17.5	1.9	80.6
LAINGSBURG COMM SCHOOL DIST	21.0	59.7	19.3	0.0	80.7
BYRON AREA SCHOOLS	36.4	44.4	17.2	2.0	80.8
PUBLIC SCHOOLS OF PETOSKEY	35.5	45.3	18.2	1.0	80.8
CROSWELL-LEXINGTON SCHOOL DISTRICT	31.9	48.9	16.6	2.6	80.8

KINGSTON COMMUNITY SCHOOLS	23.1	57.7	17.3	1.9	80.8
WARREN CONSOLIDATED SCHOOLS	33.7	47.2	17.4	1.6	80.9
PLAINWELL COMMUNITY SCHOOLS	33.5	47.4	15.8	3.3	80.9
EXCEL CHARTER ACADEMY	32.4	48.5	17.6	1.5	80.9
COOPERSVILLE PUBLIC SCH DIST	29.0	51.9	19.1	0.0	80.9
TECUMSEH PUBLIC SCHOOLS	24.1	56.8	18.7	0.4	80.9
CADILLAC AREA PUBLIC SCHOOLS	27.3	53.7	18.2	0.8	81.0
SAGINAW TOWNSHIP COMMUNITY SCHOOLS	38.1	43.0	16.9	2.0	81.1
SOUTH ARBOR CHARTER ACADEMY	28.4	52.7	17.6	1.4	81.1
KENOWA HILLS PUBLIC SCHOOLS	29.0	52.2	16.7	2.2	81.2
FARWELL AREA SCHOOLS	32.4	48.9	16.5	2.2	81.3
CLINTON COMMUNITY SCHOOLS	22.5	58.8	16.3	2.5	81.3
BEAR LAKE SCHOOL DISTRICT	39.5	41.9	18.6	0.0	81.4
BERKLEY SCHOOL DISTRICT	32.8	48.6	16.2	2.4	81.4
BRIMLEY AREA SCHOOLS	20.9	60.5	16.3	2.3	81.4
CHELSEA SCHOOL DISTRICT	38.3	43.2	17.1	1.4	81.5
CROSSROADS CHARTER ACADEMY	36.8	44.7	18.4	0.0	81.5
DAVISON COMMUNITY SCHOOLS	35.6	45.9	17.3	1.3	81.5
WEBBERVILLE COMMUNITY SCHS	30.6	51.0	18.4	0.0	81.6
LAKEWOOD PUBLIC SCHOOLS	29.1	52.6	17.3	1.0	81.7
IONIA PUBLIC SCHOOLS	27.9	53.8	17.9	0.4	81.7
GODFREY LEE PUBLIC SCH DIST	17.2	64.5	15.1	3.2	81.7
ASHLEY COMMUNITY SCHOOLS	13.6	68.2	18.2	0.0	81.8
WAYLAND UNION SCHOOLS	33.9	48.0	16.9	1.2	81.9
BEDFORD PUBLIC SCHOOLS	33.6	48.4	17.3	0.7	82.0
ALLENDALE PUBLIC SCHOOL DISTRICT	29.7	52.3	17.4	0.6	82.0
PINCONNING AREA SCHOOLS	28.2	53.8	16.2	1.7	82.0
GLADSTONE AREA SCHOOLS	26.0	56.1	17.1	0.8	82.1
SOUTHGATE COMMUNITY SCHOOL DIST	36.9	45.3	15.1	2.6	82.2
LAPEER COMMUNITY SCHOOLS	29.1	53.1	16.4	1.4	82.2
FLAT ROCK COMMUNITY SCHOOLS	28.9	53.3	17.8	0.0	82.2
WYANDOTTE PUBLIC SCHOOLS	26.0	56.2	16.0	1.8	82.2
CLAWSON CITY SCHOOL DISTRICT	23.8	58.4	17.8	0.0	82.2
BEAVERTON RURAL SCHOOLS	17.9	64.3	17.9	0.0	82.2
LITTLEFIELD PUBLIC SCH DIST	14.3	67.9	14.3	3.6	82.2
WILLIAMSTON COMM SCHOOLS	30.1	52.2	15.4	2.2	82.3
BANGOR TOWNSHIP SCHOOLS	28.4	53.9	16.7	1.0	82.3

NOTTAWA COMMUNITY SCHOOL	17.6	64.7	17.6	0.0	82.3
HAMILTON COMMUNITY SCHOOLS	34.6	47.8	14.6	2.9	82.4
IMLAY CITY COMMUNITY SCHOOLS	29.7	52.7	15.4	2.2	82.4
CASS CITY PUBLIC SCHOOLS	28.0	54.4	17.6	0.0	82.4
ESSEXVILLE-HAMPTON PUBLIC SCHOOLS	28.0	54.4	17.6	0.0	82.4
THREE RIVERS COMMUNITY SCHS	37.4	45.1	16.0	1.5	82.5
MT PLEASANT PUBLIC SCHOOLS	34.0	48.5	15.6	1.9	82.5
CONCORD COMMUNITY SCHOOLS	20.3	62.2	13.5	4.1	82.5
CENTRAL LAKE PUBLIC SCHOOLS	26.1	56.5	13.0	4.3	82.6
ST JOHNS PUBLIC SCHOOLS	33.8	48.9	16.5	0.8	82.7
WATERFORD SCHOOL DISTRICT	30.9	51.8	16.3	1.0	82.7
HASTINGS AREA SCHOOL SYSTEM	33.9	48.9	14.6	2.6	82.8
BIG RAPIDS PUBLIC SCHOOLS	31.4	51.4	15.7	1.4	82.8
NORWAY VULCAN AREA SCHOOLS	42.9	40.0	14.3	2.9	82.9
WARREN WOODS PUBLIC SCHOOLS	30.6	52.3	16.1	1.0	82.9
MANISTEE PUBLIC SCHOOLS	22.9	60.0	15.0	2.1	82.9
HURON VALLEY SCHOOLS	33.5	49.5	15.6	1.3	83.0
MILLINGTON COMM SCHOOLS	20.5	62.5	17.0	0.0	83.0
ALGONAC COMMUNITY SCH DIST	36.2	46.9	14.6	2.3	83.1
SPARTA AREA SCHOOLS	30.2	52.9	15.9	1.1	83.1
HOWELL PUBLIC SCHOOLS	28.3	54.8	15.3	1.6	83.1
POTTERVILLE PUBLIC SCHOOLS	20.0	63.1	13.8	3.1	83.1
HURON SCHOOL DISTRICT	36.1	47.1	16.1	0.6	83.2
BAD AXE PUBLIC SCHOOLS	35.8	47.4	15.8	1.1	83.2
CHEBOYGAN AREA SCHOOLS	31.5	51.7	16.8	0.0	83.2
ALPENA PUBLIC SCHOOLS	30.8	52.4	15.4	1.4	83.2
MAR LEE SCHOOL DISTRICT	23.3	60.0	16.7	0.0	83.3
WOLVERINE COMM SCHOOL DIST	20.8	62.5	16.7	0.0	83.3
KELLOGGSVILLE PUBLIC SCHOOLS	35.0	48.4	12.7	3.8	83.4
ANN ARBOR PUBLIC SCHOOLS	45.0	38.5	14.3	2.1	83.5
CHIPPEWA HILLS SCHOOL DIST	25.9	57.6	15.2	1.3	83.5
DOWAGIAC UNION SCHOOLS	37.6	46.0	14.9	1.5	83.6
PARCHMENT SCHOOL DISTRICT	34.3	49.3	15.7	0.7	83.6
STOCKBRIDGE COMMUNITY SCHOOLS	42.6	41.2	14.7	1.5	83.8
LIVINGSTON DEVELOPMENTAL ACADEMY	35.5	48.4	16.1	0.0	83.9
CLIMAX SCOTTS SCHOOL DISTRICT	27.4	56.5	12.9	3.2	83.9
CROSS CREEK CHARTER ACADEMY	41.1	42.9	14.3	1.8	84.0

ONEKAMA CONSOLIDATED SCHOOLS	38.0	46.0	14.0	2.0	84.0
ROSEVILLE COMMUNITY SCHOOLS	32.5	51.5	14.5	1.4	84.0
MASON COUNTY CENTRAL SD	32.0	52.0	14.0	2.0	84.0
IRONWOOD AREA SCHOOLS	28.7	55.3	13.8	2.1	84.0
MEMPHIS COMMUNITY SCHOOLS	20.7	63.4	15.9	0.0	84.1
GWINN AREA COMMUNITY SCHOOLS	32.4	52.0	14.7	1.0	84.4
SANDUSKY COMMUNITY SCHOOLS	28.1	56.3	15.6	0.0	84.4
KNAPP CHARTER ACADEMY	45.1	39.4	11.3	4.2	84.5
FARMINGTON PUBLIC SCHOOL DISTRICT	37.8	46.7	13.8	1.6	84.5
KALEVA NORMAN DICKSON SCHOOLS	36.6	47.9	14.1	1.4	84.5
HOLT PUBLIC SCHOOLS	33.9	50.6	14.4	1.0	84.5
DEXTER COMMUNITY SCHOOL DIST	38.3	46.3	15.0	0.4	84.6
L'ANSE CREUSE PUBLIC SCHOOLS	35.1	49.7	14.0	1.2	84.8
MONTAGUE AREA PUBLIC SCHOOLS CENTRAL	32.0	52.8	15.2	0.0	84.8
NEW LOTHROP AREA PUBLIC SCHOOLS	54.7	30.2	15.1	0.0	84.9
PLYMOUTH CANTON COMMUNITY SCHOOLS	37.4	47.5	13.7	1.4	84.9
OVID-ELSIE AREA SCHOOLS	36.7	48.2	12.2	2.9	84.9
PAW PAW PUBLIC SCHOOL DIST	30.1	54.8	15.1	0.0	84.9
FRASER PUBLIC SCHOOLS	33.2	51.8	13.6	1.4	85.0
DRYDEN COMMUNITY SCHOOLS	32.9	52.1	13.7	1.4	85.0
CHIPPEWA VALLEY SCHOOLS	32.9	52.1	13.9	1.1	85.0
THE LAMPHERE SCHOOLS	30.6	54.4	15.0	0.0	85.0
PECK COMMUNITY SCHOOLS	51.1	34.0	12.8	2.1	85.1
CITY OF HARPER WOODS SCHOOLS	37.0	48.1	12.3	2.5	85.1
BRITTON MACON AREA SCHOOL	36.2	48.9	10.6	4.3	85.1
LAKER SCHOOLS	27.0	58.1	14.9	0.0	85.1
BROWN CITY COMMUNITY SCHOOL	26.6	58.5	13.8	1.1	85.1
BENZIE COUNTY CENTRAL SCHOOLS	28.9	56.4	10.7	4.0	85.3
WALKER CHARTER ACADEMY	49.3	36.2	13.0	1.4	85.5
HOLLY AREA SCHOOL DISTRICT	36.2	49.3	13.2	1.3	85.5
TAWAS AREA SCHOOLS	27.5	58.0	14.5	0.0	85.5
LINDEN COMMUNITY SCHOOLS	41.3	44.4	13.9	0.4	85.7
LEARNING CENTER ACADEMY	28.6	57.1	14.3	0.0	85.7
ADDISON COMMUNITY SCHOOLS	20.9	64.8	13.2	1.1	85.7
VANGUARD CHARTER ACADEMY	42.9	42.9	11.4	2.9	85.8
PALO COMM SCHOOL DISTRICT	42.9	42.9	14.3	0.0	85.8
LAKESHORE PUBLIC SCHOOLS	37.0	48.8	13.7	0.5	85.8

