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## Space, Time and Matter (Physical Science)

### Essential Question: What are the different forms that matter can take and how do

Enduring Knowledge	Science Concepts	GE	Evidence of Understanding
<p><b>Properties of Matter:</b> All living and non-living things are composed of matter having characteristic properties that distinguish one substance from another.</p>	<p>a. The density of a substance can be measured and quantified as the mass (amount of a substance) that is contained per unit volume of that substance. b. Changing the temperature of materials will change the density of the material.</p>	9	<p>Calculating the density of regularly and irregularly shaped objects Explaining why all three states of matter can be observed in a room that has a uniform temperature</p>
<p><b>Properties of Matter:</b> All living and non-living things are composed of matter having characteristic properties that distinguish one substance from another.</p>	<p>a. All matter is made up of atoms that are too small to see. b. Atoms bond together to form molecules. c. An element is a substance in which the atoms are all the same. d. All living and non-living things are formed from combinations of about 100 elements.</p>	10	<p>Illustrating through words or representations, the differences between atoms and molecules Recognizing that all living things and non-living things are formed from combinations of about 100 elements</p>
<p><b>Properties of Matter:</b> All living and non-living things are composed of matter having characteristic properties that distinguish one substance from another.</p>	<p>a. Atoms and molecules are in perpetual motion. b. The atoms in solids only vibrate closely together. c. The atoms in liquids loosely slide past one another. d. The atoms in gases move freely apart from one another, and collide with one another.</p>	12	<p>Modeling (plays, models, diagrams) molecular motion of the three states of matter and explaining how that motion defines each state</p>
<p><b>Properties of Matter:</b> All living and non-living things are composed of matter having characteristic properties that distinguish one substance from another.</p>	<p>a. There exists a predictable relationship among the volume, temperature, and amount of a gas and the pressure the gas exerts. b. For any specified amount of a gas, the pressure that the gas exerts will increase as the temperature increases or the volume of the gas decreases. The pressure that the gas exerts will decrease as the temperature decreases or the volume of the gas increases. c. Gases exert pressure in all directions.</p>	13	<p>Using real world examples (tires, balloons, soda) to predict and explain the effect that a change in one variable (pressure, temperature or volume) will have on the other(s)</p>

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**these forms behave under different conditions?**

Concepts in Detail	Potential Inquiries/Activities	Resources/Notes
<ul style="list-style-type: none"> <li>- The density of a substance can be measured and quantified as the mass (amount of a substance) that is contained per unit volume of that substance.</li> <li>- Density = mass ÷ volume (D = M/V)</li> <li>- Changing the temperature of materials will change the density of the material.</li> <li>- Increasing the temperature will increase the volume of a substance, which will decrease the density.</li> <li>- Decreasing the temperature will decrease the volume of a substance, which will increase the density.</li> </ul>	<p>Does the shape and/or amount of clay affect its density? (use same type of clay) How are the densities of liquid and solid water different?</p>	
<ul style="list-style-type: none"> <li>- Atoms are supermicroscopic particles that make up all matter.</li> <li>- You can see some atoms with very powerful microscopes.</li> <li>- Matter is anything that takes up space and has mass.</li> <li>- Molecules are 2 or more atoms that are connected together.</li> <li>- The atoms that make up molecules can be the same type of atom or different.</li> <li>- There are about 100 different types of atoms.</li> <li>- An element is a certain material that has just 1 type of atom in it.</li> <li>- All living and non-living things are made up of combinations of some of the 100 elements.</li> <li>- Like a piece of gold, there are some non-living things that are made up of many atoms of the same element.</li> </ul>	<p>Activity: Use different colored circles to represent different atoms; have students show atoms in molecules when presented with chemical formula.</p> <p>Activity: Show students samples of different elements and compounds (gold, iron, salt, marble chips, water).</p>	
<ul style="list-style-type: none"> <li>- All atoms and molecules are in constant motion.</li> <li>- Atoms in solids are arranged tightly and are very close together.</li> <li>- Atoms in solids vibrate.</li> <li>- Atoms in liquids are arranged less tightly than solids but are still close together.</li> <li>- Atoms in liquids are able to "flow" around each other.</li> <li>- Atoms in gases are not in any particular arrangement.</li> <li>- Atoms in gases are able to move where their environment allows them to, and often collide with each other.</li> </ul>	<p>How can you show the phase of matter and the distance between the molecules on a graph?</p> <p>Activity: Use students are molecules and act out phases of matter.</p>	
<ul style="list-style-type: none"> <li>- There exists a predicable relationship among the volume, temperature, and amount of a gas and the pressure the gas exerts.</li> <li>- As volume, temperature, or pressure increases or decreases, the others will change, given a constant amount of gas.</li> <li>- If you increase the temperature of a gas, the volume or the pressure will increase depending on which one is held constant.</li> <li>- If you increase the volume of a gas, the temperature or the pressure will decrease depending on which one is held constant.</li> <li>- If you decrease the temperature of a gas, the pressure that the gas exerts will decrease or the volume of a gas will decrease, depending on which one is held constant.</li> <li>- If you decrease the volume of a gas, the temperature or pressure will increase, depending on which one is held constant.</li> <li>- If you increase the pressure that a gas exerts, the volume decreases or the temperature increases, depending on which one is held constant.</li> <li>- If you decrease the pressure that a gas exerts, the volume increases or the temperature decreases, depending on which one is held constant.</li> <li>- Gases exert pressure in all directions.</li> </ul>	<p>Using a balloon, predict and explain the effects that a change in temperature will have on the pressure or volume of the balloon.</p> <p>When you decrease the pressure that a gas exerts, what happens to the gas's volume? (open soda bottle with balloon fitted over top).</p>	

