

## Strong Chemistry: Teacher's Guide

**Grade Level:** 6-8

**Curriculum Focus:** Physical Science

**Lesson Duration:** Two class periods

### Program Description

*It's Elementary!* – Explores the discovery of the elements and the creation of the periodic table of the elements. *Combined Strength* – Explains how elements combine to form compounds and composites by using aspirin as an example. *Diamonds!* – A penetrating look at where diamonds come from and how they are made and sold. *Inside the Sun* – A look into the interactions going on inside the sun and the NASA satellites that warn of incoming solar radiation.

- I. It's Elementary (6 min.)
  - II. Combined Strength (5 min.)
  - III. Diamonds! (32 min.)
  - IV. Inside the Sun (5 min.)
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### Onscreen Questions

Segments I & II

- How has the scientific method helped us understand the world? What other methods have people used?
- How has the science of chemistry helped us understand what things are made of?

Segments III and IV

- What are the natural processes that can change atoms of carbon into diamonds?
  - How can the elements in the sun affect life on Earth?
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### Lesson Plan

#### *Student Objectives*

- Review basic facts about diamonds.
- Review the definitions of mineral and gemstone, and their properties.

- Conduct research on a gemstone of choice.
- Create a poster illustrating the gemstone's appearance, properties, and chemical makeup.

### Materials

- *Strong Chemistry* video and VCR, or DVD and DVD player
- Computer with Internet access
- Print resources on mineral gemstones
- Poster board and markers
- Color printer for printing Web research images (optional)

### Procedures

1. As a class, review what you learned in the video about diamonds. What is a diamond made of? (The element carbon) How are diamonds formed? (They form under very high pressure deep within the earth.) How do they come to the surface? (In rocks released during volcanic eruptions) What are some properties of diamonds? (They are very hard, durable, reflect light well, and refract light into many colors.) If students want to learn more about diamonds, visit the Nature of Diamonds feature on the American Museum of Natural History's Web site: <http://www.amnh.org/exhibitions/diamonds>.
2. Explain that a diamond is a mineral—a solid substance that occurs naturally in rocks or in the ground. Every mineral has a unique chemical makeup and distinct characteristics. Some minerals are treasured for their beauty, durability, and rarity. These minerals, called gemstones, often are cut, polished, and used for jewelry or decoration. Gemstones include emeralds, rubies, and sapphires, as well as diamonds.
3. Explain that all minerals, including gemstones, are described by their properties, which include the following:
  - **Color:** A mineral may vary in color, depending on its chemical makeup.
  - **Streak:** When a mineral is crushed or rubbed against another surface, the resulting color is its streak. A mineral's streak is often different from the mineral's color.
  - **Specific Gravity (or SG):** A mineral's density or weight is calculated by how heavy it is relative to water. For example, if a mineral has an SG of 3.5, it is 3.5 times heavier than the same amount of water. Most minerals have an SG of between 2 and 4.5.
  - **Luster:** This property describes how the mineral's surface reflects light—for example, "dull," "metallic," or "brilliant."
  - **Hardness:** How well a mineral resists scratching by another is determined by its hardness. Diamonds (the hardest mineral) can scratch talc (the softest); talc cannot scratch diamonds. Two minerals that scratch each other are the same hardness.
4. Explain that a mineral's hardness is one of the most important properties in identification. The standard scale for measuring and describing hardness is the Mohs Scale, which was invented by Austrian mineralogist Frederick Mohs in 1822. The scale ranges from 1 to 10, with 1 being the



softest and 10 the hardest. Each number represents a different mineral: 1 is talc, which crumbles easily; 10 is diamond, the hardest known substance.

5. Divide the class into pairs of students and assign or have them choose a gemstone, such as the following:
  - Amethyst
  - Aquamarine
  - Diamond
  - Emerald
  - Jade
  - Opal
  - Ruby
  - Sapphire
  - Topaz
  - Turquoise
6. Tell students that they will be creating a gemstone poster, which they will use to give their class report. The poster should feature at least two images and include answers to the following questions:
  - Is this mineral part of a larger mineral group or class? If so, which one? What, if any, other gemstones belong in this group?
  - What chemical elements make up this gemstone?
  - What is this gemstone's relative hardness?
  - What is its specific gravity?
  - What color (or colors) is this gemstone?
  - Describe the luster of this gemstone.
7. Suggest the Web sites below to guide students' research. Explain that each pair will use books and the Internet to research their gemstone and present their findings to the class. Assign or have pairs choose one of the following sites:
  - Gemstones  
[http://www.minerals.net/gemstone/gem\\_abc/gem\\_abcd.htm](http://www.minerals.net/gemstone/gem_abc/gem_abcd.htm)
  - USGS: Mineral Gemstones  
<http://pubs.usgs.gov/gip/gemstones/mineral.html>
  - Chemical Formulas of Gemstones  
<http://pubs.usgs.gov/gip/gemstones/formulas.html>

- Identification of Rocks and Minerals  
<http://rocksforkids.com/RFK/identification.html>
  - Mineral Properties  
<http://www.minerals.net/resource/property/properti.htm>
8. When students have completed their posters, have them give five-minute presentations to the class. Have students hang their posters in an area of the room designated as the "Gemstone Gallery."

