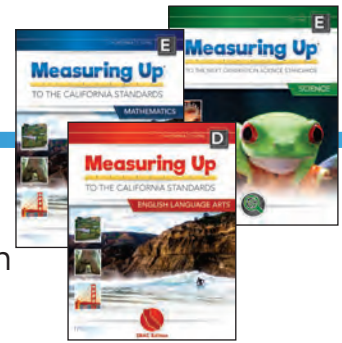


Try It Out! Sample Pack | Science | Grade 8 | Lesson 19

Measuring Up to the CA Standards



The **Try It Out!** sample pack features:

- 1 full student lesson with complete Teacher Edition lesson
- 1 full Table of Contents for your grade level
- Correlation to your state standards

Developed to meet the rigor of the standards, **Measuring Up** employs support for using and applying critical thinking skills with direct standards instruction that elevate and engage student thinking.

Standards-based lessons feature introductions that set students up for success with:

- ✓ Vocabulary in Action
- ✓ Relevant real-world connections
- ✓ Clearly identified learning goals
- ✓ Connections to prior learning

Guided Instruction and Independent Learning strengthen learning with:

- ✓ Deep thinking prompts
- ✓ Collaborative learning
- ✓ Self-evaluation
- ✓ Demonstration of problem-solving logic
- ✓ Application of higher-order thinking

Flexible design meets the needs of whole- or small-group instruction. Use for:

- ✓ Introducing standards
- ✓ Reinforcement or standards review
- ✓ Intervention
- ✓ Remediation
- ✓ Test Preparation

Extend learning with online digital resources!

Measuring Up Live 2.0 blends instructional print resources with online, dynamic assessment and practice. Meet the needs of all students for standards mastery with resources that pinpoint student needs with customized practice.



WORDS TO KNOW

flammability
density
melting point
boiling point
solubility
physical change
chemical change

Lesson 19

HOW CAN SUBSTANCES INTERACT AND CHANGE?

THE BIG IDEA

- Substances have unique properties.
- Analyzing data before and after substances interact can show if a chemical reaction has occurred.

▶ THINK ABOUT IT

How can you tell if a change in a material is chemical or physical?

WHAT I NEED TO KNOW

Substances are elements or compounds that have specific chemical compositions. Every substance has several physical and chemical properties. For example, **flammability** is a chemical property of a substance that describes how easily the substance will burn.

Substances also have several types of physical properties. **Density** is the ratio of mass to volume for an object. **Melting point** is a physical property of a substance that describes the temperature at which the substance changes from a solid to a liquid. **Boiling point** is a physical property of a substance that describes the temperature at which the substance changes from a liquid to a gas. **Solubility** is a physical property of a substance that describes the ability of a substance to dissolve in a different substance. These properties can be used to identify different substances.



Coal is flammable, which makes it useful to burn for energy.

Substance	Physical Properties	Physical Changes
water	colorless liquid, boiling point = 100°C, freezing point = 0°C, density = 1 g/cc	melting, freezing, evaporating
copper	Shiny yellow-orange solid, melting point = 1083°C, conducts heat and electricity, density = 8.96 g/cc	melting, hammering into a flat sheet, pulling into a wire
table salt	White crystals, melting point = 801°C, density = 2.17 g/cc	crushing, dissolving in water

This table lists physical properties and physical changes of water, copper, and table salt.

A **physical change** is a change in the physical properties of a substance that does not change its chemical composition. A change of phase, such as melting, boiling, and freezing, is a physical change. Physical changes are often reversible. Ice, liquid water, and steam are all forms of the same substance—water. Raising the temperature of ice makes it melt into water. If you continue to heat the water, it boils and then changes to a gas, which condenses back into water as it cools. Other physical changes include breaking, crushing, grinding, and dissolving.

A **chemical change** is a change in the composition of a substance through chemical reactions that creates a new substance with new properties. You can tell that the chemical nature of a substance has changed if there is a change of color or bubbles of gas are produced. If you mix two liquids, and a solid appears, a new substance must have formed. Chemical changes, such as burning, can release heat and light. Rusting, burning, digesting food, and the tarnishing of metals are all chemical changes. Shown below is an example of a chemical change that occurs when sodium and chlorine mix. You might know sodium chloride as table salt.

Substance	Physical Properties
Sodium	Soft, shiny, metallic substance
Chlorine	Greenish-yellowish gas
Sodium + chlorine → sodium chloride	White, crystalline solid

This table lists physical properties of sodium and chlorine before and after they are mixed together, showing a chemical change.

Unlike physical changes, chemical changes cannot easily reverse, and many times chemical changes cannot reverse at all. A common chemical reaction is oxidation, or burning. When you watch wood burn, for example, you are observing a chemical change because the wood changes into two new substances—ash and smoke. The molecules in wood are different from the molecules in ash and smoke. You cannot reform a piece of wood from ash and smoke. That chemical change is permanent.

