Chemical Reactions: Discussion Guide

Overview
When a candle burns or a nail rusts, a chemical reaction is taking place. Explore the chemical processes that occur when one substance reacts with another, and the new substances that result. From soap to ash to table salt, look at common compounds in the everyday world and discover how they acquire their chemical properties. Trace these processes to the role of electrons forming chemical bonds. Learning about fire and fireworks makes the study of chemical reactions come alive. Students will see that chemistry is everywhere—and can be exciting!

Classroom Activities

1. Show the segment “Electrons Form Chemical Bonds” from the video Greatest Discoveries with Bill Nye: Chemistry.

   - **Pre-Viewing Activity:** Introduce the video clip by defining the terms *element, atom, and electron.* Ask students what they know about these terms. Make sure they understand that electrons surround the nucleus of an atom and have a negative charge.

   - **Note-taking:** Instruct students to take notes on the video segment, and model note-taking methods with the overhead projector. Show the video segment twice to allow students another opportunity to record important information, since considerable information is conveyed in the video in a short time.

   - **Discussion:** Discuss common chemical reactions in everyday life. Ask students: What is a chemical reaction? What are common everyday chemical reactions? What are chemical reactions in nature? How do these occur? What is their purpose? Prompt students to consider reactions that they may have experience with but might not think of immediately, such as bread rising, food cooking, or fruit ripening.
- **Brainstorming**: Have students brainstorm a list of chemical reactions and processes that occur in their bodies and around them every day (e.g., breathing, digestion, combustion in a car engine, photosynthesis in leaves, rusting, decomposing). Remind students that in each reaction, electrons form bonds and new substances are formed.

- **Biography**: Have students read a biographical article about Gilbert Lewis and his experiments. Ask students to discuss why Lewis’s ideas marked a breakthrough in scientific understanding.

- **Research**: Invite students to research other famous chemists, such as Marie Curie, Alfred Noble, Edward Tatum, and Louis Pasteur, or return to their work from the previous DiscoverySchool discussion guide, Icons of Science, to consider chemists they have studied already with a new understanding of their scientific work.

- **Modeling**: Ask students to develop a model showing a) an atom’s electrons and b) an atom forming a bond with another atom by giving up and accepting one or more electrons. Students might draw a diagram, or use beads on wires to represent the atom’s shells of electrons.

2. Show the “Chemical Reactions” segment from the video *Elements of Chemistry: Compounds and Reactions*. (Access to unitedstreaming is required.)

- **Diagramming**: Have students diagram a chemical reaction—one or more substances converted into a new substance with different physical and chemical properties. Explain that equations are shorthand for writing reactions, and that because matter can neither be created nor destroyed, both sides of an equation must balance.

- **Discussion**: Ask students: What happens in a chemical reaction? What is a chemical compound? Why do some substances react more easily together than others? What can make a reaction happen more quickly?

- **Brainstorming**: List on the chalkboard common compounds such as toothpaste, shampoo, sunscreen, lip gloss, hand cream, salt, and baking soda. Ask students to brainstorm to add to the list, and emphasize that these frequently used compounds are formed by chemical reactions.

- **Chart**: Ask students to make a two-column chart listing compounds in one column and mixtures in the other. Discuss the differences.

- **Demonstrations**: Ask students to perform simple demonstrations of chemical reactions, such as the following:
  - Mixing vinegar with baking soda to release carbon dioxide and water
- Combining hydrogen peroxide with yeast to form oxygen and water
- Dipping pennies into a vinegar and salt solution, which removes the copper oxide coating to make the pennies shiny
- Coating half of a cut apple with lemon juice and leaving half plain

**Online Experiment:** Have students do virtual chemistry experiments or watch chemistry demonstrations online to see chemical reactions. Web sites for this activity include Nye Labs [www.billnye.com](http://www.billnye.com), Try Science [www.tryscience.org](http://www.tryscience.org), and Virtual Chemistry Lab [www.chem.ox.ac.uk/vrchemistry](http://www.chem.ox.ac.uk/vrchemistry).

**Review:** Review the terms for the types of chemical reactions shown in the video: *synthesis*, *single replacement* and *double replacement*. Discuss the differences and similarities. Have students provide examples of each.

**News:** Have students bring in news articles related to chemistry and new chemical substances. These might include new fabrics, medicines, cosmetics, or foods. Display these on a class bulletin board, and discuss the usefulness of chemistry for the new products.


**Discussion:** Ask students: How do fireworks involve chemical reactions? What makes the chemical reaction occur? What makes the chemical reaction so intense? What is the product of this reaction?

**Diagram:** Have students create diagrams labeling the components of fireworks: *lift charge, bursting charge, star bundle, fuse, aerial shell, and mortar tubes*. Discuss where chemical reactions take place within the fireworks.

**Visualization:** Have students use colored markers to indicate the colors the following metals create in fireworks: strontium, barium, and copper. Ask them to draw each element’s electron shells.

**Descriptive Writing:** Replay the video and ask students to describe fireworks either in prose or poetry. Encourage them to use vivid words, images, metaphors, and similes to create word pictures. Have volunteers read their descriptions aloud to the class.
- **Glossary:** Have students keep a glossary defining terms from this unit, including *star bundle* and *exothermic reaction*. Make sure that students understand that some reactions create heat energy; these are *exothermic*, while reactions that absorb or take in heat energy are *endothermic*.

- **Speaker:** Invite a chemist or science teacher to class to explain the chemical reaction that occurs to produce fireworks, answer questions about chemical reactions, and discuss careers in chemistry.

4. Show “The Chemistry of Fire” segment from the video *Physical Science: Chemistry*. (Access to *unitedstreaming* is required.)

- **Discussion:** Discuss with students: What happens when something catches fire? What three ingredients are needed to create and sustain fire? What are the products of fire? How do firefighters stop this chemical reaction?

- **Demonstration:** Light a candle and discuss what is occurring. Make sure that students understand that burning is the rapid oxidation of fuel. In chemical terms, the substance loses electrons as it combines with oxygen during burning. Ask students: Why do matches have sulfur heads?

- **Panel:** Invite a firefighter and a science teacher to class to discuss firefighting techniques and the chemistry behind how they work.

- **Drawing:** Ask students to draw the elements of a fire with callouts indicating the three necessary ingredients.

- **Writing:** Have students describe fires they have seen (e.g., bonfire, charcoal grill fire, match, fireplace, etc.) and the ingredients that created them.

- **Equation:** Discuss what happens when fire breaks out. Show students a word equation for fire as fuel + oxygen → heat + water + carbon dioxide. Ask students to predict the causes and results of forest fires.

- **Posters:** Assign each student to investigate a common chemical reaction and make a poster picturing it and showing its equation.

**Academic Standards**

**Mid-continent Research for Education and Learning (McREL)**

McREL’s Content Knowledge: A Compendium of Standards and Benchmarks for K–12 Education addresses 14 content areas. To view the standards and benchmarks, visit [http://www.mcrel.org/compendium/browse.asp](http://www.mcrel.org/compendium/browse.asp).