Chemical Elements
&
Fuel Cell Curriculum

Handouts

Conservation Facts:

- Replacing ____ incandescent light bulb with a compact fluorescent lamp would save 500 pounds of coal and over ½ ton of CO_2 emissions.
- If just____ in 10 homes used ENERGY STAR qualified appliances, the environmental benefit would be like planting 1.7 million new acres of trees.
- If everyone reduced their driving speed from ____ to ____ mph, we'd save three million gallons of gas a day.

Smithsonian Magazine, September 2006, Chevron Human Energy, pg 15

Intro & Pre-Activity Websites:

http://www.eia.doe.gov/kids/energyfacts/sources/electricity.html

http://www.epa.gov/globalwarming/kids/

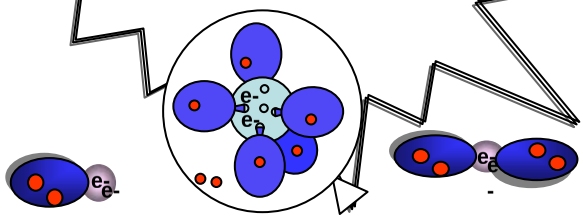
http://www.britannica.com/search?query=energy&submit=Find&source=MWTEXT

http://www.wordcentral.com/

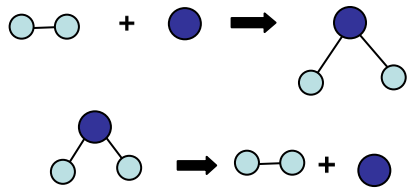
http://www.balancedenergy.org/abec/

http://www.eia.doe.gov/emeu/states/_multi_states.html

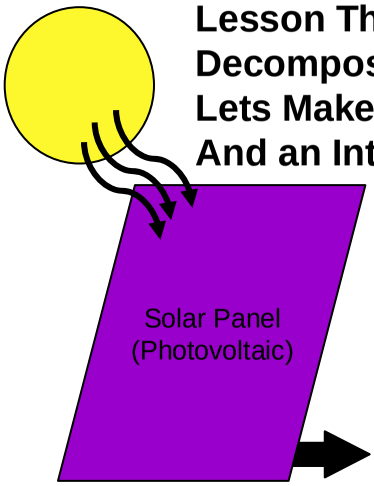
Lesson One:
Intro to the Periodic Table and 3-D Atomic Model



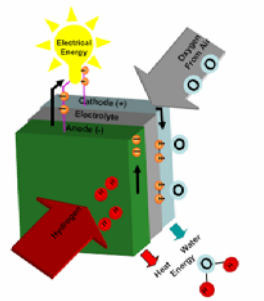
Lesson Two: Composition
Let's make Salt and Water!



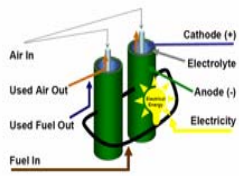
Lesson Three:
Decomposition -
Lets Make Hydrogen!
And an Intro to how a Solar Panel Works



Lesson Four:
Introduction to Fantastic Fuel Cells

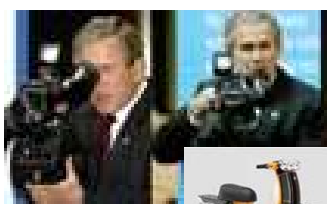


Proton Exchange Membrane Fuel Cell - PEMFC



Solid Oxide Fuel Cell - SOFC

Lesson Five: Learn About Exothermic And Endothermic Reactions

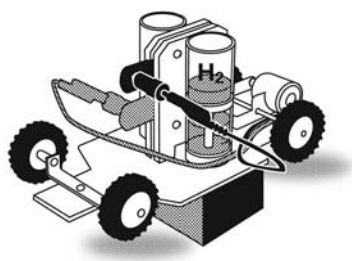


President Bush with fuel cell powered Camcorder

Lesson Six:

Critical Thinking

Observe – Record
Measure – Record
Compare and Predict



Lesson One Websites:

http://chemfinder.cambridgesoft.com/

http://www.chemicool.com/

http://chemistry.about.com/od/chemistryforkids/

http://ull.chemistry.uakron.edu/periodic_table/

CERTIFICATE OF *Participation*

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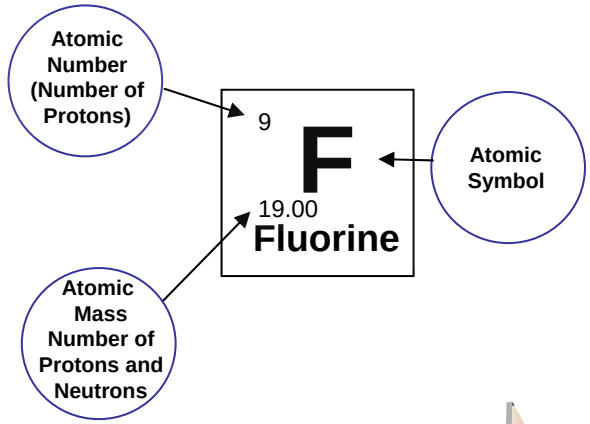

