

## Purpose

To allow students to observe and experiment with piezoelectric films operating in sensing systems and to recognize the interdependence of the system's components.

## Summary of the Activity

In this activity, students assemble, operate, and analyze a piezoelectric microphone system to detect, convert, and amplify sound.

## Advance Preparation

Have enough PVDF strips, with and without rigid backing, to supply each student group with a strip of each kind. Have substrate materials on hand: balloons work especially well; plastic wrap and aluminum foil are adequate. The support for the substrate material should be open at both ends. Students cover one end with the substrate material. You may wish to ask students to bring in amplifier/speaker units and connecting leads.

## Safety

Before students begin connecting electronic devices, discuss different safety issues they should be aware of, including:

- avoiding loud noises that can damage people's hearing
- safety issues that may be of particular concern in your classroom
- precautions they can take to enhance safety, such as keeping amplifier volume at its minimum effective level

## LINKS

**TO THE PREVIOUS ACTIVITY** Having observed a variety of sensors, students explore how one piezoelectric smart sensor system functions.

**TO THE NEXT ACTIVITY** This activity introduces piezoelectric (PVDF) film, which students work with during the rest of the module. During the next activity, students learn how the molecular structure of the film influences the way the film works.

**D TO THE DESIGN PROJECTS** Students may use PVDF's ability to generate a voltage in response to vibrations—explored in this activity—when they design their coin counters and/or new PVDF devices in the Design Projects.

## A Note on Amplification

Microphone and speaker systems usually contain amplifiers similar



to one students work with in this activity. In commercial systems, a single amplifier may not increase

the signal strength enough. If necessary, the output of one amplifier is fed into another amplifier, whose output feeds into a third, and so on in a series until the output is strong enough to be

audible or compatible with other devices.

If an amplifier does not equally amplify all frequencies of the input signal, the output will be distorted. Most smart sensor systems are designed so that the output signal is identical to the input signal except that it is magnified. Sometimes, however, the input signal must be converted into a different form—for instance, from analog to digital data. In that case, a device called a converter makes the change.

## Curriculum Connections Relating Smart

Connecting to Your Curriculum on page T16 suggests ways you can fit the Smart Sensors module into your general curriculum. The page numbers on the chart to the right refer to margin notes that you can use to make connections to the listed subjects. For more information on the function of PVDF and other piezoelectric materials in speakers, see pages A16–A18 of the Minipedia.

### Biology

The nervous system  
Stimulus/response  
Sense organs pp. 11, 13

### Chemistry

Properties of matter  
Conductivity