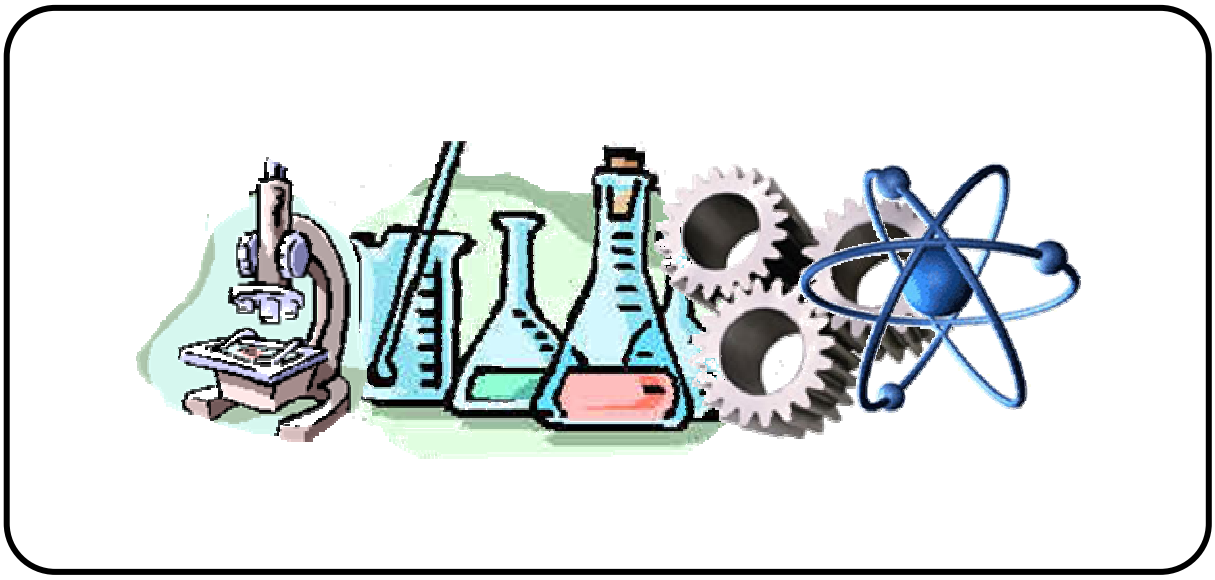
Project EASE

(Effective and Alternative Secondary Education)

INTEGRATED SCIENCE I



MODULE 8

BUREAU OF SECONDARY EDUCATION

Department of Education
DepED Complex, Meralco Avenue
Pasig City

Module 8
The Energy Story

What this module is about

This module takes you on a quick tour of the world of energy- from its sources, uses, forms, transformations from one form to another and transfer from one object to another. It discusses the impacts of energy on our everyday lives including its practical uses, its hazards and ways to address such problems. It also gives a brief review of the concept of work and its applications in simple machines. This module also imbues you with awareness of and concern for the emerging global and local energy problems. Consequently, it gives you insights on the wise use of energy.

This modules discusses the following lessons:

- **Lesson 1 - Work**
- **Lesson 2 - Simple Machines**
- **Lesson 3 - Energy**
- **Lesson 4 - Sources of Energy**
- **Lesson 5 - Using Energy Wisely**

What you are expected to learn

After going through this module, you should be able to:

1. define work and relate it to energy
2. calculate the work done by several forces
3. enumerate the different kinds of simple machines;
4. discuss the different forms of energy;
5. identify energy sources;
6. trace the transfer and transformation of energy in different systems;
7. identify, discuss, and propose solutions to some of the current energy problems; and
8. practice the wise use of energy.

How to learn from this module

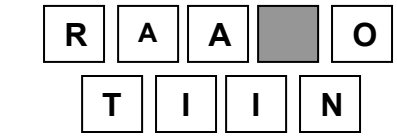
For this module to be of great help and use to you, it is important that as a reader, you devote ample time in reading and understanding its content and in performing the activities as directed. The topics are arranged according to complexity, so it is necessary not to skip any part. Take time answering the pre-test because aside from measuring your initial knowledge on the subject, it also provides you with a review of the concepts that you may have learned in elementary school.

From time to time, you will be encountering activities, self-tests or thought-experiments. Do not be discouraged if at first you find it hard to comprehend and answer the activities. There is always a second try! Why don't you go back to the section you are confused with, read and understand it again until such time that you are confident in answering the given tests? However, it pays to be honest all the time. Although answer keys are included in the module, try to answer the tests on your own for you to find out if you are really learning or not. If you answer at least 80% of the post-test items correctly, then you are ready for the next module!

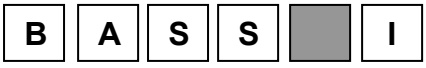
What to do before (Pretest)

I. Reshuffle the letters in the boxes to form and identify the term referred in each number. A mystery box (the one without a letter in it) should be supplied with a correct letter to complete the word. Good luck!

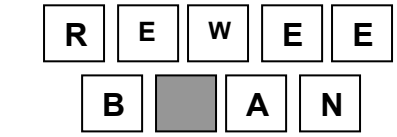
E ☐ E N Y R	1. It is the ability to do work.
R M O E H A E ☐ T L	2. It is a type of energy from the heat from beneath the surface of the earth.
I K C E I T ☐	3. It is the energy possessed by moving objects.
☐ E L R E	4. It is a simple machine consists of a bar or a plank moving about a fixed axis called the fulcrum.



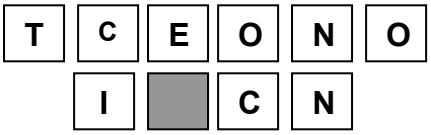
5. It is a method of heat transfer that does not need a medium but electromagnetic waves. The energy from the sun is transferred to objects on earth by this method.



6. This energy comes from the decays and wastes of animal and plant materials.



7. It is a collective term for sources of energy that are continuously replaced and reused.



8. It is a heat transfer characterized by movement of fluids due to temperature difference.

9. It is a simple machine consisting of a rotating wheel over which a belt of rope passes. This is the machine that we use to raise our flag in the pole.

