

Content and Performance Standards for Earth Science

Course Content Identification Numbers:

The first symbol represents the grade level, the second symbol is the number of the state standard being addressed, the third number is the state benchmark being addressed and the decimal number is for the course content that addresses that specific standard and benchmark.

Example: ES 23.1 E=Earth Science 2= standard 2 3=benchmark 3 1= the first course content skill under the benchmark

The Essential Vocabulary is based on OPI's recommended vocabulary though ACE has often expanded the list of terms. **The vocabulary words in bold, are OPI suggested vocabulary and may well be used in MontCAS testing.**

ACE Course Abilities for Earth Science to be applied to Content Standards:

Develop abilities in science.

- A. Higher thinking (analyze, evaluate, predict, decide, relate, interpret).
- B. Communications (present, demonstrate, explain, defend).
- C. Goal setting/attainment (brainstorm, envision, research, plan, organize).
- D. The planning process (draft, analyze, and revise when producing products).

Apply science knowledge and skills to a variety of purposes.

- A. Solve problems using the scientific method.
- B. Conduct research (field research, library research, experimentation).
- C. Use scientific equipment appropriately (safely).
- D. Apply knowledge of the relationship between humans, the environment and the earth's resources to improve the environment.
- E. Possess technical skills:
 - read/write/present: instructions, table, chart, reports (progress, research, lab), proposal, letters (complaint, request, response), manual, checklist, pamphlet, technical research, bid, technical analysis, summary
 - technology: word processing, spreadsheet, database, desktop publishing, Internet, search tools, current technology
 - measurement practice in measurement practice in metric.

Earth Science Course Content

CONTENT STANDARD 1. Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

ES 11.0 Identify a question, determine relevant variable and a control, formulate a testable hypothesis, plan and predict the outcome of an investigation, safely conduct scientific investigation, and compare and analyze data.

- .1 Compare testable vs. non-testable questions
- .2 Write a testable question for an investigation
- .3 Explain the difference between variables and control
- .4 Determine the variables and control for an investigation
- .5 Distinguish between a testable question and a testable hypothesis
- .6 Write a testable hypothesis for an investigation
- .7 Formulate a plan to test the hypothesis that includes materials, procedures, control, variables, safety precautions, data collection and analysis methods
- .8 Conduct investigations by following student-designed plan

Essential Vocabulary: hypothesis, control, variable, data, independent variable, dependent variable, prediction, testable question, prefixes: milli, centi, kilo, deca, deci, nano (***Bold Vocabulary found on OPI's SCIENCE Vocabulary for Earth Science***)

ES 12.0 Select and use appropriate tools including technology to make measurements (in metric units), gather, process and analyze data from scientific investigations.

- .1 Identify metric base units
- .2 Construct properly labeled data tables
- .3 Select and use appropriate measurement tool(s) and metric units to gather data
- .4 Identify and use the appropriate graphical representation of the data
- .5 Analyze data using median, mean, mode, range and graphical comparisons
- .6 Convert within the metric scale
- .7 Convert standard to metric and metric to standard.

Essential Vocabulary: gram, liter, meter, Celsius, mean, median, mode, range, Kelvin, cm³ (***Bold Vocabulary found on OPI's SCIENCE Vocabulary for Earth Science***)

Earth Science Course Content (cont.)

ES 13.0 Review, communicate and defend results of investigations, including considering alternative explanations.

- .1 Identify data examples that support or refute the hypothesis
- .2 Judge whether or not the data supports the hypothesis
- .3 Communicate results by sharing and comparing data with others
- .4 Compare the differences between student collected data
- .5 Infer the reasons why student collected data may vary
- .6 Defend conclusions by providing examples from the data
- .7 Share and discuss alternative conclusions

Essential Vocabulary: supported, refute, hypothesis, pie, bar & line graph, scatter plot, data analysis, draw conclusions (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Earth Science*)

ES 14.0 Create models to illustrate scientific concepts and use the model to predict change. (e.g., computer simulation, stream table, graphic representation).

- .1 Identify the similarities and differences between working models and representative models
- .2 Create representative models to demonstrate knowledge of scientific concepts (i.e., biomes, cells, life systems, density, water cycle)
- .3 Create working models to illustrate scientific concepts (i.e., biome, cells, life systems motion, energy, water cycle)
- .4 Manipulate working models to predict and make conclusions about scientific concepts
- .5 Identify the advantages and limitations of various models

Essential Vocabulary for: working models, representative models (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Earth Science*)

ES 15.0 Identify strengths and weakness in an investigation design.

- .1 Identify the essential components of investigation design (i.e. sample size and selection, repetition, controls)
- .2 Explain the purpose of each essential component and why you must plan an investigation
- .3 Identify the strengths and weaknesses in a variety of investigations

Essential Vocabulary: inquiry, investigation, sample size, control, repeated trials (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Earth Science*)

ES 16.0 Compare how observations of nature form an essential base of knowledge among the Montana American Indians.

- .1 Identify examples of various Montana American Indian tribes using observation
- .2 Compare how observations of nature form an essential base of knowledge among the different Montana American Indian tribes (e.g., migration patterns, planting cycles, etc.)

Essential Vocabulary: Montana American Indian tribes: Crow, Blackfeet, Salish, Kootenai, Assiniboine Sioux, Little Shell, Northern Cheyenne, Chippewa Cree, Pend d'Orelle, and Gros Ventre (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Earth Science*)

Earth Science Course Content (cont.)

