

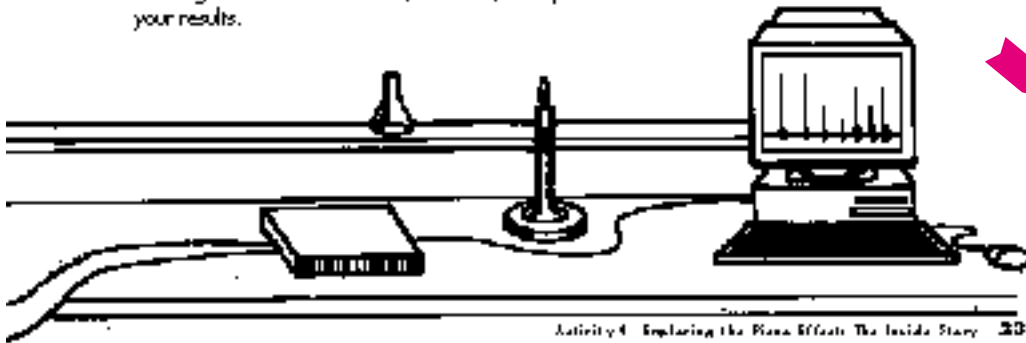


Procedure, Data, and Observations

1. To investigate the actual piezoelectric response of the PVDF film to bending, you'll need a way to measure the electrical signal. Depending on your lab equipment, you can measure the film's voltage response with a multimeter, interface the voltage with a computer or graphing calculator, or display the voltage on an oscilloscope. Ask your teacher which system to use.
2. Attach alligator clips to the two electrodes of the PVDF film and connect these leads to the measuring device. See your teacher if you have questions.
3. Devise a method of relating the direction of the bend, the amount of the bend, and the speed of the bend to the voltage produced. Keep in mind that while you are testing one variable, the others need to remain constant. Be careful not to permanently crease the PVDF film during your tests; bend it, but don't break it. Record your results.
4. Explore methods of attaching the PVDF film to a flexible substrate material (such as plastic, foam, or cardboard) instead of bending the film by itself. Test the film's response to bending in different directions, amounts, and speeds. Record your results.

We especially need imagination in science. It is not all mathematics, nor all logic, but it is somewhat beauty and poetry.

Maria Mitchell,
American astronomer



Activity 4 Exploring the Piezo Effect: The Inside Story 23

Point out to students that Mitchell (1818–1889) was the first professional woman astronomer in the United States. She discovered a comet and made pioneering studies of sunspots by taking daily photographs of them. Ask students to describe the role they think imagination might have played in her career. Then discuss what kind of role imagination has played in their own studies in science so far.

Summary of Experimental Results

The observed responses to each of the bending tests should be between 8 and 0.2 volts, depending on the instruments and circuits you use.

Extended Thinking

Resolution is a measure of how closely a sensor can discriminate among variations in a stimulus. A sensor's resolution can be defined as the smallest measurable change in input that will produce a noticeable change in output. After students have conducted the bending tests, introduce the concept of resolution and ask them to define or describe resolution of the PVDF film.



Procedure, Data, and Observations

1. Explain to students that the response they will measure is as much a function of the measuring device as it is of the PVDF film. The table on page 22 lists some characteristics of the most common devices.
2. Help students set up the measuring devices and attach leads. You may wish to go around and check each group's setup to make sure the equipment is correctly connected and calibrated.
3. Once students have set up their equipment correctly, allow them to devise their own tests and to experiment for as much time as you have available. If students have difficulty keeping the film from creasing, you may wish to have them attach the film

to a substrate (next step) and then try the bending tests.

4. The response of the film is greatly enhanced by attaching it to a thin, flexible substrate. Offer students a selection of substrates and let them attach the PVDF with transparent tape. Allow them to devise their own tests as they work with the substrate and to experiment for as much time as you have available.