Chemical changes are related to the rearrangement of atoms in the reactants and products in a chemical reaction. When a reaction occurs, atoms from the substances present before the interaction are rearranged into new configurations. This means that the new substances may have different physical or chemical properties.

TURN AND TALK

What other examples of chemical changes can you think of? Discuss with a partner.

WHAT I HAVE LEARNED

1. Which of the following is a chemical property of a substance?

- (A) Density
- (B) Flammability
- (C) Melting point
- (D) Solubility

SKETCH IT

Sketch out molecules of ice, water, and steam. How are they different?

2. Which of the following best indicates that a physical change has occurred to a substance?

- (A) The formation of a new substance
- (B) A change in the substance's mass
- (C) The formation of new atoms in the substance
- (D) A change in the substance's state of matter

HINT, HINT

The areas with no paint are exposed to the air.

3. A gate made of painted iron is beginning to rust in areas where the paint has worn away. Why is the formation of rust considered a chemical change?

- (A) Oxygen in the air combines with the paint, forming a new compound that has the same properties as iron but a different arrangement of atoms.
- (B) Oxygen in the air combines with the exposed iron, forming a new compound that has properties different from the iron.
- (C) The paint reacts with the iron beneath it and causes rust to form, changing the chemical properties of the iron.
- (D) The paint reacts with oxygen in the air and causes rust to form, changing the chemical properties of the iron.

4. The table shows common substances and examples of physical and chemical changes that may occur. Why is copper's ability to be pounded into a flat sheet a physical property and not a chemical property?

Substance	Physical Change	Chemical Change
Baking soda	Becomes a fine, white powder when ground up	Reacts with vinegar to make water, carbon dioxide, and sodium acetate
Copper	Becomes a flat sheet when pounded	Reacts with water and oxygen to form green coating
Hydrogen	Boils when heated to -253°C	Reacts with oxygen to form water
Sugar	Dissolves in water	Reacts in cells to help an organism obtain energy
Water	Density decreases as it changes from a liquid to solid ice	Reacts with carbon dioxide during photosynthesis to form sugars
Wood	Becomes sawdust when ground up	Reacts with fire to form ash and smoke

- (A) When you pound copper into a flat sheet you change its shape, but you do not change its chemical composition.
- (B) When you pound copper into a flat sheet you change the number of atoms in the copper, but you do not change their size.
- (C) When you pound copper into a flat sheet you change its density, but you do not change its chemical composition.
- (D) When you pound copper into a flat sheet you change the properties of the atoms irreversibly, but you do not change their size.

HINT, HINT

Think of the evidence that suggests a physical or chemical change has happened.

5. Sugar dissolves when you mix it with water. Antacid tablets bubble when you mix them with water. Which of the following describes how each substance changes?



- (A) Both undergo a chemical change, and their compositions change.
- (B) Both undergo a physical change, and their physical properties stay the same.
- (C) The sugar undergoes a physical change; the antacid undergoes a chemical change.
- (D) The antacid undergoes a physical change; the sugar undergoes a chemical change.
6. Which shows that a physical change has taken place?
- (A) The substance releases energy.
- (B) The substance produces gas bubbles.
- (C) The substance changes color.
- (D) The substance changes from liquid to gas.

ANNOTATED TEACHER EDITION

CONTENTS

Introduction

Letter to Students	x
Letter to Parents and Families	xi
What You'll See in <i>Measuring Up to the Next Generation Science Standards</i>	xii

Unit 1 Human Body Systems

NGSS

MS-LS1-1

MS-LS1-2

MS-LS1-3

MS-LS1-8

MS-ETS1-1, MS-LS1-3,
MS-LS1-8

LESSON

1. What Are Living Things Made of?	1
2. How Does a Cell Function?	6
3. How Do Cells Work Together?	11
4. How Does the Body Receive and Process Information?	15
Unit 1 Body Systems Lab Investigation	19
Unit 1 Building Stamina	22

Unit 2

Reproduction and Growth

NGSS

MS-LS1-3

MS-LS1-4

MS-LS1-5

MS-LS1-8

MS-LS3-2

MS-ETS1-1, MS-ETS1-2,
MS-ETS1-3, MS-ETS1-4,
MS-LS3-2

LESSON

5.	How Do Body Systems Regulate Growth and Development?	28
6.	What Characteristics of Plants and Animals Influence Their Probability of Reproduction?	32
7.	What Factors Affect the Growth of Plants?	36
8.	How Do Organisms Respond to Stimuli?	40
9.	How Do Organisms Achieve Genetic Variation?	44
	Unit 2 Reproduction and Growth Lab Investigation	49
	Unit 2 Building Stamina	52

