Chapter 5 Notes
(Energy Conversions)

- Read the introductory on page 80

Section 5.1 (Energy)

Dropping a ball is a good way to describe the transformation of potential energy into kinetic energy.

Energy changes when you drop a ball. The ball at the top of a building 50 m high has gravitational potential energy but does not have any kinetic energy because it is not moving.

When the ball is released, the potential energy is transformed into kinetic energy (motion) as it falls farther and faster.

Just before it hits the ground, the ball's gravitational potential energy is zero. All of the potential energy has been converted to kinetic energy.

At any point along the way, it is part potential energy and part kinetic energy. But everywhere in this system, the total amount of energy is the same.

- Energy is the ability to do work, which can cause changes in temperature, shape, speed or direction.

When does potential energy(stored energy) become useful.

- Electric energy is converted to light energy to illuminate your room.
- The stored energy in food is converted to kinetic energy as you walk out the door.

Check Your Understanding (page 83 #'s 1-2)

Section 5.2 (Many Forms of Energy)

We do not realize how much we use and need fossil fuels until we do not have them. Since the source of these fuels was the Sun, the same could be said for that star.

Solar energy provides us with food, as well as the energy we need for transportation, heat, and light. Students may have trouble seeing wind energy as solar-driven energy, but it is the Sun that causes and drives all winds.

Wind is caused by the uneven heating of the surface of Earth and the atmosphere. This uneven heating causes temperature differences that create areas of pressure differences in the atmosphere. Air moving from areas of high pressure to areas of low pressure creates a general circulation of the air around Earth. Wind is the movement of air from an area of high pressure to an area of low pressure.

Perhaps geothermal energy is the one source of energy that is not dependent on the Sun — now. One would have to go way back in time to show how the Sun is responsible for it, and then there would be arguments.

Heat and Thermal Energy — You may wish to review the concepts of heat and thermal energy. In *science.connect*™ *1*, these terms are interchangeable, and refer to the sum of all kinetic energies of all particles in an object.

Because temperature is a measure of the average kinetic energy of an object's particles, it is also a measure of thermal energy.

The amount of thermal energy in a bowl of soup is determined by the amount of soup in the bowl and the total amount of energy in the particles that make it up. Thermal energy flows from a warmer object to a cooler one.

Here is another example that you can use to clarify heat and thermal energy.

- Suppose you pick up a glass of ice cold lemonade. If you hold the glass for a long time, the drink warms up. Thermal energy from your hand transfers to the drink.
- A transfer of thermal energy from one object to another because of the difference in temperature is *heat*.
- Heat flows from warmer objects to cooler ones. Heat flows out of your hand and into the glass of lemonade.
- The thermal energy of the drink increases, so its temperature increases.

- Students will create an example of the various forms of energy. They can use the Internet to gather photos, or draw. In the drawing, you must make sure that you demonstrate each of the energy types discussed on page 84 and 85

Check your Understanding page 85 (#'s 1-3)

<u>Section 5.3 (Understanding Energy Conversion)</u>

In this section, students consider energy conversions, including those that occur in a living organism. Energy conversion systems require input energy, a converter, and an output form of energy.

No energy conversion system is 100 percent efficient. Each time there is an energy conversion, some energy is transformed into thermal energy. In many cases, this thermal energy is said to be "wasted" or "lost." Using the phrase "energy is lost" can be confusing for many students because they remember the law of conservation of energy which states that energy can be neither created nor destroyed.

Point out that saying energy is "wasted" or "lost" is actually inaccurate. We use these terms because we mean that some of the energy resulting from an energy conversion cannot be converted into forms of energy we use directly. However, living things use some or all of this "wasted" energy in the form of thermal energy to keep themselves alive.

In the first part of this section, students review the cell and, in particular, the mitochondrion. The mitochondrion is the so-called powerhouse of the cell. Most stages of cellular respiration occur in this organelle. Cellular respiration is the process that is used to convert the chemical energy in food into another form of chemical energy (ATP) that all living things can use.

Energy Conversions during Movement — Muscular contraction in a human is an example of an energy conversion system. The input energy is the chemical energy stored in glucose. The converter is the mitochondria in the muscle cells. The output energy is the chemical energy (ATP) that muscle cells use to contract. The chemical energy in ATP is used to do work (i.e., contract muscles).

