

# SCSU CRISP CCSA Kit Pages 2016

Title of Module: Exploring Properties: Electric Squeeze

Subject or Unit of Study: Electricity, Piezoelectric

GRADE LEVEL 5+ LENGTH OF DEMO/LESSON: \_\_\_\_\_

## STUDENT OBJECTIVES

Students will understand that the way a material behaves on the macroscale is affected by its structure on the nanoscale and that nanotechnology takes advantage of special properties at the nanoscale to create new materials.

## NEXT GENERATION SCIENCE STANDARDS

<p>NGSS Performance Tasks</p>	<p><b>4-PS3-2.</b></p> <ul style="list-style-type: none"> <li>• Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.</li> </ul> <p><b>MS-PS1-1 Matter and its Interactions</b></p> <ul style="list-style-type: none"> <li>• Develop models to describe the atomic composition of simple molecules and extended structures.</li> </ul> <p><b>HS-PS1-3 Matter and its Interactions</b></p> <ul style="list-style-type: none"> <li>• Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.</li> </ul>
<p>NGSS Disciplinary Core Ideas (DCI)</p>	<p><b>PS3.A: Definitions of Energy</b></p> <ul style="list-style-type: none"> <li>• Energy can be moved from place to place by moving objects or through sound, light, or electric currents.</li> </ul> <p><b>PS3.B: Conservation of Energy and Energy Transfer</b></p> <ul style="list-style-type: none"> <li>• Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.</li> <li>• Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.</li> </ul> <p><b>PS1.A: Structure and Properties of Matter</b></p> <ul style="list-style-type: none"> <li>• Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.</li> <li>• Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).</li> </ul> <p><b>HS-PS1.A: Structure and Properties of Matter</b></p> <ul style="list-style-type: none"> <li>• The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.</li> </ul>
<p>NGSS Cross Cutting Concepts (CCC)</p>	<p><b>CCC 5 - Energy and Matter</b></p> <ul style="list-style-type: none"> <li>• Energy can be transferred in various ways and between objects.</li> </ul>
<p>NGSS Science and Engineering Practices (SEP)</p>	<p><b>SEP 4 - Planning and Carrying out Investigations</b></p> <ul style="list-style-type: none"> <li>• Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.</li> </ul>

## COMMON CORE STANDARDS

CC-ELA/Literacy Standards	<p><b>W.4.7</b></p> <ul style="list-style-type: none"><li>• Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-PS3-2),</li></ul> <p><b>W.4.8</b></p> <ul style="list-style-type: none"><li>• Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-PS3-2)</li></ul> <p><b>HSN-Q.A.3</b></p> <ul style="list-style-type: none"><li>• Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS1-3)</li></ul> <p><b>RST.6-8.7</b></p> <ul style="list-style-type: none"><li>• Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS1-1)</li></ul>
CC-Math	

## 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

## SAFETY

*List all safety precautions needed for this lesson/demonstration*

## LEARNER BACKGROUND

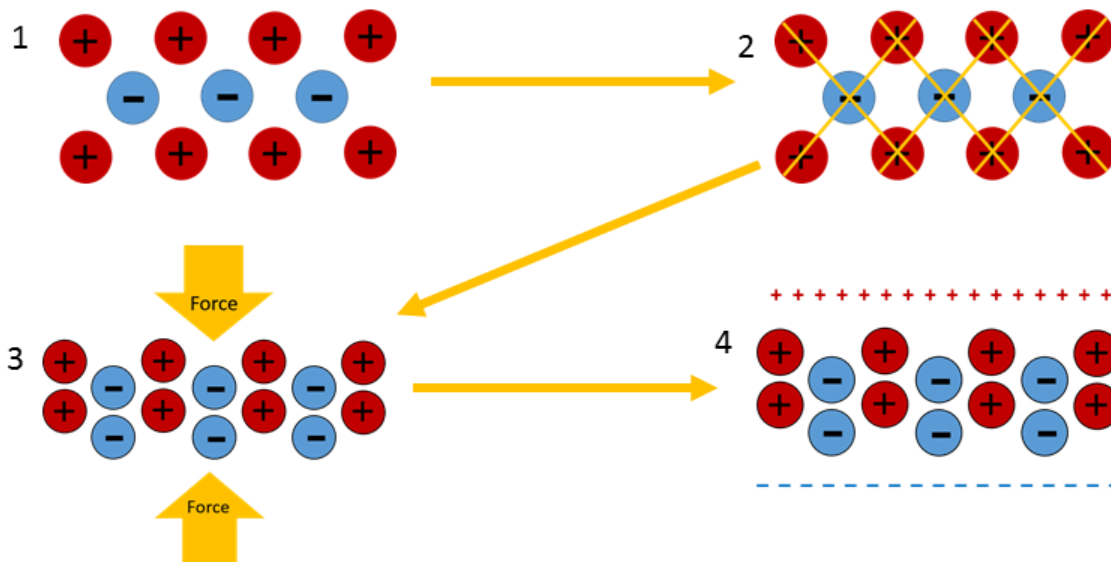
Describe the students' prior knowledge or skill related to the learning objective(s) and the content of this lesson, using data from pre-assessment as appropriate.

Students should have background knowledge about the piezoelectric effect

Here's the basic idea:

1. Normally, the charges in a piezoelectric crystal are exactly balanced, even if they're not symmetrically arranged.
2. The effects of the charges exactly cancel out, leaving no net charge on the crystal faces. (More specifically, the electric dipole moments—vector lines separating opposite charges—exactly cancel one another out.)
3. If you squeeze the crystal (massively exaggerated in this picture!), you force the charges out of balance.
4. Now the effects of the charges (their dipole moments) no longer cancel one another out and net positive and negative charges appear on opposite crystal faces. By squeezing the crystal, you've produced a voltage across its opposite faces—and that's piezoelectricity!

Source: <http://www.explainthatstuff.com/piezoelectricity.html>



**TEACHER NOTES:**

The piezoelectric disk is somewhat fragile so we recommend tapping on it with a pencil eraser, but students can use their fingers as well. Do not use large force on the disc.

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.

**STEM CAREERS:**

Electrical Engineer  
Materials Scientist  
Researcher  
Electrician  
Engineer  
Computer hardware Engineer  
Electrical Engineering Technologists  
Electrical and Electronic Engineering Technicians  
Electro-Mechanical Technicians  
Nanosystems Engineers