



Grades 6-8

Physical Science Curriculum Framework

Introduction

Science, Technology & Engineering, and Environmental Literacy & Sustainability (STEELS) Standards guide the study of the natural and human-made world through inquiry, problem-solving, critical thinking, and authentic exploration. This document displays a curriculum framework for **Grades 6-8 Physical Science**. It is designed to focus curriculum and teaching, provide guidance for multiple approaches to curriculum development, encourage less reliance on textbooks as curriculum, and avoid activity-oriented teaching without focus/purpose.

Science Long Term Transfer Goals

In support of the Curriculum Framework, Long Term Transfer Goals (LTTG) provide the overarching practices that ground the foundation for a robust curriculum; thus, all curricula should relate to one or more of the LTTGs detailed below – as they highlight the effective uses of understanding, knowledge, and skill that we seek in the long run; i.e., what we want students to be able to do when they confront new challenges – both in and outside of school.

Students will be able to engage as scientifically literate members of a global society, using their learning to:

1. Approach science as a reliable and tentative way of knowing and explaining the natural world and designed world.
2. Weigh evidence and use scientific approaches to ask questions, investigate, and make informed decisions.
3. Make and use observations to analyze relationships and patterns in order to explain phenomena, develop models, and make predictions.
4. Evaluate systems, in order to connect how form determines function and how any change to one component affects the entire system.
5. Explain how the natural and designed worlds are interrelated and the application of scientific knowledge and technology can have beneficial, detrimental, or unintended consequences.

Structure and Properties of Matter						
Key Understanding	Driving Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts	Vocabulary
All forms of matter are made up of atoms, which combine with each other in various ways.	How do atoms combine to form different types of matter?	3.2.6-8.A Develop models to describe the atomic composition of simple molecules and extended structures.	Developing and Using Models Develop a model to predict and/or describe phenomena.	Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).	Scale, Proportion, and Quantity Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small	atom compound molecule
The temperature and phase changes when thermal energy is added or removed.	How does thermal energy affect the motion of particles and the changes they undergo?	3.2.6-8.B Develop a model that predicts and describes changes in the particle motion, temperature and state of a pure substance when thermal energy is added or removed.	Developing and Using Models Develop a model to predict and/or describe phenomena.	Gasses and liquids are made of molecules or inert atoms that are moving about relative to each other. In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. The term “heat” as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of	Cause and effect Relationships may be used to predict phenomena in natural or designed systems.	gas heat kinetic energy liquid phase change solid temperature thermal energy

				<p>that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects.</p> <p>The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system’s material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material.</p> <p>Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material.</p>		
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Chemical Reactions						
Key Understanding	Driving Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts	Vocabulary
Synthetic materials come from natural resources and have impacts on society.	How are natural resources used to make synthetic materials and how do they impact society?	3.2.6-8.C Gather and make sense of information to describe how synthetic materials come from natural resources and impact society.	Obtaining, Evaluating, and Communicating Information Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or now supported by evidence.	Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.	Structure and Function Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.	natural resource synthetic material
Changes in the properties of substances before and after an interaction can be used to determine if a chemical reaction occurred.	How can changes in the properties of substances before and after an interaction determine if a chemical reaction occurred?	3.2.6-8.D Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred	Analyzing and Interpreting Data Analyze and interpret data to determine similarities and differences in findings.	Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.	Patterns Macroscopic patterns are related to the nature of microscopic and atomic level structure.	boiling point chemical properties chemical reaction density flammability melting point odor physical properties product reactant solubility

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Mass is conserved in a chemical reaction because the total number (and types) of atoms does not change.	How and why does the total mass of substances remain the same before and after a chemical reaction?	3.2.6-8.E Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.	Developing and Using Models Develop a model to describe unobservable.	Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. The total number of each type of atom is conserved, and thus the mass does not change.	Energy and Matter Matter is conserved because atoms are conserved in physical and chemical processes.	chemical reaction conservation of matter
Devices which can control the transfer of thermal energy can be constructed, tested and modified based on specified criteria and constraints.	How can a device absorb or release thermal energy to meet a need or solve a problem?	3.2.6-8.F Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.	Constructing Explanations and Designing Solutions Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.	Some chemical reactions release energy, others store energy.	Energy and Matter The transfer of energy can be tracked as energy flows through a designed or natural system.	thermal energy

Forces and Motion						
Key Understanding	Driving Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts	Vocabulary
The force experienced by one object when it collides with another is equal in strength but opposite in direction.	How can Newton's Third Law be used to solve a problem created when two objects collide?	3.2.6-8.G Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.	Constructing Explanations and Designing Solutions Apply scientific ideas or principles to design an object, tool, process or system.	For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law).	Systems and System Models Models can be used to represent systems and their interactions - such as inputs, processes and output - and energy and matter flows within systems.	collision force Newton's Third Law of Motion
An object's motion is determined by its mass and the sum of the forces acting on it.	How is the motion of an object related to the object's mass and the forces acting on it?	3.2.6-8.H Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.	Planning and Carrying Out Investigations Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.	The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.	Stability and Change Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales.	balanced force mass Newton's First Law of Motion Newton's Second Law of Motion unbalanced force