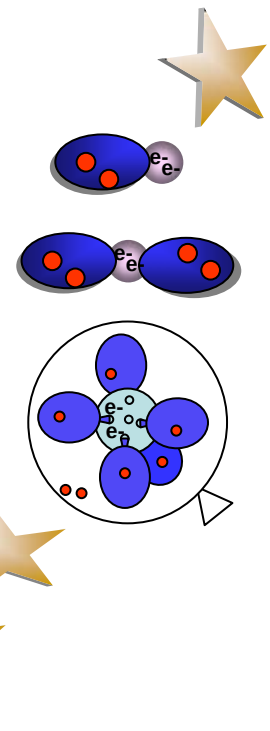

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For completing Lesson One: Introduction to the Periodic Table and 3-D Atomic Model

Mentor: _____

Lesson Two: Common Elements

Metals:

Sodium (^{11}Na), Magnesium (^{12}Mg), Potassium (^{19}K), Lead (^{82}Pb), … Transitional metals - Aluminum (^{13}Al), Iron (^{26}Fe), Nickel (^{28}Ni), Copper (^{29}Cu), Silver (^{47}Ag), Gold (^{79}Au), …

Metalloids:

Boron (^{5}Br), Silicon (^{14}Si), Arsenic (^{33}As), Antimony (^{51}Sb), …

Nonmetals:

Hydrogen (^{1}H), Oxygen (^{8}O), Carbon (^{6}C),(diamonds, graphite, anthracite), Sulfur (^{16}S), Chlorine (^{17}Cl), Bromine (^{35}Br), and Iodine (^{53}I), …

Lesson Two: Questions

What is the difference between composition and decomposition? Give examples.

Where are the metals located on the periodic table? Non-metals? Metalloids?

Name some metals, metalloids, non-metals.

Lesson Two: Questions cont.

What is the atomic number?

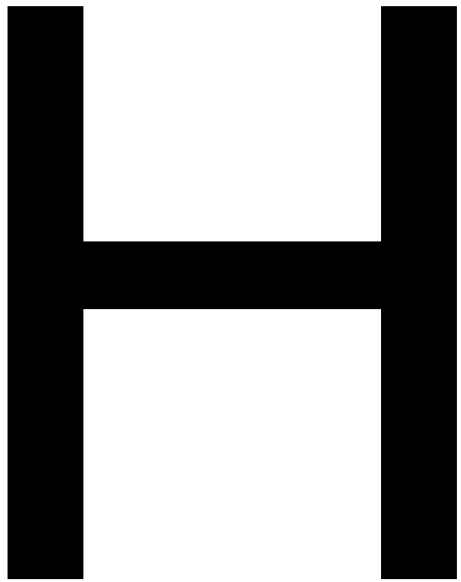
What is the periodic table?

What is the atomic mass number?

Who was Dmitri Mendeleyev?

1 Electron (1+ or 1-)

Atomic Number **1**

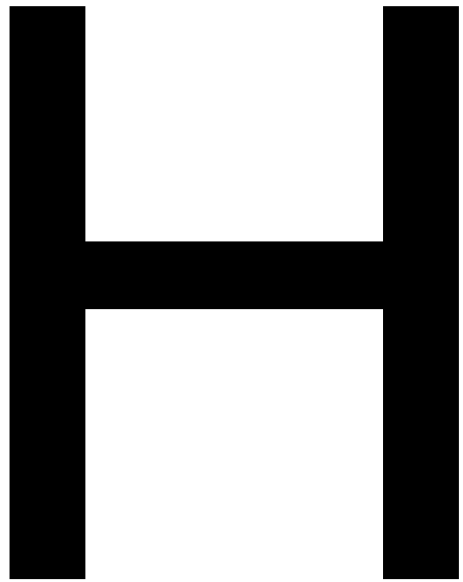


Hydrogen

1.008 (Atomic Mass)

