Pop Up Science - Weather!
Activity 2: DIY Liquid-Filled Thermometer

What you need:
- Clear plastic drinking straw
- Ruler
- Permanent marker
- Empty & clean narrow-necked small plastic bottle with a lid
- Rubbing alcohol (and adult supervision for handling the rubbing alcohol)
- A few drops of your favorite color liquid food coloring
- Paper towels
- Modeling clay
- Medicine dropper or syringe
- Small bowl
- Hot water
- Ice cubes

Follow the steps below to make your thermometer for measuring outdoor air temperature!

Preparation
1. Gather your materials.
2. Because the clear plastic straw will become the tube of your liquid-filled thermometer, use the permanent marker and the ruler to make small marks at half-centimeter intervals along the straw’s length.
3. Mold the modeling clay in your hands until it becomes soft and pliable. Form a ball out of the clay and then press it flat (it should form a circle).
4. Use the straw to poke a hole through the center of the clay circle, and then remove any clay stuck in the bottom of the straw.
5. Take your empty & clean narrow-necked small plastic bottle and fill it halfway with rubbing alcohol; then add a few drops of food coloring. Place the lid on the bottle and shake to mix. Then remove the bottle lid and set it aside as you won’t need it again.
6. Fill the medicine dropper or syringe with the colored rubbing alcohol and then set aside on a paper towel for later.

What to do
1. Place the straw through the hole you poked earlier into the modeling clay, and then place the straw/clay combo on the narrow-necked bottle such that the straw sits in the colored rubbing alcohol but does not touch the bottom of the bottle. (The majority of the straw will stick out.)
2. Press the modeling clay around the neck of the bottle and the straw so that it holds the straw in place and creates an airtight seal. The straw should stick several inches up above the clay seal.
3. Carefully, drop-by-drop, release the contents of the medicine dropper or syringe into the straw. A column of liquid should build up in the straw. Keep adding rubbing alcohol to the column of liquid until it reaches halfway up the straw.
4. Let the thermometer sit for about 5 minutes and then read the room temperature from your homemade thermometer.
5. To try it out, put some hot tap water in a bowl and then place your homemade thermometer in the water. Wait about 5-10 minutes and see how the liquid in the straw will rise, indicating a hot temperature.
6. Pour out the hot water and allow the bowl to cool. Then put cold water in the bowl and add ice cubes to make especially chilled. Place the thermometer in the ice water and wait to see the liquid in the straw sink, indicating a cold temperature.
7. Try your thermometer outside and see how shady vs. direct sunlight areas compare in terms of temperature!

What is happening?
The way liquid thermometers work is due to the principle of thermal expansion. This principle states that when a substance gets hotter, it expands to a greater volume (or space). Nearly all substances exhibit this behavior of thermal expansion. As the temperature of the liquid in the bottle increases, it expands, and the only place the liquid can go is up the straw. If the temperature of the liquid decreases, it contracts, thereby allowing more liquid to collect in the bottle and so the level in the straw then falls back down.

Modified from https://www.scientificamerican.com/article/measure-up-with-a-homemade-thermometer/