



#8878

## THE REACTIVITY OF ELEMENTS

Grade Levels: 9-12

15 minutes

BENCHMARK MEDIA 1998

### DESCRIPTION

Science lab experiments demonstrate what happens visibly and at a molecular level with the Group 1 highly reactive metals and the Group 17 highly reactive halogens from the periodic table. Experiments also illustrate the range of reactivity among metals. Video has three 5-minute segments for convenience.

### ACADEMIC STANDARDS

#### Subject Area: Physical Sciences

- ◆ Standard: Understands the sources and properties of energy
  - Benchmark: Knows how the energy associated with individual atoms and molecules can be used to identify the substances they comprise; each kind of atom or molecule can gain or lose energy only in particular discrete amounts, and thus can absorb and emit light only at wavelengths corresponding to these amounts

### INSTRUCTIONAL GOALS

1. To understand highly reactive metals in Group 1.
2. To understand highly reactive halogens in Group 17.
3. To understand the range of reactivity among metals.



### BACKGROUND INFORMATION

#### Alkali Metals

The reactivity of the alkali metals, Column 1 on the periodic table, increases as you move down the family. Since the effective nuclear charge within a family is essentially the same, the reactivity increases because of increasing size of the atoms. A size increase occurs because of one additional energy level per row. Cesium is the most reactive and its reaction with water is very explosive.

Lithium is the only alkali metal that reacts with nitrogen in the air to form lithium nitride,  $\text{Li}_3\text{N}$ . The stability of the ionic compound produced affects which oxide the alkali metal will form based on the attraction of the positively charged alkali metal ion to either the oxide, peroxide, or superoxide ion.

## Halogens

The halogens are volatile, diatomic elements, which react predictively with a variety of other elements. Fluorine is the most electronegative and therefore the most reactive. It is the completion of an almost full outermost energy level containing seven electrons that accounts for the reactivity of the halogens. The abundance of the halogens corresponds to their order in the family.

### BEFORE SHOWING

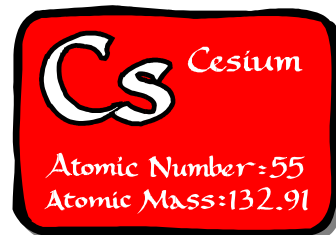
1. Compare the rate of two reactions: a) neutralization of alkaline bicarbonate solution with dilute acid and b) reduction of copper from solution on the surface of iron. Add some powdered sodium bicarbonate to dilute vinegar solution containing a pH indicator. The change in color will indicate a change from acid to alkaline. Assign the students to work in small groups. One person can record the time, another can add the bicarbonate powder to the vinegar while others record observations. Then, using a copper sulfate solution, place some shiny tacks or small nails into the solution in a test tube and observe how long it takes for the nails to become fully coated with a layer of dark copper. Discuss observations. Discuss which reaction seemed to proceed more rapidly and how the students knew that there was a reaction. Discuss the limitations of these rate experiments.
2. Discuss how the atomic structure of an element changes when reading down a group in the periodic table. Focus on some elements in Group 1 and representative halogens in Group 17. Discuss how differences in the number and distribution of electrons surrounding the nucleus may determine how reactive the elements are. Make a chart on the board with two columns, one labeled Group 1 "Alkali Metals" and the other Group 17 "Halogens." Enter the names of the elements in boxes beneath each heading and have students describe the atomic structure for each element. Leave enough space in each box to enter some observations and conclusions that the students will make after viewing the video.



### AFTER SHOWING

#### Discussion Items and Questions

Use the chart created on the chalkboard before showing the video to consolidate what students learned from the video. Invite the students to suggest which element in each group was most reactive and which least reactive. Also, encourage them to describe the events or evidence shown in the video to indicate that a reaction was taking place and how reactive the element was. Discuss why the most reactive alkali metals are lower down in Group 1 while the most reactive halogens are higher up in Group 17. Discuss with them the differences in reactivity of other metals



as shown in the latter part of the video and what aspects of their atomic structure as indicated by their position in the periodic chart may account for differences in reactivity.

## Applications and Activities

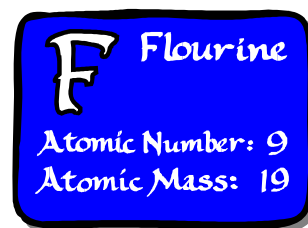
Find out how heat influences the rate of a reaction. How does heat affect the rate of copper deposition on the iron nails? The copper sulfate solution in the test tube can be heated to near boiling using a flame before adding the nail. The time required for blackening of the nail with copper deposit can be compared to the rate of copper deposition in the same solution at room temperature. What is the role of heat and its consequences in the video experiments and in the students' experiments? How does the concentration of copper sulfate affect the rate of reaction with the nails?

## RELATED RESOURCES



### Captioned Media Program

- The Periodic Table #3281
- The Periodic Table: Reactions and Relationships #3497



## World Wide Web



The following Web sites complement the contents of this guide; they were selected by professionals who have experience in teaching deaf and hard of hearing students. Every effort was made to select accurate, educationally relevant, and "kid-safe" sites. However, teachers should preview them before use. The U.S. Department of Education, the National Association of the Deaf, and the Captioned Media Program do not endorse the sites and are not responsible for their content.

- **HYPERCHEMISTRY ON THE WEB**

<http://library.thinkquest.org/2690/start.html>

Click on "The Periodic Table" to find properties on a particular element, including general and descriptive information, and physical, chemical, and structural properties. Includes other topics, such as "Experiments you can do at home," "Chemistry Glossary," and few more.

- **CHEMICAL ELEMENTS.COM**

<http://www.chemicalelements.com>

An interactive periodic table site. Provides detailed information on alkaline metals and halogens.