Unit 3

Energy Transfer and Weather

NGSS

MS-PS3-3

MS-PS3-4

MS-PS3-5

MS-ETS1-3, MS-PS3-3

LESSON

10.	How Does Thermal Energy Transfer?	59
11.	What Influences Temperature Changes?	64
12.	How Does Energy Affect Motion?	68
	Unit 3 Energy Transfer and Weather Lab Investigation	72
	Unit 3 Building Stamina	75

CONTENTS

Unit 4 Climates and Human Impacts

NGSS

MS-ESS2-4

MS-ESS2-5

MS-ESS2-6

MS-ESS3-3

MS-ESS3-5

MS-ETS1-2, MS-ESS3-3

LESSON

13. How Does the Water Cycle Function as a System?	83
14. What Is the Role of Air and Water in the Weather?	87
15. What Factors Create Global Climate Patterns?	92
16. How Do Humans Impact the Environment?	96
17. Why Are Global Temperatures Rising?	100
Unit 4 Climates and Human Impacts Lab Investigation	105
Unit 4 Building Stamina	109

Unit 5 Properties of Matter

NGSS

MS-PS1-1

MS-PS1-2

MS-PS1-3

MS-PS1-4

MS-PS1-5

MS-PS1-6

LESSON

18. How Do Atoms and Molecules Form Different Substances?	116
19. How Can Substances Interact and Change?	120
20. What Are Synthetic Materials?	125
21. How Does Thermal Energy Affect States of Matter?	129
22. What Is the Law of Conservation of Mass?	133
23. What Are Two Types of Chemical Reactions?	136

NGSS

MS-LS1-7

MS-ETS1-3, MS-PS1-2

LESSON

24. What Chemical Reactions Are Involved in Food?	140
Unit 5 Chemical Changes Lab Investigation	144
Unit 5 Building Stamina	147

Unit 6 Dynamic Interactions within Ecosystems

NGSS

MS-LS1-6

MS-LS2-1

MS-LS2-2

MS-LS2-3

MS-LS2-4

MS-LS2-5

MS-ETS1-1, MS-ETS1-2,
MS-LS2-2**LESSON**

25. What Is the Role of Plants in Ecosystems?	155
26. What Affects the Populations That Live in an Ecosystem?	159
27. How Do Organisms Interact?	163
28. How Do Matter and Energy Flow through Ecosystems?	167
29. What Happens If an Ecosystem Changes?	172
30. What Is Biodiversity?	177
Unit 6 Dynamic Interactions within Ecosystems Lab Investigation	182
Unit 6 Building Stamina	186

Unit 7 Geologic Changes in the Earth

NGSS

MS-ESS1-4

MS-ESS2-1

MS-ESS2-2

MS-ESS2-3

MS-ESS3-1

MS-ESS3-4

MS-ESS3-2

MS-ETS1-4, MS-ESS3-2

LESSON

31. What Do Rocks and Fossils Reveal About Earth's History?	195
32. How Do Earth's Systems Cycle Materials Such as Rocks and Minerals?	199
33. How Does Earth Change Over Time?	204
34. How Do We Know That the Earth's Tectonic Plates Have Moved Over Time?	209
35. Why Do Natural Resources Seem Limited in Some Areas?	213
36. How Are Humans Impacting the Natural Resources on Earth?	217
37. How Can We Predict Natural Hazards?	223
Unit 7 Flood Mitigation Design Lab Investigation	229
Unit 7 Building Stamina	233

Unit 8 Forces and Energy

NGSS

MS-PS2-1

MS-PS2-2

MS-PS2-3

LESSON

38. What Is Newton's Third Law of Motion?	240
39. What Determines the Motion of an Object?	244
40. What Factors Affect the Strength of Magnetic and Electric Forces?	248

NGSS

MS-PS2-4

MS-PS2-5

MS-PS3-1

MS-PS3-2

MS-ESS1-2

MS-ETS1-1, MS-PS3-1,
MS-PS3-2**LESSON**

41. How Do Gravitational Forces Affect an Object?	252
42. How Do Electromagnetic Fields Affect an Object?	256
43. What Factors Affect Kinetic Energy?	260
44. What Factors Affect Potential Energy?	265
45. How Does Gravitational Force Affect Our Solar System and the Milky Way?	270
Unit 8 Forces and Energy Lab Investigation	275
Unit 8 Building Stamina	279

Unit 9 Energy in Waves

NGSS

MS-PS4-1

MS-PS4-2

MS-PS4-3

MS-ETS1-2, MS-ETS1-4,
MS-PS4-3**LESSON**

46. How Can We Describe the Patterns in Waves?	286
47. How Do Waves Interact with Different Materials?	290
48. How Can Waves Transmit Information?	295
Unit 9 Energy in Waves Lab Investigation	301
Unit 9 Building Stamina	305