10. This is done whenever a force acting on an object causes it to be displaced.

II. Select the letter of the choice that correctly answers the following questions.

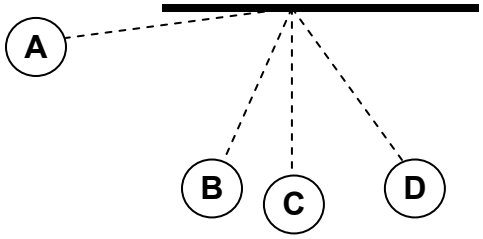
11. The zigzag road that leads us from the foot to the top of a mountain is an example of what kind of simple machine?
    a. inclined plane
    b. lever
    c. screw
    d. wheel and axle

12. Which of the following energy transformation occurs when a battery is used in a flashlight?
    a. light-chemical-thermal
    b. chemical-electrical-thermal
    c. chemical-thermal-light
    d. chemical-electrical-light

13. What source of energy supplies the energy needed by photovoltaic cells?
    a. Getothermal
    b. Biomas
    c. Solar
    d. Hydroelectric

14. To save energy at home, which of the following should you do?
    a. Use fluorescent lamps instead of incandescent bulbs
    b. Open windows to allow natural ventilation
    c. Iron clothes in bulk, not individually
    d. All of the above

15. When the pendulum bob swings back and forth, energy is converted from kinetic to potential and vice versa. At what point in its motion does the bob posses greatest potential energy?



Key to answers on page 26

How did you find the pretest? Were you challenged? If you did not score high, do not worry. You will be learning about these concepts as you go on with this module. Are you ready to learn?

Lesson 1 Work

The word **work** has several meanings to different people. Your parent or guardian probably leaves for *work* everyday. A home*work* is a task that a teacher asks you to do at home on your own time. In science, work has a different meaning.

Let us consider the following statements. Your parents tell you, "*We've got some **work** to do!*" An athlete says "*I am going to the gym to **work** out*." Your friend suggests, "*Let us **work** out this science problem*"

In all of the three statements, you notice that the term **work** refers to an action or activity to be done. However, in science there is a more precise definition of work, somehow related to the given statements, but defined specifically in terms of energy, force and motion.

How are energy, force and motion related to work? To find this out, perform this simple activity and answer the question that follow.

What you will do

Activity 1.1 Doing Work

Directions: Perform each of these activities. Then answer the questions that follow.

- **Find a concrete wall and push against it lightly, then hardly**.
  Did you exert a force? _____
  Were you able to move the wall? _____

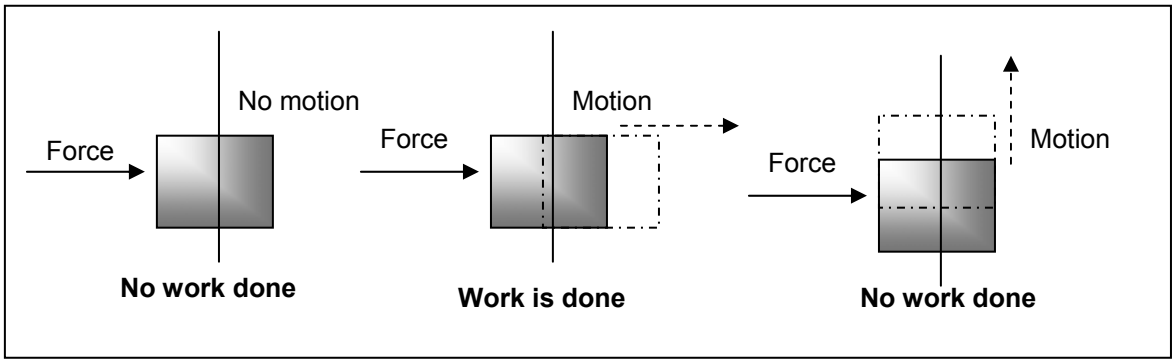
- **Lift a ballpen above your head**
  Did you exert a force? _____
  Were you able to move the ballpen? _____
  In what direction did the ballpen move? _____

- **Climb up the stairs**
  Did you exert a force in climbing the stairs? _____
  How many steps did you reach? _____
  What did you feel after climbing the stairs? _____

- **Consider the three activities you did in answering the following questions**
  In which activities did you exert a force?
  In which activities did motion occur?
  In which activities was the motion in the same direction as the force?

Key to answers on page 26

In science, work is done when a force acts upon an object to cause a displacement. There are three key words in this definition - force, displacement, and cause. Remember that displacement refers to the change in position of an object with respect to a reference point. In order for a force to qualify as having done work on an object, there must be a displacement and the force must cause the displacement in the same direction as the force applied.



What you will do

Activity 1.2 Doing Work

Consider again **Activity 1.1** and find out in which activities did you do work. Fill in the table below. Put a check mark **(√)** for yes and a cross mark **(x)** for no in the columns.

Activity	Did you exert a force on the object?	Did the object move?	Are the directions of the force applied and object's motion the same?	Is there work done in the objects?
Pushing a concrete wall				
Lifting a ball pen				
Climbing up a stair				

Key to answers on page 26

There are other several good examples of work which can be observed in everyday life - a horse pulling a plow through the fields, a father pushing a grocery cart down the aisle of a grocery store, a freshman lifting a backpack full of books upon her shoulder, a weightlifter lifting a barbell above her head or an Olympian launching the shot-put. In each case described, there is a force exerted upon an object to cause that object to be displaced.

What you will do

Self-test 1.1 When is work done?

Read the following five statements and determine whether or not they represent examples of work.

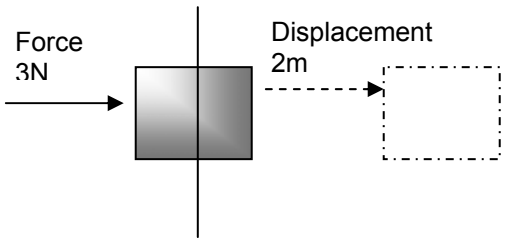
Statement	Answer with Explanation
A carpenter applies a force to a wall and becomes exhausted.	
A book is tipped off a table and falls freely to the ground.	
A waiter carries a tray on the level of his shoulder by one arm straight across the room at constant speed	
An airplane accelerates through space.	

