



Structure, States, and Properties of Matter

Draft Date 06-07-2024	Course Grade 6 Science	Duration 7 Week(s)	Grades 6	Subjects Science	Team Tom Richard, Allison Zmuda, Marinkov Monica, Bo Miller, Mark Klucharich
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Focus

We introduce a study of chemistry by looking at atomic structure and arrangement.

We analyze the reactivity and stability of molecules and substances as well as determining characteristics of acids and bases.

Stage 1: Learning Goals

Established Goals	Transfer	
Standards	Long-Term Transfer Goals	
Pennsylvania Academic Standards Science (2023): 6-8 Standards Develop models to describe the atomic composition of simple molecules and extended structures. Clarifying Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.	What kinds of long-term, independent accomplishments are desired? Students will be able to independently use their learning to... Evaluate systems, in order to connect how form determines function and how any change to one component affects the entire system. (Global Citizen, Innovative Problem Solver) (T1)	
	Meaning	
	Understandings	Essential Questions
	What specifically do you want students to understand? What inferences should they make? Students will understand that... Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms. (U1)	What thought-provoking questions will foster inquiry, meaning making, and transfer? Students will keep considering... - How do particles combine to form a variety of matter one observes? (Q1) - How do particles combine to form the variety of matter one observes? (Q2) - How do substances combine or change (react) to make new substances? (Q3)

Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete description of all individual atoms in a complex molecule or extended structure is not required. (3.2.6-8.A)

- 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.

Clarifying Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.

Assessment Boundary: N/A (3.2.6-8.B)

- Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

Clarifying Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.

- How does one characterize and explain these reactions and make predictions about them? (Q4)
- How do substances combine or change (react) to make new substances? (Q5)
- How does one characterize and explain these reactions and make predictions about them? (Q6)

Acquisition of Knowledge & Skill

Knowledge

What facts and basic concepts should students know and be able to recall?
Students will know...

- Atoms can be visualized as building blocks. (K1)
- Protons, electrons, and neutrons are found within atoms. (K2)
- Protons determine the atomic number. (K3)
- We can calculate the atomic mass based on protons and neutrons. (K4)
- Molecules are two or more atoms bonded together. (K5)
- Elements are pure substances made of one type of atom. (K6)
- Matter can have different characteristics when found in various states (solids, liquids, gases). (K7)
- Physical changes do not result in new matter. (K8)
- Chemical changes result in new matter. (K9)

Skills

What discrete skills and processes should students be able to use? Students can...

- I can write chemical formulas based on simple models. (S1)
- I can draw/build molecules based on simple chemical formulas. (S2)
- I can identify types of changes (physical/chemical). (S3)

Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor. (3.2.6-8.D)

- 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.

Clarifying Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.

Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces. (3.2.6-8.E)

Profile of a CV Learner

- Innovative Problem Solving: Students will be able to independently use their learning to approach new problems with curiosity and creativity while consistently seeking growth through self-reflection and a willingness to accept constructive feedback. (PCVL.IPS)



Properties and Effects of Forces and Motion

Draft Date 06-07-2024	Course Grade 6 Science	Duration 10 Week(s)	Grades 6	Subjects Science	Team Tom Richard, Allison Zmuda, Marinkov Monica, Bo Miller, Mark Klucharich
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Focus

We look at specific forces and force characteristics including inertia, gravitational force, and velocity, and where we can observe these concepts in the world around us.

Stage 1: Learning Goals

Established Goals	Transfer	
Standards	Long-Term Transfer Goals	
Pennsylvania Academic Standards Science (2023): 6-8 Standards ■ Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. Clarifying Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle. Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension. (3.2.6-8.G) ■ Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the	What kinds of long-term, independent accomplishments are desired? Students will be able to independently use their learning to... ■ Make and use observations to analyze relationships and patterns in order to explain phenomena, develop models, and make predictions. (Communicator) (T1)	
	Meaning	
	Understandings	Essential Questions
	What specifically do you want students to understand? What inferences should they make? Students will understand that... ■ All forces between objects arise from a few types of interactions: gravity, electromagnetism, and the strong and weak nuclear interactions. (U1)	What thought-provoking questions will foster inquiry, meaning making, and transfer? Students will keep considering... ■ How can one predict an object's continued motion, changes in motion, or stability? (Q1) ■ What underlying forces explain the variety of interactions observed? (Q2) ■ What are kinetic and potential energy? (Q3) ■ What is meant by the conservation of energy? (Q4)

object and the mass of the object.