DEWITT PUBLIC SCHOOLS	33.8	52.0	13.2	1.0	85.8
ROYAL OAK SCHOOL DISTRICT	38.8	47.1	12.9	1.2	85.9
THORNAPPLE KELLOGG SCHOOL DISTRICT	36.4	49.5	13.1	1.0	85.9
CENTER LINE PUBLIC SCHOOLS	36.3	49.7	14.0	0.0	86.0
LAKEVIEW PUBLIC SCHOOLS	38.3	47.8	12.9	1.0	86.1
SWARTZ CREEK COMMUNITY SCHOOLS	35.9	50.2	13.7	0.3	86.1
LIVONIA PUBLIC SCHOOLS	38.4	47.8	12.0	1.8	86.2
SCHOOLCRAFT COMMUNITY SCHOOLS	38.3	47.9	13.8	0.0	86.2
FENTON AREA PUBLIC SCHOOLS	38.1	48.1	13.0	0.8	86.2
IDA PUBLIC SCHOOL DISTRICT	33.7	52.5	12.9	1.0	86.2
GULL LAKE COMMUNITY SCHOOLS	33.1	53.1	11.7	2.1	86.2
NORTHVIEW PUBLIC SCHOOL DIST	40.7	45.6	11.6	2.1	86.3
CAPAC COMMUNITY SCH DISTRICT	29.8	56.5	13.0	0.8	86.3
ENGADINE CONSOLIDATED SCHOOLS	36.4	50.0	9.1	4.5	86.4
ALCONA COMMUNITY SCHOOLS	35.6	50.8	11.9	1.7	86.4
WAKEFIELD SCHOOL DIST	27.3	59.1	13.6	0.0	86.4
TRAVERSE CITY AREA PUBLIC SCHOOLS	41.5	45.0	12.7	0.9	86.5
CHATFIELD SCHOOL	36.5	50.0	13.5	0.0	86.5
CARO COMMUNITY SCHOOLS	27.0	59.5	12.2	1.4	86.5
RAPID RIVER PUBLIC SCHOOLS	43.3	43.3	13.3	0.0	86.6
CANTON CHARTER ACADEMY	41.3	45.3	12.0	1.3	86.6
SHELBY PUBLIC SCHOOLS	38.4	48.2	11.6	1.8	86.6
FREELAND COMMUNITY SCHOOL DISTRICT	37.6	49.0	12.8	0.7	86.6
BIRCH RUN AREA SCHOOL DISTRICT	34.3	52.3	12.2	1.2	86.6
UTICA COMMUNITY SCHOOLS	38.0	48.7	12.3	1.0	86.7
EAST LANSING SCHOOL DISTRICT	44.1	42.7	12.3	0.9	86.8
SUTTONS BAY PUBLIC SCH DIST	49.4	37.6	11.8	1.2	87.0
MASON PUBLIC SCHOOLS	38.7	48.3	12.2	0.8	87.0
BARK RIVER HARRIS SCH DIST	26.1	60.9	13.0	0.0	87.0
BREITUNG TWP SCHOOL DISTRICT	32.4	54.7	12.3	0.6	87.1
PINCKNEY COMMUNITY SCHOOLS	31.7	55.5	11.2	1.6	87.2
MATTAWAN CONSOLIDATED SCHOOL DIST	46.3	41.0	11.9	0.8	87.3
CONCORD ACADEMY PETOSKEY ADKINS	37.5	50.0	12.5	0.0	87.5
ADAMS TWP SCHOOL DISTRICT	32.5	55.0	12.5	0.0	87.5
PORTAGE PUBLIC SCHOOLS	42.7	44.9	11.3	1.1	87.6
MACKINAW CITY SCHOOLS	18.8	68.8	6.3	6.3	87.6
ANCHOR BAY SCHOOL DISTRICT	37.3	50.4	11.5	0.7	87.7

LAKE ORION COMMUNITY SCHOOLS	43.7	44.1	11.5	0.7	87.8
COLON COMMUNITY SCHOOLS	40.9	47.0	10.6	1.5	87.9
WALLED LAKE CONSOLIDATED SCHOOLS	39.6	48.3	11.2	1.0	87.9
LUDINGTON AREA SCHOOL DISTRICT	33.7	54.2	12.1	0.0	87.9
IRON MOUNTAIN CITY SCHOOL DISTRICT	29.3	58.6	11.2	0.9	87.9
CHANDLER WOODS CHARTER ACADEMY	58.0	30.0	10.0	2.0	88.0
GRAND HAVEN AREA PUBLIC SCHOOLS	43.3	44.8	10.9	1.0	88.1
MARYSVILLE PUBLIC SCHOOL DISTRICT	36.5	51.7	11.8	0.0	88.2
JEFFERSON SCHOOLS MONROE COUNTY	39.3	49.0	11.2	0.5	88.3
RIVER VALLEY SCHOOL DISTRICT	36.0	52.3	9.3	2.3	88.3
CORUNNA PUBLIC SCHOOL DIST	44.3	44.3	11.4	0.0	88.6
MERRILL COMM SCHOOL DISTRICT	34.3	54.3	10.0	1.4	88.6
SALINE AREA SCHOOLS	36.6	52.1	10.0	1.3	88.7
FOREST PARK SCHOOL DISTRICT	44.4	44.4	3.7	7.4	88.8
MARQUETTE AREA PUBLIC SCHOOLS	45.7	43.2	10.8	0.4	88.9
ST JOSEPH PUBLIC SCHOOLS	44.0	44.9	9.3	1.8	88.9
ARMADA AREA SCHOOLS	43.7	45.2	11.1	0.0	88.9
MONA SHORES SCHOOL DISTRICT	36.2	52.7	10.5	0.6	88.9
SWAN VALLEY SCHOOL DISTRICT	33.3	55.6	10.4	0.7	88.9
WILL CARLETON CHARTER SCHOOL	27.8	61.1	11.1	0.0	88.9
ELK RAPIDS SCHOOLS	44.0	45.0	11.0	0.0	89.0
MUNISING PUBLIC SCHOOLS	50.7	38.4	11.0	0.0	89.1
FRANKENMUTH SCHOOL DISTRICT	63.9	25.3	7.2	3.6	89.2
MIDLAND PUBLIC SCHOOLS	52.4	36.8	9.2	1.7	89.2
BRIGHTON AREA SCHOOLS	45.3	43.9	10.3	0.5	89.2
GIBRALTAR SCHOOL DISTRICT	40.3	48.9	10.0	0.9	89.2
NICE COMMUNITY SCHOOL DISTRICT	41.3	48.0	10.7	0.0	89.3
KEARSLEY COMMUNITY SCHOOLS	46.2	43.2	10.0	0.7	89.4
HASLETT PUBLIC SCHOOLS	46.1	43.3	10.6	0.0	89.4
CHESANING UNION SCHOOLS	39.8	49.6	10.6	0.0	89.4
CLARKSTON COMM SCH DIST	45.1	44.4	10.5	0.0	89.5
LOWELL AREA SCHOOLS	39.7	49.8	10.1	0.4	89.5
GROSSE ILE TOWNSHIP SCHOOLS	45.8	43.8	10.4	0.0	89.6
OXFORD AREA COMMUNITY SCHOOL DIST	38.3	51.3	8.3	2.0	89.6
SOUTH LYON COMMUNITY SCHOOLS	42.7	47.0	9.9	0.4	89.7
CHARLEVOIX PUBLIC SCHOOLS	42.3	47.4	9.3	1.0	89.7
GOBLES PUBLIC SCHOOL DISTRICT	35.3	54.4	8.8	1.5	89.7

MENOMINEE AREA PUBLIC SCHOOLS	37.2	52.6	8.8	1.5	89.8
BELLAIRE PUBLIC SCHOOLS	40.0	50.0	10.0	0.0	90.0
TRENTON PUBLIC SCHOOLS	44.8	45.3	9.0	0.9	90.1
GRAND BLANC COMM SCHOOLS	45.6	44.6	8.9	0.9	90.2
VICKSBURG COMMUNITY SCHOOLS	42.9	47.3	9.7	0.0	90.2
BRANDON SCHOOL DISTRICT	35.5	54.7	9.1	0.7	90.2
VANDERBILT AREA SCHOOL	23.8	66.7	9.5	0.0	90.5
COLUMBIA SCHOOL DISTRICT	41.3	49.3	9.4	0.0	90.6
EAST DETROIT PUBLIC SCHOOLS	40.3	50.3	8.6	0.7	90.6
BYRON CENTER PUBLIC SCHOOLS	53.3	37.4	8.8	0.5	90.7
OTSEGO PUBLIC SCHOOLS	33.1	57.6	8.7	0.6	90.7
LAKE SHORE PUBLIC SCHOOLS	32.6	58.2	8.4	0.8	90.8
EDWARDSBURG PUBLIC SCHOOLS	31.8	59.2	8.3	0.6	91.0
NEGAUNEE PUBLIC SCHOOLS	50.5	40.8	8.7	0.0	91.3
GRANDVILLE PUBLIC SCHOOLS	46.9	44.4	8.7	0.0	91.3
PORTLAND PUBLIC SCHOOLS	38.1	53.2	8.6	0.0	91.3
GRAND LEDGE PUBLIC SCHOOLS	47.3	44.1	8.4	0.3	91.4
ESCANABA AREA PUBLIC SCHOOLS	43.0	48.4	8.1	0.5	91.4
FLUSHING COMMUNITY SCHOOLS	44.6	47.1	7.7	0.6	91.7
FAIRVIEW AREA SCHOOL DIST	29.2	62.5	8.3	0.0	91.7
JOHANNESBURG-LEWISTON AREA SCHOOLS	51.6	40.3	6.5	1.6	91.9
MARSHALL PUBLIC SCHOOLS	42.4	49.5	7.6	0.5	91.9
AVONDALE SCHOOL DISTRICT	39.9	52.0	7.5	0.7	91.9
DAVID ELLIS ACADEMY	48.0	44.0	8.0	0.0	92.0
CALEDONIA COMMUNITY SCHOOLS	47.4	44.7	7.9	0.0	92.1
UNIONVILLE SEBEWAING AREA SD	42.9	49.2	7.9	0.0	92.1
GLEN LAKE COMMUNITY SCHOOL DIST	54.7	37.5	7.8	0.0	92.2
KINGSLEY AREA SCHOOL	27.0	65.2	7.0	0.9	92.2
WEST BLOOMFIELD SCHOOL DISTRICT	56.0	36.3	7.3	0.4	92.3
HOUGHTON PORTAGE TOWNSHIP SCHOOLS	41.8	50.5	7.7	0.0	92.3
NOVI COMMUNITY SCHOOLS	50.5	42.0	7.1	0.5	92.5
ROGERS CITY AREA SCHOOLS	32.5	60.0	7.5	0.0	92.5
BIG BAY DE NOC SCHOOL DIST	18.5	74.1	7.4	0.0	92.6
SPRING LAKE PUBLIC SCH DIST	56.9	35.9	5.9	1.3	92.8
HUDSONVILLE PUBLIC SCHOOLS	47.9	44.9	7.2	0.0	92.8
HANCOCK PUBLIC SCHOOLS	43.8	49.3	6.8	0.0	93.1
ROCHESTER COMMUNITY SCHOOL DIST	54.1	39.1	6.7	0.1	93.2