Types of Interactions						
Key Understanding	Driving Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts	Vocabulary
Electric and magnetic forces are affected by a variety of factors that can be described by data and observations.	How can we use data to understand electric and magnetic forces?	3.2.6-8.I Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.	Asking Questions and Defining Problems Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.	Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects.	Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems.	attract electric force electric motor electromagnet generator magnetic force repel
Gravitational forces are always attractive and depend on the masses of the interacting objects.	How do the masses of interacting objects affect how they experience gravitational forces?	3.2.6-8.J Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.	Engaging in Argument from Evidence Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.	Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun.	Systems and System Models Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems.	attract gravitational force mass

Key Understanding	Driving Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts	Vocabulary
Objects exert forces on each other when they interact, even when they are not in contact.	How can we develop and conduct investigations that allow us to determine how objects can exert force on each other even when they are not in contact?	3.2.6-8.K Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.	Planning and Carrying Out Investigations Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can serve as the basis for evidence that can meet the goals of the investigation.	Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively).	Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems.	electromagnetic field force
Definitions of Energy						
Key Understanding	Driving Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts	Vocabulary
An object's kinetic energy depends on its mass and on its speed.	In what way does measuring energy enhance our understanding of moving objects?	3.2.6-8.L Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass and speed of an object.	Analyzing and Interpreting Data Construct and interpret graphical displays of data to identify linear and nonlinear relationships.	Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.	Scale, Proportion, and Quantity Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.	kinetic energy mass speed

Conservation of Energy and Energy Transfer						
Key Understanding	Driving Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts	Vocabulary
Devices that minimize or maximize thermal energy transfer can be designed and constructed and should be tested to meet specified criteria and constraints.	How can a device be used to optimize the transfer of thermal energy?	3.2.6-8.M Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.	Constructing Explanations and Designing Solutions Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system.	Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. Energy is spontaneously transferred out of hotter regions or objects and into colder ones.	Energy and Matter The transfer of energy can be tracked as energy flows through a designed or natural system.	energy transfer thermal energy
The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the type of matter, the mass, and the environment.	In what ways do the type of matter, the mass of a substance, and the change in kinetic energy affect the temperature of a sample?	3.2.6-8.N Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.	Planning and Carrying Out Investigations Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.	Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.	Scale, Proportion, and Quantity Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.	kinetic energy mass matter temperature

Key Understanding	Driving Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts	Vocabulary
Energy is transferred to or from an object when its kinetic energy changes.	How and why does kinetic energy change when one object transfers energy to another?	3.2.6-8.O Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.	Developing and Using Models Develop a model to predict and/or describe phenomena.	Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.	Scale, Proportion, and Quantity Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.	energy transfer kinetic energy
Relationship Between Energy and Forces						
Key Understanding	Driving Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts	Vocabulary
Objects in a system contain different amounts of potential (stored) energy, which depends on the distance at which they interact.	In what ways does the potential energy of objects interacting in a system change when the distance between them either increases or decreases?	3.2.6-8.P Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.	Developing and Using Models Develop a model to describe unobservable mechanisms.	A system of objects may also contain stored (potential) energy, depending on their relative positions. When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.	Systems and System Models Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems.	potential energy

Wave Properties						
Key Understanding	Driving Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts	Vocabulary
The amplitude of a wave is related to the energy of that wave.	How and why does the amplitude of a wave represent the wave's energy?	3.2.6-8.Q Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.	Using Mathematics and Computational Thinking Use mathematical representations to describe and/or support scientific conclusions and design solutions.	A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.	Patterns Graphs and charts can be used to identify patterns in data.	amplitude frequency wave wavelength
Electromagnetic Radiation						
Key Understanding	Driving Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts	Vocabulary
Waves are reflected, absorbed, or transmitted through a variety of materials.	How can we determine whether a wave passing through various materials will be reflected, absorbed, or transmitted?	3.2.6-8.R Develop and use a model to describe how waves are reflected, absorbed, or transmitted through various materials.	Developing and Using Models Develop and use a model to describe phenomena.	A sound wave needs a medium through which it is transmitted. When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. However, because light can travel through space, it cannot be a matter wave, like sound or water waves.	Structure and Function Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.	absorption reflection transmission

Information Technologies and Instrumentation						
Key Understanding	Driving Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts	Vocabulary
Digital signals are a more reliable way to communicate information than analog signals.	In what ways can we use information to describe how and why digital signals are more reliable than analog signals for encoding and transmitting information?	3.2.6-8.S Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.	Information Technologies and Instrumentation Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.	Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.	Structure and Function Structures can be designed to serve particular functions.	analog signal digital signal encode transmit