ELECTROLYSIS LAB

MONROE

Time Frame:	Standards:
45 minutes	Idaho Standards 2.2, 2.3, 2.4

Objectives:

This lab will show students a conversion of energy from electromagnetic to chemical and from chemical to thermal and sound. There will be both an endothermic reaction and an exothermic reaction.

Background Information:

Energy is the ability to cause change. There are two broad categories of energy, one is potential and the other is kinetic.

Potential energy is the energy of position, or where "something" is at. It could be connected to another "thing", like two atoms connected together to make a molecule. Potential energy could be some "thing" at the end of a stretched rubber band, a coiled spring, or an apple held above the ground.

Kinetic energy is the energy of movement or how something is moving. The "thing" that is moving could be a mass of substance, a "field" of electromagnetic energy (photons), or the speed of a vibration of an atom within a larger molecule, like the oxygen *within* a molecule of water.

Energy can, and will, move between the categories, but energy cannot be made or destroyed. The very small exception to this is $E = mc^2$. This is Mr. Einstein's idea that matter and energy are related and interchangeable.
An endothermic reaction will absorb energy, hence the prefix "endo". The reaction will be the combination of any number of particles. Usually an endothermic reaction will show a decrease in temperature, because temperature is often a good indicator of the level of energy in a substance.

An exothermic reaction will release energy, hence the prefix "exo". The reaction will be the combination of any number of particles. Usually an exothermic reaction will show an increase in temperature.

Electrolysis of water is when kinetic electrical energy is used to replace the potential energy of the chemical binding bonds between the hydrogen and oxygen in water. A hydrogen atom is able to escape from the oxygen, and reforms with another hydrogen atom to make a hydrogen gas molecule. Oxygen is similarly separated from hydrogen in water, and combines with other free oxygen to make oxygen gas molecules.

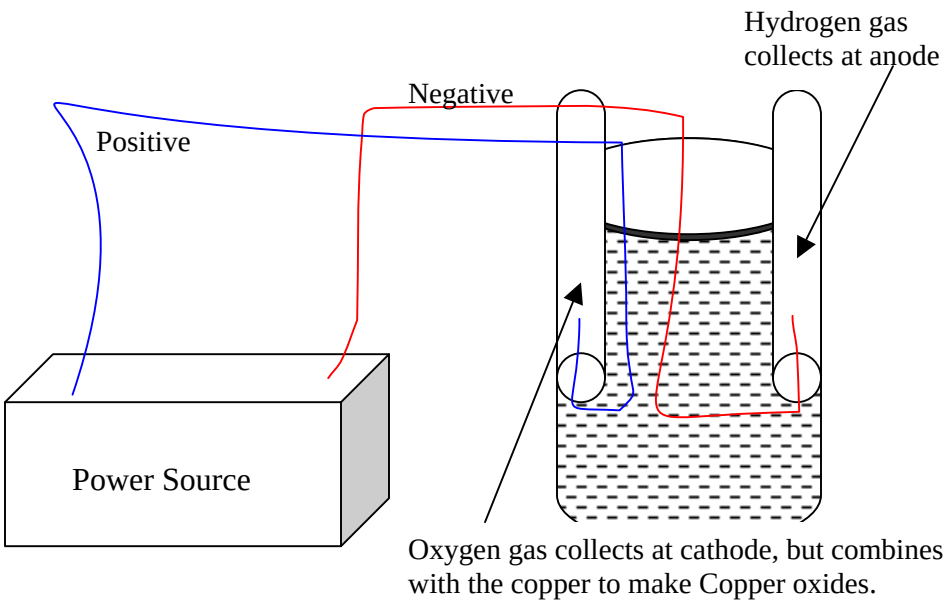
Safety Concerns:

1. Electrical shock is an issue any time current is used. The size of the concern is dependent upon the amount of current the instructor decides to use.
   a. A single 1.5 volt battery will have few safety concerns, but will also provide small amounts of gas through electrolysis.
   b. Rectified wall current will provide large amounts of gas through electrolysis, but will also present a much larger safety concern.
2. Glassware can break and be a sharp hazard
3. The chemicals used are not extremely hazardous, but caution should still be taken.
4. Copper oxides will be produced at the cathode and should be disposed of according to local codes and procedures.
5. Matches will be used, so a fire extinguisher should be nearby.
6. When the hydrogen ignites, there will be a small "pop". Because of the rare cases when a test tube may break, safety glasses and gloves should be worn.

Materials and Teacher Preparation:

1. For each lab group you will need:
   a. Two large test tubes
   b. A large beaker or clear plastic bucket
   c. Two insulated copper wires 25 cm long, stripped on both ends to expose about 3 cm of wire. House wiring works well and it is about 16 gauge.
   d. A power source. **It must be direct current**. The higher the voltage is; the more explicit the demonstration will be. KEEP IN MIND THAT HIGH VOLTAGE IS DANGEROUS. Four or five "D" size flashlight batteries, connected in series will work fine.
2. You will need something that will dissolve in water and help the electricity flow. This could be table salt, baking soda or a weak acid. These become ions and help the electricity complete a circuit in the water. Sodium chloride is safe to handle; it is cheap and it works well.
3. If the instructor chooses to use a higher voltage and is qualified to do so, it can make for an exciting demonstration.

Lab Diagram:



Lab Procedure:

This is a challenging laboratory experiment. Care should be taken so that no injuries or accidents occur. All of the safety contracts should be turned into your instructor.

