Activity: Analyzing & Creating Safety Labels

FOR THE TEACHER

Summary
In this activity, students will understand and interpret the color and number symbols on an NFPA Safety Diamond and then apply their knowledge to interpreting a label for chemicals. Students will also demonstrate an understanding of the safety precautions recommended for safe handling of specific chemicals as indicated by the diamond.

Grade Level
High School

NGSS Alignment
This activity will help prepare your students to meet the performance expectations in the following standards:

- **HS-ETS1-3:** Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
- **Scientific and Engineering Practices:**
  - Analyzing and Interpreting Data
  - Obtaining, Evaluating, and Communicating Information

Objectives
By the end of this activity, students should be able to

- Identify risks posed by potentially hazardous materials.
- Analyze what special safety equipment and procedures are applicable to a chemical.
- Create a safety label for chemicals.

Chemistry Topics
This activity supports students’ understanding of

- Lab Safety
- Chemical properties
- Physical Properties

Time:
**Teacher Preparation:** 20 minutes
**Lesson:** 45 minutes – 1 hour

Materials (per student team of 2)

- Diamond safety labels (printed from downloadable template)
- Markers or colored pencils (red, blue, yellow, black)
- Empty plastic bottle to serve as “sample chemical containers”
- Tape
- Internet access and computers/smartphones to access relevant information

Safety
- There are no safety concerns for this activity.
Teacher Notes

- Ask students to bring in empty plastic bottles to be used for this activity. You could give them extra points to encourage their participation.
- The NFPA safety diamond is designed to allow teachers, students and safety personnel to quickly and easily identify safety concerns associated with chemicals they may encounter.
- Each colored section of the fire diamond provides information of a safety concern specific to that chemical
  - Red= flammability
  - Yellow= reactivity
  - Blue= health hazard
  - White= special hazard, indicated by specific symbols/words
- In addition, each colored section is designated a specific number on a scale ranging from 0 to 4, with 0 meaning no hazard and 4 meaning extreme danger.
- The diamond was originally designed to convey information for first responders and safety personnel and not to provide complete safety information in a lab setting, which should be found by referring to the SDS or GHS symbols.
- Detailed chemical safety information for high school labs can be found here.
- You might want to show photos of fire diamonds from around the school or community and ask them how many have seen these labels and where.
- Teachers can provide printed labels (in color or black/white) for use in labeling the bottles. A template is available for download/printing.
- The teacher could show students a sample “fire diamond” and explain how to identify risks posed by the sample and analyze what special safety equipment and handling procedures are specified.
- Alternatively, you can have students use their resources to find this information for themselves and share with their peers in small groups. Follow this up by having student groups share aloud their findings about the meanings of the four parts and how the colors and numbers are used.
- For an extension, you can have students take pictures of “fire diamonds” found in their communities.
- Teachers may want to print class copies of the article (analysis question 5) for student use.

FOR THE STUDENT
Lesson

Analyzing & Creating Safety Labels

Background
In this activity, you will learn how the NFPA fire diamond is used to provide safety information, especially for first responders who might encounter chemicals in an emergency situation.

Objective
By the end of this activity, you should be able to look at a NFPA safety diamond and determine what safety concerns are associated with that chemical.

Prelab Questions
1. Why would a firefighter or paramedic need to know safety concerns about specific chemicals?
2. Why do you think a symbol is used with color coded images and not a list of text?
3. Research the meaning of these terms and symbols commonly found in the fire diamond label and record below:
Procedure
1. Create a sample safety label by randomly assigning numbers from 0 – 4 in each of the four colored sections. On the back of the label, write the important information you intended to convey to a first responder. Attach this label to an empty bottle.
2. Your teacher will collect the bottles and give one bottle to each team of two students.
3. Teams of students will pair up so that there are two teams and two bottles in a four-person group. Analyze the labels by telling the other team what information was conveyed by their labeled bottle.
4. If the information is correctly identified, you earn a point, and should indicate it in the scorecard below.
5. After one pairing, exchange your bottle with another pair of students and repeat the process.
6. Complete at least 5 safety labels.

Scorecard

<table>
<thead>
<tr>
<th>Bottle 1</th>
<th>Bottle 2</th>
<th>Bottle 3</th>
<th>Bottle 4</th>
<th>Bottle 5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Points:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Analysis
1. Below is the symbol used for acetone, which is often use as nail polish remover. What safety information is important to know about acetone?

Acetone: Colorless, highly volatile liquid; sweet odor, irritating. Also causes: muscle weakness, mental confusion, coma (high concentrations). Ingestion: GI irritation, kidney and liver damage, metabolic changes. Highly Flammable
2. A truck carrying nitric acid crashes and spills nitric acid. What would be the main safety concerns that clean-up crews should be aware of?

Nitric Acid: Clear to yellow fuming liquid; acid, suffocating odor. Corrosive, causes severe burns to eyes/skin/respiratory tract. Also causes: lung damage. Strong oxidizer capable of igniting combustibles.

3. Sulfuric acid is the acid found in car batteries. Most batteries have several warnings about not opening the battery under and circumstances. Based on the label below, why is this safety information put on all car batteries?


4. What chemical should you not use if some sulfuric acid spilled on your clothes?

5. Choose one scenario from this article and create a fire diamond for the type of chemical described, based on the information in the article. (URL: https://wwwfirerescue1.com/fire-products/hazmat-equipment/articles/275818018-3-common-hazmat-scenarios-and-how-to-respond/)