Unit 10 Mechanisms of Diversity

NGSS

MS-LS3-1

MS-LS4-1

MS-LS4-2

MS-LS4-3

MS-LS4-4

MS-LS4-5

MS-LS4-6

MS-ETS1-4, MS-LS4-6

LESSON

49. How Can Traits Change Over Time? 312

50. How Have Living Things Changed Over Time? 316

51. What Is the Evidence for Evolution? 320

52. How Can Studying Embryos Reveal Patterns and Relationships? 324

53. How Does Genetic Variation Help Organisms Survive? 328

54. How Can Humans Influence the Inheritance of Traits? 332

55. How Do Populations Change Over Time? 336

Unit 10 Mechanisms of Diversity Lab Investigation 340

Unit 10 Building Stamina 344

Unit 11 Earth and Space

NGSS

MS-ESS1-1

MS-ESS1-1

MS-ESS1-2

MS-ESS1-3

LESSON

56. Why Do We See Lunar Phases and Eclipses? 350

57. Why Do We Experience Seasons on Earth? 355

58. What Objects Are in Our Solar System? 359

59. How Do Objects in Our Solar System Compare in Size? 363

NGSS

MS-ETS1-3, MS-ESS1-1,
MS-ESS1-2, MS-ESS1-3

LESSON

Unit 11 Earth and Space Lab Investigation	370
Unit 11 Building Stamina	375

References

Acknowledgments	382
Correlation to the Next Generation Science Standards	383
Glossary	393
Graphic Organizers	400

CORRELATIONS

Correlation to the Next Generation Science Standards

This worktext is customized to the Next Generation Science Standards.

Middle School Standards	Lessons
Middle School Standards – Physical Sciences	
Disciplinary Core Idea MS-PS1: Matter and Its Interactions	
<p>MS-PS1-1 Develop models to describe the atomic composition of simple molecules and extended structures.</p> <p><i>Clarification Statements: 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 particulate-level models could include drawings, 3D ball and stick structures, or computer representations showing different substances with different types of atoms.</i></p> <p><i>Assessment Boundaries: Assessment does not include valence electrons and bonding energy, discussing the individual ions composing complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.</i></p>	18
<p>MS-PS1-2 Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.</p> <p><i>Clarification Statements: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.</i></p> <p><i>Assessment Boundaries: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.</i></p>	19, Unit 5 Inv
<p>MS-PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.</p> <p><i>Clarification Statements: 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.</i></p> <p><i>Assessment Boundaries: Assessment is limited to qualitative information.</i></p>	20
<p>MS-PS1-4 Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.</p> <p><i>Clarification Statements: 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 drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.</i></p>	21
<p>MS-PS1-5 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.</p> <p><i>Clarification Statements: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.</i></p> <p><i>Assessment Boundaries: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.</i></p>	22

CORRELATIONS

Middle School Standards	Lessons
<p>MS-PS1-6 Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.</p> <p><i>Clarification Statements: 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.</i></p> <p><i>Assessment Boundaries: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.</i></p>	23
Disciplinary Core Idea MS-PS2: Motion and Stability: Forces and Interactions	
<p>MS-PS2-1 Apply Newton’s Third Law to design a solution to a problem involving the motion of two colliding objects.</p> <p><i>Clarification Statements: 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.</i></p> <p><i>Assessment Boundaries: Assessment is limited to vertical or horizontal interactions in one dimension.</i></p>	38
<p>MS-PS2-2 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.</p> <p><i>Clarification Statements: Emphasis is on balanced (Newton’s First Law) and unbalanced forces in a system (including simple machines), qualitative comparisons of forces, mass and changes in motion (Newton’s Second Law), frame of reference, and specification of units.</i></p> <p><i>Assessment Boundaries: 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.</i></p>	39
<p>MS-PS2-3 Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.</p> <p><i>Clarification Statements: 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.</i></p> <p><i>Assessment Boundaries: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.</i></p>	40
<p>MS-PS2-4 Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.</p> <p><i>Clarification Statements: 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.</i></p> <p><i>Assessment Boundaries: Assessment does not include Newton’s Law of Gravitation or Kepler’s Laws.</i></p>	41
<p>MS-PS2-5 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.</p> <p><i>Clarification Statements: 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.</i></p> <p><i>Assessment Boundaries: Assessment is limited to electric and magnetic fields, and limited to qualitative evidence for the existence of fields.</i></p>	42