### Assessment

Use the following three-point rubric to evaluate students' work during this lesson.

- **3 points:** Students actively engaged in class discussions; demonstrated a thorough understanding of the properties of minerals; developed a clear, coherent presentation with two images and answers to all of the assigned questions.
- **2 points:** Students showed satisfactory participation in class discussions; demonstrated a satisfactory understanding of the properties of minerals; developed an adequate presentation with one or two images and answers to most of the assigned questions.
- **1 point:** Students participated minimally in class discussions; demonstrated a weak understanding of the properties of minerals; developed a simplistic presentation with no images and answers to few of the assigned questions.

### Vocabulary

#### color

*Definition:* One of the most visible properties of minerals

*Context:* The same mineral can vary in color, depending on the presence of different elements.

#### gemstone

*Definition:* A mineral treasured for its beauty, durability, and rarity

*Context:* Gemstones often are cut, polished, and used for decoration.

#### hardness

*Definition:* How well a mineral resists scratching by another mineral

*Context:* The Mohs scale is the standard scale used to describe the hardness of a gemstone.

#### luster

*Definition:* A property of minerals that describes how the surface reflects light; minerals can be metallic, dull, glassy, waxy, pearly, oily, brilliant, or silk

*Context:* Diamonds have a brilliant luster.



**mineral**

*Definition:* A pure, solid substance that occurs naturally in rocks or in the ground; every mineral has distinct characteristics and a unique chemical makeup

*Context:* All rocks are made of two or more minerals.

**specific gravity (or SG)**

*Definition:* The density or weight of a mineral; specifically, how heavy it is relative to water

*Context:* If a mineral has an SG of 3.5, it is three and a half times heavier than the same amount of water.

**streak**

*Definition:* The resulting color of a mineral's powder when it is crushed or rubbed against another surface

*Context:* Two minerals may have the same color, but different streaks.

## Academic Standards

### National Academy of Sciences

The National Science Education Standards provide guidelines for teaching science as well as a coherent vision of what it means to be scientifically literate for students in grades K-12. To view the standards, visit <http://books.nap.edu>.

This lesson plan addresses the following science standards:

- Unifying Concepts and Processes: Systems, order, and organization; Change, constancy, and measurement
- Physical Science: Properties and changes of properties in matter

### 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 link:

<http://www.mcrel.org/compendium/browse.asp>

This lesson plan addresses the following national standards:

- Science – Physical Sciences: Understands the structure and properties of matter
  - Language Arts – Viewing: Uses viewing skills and strategies to understand and interpret visual media; Writing: Uses the general skills and strategies of the writing process, Gathers and uses information for research purposes
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## Support Materials

Develop custom worksheets, educational puzzles, online quizzes, and more with the free teaching tools offered on the Discoveryschool.com Web site. Create and print support materials, or save them to a Custom Classroom account for future use. To learn more, visit

- <http://school.discovery.com/teachingtools/teachingtools.html>
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## DVD Content

This program is available in an interactive DVD format. The following information and activities are specific to the DVD version.

### *How To Use the DVD*

The DVD starting screen has the following options:

**Play Video** – This plays the video from start to finish. There are no programmed stops, except by using a remote control. With a computer, depending on the particular software player, a pause button is included with the other video controls.

**Video Index** – Here the video is divided into four parts (see below), indicated by video thumbnail icons. Watching all parts in sequence is similar to watching the video from start to finish. Brief descriptions and total running times are noted for each part. To play a particular segment, press Enter on the remote for TV playback; on a computer, click once to highlight a thumbnail and read the accompanying text description and click again to start the video.

**Curriculum Units** – These are specially edited video segments pulled from different sections of the video (see below). These nonlinear segments align with key ideas in the unit of instruction. They include onscreen pre- and post-viewing questions, reproduced below in this Teacher's Guide. Total running times for these segments are noted. To play a particular segment, press Enter on the TV remote or click once on the Curriculum Unit title on a computer.

**Standards Link** – Selecting this option displays a single screen that lists the national academic standards the video addresses.

**Teacher Resources** – This screen gives the technical support number and Web site address.

### *Video Index*

#### **I. It's Elementary (6 min.)**

Ancient Greeks believed the gods combined four natural elements to create everything in the universe. Trace chemistry's development from its early alchemical roots through the modern periodic table.



## II. Combined Strength (5 min.)

When Felix Hoffman found the composite to form aspirin, all of Europe celebrated the new medication that came without the aftereffects of traditional cures. Learn about elemental compounds and composites.

## III. Diamonds! (32 min.)

Where do we get diamonds, one of the most coveted gems on the planet? Find out where diamonds come from and how they get from the ground to the jeweler.

## IV. Inside the Sun (5 min.)

The sun is a star, but unlike the millions of other stars, its light provides the basis of life on Earth. Learn about the structure and workings of the sun.

## Curriculum Units

### 1. Alchemy

*Pre-viewing question*

Q: What is matter?

