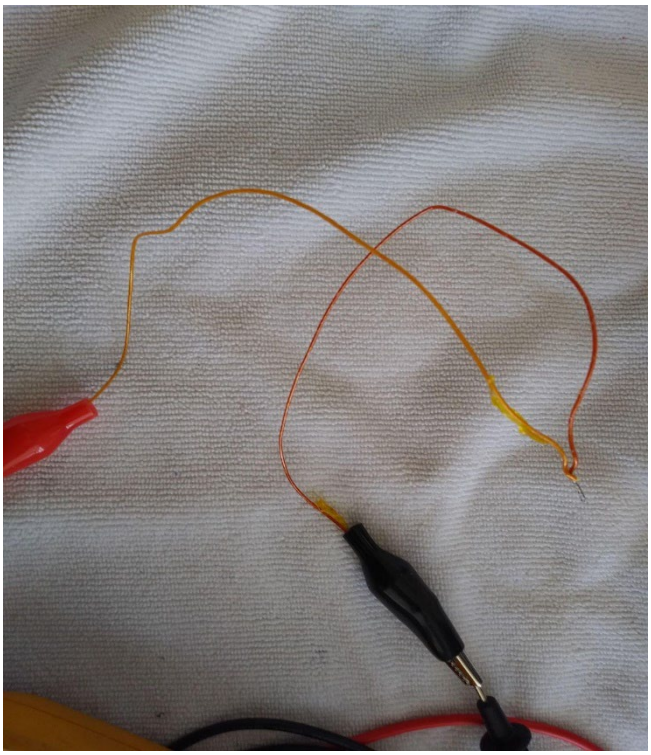
Extension Activity – Air, Water, and Soil

Title of Activity - Make Your Own Thermocouple

Concepts/Principles Covered -



Here's an easy way to make a thermocouple and measure temperature using the Seebeck Effect. From this phenomenon, a temperature difference between two dissimilar electrical conductors will produce a voltage difference between the two. When heat is applied to one of the two conductors, electrons will flow toward the cooler one.

Short Description –

Demonstrate how a thermocouple operates and how it can be used to measure temperature differences via the Seebeck Effect.

Standards Covered -

MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

8.EE.B.5: Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.

HSN.Q.A.1: Use units as a way to understand problems and to guide the solution of multi- step problems; choose and interpret units consistently in formulas, choose and interpret the scale and the origin in graphs and data display

8.F.A.3: Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.

HSN.Q.A.2: Define the appropriate quantities for the purpose of descriptive modeling

HSN.Q.A.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities

Length - 45 minutes

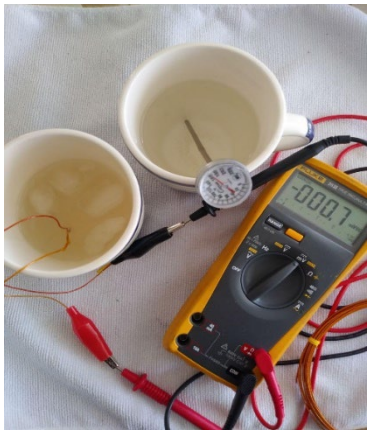
Age Group – Grades 8-12

Materials and Supplies (Simple version) -

- K-type thermocouple wire
- Wire strippers
- Wire leads with alligator clips
- Water baths (ice and boiling)
- Voltmeter
- Thermometer

Step-by-step Instructions -

- Use K-type thermocouple wire and remove the outer insulation for one strip about 10” long, obtaining one of each colored wire A and B. Strip each wire about ½” to expose conductive material.
- Tightly twist A and B wire together where they are exposed. Add alligator clips to the opposite ends, away from the twisted junction, and connect alligator clips to a voltmeter. Measure voltage of junction in air.
- Make an ice water bath and a boiling water bath. Place the junction in the ice bath and allow it to come to temperature. Measure the voltage.
- Place the junction in boiling water and measure the voltage.
- Record temperatures for ice and hot water baths as well as room temperature with a thermometer.
- Measure the temperature of an unknown liquid.



As thermocouples have a linear relationship to temperature, linear interpolation can be used to determine any temperature within the thermocouple’s range. You can also determine the response time of the thermocouple based on the data collected.

https://ww.thermocoupleinfo.com/type-k-thermocouple.htm

Deg (C)	Deg (F)	Voltage (mV) uncorrected for ice bath (.75mV)	CHART VALUES
0	32	-0.6	0.0
18	65	-0.04	0.72
99	210	1.95	4.1
115	240	2.55	4.7