Middle School Standards	Lessons
Disciplinary Core Idea MS-PS3: Energy	
<p>MS-PS3-1 Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.</p> <p><i>Clarification Statements: 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.</i></p> <p><i>Assessment Boundaries: Assessment could include both qualitative and quantitative evaluations of kinetic energy.</i></p>	43, Unit 8 Inv
<p>MS-PS3-2 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.</p> <p><i>Clarification Statements: 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</i></p> <p><i>Assessment Boundaries: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.</i></p>	44, Unit 8 Inv
<p>MS-PS3-3 Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.</p> <p><i>Clarification Statements: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.</i></p> <p><i>Assessment Boundaries: Assessment does not include calculating the total amount of thermal energy transferred.</i></p>	10, Unit 3 Inv
<p>MS-PS3-4 Plan and conduct an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the temperature of the sample of matter.</p> <p><i>Clarification Statements: 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.</i></p> <p><i>Assessment Boundaries: Assessment does not include calculating the total amount of thermal energy transferred.</i></p>	11
<p>MS-PS3-5 Construct, use, and present an argument to support the claim that when work is done on or by a system, the energy of the system changes as energy is transferred to or from the system.</p> <p><i>Clarification Statements: 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.</i></p> <p><i>Assessment Boundaries: Assessment could include calculations of work and energy.</i></p>	12
Disciplinary Core Idea MS-PS4: Waves and Their Applications in Technologies for Information Transfer	
<p>MS-PS4-1 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.</p> <p><i>Clarification Statements: Emphasis is on describing waves with both qualitative and quantitative thinking.</i></p> <p><i>Assessment Boundaries: Assessment is limited to comparing standard repeating waves of only one type (transverse or longitudinal).</i></p>	46

CORRELATIONS

Middle School Standards	Lessons
<p>MS-PS4-2 Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. <i>Clarification Statements: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.</i> <i>Assessment Boundaries: Assessment is limited to qualitative applications pertaining to light and mechanical waves.</i></p>	47
<p>MS-PS4-3 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. <i>Clarification Statements: 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.</i> <i>Assessment Boundaries: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.</i></p>	48, Unit 9 Inv
Middle School Standards – Life Sciences	
Disciplinary Core Idea MS-LS1: From Molecules to Organisms: Structures and Processes	
<p>MS-LS1-1 Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. <i>Clarification Statements: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living cells, and understanding that living things may be made of one cell or many and varied cells.</i></p>	1
<p>MS-LS1-2 Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. <i>Clarification Statements: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.</i> <i>Assessment Boundaries: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.</i></p>	2
<p>MS-LS1-3 Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. <i>Clarification Statements: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.</i> <i>Assessment Boundaries: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.</i></p>	3, 5, Unit 1 Inv

Middle School Standards	Lessons
<p>MS-LS1-4 Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively.</p> <p><i>Clarification Statements: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds, and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.</i></p>	6
<p>MS-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.</p> <p><i>Clarification Statements: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.</i></p> <p><i>Assessment Boundaries: Assessment does not include genetic mechanisms, gene regulation, biochemical processes, or natural selection.</i></p>	7
<p>MS-LS1-6 Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.</p> <p><i>Clarification Statements: Emphasis is on tracing movement of matter and flow of energy.</i></p> <p><i>Assessment Boundaries: Assessment does not include the biochemical mechanisms of photosynthesis.</i></p>	25
<p>MS-LS1-7 Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.</p> <p><i>Clarification Statements: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.</i></p> <p><i>Assessment Boundaries: Assessment does not include details of the chemical reactions for respiration or synthesis.</i></p>	24
<p>MS-LS1-8 Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.</p> <p><i>Assessment Boundaries: Assessment does not include mechanisms for the transmission of this information.</i></p>	4, 8, Unit 1 Inv
<p>Disciplinary Core Idea MS-LS2: Ecosystems: Interactions, Energy, and Dynamics</p>	
<p>MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.</p> <p><i>Clarification Statements: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.</i></p>	26
<p>MS-LS2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.</p> <p><i>Clarification Statements: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.</i></p>	27, Unit 6 Inv

CORRELATIONS

Middle School Standards	Lessons
<p>MS-LS2-3 Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. <i>Clarification Statements: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.</i> <i>Assessment Boundaries: Assessment does not include the use of chemical reactions to describe the processes.</i></p>	28
<p>MS-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. <i>Clarification Statements: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.</i></p>	29
<p>MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services. <i>Clarification Statements: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.</i></p>	30
Disciplinary Core Idea MS-LS3: Heredity: Inheritance and Variation of Traits	
<p>MS-LS3-1 Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. <i>Clarification Statements: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.</i> <i>Assessment Boundaries: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.</i></p>	49
<p>MS-LS3-2 Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. <i>Clarification Statements: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.</i></p>	9, Unit 2 Inv
MS.NS: Natural Selection and Adaptations	
<p>MS-LS4-1 Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. <i>Clarification Statements: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.</i> <i>Assessment Boundaries: Assessment does not include the names of individual species or geological eras in the fossil record.</i></p>	50
<p>MS-LS4-2 Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. <i>Clarification Statements: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.</i></p>	51