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## Space, Time and Matter

### (Physical Science)

#### Essential Question: What are the different changes matter goes through?

Enduring Knowledge	Science Concepts	GE	Evidence of Understanding
<p><b><u>Physical Change:</u> A transfer of energy can result in the physical change of state of a substance .</b></p>	<p>a. An increase in the temperature of substances causes increased motion of the atoms and molecules in the substance.            b. As the temperature and motion of molecules in a substance increase, the space between molecules in the substance increases, possibly causing a change in state.</p>	<p>14</p>	<p>Constructing their own models representing the states of matter at the molecular level, and explaining the effect of increased and decreased heat energy on the motion and arrangement of molecules            Observing the physical processes of evaporation and condensation, and accounting for the disappearance and appearance of liquid water in terms of molecular motion and conservation of mass</p>
<p><b><u>Chemical Change:</u> When matter undergoes a chemical change, it turns into a new and different substance whose properties are different than the original. No matter how substances interact with one another, the total mass of the system remains the same.</b></p>	<p>a. Chemical change is a transformation of matter that results from the interaction of the molecules in a substance, and a new substance results (e.g., electrophoresis of water). Chemical change is not reversible.            b. During chemical change, the atoms in the substances are rearranged, and because the mass of the product of a chemical reaction is the same as the mass of the reactants in that reaction. We know the total number of atoms in the substances stays the same.</p>	<p>15</p>	<p>Observing evidence of chemical change and offering qualitative explanations for the observed changes in substances in terms of interaction and rearrangement of the atoms, and the production of new substances with different characteristics but the same mass as the original substance</p>

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Concepts in Detail	Inquiries/Activities	Resources/Notes
<ul style="list-style-type: none"> <li>- When substances get more heat energy, the motion of their atoms and molecules will increase.</li> <li>- We can measure this increase in heat energy as an increase in temperature.</li> <li>- As atoms or molecules receive heat energy, they vibrate or move more quickly.</li> <li>- This increased movement increases the spaces between atoms and molecules, which could possibly cause a change in state.</li> <li>- Solids: atoms and molecules can break out of their rigid configuration;</li> <li>- Liquids: atoms and molecules could spread apart enough to become a gas;</li> <li>- Gases: the volume of the gas will increase because the atoms and molecules will be increasing the spaces between each other, and thereby, take up more space.</li> <li>- During all these physical changes, the mass of the substances remains the same.</li> </ul>	<ul style="list-style-type: none"> <li>- Apply inquiries and activities from GE 12.</li> <li>- How can you show the relationship between temperature and distance among molecules on a graph?</li> <li>- When you increase the temperature of a material, what happens to its volume? (Teacher boils water in Erlenmeyer flask with balloon fitted over top.)</li> </ul>	
<ul style="list-style-type: none"> <li>- Matter can change forms.</li> <li>- A chemical change is a transformation of matter that results from the interaction of the molecules in a substance. A new substance results.</li> <li>- Some indicators of a chemical change would be: change in color, creation of light, gas production, solid production.</li> <li>- A chemical change can not be reversed.</li> <li>- During a chemical change, the atoms in substances are rearranged and, because the mass of the products of a chemical reaction is the same as the mass of the reactants in that reaction, we know the total number of atoms in the substance remains the same.</li> <li>- Rearranged atoms create a different substance with different properties.</li> </ul>	<ul style="list-style-type: none"> <li>- Use properties of matter to prove that the reactants of a chemical change are different from the products (baking soda and vinegar).</li> <li>- Using your knowledge that atoms have mass, prove that the total number of atoms in the reactants and products of a chemical reaction are the same (baking soda, vinegar, and balloon, or ammonia and Epson salts).</li> </ul>	

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### (Physical Science)