CONTENT STANDARD 2. Students, through the inquiry process, demonstrate the knowledge of properties, forms, changes and interactions of physical and chemical systems.

All benchmarks under Standard 2 are addressed in the Physical Science Course Content (PS)

CONTENT STANDARD 3: Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

All benchmarks under Standard 3 are addressed in the Life Science Course Content (LS)

CONTENT STANDARD 4: Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

ES 41.0 Model and explain the internal structure of the earth and describe the formation and composition of earth's external features in terms of the rock cycle and plate tectonics and constructive and destructive forces.

- .1 Identify internal structures of the earth and their characteristics
- .2 Model or diagram the internal structure of the earth
- .3 Diagram convection currents inside of the earth
- .4 Explain the movement of plates over time.
- .5 Explain or model the differences between Oceanic and Continental plates.
- .6 Model and explain constructive forces on the earth (i.e., plate tectonics).
- .7 Compare and contrast types of rocks formed from different earth processes
- .8 Model and explain the appearance of the earth caused by destructive forces (i.e., weathering and erosion)

Essential Vocabulary: mantle, inner core, outer core, crust, lithosphere, rock cycle, metamorphic, sedimentary, igneous, constructive, weathering, erosion (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Earth Science*)

ES 42.0 Differentiate between rocks types and minerals types and classify both by how they are formed and the utilization by humans.

- .1 Make use of common rock and mineral identification tests to identify rocks and minerals, including common Montana rocks and minerals
- .2 List how rocks and minerals are used in daily life
- .3 Explain the importance of the mining industry in Montana and the uses of rocks and minerals
- .4 Diagram the interaction between igneous, sedimentary and metamorphic rocks through the rock cycle

Essential Vocabulary: mineral, rock, hardness, streak, luster, rock cycle, metamorphic, sedimentary, igneous (*Bold Vocabulary found on OP P's SCIENCE Vocabulary for Earth Science*)

Earth Science Course Content (cont.)

ES 43.0 Use fossils to describe the geological timeline.

- .1 Identify major geologic divisions of time
- .2 Categorize the predominant organisms that appear within each major division of geologic time

Essential Vocabulary: Cenozoic era, Mesozoic era, Paleozoic era, Precambrian (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Earth Science*)

ES 44.0 Describe the water cycle, the composition and structure of the atmosphere and the impact of oceans on large-scale weather patterns.

- .1 Identify, diagram and label the composition and structure of the atmosphere
- .2 Identify, diagram and label the components of the water cycle
- .3 Describe convection currents
- .4 Explain how ocean currents are caused by convection currents
- .5 Explain the impact of ocean currents on large-scale weather patterns

Essential Vocabulary: atmosphere, precipitation, evaporation, condensation, water vapor, troposphere, convection currents, ocean currents, jet stream, el Niño, gulf stream (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Earth Science*)

ES 45.0 Describe and model the motion and tilt of earth in relation to the sun, and explain the concepts of day, night, seasons, year, and climatic changes.

- .1 Explain, using a model, how the Earth rotates and revolves around the sun.
- .2 Identify Earth's climate zones and their key characteristics
- .3 Explain how Earth's tilt and revolution affects climate zones
- .4 Explain how Montana's location on earth influences Montana's climate
- .5 Predict how a change in planetary movement would change Earth's days, seasons, years and climate

Essential Vocabulary: rotation, revolution, orbit, axis, solstice, climate zone, Northern/Southern hemisphere, latitude, elevation, equator (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Earth Science*)

ES 46.0 Describe the earth, moon, planets and other objects in space in terms of size, force of gravity, structure, and movement in relation to the sun.

- .1 Describe the earth, moon, planets and other objects in space in terms of relative size and structure
- .2 Identify that planets in our solar system have different lengths of orbits and periods of rotation around the sun
- .3 Discuss how length of orbit and period of rotation affects length of years and days
- .4 Compare and contrast the length of days and years on different planets.
- .5 Describe the role of gravity in the orbit of moons around planets and planets around the sun

Essential Vocabulary: planet, moon, orbit, period of rotation, year, day, gravity, force (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Earth Science*)

Earth Science Course Content (cont.)

ES 47.0 Identify scientific theories about the origin and evolution of the earth and solar system.

- .1 Define scientific theory as an explanation supported by rigorous testing and multiple lines of evidence
- .2 Recognize that the sun and planets formed from the accretion of dust and gases
- .3 Identify how planets, such as the Earth, changed after their formation

Essential Vocabulary: scientific theory, evidence, solar system, gas, dust, accretion (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Earth Science*)

CONTENT STANDARD 5: Through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies

ES 51.0 Describe the specific fields of science and technology as they relate to occupations within those fields.

- .1 Research a variety of science and technological fields
- .2 Identify and describe a variety of occupations within fields of science and technology
- .3 Identify and describe uses of technology unique to specific occupations within each field of science

Essential Vocabulary for ES 51: occupations, science, technology, science fields (life science, earth science, engineering, physical science) (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Earth Science*)

ES 52.0 Apply scientific knowledge and process skills to understand issues and everyday events.

