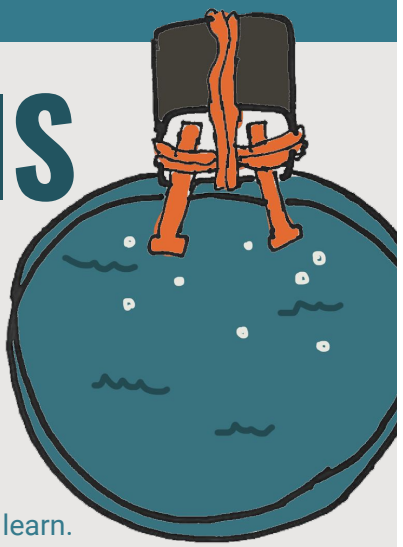
WATER ELECTROLYSIS

ELEMENTARY SCHOOL LEVEL 2



Water is made up of hydrogen and oxygen. Through the process of electrolysis we can separate these molecules inside of water. Electrolysis is a technique that uses a direct current of electricity to cause a chemical reaction. Our machine will be very rudimentary, using a battery and steel screws, but it works well and is a great way to learn.

EDUCATIONAL STANDARDS:

NGSS CONNECTION:
5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen.

COMMON CORE CONNECTION:
ELA/Literacy

W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic.

W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.

Mathematics
MP.2 Reason abstractly and quantitatively.

MP.4 Model with mathematics.

5.NBT.A.1 Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.

5.NF.B.7 Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions.

5.MD.C.3 Recognize volume as an attribute of solid figures and understand concepts of volume measurement.

5.MD.C.4 Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units.

DOK:
Level 3: Strategic Thinking
Level 4: Extended Thinking

MATERIALS NEEDED:

- ❑ Stainless steel screws
- ❑ Petri dish
- ❑ Epsom salts
- ❑ 9-volt battery
- ❑ Rubber bands
- ❑ Acid-base indicator

SAFETY:

- Battery should only be connected after experiment is set up.
- Students should not place hands in water while battery is connected.

DIRECTIONS:

1. Wrap a rubber band around the battery, laying across the terminals on top.
2. Place a screw on each of the battery terminals with the large end extended out. Slip the ends under the rubber band to hold it in place.
3. Use another rubber band to separate the battery terminals and hold the bands firmly in place.
4. Pour warm water into the petri dish and add a third of a teaspoon of Epsom salts. Stir the solution until the salt has fully dissolved.
5. Add the acid-base indicator into the solution until the color of the water has changed.
6. Place the ends of the screws into the water, **being sure not to get the battery wet.** Rest it against the side of the dish to balance.
7. Notice the reaction occurring in the dish. You will see bubbles forming at the ends of the screws. This is the chemical reaction taking place in the solution due to the charge from the battery.
8. Does one side make more bubbles than the other? Why might that be?

OBJECTIVE:

Students will be able to develop various models to demonstrate that matter is made up of particles to small to be seen.

ESSENTIAL QUESTIONS:

- What makes up matter?
- What makes one substance different than another?

FUN FACTS

A. Word Origin: *Electro* refers to energy and electricity and *-lysis* refers to splitting apart.

B. Real World Science: Water electrolysis can be used as a form of renewable energy to provide many benefits.

C. Hydrogen produced in this reaction can be stored in fuel cells and serve as electricity, decreasing CO^2 emissions and excess energy generated by solar power or wind turbines.

D. A group of engineers at Duke University set a world record for the most fuel-efficient vehicle. A hydrogen fuel cell car named "Maxwell" circled a race track 8.5 miles using only one gram of hydrogen!

ENGAGE / EXPLORE:

1. Students will be given a syringe and a small marshmallow
    a. Ask students to place the marshmallow in the syringe.
    b. Students can then experiment covering the end of the syringe and squeezing and opening the syringe to see the effect on the marshmallow
        i. In doing so students will see the marshmallow compressing and expanding based on the air pressure in the syringe (don't tell students this!)
        ii. Ask students to use words, pictures, and arrows to produce a model to explain what occurs here.
2. Students can share their observations with other groups in their attempts to construct their models
3. Evaluate
    a. Informally collect data on student misconceptions

EXPLAIN:

1. Use PhET simulation: States of matter
    a. States of matter
    b. Have students explore and identify
        i. What various substances look like at the molecular level
2. Have students revisit their model of the marshmallow syringe.
    a. Use the information they learned from the PhET simulation to revise their models
    b. They should now include concepts of small molecules that can be squeezed together or pushed apart (demonstrates that air and marshmallow are made of small molecules)
    c. Facilitate learning through reflective questioning
3. Evaluate
    a. Students models from their revision (growth)
    b. Misconceptions

ELABORATE:

1. Guide students in assembling the Electrolysis activity
2. Preach safety to students and monitor their set up
    a. You may want to withhold batteries until all setups are complete
3. Students should then observe the electrolysis and record observations
4. Have students construct models from their previous experience on what is happening
    a. Facilitate students when they are stuck
    b. Ask guided questions to elicit thinking
    c. Discuss the previous activity with them
        i. Molecules in air so what is in water?
        ii. May need to revisit PhET simulation to identify water molecule
5. Evaluate
    a. Students models
    b. Growth mindset
    c. Correcting of misconceptions and growth in understanding.