GROSSE POINTE PUBLIC SCHS	53.8	39.4	6.6	0.1	93.2
COMSTOCK PARK PUBLIC SCHOOLS	50.7	42.5	6.7	0.0	93.2
MASON COUNTY EASTERN SCHOOLS	24.4	68.9	6.7	0.0	93.3
PEWAMO WESTPHALIA SCHOOLS	26.7	66.7	6.7	0.0	93.4
DANSVILLE SCHOOLS	40.3	53.2	6.5	0.0	93.5
RIVERVIEW COMMUNITY SCH DIST	42.4	51.2	6.4	0.0	93.6
LAKE CITY AREA SCHOOL DIST	47.4	46.3	6.3	0.0	93.7
JENISON PUBLIC SCHOOLS	45.6	48.1	6.0	0.3	93.7
SARANAC COMMUNITY SCHOOLS	46.9	46.9	6.2	0.0	93.8
WESTERN SCHOOL DISTRICT	41.6	52.2	5.6	0.6	93.8
SAUGATUCK PUBLIC SCHOOLS	60.8	33.3	5.9	0.0	94.1
NEW BUFFALO AREA SCHOOL DIST	47.1	47.1	5.9	0.0	94.2
BRIDGMAN PUBLIC SCHOOLS	32.9	61.4	5.7	0.0	94.3
MID PENINSULA SCHOOL DISTRICT	61.1	33.3	5.6	0.0	94.4
ELLSWORTH COMMUNITY SCHOOL	33.3	61.1	5.6	0.0	94.4
BIRMINGHAM PUBLIC SCHOOLS	51.1	43.4	5.5	0.0	94.5
BAHWETING ANISHNABE ELEMENTARY	16.7	77.8	5.6	0.0	94.5
ROCKFORD PUBLIC SCHOOLS	50.5	44.1	5.2	0.2	94.6
BLOOMFIELD HILLS SCHOOL DISTRICT	54.9	39.9	5.2	0.0	94.8
CASEVILLE PUBLIC SCHOOL	31.6	63.2	5.3	0.0	94.8
HARTLAND CONSOLIDATED SCHOOLS	49.3	45.6	5.0	0.0	94.9
OASIS ACADEMY	26.8	68.3	4.9	0.0	95.1
TROY SCHOOL DISTRICT	65.9	29.7	4.2	0.1	95.6
OKEMOS PUBLIC SCHOOLS	68.9	26.9	3.6	0.7	95.8
NORTHVILLE PUBLIC SCHOOLS	62.2	33.6	4.2	0.0	95.8
FOREST HILLS PUBLIC SCHOOLS	58.5	37.3	4.2	0.0	95.8
HARBOR SPRINGS SCHOOL DIST	50.6	45.9	3.5	0.0	96.5
LELAND PUBLIC SCHOOL DIST	46.7	50.0	3.3	0.0	96.7
ISHPEMING PUBLIC SCHOOL DIST	71.4	25.4	3.2	0.0	96.8
MCBAIN RURAL AGRL SCHOOL	59.2	38.0	2.8	0.0	97.2
GOODRICH AREA SCHOOL DIST	60.7	37.2	2.1	0.0	97.9
MANISTIQUE AREA SCHOOLS	48.0	50.7	1.3	0.0	98.7
EAST GRAND RAPIDS PUBLIC SCHOOLS	57.3	41.7	1.0	0.0	99.0
HONEY CREEK COMMUNITY SCHOOL	69.2	30.8	0.0	0.0	100.0
DETOUR AREA SCHOOLS	66.7	33.3	0.0	0.0	100.0
DOLLAR BAY-TAMARACK CITY AREA SCHLS	54.5	45.5	0.0	0.0	100.0
MIDLAND ACAD OF ADV/CREATIVE STUDIES	45.0	55.0	0.0	0.0	100.0

Section 3.

LWS Correlation at a Glance

		LWS Resource			
		ST20 - Physical Science	ST21 - Life Science	ST22 - Earth Science	ST23 - Scientific Reasoning
Elementary Science Standards Element					
Constructing New Scientific Knowledge					
Reflecting on Scientific Knowledge					
Using Life Science Knowledge					
Using Physical Science Knowledge					
Using Earth Science Knowledge					

Section 4.

LWS Assignment Correlation

Elementary Science Standards Statement	Living with Science Resource							
	Physical Science 1	Physical Science 2	Life Science 1	Life Science 2	Earth Science 1	Earth Science 2	Scientific Reasoning 1	Scientific Reasoning 2
Constructing New Scientific Knowledge								
Generate questions about the world based on observation.	2,5,8	1,3,4,7		3,11,21	3	3		5,8
Develop solutions to problems through reasoning, observation, and investigations.	2,5,8	1,3,4	1,8,	2,4,8	3			
Manipulate simple devices that aid observation and data collection.	1	8					1,5,11	1,21
Use simple measurement devices to make measurements in scientific investigations.	1,5,11				13		1,11,21	21
Develop strategies and skills for information gathering and problem solving.	1,5	8			13		1,5,11	1
Construct charts and graphs and prepare summaries of observations.		8,21			21			1
Reflecting on Scientific Knowledge								
Develop an awareness of the need for evidence in making decisions scientifically.							22	22
Show how science concepts can be illustrated through creative expression such as language arts and fine arts.								
Describe ways in which technology is used in everyday life.		6						2,4,6,8
Develop an awareness of and sensitivity to the natural world.					1,5,11, 13			
Develop an awareness of contributions made to science by people of diverse backgrounds and cultures.								

Using Life Science Knowledge

Explain characteristics and functions of observable body parts in a variety of animals.				3,11		1,11		
Compare and contrast (K- 2) or classify (3- 5) familiar organisms on the basis of observable physical characteristics.			13,21			1		
Describe life cycles of familiar organisms.			21					
Compare and contrast food, energy, and environmental needs of selected organisms.			4,21	5,7,13				
Explain functions of selected seed plant parts.			2,6	13,21				
Give evidence that characteristics are passed from parents to young.			22					
Explain how fossils provide evidence about the nature of ancient life.					4,8,13, 21			
Explain how physical and behavioral characteristics of animals help them to survive in their environments.						1		
Identify familiar organisms as part of a food chain or food web and describe their feeding relationships within the web.			4	7,13				
Describe the basic requirements for all living things to maintain their existence.			4	2,5,6,7, 8				
Design systems that encourage growing of particular plants or animals.			2,6,21	2,4,6,8, 11,13, 21				
Describe positive and negative effects of humans on the environment.					1,4,5, 11			

Using Physical Science Knowledge

Classify common objects and substances according to observable attributes/ properties.	4,12,13, 21						3,21	7
Identify properties of materials which make them useful.	4,13,21						3	7,21
Identify forms of energy associated with common phenomena.	7,13	2,7					2,8	
Construct simple, useful electrical circuits. (3- 5)		2,6						
Describe possible electrical hazards to be avoided at home and at school. (K- 2)	6	6						
Describe common physical changes in matter size, shape; melting, freezing (K- 2); dissolving, evaporating (3- 5).		8				3,7,8		3,6,8
Prepare mixtures and separate them into their component parts.						7,8,13		
Describe or compare motions of common objects in terms of speed and direction.	1,5,7						8	
Explain how forces (pushes or pulls) are needed to speed up, slow down, stop, or change the direction of a moving object.	1,5,11, 13							
Describe patterns of interaction of magnetic materials with other magnetic and non-magnetic materials.	2,11,21						6,13	
Identify and use simple machines and describe how they change effort.		7					1,2,8	4
Manipulate simple mechanical devices and explain how their parts work together.								4
Describe sounds in terms of their properties.	3,7,11, 21	3,7,21						
Explain how sounds are made.	3,11	3,21						
Use prisms and filters with light sources to produce various colors of light.	4	4,11,21						
Explain how shadows are made.	8,13				2,11,13			

Using Earth Science Knowledge

Describe major features of the earth's surface.						2,4		
Recognize and describe different types of earth materials.							7,13	
Describe natural changes in the earth's surface.						4,7,8,		
Explain how rocks and fossils are used to understand the history of the earth.					4,8,13,21	4,11		
Describe uses of materials taken from the earth.					4,11		7,13	
Demonstrate ways to conserve natural resources and reduce pollution through reduction, reuse, and recycling of manufactured materials.					1,5,11,13		2,11	
Describe how water exists on earth in three states.							21	3,11
Trace the path that rain water follows after it falls.						3,21		
Identify sources of water and its uses.		8		6			3,11,21	
Describe weather conditions.					3,7,13	21		
Describe seasonal changes in Michigan's weather.					3,11	21		
Explain appropriate safety precautions during severe weather.								
Compare and contrast characteristics of the sun, moon and earth.					6,14	6	13	
Describe the motion of the earth around the sun and the moon around the earth.					6	2,11,13		

Section 5.

LWS Objectives Correlation

Michigan Elementary Science Standards

1	**Constructing New Scientific Knowledge**	**1**	**Generate questions about the world based on observation.** *Creates questions in a classification key to sort a group of farmyard animals.* *Observes the effect of the changing the weight of a pendulum on the time of its swing.* *Replicates and observes the stages of the water cycle.* *Observes the effects of tap water, salt water and fertiliser on the growth of plants in a nine day period.* *Observes flower pollen magnified by a microscope.* *Observes the change from kinetic energy into heat and sound energy when rubbing hands together.* *Observes the mixing of coloured light to make other colours, including the making of white light.* *Observes the relationship between length of rubber band and pitch of sound made by a stringed instrument.* *Observes the force of friction.* *Observes the weather during different seasons in a virtual representation of New York.* *Observes that images are reversed when reflected in a mirror.* *Observes how a varying incline effects the speed of a model car.* *Squashes a ball and stretches a spring to observe the effects of pushing and pulling forces.* *Observes the weakness of a beam bridge.* *Identifies questions that can be asked to sort different animals.* *Inserts questions into the correct places in a classification key so that it can be used to sort a series of dogs.* *Observes the magnetic attraction and repulsion forces between the poles of magnets.*

2 Develop solutions to problems through reasoning, observation, and investigations.

Observes that images are reversed when reflected in a mirror.
Observes the force of friction.
Observes the relationship between length of rubber band and pitch of sound made by a stringed instrument.
Observes the relationship between length of tube and pitch of sound made by a wind instrument.
Observes the relationship between volume of air and pitch of sound made by a percussion instrument.
Observes the mixing of coloured light to make other colours, including the making of white light.
Observes flower pollen magnified by a microscope.
Observes the growth of a plant when grown under different watering conditions.
Observes the effects of tap water, salt water and fertiliser on the growth of plants in a nine day period.
Investigates the bones of the human body.
Investigates the joints of the human body.
Investigates the pH levels of virtual fields to find which field is most suitable to grow crops.
Observes the magnetic attraction and repulsion forces between the poles of magnets.
Observes the weather during different seasons in a virtual representation of New York.
Squashes a ball and stretches a spring to observe the effects of pushing and pulling forces.
Observes how a varying incline effects the speed of a model car.

3 Manipulate simple devices that aid observation and data collection.

Identifies units of measurement that would be most suitable for measuring a series of different items.
Measures temperature using thermometers.
Measures and compares the heat insulation properties of different materials.
Identifies different ways to measure things.
Uses a digital light meter to measure light levels in a room.
Uses an analogue light meter to measure light levels in a room.
Uses a ruler and a motion sensor to measure height.
Measures pulling forces using a newton meter.
Students indentify tools that could be used in measurement of physical phenomena.
Uses a motion sensor to measure distances.

