Physical Science
Science

Course Description

The Physical Science Cherokee Teaching & Learning Standards provide students the necessary skills to have a richer knowledge base in physical science. The standards in this course are designed as a survey of the core ideas in the physical sciences. Those core ideas will be studied in more depth during the chemistry and physics courses. The physical science standards include abstract concepts such as the conceptualization of the structure of atoms and the role they play in determining the properties of materials, motion and forces, the conservation of energy and matter, wave behavior, electricity, and the relationship between electricity and magnetism. The idea of radioactive decay is limited to the understanding of whole half-lives and how a constant proportional rate of decay is consistent with declining measures that only gradually approach to zero. Students investigate physical science concepts through the study of phenomena, experiences in laboratory settings, and field work.

Science standards integrate the three dimensions of **Science and Engineering Practices (SEPs)**, **Crosscutting Concepts (CCCs)**, and **Disciplinary Core Ideas (DCIs)** to provide a comprehensive framework that emphasizes active engagement, interdisciplinary connections, and core scientific principles. Together, they show how science standards engage *students* in obtaining, evaluating, and communicating information.

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Science and Engineering Practices are fundamental approaches that scientists and engineers use to investigate the natural world and solve practical problems. **Crosscutting Concepts** in science are overarching themes that bridge various disciplines, helping students and researchers see connections and deepen their understanding of the natural world. **Disciplinary Core Ideas** are fundamental concepts that students need to understand to develop a deep knowledge of science across various disciplines.

Thinking Like a Scientist

Thinking Like a Scientist standards represent scientific thinking skills that should be incorporated throughout the entire course.

Overarching Standard

TLS9-12: Refine scientific inquiry skills by designing and conducting investigations, applying scientific theories, critically evaluating scientific literature, and contributing to scientific discussions.

Supporting Standards for Student Mastery

TLS9-12.a: Use specialized scientific terms and concepts to analyze and explain scientific phenomena.

TLS9-12.b: Design and conduct independent experiments with multiple variables.

TLS9-12.c: Utilize advanced tools and statistical methods for data analysis.

TLS9-12.d: Communicate complex findings through reports and presentations.

Semester 1 (August – December)

Unit 1 – Atomic Structure and the Periodic Table (4 weeks)

In this unit, students will study the Periodic Table to understand the relative properties of elements, focusing on patterns of atomic structure. Students will analyze data to identify trends, develop models to compare atomic structures, and use the Periodic Table to predict element properties.

Overarching Standard for Unit 1

PS1: Obtain, evaluate, and communicate information from the Periodic Table to explain the relative properties of elements based on patterns of atomic structure.

PS1.b: Analyze and interpret data to determine trends of the following:

- Number of valence electrons
- Types of ions formed by main group elements (cation and anion)
- Location and properties of metals, nonmetals, and metalloids
- Phases at room temperature

Supporting Standards for Student Mastery in Unit 1

PS1.a: Develop and use models to compare and contrast the structure of atoms, ions and isotopes.

(*Clarification statement*: Properties include atomic number, atomic mass and the location and charge of subatomic particles.)

PS1.c: Use the Periodic Table as a model to predict the above properties of main group elements.

- Explain why elements are grouped into families.

Unit 2A – Bonding (2.5 weeks)

In this unit, students will explore how atoms bond to form stable compounds and how matter is conserved during chemical reactions. Students will learn to use the IUPAC nomenclature for chemical names and formulas, develop models of chemical equations, and investigate the properties of ionic and covalent compounds.

Overarching Standards for Unit 2A

PS2: Obtain, evaluate, and communicate information to explain how atoms bond to form stable compounds.

PS2.c: Use the International Union of Pure and Applied Chemistry (IUPAC) nomenclature for translating between chemical names and chemical formulas.

(*Clarification statement*: Limited to binary covalent and binary ionic, containing main group elements, compounds but excludes polyatomic ions.)

PS3: Obtain, evaluate, and communicate information to support the Law of Conservation of Matter.

PS3.b: Develop and use a model of a chemical equation to illustrate how the total number of atoms is conserved during a chemical reaction.

(*Clarification statement*: Limited to chemical equations that include binary ionic and covalent compounds and will not include equations containing polyatomic ions.)

Supporting Standards for Student Mastery in Unit 2A

PS2.a: Analyze and interpret data to predict properties of ionic and covalent compounds.

(*Clarification statement*: Properties are limited to types of bonds formed, elemental composition, melting point, boiling point, and conductivity.)

PS2.b: Develop and use models to predict formulas for stable, binary ionic compounds based on balance of charges.

PS3.a: Plan and carry out investigations to generate evidence supporting the claim that mass is conserved during a chemical reaction.

(*Clarification statement*: Limited to synthesis, decomposition, single replacement, and double replacement reactions.)

Unit 2B – Reactions (2.5 weeks)

In this unit, students will investigate chemical reactions by developing models of chemical equations, using IUPAC nomenclature for chemical names and formulas, and explaining conservation of matter. Students will investigate properties and behaviors of ionic and covalent compounds during chemical reactions.