- .1 Identify a local current event or problem involving science
- .2 Research and summarize the scientific issues relevant to that local current event or problem
- .3 Present and discuss the research on the scientific issues relevant to that local current event or problem

ES 53.0 Simulate collaborative problem solving and give examples of how scientific knowledge and technology are shared with other scientists and the public.

- .1 Identify and describe methods scientists use to collaborate and share scientific findings with other scientists
- .2 Identify and describe methods scientists use to share scientific findings with the public
- .3 Identify, working in collaboration, a current event or problem involving science
- .4 Research and summarize, working in collaboration, the scientific issues relevant to that current event or problem
- .5 Present and discuss, working in collaboration, the scientific issues relevant to that current event or problem

Essential Vocabulary for ES 53: current event, problem, issue, research, summarize, collaborate, relevant (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Earth Science*)

Earth Science Course Content (cont.)

ES 54.0 Use scientific knowledge to investigate problems and their proposed solutions and evaluate those solutions while considering environmental impacts.

- .1 Identify and research a local issue with an environmental impact
- .2 Explain possible environmental impacts
- .3 Propose solutions

Essential Vocabulary: environmental impact, proposed solutions (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Earth Science*)

ES 55.0 Describe how the knowledge of science and technology influences the development of the Montana American Indian Cultures (www.opi.mt.gov/IndianEd for Science Model Lessons).

- .1 Investigate how science and technology have impact on Montana American Indians
- .2 Explain the impact of science and technology on Montana American Indians

CONTENT STANDARD 6: Understand historical developments in science and technology.

ES 61.0 Give examples of scientific discoveries and describe the interrelationship between technological advances and scientific understanding, including Montana American Indian examples (www.opi.mt.gov/IndianEd for Science Model Lessons).

- .1 Identify and describe examples of technological advances throughout history, including Montana American Indian examples
- .2 Identify and explain scientific discoveries influenced by these technologies
- .3 Explain how technology advances science understanding

ES 62.0 Identify major milestones in science that have impacted science, technology, and society.

- .1 Identify and describe the importance of various physical scientists and their discoveries such as Aristotle (motion), Archimedes (levers and properties of buoyancy), Galileo, Newton & Da Vinci (further researched motion), Einstein (discovered gravity's effect on light), Goddard (designed the first liquid propelled rocket)
- .2 Identify and describe the importance of various life scientists and their discoveries such as Hooke & Van Leeuwenhoek (development of microscope), Pasteur (pasteurization and vaccines), Mendel (heredity), Darwin (evolution), Curie (radiation), Linnaeus (binomial nomenclature), Virchow, Schwann & Schleiden (cell theory), Crick & Watson (DNA)
- .3 Identify and describe the importance of various earth scientists and their discoveries such as Steno (recognized the importance of rock layers), Hutton (Naturalness of change theory), Boltwood (dating and timescale), Horner (fossils and Museum of the Rockies), Hubble (astronomy), Cousteau (oceanography)

ES 63.0 Describe and explain science as a human endeavor and an ongoing process.

- .1 Describe examples of scientific knowledge changing human understanding of the natural world
- .2 Describe and explain the features of science that make it a human endeavor and an ongoing process

Content and Performance Standards for Science

Life Science

Course Content Identification Numbers:

The first symbol represents the grade level, the second symbol is the number of the state standard being addressed, the third number is the state benchmark being addressed and the decimal number is for the course content that addresses that specific standard and benchmark.

Example: LS 23.1 LS=Life Science 2= standard 2 3=benchmark 1= the first course content skill

The Essential Vocabulary is based on OPI's recommended vocabulary though ACE has often expanded the list of terms. **The vocabulary words in bold, are OPI suggested vocabulary and may well be used in MontCAS testing.**

ACE Course Abilities for Life Science to be applied to Content Standards:

Develop abilities in science.

- A. Higher thinking (analyze, evaluate, predict, decide, relate, interpret).
- B. Communications (present, demonstrate, explain, defend).
- C. Goal setting/attainment (brainstorm, envision, research, plan, organize).
- D. The planning process (draft, analyze, and revise when producing products).

Apply science knowledge and skills to a variety of purposes.

- A. Solve problems using the scientific method.
- B. Conduct research (field research, library research, experimentation).
- C. Use scientific equipment appropriately (safely).
- D. Apply knowledge of the relationship between humans, the environment and the earth's resources to improve the environment.
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 - read/write/present: instructions, table, chart, reports (progress, research, lab), proposal, letters (complaint, request, response), manual, checklist, pamphlet, technical research, bid, technical analysis, summary
 - technology: word processing, spreadsheet, database, desktop publishing, Internet, search tools, current technology
 - measurement practice in metric

Life Science Course Content

CONTENT STANDARD 1. Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

LS 11.0 Identify a question, determine relevant variable and a control, formulate a testable hypothesis, plan and predict the outcome of an investigation, safely conduct scientific investigation, and compare and analyze data.

- .1 Compare testable vs. non-testable questions
- .2 Write a testable question for an investigation
- .3 Explain the difference between variables and control
- .4 Determine the variables and control for an investigation
- .5 Distinguish between a testable question and a testable hypothesis
- .6 Write a testable hypothesis for an investigation
- .7 Formulate a plan to test the hypothesis that includes materials, procedures, control, variables, safety precautions, and data collection and analysis methods
- .8 Conduct investigations by following student-designed plan

Essential Vocabulary: hypothesis, control, variable, data, independent variable, dependent variable, prediction, testable question, Prefixes: milli, centi, kilo, deca, deci, nano (***Bold Vocabulary found on OPI's SCIENCE Vocabulary for Life Science***)

LS 12.0 Select and use appropriate tools including technology to make measurements (in metric units), gather, process and analyze data from scientific investigations.

