9 Work and Energy

We'll cover the following key points:

- Work
- Energy and its Types
- Energy Resources: Renewable and Non-Renewable

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Learning Outcomes

By the end of this chapter, students will be able to:

- Understand the concept of work and energy and their importance in our daily lives.
- Identify and differentiate between work and energy based on key features such as force, motion, and capacity to do work.
- Explore examples of work being done, like pushing a cart or lifting an object, and forms of energy like heat, light, and mechanical energy.
- Learn how energy is required to perform work and how different forms of energy can be transformed from one form to another.

Guidelines for Teachers

The teacher can start the chapter by introducing the concept of work and energy, encouraging students to observe and share examples from their daily lives. Discussions can focus on the key differences between work and energy, such as how work requires force and motion, and how energy is the capacity to do work. The teacher can also emphasize the transformation of energy from one form to another, helping students understand the practical applications of work and energy in their surroundings.

Warm Up

Answer the questions given below by filling up the missing letters.

1. What causes the football to move when it is kicked?
   F __ __ C __
2. Which force causes the ball to fall down after it strikes the net?
   G __ A __ I __ Y
3. Which type of energy do we get from the Sun and the flood lights?
   LI __ __ T ENERGY
4. Which type of energy is released when the referee blows his whistle?
   SO __ __ D ENERGY

Fun Fact

Energy can neither be created nor destroyed—it just changes forms! For instance, when you eat food, its chemical energy powers your body's activities. A single bolt of lightning can light up a 100-watt bulb for three months. Machines like levers and pulleys make work easier by transferring or amplifying energy. Even the act of pushing open a door showcases the principle of work in action!

Work

What is Work?

Have you ever studied for long hours during your examination and felt very tired? You might feel that you have worked so hard and therefore you are feeling tired and exhausted. However, according to science, you have not done any work at all. In science the word 'Work' has a different meaning than what you are familiar with. In Science, work is said to be done when a force applied on a body causes it to be displaced or moved through a certain distance in the direction of the force applied.

Examples of Work Done or Work Not Done

As we know, in Science, for work to be done there has to be some movement in the direction of the applied force. So in the following cases work is said to be done:

- A boy playing football or doing skating.
- Shooting a bullet from a revolver.
- Running on a track.

- Pushing a cart in a supermarket.
- Cycling.
- Swimming.

Swimming

Football

Skating

Running

On the other hand, in the following cases work is not said to be done though there is an application of force:

- Studying and preparing for your exams for long hours.
- Sitting in the computer for long hours in the office.
- Pushing a wall applying great force.

Studying

Working

Pushing

In the examples given above, although studying for your exams requires a great amount of mental work, it does not involve any physical work. Since there is no movement or displacement, work is not said to be done. Similar is the case when you are working on your computer. When you try to push a wall by applying great force, the wall doesn't move and therefore no work is said to be done.

How Much Work is Done?

Let us assume that Sahil has applied some force to move an auto rickshaw through a distance of 10 metres. Since movement has taken place in the direction of the force applied, work is said to be done.

Saran has applied some force to move a car through a distance of 15 metres. Since the weight of the car is double the weight of the auto rickshaw, he has to apply double the force. So, double the work is done.

Therefore, work done depends on the force applied.

In another case, Rahul uses some force to push his bike for 10 metres. He is said to have done some work.

Rohan uses some force to push his bike for a distance of 20 metres. He is said to have done double the work.

Therefore work done also depends on the distance moved.

Activity

Creative Learning

Aim: To see the relation between the force applied and displacement.

Materials Required: A big and a small ruler, marbles (1 big and 1 small), a Styrofoam cup, a paper card, cello tapes etc.

Procedure: Place the Styrofoam cup upside down on a table and fix it securely with the help of cello tape. Now make an incline using the ruler from the top of the styrofoam cup to the top of the table. At the base of the incline, place the paper card. Now slide the marble from different distances along the incline and note the distance moved by the paper card.

For example: 2 cm above the base of the incline, 4 cm above the base of the incline, 8 cm above the base of the incline etc. Accordingly note the distance moved by the paper card. Note down your observations in a tabular manner.

Check 'N' Mate

Critical Thinking

Write 'T' for true and 'F' for false statements.

1. When there is no movement or displacement, work is not said to be done. ☐
2. Work done depends on the force applied. ☐
3. The wall moves when you push a wall applying great force. ☐
4. Work done also depends on the distance moved. ☐

Did you know ?

