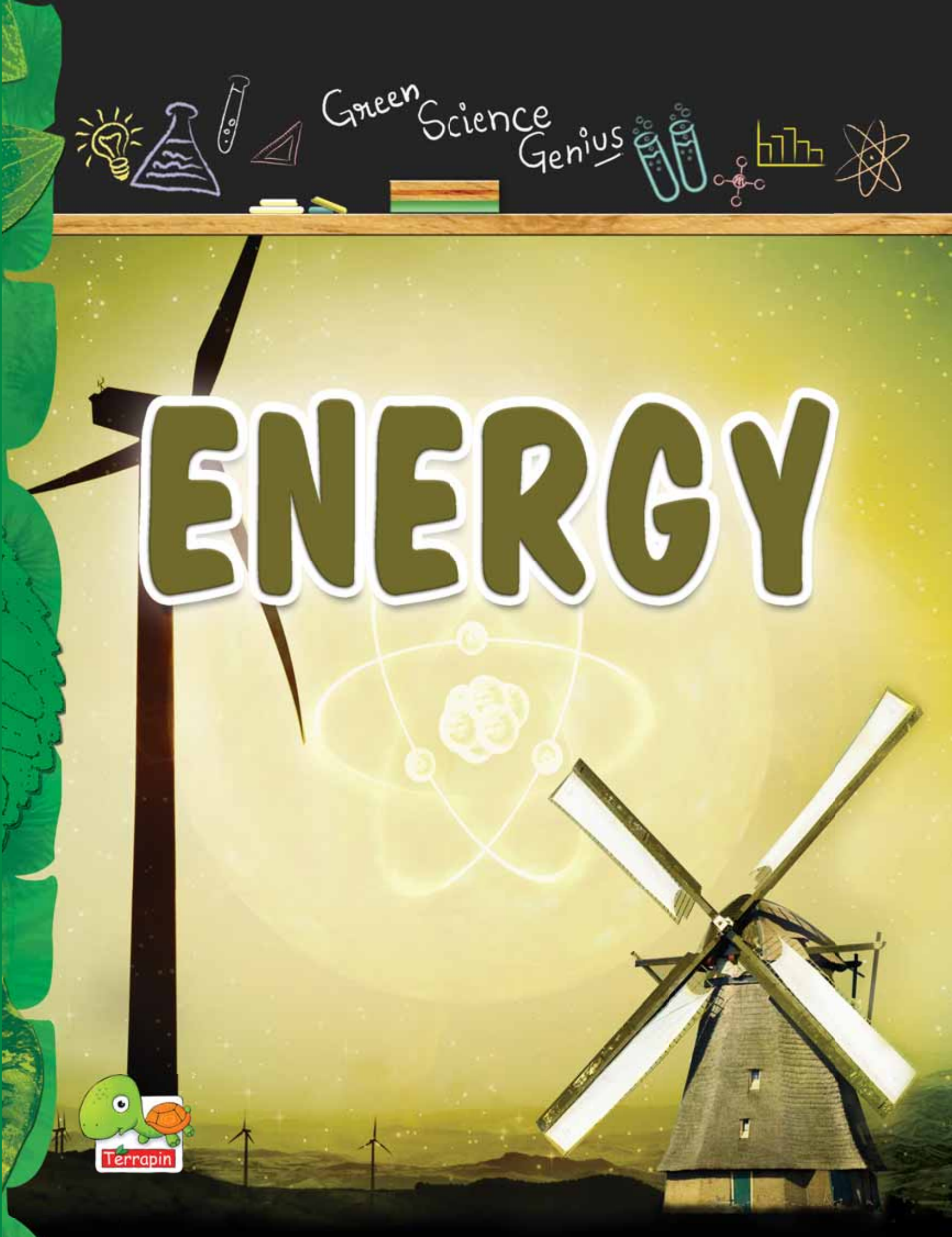
Green Science Genius

ENERGY



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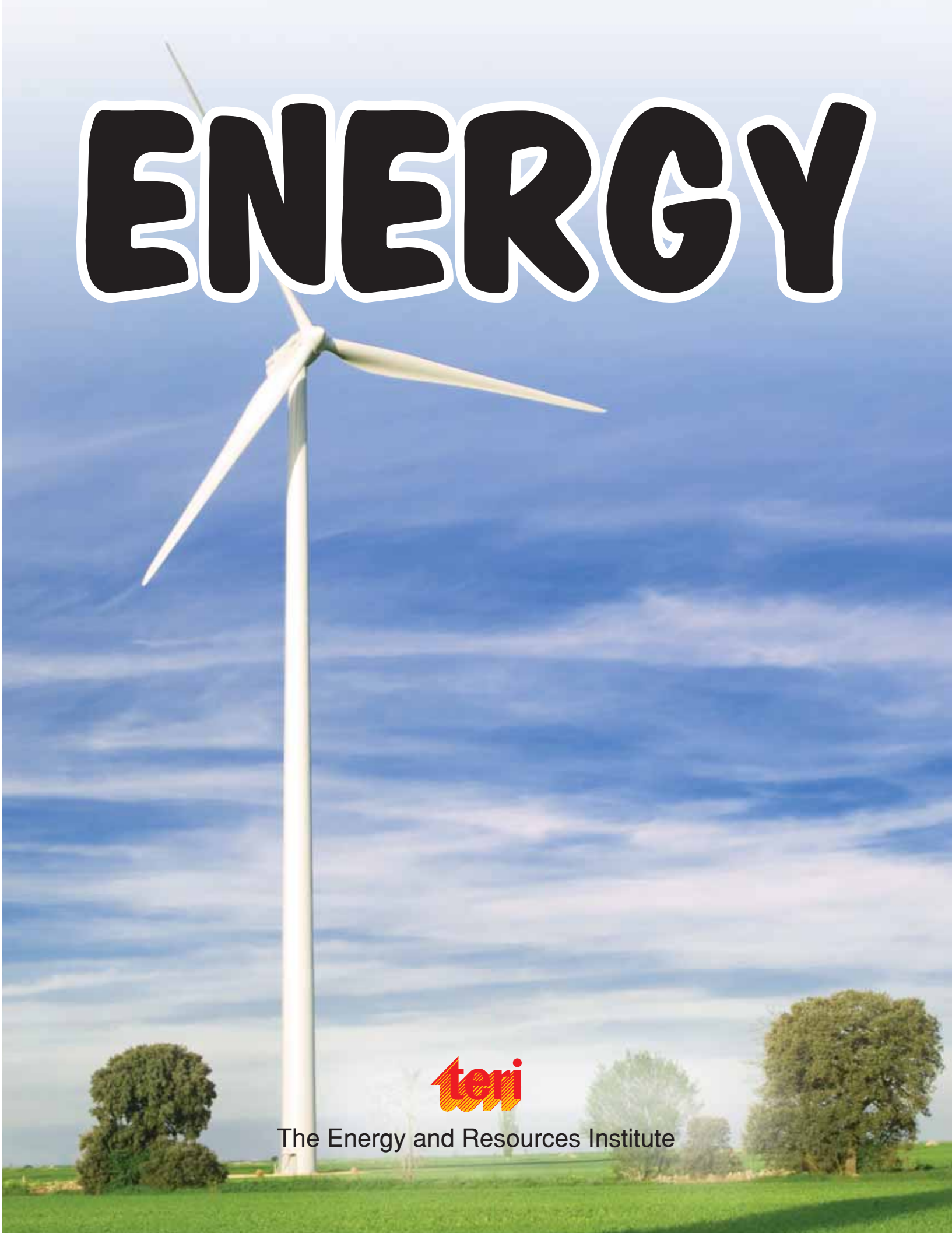


The Energy and Resources Institute

A note from Dr R K Pachauri

Human society has made remarkable progress in the field of science and technology during the past century. We have crossed boundaries in space exploration and genetics, and have also made enormous strides in the development of technologies. However, some of these changes have brought with them problems that affect our natural resources. We have endangered our flora and fauna, polluted our water resources and contaminated the air we breathe. In order to reverse the damage to our environment, we must ensure that future developments in science are in harmony with nature.

This series explores the fundamental scientific concepts of light, sound, energy, and electricity. For example, is light made up of waves or particles? How does noise pollution affect us? What are the different sources of electricity, and how is the power in our homes generated? These concepts acquire greater meaning in today's world, where science and technology offer us ideal solutions to problems that have put our planet's future at risk.

I hope that those who read these books will not only enjoy them, but will also feel inspired to protect the beautiful world of science brought alive on these pages. Children, being the future custodians of Planet Earth, are in a unique position to create a beautiful, peaceful, and healthy future for the human race.

R K Pachauri
Director-General, TERI
Chairman, Intergovernmental Panel on Climate Change

contents

What is energy?

Energy is inside us and all around us. While running we burn energy; telephones use energy; and even reading about energy requires energy! In fact, it is impossible to think of anything that does not involve energy of one type or another.