Remind students that muscles work by contracting. During this process, roughly 60 percent of the energy stored in the food is lost. Most of the remaining 40 percent is released in the form of thermal energy.

Chemical Reactions — Understanding Energy Conversions also looks at chemical reactions. Reactions that give off thermal energy are plentiful. Chemical reactions that get cooler are rarer. One example of this kind of reaction is a cold pack. Twisting or bending a cold pack mixes the chemicals, causing the pack to get colder.

- For energy to do work, it has to go through a series of conversions. The following is an example of the conversions

Input Energy ⟶ Converter ⟶ Output Energy

- Keep in mind that energy conversion is never 100% efficient, as energy is often lost.

"Chemical Conversions"

- Potential chemical energy from food can be either converted to kinetic energy for muscles to move or thermal energy to keep you warm.

** Think & Link page 90**

Check your Understanding page 91 (#'s 1-3)

<u>Section 5.4 (Conservation of Energy)</u>

- Due to the Law of Conservation of Energy, we learn that energy is not created, nor destroyed, rather it is changed from one form to another.

- For any energy conversion, the amount of input energy is the same as the amount of output energy.

Check your Understanding page 93 (#'s 1-2)

<u>Section 5.5 (Energy Conversion Systems)</u>

Science Background

Efficient energy conversions have become more important than ever in recent years. Section 5.5 gives students a chance to look at one very efficient new car. They also have a second opportunity to consider the Law of Conservation of Energy.

Along with the hybrid technology, a new generation of batteries was needed. Nickel–hydrogen, lithium–ion, and lithium–carbon batteries hold more charge than regular batteries and can withstand constant charging and discharging. Because fewer batteries are needed, the battery systems are lighter. The car consumes less fuel to carry the batteries.

Two criticisms used to be levelled against electric cars:

• Large amounts of energy are needed to produce a battery that has a short life.
• Worn-out lead acid batteries result in environmental degradation.

The new types of batteries promise to reduce the validity of both criticisms.

Check your Understanding page 95 (#'s 1-2)

Chapter 5 Review # 1-12

Chapter 6 Notes
(Electric Energy at Home)

What do we depend on electric energy for?

<u>Section 6.1 (Energy)</u>

Science Background

Earth is a giant magnet, with its magnetic poles a little more than a thousand kilometres from the geographic North and South Poles. The needle of a compass points to the magnetic North Pole.

Lodestones are naturally occurring magnets. They are composed of an iron ore called magnetite — but not all magnetite is lodestone. Some scientists believe that lodestones are created when lightning strikes the right kind of magnetite, the theory being that the electric current supplied by the lightning is sufficient to produce the strong magnetic field found in lodestone.

Whatever its origins, the mysterious magnetic properties of lodestone have caused it to be used by many peoples over the centuries for a variety of purposes, including healing, divination, and navigation.

Today magnets are used in everyday appliances such as blenders, drills, and washing machines. They are also used in expensive medical equipment like the Magnetic Resonance Imager (MRI). Powerful magnets are built right into the body of the MRI; the patient who enters the machine is essentially lying in the middle of a tube surrounded by magnets. The body part that is to be scanned is positioned at the exact centre of the magnetic field, where it is subjected to pulses of energy (similar to radio frequencies) that enable the scanner to determine information about that specific point within the body.

- Read the caption 6.1 on page 100.

- What purpose does a generator serve?

Takes the potential energy from the mineral, converts the energy to electric energy.

- When we generate electricity using generators, we turn Kinetic energy into electric energy using a generator.

Magnetism plays a very important role in electricity conversion. Electric appliances such as blenders, drills and washing machine all have magnetic sources. The combination of coil wire and the magnet helps create electricity.

Natural electric sources:

The Electric Eel. Not a true eel, but rather a snake like fish. Capable of generating 600 volts or electricity(most homes run on 120). The shock grows stronger as the fish ages.

Fish such as sharks, catfish, skates and rays are not able to produce electricity, however they can detect it.

Check Your Understanding (page 101 #'s 1-3)

<u>Section 6.2 (Generating and Distributing Electric Energy)</u>

Science Background

Almost all electricity is made in a generator. As students learned in Section 6.1, a generator consists of a magnet and a coil of wire. Moving the wire coil through the magnetic field induces electric current.

