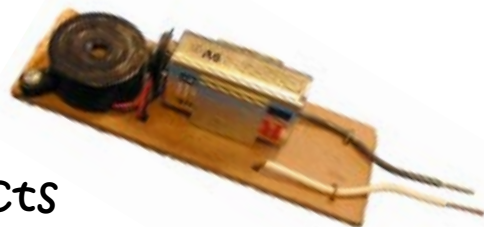




Carrying Charges

Challenge:

Can you make a solution that conducts electricity to make the buzzer buzz?



General Description:

Visitors work with water, salt, sugar, salad oil, alcohol, and vinegar to find out which liquids or solutions conduct electricity.

Objectives:

To show that some liquids and solutions conduct electricity and some do not, and to have visitors prepare simple solutions and draw inferences from observations.

Materials:

For 5 stations (1 child per station)

- 25 60 ml plastic dropping bottles
- 5 24 well plates
- 25 3 oz. plastic cups labeled for solutions and liquids
- 5 conductivity testers (buzzer type)
- Toothpicks as stirrers
- Plastic wash bottle with distilled water
- Small plastic spoons to transfer salt and sugar
- Several liters of distilled water for rinsing well plates
- 100 grams of sugar
- 100 grams of salt
- 100 ml salad oil
- 100 ml vinegar
- Large bolt or nail for demonstrating the buzzer
- Paper towels for spills
- A container of clean water
- A safe container to dump solutions into and seal (waste container)



Activity Preparation (approx. 20 min.):

Each station includes:

- 24-cell well plate placed on a paper towel
- Labeled dropping bottles with water, salad oil, and vinegar
- A plastic cup containing sugar with spoon
- A plastic cup containing salt with spoon (Two children can share a set of cups with salt and sugar)

Directions:

Have visitors do the following:

1. Participant **must** wear a pair of safety goggles before beginning!
2. Put a small amount of each liquid in separate wells in the well plate.
3. **Dip** the ends of both wires (electrodes) into each liquid and observe what happens. If the buzzer sounds, then the liquid conducts electricity and has ions in it.
4. Add either salt or sugar to the liquids in the well plate. Stir mixture to dissolve the solid and test the resulting solution, as done in step 3, to see if it conducts electricity.



Clean Up (approx. 15 min):

- All solution liquids and solids can go down the drain or in the trash bin.
- Clean up with soap and water.
- None of the materials are hazardous.
- Clean goggles with window cleaner and white paper towels.
- Disinfect in goggle cabinet for full 15 minutes.

Safety Issues:

Participant must wear a pair of safety goggles before beginning!
Goggles must be sterilized before use.

While all of these solutions can go down the drain, vinegar can be irritating.
Clean any spills immediately, and wash thoroughly if a visitor gets it on their skin.
If solutions get in eyes, flush immediately with clean water.



Tips For Doing the Activity:

- Demonstrate the conductivity detector by touching a piece of metal with the two leads of the detector (a large bolt or nail will do). The detector buzzes.
- Explain that some liquids can conduct electricity like metal wires because they have tiny particles called ions that carry the electricity through the liquid. Some solids when added to liquids can form these ions and the solution will conduct electricity. Their task is to discover which liquids and solids can carry (conduct) electricity.
- Encourage participants to just dip detector in liquids. Keeping electrode in the solution runs down the batteries and the noise can be maddening to adults.
- Explain that in this experiment sugar and salt are not to be eaten or tasted!
Experimental chemicals are never tasted.
- After each use the well plates must be carefully rinsed with distilled water. Even a little bit of salt or salt water will cause confusing results.
- Make sure the participants do not mix up the solid chemicals and the spoons used to dispense the chemicals. Contaminating sugar with even a little bit of salt will create confusing results.
- Participants can test other liquids such as juices if they are available. All liquids used should be discarded after use.

Background Information:

Many compounds can break apart in water to form positive and negative particles called ions. The ions are able to carry electric current through a solution. The more ions present, the more current can be carried. Pure water forms very few ions and does not conduct electricity very well. However, many compounds such as salt that do form ions dissolve in water allowing the solution to conduct electricity. Some compounds such as sugar, dissolve in water but do not form ions. Some liquids such as oil or alcohol do not form ions and do not conduct electricity. Vinegar is mostly water with a small amount of acetic acid in it. The acetic acid separates into ions so that the solution conducts electricity.