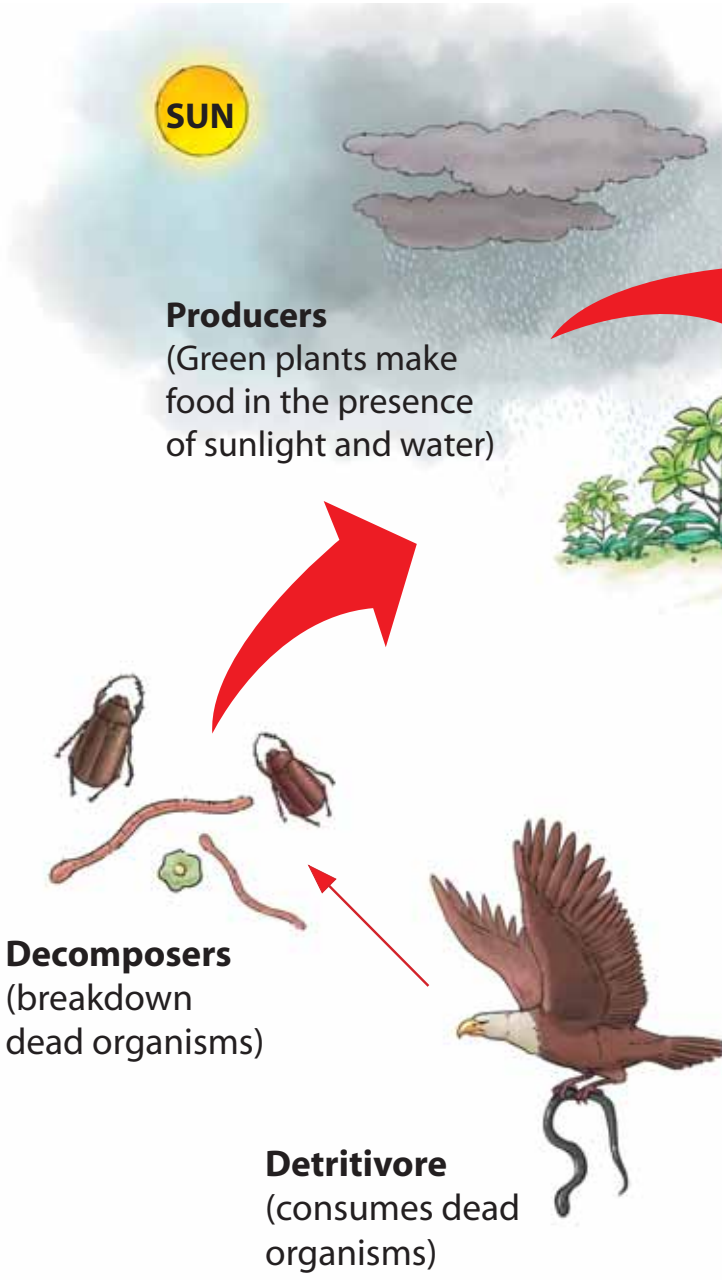
Work, force, and energy

Scientists define energy as the 'ability to do work', where **work** implies 'moving something against a force'. For example, when

we do the 'work' of lifting a heavy suitcase, we find it difficult because the force of gravity pulls it downward while we are trying to pull it up. Thus, we need energy to lift the suitcase.

The circle of energy

All living things need energy to survive. The major source of energy for both plants and animals is the sun. Leaves contain chlorophyll, a green pigment that traps energy from sunlight to make food by a process called **photosynthesis.**

