
IMH TEP'S

LEGACY ACADEMY

8.6 Copper Plating & Electrolysis

Grade 8 Activity Plan

Reviews and Updates

8.6 Copper Plating & Electrolysis

Objectives:

1. To understand how the laws of attraction govern the formation of ions and molecules
2. To predict the products of the electrolysis of water based on the chemical composition of water
3. To use electrolysis to separate water into hydrogen and oxygen gas
4. To use an electrolytic cell to electroplate an object with copper

Keywords/concepts: cation, anion, cathode, anode, electrolysis, electrodeposition.

Take-home product: Iron strips coated with copper

Segment	Details
African Proverb and Cultural Relevance (5 min.)	“Lack of knowledge is darker than night.” Kenya Discuss Francis Jeffers and his organization Visions of Science
Pre-test (5 min.)	If you have two ‘gold’ bracelets that look the same but priced differently, why is one so much cheaper than the other? Discuss common uses of electrolysis and electroplating.
Activity 1 (10 min.)	Discuss atoms and subatomic particles with the visual aid of ‘atom magnets’. Demonstrate how ions are formed, and how they combine to form molecules. Encourage student participation.
Activity 2 (5 min.)	Have students create water molecules from Styrofoam balls and pipe cleaners. Introduce the concept of electrolysis, and have students separate their molecules back into atoms to demonstrate the process. Link this to the rate of formation of hydrogen and oxygen gas during electrolysis.
Activity 3 (30 min.)	Describe what happens when an electric current is passed through water – use diagram. Watch an electrolysis video, and then conduct electrolysis activity.
Activity 4 (25 min.)	Use a diagram to illustrate the movement of ions in electroplating. Conduct copper plating activity.
Post-test (10 min.)	GAME: Play electrolysis (walking!) tag

Suggested interpretation of the proverb: Without knowledge, you will be blind to what’s out there, and you will not know how to proceed. In this activity knowledge is crucial to complete the experiment. If the wires are misconnected, or the wrong metals used, a black coating will cover one of the electrodes.

Cultural Relevance

Francis Jeffers knows that scientific innovation comes from one's community. As founder and president of Visions of Science, Jeffers maintains close ties to the black community in an ongoing effort to promote science and technology to African and Caribbean communities. His organization has had a significant impact on the lives of countless young people, particularly through its annual forum, showing thousands of minority students that science is a viable career for them.



Jeffers is president and co-founder of the African Relief Committee in Canada, and he and his wife have recently acquired The International Black Inventions Museum, a mobile museum that teaches about the contributions Africans have made to civilization. Widely recognized as a leader in science and community involvement, Jeffers is a model for the young people he inspires and the colleagues whose accomplishments he helps celebrate.

BACKGROUND INFORMATION

Subatomic Particles

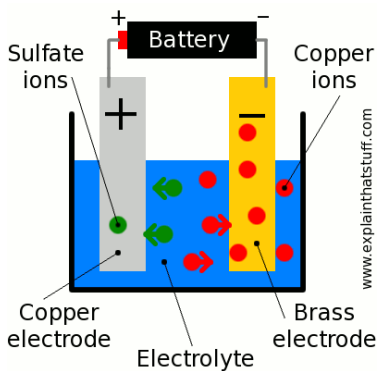
Protons, neutrons, and electrons are subatomic particles that make up an atom. Neutrons and protons are found in the nucleus of the atom and electrons are found on the outer orbits. Protons have a positive charge; electrons have a negative charge and neutrons have no charge. If an atom has a net charge that is either positive or negative (aka not zero), then it is called an **ion**.

Cations have a positive net charge (more protons than electrons).

Anions have a negative charge (more electrons than protons).

Electroplating (often just called "plating") is the deposition of a metal coating onto an object by putting a negative charge on it and putting it into a solution which contains a metal salt. The metal salt contains positively charged metal ions which are attracted to the negatively charged object and are "reduced" to metallic form upon it.

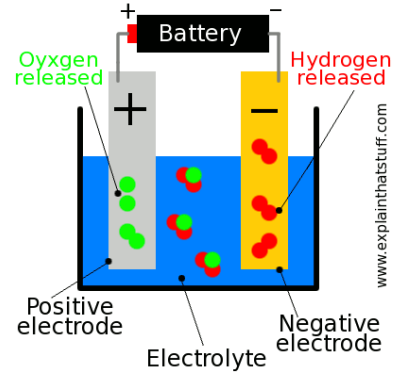
Electroplating involves passing an electric current through a solution called an electrolyte. This is done by dipping two terminals called electrodes into the electrolyte and connecting them into a circuit with a battery or other power supply. When the electricity flows through the circuit they make, the electrolyte splits up and some of the metal atoms it contains are deposited in a thin layer on top of one of the electrodes—it becomes electroplated.



Generally, one of the electrodes is made from the metal we're trying to plate and the electrolyte is a solution of a salt of the same metal. So, for example, if we're copper plating some brass, we need a copper electrode, a brass electrode, and a solution of a copper-based compound such as copper sulfate solution. When we switch on the power, the copper sulfate solution splits into ions. Copper ions (which are positively charged) are attracted to the negatively charged brass electrode and slowly deposit it on it—producing a thin later of copper plate. Meanwhile, sulfate ions (which are negatively charged) arrive at the positively charged copper anode, releasing electrons that move through the battery toward the negative, brass electrode.