1 Electron (1+ or 1-)

Atomic Number 1



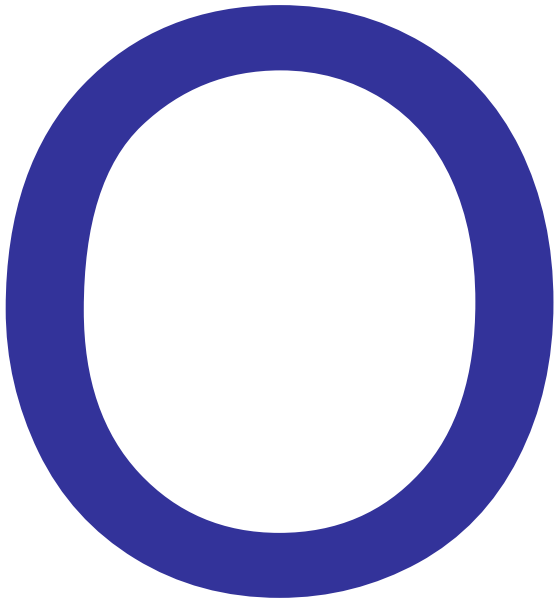
Hydrogen

1.008 (Atomic Mass)

6 Electrons (2-)

In outermost shell

Atomic Number 8

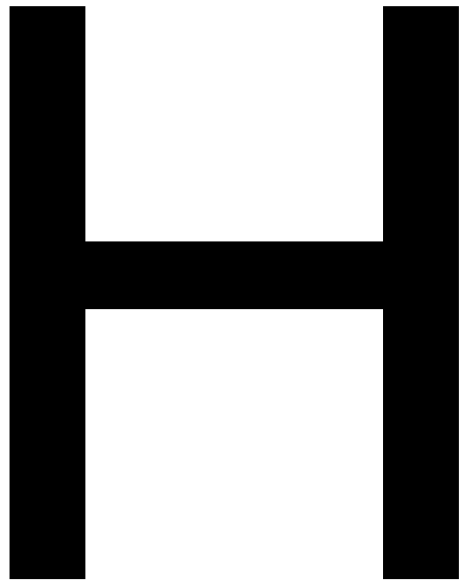


Oxygen

16.00 (Atomic Mass)

1 Electron (1+ or 1-)

Atomic Number 1

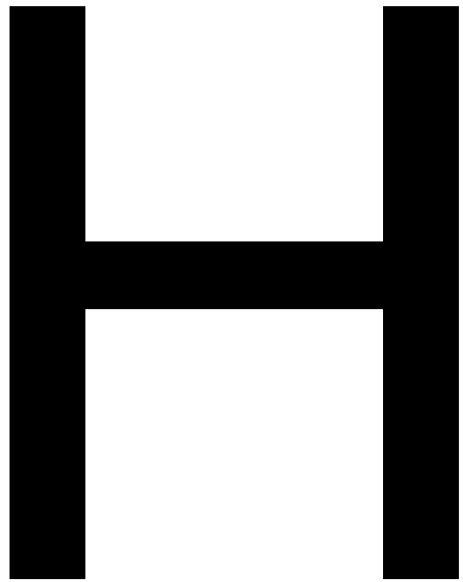


Hydrogen

1.008 (Atomic Mass)

1 Electron (1+ or 1-)

Atomic Number 1



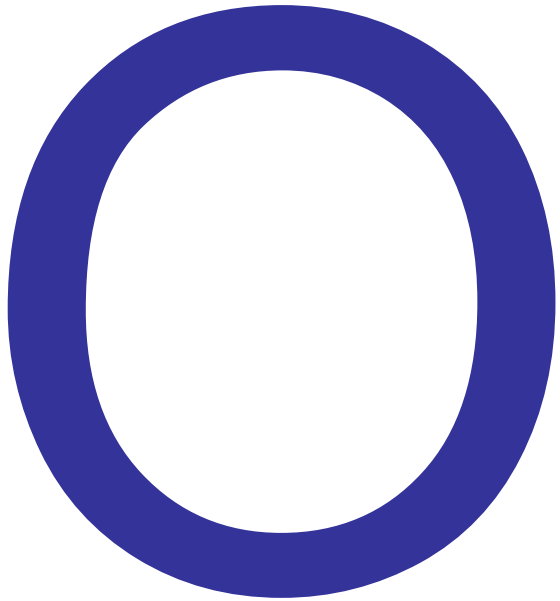
Hydrogen

1.008 (Atomic Mass)

Atomic Number 8

6 Electrons (2-)

In outermost shell



Oxygen

16.00 (Atomic Mass)

1 Electron (1+)

In outermost shell

Atomic Number
11

Na

Sodium

23.00 (Atomic Mass)

7 Electrons (1+, 5+, 7+, 1-)

In outermost shell

Atomic Number **17**

Cl

Chlorine

35.45 (Atomic Mass)

Atomic Number
11

1 Electron (1+)
In outermost shell

Na

Sodium

23.00 (Atomic Mass)

7 Electrons (1+, 5+, 7+, 1-)

In outermost shell

Atomic Number **17**

Cl

Chlorine

35.45 (Atomic Mass)