Large electric generating stations use a turbine to turn the generator. Thermal energy or kinetic energy turns a turbine. The turbine turns a generator. The generator turns and produces electricity.

The exception to this is electricity produced by solar cells. These devices use photovoltaic solar cells to turn solar energy directly into electric energy. Photovoltaic (PV) cells are wafers made of the element silicon that is covered with thin layers of metals. When the solar energy strikes these layers, a stream of electrons (electricity) is created.

Power Grid — A power grid is an electricity distribution network. The grid starts at the power plant where the electricity has been produced. The power leaves the power station and passes through a transmission substation. The substation converts the voltage into high voltages for transmission over long distances. When the voltage reaches another substation, it is downgraded for distribution to various utility customers.

There is mounting concern over the biological and psychological effects to humans of the electromagnetic *corona* around transmission lines. This is one of the newer problems power companies face when putting in new lines. They need to negotiate how to put power lines through built-up areas where the electromagnetic fields might negatively affect residents.

Dams constructed for hydro-electric plants frequently damage the local environment by altering the amount and quality of water, impeding the migration of fish and wildlife, and changing the characteristics of the river's flood plain. Some methods that are used to alleviate these problems are:

• regular water testing,
• fish ladders, and
• examination of fertilization of farmland.

- Most generators use a turbine(s). The blades are carfully adjusted to collect as much water, steam or wind as possible. Thermal or Kinetic energy usually turns in the turbine. The turning of the turbine produces electricity.

- Solar generated energy uses photovoltaic cells, silcon and layers of thin metals to produce the electric current

Hydo electicity is very safe and not a harmfull to the environment, however the main disadvantage is the large lakes or reservoirs that flood land and change the ecology of an area.

In Thermonuclear generating stations, uraninum atoms are spilt by nuclear fission. The splitting realeases large amounts of thermal energy, which is used to make steam.

Check your Understanding page 85 (#’s 1-3)

<u>Section 6.3 (Electric Energy and Power)</u>

Science Background

Electric power involves the movement of electrons from the power source to the customer. Electricity is produced at a power plant. It is transported via power poles and metal cables — what many call a wire-grid system.

Specific terms are used when talking about electricity.

- The speed of movement of electrons is called current and is measured in amperes.
- The electric force moving the electrons is called voltage and is measured in volts.
- The product of the current and the voltage is power. Power is measured in watts.

The amount of electric power needed by customers is called the load. Customers pay for the electric load in kilowatt-hours (1000 watt hours). The number of kilowatt-hours used appears on their utility bills.

- Energy is the ability to do work. Work = Force X distance
- Force is measured in Newtons.
- When a Newton of force is applied for one meter of distance, 1 joule of work is done. Joules are what we use to measure energy
- Power is the rate at which energy is transferred. This tells us how fast energy is used or produced.
- Work and energy are both equivalent ,where as power relates to the rate at which work is done.

1 Watt = 1 joule per second or $1w = \frac{1J}{s}$

- When you buy “power” form the electric company you are really buying electric energy. The consumption of power is measured in watts. Usually the watts are multiplied by the time it takes to use them. For example if an appliance uses one 3 watts of power every hours, it uses 3 watt hours (W.H)

- Electric power involves the movement of electrons form the power source to the customer. (Go over the power grid)

Note:
1. The speed of movement of electrons is called current and is measured in amperes
2. The electric force moving the electrons is called voltage and is measure in volts.

3. The product of the current and the voltage is power and is measured in watts.

- The amount of electric power needed by customers is call the load. Customs pay for electricty in kilowatt hours.n 1 kilowatt hour is equaled to 1000 watt

Energy = power x time

Chapter 7 Notes
(Energy for Life)

What do we depend on electric energy for?

Section 7.1 (Nature's Energy Conversion)

Light Intensities and Length Affect Energy Conversions — As they go through their life stages, plants require different light intensities as they enter different phases of their growth, such as flowering. Many plant species are attuned to regular climatic patterns, as well as the length of the days. For example, poinsettias and Christmas cactuses bloom best when they experience 12 hours of sunlight and 12 hours of darkness. Home gardeners are encouraged to provide this exact amount of light to plants that are not blossoming.