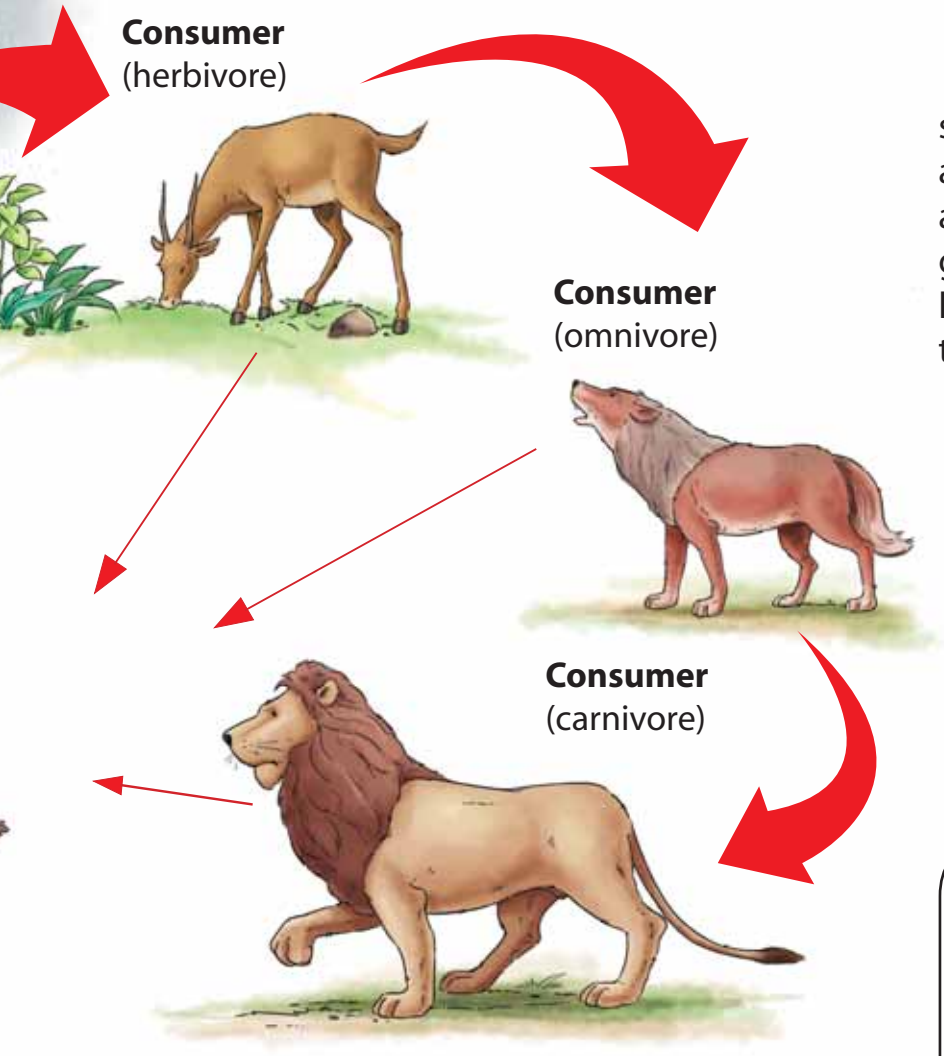


When animals eat plants, the energy inside plants gets stored inside animals. Even for animals that feed on other animals, the indirect source of energy is plants. For example, a hawk hunts snakes; snakes eat frogs; frogs eat insects; and insects feed on plants. This interlinked chain is called the **food chain**, which in other words is a trail of energy.

Search for alternatives

The energy we use in our homes, offices, and

In nature, energy flows from the sun to photosynthetic plants, and then to herbivores and carnivores, and detritivores. Ultimately, all plant and animal matter is broken down by decomposers and the nutrients return to the soil, from where they are again used by plants.



sources. Not only are these sources available in endless quantity, they are also environment friendly. By 'going green'—using less energy and causing less pollution—all of us can contribute towards protecting the environment.

ENERGY EXTRAS

Energy is measured in joules. It is named after James Prescott Joule, a British scientist.

factories, is derived either from **fossil fuels** (coal, oil, and natural gas) or **renewable sources** (such as wind, sun, water, and others). However, the availability of fossil fuels is limited, and the rate at which we are using these fuels, their stock could soon be over. Also, when these fuels are burnt, they release harmful substances and pollute the environment. This is why scientists are harnessing energy from renewable

ENERGY QUOTIENT

Burning coal releases harmful metals like mercury in the air, which get deposited in water bodies and harm aquatic life.

Potential energy and kinetic energy

All forms of energy can be classified into potential and kinetic energy. Potential energy remains stored inside an object and can be converted into other forms of energy. Kinetic energy is the energy of an object in motion.