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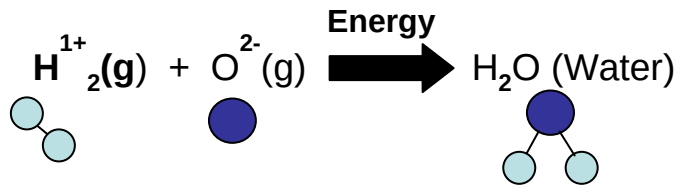
For Completing Lesson Two:
Composition and Decomposition

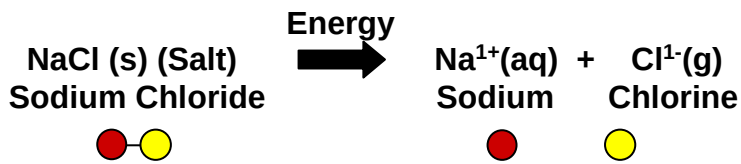
Mentor: _____

Chemical Equations

Composition



Decomposition



Lesson Three Websites:

MISSION H2 Scavenger Hunt can be found at:
http://www.bpa.gov/Energy/N/projects/fuel_cell/education

http://chemfinder.cambridgesoft.com/

http://www.chemicool.com/

http://chemistry.about.com/od/chemistryforkids/

http://www-tech.mit.edu/Chemicool/

www.hydrogenassociation.org

http://www.usfcc.com/

http://www.californiahydrogen.org/

http://www.kids4hydrogen.com/newsbulletin.htm

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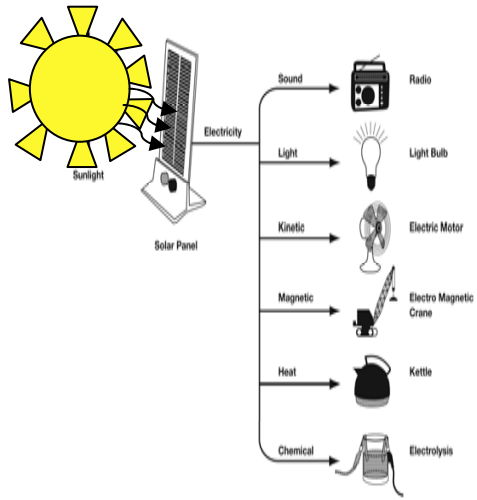

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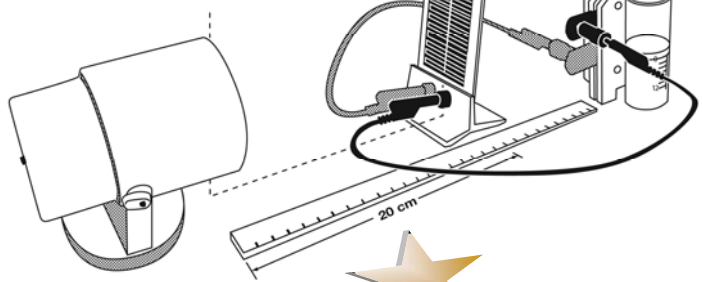
For Completing Lesson Three:
Let’s Make Hydrogen - Decomposition

Mentor: _____



Lesson Four Terms:

Electric Charge: The charge obtained by an object as it gains or loses electrons.

Electric Circuit: The path along which electrons flow.

Electric Current: The flow of electrons from a negatively charged object to a positively charged object.

Electric Force: The attraction or repulsion of objects due to their electric charges.

Lesson Four Questions:

What is the charge obtained by an object as it gains or loses electrons?

What is the electric circuit?

What do you call the flow of electrons from a negatively charged object to a positively charged object?

What is the electric force?

What's important about a fuel cell?

Explain what happens when you decompose H2O.

What does exothermic mean?

What does endothermic mean?

Lesson Four Websites:

Student information on electricity:

