8th Grade

Distinguish between physical and chemical changes, noting that mass is conserved during any change

Students can:

a. Identify the distinguishing characteristics between a chemical and a physical change (DOK 1)
b. Gather, analyze, and interpret data on physical and chemical changes (DOK 1-2)
c. Gather, analyze, and interpret data that show mass is conserved in a given chemical or physical change (DOK 1-2)
d. Identify evidence that suggests that matter is always conserved in physical and chemical changes (DOK 1)
e. Examine, evaluate, question, and ethically use information from a variety of sources and media to investigate physical and chemical changes (DOK 1-2)

Inquiry Questions:

1. What evidence can indicate whether a change is physical or chemical?
2. Is it easier to observe the conservation of mass in physical or chemical changes? Why?
3. What would happen if mass were not conserved?

Relevance and Application:

1. The freezing, thawing, and vaporization of Earth's water provide examples of physical changes.
2. An understanding of chemical changes have resulted in the design various products such as refrigerants in air conditioners and refrigerators.
3. Physical and chemical changes are involved in the collection and refinement of natural resources such as using arsenic in gold mining.
4. Living systems conserve mass when waste products from some organisms are nutrients for others.

Identify and calculate the direction and magnitude of forces that act on an object, and explain the results in the object's change of motion

Students can:

a. Predict and evaluate the movement of an object by examining the forces applied to it (DOK 1-2)
b. Use mathematical expressions to describe the movement of an object (DOK 1-2)
c. Develop and design a scientific investigation to collect and analyze speed and acceleration data to determine the net forces acting on a moving object (DOK 2-4)

Inquiry Questions:

1. What relationships exists among force, mass, speed, and acceleration?
2. What evidence indicates a force has acted on a system? Is it possible for a force to act on a system without having an effect?

There are different forms of energy, and those forms of energy can be changed from one form to another – but total energy is conserved

Students can:

a. Gather, analyze, and interpret data to describe the different forms of energy and energy transfer (DOK 1-2)

b. Develop a research-based analysis of different forms of energy and energy transfer (DOK 1-3)
c. Use research-based models to describe energy transfer mechanisms, and predict amounts of energy transferred (DOK 1-2)

Inquiry Questions:

1. Which forms of energy can be directly observed, and which forms of energy must be inferred?
2. What evidence supports the existence of potential and kinetic energy?
3. Is there a limit to how many times energy can be transferred? Explain your answer.

Recognize that waves such as electromagnetic, sound, seismic, and water have common characteristics and unique properties

Students can:

a. Compare and contrast different types of waves (DOK 1-2)
b. Describe for various waves the amplitude, frequency, wavelength, and speed (DOK 1)
c. Describe the relationship between pitch and frequency in sound (DOK 1)
d. Develop and design a scientific investigation regarding absorption, reflection, and refraction of light (DOK 2-4)

Inquiry Questions:

1. What are some different ways to describe waves?

Relevance and Application:

1. Different vibrations create waves with different characteristics. For example, a vibrating low-pitch guitar string feels different to the touch than a high-pitch guitar string.
2. Dealing with different types of waves presents design challenges. For example, higher frequency waves have shorter wavelengths, which affect ships, buildings, and antenna design.
3. Energy from different types of waves can affect the environment. For example, natural waves cause different beach erosion and boat wakes
4. There are many applications of light and lasers such as using fiber optics in high speed communication and lasers in surgery.
5. Living organisms collect and use light and sound waves – such as for hearing and vision – to gather information about their surroundings.

7th Grade

1. Mixtures of substances can be separated based on their properties such as solubility, boiling points, magnetic properties, and densities

Students can:

a. Identify properties of substances in a mixture that could be used to separate those substances from each other (DOK 1)
b. Develop and design a scientific investigation to separate the components of a mixture (DOK 2-4)

Inquiry Questions:

1. What techniques can be used to separate mixtures of substances based their properties?
2. Which properties are the most useful in trying to separate mixtures of substances?
3. How much difference must there be among the properties of substances for the properties to be useful in separating the substances?

Relevance and Application:
1. Materials are sorted based on their properties in a variety of applications. For example, water filtration systems rely on the solubility, density, and physical sizes of substances and recycling facilities use the properties of materials to separate substances in single-stream recycling systems.
2. Mining and oil refining processes use properties to separate materials.
3. The kidneys use properties to filter wastes from the blood.

6th Grade

All matter is made of atoms, which are far too small to see directly through a light microscope. Elements have unique atoms and thus, unique properties. Atoms themselves are made of even smaller particles

Students can:
a. Identify evidence that suggests there is a fundamental building block of matter (DOK 1)
b. Use the particle model of matter to illustrate characteristics of different substances (DOK 1-2)
c. Develop an evidence based scientific explanation of the atomic model as the foundation for all chemistry (DOK 1-3)
d. Find and evaluate appropriate information from reference books, journals, magazines, online references, and databases to compare and contrast historical explanations for the nature of matter (DOK 1-2)
Inquiry Questions:
1. In the world of science what makes something a building block?
Relevance and Application:
1. Living things consist of the same matter as the rest of the universe.

2. Atoms may stick together in well-defined molecules or be packed together in large arrays.
Different arrangements of atoms into groups compose all substances

Students can:
a. Explain the similarities and differences between elements and compounds (DOK 1-2)
b. Identify evidence suggesting that atoms form into molecules with different properties than their components (DOK 1-2)
c. Find and evaluate information from a variety of resources about molecules (DOK 1-2)
Inquiry Questions:
1. Why do substances behave differently? For example, why does water pour rapidly while syrup pours slowly?
Relevance and Application:
1. Different arrangements of atoms provide different properties.
2. Very small devices consist of large numbers of arranged groups of atoms that perform a specific function.