Key to answers on page 26

The amount of work done on an object can be calculated by multiplying the force exerted on it by the displacement the object moved. If we represent work as **W**, force as **F** and displacement as **d**, then the equation for work is

$$W = Fxd$$

With this, we are assuming that the directions of the force and object's displacement are the same. Hence, when you exerted a force of 3 Newton in moving a crate 2 meters, the work that you do on the object is 6 N.m or 6 Joules because 1 N.m is equal to 1 Joule of work.



Work = F x d
= 3 N x 2 m
= 6 Nm
= 6 J

Now, it is your turn. Try solving the given problem on the next page.

What you will do

Activity 1.3 Problem solving on work

Calculate the work done in pushing a box 2 meters across the floor with a force of 12 N. What happens to the work that you do when you double the force that you exert?

Key to answers on page 26

Lesson 2 Simple Machines

Throughout the centuries, humans have been challenged to make life easier. Consequently, we continually invent tools to make jobs less difficult. Today, we know these tools as machines.

We use machines at home. We use washing machines to wash our clothes, electric fans to provide ventilation and hairdryer to dry our hair after a bath. Can you identify useful machines that you find in school?

Who discovered the first simple machine?

Thousands of years ago, a caveman named "Ug Lee," needed a better way to cut up the Woolly Mammoth that he stoned to death. He took his favorite rock, and tried his best to remove some choice morsels. However he realized that his trusty rock just wasn't completing the job. His wife "Hoam" told Ug that he should try her favorite stick. Ug realized that if he attached his favorite rock to Hoam's favorite stick, his job might be a little simpler. Thus, Ug and Hoam Lee invented the first simple machine.

The tools most people think about when they hear the word "machine" are actually a combination of two or more simple machines. A **simple machine** is any device that helps us perform our work more easily when a force is applied on it. A screw, wheelbarrow and a bottle opener are all simple machines. To make these simple machines do work for us, we need to apply a force on them.

Simple machines can help us in many ways. These machines allow us to use a smaller force to overcome a larger force. They help us change the direction of the force and work at a faster rate.

Basically, there are six types of simple machines: the inclined plane, wedge, screw, levers, pulley, and the wheel and axle. These are shown in figure 1.

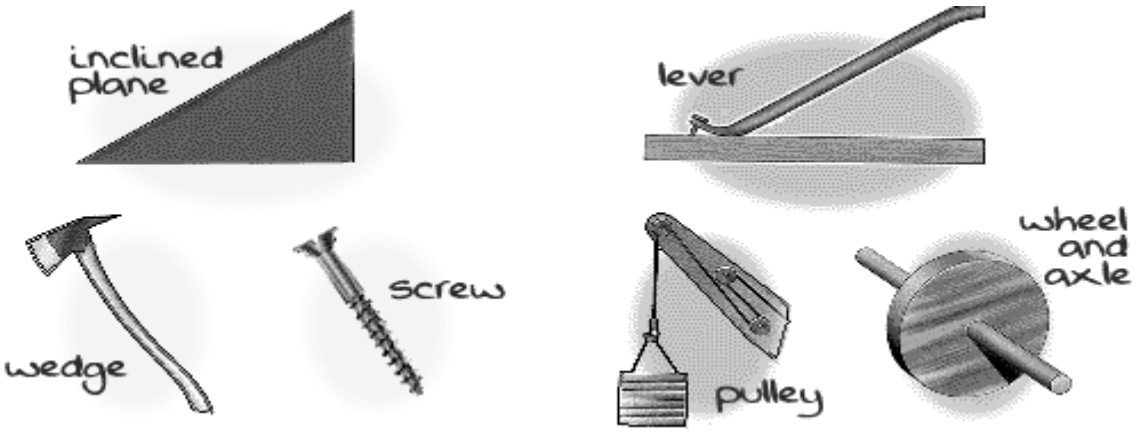


Figure 2.1 Simple types of machines

Let us discuss each simple machine one by one…

Inclined Plane

The inclined plane is the simplest of all machines. It is a sloping surface that connects two points together. We call it a ramp like the ones people use to load or unload heavy objects from a truck. The longer the ramp, the easier it is to roll an object on it but the longer it takes for work to be done.

Wedge

A wedge is a simple machine shaped like an inclined plane. A wedge is actually like a moving inclined plane that is viewed as if standing on its narrow end. A small force applied to the wide end of a wedge whose narrow end is being pushed into something will send a strong force pushing out at the sides. We can use the wedge action to cut and shape ice and wood sculptures, clay or whatever. When an axe, a kind of wedge, bangs into a log, the log splits open.

A wedge may seem like a simple tool but its importance cannot be underestimated. A shovel acts as a wedge while you shovel the sand or soil. It's a lot easier to move an object using a wedge than with bare hands.

Screw

A screw is also another type of inclined plane that connects two ends together and winds around a core. The screw available at hardware shops is a typical example of this machine. The road winding up the mountain can also be considered a big screw. We can go up the mountain with this type of inclined plane. However, again a lot of effort will be needed if the slope is very steep.

Lever

The lever is a simple machine made with a bar free to move about a fixed point called a fulcrum. The lever consists of three parts: fulcrum, load and a rod or plank. Levers are classified into three classes: first, second and third classes, depending on the positions of its parts on a simple machine

Let's see how each lever is grouped under their individual properties.

The first class lever is the one with the fulcrum in the center. In class, the fulcrum is the edge of the tin of biscuits. The load is much nearer to the fulcrum than the effort. Therefore we can use a small force to pull out the nail compared to pulling it out directly without using the lever. Also notice that the lever changes the direction of the force. As the handle of the spoon goes down, the lid goes up.

For the second class lever the load is in the center. Whenever the load is nearer to the fulcrum, the effort needed to lift the load will be less.

The third class lever however, is the disadvantageous one. It has the effort in the center. No matter how close or how far the load is from the fulcrum, the effort used to lift the load, has to be greater than the load!

Wheel and Axle

The wheel and axle looks like a kind of lever. A wheel and axle is made up of a small rod which is the axle, stuck rigidly to a large wheel so that when the wheel turns, the rod stuck to it also turns. A good example of this machine are the screw drivers and electric fans we use at home.

Can you identify which is the wheel and axle in the two given examples?

Pulley

A pulley is a wheel over which a rope, chain or belt passes. The pulley is usually used to lift a heavy object (load). A pulley changes the direction of the force, making it easier to lift things to high-rise areas.