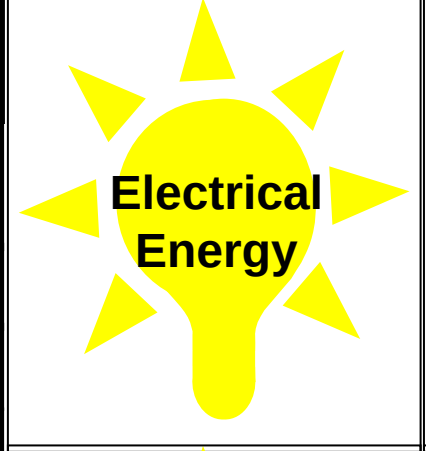
http://www.peakstudents.org/

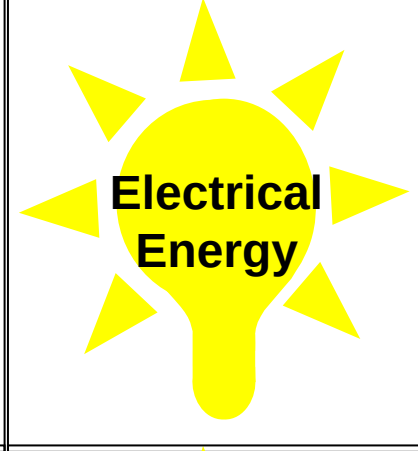
http://www.need.org

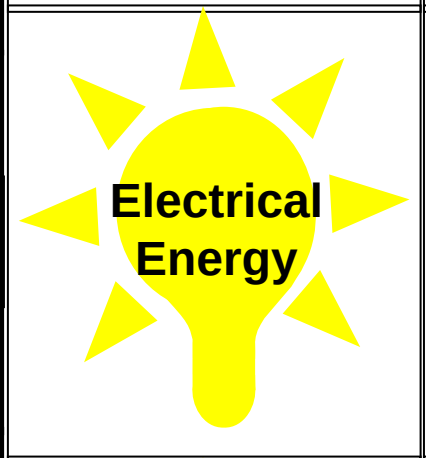
http://www.energystar.gov/

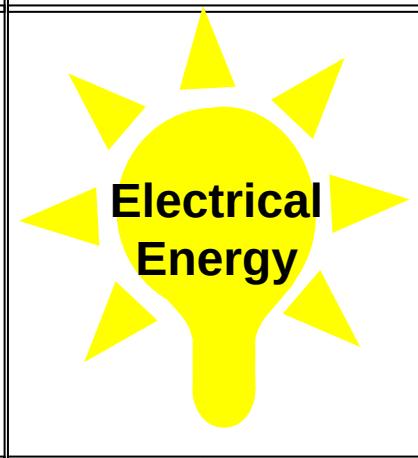
http://www.energyquest.ca.gov/

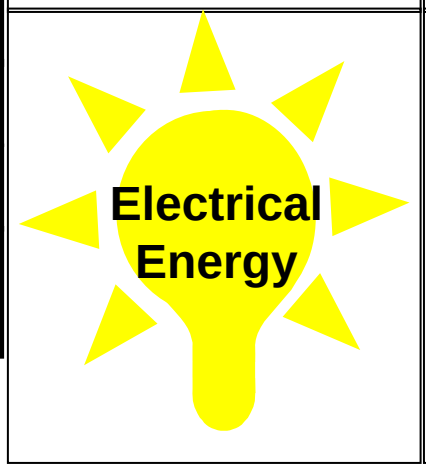
Electric Current e- e- e- e- e- e-	Electric Current e- e- e- e- e- e-	Electric Current e- e- e- e- e- e-
Electric Circuit (Pipeline)	Electric Circuit (Pipeline)	Electric Circuit (Pipeline)
Cathode (+)	Cathode (+)	Cathode (+)
Anode (-)	Anode (-)	Anode (-)
Air Tube	Air Tube	Air Tube
Electrolyte Membrane	Electrolyte Membrane	Electrolyte Membrane
Electric Current e- e- e- e- e- e-	Electric Current e- e- e- e- e- e-	Electric Current e- e- e- e- e- e-
Electric Circuit (Pipeline)	Electric Circuit (Pipeline)	Electric Circuit (Pipeline)
Cathode (+)	Cathode (+)	Cathode (+)
Anode (-)	Anode (-)	Anode (-)
Air Tube	Air Tube	Air Tube
Electrolyte Membrane	Electrolyte Membrane	Electrolyte Membrane

