

Hydrogen K-W-L

Student Objective

The student:

- (intro activity) will know their level of knowledge of hydrogen technology
- (follow-up activity) will assess what they have learned about hydrogen

Materials:

- Student Journal
- extra copy of Student Journal pages (1 per group)
- flip chart paper (2 - 4 sheets)

Key Words:

(These words will be covered in the High-energy Hydrogen unit)

atom
electrolysis
electron
fuel cell
Hindenburg
H₂O
hydrogen
oxygen
pollution

Time:

1 class period

Procedure

1. Explain to students that they will be answering a few questions in their Science Journal about hydrogen. Tell the students that their answers today will not be graded and that there will probably be many questions that they don't know the answers to yet. Explain to them that these are the questions that they will be researching during this unit.
2. Give the students time to answer the questions in their journals
3. Divide the students into lab groups of 3 - 5 students.
4. Pass out a blank copy of the of the Science Journal questions to each group.
5. Explain to the groups that they are to discuss the questions among themselves and decide on a group answer to each.
6. Give the groups time to decide on their answers.
7. For each question, ask the groups which answer they thought was the best. You may wish to chart these group answers on the board. Tell the students that during the unit they will be investigating these questions and finding out which answers are correct.
8. Label one piece of flip chart paper with a 'K' and one with a 'W'.
9. Ask the students to list off the things they know about hydrogen and list their responses on the K paper. Don't worry if some of the answers at this time are incorrect.
10. On the W sheet list all the things that the students want to know. Don't answer any

- questions at this time, just list them.
11. Save these sheets for the follow-up activity.

Procedure (Follow-up Activity, to be done at the end of the unit)

1. Bring out the K and W sheets.
2. Read through the K items and ask the students for clarification on any items that are incorrect. Correct these statements as needed.
3. Read through the W items and have the students answer each one. If an item on the W list hasn't been answered yet, you may wish to ask if a student would like to research the answer for the class (this could be extra credit).

Answer Key

1. A. Hydrogen
2. B. 25%
3. C. 55%
4. A. Water vapor and heat
5. D. Hydrogen and Oxygen
6. D. Burning fossil fuels
7. B. Protons
8. A. Electrolysis
9. C. Hydrogen will be used to provide our power needs
10. D. All of the above
11. B. Hydrogen can be used to create electricity cleanly—with only water and heat as by-products
12. T
13. F
14. F
15. T
16. T

Hydrogen K-W-L

			.1	.2	.3	.4	.5	.6	.7
Nature of Matter	Standard 1	SC.A.1.3-					X		
	Standard 2	SC.A.2.3-		X					
Energy	Standard 1	SC.B.1.3-	X	X					
	Standard 2	SC.B.2.3-		X					
Processes that Shape the Earth	Standard 1	SC.D.1.3-							
	Standard 2	SC.D.2.3-		X					
Nature of Science	Standard 1	SC.H.1.3-							
	Standard 2	SC.H.2.3-							
	Standard 3	SC.H.3.3-				X			

Benchmark SC.A.1.3.5 - The student knows the difference between a physical change in a substance and a chemical change producing new substances with different characteristics.

Grade Level Expectations

The student:

Sixth

- knows the chemical properties of various substances

Seventh

- knows that chemical changes result in new substances with different characteristics.

Benchmark SC.A.2.3.2 - The student knows the general properties of the atom and accepts that single atoms are not visible.

Grade Level Expectations

The student:

Seventh

- understands that protons and neutrons are located in the nucleus of the atom while electrons exist in areas of probability outside of the nucleus

Eighth

- knows that when electrons are transferred from one substance to another, the general properties of both substances change.

Benchmark SC.B.1.3.1 - The student identifies forms of energy and explains that they can be measured and compared.

Grade Level Expectations

The student:

Sixth

- understands that energy can be converted from one form to another

Eighth

- knows examples of natural and man-made systems in which energy is transferred from one form to another.

Benchmark SC.B.1.3.2 - The student knows that energy cannot be created or destroyed, but only changed from one form to another.