There are three types of pulleys: fixed, movable and combined.

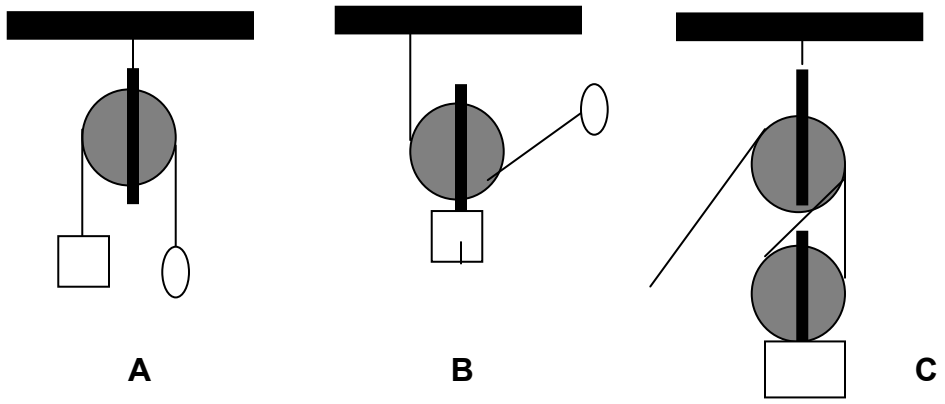


Figure 2.2 Types of Pulleys: (A) Fixed, (B) Movable and (C) Combined

A fixed pulley is the only pulley that when used individually, uses more effort than the load to lift the load from the ground. The fixed pulley when attached to an unmovable object e.g. a ceiling or wall, acts as a first class lever with the fulcrum being located at the axis but with a minor change, the bar becomes a rope. The advantage of the fixed pulley is that you do not have to pull or push the pulley up and down. The disadvantage is that you have to apply more effort than the load.

A movable pulley is a pulley that moves with the load. The movable pulley allows the effort to be less than the weight of the load. The movable pulley also acts as a second-class lever. The load is between the fulcrum and the effort. The main disadvantage of a movable pulley is that you have to pull or push the pulley up or down. Its main advantage is you use less effort to pull the load.

A combined pulley makes life easier as the effort needed to lift the load is less than half the weight of the load. The main advantage of this pulley is the amount of effort needed is less than half of the load. Its main disadvantage is it travels a very long distance.

What you will do

Activity 2.1 Simple Machines

Materials:

Large books, ruler, one cup of rice inside a small plastic sandwich bag (closed with a twist tie), rubber band strip tied to the top of the bag

Procedure:

Stack the books in one pile. Lean one book against the other to create an inclined plane. Place the bag of rice on the table. While holding the end of the rubber band, lift the bag of rice straight up to the top of your book stack. Use the ruler to measure the length of the rubber band. Now put the bag of rice at the bottom of the inclined plane and drag it to the top of the stack of books by pulling on the rubber band. When it is almost to the top, measure the length of the rubber band.

Things to think about during this experiment:

1. What simple machine reduces the length of the rubber band in this experiment?

2. Why was the rubber band more stretched when the bag was lifted straight up into the air?

3. What other inclined planes could be used in an experiment like this?

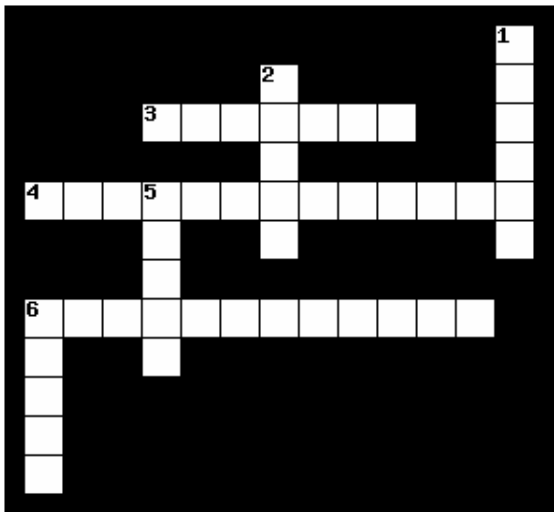
Key to answers on page 26

To recall the things you have just learned, why don't you answer this crossword puzzle?

What you will do

Activity 2.2 Simple Machine Crossword

Direction: identify what is being referred to in each number to answer the crossword puzzle.



Across

3. The point about which 5 down pivots
4. A ramp
6. This simple machine lets cars and bicycles roll

Down

1. A wheel over which a rope or belt is passed
2. A spiral version of 4 across
5. There are three basic types of this simple machine
6. A modified version of 4 across, it can be found in the blade of a knife or an axe

Key to answers on page 26

Lesson 3 Energy

Energy is one of the most important concepts in science, but it is hard to define in just a few words because it could not be seen although its effects can be observed.

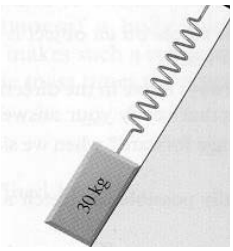
What is energy? We have heard the word **energy** all our life. We say that small children have a lot of *energy*. They are always running instead of walking, jumping instead of stepping. We also say that we need to eat to gain energy after a day's work. We can also say that the blocks in the walls of our home have energy. Energy is everywhere in nature-sunlight, wind, water, plants, and animals. We use energy everyday.

Energy is the ability to do work. We say that an object has energy if it can produce a change in itself or in its surroundings. In other words, an object with energy can do work or can use up the energy. The amount of energy you expend in moving something is equal to

the work done on it. This is why both work and energy have the same unit of measurement – Joules in the SI system.

Forms of Energy

Although energy occurs in many forms, the two most fundamental of which are potential and kinetic energies. Potential energy is the energy of a body due to its position or location. If a book is lifted from a lower to a higher height, the amount of work done on it is equal to the potential energy it gains.



The rocks, battery and spring have potential energies

Potential energy maybe gravitational, elastic, chemical or magnetic. A huge rock that is about to fall from a high cliff has gravitational potential energy. The food that we eat, the fuel that we use and the batteries of our flashlights have stored chemical energy. A spring or rubber band compressed and stretched have elastic potential energy. The attraction and repulsion of magnets have magnetic potential energy.