- .1 Identify metric base units
- .2 Construct properly labeled data tables
- .3 Select and use appropriate measurement tool(s) and metric units to gather data
- .4 Identify and use the appropriate graphical representation of the data
- .5 Analyze data using median, mean, mode, range and graphical comparisons

Essential Vocabulary: gram, liter, meter, Celsius, mean, median, mode, range, Kelvin, cm³ (***Bold Vocabulary found on OPI's SCIENCE Vocabulary for Life Science***)

Life Science Course Content (cont.)

LS 13.0 Review, communicate and defend results of investigations, including considering alternative explanations.

- .1 Identify data examples that support or refute the hypothesis
- .2 Judge whether or not the data supports the hypothesis
- .3 Communicate results by sharing and comparing data with others
- .4 Compare the differences between student collected data
- .5 Infer the reasons why student collected data may vary
- .6 Defend conclusions by providing examples from the data
- .7 Share and discuss alternative conclusions

Essential Vocabulary: supported, refute, hypothesis, pie, bar & line graph, scatter plot, data analysis, draw conclusions (***Bold Vocabulary found on OPI's SCIENCE Vocabulary for Life Science***)

LS 14.0 Create models to illustrate scientific concepts and use the model to predict change. (e.g., computer simulation, stream table, graphic representation).

- .1 Identify the similarities and differences between working models and representative models
- .2 Create representative models to demonstrate knowledge of scientific concepts (i.e., biomes, cells, life systems, density, water cycle)
- .3 Create working models to illustrate scientific concepts (i.e., biome, cells, life systems, motion, energy, water cycle)
- .4 Manipulate working models to predict and make conclusions about scientific concepts
- .5 Identify the advantages and limitations of various models

Essential Vocabulary: working models, representative models (***Bold Vocabulary found on OPI's SCIENCE Vocabulary for Life Science***)

LS 15.0 Identify strengths and weakness in an investigation design.

- .1 Identify the essential components of investigation design (i.e. sample size and selection, repetition, controls)
- .2 Explain the purpose of each essential component and why you must plan an investigation
- .3 Identify the strengths and weaknesses in a variety of investigations

Essential Vocabulary: inquiry, investigation, sample size, control, repeated trials (***Bold Vocabulary found on OPI's SCIENCE Vocabulary for Life Science***)

LS 16.0 Compare how observations of nature form an essential base of knowledge among the Montana American Indians.

- .1 Identify examples of various Montana American Indian tribes using observation
- .2 Compare how observations of nature form an essential base of knowledge among the different Montana American Indian tribes (e.g., migration patterns, planting cycles, etc.)

Essential Vocabulary: Montana American Indian tribes: Crow, Blackfeet, Salish, Kootenai, Assiniboine Sioux, Little Shell, Northern Cheyenne, Chippewa Cree, Pend d'Orelle, and Gros Ventre (***Bold Vocabulary found on OPI's SCIENCE Vocabulary for Life Science***)

Life Science Course Content (cont.)

CONTENT STANDARD 2. Students, through the inquiry process, demonstrate the knowledge of properties, forms, changes and interactions of physical and chemical systems.

All benchmarks under Standard 2 are addressed in the Physical Science Course Content (PS)

CONTENT STANDARD 3: Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

LS 31.0 Compare the structure and function of prokaryotic cells (bacteria) and eukaryotic cells (plant, animal, etc.) including the levels of organization of the structure and function, particularly with humans.

- .1 Identify and observe single-celled and multicellular organisms
- .2 Define nucleus, prokaryotic and eukaryotic cells
- .3 Classify cells as prokaryotic and eukaryotic
- .4 Identify and describe the functions of cell organelles in meeting the needs of cells
- .5 Define cell, tissue, organ, system, and organism
- .6 Illustrate the hierarchical relationships of cells, tissues, organs, organ systems, and organisms
- .7 Describe and identify the life cycle and function of viruses
- .8 Define the cell theory

Essential Vocabulary: cell, tissue, organ, system, organism, organelle, eukaryotic, prokaryotic, nucleus, bacteria, virus, cell theory, DNA, ribosome, lysosome, nucleus, vacuole, cytoplasm, mitochondria, chloroplast, protoplasm, cell membrane, cell wall, endoplasmic reticulum, golgi body (***Bold Vocabulary found on OPI's SCIENCE Vocabulary for Life Science***)

LS 32.0 Explain how organisms and systems of organisms obtain and use energy resources to maintain stable conditions (e.g., food webs, photosynthesis, respiration).

- .1 Describe the process by which organisms (plants and animals) use the energy from sugars to carry out life functions
- .2 Explain the process by which organisms obtain energy from the sun
- .3 Diagram the flow of energy through photosynthesis and its decomposition through respiration
- .4 Analyze energy movements in biomes (food webs and pyramids)
- .5 Classify organisms in food webs based upon trophic levels

Essential Vocabulary: photosynthesis, respiration, niche, autotrophic, heterotrophic, tropism, biosphere, trophic level, biomes, food web, food pyramid, producer, primary and secondary consumer, food chain, decomposer (***Bold Vocabulary found on OPI's SCIENCE Vocabulary for Life Science***)

Life Science Course Content (cont.)

