A BURST OF LIGHT

Grade Level: 5 - 6

Purpose: To show that many mineral resources are used in industry.

Goals:
1. To demonstrate that common minerals found in the grocery store can be used to conduct flame tests.
2. To demonstrate that colors are produced when certain minerals are used in fireworks.
3. To walk students through safe experimentation with common ingredients.

Objectives: By the end of this lesson, students will be able to:
1. Demonstrate the special effects created by certain minerals.
2. Conduct a successful experiment and observe and record the results.
3. Explain how minerals are used by society.
4. Predict, based on current evidence and trends, if the fireworks industry will continue to grow.

Background: "As the nation celebrates the Declaration of Independence on July 4th, take a moment to consider the minerals that make fireworks such a spectacular part of the festivities," suggests the Interior Department's Bureau of Mines. Each color in a fireworks display is produced by a specific mineral compound: bright greens are made with barium; deep reds are a product of strontium; blues come from copper; and yellows require sodium.

More colors can be created by mixing compounds. Strontium and sodium together produce a brilliant orange. Titanium, zirconium, and magnesium alloys combine to make a silvery white. Copper and strontium mix to yield a lavender.

Certain minerals are used for special effects. Iron filings and small particles of charcoal produce gold sparks. If you want a loud flash, fine aluminum powder is the fuel to choose. Larger particles, such as small flakes or granules, give a longer, shower-like effect. Magnalium, a magnesium-aluminum alloy, can produce a tiny series of silvery-white flashes. Aluminum, antimony sulfide, and perchlorate are some flash mixtures. " —from *Out of the Rock*

Materials/Preparation:
- Sodium solution (NaCl-table salt). Make a saturated solution by stirring salt into a small amount of water until no more will dissolve.
- Potassium solution (KCL-saltless salt substitute, available in grocery stores). Make a saturated solution by stirring salt substitute into a small amount of water until no more will dissolve.
- Skewer sticks or splints or popsicle sticks (Soak them in different solutions overnight to 24 hours.)

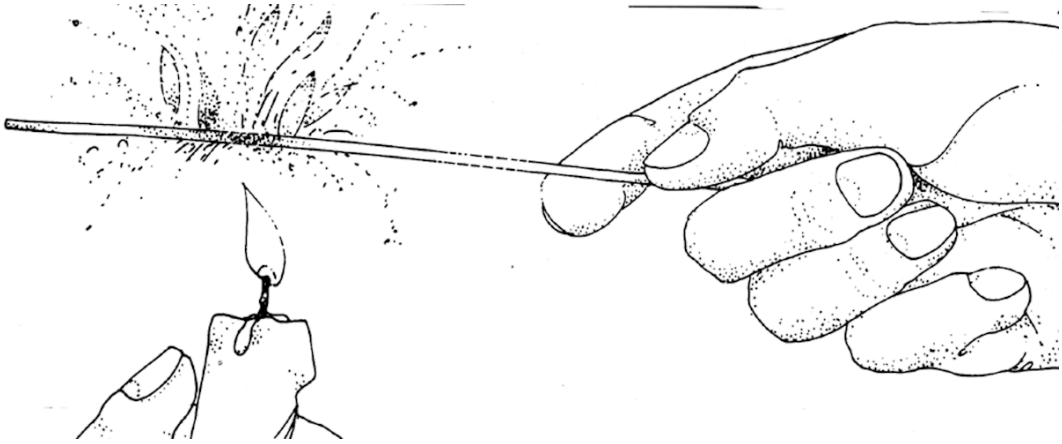
- Matches
- Candles, alcohol burners, Bunsen burners, or propane burners (These may be a bit better than candles because they do not have a yellow flame which can distort the colors.)
- Safety glasses
- Aluminum pan (placed under burner to catch wax or sparks)
- Rectangular aluminum pan, filled with water (to put out burning skewers)
- Periodic Table (for reference)
- (optional) Flame kits are available from scientific supply companies such as Flinn Scientific or Carolina Biological that include other chemicals for use such as: barium chloride, calcium chloride, lithium chloride, sodium chloride, strontium chloride

Procedure:

1. Ask the students the following question to assess their knowledge and to stimulate interest in the activity: *If you wanted to create a spectacular fireworks display, creating specific colors and effects, what special knowledge would you need?*

2. Discuss fireworks with students. Raise questions about colors that are produced. Review the light spectrum – ROY G BIV.

3. Explain to students that you can create your own fireworks. Light your candle or alcohol burner (you may wish to allow your students to divide into small groups to do their own flame tests – or divide the class in half, and while one group is working on another activity, go through the fireworks together). Stress to the students that extreme caution should be exercised for this activity. Have them check off the safety items on the Lab Sheet (attached) before they begin, Tell the students that your skewer has been soaking in a sodium solution. Ask them to predict what will happen when you place the skewer into the flame. Have them record their predictions on their Lab Sheet and then proceed with the experiment.



4. Conduct the flame test and let students observe. Have students record their observations on their lab sheet.

5. Repeat steps 3 and 4 for the potassium solution.

6. Discuss with students that it is the mineral compounds in the solutions that cause the color. Using a periodic table, explain the colors produced from other minerals that are commonly used in fireworks. (See background information.)

7. Talk with students about society's growing reliance upon minerals for the manufacturing of fireworks as the use of fireworks increases.

8. Have students list the many events at which fireworks are used. (celebrations, concerts, sports events, entertainment parks, etc.) Have students work in groups and report their findings to the class.

Questions:
1. Research and discuss: Will the fireworks industry continue to grow, or will it become smaller? Why?
2. Could the use of fireworks present environmental concerns?
3. What minerals have to be mined to get the materials that fireworks companies need?

Extensions:
1. Transfer the understanding developed by the flame test that minerals produce colors when burned to how astronomers can tell what gases stars are producing by the colors the gases give off when they are burning.
2. Have students research the firework industry and its economic impact on countries that import and export fireworks.

Assessment:
1. Observe students as they work through the experiments and check through science notebooks for observations.
2. Observe discussions and evaluate responses.
3. Evaluate reports to the class on the use of fireworks at various events.

Lesson Specifics:
Skills - Experimentation, observing, recording, predicting, searching for information

Duration - 40 minute class period (more w/ extensions)

Group size - small group, whole class

Setting - Classroom, lab

Illinois State Board of Education Goals and Standards:

11.A.3b: Conduct scientific experiments that control all but one variable.

11.A.3c: Collect and record data accurately using consistent measuring and recording techniques and media.

11.A.3g: Report and display the process and results of a scientific investigation.

Print Resources

Lancaster, R., et al. 1998. Fireworks Principles and Practice. New York: Chemical Publishing.

National Energy Foundation. 1995. Out of the Rock: Integrated Learning Activities for Students. Salt Lake City, UT: Author.

Plimpton, G. 1984. Fireworks: A History and Celebration. New York: Doubleday.

Salatino, K. 1998. Incendiary Art: The Representation of Fireworks in Early Modern Europe. Los Angeles: J. Paul Getty.

Shimizu, T. 1998. Fireworks: Art, Science, and Technique New York: Pyrotechnica.

Video Resources

Fireworks! Series: NOVA, 1 hr. (VHS)

Web Resources

Nova
Fireworks discussion and resources
http://www.pbs.org/wgbh/nova/fireworks/

Lab Sheet – A Burst of Light

Name _____

Safety Materials Check-list: ___ Safety glasses ___ Aluminum pan to work over ___ Rectangular pan of water

Solution	**Prediction**	**Observation**
Sodium chloride NaCl		
Potassium chloride KCl		
Other		
Other		

Conclusions: _____