Potential energy in any form is stored for future use. When put to use, this energy is transformed into kinetic energy, the energy in motion. All moving objects possess kinetic energy, which like potential energy, also exists in many forms. The electricity flowing through wires has electrical energy, the candle's burning flame has thermal energy and a vibrating guitar string has sound energy.

A good example of kinetic and potential energy is a frog leaping. A frog sitting on a lily pad possesses potential energy. The frog leaping is an example of kinetic energy.

Can you think of other forms of potential and kinetic energies?

Calculating Potential and Kinetic Energy

To compute an object's kinetic energy, we just need to get one half of the product of the mass and the square of velocity of an object. In equation form

$$\textbf{K.E.} = \tfrac{1}{2}\, mv^2$$

If mass is in kilograms and velocity in meters per second, then the unit of kinetic energy is Joules. How do you compare the units of work and kinetic energy?

For example, a 40-kg person running at 3 m/s has a kinetic energy of

$$K.E. = \frac{1}{2} mv^2$$
$$K.E. = \frac{1}{2} (40\text{-kg}) (3 \text{ m/s})^2$$
$$KE = \frac{1}{2} (40 \text{ kg}) (9 \text{ ms/s})^2$$
$$KE = 180 \text{ kgm}^2/\text{s}^2 = 180 \text{ J}$$

Key to answers on page 26

Potential energy depends on three quantities: object's mass and position (height) and acceleration due to gravity. Its value can be calculated by simply getting the product of the three quantities. In equation form

PE = mass x height x acceleration due to gravity
PE = mhg

Like kinetic energy, the unit of potential energy is Joules (J).

When a 1.5 kg book is resting on top of a 2-m high table, then its potential energy is

$$PE = mhg$$
$$PE = (1.5 \text{ kg}) (2 \text{ m}) (9.8 \text{ m/s}^2)$$

What you will do

Self-Test 3.1 Problem Solving

Directions: Solve the following problem on a piece of paper

1. What is the kinetic energy of a 1.2 kg ball that is thrown at a velocity of 6 m/s?
2. What is its potential energy upon hitting the net that is located 3 meters from the ground?

Key to answers on page 26

Forms of Energy

Energy constantly changes from one form to another as it changes everything around it. There are numerous forms of energy, but we will describe the ones important to us.

Light is energy that moves in the form of waves from the sun and other stars. The waves are ordered according to their wavelength to form electromagnetic spectrum of radiation (light energy). Gamma rays have the highest frequency (shortest wavelength) of the spectrum and therefore carry the most energy. Radio waves have the lowest frequency (longest wavelength) and therefore carry the least energy. Visible light is in the middle but takes up only a small portion of the spectrum.

Thermal energy is the total energy of the particles in a material. This includes both the potential and the kinetic energy of the particles.

Chemical energy is the energy released in a chemical reaction. An example of chemical energy is the burning of wood or oil. The type of energy released in these examples is transformed into heat energy when chemical reaction takes place.

Electrical energy is the movement of electrons from one atom to another. An example of electricity is lightning. When the sky collects many electrons, they travel through the air molecules to meet the more positive earth to get rid of the sky's extra electrons. The electrons will continue to travel from the negative point to the positive until the charges equalize.

Nuclear energy comes from nuclear fission and fusion. Nuclear fission occurs when a free proton is shot at an atom of uranium or plutonium (because of their large nucleus) and it explodes into two smaller nuclei, also releasing several more protons, which explode other nuclei, causing a chain reaction. It then heats up to millions of degrees. Nuclear fusion occurs when atoms of tritium and deuterium are heated up to the point where the atoms bang into each other so hard that they fuse together, forming an unstable form of helium, then the free neutron explodes. This explosion causes the fuel to heat up more than you originally heated it. This occurs on the sun and other stars, which is why they release so much energy.

An object may have one or as many other forms of energy. Within the object, such energies may change from one form to another but the object's total energy never changes. **This is the law of conservation of energy.**

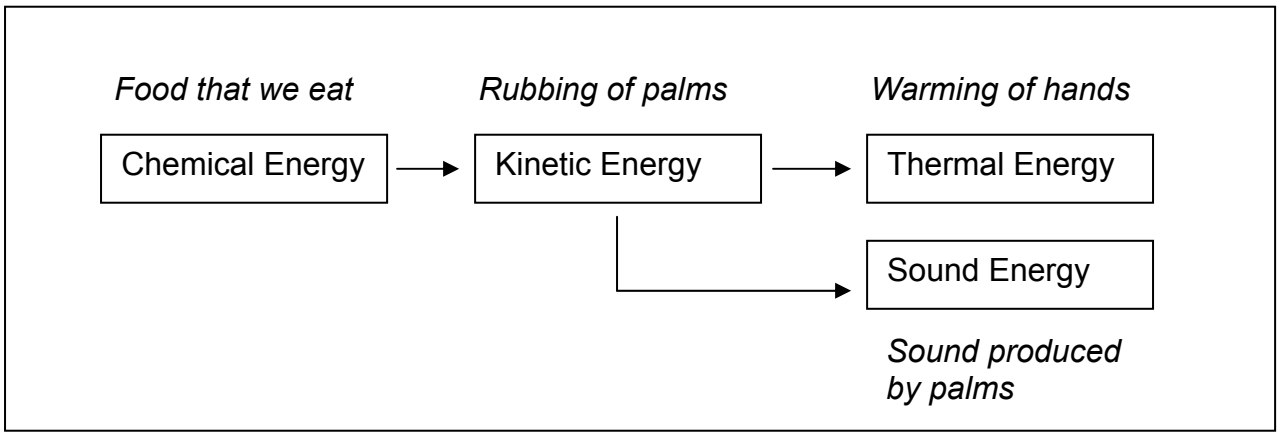
Transformation of Energy

What do you feel when you rub your palms together for a few seconds? Do you feel your palms turn warm? What if you rub your palms together more briskly? Do they get even warmer? How did this happen? What happens when you place your warm hands on your cheek?

By rubbing your palms together, you exert a force to overcome friction between your palms. This force comes from the stored chemical energy in the food that you eat. Work is done when you apply this force in moving you palms against each other. By this doing, two other forms of energy -heat and sound- are generated. When you do more work by rubbing your hands more briskly, more heat is produced.