Grade Level Expectations

The student:

Sixth

- understands that energy can be changed in form.

Benchmark SC.B.2.3.2 - The student knows that most of the energy used today is derived from burning stored energy collected by organisms millions of years ago.

Grade Level Expectations

The student:

Seventh

- knows that fossil fuels are found in the Earth, they are nonrenewable, and the advantages and disadvantages of their use

Eighth

- understands how fossil fuels are formed in the Earth, why they are nonrenewable, and the advantages and disadvantages of their use.

Benchmark SC.D.2.3.2 - The student knows the positive and negative consequences of human action on the Earth's systems.

Grade Level Expectations

The student:

Sixth

- knows positive and negative consequences of human action on the Earth's systems.

Benchmark SC.G.2.3.1 - The student knows that some resources are renewable and others are nonrenewable.

Grade Level Expectations

The student:

Sixth

- knows renewable and nonrenewable energy sources

Seventh

- understands the importance of informed use of natural resources

Eighth

- knows that some resources are renewable and others are nonrenewable.

Benchmark SC.H.3.3.4 - The student knows that technological design should require taking into account constraints such as natural laws, the properties of the materials used, and economic political, social, ethical, and aesthetic values.

Grade Level Expectations

The student:

Sixth

- knows some ways that scientific discoveries create new technologies that affect society.

Hydrogen K-W-L

biomass - plant material, vegetation, or agricultural waste used as a fuel or energy source.

electrolysis - chemical change, especially decomposition, produced in an electrolyte by an electric current

electron - an elementary particle with negative charge

element - a substance that cannot be reduced to simpler substances by normal chemical means and that is composed of atoms having an identical number of protons in each nucleus.

fuel cell - an electrochemical cell in which the energy of a reaction between a fuel, such as hydrogen, and an oxidant, such as oxygen, is converted directly and continuously into electrical energy

Hindenburg - the largest aircraft to ever fly, the Hindenburg was a gas-filled dirigible (blimp, zeppelin), that crashed upon landing at Lakehurst, New Jersey on May 6, 1937

hydrogen - a colorless, highly flammable gaseous element, the lightest of all gases and the most abundant element in the universe

oxygen - an element that at standard temperature and pressure is colorless, tasteless, and odorless. Oxygen is required for nearly all combustion and in the cellular functioning of animals

photovoltaics - the process of turning the energy of the sun into electricity by using a solar (photovoltaic) cell

proton - a stable, positively charged subatomic particle

vapor - barely visible or cloudy diffused matter, such as mist, fumes, or smoke, suspended in the air.

Hydrogen K-W-L (Introductory Activity)

Multiple Choice. Circle the best answer.

1. Which element has the highest energy content by weight?
 - A. Hydrogen
 - B. Uranium
 - C. Carbon
 - D. Oxygen

2. How much of the global oil supply is consumed in the United States?
 - A. 30%
 - B. 25%
 - C. 15%
 - D. 20%

3. What percent of the oil consumed by the United States is used for transportation?
 - A. 30%
 - B. 10%
 - C. 55%
 - D. 25%

4. What are the by-products of hydrogen fuel cells?
 - A. Water vapor and heat
 - B. Carbon and oxygen
 - C. Exhaust
 - D. Hydrogen vapor

5. What two elements do hydrogen fuel cells combine?
 - A. Oxygen and carbon
 - B. Hydrogen and carbon
 - C. Water and vapor
 - D. Hydrogen and oxygen

6. Which of these cannot be used to produce hydrogen without releasing greenhouse gases?
(Circle all that apply)
 - A. Photovoltaics
 - B. Wind power
 - C. Biomass
 - D. Burning fossil fuels