Knowledge of plant requirements is also important for hydroponic growers. For example, one type of light — in regulated amounts of time — is necessary during plant growth. When trying to induce flowering, another type of lamp — and duration of light exposure — is used.

Chemical Reactions During Cellular Respiration — Through cellular respiration, about 300 000 chemical reactions take place within our bodies each second. It is possible to speed up the rate of cellular respiration within the body. For example, more thermal energy is generated in individuals who are very fit because their bodies continually supply more energy to the muscles than to fat. That is why athletes have higher metabolisms — more cellular respiration is taking place. This helps explain the great number of calories athletes need to consume.

- The cells of green plants have special parts known as chloroplasts, which contain chlorophyll

- Chlorophyll is a green colored chemical which helps convert carbon dioxide and water into glucose and oxygen. The process is know as photosynthesis.

Photosynthesis = Carbon Dioxide + Water + Light to produce Glucose + Oxygen.

Cellular Respiration is a process use by plants and animals cells to obtain energy from food..

- CR takes place in specialized cells call mitochondria.. This "Power Plant" gets it energy from consuming chemical potential energy from plants and animals.

Energy conversions for Plants and Animals:

Plants= Solar (input)to Chloroplast(converter) to chemical potential energy (glucose, which is carbohydrates)

Animals= Chemical potential energy to mitochondria to muscular activity (kinetic energy)

- During all conversions energy is lost. This usually happens in the form of heat.
- The energy pyramid shows how it takes many organisms at the bottom to support life at he top.

Check Your Understanding (page 12 #'s 1-4)

Section 7.2 (The Need for Energy)

Homeostasis — Conditions inside every cell must remain nearly constant for it to continue to perform its life functions. The steady state that results from maintaining near-constant conditions in the internal environment of a living thing is called homeostasis. The regulation of body temperature in mammals is one example of homeostasis.

Students were first introduced to homeostasis in Unit C of *science.connect™ 1*. This section expands on what students learned in Science 14.

Maintaining Body Temperature — Mammals, including humans, generally have a body temperature considerably higher than the average temperature of their environment. Not only does a high body temperature produce a higher metabolic rate and make possible a high activity level, but a constant temperature higher than that of the environment is much easier to maintain than one lower than that of the surroundings.

Mammals have very effective layers of insulation, such as the fat layers in seals and whales and the thick fur of wolves and musk-ox. In addition, many animals have ways to shunt blood away from blood vessels near the body surface. Closing down these vessels keeps warm blood near the body core.

Shivering is an intense muscle activity that rapidly uses up ATP (high-energy compound) and thus stimulates more cellular respiration and more thermal energy production. In this way, and by shunting blood away from the body surface, an Arctic hare can maintain a constant body temperature that may be 60 degrees above the temperature of its surroundings.

Metabolism and Body Temperature — Mammals cannot survive if their body temperature rises more than a few degrees above their optimal body temperature. That is why they have physiological and behavioural mechanisms in place to keep their body cool — in other words, to maintain homeostasis.

Metabolism releases thermal energy that increases the temperature of the animal. To keep cool, the animal can avoid the hot environmental temperatures by staying in a burrow or in the shade. It may have a way to shunt more blood to the blood vessels near the surface of the skin where thermal energy transfer is greatest.

Some animals, including humans, sweat. It requires thermal energy to evaporate sweat (water) from the surface of the skin. Some of this thermal energy is transferred from the body core. The water evaporated from the tongue of a panting dog, for example, helps to cool it.

Homeostasis in warm-blooded animals involves mechanisms that produce sufficient thermal energy to keep their body temperature constant when the environment is cold. It also involves mechanisms to remove excess thermal energy.

Check your Understanding page 85 (#'s 1-3)

- One of the main reasons why we need energy is to maintain balance (homeostasis) in our bodies.
- Our body reacts in different ways to adjust it temp.

- The rate at which our body uses energy is refereed to as metabolism. People with low metabolism have low energy needs.

- Building lean muscle mass will increase your metabolic rate.

Section 7.3 (Sources of Energy)

In the human body, the greater the number of bonds contained within the macromolecule, the greater the amount of stored energy. Fats are larger and contain more bonds; therefore, they have more stored energy than carbohydrates do.

When working on Conduct an Investigation 7–C: Is There Energy in Common Snack Foods?, students will ignite the lipids in the snack food. It is this material that burns longer and more intensely than other food components. Foods, such as nuts, that contain oils are high in lipids.