1. The word energy comes from the Greek word Energeia.
2. Most types of energy are either a form of kinetic energy or potential energy.
3. The law of conservation of energy states that energy can only be transformed, it can't be created or destroyed.
4. Food contains chemical energy which is used by living organisms such as animals to grow and reproduce. Food energy is usually measured in calories or joules.

Energy and its Types

What is Energy?

The term energy is very closely associated with work. When an athlete runs a race or a swimmer swims, he/she becomes tired and exhausted. Whenever work is done, energy is used up. Energy is the capacity to work. Energy has to be supplied to the body by means of energy-giving food. Carbohydrates and fats are some examples of energy-giving foods. Cereals, sugar, and potatoes are examples of carbohydrates. Oil, ghee, nuts, butter, and cheese are examples of food containing fats.

The amount of energy needed by different people depends on the nature of he work that they do. For example, a daily labourer or an athlete needs more energy than a computer professional.

Did you know ?

1. Every day there are over eight million lightning strikes across the world. Each bolt superheats the air around it to about 54,000 degrees Fahrenheit-five time hotter than the Sun.
2. One hour's worth of energy from the Sun could power the Earth for a year.
3. 8 people riding bikes for 24 hours can generate enough power to run a TV for a week.
4. Mount Everest is a minnow compared to the world's deepest oil well.

Types of Energy

Energy can be classified into various types. For example, mechanical energy, kinetic energy chemical energy, electrical energy, heat energy, light energy, sound energy, wind energy, solar energy etc.

Energy can be broadly classified under two forms. Kinetic energy and Potential energy.

Kinetic energy is the energy possessed by a body due to its motion. Example a fast moving car or an arrow that is shot possess kinetic energy.

Potential energy is the energy possessed by a body due to its position. Example, a raised hammer has great energy. This form of energy is called Potential energy.

Mechanical Energy: It is the energy that can be used to do work. It is the sum of both potential and kinetic energy. A demolition machine is a perfect example of possessing mechanical energy. When the wrecking ball is raised vertically above the ground, it is said to possess potential energy. When the ball is released to hit a wall is possesses kinetic energy which helps to break the wall.

Moving car

A demolishing machine

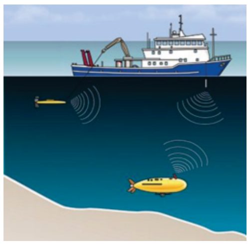
Electrical Energy: It is the movement of charged particles, negative(-ve) and positive (+ve). This form of energy can come from batteries or power plants and is also found in nature. Power plants burn fuel to make electricity which is then sent to houses and Industries through wires. This energy is in turn used to run appliances.

Light Energy: The main source of light energy is the Sun. Light energy is used by plants to make food by a process called photosynthesis. Scientists use it to create lasers. In a solar cell, light energy is converted into electric energy. Electric bulbs, candles, tube lights etc. are other sources of light energy.

Solar cells

Thermal or Heat Energy: This energy is created due to the vibration of atoms and molecules inside substances. The faster they move, the more energy they create and the hotter they become. Example, water boiling in a kettle possesses thermal energy.

Chemical Energy: It is the energy stored in the bonds of atoms and molecules. This energy is released in a chemical reaction in the form of heat. Example, During the burning of coal, chemical energy is changed into light and heat energy.



Sound Energy: It is a form of energy that is produced due to the vibration of particles. Example, Sonar uses sound waves to detect and determine the location, size and relative motion of underwater objects. The use of sonar systems is useful in detecting icebergs at sea.

Take a Task

Watch Remedial

Energy Resources: Renewable and Non-Renewable

The sources of energy may be divided into two categories. Renewable and non-renewable energy resources.

Non-renewable energy resources are those that are available in short supply in nature. They take millions of years to regenerate if they are exhausted. For example, Coal, Petroleum and natural gas etc.

Oil

Natural gas

Coal

Nuclear Power

Coal: Coal is a natural resource that is formed from the remains of trees and other vegetation that are buried under the earth's surface millions of years ago.

Petroleum: Petroleum is a fossil fuel that is formed from the remains of ancient marine organisms that were buried millions of years ago.

Natural Gas: Natural gas is also formed along with petroleum under the oceans when marine animals die and are buried millions of years ago.

Renewable energy resources are those that may be replenished naturally once they are exhausted and over a relatively short period of time. Examples of renewable energy resources are wind, water, solar, biomass and geothermal energy resources.