Electroplating is very similar to **electrolysis** (using electricity to split up a chemical solution), which is the reverse of the process by which batteries produce electric currents. Electrolysis involves splitting a solution into the atoms from which it's made by passing electricity through it. During electrolysis you place a solution in a container and dip two terminals into it. You connect the terminals up to a battery or other power supply and pass electricity through the solution.

Chemical reactions take place and the solution splits up into its atoms. If the solution you use is pure water (H_2O), you find it quickly splitting up into hydrogen gas (at the negative electrode) and oxygen gas (at the positive electrode). It's relatively easy to collect and store these gases for use in future.



All these things are examples of electrochemistry: chemical reactions caused by or producing electricity that give scientifically or industrially useful end-products.

Activity 1: Atom Magnets

Purpose: To understand how the laws of attraction govern the formation of ions and molecules

Items	Quantity (10 Students)
Sheets of foam	4
Tape	1 pack

Procedure:

- 1) **PRIOR TO ACTIVITY, MENTOR ONLY:** Cut out a large circle of foam and draw on the atom's shells surrounding a nucleus. Cut out foam circles representing protons, neutrons and electrons.
- 2) Tape the atom to the board.
- 3) Ask students to place the correct subatomic particles on it in order to make: a neutral atom, a cation, an anion.

Activity 2: Creating a Water molecule

Purpose: To predict the products of the electrolysis of water based on the chemical composition of water

Items	Quantity (10 Students)
Styrofoam balls	10 large, 20 small
Pipe Cleaner	1 pack
Markers	1 pack

Procedure:

- 1) Have each student **construct** a water molecule. The large ball will represent the oxygen atom, the small balls will represent the two hydrogen atoms, and the pipe cleaners will symbolise the bonds holding the molecule together.
- 2) **Label** the atoms, and their charges. Explain that hydrogen has a slightly positive charge and oxygen has a slightly negative charge.
- 3) Have students **break** apart their water molecules, as if they are the electric current needed for electrolysis.

Activity 3: Electrolysis of Water

Source: <https://orbitingfrog.com/2014/11/02/electrolysis-of-water-with-pencils-and-a-9v-battery/>

Purpose: To use electrolysis to separate water into hydrogen and oxygen gas

Suggested format: Students will work in groups of 2

Items	Quantity (10 students)
250 mL beaker	5
9V batteries	5
Alligator clips	10
Cardboard squares (5 in. x 5 in.)	5
Sticks of lead (graphite)	10
Salt	~10 Tbsp
Distilled Water	1.5 L

Procedure:

1. **Fill the 250-mL beaker** with warm water. **Add salt** to the water, until it will no longer dissolve.
2. **Attach alligator clips** to the electrodes on the 9V battery, and the other ends to the tips of the graphite. It is important to make good contact with the graphite in the pencils.
3. **Punch small holes in the cardboard**, and push the graphite through the holes.
4. **Place the exposed tips of the graphite in the solution**, such that the tips are fully submerged but are not touching the bottom, and adjust the cardboard to hold the pencils.
5. **Wait** for a minute or so: Small bubbles should soon form on the tips of the pencils. Hydrogen bubbles will form on one tip (associated with the negative battery terminal - the cathode) and oxygen from the other.

Additional Resources:

Electrolysis video:

<http://www.youtube.com/watch?v=2t13S-KpGeE&feature=related>

Collect and test the gases:

<http://www.msnuclous.org/membership/html/jh/physical/atomictheory/lesson4/atomic4d.html>

Activity 4: Copper Plating

Purpose: To use an electrolytic cell to electroplate an object with copper

Items	Quantity (10 Students)
250 mL beakers	10
9V batteries	10
Alligator clips	20
8 cm copper wire	20 pieces
Metal objects to plate (iron strip)	10
Copper strips	10
Distilled Water	2L
Copper Sulphate	50g
Electronic scale	1
Ziploc Bag	10

Procedure:

1. **Fill** the 250-mL beaker with water.
2. Using the scapula and weighing scale, **measure 5g copper sulphate** crystals and add it to the water.
3. **Cut two 12 cm sections of wire**. Wrap one wire around the iron strip, and the other around the copper strip.
4. Using alligator clips, **connect** the wire wrapped to the piece of copper to the POSITIVE battery terminal. Connect the other wire to the NEGATIVE battery terminal. You should now have copper connected to the cathode, and iron connected to the anode.
5. **Place the electrodes in the solution** and let the experiment stand for about 5 minutes. When removed, the anode should be coated with copper.
6. When you're done the experiment, you can safely dispose of the solution down the sink or you can keep it. The solution is reusable for a few years.
7. Have the students take home their metal strip in a Ziploc bag.

Post-test

Electrolysis tag:

Items	Quantity
Masking Tape	1 roll

Use masking tape to label students with an H or an O and have them link arms to form water molecules. Draw a line across the floor between a positive and a negative electrode to represent the electric current. Both 'it' and 'water' must start on the same spot but 'it' must count to 5 before 'it' begins to walk. 'Water' must move as a group until they cross the line and then separate and migrate to the proper electrode before 'it' catches them. The first student who is caught becomes 'it'. If no students are caught, then the last student to touch the wrong electrode becomes 'it'.