CHAPTER 10

Heat, light and sound

You will discover

- What heat, light and sound have in common
- How heat moves from place to place
- How we see and hear
- How mirrors work

Lights are flashing, the crowd is crushed around you so tightly that it feels as hot as a sauna, and the music is so loud that you can feel the vibrations. You are surrounded by heat, light and sound energy!

The band has been playing for only 15 minutes and your ears are beginning to ring. Maybe you should have brought along some earplugs. But the atmosphere is electric!

When the concert is over, your ears are still ringing. You're also having trouble hearing. Even after you go to bed and the house is silent, the ringing is still there. The ringing in your ears is called tinnitus (pronounced tin-eye-tus). Some of the cells in your inner ear — the ones that detect vibrations — have been damaged. Fortunately, they are likely to recover. The ringing will stop and your hearing will return to normal — hopefully in a few hours, — but maybe in a day or two. If you listen to loud music for too long or too often, the cells don't recover. Your hearing can be permanently damaged.

1. What caused the vibrations I could feel?
2. How loud does the sound have to be to cause ringing — or even pain?
3. Why did the singer's lips start moving before I heard the sound?
4. How come I could see the light beams, and why was I so hot?

Energy and change

Energy is not an easy concept to define because you can't see it. But we can see the effect of energy and know that it has many forms. We also know that energy can't disappear or be created. However, energy can be changed from one form to another.

Energy can cause change in an object or **system**. Energy can make objects move, give objects the potential to move, change temperature, create the sound we hear, allow us to see objects, power our appliances and chemically bind atoms together. Movement, heat, light, sound and electricity are all forms of energy. To cause change, energy is either **transferred** to an object or system, or **transformed**.

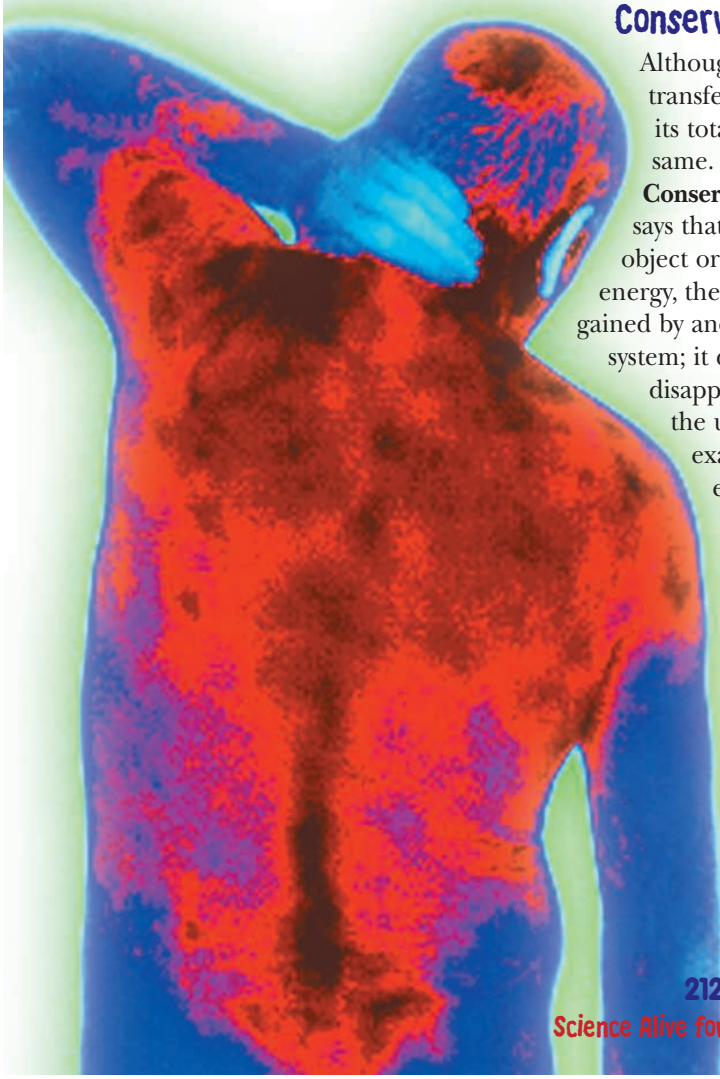
Transferring and transforming

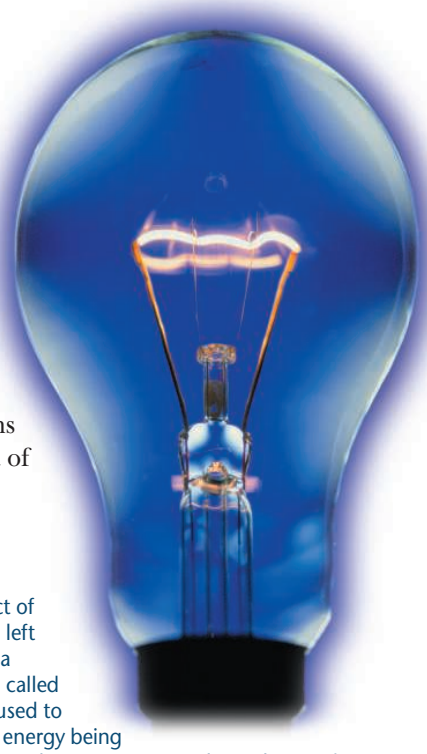
Energy can be transferred to another object or system, or to the surrounding environment. For example, if you hug a hot-water bottle, the heat will be transferred from the bottle to you. The heat has been transferred from one object to another, but has not changed form.