Your cheeks likewise feel warm when you touch them with your hands because the thermal energy in your palms is transferred to your cheeks.

We can trace this transformation of energy with the following diagram



Can you trace the energy transformation when a monkey leaps from tree to tree? Using the illustrations as clues, write in the boxes the conversion of the monkey's energy. Turn to the next page and have a try!

What you will do

Activity 3.2 Transformation of Energy

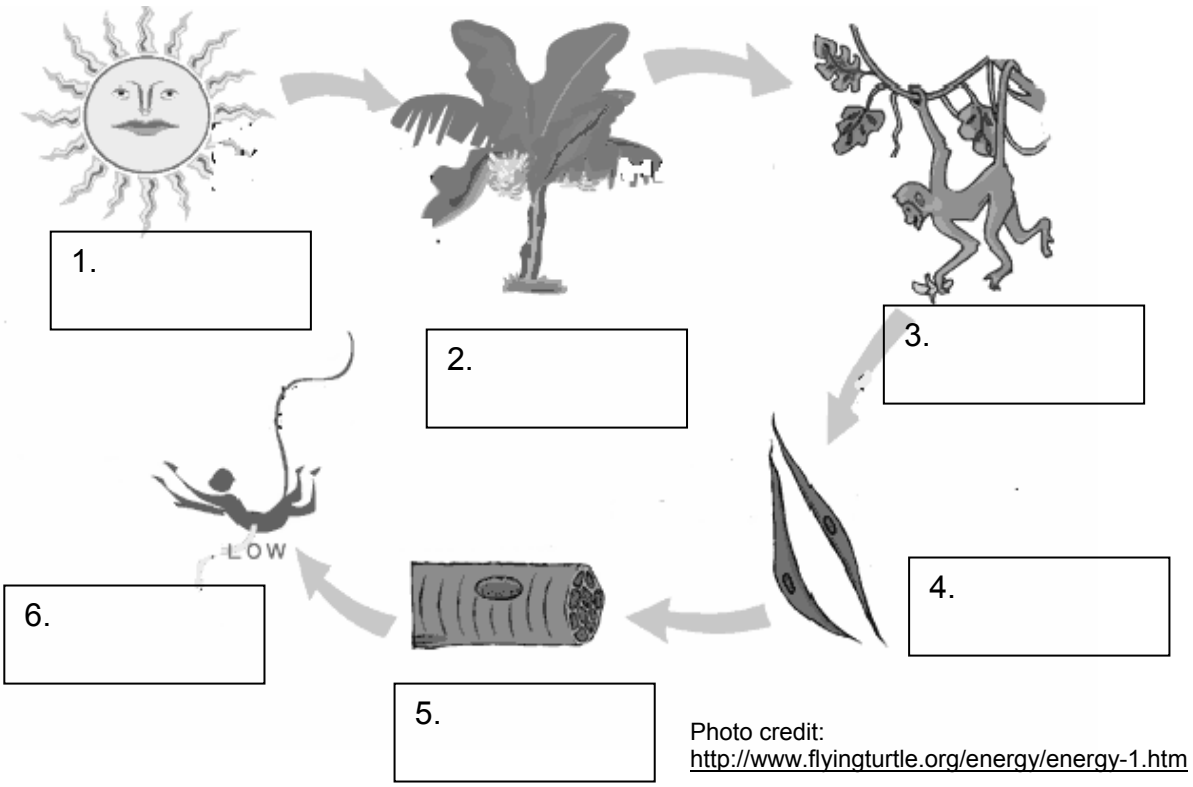


Photo credit:
http://www.flyingturtle.org/energy/energy-1.htm

Key to answers on page 27

Lesson 4 Sources of Energy

You have learned from the previous lessons that we need energy to do work. For human beings and animals, the primary source of energy is the food that we eat. However, the work that we can do with the energy that we have may be limited. For more work to be done, more sources of energy need to be explored.

Energy resources can be described as renewable and non-renewable. **Renewable energy sources** are those that are continually being replaced such as energy from the sun (solar) and wind. If an energy resource is being used faster than it can be replaced (for example, coal takes millions of years to form) then it will eventually run out. This is called a **non-renewable energy source**.

Solar Energy

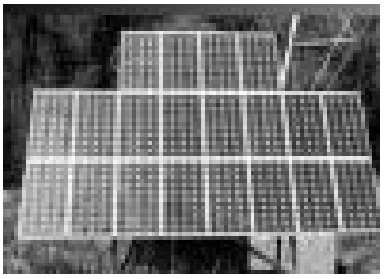


Fig. 4.1 Solar cells

Solar energy is light and heat energy from the sun. Solar cells convert sunlight into electrical energy while thermal collectors convert sunlight into heat energy. Solar technologies are used in watches, calculators, water pumps, space satellites, for heating water, and supplying clean electricity to the power grid. There is enough solar radiation striking the surface of the earth to provide all of our energy needs.

There are two main ways of using solar energy to produce electricity. These are through the use of solar cells and solar thermal technology. Using solar technologies to generate electricity is, at present, more expensive than using coal-fired power stations, but it produces much less pollution.

Solar cells are photovoltaic cells that turn light into electricity. Solar cells are used in three main ways. They are used in small electrical items, like calculators, and for remote area power supplies, like telephones and space satellites. Today, solar cells are also used to a limited extent in the development of solar-powered vehicles

Wind Energy

Fig. 4.2 Windmills

Moving air turns the blades of large windmills or generators to make electricity, or to pump water out of the ground. A high wind speed is needed to power wind generators effectively. While wind generators don't produce any greenhouse gas emissions they may cause vibrations, noise and visual pollution.

Tidal/Wave Energy

If a dam or barrage is built across a river mouth or inlet, electricity can be obtained by the flow of water through turbines in the dam as the tide rises and falls. The movement of waves can also drive air turbines to make electricity.

Biomass Energy

Biomass is plant and animal material that can be used for energy. This includes using wood from trees, waste from other plants (for example, bagasse from sugar cane) and manure from livestock. Biomass can be used to generate electricity, light, heat, motion and fuel. Converting biomass energy into useable energy has many environmental benefits. It uses waste materials that are usually dumped, and uses up methane (a greenhouse gas). Fuels such as ethanol can be made from biomass and used as an alternative to petrol to power motorcars.