Clarifying Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.

Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry. (3.2.6-8.H)

- Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.

Clarifying Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.

Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking. (3.2.6-8.I)

- Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and

- How is energy transferred between objects or systems? (Q5)
- How are forces related to energy? (Q6)

Acquisition of Knowledge & Skill

Knowledge

What facts and basic concepts should students know and be able to recall?

Students will know...

- An object at rest may have potential energy. (K1)
- Objects in motion have kinetic energy. (K2)
- The changing ratio of potential to kinetic energy as an object moves (K3)
- Balanced and unbalanced forces contribute to the motion and/or stability/instability of an object. (K4)
- Magnetic forces, electromagnetic forces, and gravitational forces (K5)
- Energy can neither be created nor destroyed. (K6)
- The relationship between mass and kinetic energy (K7)
- The effects of colliding masses (K8)

Skills

What discrete skills and processes should students be able to use? Students can...

- I can demonstrate the transition between kinetic and potential energy based on position. (S1)
- I can create can explain demonstrations of Newton's Third Law of Motion. (S2)
- I can demonstrate the difference between balanced and unbalanced forces. (S3)
- I can use magnets (and/or electromagnets) to solve problems or perform tasks. (S4)

depend on the masses of interacting objects.

Clarifying Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system.

Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws. (3.2.6-8.J)

- 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.

Clarifying Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.

Assessment Boundary: Assessment is limited to electric and magnetic fields, and limited to qualitative evidence for the existence of fields. (3.2.6-8.K)

- Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass and speed of an object.

Clarifying Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball.

Assessment Boundary: N/A (3.2.6-8.L)

- 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.

Clarifying Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.

Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred. (3.2.6-8.N)

- 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.

Clarifying Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.

Assessment Boundary: Assessment does not include calculations of energy. (3.2.6-8.O)

- 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.

Clarifying Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.

Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions. (3.2.6-8.P)

Profile of a CV Learner

- Collaboration: Students will be able to independently engage and meaningfully contribute to a team to reach a common goal, through mutual reflection, feedback, and shared responsibility. (*PCVL.CO*)



Energy Transfer

Draft Date 06-07-2024	Course Grade 6 Science	Duration 6 Week(s)	Grades 6	Subjects Science	Team Tom Richard, Allison Zmuda, Marinkov Monica, Bo Miller, Mark Klucharich
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Focus

We examine thermal energy, electricity, and electrical circuits and the transfer of energy.

We discover how light and other waves behave.

Stage 1: Learning Goals

Established Goals	Transfer	
Standards	Long-Term Transfer Goals	
Pennsylvania Academic Standards Science (2023): 6-8 Standards Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. Clarifying Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride. Assessment Boundary: Assessment is	What kinds of long-term, independent accomplishments are desired? Students will be able to independently use their learning to... Weigh evidence and use scientific approaches to ask questions, investigate, and make informed decisions. (Innovative Problem Solver) (T1)	
	Meaning	
	Understandings	Essential Questions
	What specifically do you want students to understand? What inferences should they make? Students will understand that... - Interactions of objects or systems of objects can be predicted and explained using the concept of transfer of energy from one object or system of objects to another. (U1) - Waves are a repeating pattern of motion that transfers energy from	What thought-provoking questions will foster inquiry, meaning making, and transfer? Students will keep considering... - What is light? How can one explain the varied effects that involve light? What other forms of electromagnetic radiation are there? (Q1) - How are instruments that transmit and detect waves used to extend human senses? (Q2)

limited to the criteria of amount, time, and temperature of substance in testing the device. (3.2.6-8.F)

- Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.

Clarifying Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.

Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking. (3.2.6-8.I)

- Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.