Energy at rest

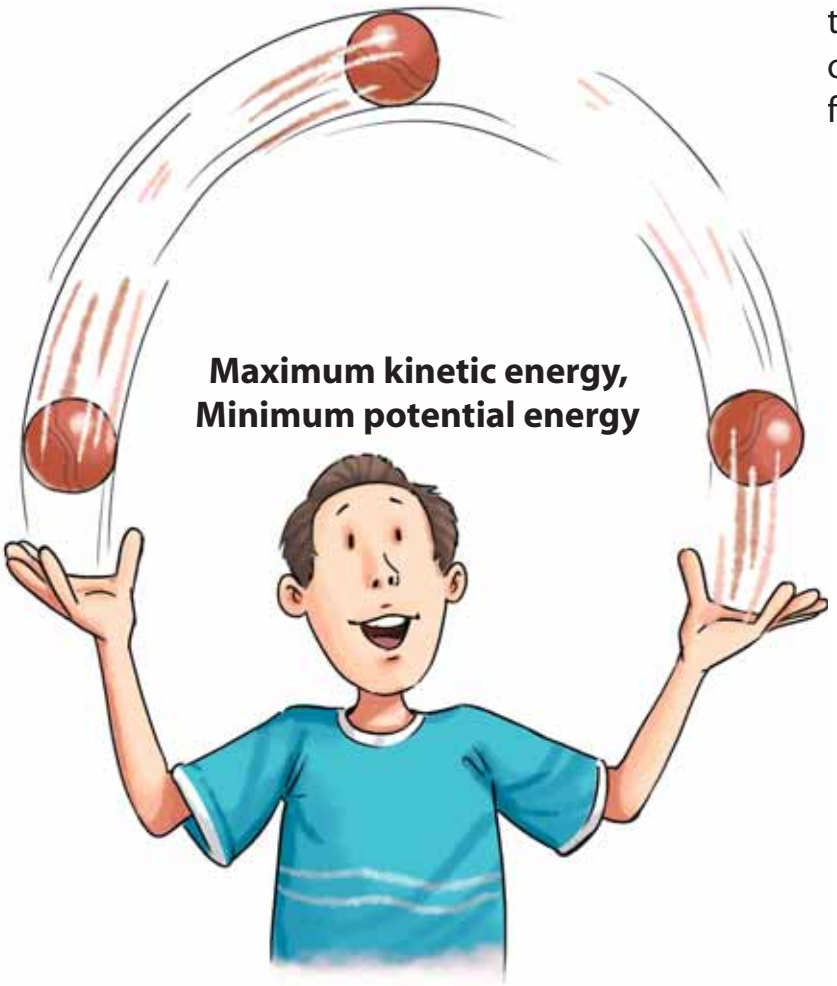
Potential energy is of various kinds. Objects under tension such as a stretched rubber band or coiled spring contain elastic energy. This type of potential energy is also called mechanical energy. Atoms and molecules are held together by chemical energy, while nuclear energy binds together protons, neutrons, and electrons in the nucleus of atoms. Chemicals inside batteries store electrical energy. A body at a height has gravitational potential energy—the amount of energy depends on how high it is from the ground.

Packed together

The atoms of materials such as ceramic, plastic, rubber, and glass, are made up of electrons that are tightly bound and do not move around freely. That is why they do not share their electrons easily. Such materials are called **insulators** because they do not allow electricity to pass through them.

Energy in motion

Releasing a coiled spring or a stretched rubber band converts its potential energy



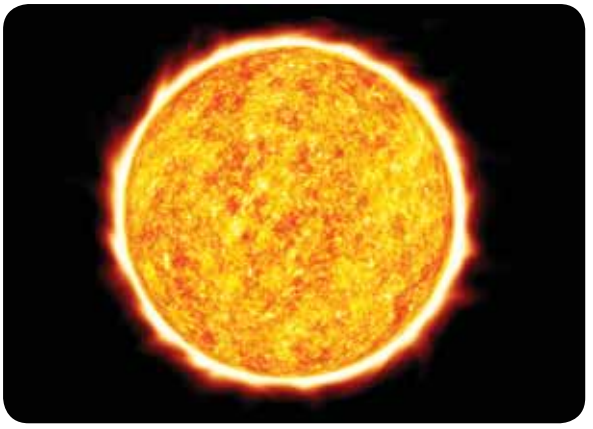
into kinetic energy. The heavier a moving object, the greater is its kinetic energy. Also, the faster it moves, the higher is its kinetic energy. For example, if a sprinter and a car are moving at the same speed, the car will have more kinetic energy simply because it is heavier of the two.

Energy lost = energy gained

When we push a rock downhill, potential energy is transformed into kinetic energy. The reverse is true as well. For example, when a rock reaches the top after we have pushed it up a slope, the kinetic energy gets stored inside it as potential energy to be reused in future. This brings us to an important law called the **law of conservation of energy**. It states that the total amount of energy in the universe is constant. We cannot create or destroy energy, but simply change it from one form to another.

ENERGY EXTRAS

A device that converts one form of energy to another is called a transducer. For example, a light bulb is a transducer because it converts electrical energy into light energy.



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Scientists believe that the sun was formed when gravity pulled together a big cloud of gas and dust. The gravitational force released energy and heated the early sun.

Green Science Genius : Energy

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