		4	**Use simple measurement devices to make measurements in scientific investigations.** *Uses non-standard measurements, such as paper clips and hands, to measure different objects.* *Students indentify tools that could be used in measurement of physical phenomena.* *Identifies units of measurement that would be most suitable for measuring a series of different items.* *Measures pulling forces using a newton meter.* *Identifies that pushes and pulls are forces that can be measured in newtons.* *Identifies symbols and instruments which can be used to represent and measure the weather.* *Uses a motion sensor to measure distances.* *Identifies different ways to measure things.* *Measures the effect that the force of gravity has on a mass placed on an inclined plane.*
		5	**Develop strategies and skills for information gathering and problem solving.** *Measures the effect that the force of gravity has on a mass placed on an inclined plane.* *Measures and compares the heat insulation properties of different materials.* *Identifies different ways to measure things.* *Uses an analogue light meter to measure light levels in a room.* *Students identify tools that could be used in measurement of physical phenomena.* *Uses non-standard measurements, such as paper clips and hands, to measure different objects.* *Uses a motion sensor to measure distances.* *Measures pulling forces using a newton meter.* *Measures temperature using thermometers.* *Identifies symbols and instruments which can be used to represent and measure the weather.* *Identifies units of measurement that would be most suitable for measuring a series of different items.* *Uses a ruler and a motion sensor to measure height.*
		6	**Construct charts and graphs and prepare summaries of observations.** *Records rainfall information into a table and constructs a bar chart of the results.* *Uses graphs to plot the change of temperature over periods of time.* *Compares the heat loss in different materials using graphs.* *Displays results from a friction experiment in a series of bar charts.*
2	**Reflecting on Scientific Knowledge**	**1**	**Develop an awareness of the need for evidence in making decisions scientifically.** *Students state whether an experiment tests a hypothesis.* *Students analyze experimental data to identify if the hypothesis is disproved or supported.* *Students identify tools that could be used in measurement of physical phenomena.* *Students identify the typical stages in a scientific experiment.*

		2	**Show how science concepts can be illustrated through creative expression such as language arts and fine arts.** *N/A*
		3	**Describe ways in which technology is used in everyday life.** *Sends messages using coded signals.* *Discovers how electricity flows in series and parallel circuits.* *Interprets electrical diagrams to predict the behaviour of electrical components connected in parallel.* *States the use of parallel and series electrical circuits in the home.* *Discovers the uses of a windlass.* *Constructs a windlass to observe that a gear will increase the amount of lift for each turn of its handle.* *Changes the balance of a model aeroplane to see the effect on flight.* *Sends messages using light signals.* *Uses different supports to make a bridge stronger.* *Constructs a bridge to span a gap.* *Observes the weakness of a beam bridge.* *Uses wing flaps and rudders to control the direction of aeroplanes in the air.* *Changes the size and shape of a wing of a model aeroplane to see the effect in the lift given.* *Sends messages using radio waves.*
		4	**Develop an awareness of and sensitivity to the natural world.** *Identifies what effect pollution can have on rivers and ponds.* *Identifies processes by which different materials can be recycled.* *Identifies how different materials can be recycled.* *Identifies if things are alive or not alive and how they can be affected by pollution.*
		5	**Develop an awareness of contributions made to science by people of diverse backgrounds and cultures.** *N/A*
3	**Using Life Science Knowledge**	1	**Explain characteristics and functions of observable body parts in a variety of animals.** *Uses classification keys to sort animals.* *Creates questions in a classification key to sort a group of farmyard animals.* *Identifies questions that can be asked to sort different animals.* *Discovers the characteristics of animals that allow them to survive in their natural habitats.* *Describes characteristics of animals habitats.*

2 **Compare and contrast (K- 2) or classify (3- 5) familiar organisms on the basis of observable physical characteristics.**
Discovers the characteristics of animals that allow them to survive in their natural habitats.
Compares the life cycles of plants and identifies similarities and differences between them.
Compares the life cycles of animals and identifies similarities and differences between them.
Identifies characteristics of the lungs, stomach and heart of the human body.

3 **Describe life cycles of familiar organisms.**
Compares the life cycles of plants and identifies similarities and differences between them.
Compares the life cycles of animals and identifies similarities and differences between them.

4 **Compare and contrast food, energy, and environmental needs of selected organisms.**
Identifies if everyday foods come from plants or animals.
Students identify how populations can be affected by changes in a food chain.
Uses a matching game to find what foods humans can obtain from animals.
Uses a matching game to find what foods humans can obtain from plants.
Identifies the nutrients contained in different foods.
States the energy transfer that occurs between plants to animals and animals to animals in food chains.
Identifies the producers primary consumers and secondary consumers in food chains.
Determines the placement of animals and plants in food chains.

5 **Explain functions of selected seed plant parts.**
Identifies the parts of plants that help them to make their own food.
Uses software to discover methods of seeds dispersal from different plants.
Interprets text and diagrams to identify the structure of a plant leaf and how it is given its green color.
Uses a microscope to view the cells of plants.

6 **Give evidence that characteristics are passed from parents to young.**
Students identify that heredity traits are those that are passed between parent and offspring.
Students identify the differences between learnt and inherited traits.

7 **Explain how fossils provide evidence about the nature of ancient life.**
Uses symbols to represent different types of fossil.
Identifies how fossil fuels are made and where they come from.
Identifies what fossils fuels can be used for.
Uses a virtual excavation to find different fossils.
Uses software to find out how different types of fossils are formed.
Describes how fossils are formed.

8 **Explain how physical and behavioral characteristics of animals help them to survive in their environments.**
Discovers the characteristics of animals that allow them to survive in their natural habitats.
Discovers the habitats of different animals.

9 **Identify familiar organisms as part of a food chain or food web and describe their feeding relationships within the web.**
Uses a matching game to find what foods humans can obtain from plants.
States the energy transfer that occurs between plants to animals and animals to animals in food chains.
Identifies the producers primary consumers and secondary consumers in food chains.
Determines the placement of animals and plants in food chains.
Uses a matching game to find what foods humans can obtain from animals.

10 **Describe the basic requirements for all living things to maintain their existence.**
Discovers the effects that sunlight and water have on the growth of plants.
Discovers that plants require carbon dioxide and produce oxygen as a waste product.
Observes the effects of tap water, salt water and fertiliser on the growth of plants in a nine day period.
Determines the nutrients that plants need to grow.
Classifies animals as carnivores, herbivores or omnivores.
States the energy transfer that occurs between plants to animals and animals to animals in food chains.
Uses a matching game to find what foods humans can obtain from plants.
Discovers the food groups necessary for a healthy balanced diet.
Uses a matching game to find what foods humans can obtain from animals.
Identifies the nutrients contained in different foods.
Identifies the producers primary consumers and secondary consumers in food chains.
Discovers how insects aid pollination in the life cycle of a plant.
Observes flower pollen magnified by a microscope.
Recognises the purpose of photosynthesis in plants.

11 Design systems that encourage growing of particular plants or animals.

Recognises the purpose of photosynthesis in plants.
Discovers the effects that sunlight and water have on the growth of plants.
Discovers that plants require carbon dioxide and produce oxygen as a waste product.
Determines the nutrients that plants need to grow.
Describes different forms of climate control used to grow plants.
Relates plant growth with climate.
Uses a microscope to view the cells of plants.
Identifies the parts of plants that help them to make their own food.
Observes the effects of tap water, salt water and fertiliser on the growth of plants in a nine day period.
Observes the growth of a plant when grown under different temperature conditions.
Discovers how insects aid pollination in the life cycle of a plant.
Uses software to discover methods of seeds dispersal from different plants.
Interprets text and diagrams to identify the habitats of different plants.
Interprets text and diagrams to plan a fair experiment that tests how different soil types can effect the growth of a plant.
Interprets text and diagrams to identify the structure of a plant leaf and how it is given its green color.
Compares the life cycles of plants and identifies similarities and differences between them.
Observes the growth of a plant when grown under different watering conditions.

12 Describe positive and negative effects of humans on the environment.

Identifies how different materials can be recycled.
Discovers some of the causes of global warming.
Explores the effects of global warming and alternative energy sources.
Uses a simple classification key to sort three different types of metal.
Identifies how fossil fuels are made and where they come from.
Identifies what fossils fuels can be used for.
Identifies if things are alive or not alive and how they can be affected by pollution.
Identifies what effect pollution can have on rivers and ponds.

4	Using Physical Science Knowledge	1	**Classify common objects and substances according to observable attributes/ properties.** *Identifies objects around the classroom that are light sources.* *Describes how density of an object can effect if it floats or sinks in water.* *Tests a series of different objects to find if they are flexible, inflexible or elastic.* *Identifies if objects are electrical conductors or electrical insulators.* *Determines if objects are transparent or opaque using a light ray box.* *Uses non-standard measurements, such as paper clips and hands, to measure different objects.* *Determines that the parts of a mirror do not create a reflection until they are combined and identifies objects around the classroom that give reflections.* *Identifies the weight of objects in units of newtons and places them in order of their weight.* *Identifies the attraction and repulsion between magnets and other objects.*
		2	**Identify properties of materials which make them useful.** *Identifies objects around the classroom that are light sources.* *Identifies the attraction and repulsion between magnets and other objects.* *Describes how density of an object can effect if it floats or sinks in water.* *Determines if objects are transparent or opaque using a light ray box.* *Tests a series of different objects to find if they are flexible, inflexible or elastic.* *Identifies if objects are electrical conductors or electrical insulators.* *Determines the effect of air resistance on an object when gravity is pulling the object towards the ground.* *Determines that the parts of a mirror do not create a reflection until they are combined and identifies objects around the classroom that give reflections.* *Identifies the weight of objects in units of newtons and places them in order of their weight.*
		3	**Identify forms of energy associated with common phenomena.** *Discovers that a dynamo can be used to convert kinetic energy into electrical energy.* *Uses flow diagrams to track the conversion of energy.* *Discovers where kinetic, potential, chemical, light, heat and sound energy can occur.* *Uses components, like lamps and buzzers, to discover that electrical energy can be changed into different energies.* *Modifies a crawler so that it can store enough energy to reach the top of a slope.* *Finds the effects of giving a crawler more energy.* *Identifies renewable and non-renewable energy sources.* *Identifies different types of energy.* *Uses a model car on a track to find when the car has enough energy to travel over a hill.* *Observes the change from kinetic energy into heat and sound energy when rubbing hands together.*

4 Construct simple, useful electrical circuits. (3- 5)

Uses components, like lamps and buzzers, to discover that electrical energy can be changed into different energies.
Interprets electrical diagrams to predict the behaviour of electrical components connected in series.
Discovers how electricity flows in series and parallel circuits.
Interprets electrical diagrams to predict the behaviour of electrical components connected in parallel.
States the use of parallel and series electrical circuits in the home.

5 Describe possible electrical hazards to be avoided at home and at school. (K- 2)

Determines if materials are electrical conductors or electrical insulators using a simple lamp circuit.
States the use of parallel and series electrical circuits in the home.
Discovers that electricity cannot flow unless a circuit is complete.

6 Describe common physical changes in matter size, shape; melting, freezing (K- 2); dissolving, evaporating (3- 5).

Describes the changes that occur in different materials when they are heated.
Describes the changes that occur in different materials when they are cooled.
States the necessary conditions for the formation of clouds and precipitation.
States if changes in different materials, caused by heating and cooling, can be reversed.
Compares the heat loss in different materials using graphs.
Replicates and observes the stages of the water cycle.
Observes the effect of adding an insoluble material to a liquid.
Tests if materials are soluble or insoluble.
Separates solids and liquids using filter paper.
Separates mixtures using a sieve.
Identifies the use of insulating domestic water pipes against cold.
Measures and compares the heat insulation properties of different materials.

7 Prepare mixtures and separate them into their component parts.

Separates solids and liquids using filter paper.
Tests if materials are soluble or insoluble.
Observes the effect of adding an insoluble material to a liquid.
Identifies how mixtures can be separated using different filters.
Describes what happens to soluble and insoluble materials when they are added to a liquid.
Separates mixtures using a sieve.

8 Describe or compare motions of common objects in terms of speed and direction.

Modifies a crawler so that it can store enough energy to reach the top of a slope.
Squashes a ball and stretches a spring to observe the effects of pushing and pulling forces.
Measures the effect that the force of gravity has on a mass placed on an inclined plane.
Discovers where kinetic, potential, chemical, light, heat and sound energy can occur.
Uses a model car on a track to find when the car has enough energy to travel over a hill.
States if illustrated movements are pushes or pulls.
Finds the effects of giving a crawler more energy.
Measures pulling forces using a newton meter.
Modifies a crawler to change the direction it moves in.
Observes how a varying incline effects the speed of a model car.

9 Explain how forces (pushes or pulls) are needed to speed up, slow down, stop, or change the direction of a moving object.

States if illustrated movements are pushes or pulls.
Describes the effect of pushing and pulling forces.
Identifies that pushes and pulls are forces that can be measured in newtons.
Measures the effect that the force of gravity has on a mass placed on an inclined plane.
Observes how a varying incline effects the speed of a model car.
Measures pulling forces using a newton meter.
Squashes a ball and stretches a spring to observe the effects of pushing and pulling forces.

