

## **Unit: Alternative Fuels**

### **Problem Area: California Resources**

#### **Lesson: The uses of Hydrogen**

#### **Learning Standard:**

##### **California Academic Standard: Earth Sciences**

Each element on Earth moves among reservoirs, which exist in the solid earth, in oceans, in the atmosphere and within and among organisms as part of biogeochemical cycles. 7b - Students know the global carbon cycle: the different physical and chemical forms of carbon in the atmosphere, oceans, biomass, fossil fuels, and the movement of carbon among these reservoirs.

**California Academic Standard:** English-Language Arts Grades 9-10 Writing-Standard 1.0 – Writing Strategies: Students write coherent and focused essays that convey a well-defined perspective and tightly reasoned argument. The writing demonstrates students' awareness of the audience and purpose. Students' progress through the stages of the writing process as needed.

**California Agriculture Standard: C2.5** Agriscience Pathway: Understand how new energy sources are developed from agricultural products (e.g. gas-cogeneration and ethanol)

**Student Learning Objectives:** Instruction in this lesson should result in students achieving the following objectives:

1. The importance of using alternative fuels.
2. Identify other major sources of energy
3. Describe energy and its relationship to the world around us.

#### **List of Equipment, Tools, Supplies, and Facilities**

Writing Surface

9 Volt Battery

Salt

Electrical wire

Water

Two regular number 2 pencils

Thin Cardboard

Small Glass

## **Terms:**

Hydrogen

Electrolysis

Greenhouse gas emissions

Sequestration

Carbon Monoxide

Carbon Dioxide

Geo-thermal

Hydro-electric

**Interest Approach:** Ask students what is meant by alternative fuels. If you were to look at all of the types of alternative fuels what would you find? Would you expect the students to find one type of alternative fuels?

## **Summary of Content and teaching Strategies:**

### **Objective 1: Explain what Hydrogen is.**

*Anticipated Problem:* What is Hydrogen?

1. **Hydrogen** is the simplest and lightest fuel. Hydrogen is in a gaseous state atmospheric at pressure and ambient temperatures. Hydrogen may contain low levels of **carbon monoxide** and **carbon dioxide**, depending on the source.
2. The energy density of hydrogen is very low under ambient conditions.
3. The ability to create hydrogen from a variety of resources and its clean-burning properties make it a desirable alternative fuel.

### **Objective 2: Explain where Hydrogen comes from.**

*Anticipated Problem:* How is Hydrogen made?

1. Hydrogen can be produced using diverse, domestic resources including fossil fuels, such as natural gas and coal (with carbon **sequestration**); nuclear; and biomass and other renewable energy technologies, such as wind, solar, **geothermal**, and **hydro-electric** power.

2. Hydrogen can be produced in large, central facilities (50-300 miles from the point of use), smaller semi-central (located 25-100 miles of use) and distributed (near or at point of use).

### **Objective 3: How can Hydrogen benefit us?**

*Anticipated Problem:* What are the benefits of Hydrogen?

1. Hydrogen would reduce the **Greenhouse Gas Emissions**- Greenhouse gases are thought to be responsible for changes in global climate. Greenhouse gases trap excess heat from the sun's infrared radiation that would otherwise escape into space; much like a greenhouse is used to trap heat.
2. Reduce Air Pollution- Combustion of fossil fuels by electric power plants, vehicles, and other sources are responsible for most of the smog and harmful particulates in the air.
3. Improve Energy Efficiency- fuel cells are significantly more energy efficient than combustion-based power generation technologies. Vehicles using electric motors powered by hydrogen fuel cells are much more energy efficient, utilizing 40-60 percent of the fuel's energy. Even Fuel Cell Vehicles (FCVs) that reform hydrogen from gasoline can use about 40 percent of the energy in the fuel.
4. Strengthen National Energy Security- Hydrogen and fuel cell technology has the potential to strengthen our national energy security by reducing our dependence on foreign oil.

**Review/Summary:** Ask the students the 3 learning objectives from the beginning of the lesson.

1. What is the importance of alternative fuels?
2. What are other major sources of energy besides hydrogen?
3. Describe what energy is and the relationship it has with us and around the world. Check for understanding of the questions.

**Application:** Application can involve the following student lab activity:  
H<sub>2</sub>O Electrolysis can be found on [www.energyquest.ca.gov/projects](http://www.energyquest.ca.gov/projects)