Energy can also be transformed into other forms of energy. For example, the electric motor in a hair dryer transforms electrical energy into mechanical energy (the energy that causes the parts to move). Sometimes, during a transformation of energy, not all of the energy is transformed into useful forms. Some of the energy is transferred to the surrounding environment as unwanted heat, light or sound. For example, not all of the energy you use to ride a bike up a very steep hill goes into making the pedals move. Some of the energy is 'wasted' when your body gives off heat.

Conservation of energy

Although energy can be transferred or transformed, its total amount stays the same. The **Law of Conservation of Energy** says that, although an object or system can lose energy, the lost energy is always gained by another object or system; it does not simply disappear. This means that the universe always contains exactly the same amount of energy.





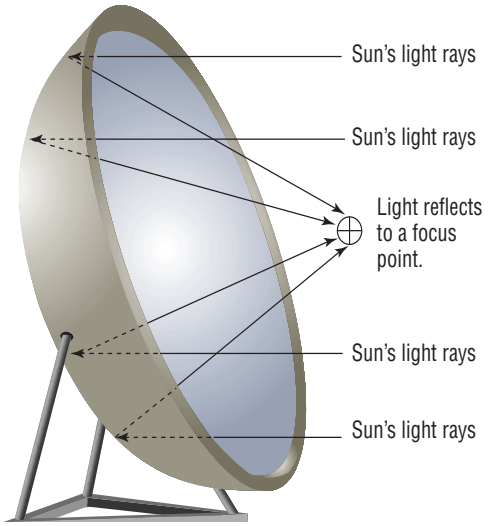
We can often see the effect of energy. The image on the left shows a naked man with a sunburnt back. A process called thermography has been used to show the amount of heat energy being transferred from the man to the environment. The scale runs from black (warmest), to red, and green (coldest). The image above shows an electric light bulb. Electrical energy (in the form of an electric current) is passed through the wire in the centre of the bulb (the filament), and is then transformed into heat and light energy. The light energy is the desirable energy, but the heat is considered 'wasted' energy because it has no benefit to us in this system.

Heat, light and sound energy

This chapter looks at heat, light and sound energy: what they are, how they cause change, how they are transferred and transformed, and how we use them in our machines, tools and appliances. However, energy is everywhere — it's what allows the universe to operate — and, if you read carefully, you will notice that the word 'energy' appears throughout other chapters as well.

We do most of our cooking using energy from electricity, burning gas or fire. However, these are generated from non-renewable resources; that is, we use the source of these energies much faster than we can replace them. Using non-renewable energy sources depletes the Earth of its natural resources and creates by-products that damage the environment.

The Sun is an example of a renewable energy source; that is, it continually provides energy. Scientists have been working hard to harness the Sun's energy for everyday tasks like cooking. The solar cooker project has been particularly important for developing countries that rely on wood fires for their cooking. Many developing countries in Africa and Asia currently have a fuel shortage crisis, as forests have been stripped of wood for commerce, agriculture and fuel. Solar cookers address this problem by transforming light energy from the Sun into heat energy. In the solar barbecue, the inside of the concave shape is covered in a shiny metal (such as aluminium foil). Light rays from the Sun reflect off the shiny surface and are concentrated into a central area called the **focus**. Food placed at the focus cooks more quickly than food placed anywhere else in the barbecue because the light (and, hence, heat) is more intense at this point.



Solar cooking is smoke-free, relatively cheap, and uses renewable energy. Here, an elderly Chinese Tibetan woman adjusts the position of her homemade solar cooker to boil water.

REMEMBER

1. In your own words, write a description of energy transfer and transformation.
2. How much energy does the universe lose every year? Explain your answer.

THINK

3. What different types of energy do you think would be involved when a Formula One racing car does a lap during a race?
4. A saucepan of water is heated on an electric hotplate. List three examples of the way that energy in this scenario is transformed or transferred.

DESIGN AND CREATE

5. Draw a rough sketch of a hairdryer. Think about the different forms of energy that are involved in its operation. Add labels to your sketch showing where the different forms of energy are used or produced.

learning

I CAN:

- ☐ understand that energy can change objects and systems
- ☐ define energy transformation and energy transfer
- ☐ understand that energy is never lost or created.