10 Describe patterns of interaction of magnetic materials with other magnetic and non- magnetic materials.

Uses a bar magnet and an electromagnet to find the differences and similarities between them.
Discovers that materials containing iron stick to magnets.
Identifies the behaviour of temporary and permanent magnets.
Increases the strength of an electromagnet.
Observes the magnetic attraction and repulsion forces between the poles of magnets.
Identifies everyday items that would stick to a magnet.
Determines which materials stick to a magnet.
Identifies the attraction and repulsion between magnets and other objects.

11 Identify and use simple machines and describe how they change effort.

Modifies a crawler so that it can store enough energy to reach the top of a slope.
Discovers the uses of a windlass.
Modifies a crawler to change the direction it moves in.
Finds the effects of giving a crawler more energy.
Uses a solar panel to generate electricity in a circuit.
Uses a ruler and a motion sensor to measure height.
Uses a motion sensor to measure distances.
Constructs a windlass to observe that a gear will increase the amount of lift for each turn of its handle.
Discovers that a dynamo can be used to convert kinetic energy into electrical energy.

12 Manipulate simple mechanical devices and explain how their parts work together.

Discovers the uses of a windlass.
Constructs a windlass to observe that a gear will increase the amount of lift for each turn of its handle.

13 Describe sounds in terms of their properties.

Observes the relationship between length of rubber band and pitch of sound made by a stringed instrument.
Observes the change from kinetic energy into heat and sound energy when rubbing hands together.
Observes the relationship between volume of air and pitch of sound made by a percussion instrument.
Observes the relationship between length of tube and pitch of sound made by a wind instrument.
Discovers where kinetic, potential, chemical, light, heat and sound energy can occur.
Identifies that sound travels through string as a vibration by using a string telephone.
Identifies that sound travels as a vibration by speaking into a balloon.
Identifies that the volume of a sound changes as the distance from the source of the sound is increased.
Identifies that sound travels as a vibration and so can travel through solids.
Identifies how the size of a vibration can effect the loudness of a sound.

		14	**Explain how sounds are made.** *Identifies how the size of a vibration can effect the loudness of a sound.* *Identifies that sound travels as a vibration by speaking into a balloon.* *Identifies that sound travels through string as a vibration by using a string telephone.* *Identifies that sound travels as a vibration and so can travel through solids.* *Observes the relationship between length of rubber band and pitch of sound made by a stringed instrument.* *Observes the relationship between length of tube and pitch of sound made by a wind instrument.* *Observes the relationship between volume of air and pitch of sound made by a percussion instrument.*
		15	**Use prisms and filters with light sources to produce various colors of light.** *Determines if objects are transparent or opaque using a light ray box.* *Describes the behaviour of light.* *Recognises the lenses that bend light rays.* *Uses lenses to bend light rays.* *Uses a triangular prism to split white light into the colors from which it is composed.* *Observes the mixing of coloured light to make other colours, including the making of white light.*
		16	**Explain how shadows are made.** *Identifies how shadows are formed and how they change depending on their distance from a light source.* *Describes the appearance of reflections and shadows.* *Uses a shadow trainer to find out why shadows change shape during the day.* *Describes what causes day and night and what happens to shadows during the day.*
5	**Using Earth Science Knowledge**	1	**Describe major features of the earth's surface.** *Recognises planets in the solar system.* *Describes the different conditions for the formation of various rocks.* *Sorts rocks into sedimentary, metamorphic and igneous rock types.*
		2	**Recognize and describe different types of earth materials.** *Identifies what natural materials have been used to make a series of sample objects.* *Identifies if materials come from the Earth, from plants or from animals.* *Identifies where different natural materials come from.*
		3	**Describe natural changes in the earth's surface.** *Separates mixtures using a sieve.* *Separates solids and liquids using filter paper.* *Observes the effect of adding an insoluble material to a liquid.* *Describes the different conditions for the formation of various rocks.* *Sorts rocks into sedimentary, metamorphic and igneous rock types.* *Tests if materials are soluble or insoluble.*

4 **Explain how rocks and fossils are used to understand the history of the earth.**
Identifies what fossils fuels can be used for.
States how different rocks are formed.
Sorts rocks into sedimentary, metamorphic and igneous rock types.
Describes the different conditions for the formation of various rocks.
Describes how fossils are formed.
Uses a virtual excavation to find different fossils.
Identifies how fossil fuels are made and where they come from.
Uses symbols to represent different types of fossil.
Uses software to find out how different types of fossils are formed.

5 **Describe uses of materials taken from the earth.**
Identifies if materials come from the Earth, from plants or from animals.
Identifies fossil fuels and how they are made.
Identifies where different natural materials come from.
Identifies how fossil fuels are made and where they come from.
Identifies what fossils fuels can be used for.
Identifies what natural materials have been used to make a series of sample objects.

6 **Demonstrate ways to conserve natural resources and reduce pollution through reduction, reuse, and recycling of manufactured materials.**
Identifies what effect pollution can have on rivers and ponds.
Identifies if things are alive or not alive and how they can be affected by pollution.
Identifies renewable and non-renewable energy sources.
Uses a solar panel to generate electricity in a circuit.
Identifies renewable and non-renewable energy sources.
Identifies processes by which different materials can be recycled.
Identifies how different materials can be recycled.

7 **Describe how water exists on earth in three states.**
States if everyday items are solids, liquids or gases.
Describes the changes that occur in different materials when they are cooled.
States if changes in different materials, caused by heating and cooling, can be reversed.
Identifies the changes that happen to materials when they are heated and cooled.
Describes the states and processes of the water cycle.
Describes the changes that occur in different materials when they are heated.

8 **Trace the path that rain water follows after it falls.**
States the different forms of water in the water cycle.
Interprets text and diagrams to identify natural sources of water, such as rivers, lakes and oceans.
Replicates and observes the stages of the water cycle.

9 Identify sources of water and its uses.
Discovers the effects that sunlight and water have on the growth of plants.
Replicates and observes the stages of the water cycle.
States the different forms of water in the water cycle.
Describes the states and processes of the water cycle.
Interprets text and diagrams to identify natural sources of water, such as rivers, lakes and oceans.
Identifies the use of insulating domestic water pipes against cold.

10 Describe weather conditions.
Interprets text and diagrams to identify physical, chemical and biological forms of weathering.
Identifies symbols and instruments which can be used to represent and measure the weather.
Uses a virtual weather station to record temperature and rainfall.
Discovers symbols that are used to represent the weather.
Observes the weather during different seasons in a virtual representation of New York.
Uses a software simulation to find out how seasons are linked to the position of the Earth in relation to the Sun.

11 Describe seasonal changes in Michigan's weather.
Uses a model of the Earth to identify how the position of the Earth during different seasons effects the hours of daylight.
Identifies the seasons at different places on the Earth.
Observes the weather during different seasons in a virtual representation of New York.
Uses a software simulation to find out how seasons are linked to the position of the Earth in relation to the Sun.

12 Explain appropriate safety precautions during severe weather.
N/A

13 Compare and contrast characteristics of the sun, moon and earth.
States the effects that the Sun has on the light levels on the planets of the solar system.
Uses software to discover facts about the Moon and its relation to the Earth.
Identifies characteristics of the Moon and its phases.
Identifies if materials come from the Earth, from plants or from animals.

14 Describe the motion of the earth around the sun and the moon around the earth.
States the position of the planets in the solar system.
Recognises planets in the solar system.
Identifies planets in the solar system.
Relates the position of a planet in the solar system to the amount of light it receives.
Uses software to discover facts about the Moon and its relation to the Earth.

Section 6.

LWS Objective Lists

ST20-1 Living with Physical Science Level-1

1 Pushes and Pulls

1 States if illustrated movements are pushes or pulls.
2 Measures pulling forces using a Newton meter.

2 Magnets

1 Determines which materials stick to a magnet.
2 Discovers that materials containing iron stick to magnets.
3 Observes the magnetic attraction and repulsion forces between the poles of magnets.

3 Sound Travel

1 Identifies that sound travels as a vibration by speaking into a balloon.
2 Identifies that sound travels through string as a vibration by using a string telephone.

4 Light Sources

1 Identifies objects around the classroom that are light sources.
2 Determines if objects are transparent or opaque using a light ray box.

5 Effects of Force

1 Squashes a ball and stretches a spring to observe the effects of pushing and pulling forces.
2 Observes how a varying incline effects the speed of a model car.
3 Measures the effect that the force of gravity has on a mass placed on an inclined plane.

6 Electrical Conductors

1 Determines if materials are electrical conductors or electrical insulators using a simple lamp circuit.
2 Discovers that electricity cannot flow unless a circuit is complete.

7 Types of Energy

1 Discovers where kinetic, potential, chemical, light, heat and sound energy can occur.
2 Uses a model car on a track to find when the car has enough energy to travel over a hill.

8 Reflections and Shadows

1 Observes that images are reversed when reflected in a mirror.
2 Identifies how shadows are formed and how they change depending on their distance from a light source.

11 Pre Test Quiz 1

1 Identifies that pushes and pulls are forces that can be measured in Newton's.
2 Identifies the attraction and repulsion between magnets and other objects.
3 Identifies that sound travels as a vibration and so can travel through solids.
4 Identifies if objects are light sources and if they are transparent or opaque.

12 Post Test Quiz 1

1 Identifies that pushes and pulls are forces that can be measured in Newton's.
2 Identifies the attraction and repulsion between magnets and other objects.
3 Identifies that sound travels as a vibration and so can travel through solids.
4 Identifies if objects are light sources and if they are transparent or opaque.

13 Pre Test Quiz 2

1 Describes the effect of pushing and pulling forces.
2 Identifies if objects are electrical conductors or electrical insulators.
3 Identifies different types of energy.
4 Describes the appearance of reflections and shadows.

14 Post Test Quiz 2

1 Describes the effect of pushing and pulling forces.
2 Identifies if objects are electrical conductors or electrical insulators.
3 Identifies different types of energy.
4 Describes the appearance of reflections and shadows.

ST20-2 Living with Physical Science Level-2

1 Friction

1 Observes the force of friction.
2 Compares the force of friction between different materials.

2 Series Circuits

1 Uses components, like lamps and buzzers, to discover that electrical energy can be changed into different energies.
2 Interprets electrical diagrams to predict the behavior of electrical components connected in series.

3 Musical Sounds

1 Observes the relationship between length of rubber band and pitch of sound made by a stringed instrument.
2 Observes the relationship between length of tube and pitch of sound made by a wind instrument.
3 Observes the relationship between volume of air and pitch of sound made by a percussion instrument.

4 Light Rays

1 Uses lenses to bend light rays.
2 Observes the mixing of colored light to make other colors, including the making of white light.

5 Springs

1 Discovers the elastic properties of metal springs.
2 Discovers that the stretch of spring is proportional to the weight placed on it.

6 Parallel Circuits

1 Discovers how electricity flows in series and parallel circuits.
2 Interprets electrical diagrams to predict the behavior of electrical components connected in parallel.
3 States the use of parallel and series electrical circuits in the home.

7 Energy Conversion

1 Uses flow diagrams to track the conversion of energy.
2 Observes the change from kinetic energy into heat and sound energy when rubbing hands together.
3 Discovers that a dynamo can be used to convert kinetic energy into electrical energy.

8 Cooling

1 Compares the heat loss in different materials using graphs.
2 Measures and compares the heat insulation properties of different materials.
3 Identifies the use of insulating domestic water pipes against cold.

11 Pre Test Quiz 3

1 Describes the friction force that occurs between two surfaces.
2 Describes how electrical components work in series circuits.
3 Predicts how the pitch of sound produced by a vibrating object changes with object size.
4 Recognizes the lenses that bend light rays.

12 Post Test Quiz 3

1 Describes the friction force that occurs between two surfaces.
2 Predicts how the pitch of sound produced by a vibrating object changes with object size.
3 Describes how electrical components work in series circuits.
4 Describes the behavior of light.

13 Pre Test Quiz 4

1 Predicts that the stretch of a spring is proportional to the weight placed on it.
2 Describes how electrical components work in parallel circuits.
3 Recognizes different forms of energy.
4 Describes how heat insulators and heat conductors lose heat.