LS 33.0 Communicate the differences in the reproductive processes of a variety of plants and animals using the principles of genetic modeling (e.g., Punnett squares).

- .1 Explain the function of a chromosome
- .2 Identify that organisms have different numbers of chromosomes
- .3 Identify the number of chromosomes in human body cells and human sex cells
- .4 Identify the purposes of cell division
- .5 Describe the key events in each phase of mitosis
- .6 Identify the differences in mitosis and meiosis
- .7 Differentiate between sexual reproduction and asexual reproduction
- .8 Define and identify gene, inheritance, phenotype, genotype and allele.
- .9 Define and identify dominant and recessive traits
- .11 Identify examples of inherited characteristics
- .12 Explain why inherited characteristics of living things depend on genes
- .13 Define Punnett square and genetic cross
- .14 Predict genetic crosses using Punnett squares
- .15 Interpret simple genetic crosses using Punnett squares

Essential Vocabulary for LS 33.0:

- .1-3 = chromosome, body cell, sex cell**, sperm, egg, zygote, gamete, haploid, diploid, DNA
 - .4-7 = mitosis, meiosis, asexual, sexual reproduction, phase**, binary fission, regeneration, budding, metaphase, anaphase, telophase, prophase, cytokinesis, interphase,
 - .8-12= phenotype, genotype, dominant, recessive, gene, inheritance, traits**, allele, homozygous, heterozygous
 - .13-15= Punnett square, genetic cross, genotype, phenotype**, probability ratio, variation, monohybrid, dihybrid
- (Bold Vocabulary found on OPI's SCIENCE Vocabulary for Life Science)*

Life Science Course Content (cont.)

LS 34.0 Investigate and explain the interdependent nature of populations and communities in the environment and describe how species in these populations adapt by evolving.

- .1 Distinguish between a population and a community
- .2 Identify living and non-living factors that effect populations and communities
- .3 Identify the different types of symbiosis and their positive and negative effects
- .4 Explain how populations are impacted by changes in living and non-living factors in the environment
- .5 Explain and provide examples of adaptations
- .6 Define natural selection
- .7 Explain the relationship between adaptations and natural selection
- .8 Identify natural selection as a mechanism for evolution
- .9 Identify evidence that supports evolution (i.e., fossils, homologous structure, vestigial structures, DNA)
- .11 Explain how the fossil record provides evidence of life forms' appearance, diversification, and extinction

Essential Vocabulary: population, community, symbiosis, mutualism, commensalism, parasitism, predator, prey, competition, water cycle, ecosystem, biotic, abiotic, carbon cycle, nitrogen cycle, adaptation, natural selection, evolution, fossil, extinction, diversification, Darwin, homologous structure, vestigial structure (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Life Science*)

LS 35.0 Create and use a basic classification scheme to identify plants and animals.

- .1 Explain the relationship between kingdom, phylum, class, order, family, genus, and species
- .2 Identify and describe similarities and differences among organisms of different, but closely related taxa (i.e., pine trees, big cats, rodents ungulates)
- .3 Create and use a classification scheme to identify plants and animals (i.e., dichotomous key, branching diagram)

Essential Vocabulary for LS 35: dichotomous key, kingdom, taxonomy, phylum, genus, species, scientific name, scheme binomial nomenclature, endotherm, ectotherm, Linnaeus, classification, class, order, family (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Life Science*)

CONTENT STANDARD 4: Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

All benchmarks under Standard 4 are addressed in the Earth Science Course Content (ES)

Life Science Course Content (cont.)

CONTENT STANDARD 5: Through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.

LS 51.0 Describe the specific fields of science and technology as they relate to occupations within those fields.

- .1 Research a variety of science and technological fields
- .2 Identify and describe a variety of occupations within fields of science and technology
- .3 Identify and describe uses of technology unique to specific occupations within each field of science

Essential Vocabulary: occupations, science, technology, science fields (life science, earth science, engineering, physical science) (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Life Science*)

LS 52.0 Apply scientific knowledge and process skills to understand issues and everyday events.

- .1 Identify a local current event or problem involving science
- .2 Research and summarize the scientific issues relevant to that local current event or problem
- .3 Present and discuss the research on the scientific issues relevant to that local current event or problem

LS 53.0 Simulate collaborative problem solving and give examples of how scientific knowledge and technology are shared with other scientists and the public.

- .1 Identify and describe methods scientists use to collaborate and share scientific findings with other scientists
- .2 Identify and describe methods scientists use to share scientific findings with the public
- .3 Identify, working in collaboration, a current event or problem involving science
- .4 Research and summarize, working in collaboration, the scientific issues relevant to that current event or problem
- .5 Present and discuss, working in collaboration, the scientific issues relevant to that current event or problem

Essential Vocabulary: current event, problem, issue, research, summarize, collaborate, relevant (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Life Science*)

LS 54.0 Use scientific knowledge to investigate problems and their proposed solutions and evaluate those solutions while considering environmental impacts.

