**Extension Activity –** Soil

**Title of Activity –** Moisture Sensor/Meter with Simple Circuits

**Concepts/Principles Covered –**

Tap water is **conductive** (able to conduct electricity) because there are **mineral ions**, such as sodium or fluoride, to carry electronic charge in the solution. **Deionized** water is purified water where ionic minerals dissolved in the water have been removed. This type of water will not conduct electricity well.

An **electric circuit** is a path for **current** to flow from an energy source (like a battery) and may include wires, cables, capacitors, resistors, or voltmeters. In a **closed circuit**, current flows in an uninterrupted path. An **open circuit** has an interruption, like a blown fuse or missing component, which will not allow current to flow. In the moisture sensor, water closes the circuit allowing current to flow.

IMPORTANT TERMS
* Voltage (V) – measure of the pushing force available to push the current through the circuit. Higher voltage pushes harder and forces more current through a given load.
Common unit of voltage is Volts.

* Current (I) – continuous movement of positive charges through the circuit. Actually, negative charges (electrons) are what move. Current is the flow of positive charge, but electrons actually move, and the direction of movement is OPPOSITE that of the current.

Conventional standards assume that current flows out of the positive terminal, through the circuit and into the negative terminal of the source. Electron flow happens as electrons flow out of the negative terminal, through the circuit and into the positive terminal of the source.

Common unit of current is Amperes or Amps.

* Resistance (R) – something that opposes, or makes difficult, the flow of current (like a load on the circuit). Common unit of resistance is Ohm(s).

* Ohm's Law: V = IR (V in Volts, I in Amps, R in Ohms)

**Short Description –**

Learn about simple electrical circuits and conductivity as well as how the amount of water present in soil can change. Use simple components to build and experiment with some simple electric circuits and identify the importance of understanding circuits as well as how circuits are the foundation for sensing systems. Circuits and sensors are present in a wide variety of devices used everywhere. Examples include guidance systems, control circuits on machinery and propulsion plants, automobile engines and other vehicle components, medical diagnostic equipment, home appliances, cell phones, etc.

**Standards Covered** -

MS-ETS1-4: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. *Grades 6-8.*

MS-PS2-3: Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.

MS-PS2-B: Types of Interactions - Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects.

HS-PS2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

HS-PS2-2, HS-PS2-4: Use mathematical representations of phenomena to describe explanations.

HS-PS2-5: Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

CCSS.MATH.CONTENT.HSA.CED.A.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

**Length -** 60 minutes

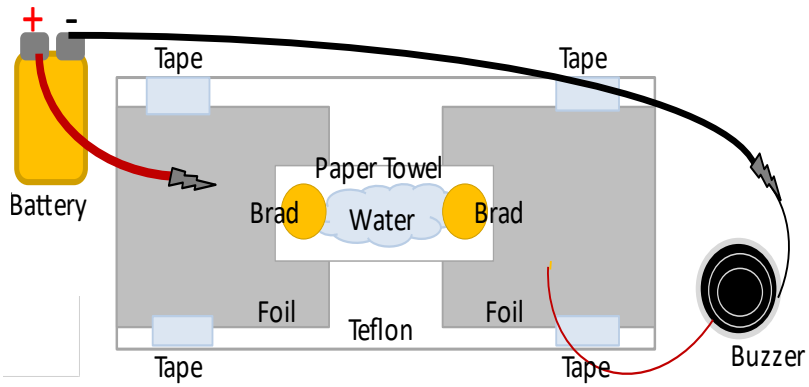
**Age Group –** Grades 6-10

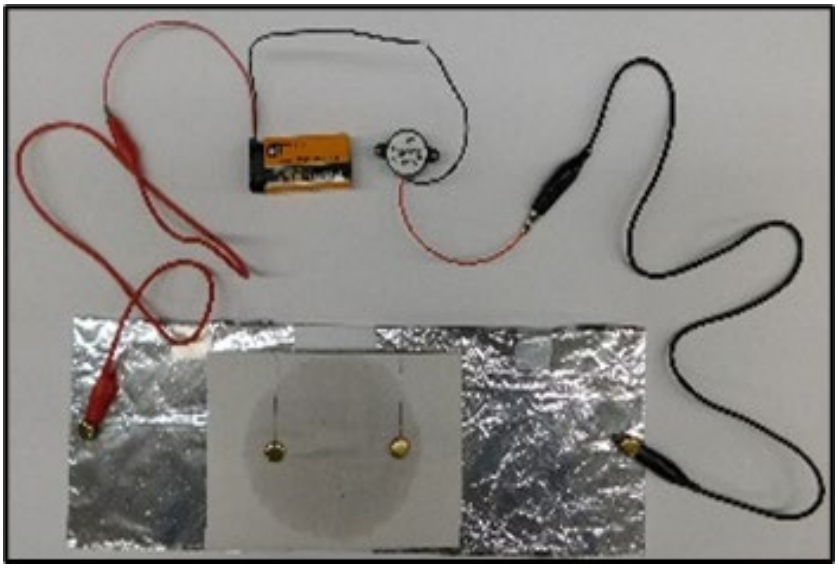
**Materials and Supplies –**

- Electric Circuit kit from Amazon with 2 AA batteries
- 9V battery
- Sheet of Teflon
- Alligator clips and wires
- LED or buzzer
- Water
- Paper towels
- Brads (paper fasteners)
- Tape
- Aluminum foil

**Step-by-step Instructions -**

- Cut a rectangle (5” x 8”) out of Teflon.
- Punch two holes (1/4”) into the middle of the Teflon roughly two inches apart.
- Cut two pieces of aluminum foil into 3” x 3” rectangles.
- Tape the foil on the Teflon so the foil covers the holes. Make sure the foil pieces are not touching each other!



- Attach a paper towel between the foil pieces. Secure both the paper towel and foil sheets using metal paper fasteners (brads). Poke a hole with the brad through the paper and aluminum to do this.

- Build a circuit that includes a battery and a buzzer and connects to the foil. You may use alligator clips or wires.

- Add water drops to the middle of the paper towel. What happens when the water touches the paper fasteners? Add the water incrementally to find a relationship between amount of water and volume of the buzzer.