Overarching Standards for Unit 2B

PS2: Obtain, evaluate, and communicate information to explain how atoms bond to form stable compounds.

PS2.c: Use the International Union of Pure and Applied Chemistry (IUPAC) nomenclature for translating between chemical names and chemical formulas.
(*Clarification statement*: Limited to binary covalent and binary ionic, containing main group elements, compounds but excludes polyatomic ions.)

PS3: Obtain, evaluate, and communicate information to support the Law of Conservation of Matter.

PS3.b: Develop and use a model of a chemical equation to illustrate how the total number of atoms is conserved during a chemical reaction.
(*Clarification statement*: Limited to chemical equations that include binary ionic and covalent compounds and will not include equations containing polyatomic ions.)

Supporting Standards for Student Mastery in Unit 2B

PS2.a: Analyze and interpret data to predict properties of ionic and covalent compounds.
(*Clarification statement*: Properties are limited to types of bonds formed, elemental composition, melting point, boiling point, and conductivity.)

PS2.b: Develop and use models to predict formulas for stable, binary ionic compounds based on balance of charges.

PS3.a: Plan and carry out investigations to generate evidence supporting the claim that mass is conserved during a chemical reaction.
(*Clarification statement*: Limited to synthesis, decomposition, single replacement, and double replacement reactions.)

Unit 3A – Properties of Matter: Acids/Bases, and Solutions (2.5 weeks)

In this unit, students will develop models to explain solution properties, conduct experiments to determine how various factors affect solubility, and analyze data from solubility curves. Students will study the structure and properties of acids and bases and carry out investigations to classify common substances as acidic, basic, or neutral.

Overarching Standards for Unit 3A

PS6: Obtain, evaluate, and communicate information to explain the properties of solutions.

PS6.a: Develop and use models to explain the properties (solute/solvent, conductivity, and concentration) of solutions.

Supporting Standards for Student Mastery in Unit 3A

PS6.b: Plan and carry out investigations to determine how temperature, surface area, and agitation affect the rate solutes dissolve in a specific solvent.

PS6.c: Analyze and interpret data from a solubility curve to determine the effect of temperature on solubility.

PS6.d: Obtain and communicate information to explain the relationship between the structure and properties (e.g., pH, and color change in the presence of an indicator) of acids and bases.
(*Clarification statement*: Limited to only the structure of simple acids and bases (e.g., HCl and NaOH) that demonstrates the presence of an H+ or OH-.

PS6.e: Plan and carry out investigations to detect patterns in order to classify common household substances as acidic, basic, or neutral.

Unit 3B – Properties of Matter: States and Gas Laws (2.5 weeks)

In this unit, students will explore the phases of matter, focusing on atomic and molecular motion. Students will investigate the relationships among temperature, pressure, volume, and density of gases in closed systems.

Overarching Standards for Unit 3B

PS5: Obtain, evaluate, and communicate information to compare and contrast the phases of matter as they relate to atomic and molecular motion.

PS5.b: Plan and carry out investigations to identify the relationships among temperature, pressure, volume, and density of gases in closed systems.
(*Clarification statement*: Using specific Gas laws to perform calculations is beyond the scope of this standard; emphasis should focus on the conceptual understanding of the behavior of gases rather than calculations.)

Supporting Standards for Student Mastery in Unit 3B

PS5.a: Ask questions to compare and contrast models (including phase diagrams) depicting the particle arrangement and motion in solids, liquids, gases, and plasmas.

Unit 4 – Nuclear Energy (4 weeks)

In this unit, students will learn about the changes in nuclear structure due to fission, fusion, and radioactive decay. Students will develop models to illustrate how the nucleus changes during fission and fusion processes. They will use mathematical and computational thinking to understand and calculate half-life in the context of radioactive decay. This information will be used to construct evidence-based arguments to evaluate the applications, benefits, and potential problems of using nuclear energy as an alternative energy source.

Overarching Standard for Unit 4

PS4: Obtain, evaluate, and communicate information to explain the changes in nuclear structure as a result of fission, fusion, and radioactive decay.

PS4.a: Develop a model that illustrates how the nucleus changes as a result of fission and fusion.

- Identify and correctly use isotope notation.

Supporting Standards for Student Mastery in Unit 4

PS4.b: Use mathematics and computational thinking to explain the process of half-life as it relates to radioactive decay. (*Clarification statement*: Limited to calculations that include whole half-lives. Students should interpret data showing decay of radioactive elements to determine half-life.)

PS4.c: Construct arguments based on evidence about the applications, benefits, and problems of nuclear energy as an alternative energy source.

Semester 2 (January - May)

Unit 5 – Kinematics (2-3 weeks)

In this unit, students will explore the relationships among force, mass, and motion and analyze data to understand the relationship between mass and gravitational force on falling objects. Students will plan and carry out investigations to analyze the motion of objects using mathematical and graphical models, including concepts such as distance, displacement, speed, velocity, time, and acceleration.

Overarching Standard for Unit 5

PS8: Obtain, evaluate, and communicate information to explain the relationships among force, mass, and motion.