- .1 Identify and research a local issue with an environmental impact
- .2 Explain possible environmental impacts
- .3 Propose solutions

Essential Vocabulary for LS 54: environmental impact, proposed solutions (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Life Science*)

Life Science Course Content (cont.)

LS 55.0 Describe how the knowledge of science and technology influences the development of the Montana American Indian Cultures (go to www.opi.mt.gov/IndianEd for Science Model Lessons).

- .1 Investigate how science and technology have impact on Montana American Indians
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CONTENT STANDARD 6: Understand historical developments in science and technology.

LS 61.0 Give examples of scientific discoveries and describe the interrelationship between technological advances and scientific understanding, including Montana American Indian examples (go to www.opi.mt.gov/IndianEd for Science Model Lessons).

- .1 Identify and describe examples of technological advances throughout history, including Montana American Indian examples
- .2 Identify and explain scientific discoveries influenced by these technologies
- .3 Explain how technology advances science understanding

LS 62.0 Identify major milestones in science that have impacted science, technology, and society.

- .1 Identify and describe the importance of various physical scientists and their discoveries such as Aristotle (motion), Archimedes (levers and properties of buoyancy), Galileo, Newton & Da Vinci (further researched motion), Einstein (discovered gravity's effect on light), Goddard (designed the first liquid propelled rocket)
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- .3 Identify and describe the importance of various earth scientists and their discoveries such as Steno (recognized the importance of rock layers), Hutton (Naturalness of change theory), Boltwood (dating and timescale), Horner (fossils and Museum of the Rockies), Hubble (astronomy), Cousteau (oceanography)

LS 63.0 Describe and explain science as a human endeavor and an ongoing process.

- .1 Describe examples of scientific knowledge changing human understanding of the natural world
- .2 Describe and explain the features of science that make it a human endeavor and an ongoing process

Content and Performance Standards for Science

Physical Science

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- A. Higher thinking (analyze, evaluate, predict, decide, relate, interpret).
- B. Communications (present, demonstrate, explain, defend).
- C. Goal setting/attainment (brainstorm, envision, research, plan, organize).
- D. The planning process (draft, analyze, and revise when producing products).

Apply science knowledge and skills to a variety of purposes.

- A. Solve problems using the scientific method.
- B. Conduct research (field research, library research, experimentation).
- C. Use scientific equipment appropriately (safely).
- D. Apply knowledge of the relationship between humans, the environment and the earth's resources to improve the environment.
- E. Possess technical skills:
 - read/write/present: instructions, table, chart, reports (progress, research, lab), proposal, letters (complaint, request, response), manual, checklist, pamphlet, technical research, bid, technical analysis, summary
 - technology: i.e. –
 - word processing, spreadsheet, database, desktop publishing, Internet, search tools, current technology
 - measurement practice in metric

Physical Science Course Content

CONTENT STANDARD 1. Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

PS 11.0 Identify a question, determine relevant variable and a control, formulate a testable hypothesis, plan and predict the outcome of an investigation, safely conduct scientific investigation, and compare and analyze data.

- .1 Compare testable vs. non-testable questions
- .2 Write a testable question for an investigation
- .3 Explain the difference between variables and control
- .4 Determine the variables and control for an investigation
- .5 Distinguish between a testable question and a testable hypothesis
- .6 Write a testable hypothesis for an investigation
- .7 Formulate a plan to test the hypothesis that includes materials, procedures, control, variables, safety precautions, data collection and analysis methods
- .8 Conduct investigation by following student-designed plan

Essential Vocabulary: hypothesis, control, variable, data, independent variable, dependent variable, prediction, testable question, Prefixes: milli, centi, kilo, deca, deci, nano (***Bold Vocabulary found on OPI's SCIENCE Vocabulary for Physical Science***)

PS 12.0 Select and use appropriate tools including technology to make measurements (in metric units), gather, process and analyze data from scientific investigations.

- .1 Identify metric base units
- .2 Construct properly labeled data tables
- .3 Select and use appropriate measurement tool(s) and metric units to gather data
- .4 Identify and use the appropriate graphical representation of the data
- .5 Analyze data using median, mean, mode, range and graphical comparisons

Essential Vocabulary: gram, liter, meter, Celsius, mean, median, mode, range, Kelvin, cm³ (***Bold Vocabulary found on OPI's SCIENCE Vocabulary for Physical Science***)

Physical Science Course Content (cont.)

PS 13.0 Review, communicate and defend results of investigations, including considering alternative explanations.

- .1 Identify data examples that support or refute the hypothesis
- .2 Judge whether or not the data supports the hypothesis
- .3 Communicate results by sharing and comparing data with others
- .4 Compare the differences between student collected data
- .5 Infer the reasons why student collected data may vary
- .6 Defend conclusions by providing examples from the data
- .7 Share and discuss alternative conclusions

Essential Vocabulary: supported, refute, hypothesis, pie, bar & line graph, scatter plot, data analysis, draw conclusions (***Bold Vocabulary found on OPI's SCIENCE Vocabulary for Physical Science***)

PS 14.0 Create models to illustrate scientific concepts and use the model to predict change. (e.g., computer simulation, stream table, graphic representation).

