CORPS
Central Oklahoma Rural Partnership For Science

PHENOMENON-BASED INSTRUCTIONAL TASK | **GRADE LEVEL:** 7th Grade

CHEMICAL CHANGE

TARGETED DCI AND/OR ASSOCIATED PE

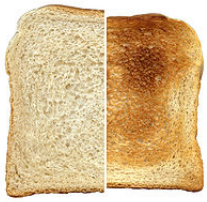
PE | MS-PS1-2
Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

DCI | 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.

POSSIBLE DRIVING PHENOMENA

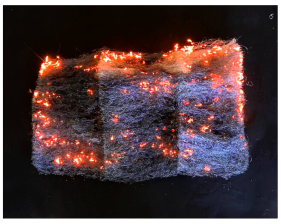
Student observation or initial interaction:

Students observe the process of cooking via images, video, or live demonstrations.



Student observation or initial interaction:

Students observe images of iron or actual iron materials that have rusted or watch videos of steel wool burning.



Student observation or initial interaction:
Students observe images, videos, or demonstrations of precipitation reactions between sodium hydroxide (NaOH) and various solutions containing transition metals such as iron, zinc, or copper.

Student observation or initial interaction:

Students observe videos or demonstrations of silver nitrate solution and sodium chloride solution combining to form a white precipitate.

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Phenomena explanation for teachers:
These phenomena involve a chemical reaction occurring due to the oxidation of each substance. A chemical reaction is the process by which atoms that make up a specific substance interact with atoms of another substance to form new substances with different compositions and properties. In the reactions involving marshmallows and bread, heat causes the breakdown of sugars into new carbon substances with a darker color and an accompanying release of water vapor. When iron rusts, it combines with oxygen from the air in the presence of water to form iron hydroxide. When steel wool is burned, the high temperature causes it to combine with oxygen to produce iron oxide. This reaction releases a lot of heat, which keeps the reaction going until all of the steel wool has been converted to iron oxide. Even though these reactions cannot be seen, evidence of a chemical reaction (e.g. changes in color and texture, release of heat, formation of gases) can be observed to identify that a reaction has occurred.

Phenomena explanation for teachers:
These phenomena involve a chemical reaction occurring as a result the interaction of two substances to form new substances. The atoms of the original substances (reactants) rearrange to form different substance (products) with different atomic structures and distinct physical properties. The reactions shown here are called precipitation reactions because ions in two different soluble solutions are mixed together and recombine to produce an insoluble ionic solid called a precipitate**.** If a solution of any soluble transition metal compound (e.g. copper sulfate, iron nitrate, zinc chloride) is mixed with sodium hydroxide solution, a displacement reaction occurs. The sodium is the more reactive metal and displaces the transition metal from its compound. A transition metal hydroxide is produced as a result. This hydroxide is insoluble in water and precipitates out as a solid in the liquid. Even though the reactions themselves cannot be seen, formation of a precipitate provides evidence of a chemical reaction because it indicates the formation of a new (insoluble) substance.

HOW DOES THE PHENOMENON CONNECT TO THE DCI OR PE?

All matter is made up of atoms. Pure substances have physical and chemical properties that can be used to identify them. Pure substances are made of a single type of atom, such as two oxygen atoms bonding together to make a molecule of oxygen (i.e. O_2), or single types of molecules, such as table sugar (sucrose, $C_{12}H_{22}O_{11}$). A pure substance has the same properties no matter the amount of the substance present. As students begin to understand basic atomic structure, they can analyze chemical and physical properties of various substances and determine similarities and differences among substances. Atoms bond together with other atoms to form molecules, which can range in size from two atoms to thousands of atoms.

A chemical reaction is the process by which atoms that make up a specific substance interact with other atoms of another specific substance to form new substances with different compositions and properties. Even though reactions cannot be seen, evidence that a chemical reaction has occurred can be observed to determine if a reaction has occurred. Students can plan and conduct investigations, such as burning sugar or steel wool, reacting baking soda with vinegar, mixing zinc with hydrochloric acid (HCl), or mixing calcium chloride and sodium carbonate in order to collect data. Common evidence that a chemical reaction has occurred includes color change, temperature change, formation of a gas, or formation of a precipitate (a solid formed from mixing of solutions).

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GATHERING AND REASONING IN ORDER TO CONSTRUCT AND REFINE EXPLANATIONS:

How could students gather evidence using SEPs and CCCs that will help them construct/refine a supported explanation of the phenomenon?

1. INITIAL ENGAGEMENT WITH THE PHENOMENON:

- Students observe the phenomenon through first-hand investigations, demonstrations, or videos. Students can begin to ask scientific questions that can be investigated.
- Students can plan and conduct investigations to collect data about the characteristics of substances before and after changes.
- Students can analyze data from their investigations, including the properties of the substances both before (reactants) and after (products) the chemical reaction, to determine if a chemical reaction has occurred and if new substances have been formed.

2. CONTINUING EXPLORATION:

Students can develop models to both understand and demonstrate how they think different combinations of atoms bond together to form new substances. Student molecular models could include drawings or other visual representations, ball and stick models, other physical models, or computer representations.

GUIDING QUESTIONS:

- What patterns do you notice within the changes you observed?
- What patterns do you notice across the changes that you observed?
- What do you think is the cause of the patterns you observed?
- Draw a model that could explain the patterns you observed. Is this model smaller, larger, or the same size as the phenomenon that you observed?
- What happens to the stability of this system as the change occurs?
- What are the parts of the system involved in the change you observed?
- How do these parts interact with each other?
- How do the molecules move in the change you observed?
- How are the atoms in the molecules involved being rearranged into different molecules?
- What evidence is there that matter is conserved in these changes?

COMMUNICATE FINAL EXPLANATION OF THE PHENOMENON:

How might students communicate their understanding of the targeted DCI or PE in an explanation supported by evidence?

Students can explain that changes can be physical and/or chemical. In a physical change the substance remains the same. However, in a chemical change a new substance is formed.

Possible formats for constructing explanations of this phenomenon.

- Students can develop models to show how a chemical change occurs.
- Students can present data, such as the characteristics of substances both before and after a change, to make a claim that a new substance has been formed and that a chemical change has occurred.
- Students can use a card sort with different scenarios of changes that substances could undergo. Students can then construct arguments, supported by evidence, about which changes are physical and which are chemical.

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