A: Anything that has mass and takes up space

*Post-viewing question*

Q: What did the alchemists hope to achieve?

A: Alchemists tried to solve the mysteries of life by mixing elements into potions, salves, and elixirs. They hoped that by combining the right elements, they would find the key to eternal life, cures for disease, and how to make gold from ordinary metals.

### 2. Discovering the Periodic Law

*Pre-viewing question*

Q: What is the periodic table of the elements?

A: The periodic table is a chart listing all known elements by order of their atomic number – the number of protons in their nucleus. As the cornerstone of chemistry, the table is used by chemists to predict how elements will react to one another.

*Post-viewing question*

Q: What was the Law of Octaves?

A: In 1863, English chemist John Newlands organized the known elements by order of increasing weight. He noticed that every eighth element seemed similar to the one that came next, reminding him of musical octaves in which every eighth note resembles the first. His theory was the essence of the periodic law, which groups elements according to their ability to react with one another. Newlands' law fell apart when it was discovered that too many elements did not fit the pattern.



### 3. Compounds and Medicine

*Pre-viewing question*

Q: Why do you think most elements are found in compounds instead of in pure form?

A: Answers will vary.

*Post-viewing question*

Q: What are some composites that you see and use in everyday life?

A: Answers will vary.

### 4. Carbon Bonds

*Pre-viewing question*

Q: What objects that you use contain carbon?

A: Answers will vary.

*Post-viewing question*

Q: What makes carbon unique?

A: It is the only element that can form long, stable chains. Other atoms attach to these chains to make the basis of all living things.

### 5. 47th Street

*Pre-viewing question*

Q: Why is the diamond industry such big business?

A: A rough diamond has been cleaned up. Although it is pure, it has not yet been cut and polished, and looks more like a quartz crystal than a finished diamond.

*Post-viewing question*

Q: What is the difference between a rough diamond and the finished product?

A: A rough diamond has been cleaned up. Although it is pure, it has not yet been cut and polished, and looks more like a quartz crystal than a finished diamond.

### 6. Diamond Mining

*Pre-viewing question*

Q: Do you think diamond mining is worth the effort?

A: Answers will vary.

*Post-viewing question*

Q: Why are most diamond deposits found in kimberlite ore?

A: Diamonds are formed deep in the Earth and are carried to the surface by magma, which settles and cools into kimberlite rock. Diamonds are often found where this kimberlite has settled and formed.

### 7. The Polished Details

*Pre-viewing question*

Q: What do diamond dealers look for in a diamond?

A: Shape, size, clarity, depth, color, purity, and imperfections are examples.



*Post-viewing question*

Q: What are the structural components of a finished diamond?

A: Table, the top surface of the diamond; girdle, the middle and widest section; pavilion, the bottom portion of the diamond; and culet, the very tip of the diamond.

## 8. Cutting the Rough

*Pre-viewing question*

Q: Is it difficult to create a finished diamond?

A: Answers will vary.

*Post-viewing question*

Q: Who do you think has the hardest job in the diamond industry?

A: Answers will vary.

## 9. Antwerp, the City of Diamonds

*Pre-viewing question*

Q: How do you know if you have a high-quality diamond?

A: Answers will vary.

*Post-viewing question*

Q: What makes Antwerp the world's diamond capital?

A: For centuries, Antwerp has been known as the source for all kinds of diamonds – inexpensive, expensive, glamorous, perfect, and imperfect. The banks in Antwerp commonly deal with the diamond business.

## 10. Diamond Dealers

*Pre-viewing question*

Q: What do you think is the most difficult aspect of working as a diamond dealer?

A: Answers will vary.

*Post-viewing question*

Q: How do diamond dealers seal a deal?

A: In the diamond industry, dealers seal a deal with a handshake and the Hebrew word mazel, meaning good luck. Among diamond dealers, this ritual is as binding as a signed contract.

## 11. The Business

*Pre-viewing question*

Q: Why do you think diamond work is still mainly done by hand?

A: Answers will vary.

*Post-viewing question*

Q: Why is it so hard to break into the diamond business?

A: It requires a large amount of start-up money. Also, the industry traditionally is family oriented; one's family name plays a large part in getting started in the business.



## 12. What is the Sun?

### *Pre-viewing question*

Q: How is the sun different from other stars?

A: Possible answers include the sun provides heat for the Earth, it is larger than most other stars, it contains 99 percent of the mass in our solar system, and the sun's light provides energy for photosynthesis.

### *Post-viewing question*

Q: What is the sun made of?

A: The sun is made of about 75-percent hydrogen and 25-percent helium. The sun has enough hydrogen to continue producing energy for about seven billion year.

## 13. Radiation and Technology

### *Pre-viewing question*

Q: What is radiation?

A: Radiation is energy transmitted in rays or particles as visible light, infrared light, ultraviolet light, gamma rays, or X-rays.

### *Post-viewing question*

Q: What kinds of energy do the corona and photosphere emit?

A: The lowest layer of the solar atmosphere, the photosphere emits energy primarily as visible light. As the outmost layer, the corona emits energy in ultraviolet light and X-rays.