

Video: Hydrogen - The Pollution Solution

Student Objectives

The student:

- will be able to explain how fossil fuels have caused our pollution problem
- will be able to explain how hydrogen fits into our transportation future
- will be able to list several benefits of hydrogen as an energy carrier

Key Words:

emissions
inexhaustible
pollution

Time: 1 hour

Materials

- The Pollution Solution video

Background

The Air Pollution Issue

An air pollutant is classified as any substance in the air that is detrimental in some way to human health or is threatening to other forms of life. Pollutants which have an immediate effect are *primary* air pollutants, and those that become a problem when converted to other forms are *secondary* air pollutants. Primary pollutants include carbon monoxide, radioactive wastes and highly toxic compounds such as xylenes, cyantes, and atmospheric metals. Secondary pollutants include low level ozone which is produced by sunlight reacting with the exhaust from combustion engines. Some of our pollutants are natural components of the atmosphere and become pollutants when they reach critical levels that affect life. These natural pollutants include such things as volcanic eruptions, violent storms, forest fires, wind erosion, natural gases from the decay of dead organisms, and pollen and spores.

Scientists are unable to agree on just how stable our environment is and whether or not human activity is changing our air to a point where it could affect life as we know it. The scientific community also has been unable to determine the degree of damage that has already been done to our atmosphere. However, there are some facts that relate directly to the issue of air pollution.

- World population is six million, and continues to increase. Humans have colonized and now affect every continent on our earth. The number of people living in urban areas is projected to reach 50% worldwide by 2005
- Many of the new technologies have created waste products that are emitted into our atmosphere during product manufacturing or product use
- Many of our lakes and forests have become acidic in the past fifty years.

Is air pollution a health threat?

- The number of asthma cases has increased from 10.4 million to 14.6 million from 1990 to 1994. Studies have shown that this is attributable to chemicals found in air pollution
- Every year, some 64,000 people may die prematurely from cardiopulmonary causes linked to particulate air pollution, according to an analysis conducted by the National Resource Defense Council. In the most polluted cities, lives are shortened by an average of one to two years.
- Depending on which air toxins an individual is exposed to, the health effects can include damage to the immune system, as well as neurological, reproductive (e.g., reduced fertility), developmental, and respiratory problems. The susceptibility of certain population groups to the toxic or non-toxic exposures, such as the elderly and children has to be given special consideration. Moreover air pollution induces early fatigue, and effectively an overall reduction in efficiency and potential even in the otherwise healthy human beings. This can slacken the progress of a nation, its economy and commerce. Thus, the government needs to be pro-active to understand the implications of pollution on human health and take appropriate corrective measures. See chart below.

Hydrogen in transportation

The world's leading automakers are in a race to bring fuel cell vehicles to the marketplace. Hydrogen fuel cells have the potential to power cars, trucks, and buses without producing harmful emissions. Vehicles powered by fuel cells will be cleaner and quieter, and consume less energy than those powered by internal combustion engines. And because the hydrogen used in fuel cells can be produced from a variety of sources, we won't need to rely on just one source of fuel for our transportation.

In comparison to the internal combustion engine, a fuel cell power system doesn't have as many moving parts, is nearly silent, doesn't get as hot and has fewer mechanical parts. PEM fuel cells can capture 50% or more of hydrogen's energy to power a car, while the internal combustion engines in today's cars convert less than 20% of the energy in gasoline into power. And while automotive engineers have found ingenious ways to make internal combustion engines run more cleanly and efficiently, there's a limit to how good these engines can ever be.

About 60 million new cars are sold worldwide each year. Automotive industry leaders have speculated that fuel cell vehicles could account for 20 to 25 percent of new car sales within the next 20 to 25 years, a potential market of 12 million to 15 million vehicles each year.

Procedure

1. Show the 6 minute video.
2. Take a few minutes to discuss the video and discuss any questions that arise. If the students ask a question and you don't know the answer, ask if anyone in the class would like to research the question for the class (possibly for extra credit) and report back with the answer next class period.
3. Lead a discussion on pollution and the future of transportation. Things to discuss:
 - What sources of air pollution have they noticed in their community? *(Make sure to include any factories and power plants you may have in your area, as well as school buses, and lawn equipment—an often overlooked source of air pollution)*

- What effects of air pollution have they noticed in their community? *(You may choose to discuss the increase in asthma that has been documented in children their age.)*
- What can be done to clean up this air pollution? *(Allow any answers here)*
- What kind of car do they think they will be driving in 15 - 20 years? What do they envision it looking like? How will they refuel it?
- What did the video mean when it said that hydrogen was 'inexhaustible'? How can we get hydrogen?

Further Research

1. Which auto manufacturers are working on hydrogen fuel cell vehicles? How long do they predict it will be until they are on the market?
2. How do scientists think the hydrogen vehicles of the future will be refueled—at a service station or at home?
3. Draw your concept of a future fuel cell vehicle.

Internet Sites

http://www.gm.com/company/gmability/edu_k-12/

General Motor's hydrogen transportation site for students. Includes games, stories and activities about hydrogen in transportation.

<http://www.pbs.org/wgbh/nova/sciencenow/3210/01-car-nf.html>

Nova Science Now. Interactive site shows how a fuel cell car works.

<http://www.smogcity.com/>

Sacramento Metropolitan Air Quality Management District's Smog City site. Interactive game lets students examine the roles of population, emissions and weather on air pollution and health.

<http://www.epa.gov/kids/>

Environmental Protection Agency, Environmental Kids Club. Activities for students and teachers on pollution, the environment, and recycling.

High-energy Hydrogen I

Florida Sunshine Standards Benchmarks/ Grade Level Expectations

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			.1	.2	.3	.4	.5	.6
Energy	Standard 1	SC.B.1.2-		X				
	Standard 2	SC.B.2.2-		X	X			
Processes that Shape the Earth	Standard 1	SC.D.1.2-						
	Standard 2	SC.D.2.2-	X					
Nature of Science	Standard 1	SC.H.1.2-						
	Standard 2	SC.H.2.2-						
	Standard 3	SC.H.3.2-	X					

Benchmark SC.B.1.3.1 - The student recognizes various forms of energy.

Grade Level Expectations

The student:

Third

- knows different forms of energy

Fourth

- knows that there are a variety of sources for electricity.

Benchmark SC.B.2.2.2 - The student recognizes the costs and risks to society and the environment posed by the use of nonrenewable energy.

Grade Level Expectations

The student:

Third

- classifies resources as renewable or nonrenewable

Fourth

- knows the risk factors associated with the use of nonrenewable energy sources.

Benchmark SC.B.2.2.3 - The student knows that the limited supply of usable energy sources places great significance on the development of renewable energy sources.

Grade Level Expectations

The student:

Third

- knows that alternate energy sources are being explored using natural and mechanical

processes.

Fifth

- knows that the limited supply of usable energy sources places great significance on the development of renewable energy sources.

Benchmark SC.D.2.2.1 - The student knows that reusing, recycling, and reducing the use of natural resources improves and protects the quality of life.

Grade Level Expectations

The student:

Fourth

- knows ways misuse of natural resources affects the quality of life for all species.

Benchmark SC.H.3.2.1 - The student understands that people, alone or in groups, invent new tools to solve problems and do work that affects aspects of life outside of science.

Grade Level Expectations

The student:

Fourth

- knows that technologies often have costs, as well as benefits, and can have an enormous effect on people and other living things.

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emissions - a substance discharged into the air, especially by an internal combustion engine

inexhaustible - cannot be entirely consumed or used up

pollution - the contamination of soil, water, or the atmosphere by the discharge of harmful substances.