4. Distinguish among, explain, and apply the relationships among mass, weight, volume, and density

Students can:

a. Explain that the mass of an object does not change, but its weight changes based on the gravitational forces acting upon it (DOK 1)
b. Predict how changes in acceleration due to gravity will affect the mss and weight of an object (DOK 1-2)
c. Predict how mass, weight, and volume affect density (DOK 1-2)
d. Measure mass and volume, and use these quantities to calculate density (DOK 1)
e. Use tools to gather, view, analyze, and report results for scientific investigations about the relationships among mass, weight, volume, and density (DOK 1-2)

Inquiry Questions:

1. Which of the following is the best recommendation for a person trying to lose weight and why?
   - Reduce the number of calories he or she eats.
   - Exercise more.
   - Go to the Moon.
2. If weight and mass are not the same thing, why might people use the words interchangeably?
3. Describe a situation in which mass would be the most useful information to know about an object? Do the same for weight, volume, and density.

5th Grade

1. Mixtures of matter can be separated regardless of how they were created; all weight and mass of the mixture are the same as the sum of weight and mass of its parts

Students can:

a. Develop, communicate, and justify a procedure to separate simple mixtures based on physical properties (DOK 1- 3)
b. Share evidence-based conclusions and an understanding of the impact on the weight/mass of a liquid or gas mixture before and after it is separated into parts (DOK 1-3)

Inquiry Questions:

1. How do mixtures act similarly and differently from their original materials?
2. What are some ways that mixtures can be separated?

Relevance and Application:

1. Knowing properties helps determine how to separate mixtures.
2. Mixtures make up Earth's layers. For example, rocks are mixtures of minerals, and minerals are mixtures of elements and compounds.

4th Grade

1. Energy comes in many forms such as light, heat, sound, magnetic, chemical, and electrical

Students can:

a. Identify and describe the variety of energy sources (DOK 1)
b. Show that electricity in circuits requires a complete loop through which current can pass (DOK 1)
c. Describe the energy transformation that takes place in electrical circuits where light, heat, sound, and magnetic effects are produced (DOK 1-2)

d. Use multiple resources – including print, electronic, and human – to locate information about different sources of renewable and nonrenewable energy (DOK 1-2)

Inquiry Questions:

1. How do we know that energy exists within a system such as in an electrical circuit?
2. How can heat be transferred from one object to another?

Relevance and Application:

1. There are multiple energy sources, both renewable and nonrenewable.
2. Energy can be used or stored. For example, it can be stored in a battery and then used when running a portable media player such as an iPod.
3. Transportation, manufacturing, and technology are driven by energy.

2nd Grade

1. Changes in speed or direction of motion are caused by forces such as pushes and pulls

Students can:

a. Identify and predict how the direction or speed of an object may change due to an outside force (DOK 1-2)
b. Analyze and interpret observable data about the impact of forces on the motion of objects (DOK 1-2)

Inquiry Questions:

1. What must be known about a force to predict how it will change an object's motion?
2. How does applying a force affect the way an object moves?
3. How do an object's properties affect how it will move when a force is applied?

Relevance and Application:

1. Technology makes our lives easier by applying what we know about how forces can affect objects such as tires, bicycles, and snow throwers.
2. In many recreational activities, such

1st Grade

Solids and liquids have unique properties that distinguish them

Students can:

a. Analyze and interpret observations about solids and liquids and their unique properties (DOK 1-3)
b. Identify the similarities and differences of two or more groups of solids or liquids (DOK 1-2)
c. Classify solids and liquids based on their properties, and justify your choice based on evidence (DOK 1-3)

Inquiry Questions:

1. What do all liquids have in common? What are some differences they can have and still be considered liquids?
2. What do all solids have in common? What are some differences they can have and still be considered solids?
3. What properties of liquids can be used to sort them?
4. What properties of solids can be used to sort them?

Relevance and Application:

1. The properties of solids and liquids help us understand how to use matter. For example, we not build a bridge out of tissue because it is not strong enough.
2. There are practical reasons for sorting liquids or solids.

Kindergarten

2. Objects can be sorted by physical properties, which can be observed and measured

Students can:

a. Observe, investigate, and describe how objects can be sorted using their physical properties (DOK 1-2)
b. Explain why objects are sorted into categories (DOK 2)
c. Sort a set of objects based on their physical characteristics, and then explain how the objects are sorted (DOK 1-2)

Inquiry Questions:

1. How can objects belong to more than one group?
2. How do you decide which properties are most important when putting objects into groups?

Relevance and Application:

1. Materials have uses based on properties such as whether they are glass or plastic.
2. Machines such as coin sorting machines can be designed to sort things efficiently.

1. Objects can move in a variety of ways that can be described by speed and direction

Students can:

a. Observe, investigate, and describe how different objects move (DOK 1-2)
b. Describe the motion of a child who is playing (DOK 1)

Inquiry Questions:

1. What can change how fast or slow an object travels?
2. What indicates which objects will be easier or harder to move?

Relevance and Application:

1. People must push harder to move their bikes, skateboards, or scooters as they go faster or as they go up a hill.
2. Information about motion can be represented in pictures, illustrations, and simple charts.