

Warm-Up | Energy



Lesson Objectives

By the end of this lesson, you should be able to:

- Differentiate among the various forms of energy, including **kinetic** energy, potential energy, chemical energy, and thermal energy.
- Explain that energy can be transformed from one form to another.
- Describe the law of **conservation** of energy.

Science Practice: Integrate concepts from both chemistry and physics to analyze energy transformations and the conservation of energy.



Words to Know

Fill in this table as you work through the lesson. You may also use the glossary to help you.

chemical energy	the energy stored in chemical bonds
closed system	a system that can exchange energy, but not matter, with its surroundings
electromagnetic energy	the energy associated with electric fields, magnetic fields, and electromagnetic radiation
energy	the ability to do work or cause change
heat	the transfer of kinetic energy between molecules as faster-moving molecules collide with slower-moving molecules; energy that flows from a warmer object or substance to a cooler object or substance

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Words to Know

joule	the SI unit of energy
kinetic energy	the energy associated with movement
law of conservation of energy	the law stating that energy cannot be created or destroyed , but it can change from one form to another
mechanical energy	the sum of the kinetic and potential energy of an object
open system	a system that can exchange both matter and energy with its surroundings
potential energy	the energy associated with position
thermal energy	the kinetic energies of the molecules making up a substance; energy that can flow as heat

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Lesson Question

What is the nature of energy, and how is it conserved?

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Energy

- **Energy:** the ability to do work or cause **change**
- **Joule** (J): the SI unit of energy
- Other common units: calorie (cal), kilocalorie (kcal or Cal), kilowatt-hour (kWh)

Energy is necessary for all **life** processes and everyday activities.

Kinetic Energy

- **Kinetic energy:** energy associated with movement
 - Depends on mass and **velocity** of moving object
 - Is related to the amount of **work** done by moving object

Work and Kinetic Energy

- Work = **force** × **distance**
- More kinetic **energy** = more work that can be done
- Energy in must be **greater** than or equal to work done.

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Potential Energy

- **Potential energy:** energy associated with position
 - **Gravitational** potential energy: related to height above Earth's surface; depends on mass and **height**

Potential energy is stored energy.

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Mechanical Energy

- **Mechanical energy:** the sum of the **kinetic** and potential energy of an object
 - Gravitational potential energy
 - **Elastic** potential energy

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Thermal Energy and Heat

- **Thermal energy:** energy associated with **temperature**; energy that can flow as heat
 - Depends on **mass** and temperature
- **Heat:** energy that flows from a warmer object or **substance** to a cooler object or substance

Heat flows from a **warm** object to a cool object until the two objects have the same temperature.

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Temperature

- Temperature: the **average** kinetic energy of the particles in a substance
 - Measure of **thermal** energy
- Higher temperature = more kinetic energy (particles moving faster)

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Electromagnetic Energy

- **Electromagnetic energy**: energy associated with electric fields, **magnetic** fields, and electromagnetic **radiation**
 - Visible light
 - X-rays
 - Radio waves
 - Electrical energy

Chemical Energy

- **Chemical energy**: energy stored in **chemical** bonds
 - Is a form of potential energy
 - Can be released (exothermic) or stored (**endothermic**) during chemical reactions

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Law of Conservation of Energy

- **Law of conservation of energy:** energy cannot be **created** or destroyed, but it can change from one form to another
- **Open system:** a system that can exchange matter and energy with the surroundings
- **Closed system:** a system that can exchange energy, but not **matter**, with the surroundings

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Energy Transfer and Transformation

- Energy transfer: **movement** of energy
- Energy transformation: change in energy from one **form** to another

Energy is not created or **destroyed** during energy transfer or energy transformation.

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Sources of Energy

- Sun
- Earth's interior
- **Fossil** fuels
- **Radioactive** elements
- Moving **air** /water
- Food

Summary | Energy

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Lesson Question

What is the nature of energy, and how is it conserved?

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Answer

(Sample answer) It is the nature of energy to do work or cause change. According to the law of conservation of energy, energy cannot be created or destroyed, but it can be changed from one form to another, such as the potential energy of a roller coaster at the top of the track transforming into kinetic energy as it rolls down the tracks toward Earth.

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Forms of Energy

- Energy is the ability to do work or cause change.
- The joule is the **SI** unit of energy. Other common energy units are calories and **kilowatt-hours**.
- There are many forms of energy.
 - Kinetic energy: energy of motion
 - Potential energy: energy of position
 - Mechanical energy: kinetic energy + potential energy
 - Thermal energy: energy related to temperature
 - Electromagnetic energy: energy of **electromagnetic** radiation
 - Chemical energy: energy stored in chemical bonds

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Energy Transfer and Transformation

- The **law** of conservation of energy states that **energy** cannot be created or destroyed.
- Energy transfer occurs when energy moves from one place to another.
- Energy transformation occurs when energy changes from one form to another.
- Humans get energy from a variety of **sources**.

Use this space to write any questions or thoughts about this lesson.