4

INTRODUCTION

In Activity 3, you saw how piezo film responds to vibrations of sound waves. Now you'll slow the vibration to a single bending and learn how the piezoelectric film is constructed so that it can respond to such a stimulus.

Piezoelectricity

Quartz is a mineral made of silicon dioxide (SiO_2) that forms hexagonal (six-sided) crystals or masses of crystals. The Curie brothers, Jacques and Pierre, discovered an electrical effect in quartz in 1880. They called this phenomenon piezoelectricity, derived from the Greek word *piezein,* meaning to press.

Sonar operators in today's submarines use a technology based on early experiments with piezoelectricity.

Very little practical use was made of piezoelectric properties until 1917, when Paul Langevin, a student of Pierre Curie, used quartz piezoelectricity to generate and detect sound waves in water. This was the precursor to the first sonar (acronym for *so*und *na*vigation *r*anging) device used for underwater detection and exploration.

During the 1960s and 1970s, researchers who were looking for ever-better piezo materials discovered that various organic materials exhibit the piezo effect. They studied many polymers, including polystyrene, polymethyl methacrylate, and Teflon.™ Polymers are very large molecules composed of thousands or millions of smaller, simpler molecules known as monomers. In 1969, Japanese physicist H. Kawai discovered a strong piezoelectric response in the polymer polyvinylidene fluoride (PVDF). PVDF developed far greater piezo activity than any other synthetic or natural polymer.

CONCEPTS *behind* SMART SENSORS

The chemical structure of a piezoelectric material allows charges to shift on the material's surface when the surface is bent. These shifting charges cause the material to generate voltage.