Middle School Standards	Lessons
<p>MS-LS4-3 Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. <i>Clarification Statements: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.</i> <i>Assessment Boundaries: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.</i></p>	52
<p>MS-LS4-4 Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. <i>Clarification Statements: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.</i></p>	53
<p>MS-LS4-5 Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. <i>Clarification Statements: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.</i></p>	54
<p>MS-LS4-6 Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. <i>Clarification Statements: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.</i> <i>Assessment Boundaries: Assessment does not include Hardy Weinberg calculations.</i></p>	55, Unit 10 Inv
Middle School Standards – Earth and Space Sciences	
Disciplinary Core Idea MS-ESS1: Earth's Place in the Universe	
<p>MS-ESS1-1 Develop and use a model of the Earth-Sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the Sun and moon, and seasons. <i>Clarification Statements: Examples of models can be physical, graphical, or conceptual.</i></p>	56, 57, Unit 11 Inv
<p>MS-ESS1-2 Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. <i>Clarification Statements: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as students' school or state).</i> <i>Assessment Boundaries: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.</i></p>	45, 58, Unit 11 Inv

CORRELATIONS

Middle School Standards	Lessons
<p>MS-ESS1-3 Analyze and interpret data to determine scale properties of objects in the solar system. <i>Clarification Statements: Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object’s layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.</i> <i>Assessment Boundaries: Assessment does not include recalling facts about properties of the planets and other solar system bodies.</i></p>	59, Unit 11 Inv
<p>MS-ESS1-4 Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth’s 4.6-billion-year-old history. <i>Clarification Statements: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth’s history. Examples of Earth’s major events or evidence could include very recent events or evidence (such as the last Ice Age or the earliest fossils of Homo sapiens) to very old events or evidence (such as the formation of Earth or the earliest evidence of life). Examples of evidence could include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.</i> <i>Assessment Boundaries: Assessment does not include recalling the names of specific periods or epochs and events within them.</i></p>	31
<p>Disciplinary Core Idea MS-ESS2: Earth’s Systems</p>	
<p>MS-ESS2-1 Develop a model to describe the cycling of Earth’s materials and the flow of energy that drives this process. <i>Clarification Statements: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth’s materials.</i> <i>Assessment Boundaries: Assessment does not include the specific identification and naming of minerals and rocks but could include the general classification of rocks as igneous, metamorphic, or sedimentary.</i></p>	32
<p>MS-ESS2-2 Construct an explanation based on evidence for how geoscience processes have changed Earth’s surface at varying time and spatial scales. <i>Clarification Statements: Emphasis is on how processes change Earth’s surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.</i></p>	33
<p>MS-ESS2-3 Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. <i>Clarification Statements: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches).</i> <i>Assessment Boundaries: Paleomagnetic anomalies in oceanic and continental crust are not assessed.</i></p>	34

Middle School Standards	Lessons
<p>MS-ESS2-4 Develop a model to describe the cycling of water through Earth’s systems driven by energy from the sun and the force of gravity.</p> <p><i>Clarification Statements: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.</i></p> <p><i>Assessment Boundaries: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.</i></p>	13
<p>MS-ESS2-5 Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.</p> <p><i>Clarification Statements: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).</i></p> <p><i>Assessment Boundaries: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.</i></p>	14
<p>MS-ESS2-6 Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.</p> <p><i>Clarification Statements: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.</i></p> <p><i>Assessment Boundaries: Assessment does not include the dynamics of the Coriolis effect.</i></p>	15
Disciplinary Core Idea MS-ESS3: Earth and Human Activity	
<p>MS-ESS3-1 Construct a scientific explanation based on evidence for how the uneven distributions of Earth’s mineral, energy, and groundwater resources are the result of past and current geoscience processes.</p> <p><i>Clarification Statements: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).</i></p>	35
<p>MS-ESS3-2 Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.</p> <p><i>Clarification Statements: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).</i></p>	37, Unit 7 Inv

CORRELATIONS

Middle School Standards	Lessons
<p>MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.</p> <p><i>Clarification Statements: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).</i></p>	16, Unit 4 Inv
<p>MS-ESS3-4 Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.</p> <p><i>Clarification Statements: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.</i></p>	36
<p>MS-ESS3-5 Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.</p> <p><i>Clarification Statements: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.</i></p>	17
<p>Disciplinary Core Idea MS-ETS1: Engineering Design</p>	
<p>MS-ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.</p>	Unit 1 Inv, Unit 2 Inv, Unit 6 Inv, Unit 8 Inv
<p>MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.</p>	Unit 2 Inv, Unit 4 Inv, Unit 6 Inv, Unit 9 Inv
<p>MS-ETS1-3 Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.</p>	Unit 2 Inv, Unit 3 Inv, Unit 5 Inv, Unit 11 Inv
<p>MS-ETS1-4 Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.</p>	Unit 2 Inv, Unit 7 Inv, Unit 9 Inv, Unit 10 Inv

WORDS TO KNOW

- flammability
- density
- melting point
- boiling point
- solubility
- physical change
- chemical change

▶ THINK ABOUT IT

How can you tell if a change in a material is chemical or physical?