- .1 Identify the similarities and differences between working models and representative models
- .2 Create representative models to demonstrate knowledge of scientific concepts (i.e., biomes, cells, life systems, density, water cycle)
- .3 Create working models to illustrate scientific concepts (ie., biome, cells, life systems motion, energy, water cycle)
- .4 Manipulate working models to predict and make conclusions about scientific concepts
- .5 Identify the advantages and limitations of various models

Essential Vocabulary: working models, representative models (***Bold Vocabulary found on OPI's SCIENCE Vocabulary for Physical Science***)

PS 15.0 Identify strengths and weakness in an investigation design.

- .1 Identify the essential components of investigation design (i.e. sample size and selection, repetition, controls)
- .2 Explain the purpose of each essential component and why you must plan an investigation
- .3 Identify the strengths and weaknesses in a variety of investigations

Essential Vocabulary: inquiry, investigation, sample size, control, repeated trials (***Bold Vocabulary found on OPI's SCIENCE Vocabulary for Physical Science***)

PS 16.0 Compare how observations of nature form an essential base of knowledge among the Montana American Indians.

- .1 Identify examples of various Montana American Indian tribes using observation
- .2 Compare how observations of nature form an essential base of knowledge among the different Montana American Indian tribes (e.g., migration patterns, planting cycles, etc.)

Essential Vocabulary: Montana American Indian tribes: Crow, Blackfeet, Salish, Kootenai, Assiniboine Sioux, Little Shell, Northern Cheyenne, Chippewa Cree, Pend d'Orelle, and Gros Ventre

Physical Science Course Content (cont.)

CONTENT STANDARD 2. Students, through the inquiry process, demonstrate the knowledge of properties, forms, changes and interactions of physical and chemical systems.

PS 21.0 Classify, describe, and manipulate the physical models of matter in terms of: elements, and compounds, pure substances and mixtures, atoms, and molecules.

- .1 Classify matter as atoms, molecules, elements, compounds, pure substances, or mixtures.
- .2 Identify common element and compounds by their symbol and chemical formula
- .3 Create and manipulate simple models of common elements and compounds.
- .4 Identify the relationship between atoms, molecules, elements, compounds, pure substances and mixtures.

Essential Vocabulary: atom, element, compound, pure substance, mixture, molecule, diatomic

PS 22.0 Examine, describe, compare and classify objects and substances based on common physical properties and simple chemical properties.

- .1 Distinguish between chemical and physical properties of matter
- .2 Compare objects and substances based on their physical properties and simple chemical properties
- .3 Classify objects and substances based on common physical properties and simple chemical properties
- .4 Manipulate simple formulas (density, $F=ma$, . . .)

Essential Vocabulary: chemical property, physical property, chemical change, physical change, and density

Physical Science Course Content (cont.)

PS 23.0 Describe energy and compare and contrast the energy transformations and the characteristics of light, heat, motion, magnetism, electricity, sound and mechanical waves.

- .1 Describe energy
- .2 Identify examples of various forms of energy
- .3 Compare and contrast various forms of energy
- .4 Explain the Law of Conservation of energy using various forms of energy transformation.
- .5 Describe various types of light (visible and invisible)
- .6 Describe the behavior of light (e.g. refraction, reflection, diffraction)
- .7 Identify characteristics of the electromagnetic spectrum
- .8 Explain the behavior of light (particle vs. wave, reflection, diffraction, speed)
- .9 Compare and contrast the three types of heat transfer

Essential Vocabulary: *(Bold Vocabulary found on OPI's SCIENCE Vocabulary for Physical Science)*

- .1-.4 = **energy, potential energy, kinetic energy, thermal energy, mechanical energy, radiant energy, chemical energy, nuclear energy, electric energy, Law of Conservation of Energy**
- .5-.8 = **visible spectrum, ultraviolet, infrared, reflection, refraction, electromagnetic spectrum**
- .9 = **radiant heat, conduction, convection**
- .12-.13 = **electromagnet, magnet, electricity, current, voltage**
- .16-.19 = **crest, trough, resting position, wavelength, amplitude, intensity, frequency, pitch, resonance, interference**

PS 24.0 Model and explain that states of matter are dependent upon the quantity of energy present in the system and describe what will change and what will remain unchanged at the particulate level when matter experiences an external force or energy change.

- .1 Explain the four states of matter and how they relate to temperature change
- .2 Explain the relationship between changes in thermal energy and states of matter (e.g., increase/decrease of thermal energy = change in state)
- .3 Recognize that temperature measures the average kinetic energy of particles in a substance.
- .4 Describe what will change and what will remain unchanged at the particulate level when matter experiences an external force or energy change

Essential Vocabulary: **thermal energy, melting point, boiling point, solid, liquid, gas, sublimation, evaporation, condensation, plasma, heat** *(Bold Vocabulary found on OPI's SCIENCE Vocabulary for Physical Science)*

Physical Science Course Content (cont.)

PS 25.0 Describe and explain the motion of an object in terms of its position, direction, & speed as well as the forces acting upon it.

- .1 Describe the basic characteristics of motion (position, direction, speed, reference point)
- .2 Identify variables that affect the motion of an object
- .3 Define force
- .4 Explain different types of forces
- .5 Describe Newton's laws of motion
- .6 Explain, the relationship between speed, velocity, acceleration, force, mass, and momentum

Essential Vocabulary: gravity, balanced force, unbalanced force, friction, net force, air resistance, speed, velocity, acceleration, mass, inertia, momentum, air pressure, lift, drag, Newton's laws of motion (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Physical Science*)

PS 26.0 Identify, build, describe, measure, and analyze mechanical systems (e.g., simple and complex compound machines) and describe the forces acting within those systems.

