Smithsonian's Use of **Thermal Energy**

Light is the only type of energy that can be seen with the naked eye. All other kinds of energy are invisible to humans. But a special kind of technology can be used to see heat energy. It is called *infrared thermography*. Infrared means "thermal energy," or heat. Thermography means "heat picture." In other words, special **imaging devices** are used to take pictures and videos of heat. Workers at the Smithsonian Institution use this technology to help protect artifacts.

To understand how this technology works, we have to start small. Everything is made of atoms and molecules, which are super tiny particles. Both living and nonliving things are made of these particles, and they are moving all the time. They spin, vibrate, change places, and bump into one another. The faster the particles move, the more kinetic energy they have. High kinetic energy means a higher temperature, or intensity of heat.

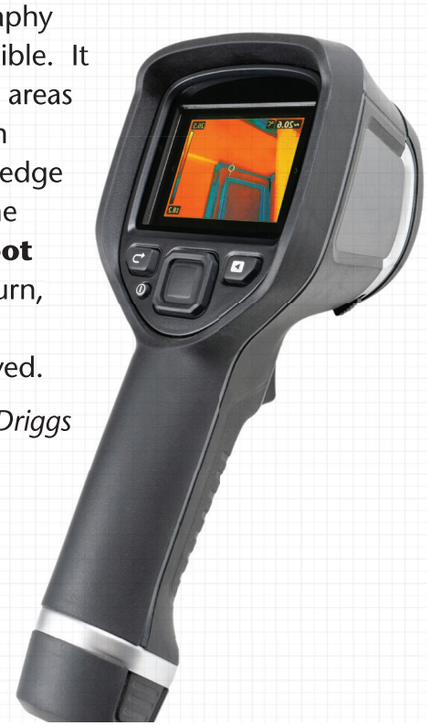
People usually measure temperature with a **thermometer**. This tool shows the temperature of an object as a number. But infrared thermography uses a different tool and method. First, a special camera is used to look at an object or environment. The camera **detects** all the heat energy. It takes pictures or videos that measure heat in shades of color. Warm temperatures are shown in bright colors. Yellow, orange, and red mean that a lot of heat is present. Meanwhile, cooler temperatures are shown in darker colors. Purple, blue, and black show a lack of heat.

How does this technology help the Smithsonian? Workers use it to spot problems in their museums. Their goal is to protect the millions of important objects in their collections. These scientific items, works of art, and historical documents are fragile. Everything must be kept under carefully controlled conditions. For example, documents might be put in special cases that have temperature controls. Workers use thermal cameras to check the machines and **mechanical systems** that preserve artifacts. If a machine gives off more heat or less heat than normal, something is probably wrong. This can be an early warning that repairs are needed. And being able to make a small fix now could prevent a larger breakdown later. Workers also use this technology to examine roofs, walls, pipes, and other parts of buildings for damage. This allows workers to spot weak points and plan to improve them.

As you might have guessed, infrared thermography has uses beyond the Smithsonian. For example, think of a rescue team searching for a missing hiker. Even in a thick forest on a very dark night, a thermal camera can spot a person. The heat from the person's body would show up in bright colors. Also, this technology is widely used in health care. Doctors use it to detect various health problems, such as fevers and high blood pressure. It has also been used to detect certain types of cancer.

Infrared thermography makes the invisible visible. It allows workers to find areas of concern in museum buildings. This knowledge gives museum staff the ability to **troubleshoot** problems. And in return, priceless artifacts are protected and preserved.

—Lorin Driggs



DEFINE

- **detects**—picks up on
- **imaging devices**—pieces of equipment, such as special cameras, used to take images of things that are not visible to the human eye
- **mechanical systems**—groups of machines and other parts that work together
- **thermometer**—a tool used to determine temperature
- **troubleshoot**—to find a solution to a problem by searching for the source of the problem

DISCUSS

1. How are atoms and molecules related to heat?
2. How does infrared thermography work?
3. Why is it important to keep systems at the Smithsonian working properly?
4. What might happen at the Smithsonian if this technology did not exist?

WRITE

Infrared thermography is a relatively new form of technology. Choose at least two forms of technology, and write about how each one has changed the way people do things. Describe the benefits of these changes as well as any problems they might have created.

CREATE

Create a cartoon or comic strip that illustrates how heat affects atoms and molecules. Tell a story using one living thing (person or animal) and one nonliving thing. Think about how to show the temperature differences between living and nonliving things. Make it accurate and funny!