Safety of Hydrogen

Student Objective
The student:
- will be able to explain the current theory behind the Hindenburg disaster
- will analyze the safety of gasoline vs hydrogen

Key Words:
Hindenburg

Time:
1 class period

Materials:
- video of the Hindenburg disaster newsreel (see Internet Sites below–vidicom-tv link)
- PowerPoint presentation on the chemical causes of the Hindenburg disaster (see Internet Sites below–pbs.org)
- online or printed copy of *The True Story of Hydrogen and the Hindenburg Disaster* (see Internet Sites below)
- Slides of fuel leak simulation (see Internet Sites below–eere link)

Background Information

Many people believe hydrogen is dangerous, too dangerous to be used in society. Many use the Hindenburg disaster as one example, and the H-bomb and the first shuttle explosion as other examples. Some people know the H-bomb is made using tritium, an isotope of hydrogen. While the shuttle explosion was determined to be caused by an O-ring, it was only recently that additional information was obtained relative to the Hindenburg disaster. The new information is related to the "rocket fuel" that was painted on the airship.

The fuel leak simulation shows what happens when two cars, one filled with hydrogen and the other filled with gas, are ignited. In the gasoline car, the fuel line was punctured with a 1/16 inch diameter hole which enabled the gasoline to leaked out of the fuel line under the middle of the car. During the 3.5 minutes of videotaping, the vehicle leaked five pints of gasoline (approximately 70,000 BTU). During the video, the hydrogen vehicle leaked 3.4 pounds of hydrogen (approximately 175,000 BTU).

Procedure

1. Ask the students if they have heard of the Hindenburg disaster. Show the newsclip video (the vidicom-tv link in the Internet Sites section).
2. Ask them to individually write down an answer to the following question. "Why did the Hindenburg crash?" After everyone has had time to answer the question write some of the responses on the board.
3. Show the slides from the PBS website and continue the discussion explaining any of the chemistry that they do not understand.
4. Pass out copies of *The True Story of Hydrogen and the Hindenburg Disaster* (see Internet Sites below), or have the students access it online.
5. Ask the students if their opinion of the cause of the crash and the safety of hydrogen has changed.
6. Next, ask the students to individually write down an answer to the following question. "Which car would it probably be safer to be in, in the event that the fuel tank is ruptured and ignited–a gasoline car or a hydrogen powered car? Why? After everyone has had time to answer the question, give the students a few minutes to discuss their answers.
7. Show the slides from the fuel leak simulation.
8. Lead a discussion on the safety of gasoline versus hydrogen powered cars, and the public misconception of the danger of hydrogen and the safety of gasoline. Some possible questions to ask:
    - Why does the hydrogen flame go straight up? *(hydrogen gas is lighter than air)*
    - Why didn't the hydrogen ignite the car? *(it escaped quickly into the atmosphere and burned off quickly)*
    - Why did the gasoline car have more damage? *(gasoline, being a liquid, pooled below the car, enabling it to burn longer and ignite the car)*
    - Why do many people think that gasoline is safer than hydrogen?

Further Research

1. Lead a classroom discussion on public perception/misinformation–how it comes about, what factors contribute to it, and ways to get out the truth of a situation.
2. Research the comparative safety in the production stage of hydrogen and gasoline.
3. Which fuel, hydrogen or gasoline is the safest to transport and store?

Internet Sites

http://www.vidicom-tv.com/tohiburg.htm

A video of the Hindenburg disaster. Needs Quicktime 5.0.2 or better.

http://www.pbs.org/wnet/secrets/html/e3-chemistry.html

A slide show illustrating the cause of the Hindenburg disaster.

http://www.nlhs.com/hindenburg.htm

History and photographs of the Hindenburg

http://www.ch2bc.org/hindenburg.htm

International Clearinghouse for Hydrogen Commerce, *"The True Story of Hydrogen and the Hindenburg Disaster"* Discussion on the downing of the Hindenburg

http://www.eere.energy.gov/hydrogenandfuelcells/pdfs/30535be.pdf

Dr. Michael Swain's paper comparing two vehicle fuel leaks–a gasoline and a hydrogen leak.

http://evworld.com/view.cfm?section=article&storyid=482

Electric Vehicle World's news coverage of Dr. Swain's experiment

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			.1	.2	.3	.4	.5	.6	.7
Nature of Matter	Standard 1	SC.A.1.3-	X			X			
	Standard 2	SC.A.2.3-							
Nature of Science	Standard 1	SC.H.1.3-	X	X				X	
	Standard 2	SC.H.2.3-							
	Standard 3	SC.H.3.3-					X		

Benchmark SC.A.1.3.1 - The student identifies various ways in which substances differ.
Grade Level Expectations
The student:
Sixth
- knows ways in which substances differ.

Benchmark SC.A.1.3.4 - The student knows that atoms in solids are close together and do not move around easily; in liquids, atoms tend to move farther apart; in gas, atoms are quite far apart and move around freely.
Grade Level Expectations
The student:
Sixth
- knows that molecular motion increases from solids to liquids to gases.

Benchmark SC.H.1.3.1 - The student knows that scientific knowledge is subject to modification as new information challenges prevailing theories and as a new theory leads to looking at old observations in a new way.
Grade Level Expectations
The student:
Sixth
- knows ways scientific theories may change with new discoveries
- understand that new technology may lead to new discoveries

Seventh
- understands that new scientific knowledge is often used to reevaluate existing theories

Eighth
- knows that scientific knowledge is subject to modification as new information challenges prevailing theories and as a new theory leads to looking at old observations in a new way.

Benchmark SC.H.1.3.2 - The student knows that the study of the events that led scientists to discoveries can provide information about the inquiry process and its effects.

Grade Level Expectations

The student:

Sixth

- knows that the scientific method is a process that involves a logical and empirical but flexible approach to problem solving

Eighth

- knows that the study of the events that led scientists to discoveries can provide information about the inquiry process and its effects.

Benchmark SC.H.1.3.6 - The student recognizes the scientific contributions that are made by individuals of diverse backgrounds, interests, talents, and motivations.

Grade Level Expectations

The student:

Sixth

- knows selected scientists and their accomplishments
- knows that scientists who make contributions to knowledge come from all kinds of backgrounds and possess varied talents, interests, and goals

Seventh

- extends and refines knowledge of selected scientists and their accomplishments and recognizes their varied backgrounds, talents, interests, and goals

Eighth

- extends and refines knowledge of selected scientists and their accomplishments and recognizes their varied backgrounds, talents, interests, and goals.

Benchmark SC.H.3.3.5 - The student understands that contributions to the advancement of science, mathematics, and technology have been made by different kinds of people, in different cultures, at different times and are an intrinsic part of the development of human culture.

Grade Level Expectations

The student:

Sixth

- knows that the advancement of science, mathematics, and technology is ongoing and influenced by a diverse population of scientists.

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Hindenburg - The largest aircraft to ever fly, the Hindenburg was a gas-filled dirigible (zepplin, 'air-ship'), that crashed upon landing at Lakehurst New Jersey on May 6, 1937.