All plant and animal matter is called biomass. It is the mass of biological matter on earth. We can get energy directly from plants by burning wood for cooking and heating and from animal wastes, for example biogas (mainly methane gas) from sewage and manure.

An increasing number of renewable energy projects using biomass have been developed. Most of these use waste products from agriculture, so they solve a waste disposal problem and, at the same time, create energy for use in homes, farms and factories.

Hydroelectric Energy

Fast-flowing water released from dams in mountainous areas can turn water turbines to produce electricity. While it doesn't cause pollution, there are many other environmental impacts to consider. Ecosystems may be destroyed, cultural sites may be flooded and sometimes people need to be resettled. There are also impacts on fish breeding, loss of wildlife habitat and changes in water flow of rivers.

Places with high rainfall and steep mountains are ideal for hydroelectricity. Can you identify some places in the Philippines that may be good location for a hydroelectric power plant?

Geothermal Energy

Geothermal energy uses heat energy from beneath the surface of the earth. Some of this heat finds its way to the surface in the form of hot springs or geysers. Other schemes tap the heat energy by pumping water through hot dry rocks several kilometers beneath the earth's surface.

Coal

Coal is a fossil fuel formed over millions of years from decomposing plants. Coal is mainly burned in power stations to make electricity. When coal is burned it produces large amounts of carbon dioxide, one of the gases responsible for the enhanced greenhouse effect (the increase in the world's temperature due to the increased insulating effect of the earth's atmosphere).

Petroleum

Petroleum, or crude oil, is formed in a similar way as coal. But instead of becoming a rock, it becomes a liquid trapped between layers of rocks. It can be made into gas, petrol, kerosene, diesel fuel, oils and bitumen. These products are used in houses for heating and cooking and in factories as a source of heat energy. They are also used in power stations and can provide fuel for transport. However their use, especially petrol and diesel, produces large amounts of carbon dioxide emissions. It also produces other poisonous gases that may harm the environment and people's health.

Gas

Gas is made in the same way as petroleum and is also trapped between layers of rock. Natural gas is tapped, compressed and piped into homes to be used in stoves and hot water systems. LPG (Liquefied Petroleum Gas) is made from crude oil. It is used for cooking and heating in homes, industrial heating in boilers, kilns and furnaces, and for camping and caravanning appliances. LPG can also be used as an alternative to petrol as an engine and transport fuel.

Nuclear Energy

Nuclear energy is the energy released when atoms are either split or joined together. A mineral called uranium is usually used in this process. Heat energy and steam produced can drive an electricity generator in a power station, or provide direct mechanical power in a ship or submarine. At each stage of the process various types of radioactive waste are produced. This waste is poisonous and can cause harm to people and the environment coming into contact with it.

To recap the most common energy sources, try answering this crossword puzzle.

What you will do

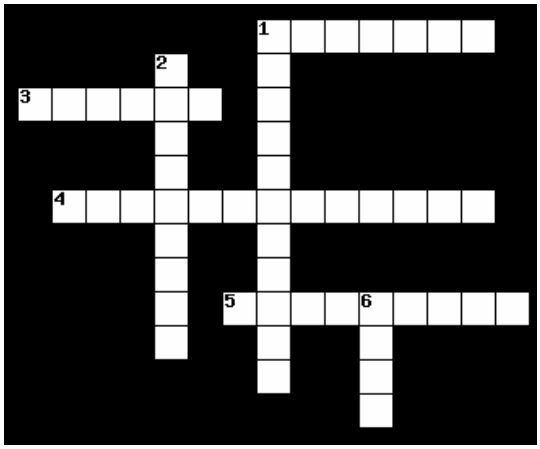
Activity 4.1 Energy Sources

Across

1. This process is used in nuclear power plants.
3. This process is how the sun produces energy.
4. This type of power plant produces energy by harnessing moving water.
5. Term for resources that do not run out

Down

1. Examples are coal, oil and natural gas
2. A device that can convert sunlight directly to electricity.
6. It is harnessed by windmills to produce energy



Key to answers on page 28

Lesson 5 Using Energy Wisely

We use energy to do work everyday. Most of the time, it is easier to make use of those that come from non-renewable sources because of their availability in the market, for example, the gasoline that serves as fuel for our cars, motors and equipment and the LPG gas that we use to cook our food. Our growing energy consumption and depleting energy sources pose a great problem because we are using more energy than we produce.

To solve this problem, we can only do two things: tap more renewable sources, which surely will cost us more, or use the available energy wisely. We cannot do anything with the non-renewable energy sources because they involve natural processes. For instance, say it takes million of years before fossil fuels are formed. But we can always save and economize on our available energy.

Can you think of ways on how you can save more energy at home and in school? Do the next activity.

What you will do

Activity 5.1 Using energy wisely

Identify the available energy forms in your school and home and list down ways to use them wisely. You may use additional sheets of paper.

	Energy Available	How to use the energy wisely
Home	**Example:** Electrical energy	**Example:** Turn off the lights when not in use.
School		

Key to answers on page 28

Let's summarize

In this module, you have learned that:

1. Work is done by a force on an object when the force causes the object to be displaced.

2. Simple machines are devices that help us do work more easily. They can either multiply or change the direction of the force.

3. Energy is the ability to do work. Energy has different forms and sources.

4. Potential energy is the energy due to an object's position. Potential energy can be computed by finding the product of the object's mass, position (height) and acceleration due to gravity.

5. Kinetic energy is the energy possessed by moving objects. Kinetic energy is one half the product of mass and the square of the velocity of an object.

6. Work is related to energy. In doing work, energy is used.

7. Energy cannot be created or destroyed but can only be transformed from one form to another.

8. Thermal energy can be transferred through conduction, convection and radiation.

9. Energy sources can either be renewable or non-renewable. Renewable sources are those that are continually being replaced and reused. Non-renewable sources are those that may run out.

10. Shortage and high production cost of energy sources pose a problem to the community with growing population. It is important that we make use of our energy resources wisely to ensure that there is enough supply for future use.

Posttest

Select the letter of the choice that correctly answers the questions or completes the statements.

