

# Sixth Grade Science – Physical Science

## State Standards

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

Content Standard 2—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.

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.

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.

Content Standard 5—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.

Content Standard 6—Students understand historical developments in science and technology.

**Course Abilities for Physical Science** to be applied to Content Standards as appropriate to grade level:

### Develop abilities in science.

1. Higher thinking (analyze, evaluate, predict, decide, relate, interpret).
2. Communications (present, demonstrate, explain, defend).
3. Goal setting/attainment (brainstorm, envision, research, plan, organize).
4. The planning process (draft, analyze, and revise when producing products).

### Apply science knowledge and skills to a variety of purposes.

1. Solve problems using the scientific method.
2. Conduct research (field research, library research, experimentation).
3. Use scientific equipment appropriately (safely).
4. Apply knowledge of the relationship between humans, the environment and the earth's resources to improve the environment.
5. 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 standard and metric

## Course Content for Physical Science by Standards/Benchmarks & ELEs (Essential Learner Expectations)

**\*\* NOTE:** *Under each "Essential Vocabulary" those words in bold are words found on OPI's Science Vocabulary list for Physical Science*

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

**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

**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, cm<sup>3</sup>

**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, scatterplot, data analysis, draw conclusions

**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

**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**

**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**

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

**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**

**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, density**

**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: energy, potential energy, kinetic energy, thermal energy, mechanical energy, radiant energy, chemical energy, nuclear energy, electric energy, Law of Conservation of Energy visible spectrum, ultraviolet, infrared, reflection, refraction, electromagnetic spectrum radiant heat, conduction, convection, electromagnet, magnet,**

**electricity, current, voltage crest, trough, resting position, wavelength, amplitude, intensity, frequency, pitch, resonance, interference**

**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**

**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**

**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**

**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/transfers and conservation of energy

**Essential Vocabulary: energy, transformation, energy, conservation**

**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.**

**Standard 4:** Addressed in the Earth Science Course Content

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

**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)**

**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

**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**

**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**

**Describe how the knowledge of science and technology influences the development of the Montana American Indian Cultures.**

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: Students understand historical developments in science and technology.**

**Give examples of scientific discoveries and describe the interrelationship between technological advances and scientific understanding, including Montana American Indian examples.**

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

**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 & DaVinci (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)

**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