The high fat content of many food choices in North America is one reason for the increase in overweight individuals.

Through doing this chapter, students should gain insight into the energy contained in fat. They might extrapolate — or be led to extrapolate — that foods high in fat can lead to weight gain. Food is something that keeps humans warm, active and alive.

- The main source of energy for humans is carbohydrates. Through CR glucose is broken down to provide energy. If more glucose is taken in than is needed, the extra is converted to glycogen. Glycogen is then stored in the liver and muscles and converted back to glucose when needed.

- It is recommended that we use approximately 55-60 percent of our calories form carbs.

- Carb loading is a concept where the glucose is stored, then used a couple of days later.

Fat

- We need fat for three main reasons.
  1. Insulation
  2. Conservation of energy
  3. Source of energy

- Once the body is out of carbs. It will turn to fat to meet its energy needs.

- There are 2 types of fats. Saturated and unsaturated.

- Saturated fat comes mostly from animal fats and some oils. This increases your risk for a heart attack.

- Unsaturated fats include most vegetable oil (Canola and olive). These fats are less dangerous with respect to heart disease.

- It is recommended that 30% of our caloric intake come form fat.

Chapter 8 Notes
(Fossil Fuels)

<u>Section 8.1 (What are Fossil Fuels)</u>

- Using the figure on page 136 trace the formation of coal.

A. Coal was formed from swamp vegetation
B. Plants died and fell into the swamp, and covered by layers of sediment. Since there was not oxygen, it could not decompose. Eventually soft coal (lignite) was formed.
C. More layers of sediment compressed it even further. Since they were deep, the temp. was high, causing more compression.
D. Some layers produced even harder coal known as anthracite.

"The use of coal, oil and natural Gas"

- We use coal it because it is cheap, easy to mine and easy to transport

- Natural Gas is more dangerous to control and transport.

- Crude Oil is in liquid form and extracted by drilling a hole into the Earth's crust.

- Companies spend millions of dollars looking for large deposits of coal and oil. Seismic teams lead the search (use survey, shock waves of compressed air guns, thumper trucks or explosives). Once identified, drilling companies start exploratory drilling. Pump jack are used to bring the oil into storage containers located nearby.

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Check Your Understanding (page 138 #'s 1-2)

<u>Section 8.2 (Extracting Coal and Oil)</u>

Mining Coal

- When coal is near the surface, open pit techniques are used.. The exposed coal is blasted to making the shoveling process easier. Underground mining involves excavating coal from underground . Shafts are dug, blasts re used an coal is brought to the surface using small trains or shuttle cars.

Oil Underground

- Oil is found in microscopic pores between the particle that make up rocks. Over time, tiny oil droplets are forced into rock (reservoir rock). Movements in the earths crust traps the oil and natural gas between layer so impermeable rock.
- Geologists use seismic surveying to give them an idea of potential reservoirs.

Drilling for Oil

- As oil is removed from the reservoir, the pressure of the oil drops. A pump jack or lift pump may be used to maintain pressure.

Refining Oil

- The refinement of oil is necessary as the crude needs to be separated based on their boiling points. This distillation phase is very important.
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Section 8.3 (Combustion)

- Combustion is the conversion of fossil fuel to thermal energy. This is a chemical reaction that takes place with oxygen.

- Propane is an example of these gases that go through the separation phase.

- Depending on how it burns the result may be either complete (where carbon dioxide and water) are produced, or incomplete where carbon monoxide is produced

- An example of incomplete combustion would be using a BBQ inside, where there is insufficient oxygen available.

"Combustion and Cellular Respiration"

- There are similarities between the products and the reactants are apparent in both combustion and cellular respiration.

Section 8.4 (The other side of the coin)

- Fossil fuels is a non renewable resource. At the current rate that we are going we could run low in some fuels by 2010.

Fossil Fuel problems:

- Difficult to transport
- Leaks and spills are tough to clean up

Why Reduce Fuel consumption?

- the burning of fossil fuels contributes to extract sulfur in the atmosphere. This contributes to acid rain precipitation. When acid levels get to high, fish and certain plant life cannot survive.

Greenhouse Gas
The burning of fossil fuels contribute to the Greenhouse Gas effect.

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