Expected Results

Liquid	Buzzes?	Solution	Buzzes?	Solution	Buzzes?
Pure water	no	Water + salt	yes	Water + sugar	no
Tap water	very low	----	----	----	----
Alcohol	no	Alcohol + salt	no	Alcohol + sugar	no
Oil	no	Oil + salt	no	Oil + sugar	no
Vinegar	yes	Vinegar + salt	yes very loud	Vinegar + sugar	yes

Tap water may or may not conduct electricity depending on its hardness. Solutions containing vinegar always conduct electricity because it starts with ions already in it.

Credits and Disclaimer



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Acknowledgments: These activities were developed by the Sciencenter with a grant from the Camille and Henry Dreyfus Foundation, Inc.

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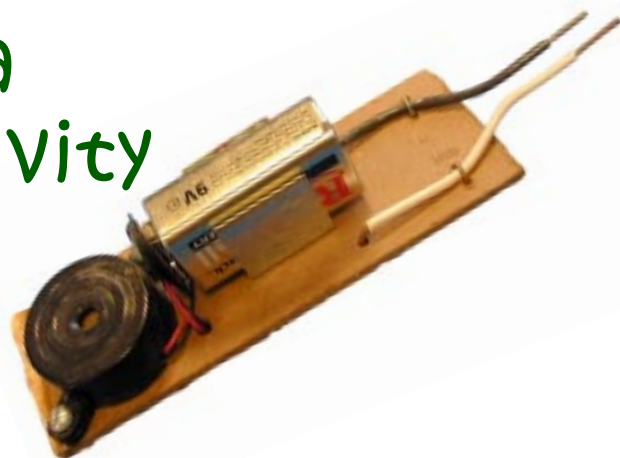
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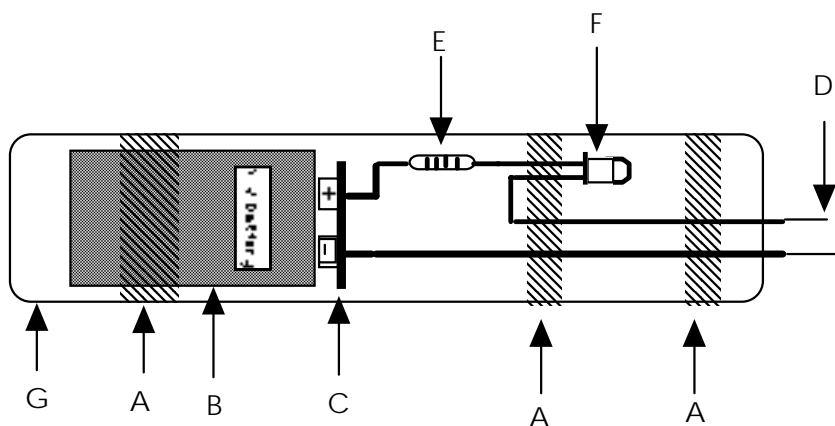


Building a Conductivity Detector



Build Your Own!

You can purchase a conductivity detector through Flinn Scientific or make your own. It takes about 15 minutes to make the detector. All of the parts are available at Radio Shack. Tape solder, available from Radio Shack or a hobby shop, is much easier to use than regular solder and does not require a soldering iron. It can be melted with a match or candle flame. A buzzer that can be used instead the LED is also available from Radio Shack. The decibel level is roughly proportional to the conductivity. Simply assemble the parts as in the diagram.



Diagram

of the finished conductivity detector attached to a small piece of wood

- A) tape
- B) 9-V battery
- C) battery clip
- D) bare wire leads
- E) resistor
- F) LED or buzzer
- G) wood backing.

Tools you will need

- Scissors
- Wire stripper
- Tape solder
- 1 nail
- Pliers
- Matches , Candle or soldering iron

Parts list for conductivity tester

- 9-V battery
- Battery snap connectors
- 2-12 inch lengths of wire (black and red)
- 1- light-emitting diode or siren
- 1 kilo-ohm 1/4 watt resistor
- 12 inches of black electrical tape
- 1 x 6 inch thin wood (tongue depressor works)
- tape solder
- LED or Buzzer

Problems?

The most common problems are cold solder joints or if a LED is used instead of a siren or incorrectly wired LEDs. If an LED is hooked up incorrectly, it will be irreparably damaged and will have to be replaced. The long lead of the LED is connected to the resistor. If a siren is used either lead can be hooked to the resistor