Solar

Biomass

Wind

Geothermal

Check 'N' Mate

Critical Thinking

Fill in the blanks with correct words.

1. ____________ (Potential/Mechanical) energy possessed by a body due to its position.
2. The main source of light energy is ________________ (Moon/Sun).
3. ________________ (Solar/Sound) form of energy is produced due to vibration of particles.
4. Coal, petroleum and natural gas are ________________ (renewable/non-renewable) energy sources.

Did you know ?

1. Windmills have been in use since 2000 B.C. and were first developed in Persia and China. Ancient mariners sailed to distant lands by making use of winds. Farmers used wind power to pump water and for grinding grains.
2. Biomass energy currently meets about 10% of human energy needs around the world.
3. Solar energy is cheaper than fossil fuels and a solar power plant can last for 40 years or more. China is the world leader in solar energy.
4. The largest hydroelectric power station in the world is the Three Gorges Dam in China.
5. Humans have enjoyed geothermal energy in the form of hot springs for thousands of years.

In a Nutshell

- Work is said to be done when a force applied on a body causes it to be displaced or moved through a certain distance in the direction of the force applied.
- If there is no movement in the direction of the applied force, no work is done.
- Energy is the capacity to do work.
- Energy can be broadly classified into Potential and Kinetic Energy.
- Potential energy is the energy possessed by a body due to its position.
- Kinetic energy is the energy possessed by a body due to its motion.
- Mechanical Energy is the sum of both potential and kinetic energies.
- Other forms of energy are electrical energy, light energy, thermal energy, chemical energy, sound energy etc.
- Energy resources may be either renewable or non-renewable.
- Non-renewable energy resources are coal, petroleum, natural gas etc.
- Renewable energy resources are wind, solar and water resources to name a few.

Key Words

Improving Vocabulary

Exhausted	:	Very tired and worn out.
Resource	:	A useful or valuable thing.
Displacement	:	The act of moving something from its original position.
Sonar	:	A system of detecting objects underwater by emitting sound waves and receiving them back.

EXERCISE

That turn curiosity into confidence—let's begin!

Gap Analyzer™
Take a Test

A. Objective Type Questions.

1. The energy due to an object's condition or position is called:
   a. Potential energy ☐ b. Thermal energy ☐
   c. Kinetic energy ☐ d. Geothermal energy ☐
2. Which is a renewable source of energy?
   a. Coal ☐ b. Petroleum ☐
   c. Wind ☐ d. Natural gas ☐
3. Which of the following is an example of kinetic energy?
   a. A car moving ☐ b. A girl watching TV ☐
   c. A baby sleeping ☐ d. A switched OFF fan ☐
4. There is work done if you are pushing a wall.
   a. True ☐ b. False ☐ c. Can't say ☐
5. Charging of mobile phone is an example of:
   a. Mechanical energy to electrical energy change ☐
   b. Electrical energy to chemical energy change ☐
   c. Electrical energy to heat energy change ☐
   d. None of the above ☐
6. Which according to science is an example of work being done:
   a. Studying for your exams ☐ b. Cycling ☐
   c. Working on your computer ☐ d. Reading a story book ☐

B. Fill in the blanks :

1. _____ is the energy possessed by a body due to its motion.
2. Two examples of renewable energy are _____ and _____ .
3. Electrical energy comes from _____ and _____ and also found in _____ .
4. Work done depends on _____ and _____ .
5. Coal, petroleum and natural are examples of _____ energy resources.

C. Very Short Answer Questions.

Name them.

1. Capacity to do work is _____ .
2. Two examples of non-renewable energy are _____ and _____ .
3. The form of energy that allows us to see things around us _____ .
4. A solar panel converts sunlight into _____ .
5. Two renewable energy resources _____, _____ .

D. Short Answer Questions.

1. Define work done. How much work is done if a boy studies for 5 hours? Why?
2. How is fossil fuel formed?
3. How can energy be supplied to the body? Give a few examples of energy giving foods.
4. Energy can be classified under two broad forms? What are they? Explain.