- .1 Compare and contrast simple and compound machines
- .2 Recognize that a machine makes work easier by changing the amount or direction of the force
- .3 Identify that simple and compound machines transfer energy by doing work
- .4 Measure and calculate efficiency, ideal and actual mechanical advantage for simple machines using the appropriate formulas (e.g., work $w=f \times d$)
- .5 Create simple and complex compound machines to examine and measure the related forces

Essential Vocabulary: simple machine, compound machine, work, force, lever, pulley, inclined plane, wedge, screw, wheel and axle, fulcrum, pivot, mechanical advantage, ideal mechanical advantage, efficiency (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Physical Science*)

PS 27.0 Give examples and describe how energy is transferred and conserved (e.g. electric to light and heat [light bulb], chemical to mechanical [fuel to propulsion]).

- .1 Discuss that energy can be transferred (one object to another) or transformed (one form to another)
- .2 Discuss multi-step energy transformations/transfers
- .3 The relationship between energy transfer/transformation and conservation of energy.

Essential Vocabulary: energy, transformation, energy conservation (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Physical Science*)

CONTENT STANDARD 3: Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

All benchmarks under Standard 3 are addressed in the Life Science Course Content (LS)

Physical Science Course Content (cont.)

CONTENT STANDARD 4: Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

All benchmarks under Standard 3 are addressed in the Earth Science Course Content (ES)

CONTENT STANDARD 5: Through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.

PS 51.0 Describe the specific fields of science and technology as they relate to occupations within those fields.

- .1 Research a variety of science and technological fields
- .2 Identify and describe a variety of occupations within fields of science and technology
- .3 Identify and describe uses of technology unique to specific occupations within each field of science

Essential Vocabulary: occupations, science, technology, science fields (life science, earth science, engineering, physical science) (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Physical Science*)

PS 52.0 Apply scientific knowledge and process skills to understand issues and everyday events.

- .1 Identify a local current event or problem involving science
- .2 Research and summarize the scientific issues relevant to that local current event or problem
- .3 Present and discuss the research on the scientific issues relevant to that local current event or problem

PS 53.0 Simulate collaborative problem solving and give examples of how scientific knowledge and technology are shared with other scientists and the public.

- .1 Identify and describe methods scientists use to collaborate and share scientific findings with other scientists
- .2 Identify and describe methods scientists use to share scientific findings with the public
- .3 Identify, working in collaboration, a current event or problem involving science
- .4 Research and summarize, working in collaboration, the scientific issues relevant to that current event or problem
- .5 Present and discuss, working in collaboration, the scientific issues relevant to that current event or problem

Essential Vocabulary: current event, problem, issue, research, summarize, collaborate, relevant (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Physical Science*)

Physical Science Course Content (cont.)

PS 54.0 Use scientific knowledge to investigate problems and their proposed solutions and evaluate those solutions while considering environmental impacts.

- .1 Identify and research a local issue with an environmental impact
- .2 Explain possible environmental impacts
- .3 Propose solutions

Essential Vocabulary: environmental impact, proposed solutions (*Bold Vocabulary found on OPI's SCIENCE Vocabulary for Physical Science*)

PS 55.0 Describe how the knowledge of science and technology influences the development of the Montana American Indian Cultures (go to www.opi.mt.gov/IndianEd for Science Model Lessons).

- .1 Investigate how science and technology have impact on Montana American Indians
- .2 Explain the impact of science and technology on Montana American Indians

CONTENT STANDARD 6: Understand historical developments in science and technology.

PS 61.0 Give examples of scientific discoveries and describe the interrelationship between technological advances and scientific understanding, including Montana American Indian examples (go to www.opi.mt.gov/IndianEd for Science Model Lessons).

- .1 Identify and describe examples of technological advances throughout history, including Montana American Indian examples
- .2 Identify and explain scientific discoveries influenced by these technologies
- .3 Explain how technology advances science understanding

PS 62.0 Identify major milestones in science that have impacted science, technology, and society.

- .1 Identify and describe the importance of various physical scientists and their discoveries such as Aristotle (motion), Archimedes (levers and properties of buoyancy), Galileo, Newton & Da Vinci (further researched motion), Einstein (discovered gravity's effect on light), Goddard (designed the first liquid propelled rocket)
- .2 Identify and describe the importance of various life scientists and their discoveries such as Hooke & Van Leeuwenhoek (development of microscope), Pasteur (pasteurization and vaccines), Mendel (heredity), Darwin (evolution), Curie (radiation), Linnaeus (binomial nomenclature), Virchow, Schwann & Schleiden (cell theory), Crick & Watson (DNA)
- .3 Identify and describe the importance of various earth scientists and their discoveries such as Steno (recognized the importance of rock layers), Hutton (Naturalness of change theory), Boltwood (dating and timescale), Horner (fossils and Museum of the Rockies), Hubble (astronomy), Cousteau (oceanography)

Physical Science Course Content (cont.)

PS 63.0 Describe and explain science as a human endeavor and an ongoing process.

- .1 Describe examples of scientific knowledge changing human understanding of the natural world
- .2 Describe and explain the features of science that make it a human endeavor and an ongoing process