Coal is flammable, which makes it useful to burn for energy.

LESSON 19

HOW CAN SUBSTANCES INTERACT AND CHANGE?

THE BIG IDEA

- Substances have unique properties.
- Analyzing data before and after substances interact can show if a chemical reaction has occurred.

WHAT I NEED TO KNOW

Substances are elements or compounds that have specific chemical compositions. Every substance has several physical and chemical properties. For example, flammability is a chemical property of a substance that describes how easily the substance will burn.

Substances also have several types of physical properties. Density is the ratio of mass to volume for an object. Melting point is a physical property of a substance that describes the temperature at which the substance changes from a solid to a liquid. Boiling point is a physical property of a substance that describes the temperature at which the substance changes from a liquid to a gas. Solubility is a physical property of a substance that describes the ability of a substance to dissolve in a different substance. These properties can be used to identify different substances.

Substance	Physical Properties	Physical Changes
water	colorless liquid, boiling point = 100°C, freezing point = 0°C, density = 1 g/cc	melting, freezing, evaporating
copper	shiny yellow-orange solid, melting point = 1083°C, conducts heat and electricity, density = 8.96 g/cc	melting, hammering into a flat sheet, pulling into a wire
table salt	white crystals, melting point = 801°C, density = 2.17 g/cc	crushing, dissolving in water

This table lists physical properties and physical changes of water, copper, and table salt.

Copying is prohibited.

A physical change is a change in the physical properties of a substance that does not change its chemical composition. A change of phase, such as melting, boiling, and freezing, is a physical change. Physical changes are often reversible. Ice, liquid water, and steam are all forms of the same substance—water.

Raising the temperature of ice makes it melt into water. If you continue to heat the water, it boils and then changes to a gas, which condenses back into water as it cools. Other physical changes include breaking, crushing, grinding, and dissolving.

A chemical change is a change in the composition of a substance through chemical reactions that creates a new substance with new properties. You can tell that the chemical nature of a substance has changed if there is a change of color or bubbles of gas are produced. If you mix two liquids, and a solid appears, a new substance must have formed. Chemical changes, such as burning, can release heat and light. Rusting, burning, digesting food, and the tarnishing of metals are all chemical changes. Shown below is an example of a chemical change that occurs when sodium and chlorine mix. You might know sodium chloride as table salt.

Substance	Physical Properties
Sodium	Soft, shiny, metallic substance
Chlorine	Greenish-yellowish gas
Sodium + chlorine → sodium chloride	White, crystalline solid

This table lists physical properties of sodium and chlorine before and after they are mixed together, showing a chemical change.

Unlike physical changes, chemical changes cannot easily reverse, and many times chemical changes cannot reverse at all. A common chemical reaction is oxidation, or burning. When you watch wood burn, for example, you are observing a chemical change because the wood changes into two new substances—ash and smoke. The molecules in wood are different from the molecules in ash and smoke. You cannot reform a piece of wood from ash and smoke. That chemical change is permanent.

Chemical changes are related to the rearrangement of atoms in the reactants and products in a chemical reaction. When a reaction occurs, atoms from the substances present before the interaction are rearranged into new configurations. This means that the new substances may have different physical or chemical properties.

◀ TURN AND TALK

What other examples of chemical changes can you think of? Discuss with a partner.

Copying is prohibited.

WHAT I HAVE LEARNED

1. Which of the following is a chemical property of a substance?

- (A) Density
 - (B) Flammability
 - (C) Melting point
 - (D) Solubility
- [DOK 1]

2. Which of the following best indicates that a physical change has occurred to a substance?

- (A) The formation of a new substance
 - (B) A change in the substance's mass
 - (C) The formation of new atoms in the substance
 - (D) A change in the substance's state of matter
- [DOK 2]

▶ SKETCH IT

Sketch out molecules of ice, water, and steam. How are they different?

▶ HINT, HINT

The areas with no paint are exposed to the air.

3. A gate made of painted iron is beginning to rust in areas where the paint has worn away. Why is the formation of rust considered a chemical change?