14 Post Test Quiz 4

1 Predicts that the stretch of a spring is proportional to the weight placed on it.
2 Describes how electrical components work in parallel circuits.
3 Recognizes different forms of energy.
4 Describes how heat insulators and heat conductors lose heat.

ST21-1 Living with Life Science Level-1

1 Bones
1 Investigates the bones of the human body.
2 Investigates the joints of the human body.

2 Plant Life Cycles
1 Uses a board-game to discover the stages in the life cycle of a plant.
2 Uses software to discover methods of seeds dispersal from different plants.

3 Animal Life Cycles
1 Using software, discovers the different stages of the human life cycle.
2 Using software, discovers the different stages in the life cycle of butterflies and frogs.

4 Food Providers
1 Uses a matching game to find what foods humans can obtain from animals.
2 Uses a matching game to find what foods humans can obtain from plants.

5 The Body
1 Investigates the lungs of the human body.
2 Investigates the stomach of the human body.
3 Investigates the heart of the human body.

6 Using a Microscope
1 Identifies the parts and controls of a microscope.
2 Uses a microscope to view the cells of plants.

7 Senses
1 Uses software to find what parts of the human body give each of the five senses.
2 Specifies what senses can be used to identify different things.

8 Acids and Bases
1 Uses litmus paper to find out if samples are acidic, basic or neutral.
2 Investigates the pH levels of virtual fields to find which field is most suitable to grow crops.

11 Pre Test Quiz 1
1 Identifies bones and joints of the human body.
2 Identifies the stages in the life cycle of a plant.
3 Identifies stages in the life cycle of animals.
4 Identifies foods that come from plants and animals.

12 Post Test Quiz 1
1 Identifies bones and joints of the human body.
2 Identifies the stages in the life cycle of a plant.
3 Identifies stages in the life cycle of animals.
4 Identifies foods that come from plants and animals.

13 Pre Test Quiz 2
1 Identifies characteristics of the lungs, stomach and heart of the human body.
2 States the uses of a microscope.
3 Identifies senses of the human body.
4 Identifies the pH levels of acids and bases.

14 Post Test Quiz 2
1 Identifies characteristics of the lungs, stomach and heart of the human body.
2 States the uses of a microscope.
3 Identifies senses of the human body.
4 Identifies the pH levels of acids and bases.

ST21-2 Living with Life Science Level-2

1 Exercise
1 Discovers the relationship between heartbeat and pulse.
2 Determines the effect of exercise on heart rate.

2 Pollination
1 Observes flower pollen magnified by a microscope.
2 Discovers how insects aid pollination in the life cycle of a plant.

3 Sorting Animals
1 Uses classification keys to sort animals.
2 Creates questions in a classification key to sort a group of farmyard animals.

4 Climate Control
1 Observes the growth of a plant when grown under different watering conditions.
2 Observes the growth of a plant when grown under different temperature conditions.
3 Describes different forms of climate control used to grow plants.

5 Diet
1 Identifies the nutrients contained in different foods.
2 Discovers the food groups necessary for a healthy balanced diet.

6 Plant Food
1 Recognizes the purpose of photosynthesis in plants.
2 Discovers the effects that sunlight and water have on the growth of plants.
3 Discovers that plants require carbon dioxide and produce oxygen as a waste product.

7 Food Chains
1 States the energy transfer that occurs between plants to animals and animals to animals in food chains.
2 Identifies the producers primary consumers and secondary consumers in food chains.
3 Classifies animals as carnivores, herbivores or omnivores.

8 Nutrients
1 Determines the nutrients that plants need to grow.
2 Observes the effects of tap water, salt water and fertilizer on the growth of plants in a nine day period.

11 Pre Test Quiz 3
1 Describes the pulse as a method of detecting blood flow around the body.
2 Describes the relationship between a honeybee and a flower for pollination to occur.
3 Identifies questions that can be asked to sort different animals.
4 Relates plant growth with climate.

12 Post Test Quiz 3
1 Identifies questions that can be asked to sort different animals.
2 Describes the relationship between a honeybee and a flower for pollination to occur.
3 States the appropriate climate to grow different plants.
4 Describes the pulse as a method of detecting blood flow around the body.

13 Pre Test Quiz 4
1 Associates various nutrients with food groups.
2 Identifies the parts of plants that help them to make their own food.
3 Determines the placement of animals and plants in food chains.
4 Identifies the nutrients plants use for growth.

14 Post Test Quiz 4
1 Associates various nutrients with food groups.
2 Identifies the parts of plants that help them to make their own food.
3 Identifies the various nutrients plants use for growth.
4 Distinguishes between a herbivore and a carnivore.

ST22-1 Living with Earth Science Level-1

1 Rivers and Ponds

1 Uses a checklist of the seven life processes to identify if things are living or not living.
2 Identifies what effect pollution can have on rivers and ponds.

2 Day and Night

1 Uses software to find out why there is day and night.
2 Uses a shadow trainer to find out why shadows change shape during the day.

3 The Seasons

1 Observes the weather during different seasons in a virtual representation of New York.
2 Uses a software simulation to find out how seasons are linked to the position of the Earth in relation to the Sun.

4 Fossil Fuels

1 Identifies how fossil fuels are made and where they come from.
2 Identifies what fossils fuels can be used for.

5 Recycling

1 Identifies how different materials can be recycled.
2 Uses a simple classification key to sort three different types of metal.

6 The Moon

1 Uses software to discover facts about the Moon and its relation to the Earth.
2 Uses software to discover the different phases of the Moon.

7 Weather Records

1 Discovers symbols that are used to represent the weather.
2 Uses a virtual weather station to record temperature and rainfall.

8 Fossils

1 Uses a virtual excavation to find different fossils.
2 Uses software to find out how different types of fossils are formed.

11 Pre Test Quiz 1

1 Identifies if things are alive or not alive and how they can be affected by pollution.
2 Describes what causes day and night and what happens to shadows during the day.
3 Identifies the seasons at different places on the Earth.
4 Identifies fossil fuels and how they are made.

12 Post Test Quiz 1

1 Identifies if things are alive or not alive and how they can be affected by pollution.
2 Describes what causes day and night and what happens to shadows during the day.
3 Identifies the seasons at different places on the Earth.
4 Identifies fossil fuels and how they are made.

13 Pre Test Quiz 2

1 Identifies processes by which different materials can be recycled.
2 Identifies characteristics of the Moon and its phases.
3 Identifies symbols and instruments which can be used to represent and measure the weather.
4 Describes how fossils are formed.

14 Post Test Quiz 2

1 Identifies processes by which different materials can be recycled.
2 Identifies characteristics of the Moon and its phases.
3 Identifies symbols and instruments which can be used to represent and measure the weather.
4 Describes how fossils are formed.

ST22-2 Living with Earth Science Level-2

1 Habitats
1 Discovers the characteristics of animals that allow them to survive in their natural habitats.
2 Discovers the habitats of different animals.

2 The Planets
1 States the position of the planets in the solar system.
2 Recognizes planets in the solar system.

3 Rain and Clouds
1 States the necessary conditions for the formation of clouds and precipitation.
2 Replicates and observes the stages of the water cycle.
3 States the different forms of water in the water cycle.

4 Rocks
1 Describes the different conditions for the formation of various rocks.
2 Sorts rocks into sedimentary, metamorphic and igneous rock types.

5 Global Warming
1 Discovers some of the causes of global warming.
2 Explores the effects of global warming and alternative energy sources.

6 The Sun
1 States the effects that the Sun has on the light levels on the planets of the solar system.
2 Observes the effect that distance has on light levels.

7 Separating Mixtures
1 Separates mixtures using a sieve.
2 Separates solids and liquids using filter paper.

8 Solubility
1 Tests if materials are soluble or insoluble.
2 Observes the effect of adding an insoluble material to a liquid.

11 Pre Test Quiz 3
1 Describes characteristics of animals habitats.
2 Identifies planets in the solar system.
3 Describes the states and processes of the water cycle.
4 States how different rocks are formed.

12 Post Test Quiz 3
1 Describes characteristics of animals habitats.
2 States how different rocks are formed.
3 Identifies planets in the solar system.
4 Describes the states and processes of the water cycle.

13 Pre Test Quiz 4
1 Identifies some causes and effects of global warming.
2 Relates the position of a planet in the solar system to the amount of light it receives.
3 Identifies how mixtures can be separated using different filters.
4 Describes what happens to soluble and insoluble materials when they are added to a liquid.

14 Post Test Quiz 4
1 Describes what happens to soluble and insoluble materials when they are added to a liquid.
2 Identifies how mixtures can be separated using filters.
3 Relates the position of a planet in the solar system to the amount of light it receives.
4 Identifies some causes and effects of global warming.

ST23-1 Living with Scientific Reasoning Level-1

1 Measuring Distance

1 Uses a motion sensor to measure distances.
2 Uses a ruler and a motion sensor to measure height.

2 Alternative Energy

1 Identifies renewable and non-renewable energy sources.
2 Uses a solar panel to generate electricity in a circuit.

3 Elasticity

1 Tests a series of different objects to find if they are flexible, inflexible or elastic.
2 Identifies if different objects should be flexible, inflexible or elastic in order to do their jobs.

4 Balance

1 Discovers the effect of forces on a lever.
2 Uses a lever to balance weights.

5 Light Levels

1 Uses an analogue light meter to measure light levels in a room.
2 Uses a digital light meter to measure light levels in a room.

6 Electromagnets

1 Uses a bar magnet and an electromagnet to find the differences and similarities between them.
2 Increases the strength of an electromagnet.

7 Natural Materials

1 Identifies where different natural materials come from.
2 Identifies what natural materials have been used to make a series of sample objects.

8 Crawler

1 Finds the effects of giving a crawler more energy.
2 Modifies a crawler so that it can store enough energy to reach the top of a slope.
3 Modifies a crawler to change the direction it moves in.

11 Pre Test Quiz 1

1 Identifies different ways to measure things.
2 Identifies renewable and non-renewable energy sources.
3 Identifies flexible, inflexible and elastic material properties.
4 Indicates how levers can be used to balance weights.

12 Post Test Quiz 1

1 Identifies different ways to measure things.
2 Identifies renewable and non-renewable energy sources.
3 Identifies flexible, inflexible and elastic material properties.
4 Indicates how levers can be used to balance weights.

13 Pre Test Quiz 2

1 Identifies how the level of light can be measured.
2 Identifies the behavior of temporary and permanent magnets.
3 Identifies if materials come from the Earth, from plants or from animals.
4 Identifies how a device called a crawler works on different surfaces when given varying amounts of energy.

14 Post Test Quiz 2

1 Identifies how the level of light can be measured.
2 Identifies the behavior of temporary and permanent magnets.
3 Identifies if materials come from the Earth, from plants or from animals.
4 Identifies how a device called a crawler works on different surfaces when given varying amounts of energy.

ST23-2 Living with Scientific Reasoning Level-2

1 Temperature

1 Measures temperature using thermometers.
2 Uses graphs to plot the change of temperature over periods of time.

2 Flight

1 Uses wing flaps and rudders to control the direction of airplanes in the air.
2 Changes the size and shape of a wing of a model airplane to see the effect in the lift given.
3 Changes the balance of a model airplane to see the effect on flight.

3 Changes

1 Describes the changes that occur in different materials when they are heated.
2 Describes the changes that occur in different materials when they are cooled.
3 States if changes in different materials, caused by heating and cooling, can be reversed.

4 Lifting Machines

1 Discovers the uses of a windlass.
2 Constructs a windlass to observe that a gear will increase the amount of lift for each turn of its handle.

5 Pendulum

1 Observes the effect of the changing the weight of a pendulum on the time of its swing.
2 Observes the effect of changing the length of a pendulum on the time of its swing.
3 Constructs a pendulum to observe the relationship between pendulum weight and length with its swing time.

6 Sending Signals

1 Sends messages using radio waves.
2 Sends messages using light signals.
3 Sends messages using coded signals.

7 Density

1 Describes how density of an object can effect if it floats or sinks in water.
2 Relates the weight, shape and size of a material to its density.