Clarifying Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.

Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred. (3.2.6-8.M)

- Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is

place to place without overall displacement of matter. (U2)

Acquisition of Knowledge & Skill

Knowledge

What facts and basic concepts should students know and be able to recall?
Students will know...

- Energy can be transferred from one object or place to another. (K1)
- Energy can be transferred through matter or space in repeating movements known as waves. (K2)
- Waves with greater energy will have higher amplitude than waves with less energy. (K3)

Skills

What discrete skills and processes should students be able to use? Students can...

- I can create and label diagrams of waves with high energy and low energy. (S1)
- I can demonstrate amplitude using a rope/string. (S2)
- I can demonstrate and draw a representation of how a light can be reflected. (S3)
- I can demonstrate how light travels at different speeds as it passes through different materials. (S4)

related to the energy in a wave.

Clarifying Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.

Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.
(3.2.6-8.Q)

- Develop and use a model to describe how waves are reflected, absorbed, or transmitted through various materials.

Clarifying Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.

Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.
(3.2.6-8.R)

- 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.

Clarifying Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in wifi devices, and conversion of stored binary patterns to make sound or

text on a computer screen.

Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device. (3.2.6-8.S)

Profile of a CV Learner

- Communication: Students will be able to independently and confidently adapt their writing and speaking in relation to audience, task, and purpose, as well as practice active listening to understand other perspectives, viewpoints, and cultures. (PCVL.CM)



Resource Sustainability

Draft Date	Course	Duration	Grades	Subjects	Team
06-07-2024	Grade 6 Science	7 Week(s)	6	Science	Tom Richard, Allison Zmuda, Marinkov Monica, Bo Miller, Mark Klucharich
Focus					
We look at the impact of the way we use natural resources and our environment on the ability to produce food and energy in a sustained way.					
Stage 1: Learning Goals					
Established Goals			Transfer		
Standards			Long-Term Transfer Goals		
Pennsylvania Academic Standards Science (2023): 6-8 Standards ■ Gather and make sense of information to describe how synthetic materials come from natural resources and impact society. Clarifying Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels. Assessment Boundary: Assessment is limited to qualitative information. (3.2.6-8.C)			What kinds of long-term, independent accomplishments are desired? Students will be able to independently use their learning to... ■ Evaluate systems, in order to connect how form determines function and how any change to one component affects the entire system. (Global Citizen, Innovative Problem Solver) (T1)		
			Meaning		
			Understandings	Essential Questions	
			What specifically do you want students to understand? What inferences should they make? Students will understand that... ■ The Earth's surface processes affect and are affected by human activities. (U1)	What thought-provoking questions will foster inquiry, meaning making, and transfer? Students will keep considering... ■ How do regional and local conditions impact the environment? (Q1) ■ How do food systems function? (Q2)	

**Environmental Literacy & Sustainability (2023):
6-8 Environmental Literacy & Sustainability**

- Develop a model to describe how agricultural and food systems function, including the sustainable use of natural resources and the production, processing, and management of food, fiber, and energy. (3.4.6-8.A)
- Construct an explanation that describes regional environmental conditions and their implications on environmental justice and social equity. (3.4.6-8.I)

Profile of a CV Learner

- Global Citizenship: Students will be able to mindfully and respectfully seek to understand the ideas and perspectives of others to responsibly participate in all facets of local and global society. (PCVL.GC)

Acquisition of Knowledge & Skill

Knowledge

What facts and basic concepts should students know and be able to recall?
Students will know...

- Not everyone has access to natural resources (clean air, water, soil). (K1)
- There is a need to preserve and use resources responsibly. (K2)
- Modern farming practices allow food production to be much more efficient and sustainable surpassing traditional farming methods. (K3)

Skills

What discrete skills and processes should students be able to use? Students can...

- I can explain how agricultural and food systems function. (S1)
- I can explain the sustainable use of natural resources in the production of food, fiber and energy. (S2)
- I can explain how regional location and climate directly affect resource availability. (S3)
- I can care for vegetables growing in hydroponic gardens and the fish that are part of the same system. (S4)