- (A) Oxygen in the air combines with the paint, forming a new compound that has the same properties as iron but a different arrangement of atoms.
 - (B) Oxygen in the air combines with the exposed iron, forming a new compound that has properties different from the iron.
 - (C) The paint reacts with the iron beneath it and causes rust to form, changing the chemical properties of the iron.
 - (D) The paint reacts with oxygen in the air and causes rust to form, changing the chemical properties of the iron.
- [DOK 3]

4. The table shows common substances and examples of physical and chemical changes that may occur. Why is copper's ability to be pounded into a flat sheet a physical property and not a chemical property?

Substance	Physical Change	Chemical Change
Baking soda	Becomes a fine, white powder when ground up	Reacts with vinegar to make water, carbon dioxide, and sodium acetate
Copper	Becomes a flat sheet when pounded	Reacts with water and oxygen to form green coating
Hydrogen	Boils when heated to -253°C	Reacts with oxygen to form water
Sugar	Dissolves in water	Reacts in cells to help an organism obtain energy
Water	Density decreases as it changes from a liquid to solid ice	Reacts with carbon dioxide during photosynthesis to form sugars
Wood	Becomes sawdust when ground up	Reacts with fire to form ash and smoke

- (A) When you pound copper into a flat sheet you change its shape, but you do not change its chemical composition.
 - (B) When you pound copper into a flat sheet you change the number of atoms in the copper, but you do not change their size.
 - (C) When you pound copper into a flat sheet you change its density, but you do not change its chemical composition.
 - (D) When you pound copper into a flat sheet you change the properties of the atoms irreversibly, but you do not change their size.
- [DOK 3]

HINT, HINT

Think of the evidence that suggests a physical or chemical change has happened.

5. Sugar dissolves when you mix it with water. Antacid tablets bubble when you mix them with water. Which of the following describes how each substance changes?



- (A) Both undergo a chemical change, and their compositions change.
(B) Both undergo a physical change, and their physical properties stay the same.
(C) The sugar undergoes a physical change; the antacid undergoes a chemical change.
(D) The antacid undergoes a physical change; the sugar undergoes a chemical change. [DOK 2]
6. Which shows that a physical change has taken place?
- (A) The substance releases energy.
(B) The substance produces gas bubbles.
(C) The substance changes color.
(D) The substance changes from liquid to gas. [DOK 1]

TEACHER NOTES

STANDARDS MS-PS1-2

Performance Expectation

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

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter

- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.

PS1.B: Chemical Reactions

- 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.

Science and Engineering Practices

Analyzing and Interpreting Data

Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Analyze and interpret data to determine similarities and differences in findings.

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence

- Science knowledge is based upon logical and conceptual connections between evidence and explanations.

Crosscutting Concepts

Patterns

- Macroscopic patterns are related to the nature of microscopic and atomic-level structure.

Prerequisite Knowledge & Standards

- When two or more different substances are mixed, a new substance with different properties may be formed. (5-PS1-4)
- No matter what reaction or change in properties occurs, the total weight of the substances does not change. (5-PS1-2)

TEACHER NOTES

Math Connection

MP.2: Reason abstractly and quantitatively.

6.RPA.3: Use ratio and rate reasoning to solve real-world and mathematical problems.

6.SP.B.4: Display numerical data in plots on a number line, including dot plots, histograms, and box plots.

6.SP.B.5: Summarize numerical data sets in relation to their context.

ELA Connection

RST.6-8.1: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

RST.6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

Misconceptions

- If two substances share the same property, they are the same substance. (1)
- Chemical changes are additive, not interactive. (2)
- Atoms in a chemical reaction are transformed into different atoms. (1)
- Characteristics like color, melting point, boiling point, and density are not properties of substances. (1)
- Descriptions like temperature, mass/weight, shape, or length are properties of substances. (1)

TIPS FOR THE STRUGGLING LEARNER

- Some students may struggle with differentiating between chemical and physical changes. Set up stations around the room that show different types of physical and chemical changes. Changes could include melting ice, sugar dissolving in water, shredding paper, burning wood [with teacher supervision], and mixing antacid tablets with water. Have students circulate in small groups through the stations after they have read the lesson text. Allow them to observe, describe, and ask questions about the changes.

TIPS FOR THE ENGLISH LANGUAGE LEARNER

- Make sure English language learners have the opportunity, if needed, to use both their home languages and English to discuss the science terms and concepts in this lesson. Consider using hands-on objects and creating separate bilingual labels to describe the changes and then allow students to place the labels in the correct location. Have students use these physical examples to help them comprehend key terms. You can also use this opportunity to allow all students to learn these terms in another language.

ACTIVITIES FOR THE ADVANCED LEARNER

- Challenge advanced learners to complete a self-directed assignment in place of the independent practice. Students can pick a substance (water, a metal, and so on) and research all of the ways the substance can undergo physical and chemical changes, stating why each change is physical or chemical and explaining whether or not the substance can return to its original form.