8 Bridges

1 Uses different supports to make a bridge stronger.
2 Constructs a bridge to span a gap.
3 Observes the weakness of a beam bridge.

11 Pre Test Quiz 3

1 States how temperature can be measured and identifies the temperature of the human body.
2 States how wings can be used in flight.
3 Identifies the changes that happen to materials when they are heated and cooled.
4 Describes the function of lifting machines.

12 Post Test Quiz 3

1 States how temperature can be measured and states the temperature of the human body.
2 Identifies the change that happens to materials when they are heated and cooled.
3 States how wings can be used in flight.
4 Describes the function of a lifting machine.

13 Pre Test Quiz 4

1 Relates the swing time of a pendulum with its length.
2 States different ways that signals can be sent.
3 States the relationship between weight, size and density of a material.
4 Identifies different types of bridges.

14 Post Test Quiz 4

1 States the relationship between weight, size and density of a material.
2 States different ways that signals can be sent.
3 Identifies different types of bridges.
4 Relates the swing time of a pendulum with its length.

Section 7.

ClassAct Student Report

Michigan Elementary Science Standards Report

Student Name: Lorraine Murphy **Student ID: LM17543**

Class: Grade 4 Science

Scores – A*, A, B, C, D, F

A – Constructing New Scientific Knowledge

A **Generate questions about the world based on observation.**

Observes flower pollen magnified by a microscope.
Observes that images are reversed when reflected in a mirror.
Squashes a ball and stretches a spring to observe the effects of pushing and pulling forces.
Observes the weakness of a beam bridge.
Observes the effect of the changing the weight of a pendulum on the time of its swing.
Observes the effects of tap water, salt water and fertilizer on the growth of plants in a nine day period.
Observes the change from kinetic energy into heat and sound energy when rubbing hands together.
Observes the mixing of colored light to make other colors, including the making of white light.
Identifies questions that can be asked to sort different animals.
Replicates and observes the stages of the water cycle.
Inserts questions into the correct places in a classification key so that it can be used to sort a series of dogs.
Observes the relationship between length of rubber band and pitch of sound made by a stringed instrument.
Observes the magnetic attraction and repulsion forces between the poles of magnets.
Observes how a varying incline effects the speed of a model car.
Observes the weather during different seasons in a virtual representation of New York.
Observes the force of friction.
Creates questions in a classification key to sort a group of farmyard animals.

A **Develop solutions to problems through reasoning, observation, and investigations.**

Observes the relationship between length of tube and pitch of sound made by a wind instrument.
Investigates the bones of the human body.
Observes flower pollen magnified by a microscope.
Investigates the joints of the human body.
Observes the growth of a plant when grown under different watering conditions.
Investigates the pH levels of virtual fields to find which field is most suitable to grow crops.
Observes the mixing of colored light to make other colors, including the making of white light.
Observes the relationship between volume of air and pitch of sound made by a percussion instrument.
Observes the relationship between length of rubber band and pitch of sound made by a stringed instrument.
Observes the force of friction.
Observes the weather during different seasons in a virtual representation of New York.
Observes that images are reversed when reflected in a mirror.
Observes how a varying incline effects the speed of a model car.
Squashes a ball and stretches a spring to observe the effects of pushing and pulling forces.
Observes the effects of tap water, salt water and fertilizer on the growth of plants in a nine day period.
Observes the magnetic attraction and repulsion forces between the poles of magnets.

B **Manipulate simple devices that aid observation and data collection.**

Uses an analogue light meter to measure light levels in a room.
Uses a ruler and a motion sensor to measure height.
Identifies different ways to measure things.
Measures temperature using thermometers.
Identifies units of measurement that would be most suitable for measuring a series of different items.
Measures pulling forces using a Newton meter.
Uses a digital light meter to measure light levels in a room.
Uses a motion sensor to measure distances.
Students identify tools that could be used in measurement of physical phenomena.
Measures and compares the heat insulation properties of different materials.

A* **Use simple measurement devices to make measurements in scientific investigations.**
Identifies that pushes and pulls are forces that can be measured in Newton's.
Identifies different ways to measure things.
Students identify tools that could be used in measurement of physical phenomena.
Measures the effect that the force of gravity has on a mass placed on an inclined plane.
Uses a motion sensor to measure distances.
Identifies units of measurement that would be most suitable for measuring a series of different items.
Identifies symbols and instruments which can be used to represent and measure the weather.
Measures pulling forces using a Newton meter.
Uses non-standard measurements, such as paper clips and hands, to measure different objects.

A **Develop strategies and skills for information gathering and problem solving.**
Identifies symbols and instruments which can be used to represent and measure the weather.
Measures pulling forces using a Newton meter.
Measures and compares the heat insulation properties of different materials.
Uses non-standard measurements, such as paper clips and hands, to measure different objects.
Measures the effect that the force of gravity has on a mass placed on an inclined plane.
Uses a ruler and a motion sensor to measure height.
Uses an analogue light meter to measure light levels in a room.
Identifies different ways to measure things.
Measures temperature using thermometers.
Identifies units of measurement that would be most suitable for measuring a series of different items.
Students identify tools that could be used in measurement of physical phenomena.
Uses a motion sensor to measure distances.

B **Construct charts and graphs and prepare summaries of observations.**
Displays results from a friction experiment in a series of bar charts.
Records rainfall information into a table and constructs a bar chart of the results.
Compares the heat loss in different materials using graphs.
Uses graphs to plot the change of temperature over periods of time.

B – Reflecting on Scientific Knowledge

B **Develop an awareness of the need for evidence in making decisions scientifically.**
Students identify tools that could be used in measurement of physical phenomena.
Students state whether an experiment tests a hypothesis.
Students identify the typical stages in a scientific experiment.
Students analyze experimental data to identify if the hypothesis is disproved or supported.

Show how science concepts can be illustrated through creative expression such as language arts and fine arts.
N/A

B **Describe ways in which technology is used in everyday life.**
Sends messages using coded signals.
Discovers how electricity flows in series and parallel circuits.
Interprets electrical diagrams to predict the behavior of electrical components connected in parallel.
States the use of parallel and series electrical circuits in the home.
Discovers the uses of a windlass.
Constructs a windlass to observe that a gear will increase the amount of lift for each turn of its handle.
Changes the balance of a model airplane to see the effect on flight.
Sends messages using light signals.
Uses different supports to make a bridge stronger.
Constructs a bridge to span a gap.
Observes the weakness of a beam bridge.
Uses wing flaps and rudders to control the direction of airplanes in the air.
Changes the size and shape of a wing of a model airplane to see the effect in the lift given.
Sends messages using radio waves.

B **Develop an awareness of and sensitivity to the natural world.**
Identifies what effect pollution can have on rivers and ponds.
Identifies processes by which different materials can be recycled.
Identifies how different materials can be recycled.
Identifies if things are alive or not alive and how they can be affected by pollution.

Develop an awareness of contributions made to science by people of diverse backgrounds and cultures.
N/A

A – Using Life Science Knowledge

B **Explain characteristics and functions of observable body parts in a variety of animals.**
Creates questions in a classification key to sort a group of farmyard animals.
Describes characteristics of animals habitats.
Identifies questions that can be asked to sort different animals.
Uses classification keys to sort animals.
Discovers the characteristics of animals that allow them to survive in their natural habitats.

A **Compare and contrast (K- 2) or classify (3- 5) familiar organisms on the basis of observable physical characteristics.**
Discovers the characteristics of animals that allow them to survive in their natural habitats.
Identifies characteristics of the lungs, stomach and heart of the human body.
Compares the life cycles of animals and identifies similarities and differences between them.
Compares the life cycles of plants and identifies similarities and differences between them.

A **Describe life cycles of familiar organisms.**
Compares the life cycles of animals and identifies similarities and differences between them.
Compares the life cycles of plants and identifies similarities and differences between them.

A **Compare and contrast food, energy, and environmental needs of selected organisms.**
Determines the placement of animals and plants in food chains.
Students identify how populations can be affected by changes in a food chain.
Identifies the producers primary consumers and secondary consumers in food chains.
States the energy transfer that occurs between plants to animals and animals to animals in food chains.
Uses a matching game to find what foods humans can obtain from plants.
Identifies if everyday foods come from plants or animals.
Identifies the nutrients contained in different foods.
Uses a matching game to find what foods humans can obtain from animals.

B **Explain functions of selected seed plant parts.**
Uses software to discover methods of seeds dispersal from different plants.
Interprets text and diagrams to identify the structure of a plant leaf and how it is given its green color.
Uses a microscope to view the cells of plants.
Identifies the parts of plants that help them to make their own food.

A **Give evidence that characteristics are passed from parents to young.**
Students identify the differences between learnt and inherited traits.
Students identify that heredity traits are those that are passed between parent and offspring.

A* **Explain how fossils provide evidence about the nature of ancient life.**
Uses software to find out how different types of fossils are formed.
Uses symbols to represent different types of fossil.
Describes how fossils are formed.
Identifies what fossils fuels can be used for.
Identifies how fossil fuels are made and where they come from.
Uses a virtual excavation to find different fossils.

A **Explain how physical and behavioral characteristics of animals help them to survive in their environments.**
Discovers the characteristics of animals that allow them to survive in their natural habitats.
Discovers the habitats of different animals.

B **Identify familiar organisms as part of a food chain or food web and describe their feeding relationships within the web.**
Uses a matching game to find what foods humans can obtain from plants.
Identifies the producers primary consumers and secondary consumers in food chains.
Uses a matching game to find what foods humans can obtain from animals.
States the energy transfer that occurs between plants to animals and animals to animals in food chains.
Determines the placement of animals and plants in food chains.

A **Describe the basic requirements for all living things to maintain their existence.**
Discovers that plants require carbon dioxide and produce oxygen as a waste product.
Uses a matching game to find what foods humans can obtain from plants.
Observes the effects of tap water, salt water and fertilizer on the growth of plants in a nine day period.
Discovers the food groups necessary for a healthy balanced diet.
Determines the nutrients that plants need to grow.
Classifies animals as carnivores, herbivores or omnivores.
States the energy transfer that occurs between plants to animals and animals to animals in food chains.
Discovers the effects that sunlight and water have on the growth of plants.

A **Design systems that encourage growing of particular plants or animals.**

Interprets text and diagrams to identify the structure of a plant leaf and how it is given its green color.
Observes the growth of a plant when grown under different temperature conditions.
Interprets text and diagrams to identify the habitats of different plants.
Uses software to discover methods of seeds dispersal from different plants.
Uses a microscope to view the cells of plants.
Discovers how insects aid pollination in the life cycle of a plant.
Observes the growth of a plant when grown under different watering conditions.
Interprets text and diagrams to plan a fair experiment that tests how different soil types can effect the growth of a plant.
Recognizes the purpose of photosynthesis in plants.
Discovers the effects that sunlight and water have on the growth of plants.
Discovers that plants require carbon dioxide and produce oxygen as a waste product.
Determines the nutrients that plants need to grow.
Observes the effects of tap water, salt water and fertilizer on the growth of plants in a nine day period.
Relates plant growth with climate.
Compares the life cycles of plants and identifies similarities and differences between them.
Describes different forms of climate control used to grow plants.
Identifies the parts of plants that help them to make their own food.

A **Describe positive and negative effects of humans on the environment.**

Explores the effects of global warming and alternative energy sources.
Identifies how fossil fuels are made and where they come from.
Identifies if things are alive or not alive and how they can be affected by pollution.
Discovers some of the causes of global warming.
Identifies how different materials can be recycled.
Identifies what fossils fuels can be used for.
Identifies what effect pollution can have on rivers and ponds.
Uses a simple classification key to sort three different types of metal.