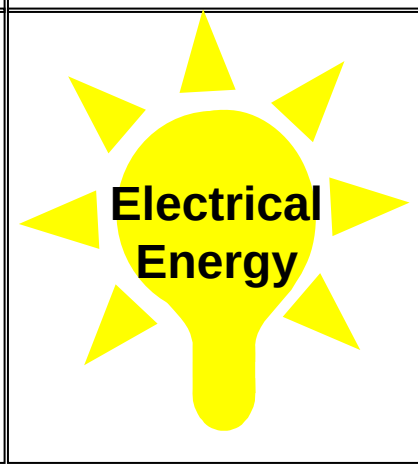






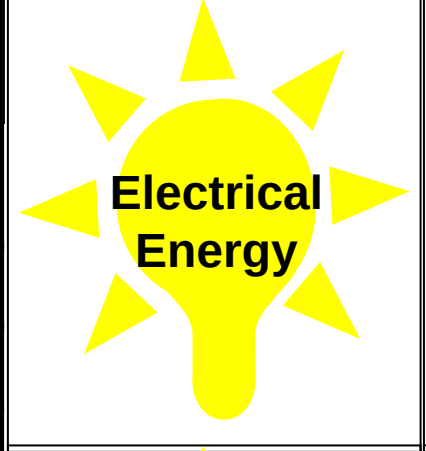


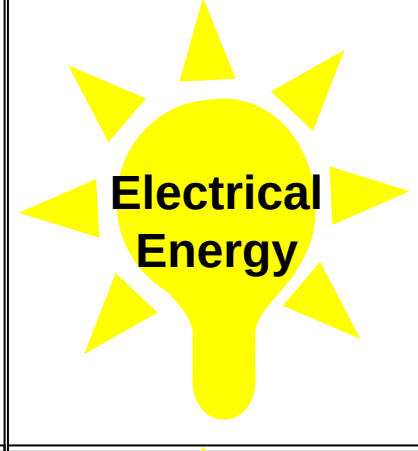


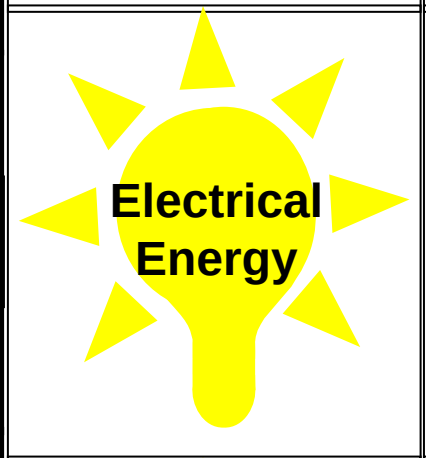


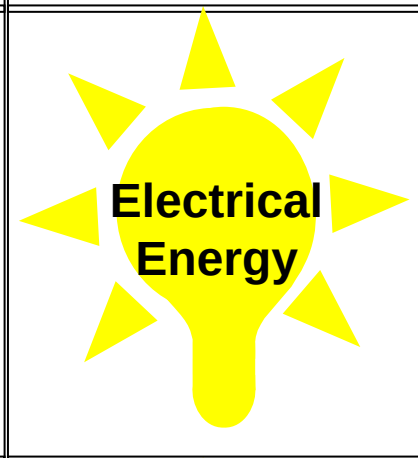
HANDOUT FOR LESSON FOUR

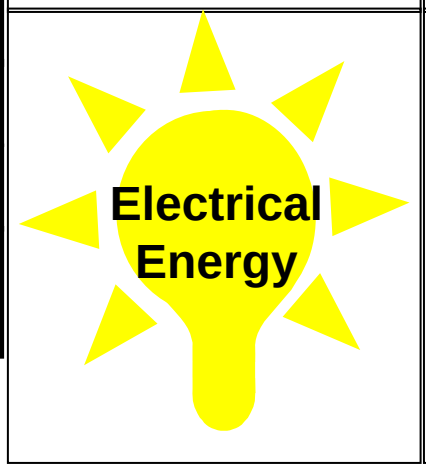
Electric Current e- e- e- e- e- e-	Electric Current e- e- e- e- e- e-	Electric Current e- e- e- e- e- e-
Electric Circuit (Pipeline)	Electric Circuit (Pipeline)	Electric Circuit (Pipeline)
Cathode (+)	Cathode (+)	Cathode (+)
Anode (-)	Anode (-)	Anode (-)
Air Tube	Air Tube	Air Tube
Electrolyte Membrane	Electrolyte Membrane	Electrolyte Membrane
Electric Current e- e- e- e- e- e-	Electric Current e- e- e- e- e- e-	Electric Current e- e- e- e- e- e-
Electric Circuit (Pipeline)	Electric Circuit (Pipeline)	Electric Circuit (Pipeline)
Cathode (+)	Cathode (+)	Cathode (+)
Anode (-)	Anode (-)	Anode (-)
Air Tube	Air Tube	Air Tube
Electrolyte Membrane	Electrolyte Membrane	Electrolyte Membrane