7. Which particles pass through the fuel cell's membrane?
 - A. Neutrons
 - B. Protons
 - C. Electrons
 - D. Molecules
8. What process uses electricity to separate water molecules into hydrogen and oxygen?
 - A. Electrolysis
 - B. Fissure
 - C. Electrolytes
 - D. Fission
9. What is meant by the 'hydrogen economy'?
 - A. Stocks rise and are said to be "lighter than air"
 - B. Paper money can be produced using hydrogen as the main ingredient
 - C. Hydrogen will be used to provide our power needs
 - D. Shares of hydrogen will be traded on the stock market
10. How is hydrogen produced?
 - A. By using electricity to separate water molecules
 - B. Naturally, using certain types of algae
 - C. By extracting it from natural gas, coal, and other fossil fuels
 - D. All of the above
11. What are the benefits of using hydrogen as a form of energy? (Circle all that are true)
 - A. Hydrogen can be found in the U.S. in pockets concentrated in the Pacific Northwest
 - B. Hydrogen can be used to create electricity cleanly—with only water and heat as byproducts
 - C. Hydrogen powered fuel cells are currently being made out of inexpensive materials
 - D. Hydrogen is currently cheaper to produce than gasoline

Mark the following True (T) or False (F)

12. _____ Fuel cells have been used by NASA to provide power aboard the Space Shuttle.
13. _____ The Hindenburg crashed because the hydrogen onboard was ignited by static electricity.
14. _____ Hydrogen is the heaviest element on earth.
15. _____ Hydrogen can exist as a gas or a liquid.
16. _____ There are many kinds of fuel cells.

Hydrogen K-W-L (Follow-up Activity)

Multiple Choice. Circle the best answer.

1. Which element has the highest energy content by weight?
 - A. Hydrogen
 - B. Uranium
 - C. Carbon
 - D. Oxygen

2. How much of the global oil supply is consumed in the United States?
 - A. 30%
 - B. 25%
 - C. 15%
 - D. 20%

3. What percent of the oil consumed by the United States is used for transportation?
 - A. 30%
 - B. 10%
 - C. 55%
 - D. 25%

4. What are the by-products of hydrogen fuel cells?
 - A. Water vapor and heat
 - B. Carbon and oxygen
 - C. Exhaust
 - D. Hydrogen vapor

5. What two elements do hydrogen fuel cells combine?
 - A. Oxygen and carbon
 - B. Hydrogen and carbon
 - C. Water and vapor
 - D. Hydrogen and oxygen

6. Which of these cannot be used to produce hydrogen without releasing greenhouse gases?
(Circle all that apply)
 - A. Photovoltaics
 - B. Wind power
 - C. Biomass
 - D. Burning fossil fuels

7. Which particles pass through the fuel cell's membrane?
 - A. Neutrons
 - B. Protons
 - C. Electrons
 - D. Molecules
8. What process uses electricity to separate water molecules into hydrogen and oxygen?
 - A. Electrolysis
 - B. Fissure
 - C. Electrolytes
 - D. Fission
9. What is meant by the 'hydrogen economy'?
 - A. Stocks rise and are said to be "lighter than air"
 - B. Paper money can be produced using hydrogen as the main ingredient
 - C. Hydrogen will be used to provide our power needs
 - D. Shares of hydrogen will be traded on the stock market
10. How is hydrogen produced?
 - A. By using electricity to separate water molecules
 - B. Naturally, using certain types of algae
 - C. By extracting it from natural gas, coal, and other fossil fuels
 - D. All of the above
11. What are the benefits of using hydrogen as a form of energy? (Circle all that are true)
 - A. Hydrogen can be found in the U.S. in pockets concentrated in the Pacific Northwest
 - B. Hydrogen can be used to create electricity cleanly—with only water and heat as byproducts
 - C. Hydrogen powered fuel cells are currently being made out of inexpensive materials
 - D. Hydrogen is currently cheaper to produce than gasoline

Mark the following True (T) or False (F)

12. _____ Fuel cells have been used by NASA to provide power aboard the Space Shuttle.
13. _____ The Hindenburg crashed because the hydrogen onboard was ignited by static electricity.
14. _____ Hydrogen is the heaviest element on earth.
15. _____ Hydrogen can exist as a gas or a liquid.
16. _____ There are many kinds of fuel cells.