B – Using Physical Science Knowledge

B **Classify common objects and substances according to observable attributes/ properties.**

Identifies objects around the classroom that are light sources.
Determines if objects are transparent or opaque using a light ray box.
Tests a series of different objects to find if they are flexible, inflexible or elastic.
Uses non-standard measurements, such as paper clips and hands, to measure different objects.
Determines that the parts of a mirror do not create a reflection until they are combined and identifies objects around the classroom that give reflections.
Identifies the attraction and repulsion between magnets and other objects.
Describes how density of an object can effect if it floats or sinks in water.
Identifies if objects are electrical conductors or electrical insulators.
Identifies the weight of objects in units of Newton's and places them in order of their weight.

C **Identify properties of materials which make them useful.**

Determines that the parts of a mirror do not create a reflection until they are combined and identifies objects around the classroom that give reflections.
Describes how density of an object can effect if it floats or sinks in water.
Tests a series of different objects to find if they are flexible, inflexible or elastic.
Identifies if objects are electrical conductors or electrical insulators.
Identifies the attraction and repulsion between magnets and other objects.
Identifies the weight of objects in units of Newton's and places them in order of their weight.
Determines the effect of air resistance on an object when gravity is pulling the object towards the ground.
Determines if objects are transparent or opaque using a light ray box.
Identifies objects around the classroom that are light sources.

B **Identify forms of energy associated with common phenomena.**

Discovers where kinetic, potential, chemical, light, heat and sound energy can occur.
Uses flow diagrams to track the conversion of energy.
Uses a model car on a track to find when the car has enough energy to travel over a hill.
Identifies different types of energy.
Identifies renewable and non-renewable energy sources.
Finds the effects of giving a crawler more energy.
Uses components, like lamps and buzzers, to discover that electrical energy can be changed into different energies.
Observes the change from kinetic energy into heat and sound energy when rubbing hands together.
Discovers that a dynamo can be used to convert kinetic energy into electrical energy.
Modifies a crawler so that it can store enough energy to reach the top of a slope.

B **Construct simple, useful electrical circuits. (3- 5)**
Uses components, like lamps and buzzers, to discover that electrical energy can be changed into different energies.
States the use of parallel and series electrical circuits in the home.
Interprets electrical diagrams to predict the behavior of electrical components connected in parallel.
Interprets electrical diagrams to predict the behavior of electrical components connected in series.
Discovers how electricity flows in series and parallel circuits.

C **Describe possible electrical hazards to be avoided at home and at school. (K- 2)**
Discovers that electricity cannot flow unless a circuit is complete.
Determines if materials are electrical conductors or electrical insulators using a simple lamp circuit.
States the use of parallel and series electrical circuits in the home.

A **Describe common physical changes in matter size, shape; melting, freezing (K- 2); dissolving, evaporating (3- 5).**
Separates solids and liquids using filter paper.
Tests if materials are soluble or insoluble.
States the necessary conditions for the formation of clouds and precipitation.
Measures and compares the heat insulation properties of different materials.
Identifies the use of insulating domestic water pipes against cold.
Separates mixtures using a sieve.
Observes the effect of adding an insoluble material to a liquid.
Replicates and observes the stages of the water cycle.
Describes the changes that occur in different materials when they are heated.
Compares the heat loss in different materials using graphs.
States if changes in different materials, caused by heating and cooling, can be reversed.
Describes the changes that occur in different materials when they are cooled.

B **Prepare mixtures and separate them into their component parts.**
Describes what happens to soluble and insoluble materials when they are added to a liquid.
Separates solids and liquids using filter paper.
Separates mixtures using a sieve.
Identifies how mixtures can be separated using different filters.
Observes the effect of adding an insoluble material to a liquid.
Tests if materials are soluble or insoluble.

B **Describe or compare motions of common objects in terms of speed and direction.**
Uses a model car on a track to find when the car has enough energy to travel over a hill.
Discovers where kinetic, potential, chemical, light, heat and sound energy can occur.
States if illustrated movements are pushes or pulls.
Modifies a crawler so that it can store enough energy to reach the top of a slope.
Measures pulling forces using a Newton meter.
Modifies a crawler to change the direction it moves in.
Measures the effect that the force of gravity has on a mass placed on an inclined plane.
Squashes a ball and stretches a spring to observe the effects of pushing and pulling forces.
Observes how a varying incline effects the speed of a model car.
Finds the effects of giving a crawler more energy.

B **Explain how forces (pushes or pulls) are needed to speed up, slow down, stop, or change the direction of a moving object.**
Measures pulling forces using a Newton meter.
Describes the effect of pushing and pulling forces.
Observes how a varying incline effects the speed of a model car.
Squashes a ball and stretches a spring to observe the effects of pushing and pulling forces.
States if illustrated movements are pushes or pulls.
Measures the effect that the force of gravity has on a mass placed on an inclined plane.
Identifies that pushes and pulls are forces that can be measured in Newton's.

A **Describe patterns of interaction of magnetic materials with other magnetic and non- magnetic materials.**
Observes the magnetic attraction and repulsion forces between the poles of magnets.
Uses a bar magnet and an electromagnet to find the differences and similarities between them.
Increases the strength of an electromagnet.
Identifies the attraction and repulsion between magnets and other objects.
Discovers that materials containing iron stick to magnets.
Determines which materials stick to a magnet.
Identifies the behavior of temporary and permanent magnets.
Identifies everyday items that would stick to a magnet.

C **Identify and use simple machines and describe how they change effort.**
Modifies a crawler to change the direction it moves in.
Finds the effects of giving a crawler more energy.
Modifies a crawler so that it can store enough energy to reach the top of a slope.
Discovers the uses of a windlass.
Uses a motion sensor to measure distances.
Uses a ruler and a motion sensor to measure height.
Discovers that a dynamo can be used to convert kinetic energy into electrical energy.
Constructs a windlass to observe that a gear will increase the amount of lift for each turn of its handle.
Uses a solar panel to generate electricity in a circuit.

B **Manipulate simple mechanical devices and explain how their parts work together.**
Discovers the uses of a windlass.
Constructs a windlass to observe that a gear will increase the amount of lift for each turn of its handle.

B **Describe sounds in terms of their properties.**
Observes the relationship between length of tube and pitch of sound made by a wind instrument.
Identifies how the size of a vibration can effect the loudness of a sound.
Observes the relationship between volume of air and pitch of sound made by a percussion instrument.
Identifies that the volume of a sound changes as the distance from the source of the sound is increased.
Identifies that sound travels as a vibration by speaking into a balloon.
Identifies that sound travels through string as a vibration by using a string telephone.
Identifies that sound travels as a vibration and so can travel through solids.
Observes the change from kinetic energy into heat and sound energy when rubbing hands together.
Observes the relationship between length of rubber band and pitch of sound made by a stringed instrument.
Discovers where kinetic, potential, chemical, light, heat and sound energy can occur.

B **Explain how sounds are made.**
Identifies that sound travels as a vibration and so can travel through solids.
Observes the relationship between length of tube and pitch of sound made by a wind instrument.
Identifies that sound travels as a vibration by speaking into a balloon.
Identifies that sound travels through string as a vibration by using a string telephone.
Identifies how the size of a vibration can effect the loudness of a sound.
Observes the relationship between volume of air and pitch of sound made by a percussion instrument.
Observes the relationship between length of rubber band and pitch of sound made by a stringed instrument.

B **Use prisms and filters with light sources to produce various colors of light.**
Uses a triangular prism to split white light into the colors from which it is composed.
Describes the behavior of light.
Recognizes the lenses that bend light rays.
Observes the mixing of colored light to make other colors, including the making of white light.
Uses lenses to bend light rays.
Determines if objects are transparent or opaque using a light ray box.

B **Explain how shadows are made.**
Describes the appearance of reflections and shadows.
Describes what causes day and night and what happens to shadows during the day.
Uses a shadow trainer to find out why shadows change shape during the day.
Identifies how shadows are formed and how they change depending on their distance from a light source.

A – Using Earth Science Knowledge

A* **Describe major features of the earth's surface.**
Recognizes planets in the solar system.
Describes the different conditions for the formation of various rocks.
Sorts rocks into sedimentary, metamorphic and igneous rock types.

A **Recognize and describe different types of earth materials.**
Identifies what natural materials have been used to make a series of sample objects.
Identifies if materials come from the Earth, from plants or from animals.
Identifies where different natural materials come from.

A **Describe natural changes in the earth's surface.**
Separates solids and liquids using filter paper.
Observes the effect of adding an insoluble material to a liquid.
Sorts rocks into sedimentary, metamorphic and igneous rock types.
Tests if materials are soluble or insoluble.
Separates mixtures using a sieve.
Describes the different conditions for the formation of various rocks.

B **Explain how rocks and fossils are used to understand the history of the earth.**
States how different rocks are formed.
Uses symbols to represent different types of fossil.
Sorts rocks into sedimentary, metamorphic and igneous rock types.
Describes the different conditions for the formation of various rocks.
Describes how fossils are formed.
Uses software to find out how different types of fossils are formed.
Uses a virtual excavation to find different fossils.
Identifies how fossil fuels are made and where they come from.
Identifies what fossils fuels can be used for.

A **Describe uses of materials taken from the earth.**
Identifies what fossils fuels can be used for.
Identifies fossil fuels and how they are made.
Identifies where different natural materials come from.
Identifies what natural materials have been used to make a series of sample objects.
Identifies how fossil fuels are made and where they come from.
Identifies if materials come from the Earth, from plants or from animals.

A **Demonstrate ways to conserve natural resources and reduce pollution through reduction, reuse, and recycling of manufactured materials.**
Identifies how different materials can be recycled.
Identifies renewable and non-renewable energy sources.
Identifies what effect pollution can have on rivers and ponds.
Identifies if things are alive or not alive and how they can be affected by pollution.
Identifies processes by which different materials can be recycled.
Uses a solar panel to generate electricity in a circuit.
Identifies renewable and non-renewable energy sources.

A **Describe how water exists on earth in three states.**
Describes the states and processes of the water cycle.
States if everyday items are solids, liquids or gases.
Describes the changes that occur in different materials when they are heated.
States if changes in different materials, caused by heating and cooling, can be reversed.
Identifies the changes that happen to materials when they are heated and cooled.
Describes the changes that occur in different materials when they are cooled.

B **Trace the path that rain water follows after it falls.**
Interprets text and diagrams to identify natural sources of water, such as rivers, lakes and oceans.
Replicates and observes the stages of the water cycle.
States the different forms of water in the water cycle.

A* **Identify sources of water and its uses.**
Interprets text and diagrams to identify natural sources of water, such as rivers, lakes and oceans.
States the different forms of water in the water cycle.
Identifies the use of insulating domestic water pipes against cold.
Replicates and observes the stages of the water cycle.
Discovers the effects that sunlight and water have on the growth of plants.
Describes the states and processes of the water cycle.

A **Describe weather conditions.**
Observes the weather during different seasons in a virtual representation of New York.
Discovers symbols that are used to represent the weather.
Interprets text and diagrams to identify physical, chemical and biological forms of weathering.
Identifies symbols and instruments which can be used to represent and measure the weather.
Uses a software simulation to find out how seasons are linked to the position of the Earth in relation to the Sun.
Uses a virtual weather station to record temperature and rainfall.

A **Describe seasonal changes in Michigan's weather.**
Uses a model of the Earth to identify how the position of the Earth during different seasons effects the hours of daylight.
Observes the weather during different seasons in a virtual representation of New York.
Uses a software simulation to find out how seasons are linked to the position of the Earth in relation to the Sun.
Identifies the seasons at different places on the Earth.

Explain appropriate safety precautions during severe weather.
N/A

A **Compare and contrast characteristics of the sun, moon and earth.**
Identifies if materials come from the Earth, from plants or from animals.
Identifies characteristics of the Moon and its phases.
States the effects that the Sun has on the light levels on the planets of the solar system.
Uses software to discover facts about the Moon and its relation to the Earth.

A **Describe the motion of the earth around the sun and the moon around the earth.**

States the position of the planets in the solar system.
Recognizes planets in the solar system.
Identifies planets in the solar system.
Relates the position of a planet in the solar system to the amount of light it receives.
Uses software to discover facts about the Moon and its relation to the Earth.