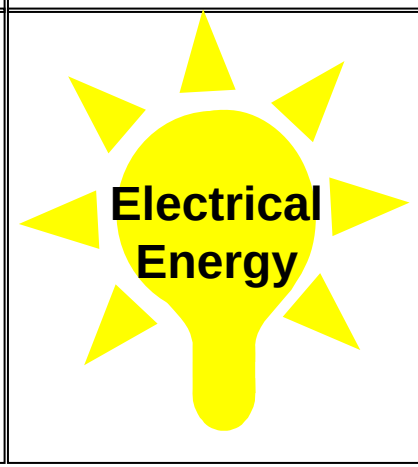












HANDOUT FOR LESSON FOUR

CERTIFICATE OF *Participation*

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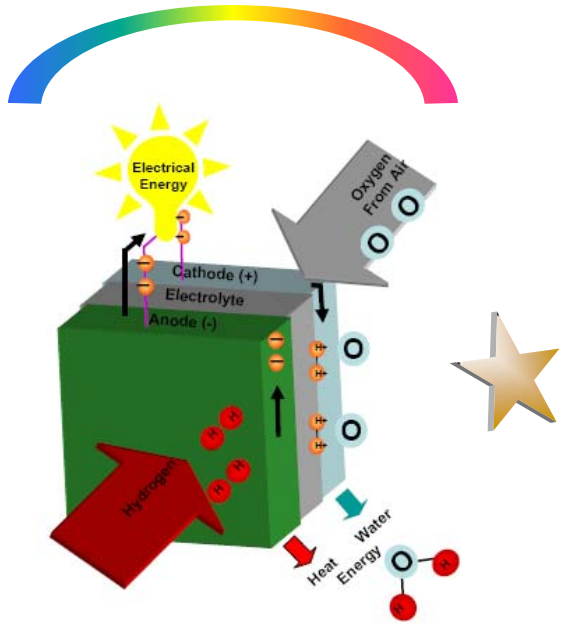

Proton Exchange Membrane Fuel Cell - PEMFC

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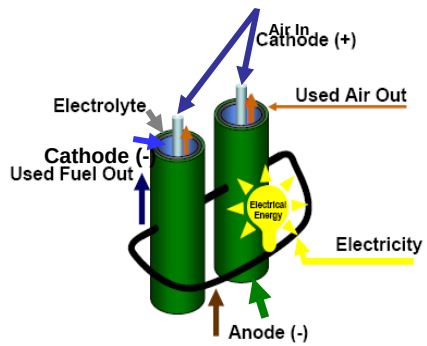
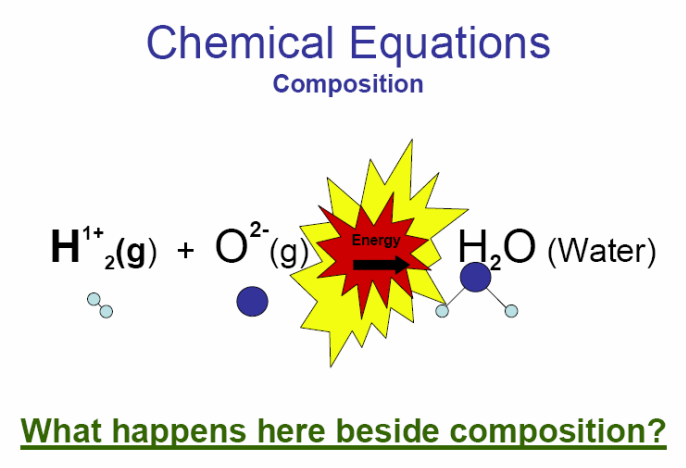
For Completing Lesson Four:
Introduction to Fantastic Fuel Cells

Mentor: _____



Solid Oxide Fuel Cell - SOFC

Lesson Five Questions:



What happens in an exothermic reaction?

What happens in an endothermic reaction?

What's important about a fuel cell?

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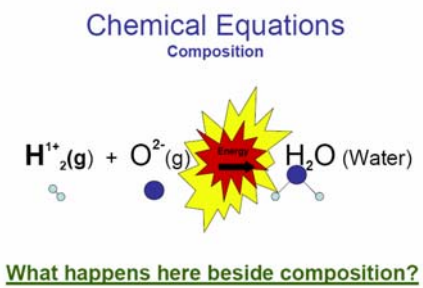

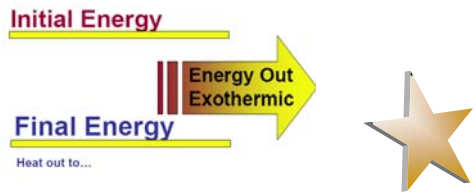

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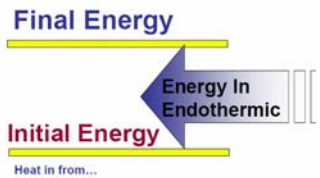
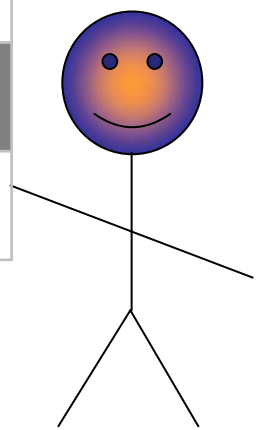
For Completing Lesson Five:
Endothermic and Exothermic Reactions



