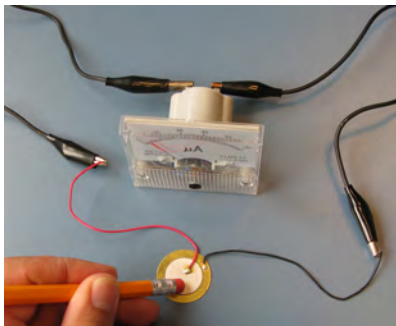


Exploring Properties—Electric Squeeze

Try this!

1. Attach the piezo disk (gold-colored disk) to the ammeter and tap on the disk with a pencil eraser.
2. What happens to the ammeter?
3. Now, attach the piezo buzzer to the battery pack. What happens?



Piezo disk



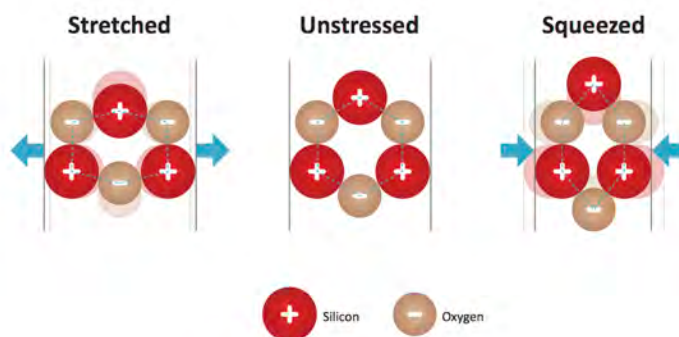
Piezo buzzer

What's going on?

Both the disk and the speaker are made with a special piezo ceramic material. When this ceramic is hit, or squeezed, it produces electricity. The ammeter, which measures electric current flowing through a circuit, allows us to detect this. When a pulse of electricity runs through the ceramic it produces vibrations—by squeezing it together and stretching it out. This vibration creates sound in the speaker. We call this reversible process the **piezoelectric effect**.

Piezoelectric materials produce electricity when they change their shape (by being stretched or squeezed) and they change their shape (by stretching or squeezing) when electricity is run through them.

Scientists are able to make piezoelectric ceramics and polymers. Naturally occurring piezoelectric materials include topaz and quartz.



Piezoelectric Effect in Quartz

How is this nano?



Floor tiles generate electricity by walking on them

The way a material behaves on the macroscale is affected by its structure on the nanoscale. When you squeeze a piezoelectric crystal, the length of the crystal may only change a few nanometers, or even less (a nanometer is a billionth of a meter), but that small change is enough to make the material generate electricity.

Piezoelectric materials are now used in a wide range of products, from speakers and microphones to sensors and switches. Some companies, like Pavegen Systems in the UK, are using piezoelectric materials in floor tiles. When people walk on these tiles the compression they cause is converted into electricity. Can you imagine other ways to make electricity through movement?

Learning objective

1. The way a material behaves on the macroscale is affected by its structure on the nanoscale.
2. Nanotechnology takes advantage of special properties at the nanoscale to create new materials.

Materials

- Piezoelectric disc with leads
- Ammeter
- Alligator clips
- Pencil with eraser
- Piezoelectric buzzer with leads
- Battery holder for 2 AA batteries
- 2 AA Batteries
- Piezoelectric effect image sheet

Notes to the presenter

The piezoelectric disk is somewhat fragile so we recommend tapping on it with a pencil eraser, but visitors can use their fingers as well.

If you find the buzzer to be too loud, you can place a piece of transparent tape over the hole. This will dampen the sound slightly.

Related educational resources

The NISE Network online catalog (www.nisenet.org/catalog) contains additional resources to introduce visitors to the fundamentals of nanotechnology:

- Public programs include *Would You Buy That?*, *The Electric Squeeze*, and *Inkjet Printer*.
- NanoDays activities include *Exploring Materials—Ferrofluids*, *Exploring Materials—Graphene*, *Exploring Products—Liquid Crystal Displays*, and *Exploring Materials—Memory Metal*.
- Exhibits include the *Nano* mini-exhibition and *Unexpected Properties*.

Credits and rights

Image of piezoelectric tiles courtesy of Pavegen Systems.



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