1. Work is done in all of the following instances EXCEPT when
    a. pushing a locked door
    b. raising a window
    c. climbing stairs
    d. scrubbing a floor

2. The ramp used to load heavy objects on a truck is an example of _____
    a. lever
    b. pulley
    c. inclined plane
    d. wheel and axle

3. As a rock falls off a cliff, its _____
    a. potential energy changes to kinetic
    b. kinetic energy changes to potential
    c. potential energy remains the same
    d. kinetic energy remains the same

4. A 400- kg truck is traveling at 8 m/s. What is the car's kinetic energy when it stops?
    a. 0 J
    b. 8 J
    c. 3200 J
    d. 6400 J

5. Which of the following energy sources is non-renewable?
    a. Coal
    b. Solar
    c. Geothermal
    d. Hydrothermal

6. Which of the following gives the correct order of energy transformation in a burning candle?
    a. Thermal – Radiant – Chemical
    b. Chemical – Thermal – Radiant
    c. Chemical – Radiant – Thermal
    d. Thermal – Chemical – Radiant

7. When you put your palms close to a fire, your hands will eventually feel warm even without touching the fire. What method of heat transfer is involved in this situation?
    a. Conduction
    b. Convection
    c. Radiation
    d. Transformation

8. A physics book and a chemistry book of equal mass are piled up so that the physics book rests over the chemistry book. Which of the following statements is correct?
    a. The physics book has more KE than the chemistry book.
    b. The physics book has more PE than the chemistry book.
    c. The two books have the same PE and KE.
    d. The chemistry book is doing work on the chemistry book.

9. The acceleration due to gravity on the moon's surface is 1/6 that of the acceleration due to gravity on earth's surface. If you walk at 1 m/s on a flat moon's surface, just as you walk here on the earth, which of these statements is correct?
    a. Your KE on earth is less than your KE on moon
    b. Your KE on earth is more than your KE on moon
    c. Your PE on earth is less than your PE on moon
    d. Your PE on earth is more than your PE on moon

10. How much energy do you use when you exert a 5-N force to move a box to a distance of 3 m?
    a. 0 J
    b. 15 J
    c. 45 J
    d. 75 J

Key to answers on page 29

Key to Answers

Pretest

1. Energy	2. Geothermal	3. Kinetic	4. Lever	5. Radiation
6. Biomass	7. renewable	8.Convection	9. Pulley	10. Work

Activity 1.2

Activity	Did you exert a force on the object?	Did the object move?	Are the directions of the force applied and object's motion the same?	Is there work done in the object s?
Pushing a concrete wall	√	X	√	x
Lifting a ball pen	√	√	√	√
Climbing up a stair	√	√	√	√

Activity 1.3 Work = Force x Displacement
Work = (12 N) x (2 m) = 24 N.m = 24 J

Activity 2.1

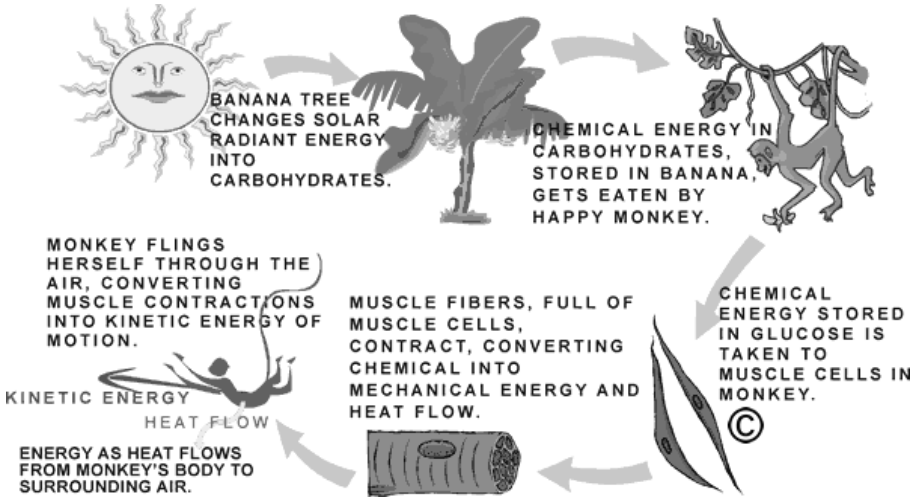
1. Inclined plane
2. It took more work to move the bag of rice straight up into the air. This is why the rubber band was stretched farther. It takes less force to move the bag of rice up the inclined plane

Activity 2.2

Across:	3. Fulcrum	4. Inclined Plane	6. Wheel and Axle	
Down:	1. Pulley	2. Screw	5. Lever	6. Wedge

Activity 3.1 1. 43.3 J 2. 35.28

Activity 3.2



Every cell in the monkey's body is constantly converting the stored solar energy in glucose into work and heat. The work is used to carry on cell processes like growing, reproducing, moving molecules around, and getting rid of waste. The heat is a byproduct of the fuel "burning" process. Heat is always given off when fuel is burned, whether it is in a diesel engine or an animal cell. In an animal the heat can be used to help keep its body at a certain warm temperature. Sometimes our bodies make too much heat (especially if we are dancing to loud music) and we have to do things like sweat or pant (if we are dogs) or fan our big heat exchanger ears (if we are elephants) to try to cool down.

All of the heat flows eventually into the surrounding air. The quantity of total energy has not and will not change. It has just moved to different forms and different places.

Source: http://www.flyingturtle.org/energy/energy-1.htm

Activity 4.1

Across	1. Fission	3. Fusion	4. Hydroelectric	5. Renewable
Down	1. Nonrenewable		2. Solar cell	6. Wind

Activity 5.1. Note: These are just suggested answers. You may see your teacher for checking of other answers.

	Energy Available	How to use the energy wisely
Home/ School	**Light Energy** **Electrical Energy**	Open the windows instead of turning on the lights Use bulbs with lower power ratings to minimize energy consumption.

Posttest 1. a 2. c 3. a 4. a 5. a
6. b 7. b 8. b 9. d 10. b

-End of Module-

References

Young, H. D. and Freedman, R. A. (1996). *University Physics, 9th Ed*. USA: Addison-Wesley Publishing Company.

Resnick, R. et al. (2002). *Physics, Fifth Edition*. USA:John Wiley and Sons, Inc

Transformation of Energy in a Monkey. http://www.flyingturtle.org/energy/energy-1.htm. Accessed on September 25, 2004