E. Long Answer Questions.

1. Explain the two types of energy resources with examples.
2. How is sound energy produced ? Give an example where sound energy is used.
3. Write short notes on:
   a. Electrical energy
   b. Light energy
   c. Thermal or Heat energy
   d. Chemical energy

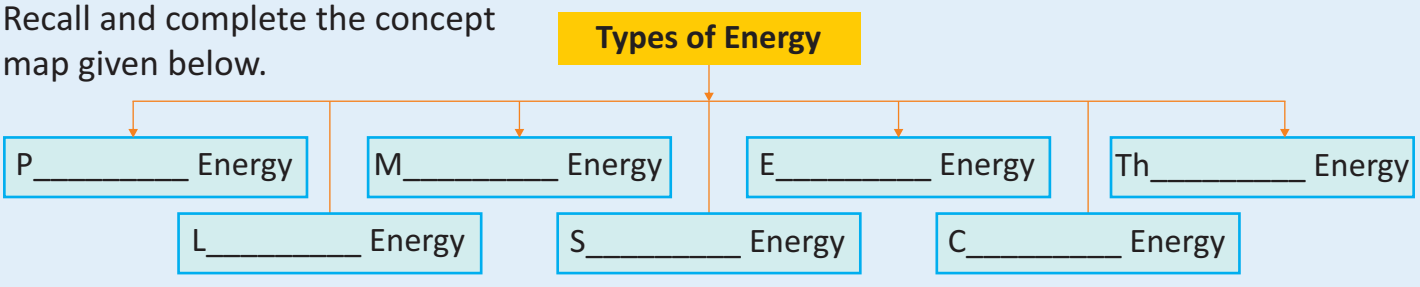
Custom Learning Path

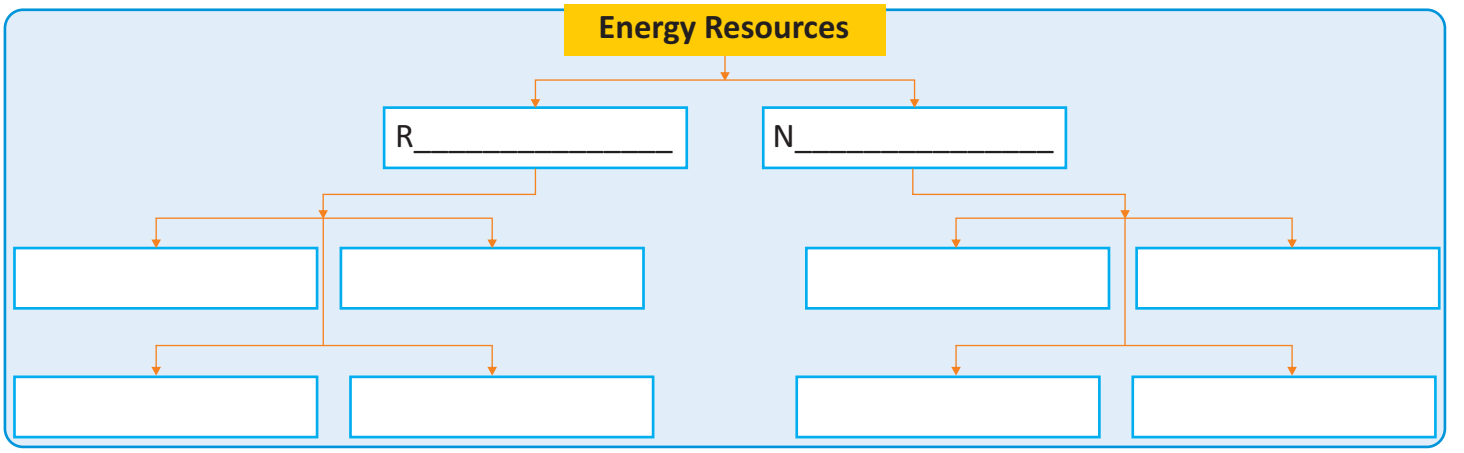
Scan to Create Your Own Learning Path

Time to Recall

Remembering and Analysing

Recall and complete the concept map given below.





Time to Apply

Applying and Creating

1. What will happen if on a see-saw, one child gets up suddenly? Why?
2. You need to be more careful when you cycle down a hill than when you cycle up the hill. Why?

Time to Discuss

Pondering and Communicating

1. Which country is the largest producer of wind energy in the world?
2. Name top 5 wind energy generating farms in India.

Time to Observe

Observing, Critical Thinking, Analysing

Which is the largest Solar power plant in India?
What is its capacity?

_____

Time to Create

Creating and Collaborating

Following are the potential Geothermal sites in India. Find out the states that they are located.

1. Puga Valley _____
2. Tatapani _____
3. Godavari Basin Manikaran _____
4. Bakreshwar _____
5. Tuwa _____
6. Unai _____
7. Jalgaon _____