

## PHENOMENA, DRIVING QUESTIONS AND STORYLINE

### CHEMICAL REACTIONS

This unit explores the anchoring phenomenon: Chemical reactions can be used to solve problems but can also create problems. Examples explored include combining certain substances releases a gas, combining certain substances releases energy (such thermal energy, light, electricity), and combining certain liquids results in a color change or formation of a solid. Students generate and answer questions such as: What happens when new materials are formed? How do particles combine into new substances? How can chemical reactions solve and create problems?

Phenomenon	Driving Questions	Guiding Questions	Activities	PE	Storyline/Flow (How an activity leads to subsequent activities)
Sometimes when we make a product, we get side products that we don't want.	What are the desired products and wastes from a chemical reaction?	How are chemical processes used to produce circuit boards? (Activity 1)	1 (12, 13)	MS-PS1-2 MS-PS1-5	Chemical reactions are used to produce desirable products (circuit boards), but they also lead to production of wastes (by-products) from chemical processes. (Substances can be identified by their properties and can't be made to just "go away.")
When you mix some substances, they do things like fizz, change color, or change temperature.	What is happening when something fizzes, changes color, or changes temperature when you mix substances?	How can you tell if a chemical change has occurred? (Activity 2)  What is the difference between a physical and a chemical change? (Activity 3)  Is the change observed a physical change or a chemical change (reaction)? (Activity 5)	2, 3, 5	MS-PS1-2 MS-PS1-5 MS-PS1-6	Four common signs frequently indicate that chemical reactions have taken place.  Careful observation of properties is needed to distinguish physical and chemical changes.  In this activity, students apply what they have learned about physical and chemical changes to several scenarios.

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## CHEMICAL REACTIONS (continued)

Phenomenon	Driving Questions	Guiding Questions	Activities	PE	Storyline/Flow (How an activity leads to subsequent activities)
In chemical reactions, the total amount of matter after the reaction is the same as the total amount of matter before the reaction.	How is mass conserved during a chemical reaction?	What happens to atoms and molecules during a chemical reaction? (Activity 4)  What happens to the mass of the reactants during a chemical reaction? (Activity 6)  Why is mass always conserved in chemical reactions? (Activity 7)	4, 6, 7	MS-PS1-2 MS-PS1-5	Atoms are reorganized and conserved in chemical reactions. Changes in the organization of particles at the atomic/ molecular scale helps to explain physical and chemical changes and to distinguish one from the other.  The total mass of the products of a reaction equals the total mass of the reactants.  The conservation of atoms during reactions explains the conservation of mass.
When you mix some chemicals, they get hot or cold or give off electricity or light.	How can chemical reactions be used to provide energy?	How can we improve the design of a chemical battery? (Activity 8)  What does thermal energy have to do with chemical reactions? (Activity 9)  How do engineers design and test a prototype hand warmer? (Activity 10)  How can the hand warmer design prototypes be redesigned and improved? (Activity 11)	8, 9, 10, 11	MS-PS1-2 MS-PS1-6 MS-ETS1-3 MS-ETS1-4	Changing certain variables can affect how much energy is produced from a reaction.  Chemical reactions can be used to release or absorb thermal energy.  Variables can be modified as a device, such as a cold pack, is designed and refined through testing.

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### CHEMICAL REACTIONS (continued)

Phenomenon	Driving Questions	Guiding Questions	Activities	PE	Storyline/Flow (How an activity leads to subsequent activities)
Sometimes when we make a product, we get side products that we don't want— but we can do something about it.	How can chemical reactions be used to clean up waste?	<p>Which metal is best at reclaiming copper from the used copper chloride solution? (Activity 12)</p> <p>Which compound in solution is best for reclaiming copper from the used copper chloride solution? (Activity 13)</p>	12, 13	MS-PS1-2 MS-PS1-5	Several chemical reactions can be used to reclaim copper, and the best reaction to use can be evaluated based on several criteria.