#### Essential Question: What happens when objects interact, and how does this affect

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<p><b><u>Motion:</u> Everything is constantly moving; motion is relative, but the motion of an object can be described and predicted by tracing and measuring its position over time.</b></p>	<p>a. Velocity indicates the speed and the direction of a moving object.            b. Momentum is the characteristic of an object in motion that depends on the object's mass and velocity. Momentum provides the ability for a moving object to stay in motion without an additional force.            c. Acceleration is a relationship between the force applied to a moving object and the mass of the object (Newton's Second Law.)</p>	19	<p>Designing investigations that illustrate the effect of a change in mass or velocity on an object's momentum            Describing that the acceleration of an object is proportional to the force on the object and inversely proportional to the mass of the object</p>
<p><b><u>Force:</u> Force is an influence that can change the motion of an object.</b></p>	<p>a. If there is no change in the speed or direction of a moving object or stationary object, the forces acting on the object are balanced.            b. If there is a change in the speed or direction of an object, an outside force needs to be applied and the forces acting on the object are unbalanced (Newton's First Law.)</p>	21	<p>Diagramming or describing, after observing a scenario with a moving object, the forces acting on the object before and after it is put in motion (Students include in their diagram or description the effect of these forces on the motion of the object)</p>
<p><b><u>Force:</u> Force is an influence that can change the motion of an object.</b></p>	<p>a. The force of gravity depends on the amount of mass objects have and how far apart they may be.            b. The force of gravity is hard to detect unless at least one of the objects has considerable mass.</p>	22	<p>Describing the effects of gravitational force on objects in the solar system, and identifying evidence that the force of gravity is relative to the mass of objects and their distance apart</p>
<p><b><u>Scale, Distances, Star Formation, Theories, Instrumentation:</u> The Universe, Earth, and all Earth systems have undergone change in the past, continue to change in the present, and are predicted to continue changing in the future.</b></p>	<p>a. The Sun is many thousands of times closer to the Earth than any other star. The Sun is located near the edge of a disc-shaped galaxy of stars.</p>	45	<p>Identifying and labeling the location of the Sun in our solar system and its relationship to the galaxy</p>

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Concepts in Detail	Potential Inquiries/Activities	Resources/Notes
<ul style="list-style-type: none"> <li>- Velocity indicates the speed and the direction of a moving object. For example, the velocity of a car could be 55 mph East.</li> <li>- Momentum describes an object's motion based on its mass and velocity.</li> <li>- Small, slow objects have less momentum than large, fast ones.</li> <li>- Momentum is a force. With greater momentum, an object will be able to apply more force to another object.</li> <li>- Newton's 2nd Law: when an object is accelerated, the amount of acceleration depends upon the mass of the object and the size of the force applied to it.</li> <li>- The amount of acceleration will be greater as the force applied to the object increases, and the mass of the object decreases.</li> <li>- Acceleration is defined as a change in speed and/or direction (a change in velocity.)</li> </ul>	<ul style="list-style-type: none"> <li>- Design an investigation that shows how a change in an object's mass or velocity affects momentum.</li> <li>- Design an investigation that shows how an object's acceleration is related to the force applied to it.</li> <li>- Design an investigation that shows how objects of different masses accelerate differently when force is constant.</li> </ul>	
<ul style="list-style-type: none"> <li>- If there is no change in the speed or direction of a moving object or stationary object, the forces acting on the object are balanced, or there is an absence of forces acting on it.</li> <li>- If unbalanced forces act upon an object, the object's speed and/or direction will change.</li> <li>- Newton's 1st Law: an object at rest or an object in motion will remain at rest or remain at a constant velocity unless acted upon by an unbalanced force.</li> </ul>	<ul style="list-style-type: none"> <li>- See Evidence of Understanding column.</li> </ul>	
<ul style="list-style-type: none"> <li>- The amount of gravity that an object exerts on another object depends on its mass and the distance between the objects.</li> <li>- The force of gravity is hard to detect when distances between objects are great or if the masses of objects are small.</li> <li>- The force of gravity is easier to detect when distances between objects are small and the mass of one object is much greater than the other.</li> <li>- The force of gravity is easiest to detect when objects have a lot of mass.</li> </ul>	<ul style="list-style-type: none"> <li>- Draw a diagram of the solar system showing the strengths of gravity with arrows between different bodies.</li> </ul>	
<ul style="list-style-type: none"> <li>- The Sun is a star.</li> <li>- The Sun is the closest star to the Earth. It is in the center of the solar system.</li> <li>- The closest star after the Sun is thousands of times as far away from the Earth as the Sun is.</li> <li>- The solar system is found in the Milky Way Galaxy.</li> <li>- The Milky Way is disk-shaped and made of arms that are rotating around the center.</li> <li>- The solar system is found at the edge of the galaxy in one of the arms.</li> <li>- The Milky Way is filled with at least 200 billion stars.</li> </ul>	<ul style="list-style-type: none"> <li>- See Evidence of Understanding column.</li> </ul>	