1. Fill your large beaker about ¾ full with water from the tap. Distilled water is not needed.
2. Fill one test tube with water from the tap, and cover it with your thumb. Turn it "upside down" and place it in the water. Little or no air should have gotten into the test tube.
3. Your partner will tape the test tube to the beaker. This is not as easy as it seems, because the test tube is on the *inside* of the beaker and the tape is on the *outside*. With care, however, it can be done.
4. Repeat the process with the other test tube.
5. Bend the insulated wires so that the *bare copper* is inside the test tubes, near the bottom.
6. Have the wires **prepared** to connect to the wire source.
7. Dissolve about 10 mL of salt into the water. This will help the electricity flow.

Stir the mixture *gently*, so the test tubes do not come loose.

8. Connect the wires to the power source. Begin answering your lab questions.
9. When the test tube is about ½ full of gas, you are ready for the next step.
10. Remove the test tube and let the water flow out.
11. Keep your finger over the opening of the test tube, holding the test tube with a glove.
12. Take your test tube to your instructor, and retrieve a lit match

Hold the test tube upside down and place the match to the lip of the test tube. The test tube should give a sharp "pop", and a bluish flame should be seen.

Assessment:

1. By looking at the test tubes, do you see any evidence that the electromagnetic energy from the power source is causing a change?

2. New energy is being used to separate the atoms in the water. Hydrogen gas and other products are being produced. Is this reaction endothermic or exothermic?

3. The kinetic energy of the electricity is being converted into potential energy. What type of potential energy is being formed?

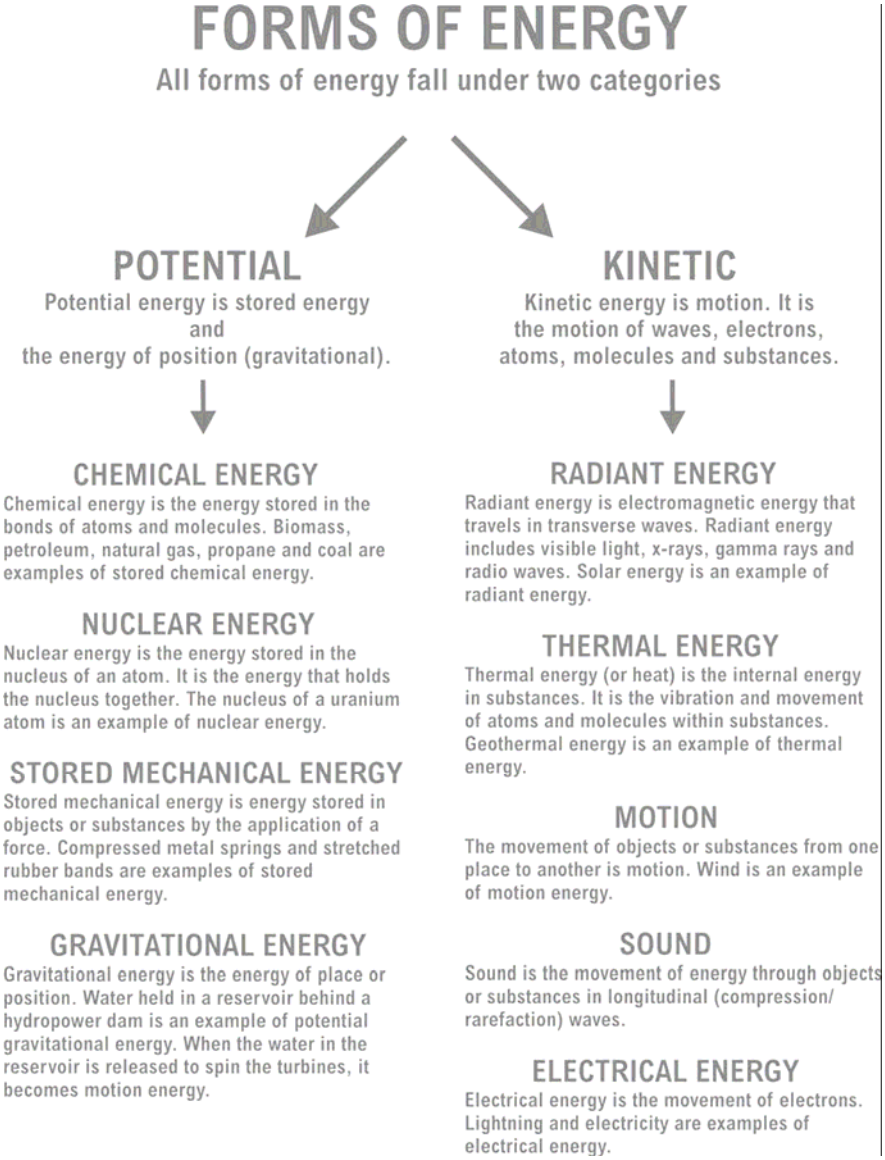
4. What energy types (and conversions) took place when you placed the match to the open end of the test tube?

Re-read the portion of your textbook that deals with types of energy. Indicate which types of energy are involved in the situations given. There may be more than one correct answer.

	Chemical Potential	Mechanical Potential	Gravity Potential	Nuclear Potential	Radiant Kinetic	Thermal Kinetic	Motion	Electricity	Sound
Apple									
Candle									
U-235									
Bullet									
Light									
Tree									
Hot Water									
Battery									

Energy Background:

Energy is the ability to cause change.



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