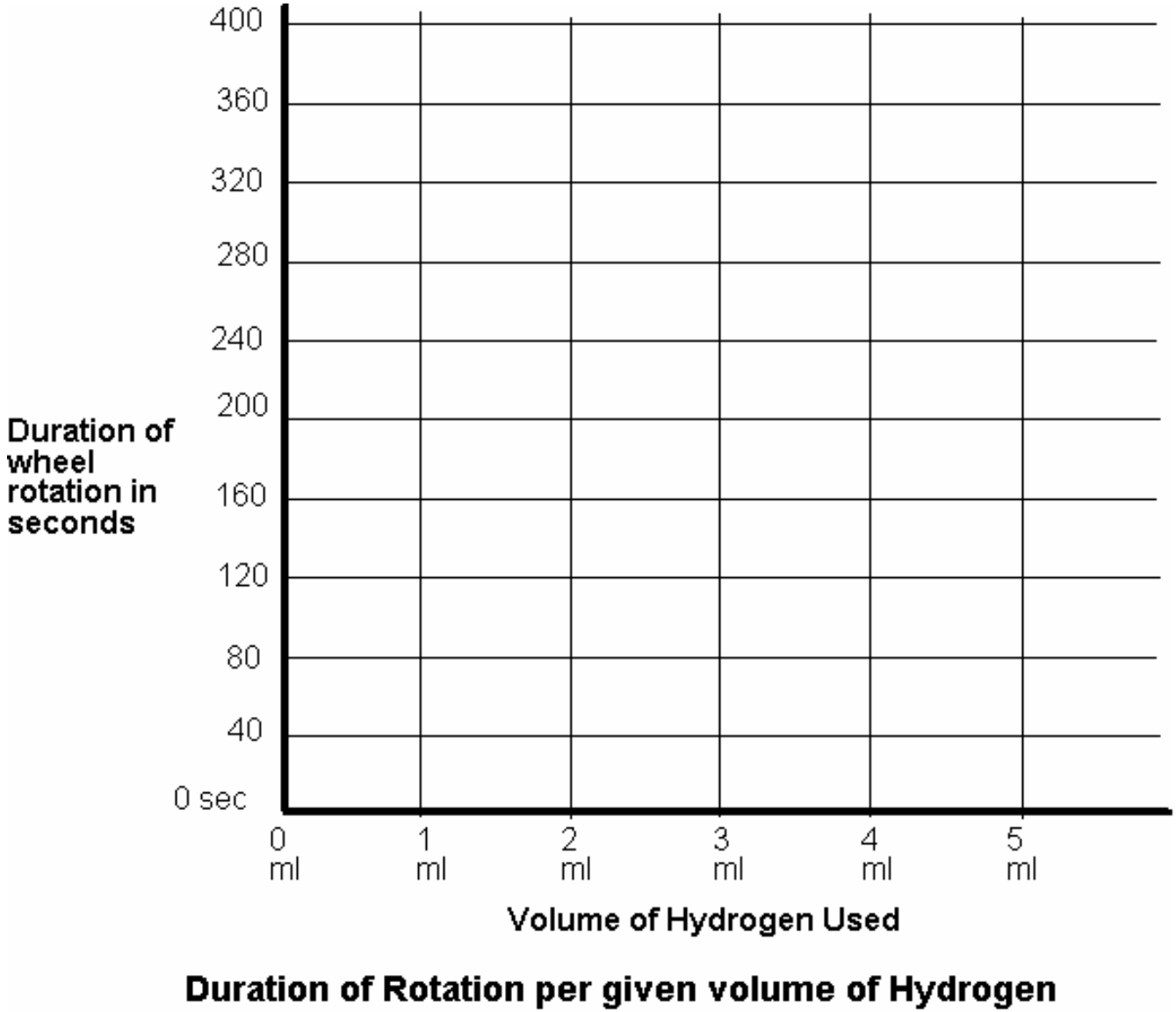
Mentor: _____

Lesson Six: Let's Measure

	Trial 1		Trial 2		Trial 3		
	time	elapsed seconds since 12 ml level	time	elapsed seconds Since 12 ml level	time	elapsed seconds since 12 ml level	Elapsed seconds of car travel (average of trials)
Time when 4 ml H_2 left							
Time when car stops, 4 ml H_2 used							



Lesson Six: Additional Chart



Duration of Rotation per given volume of Hydrogen

Lesson Six Questions:

Why do we have to know what the level of hydrogen is before we start?

What do you notice about the bubble of hydrogen and oxygen?

What was your guess (hypothesis) before we started the experiment?

How far did your car travel on 4ml of hydrogen?

CERTIFICATE OF *Participation*

PRESENTED TO

_____

Future Fuel Cell Scientist of America

For Completing Lesson Six:
Critical Thinking

Mentor: _____

Critical Thinking
Observe – Record
Measure – Record
Compare and Predict