PS8.a: Plan and carry out an investigation to analyze the motion of an object using mathematical and graphical models.
(*Clarification statement*: Mathematical and graphical models could include distance, displacement, speed, velocity, time and acceleration.)

- Analyze position vs. time graphs to describe the motion.
- Analyze velocity vs. time graphs to describe the motion.
- Calculate velocity by determining the slope of a line on a position vs. time graph.
- Determine average acceleration from the slope of a velocity vs. time graph.

Supporting Standards for Student Mastery in Unit 5

PS8.c: Analyze and interpret data to identify the relationship between mass and gravitational force for falling objects.

Unit 6 – Force and Motion (4-5 weeks)

Students will establish relationships among force, mass, and motion by constructing explanations based on experimental evidence to support Newton's three laws of motion. They will explore how these laws demonstrate the interactions among force, mass, velocity, and acceleration and will analyze and interpret data to identify the relationship between mass and gravitational force on falling objects.

Overarching Standard for Unit 6

PS8: Obtain, evaluate, and communicate information to explain the relationships among force, mass, and motion.

PS8.b: Construct an explanation based on experimental evidence to support the claims presented in Newton's three laws of motion. (*Clarification statement*: Evidence could demonstrate relationships among force, mass, velocity, and acceleration.)

- Determine when an object is in equilibrium using free body diagrams. Determine movement of an object based on net force and direction of forces.

Supporting Standards for Student Mastery in Unit 6

PS8.c: Analyze and interpret data to identify the relationship between mass and gravitational force for falling objects.

Unit 7 – Energy (3-4 weeks)

In this unit, students will investigate the flow of energy within different systems, constructing explanations for energy transformations. Students will plan and carry out experiments to understand how molecular motion is related to thermal energy changes through conduction, convection, and radiation. They will also analyze and interpret specific heat data to determine the best materials for practical applications like insulation and cooking. Students will examine heating and cooling curves to explain the flow of energy during phase changes and use mathematical and computational thinking to understand the relationships between work, mechanical advantage, and simple machines.

Overarching Standard for Unit 7

PS7: Obtain, evaluate, and communicate information to explain transformations and flow of energy within a system.

PS7.a: Construct explanations for energy transformations within a system.
(*Clarification statement*: Types of energy to be addressed include chemical, mechanical, electromagnetic, light, sound, thermal, electrical, and nuclear.)

Supporting Standards for Student Mastery in Unit 7

PS7.b: Plan and carry out investigations to describe how molecular motion relates to thermal energy changes in terms of conduction, convection, and radiation.

PS7.c: Analyze and interpret specific heat data to justify the selection of a material for a practical application (e.g., insulators and cooking vessels).

PS7.d: Analyze and interpret data to explain the flow of energy during phase changes using heating/cooling curves.

PS8.d: Use mathematics and computational thinking to identify the relationships between work, mechanical advantage, and simple machines.

Unit 8 – Waves (3-4 weeks)

In this unit, students will explore the properties of waves, analyzing and interpreting data to understand the relationships among wavelength, frequency, and energy in electromagnetic waves, as well as amplitude and energy in mechanical waves. They will develop models based on experimental evidence and illustrate the phenomena of reflection, refraction, interference, and diffraction. Students will also analyze how different media affect the speed of sound and light waves, and use models to explain the changes in sound waves associated with the Doppler Effect.

Overarching Standard for Unit 8

PS9: Obtain, evaluate, and communicate information to explain the properties of waves.

PS9.a: Analyze and interpret data to identify the relationships among wavelength, frequency, and energy in electromagnetic waves and amplitude and energy in mechanical waves.

Supporting Standards for Student Mastery in Unit 8

PS9.b: Ask questions to compare and contrast the characteristics of electromagnetic and mechanical waves.

PS9.c: Develop models based on experimental evidence that illustrate the phenomena of reflection, refraction, interference, and diffraction.

PS9.d: Analyze and interpret data to explain how different media affect the speed of sound and light waves.

PS9.e: Develop and use models to explain the changes in sound waves associated with the Doppler Effect.

Unit 9 – Electricity and Magnetism (2-3 weeks)

In this unit, students will investigate properties and relationships between electricity and magnetism to understand movement of electrical charges, using examples such as electromagnets, simple motors, and generators. By applying mathematical and computational thinking, students will analyze the relationships among voltage, current, and resistance. They will develop and use models to illustrate and explain the flow of current and electrons in simple series and parallel circuits.

Overarching Standard for Unit 9

PS10: Obtain, evaluate, and communicate information to explain the properties of and relationships between electricity and magnetism.

PS10.c: Plan and carry out investigations to determine the relationship between magnetism and the movement of electrical charge. (*Clarification statement*: Investigations could include electromagnets, simple motors, and generators.)

Supporting Standards for Student Mastery in Unit 9

PS10.a: Use mathematical and computational thinking to support a claim regarding relationships among voltage, current, and resistance.

- Calculate Ohm's Law

PS10.b: Develop and use models to illustrate and explain the conventional flow (direct and alternating) of current and the flow of electrons in simple series and parallel circuits.

(*Clarification statement*: Advantages and disadvantages of series and parallel circuits should be addressed.)