**Science 14**

**UNIT B- “The PHYSICS Unit” CHAPTER 5**

**5.1 The Nature of Heat**

Friction theory has been around for centuries. When two surfaces are rubbed \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, the parts that touch \_\_\_\_\_\_\_\_\_\_\_\_\_ movement. This resistance is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

It was Count Rumford who used \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ about friction to change the way scientists look at heat. In the late 1700s, Count Rumford observed that \_\_\_\_\_\_\_\_\_\_ was created when \_\_\_\_\_\_\_\_\_ cut metal. This heat results from friction. Rumford was an engineer and scientist who was hired to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cannons in Munich, Germany. During this project, one worker carelessly \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a rod being used to bore a hole through a piece of metal. His hand was seriously burned.

**Robert Brown and Random Movement**

Have you ever watched popcorn popping in an air popper? The random, dancing motion of the \_\_\_\_\_\_\_\_\_\_\_ is easy to observe. The cause of this motion is easy to explain. Would it surprise you to know that a similar type of random, dancing motion is occurring in the glass of water?

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| **THINK & WRITE**  Write a full sentence that compares the movement of boiling water to the movement of popcorn being popped: |

**Robert Brown** was the first to realize this. During the 1800s, he was using a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to observe pollen grains in a drop of water. He noticed that although the microscope was quite still, the pollen grains \_\_\_\_\_\_\_\_\_\_\_\_\_ around. When he increased the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the water, the jiggling motion \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. This jiggling motion became known as \_\_\_\_\_\_\_\_\_\_\_\_ motion. Observing the motion was simple. Explaining the cause was much more difficult. At first, \_\_\_\_\_\_\_\_\_\_ thought that the pollen grains were alive. Later, he reasoned that water must be composed of tiny \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ particles. These particles are in constant, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ motion. The motion of the pollen grains must be caused by \_\_\_\_\_\_\_\_\_\_\_\_\_\_ between the pollen grains and the other unseen particles. Brown was unsure what the particles were.

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| Match the correct words**: Brown Particles Temperature Heat**  \_\_\_\_\_\_\_\_\_\_\_\_\_\_ are always moving.  \_\_\_\_\_\_\_\_\_\_\_\_\_\_ affects the speed of particles.  \_\_\_\_\_\_\_\_\_\_\_\_\_\_ will always speed up motion.  \_\_\_\_\_\_\_\_\_\_\_\_\_\_ observed particles under the influence of temperature changes. |

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| **WORK: Check Your Understanding**  **Page 85**  **All Questions**  **Full sentences, Complete Answers.** |

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| ***Terms and Definitions:***  Friction  Robert Brown  Brownian motion |

**5.2 Heat and Temperature**

The modern theory of heat began with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. He was first to suggest that the \_\_\_\_\_\_\_\_\_\_ that came with heat — or \_\_\_\_\_\_\_\_\_\_\_\_ energy — was related to the \_\_\_\_\_\_\_\_\_\_ motion of unseen particles of a substance.

What are these unseen particles? What causes the jiggling motion? In Unit A, you studied the particle theory of matter, which states: • All matter \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

• These unseen \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

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| **THINK & WRITE** Write the missing 3 parts of the theory of matter not listed above: |

Kinetic means \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Kinetic art, such as mobiles, is art that \_\_\_\_\_\_\_\_. Kinetic energy is a form of energy associated with motion. Kinetic \_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a measure of the amount of motion particles have. We can use kinetic energy to explain the difference between \_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_. The motion of particles can be compared to bumper cars at a fair. Like bumper cars, atoms and molecules \_\_\_\_\_\_\_\_\_\_with each other at different speeds. All particles have different kinetic energies.

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| **THINK & WRITE**  If you were given a working thermometer that has no markings on it to tell you the rooms temperature, how could you scientifically place correct markings on this blank thermometer. |

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| **WORK: Check Your Understanding**  **Page 87**  **All Questions**  **Full sentences, Complete Answers.** |

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| ***Terms and Definitions:***  heat  thermal energy  kinetic energy  temperature |

**5.3 Transfer of Heat**

There have been many predictions about when Earth will end. Fear of Y2K computer problems brought excitement to New Year’s Eve 2000. As you study transfer of heat, you will learn about another \_\_\_\_\_\_\_\_\_\_\_\_\_\_ end to the universe.

**Forms of Heat Transfer** Heat flows from \_\_\_\_\_\_\_ to \_\_\_\_\_\_\_\_. The flow continues until both objects are at the \_\_\_\_\_\_\_\_\_\_ temperature. But what really happens? How does thermal energy transfer from one object to another?

**Conduction**

In Figure 5.10, the molecules of the hot burner vibrate \_\_\_\_\_\_\_\_\_\_\_\_\_. They have \_\_\_\_\_\_\_\_ kinetic energy than the molecules of the cooler pot. Contact \_\_\_\_\_\_\_\_\_\_\_\_\_ pot and burner causes the molecules of the hot burner to \_\_\_\_\_\_\_\_\_\_\_\_ with the slower molecules of the cool pot. The collisions result in a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ of kinetic energy. The molecules of the cooler pot start to vibrate faster, gaining kinetic energy. The molecules of the hot burner vibrate \_\_\_\_\_\_\_\_\_\_\_\_, losing kinetic energy. This transfer of heat by \_\_\_\_\_\_\_\_\_\_\_\_ is called conduction.

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| **THINK & WRITE**  In your everyday life, list a minimum of 5 examples where heat has transferred by conduction (direct contact) |

**Convection**

If you hold your hand above the hot burner of a stove, you will feel a warm \_\_\_\_\_\_\_\_\_\_\_of air. Why? Heat is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, by conduction, from the hot burner to the air molecules touching the burner. These \_\_\_\_\_\_\_\_\_ molecules \_\_\_\_\_\_\_\_\_ kinetic energy, vibrate faster, and get farther apart. These warm molecules are farther \_\_\_\_\_\_\_\_ than cooler ones, so the warm air is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ than the cool air around it. This warm air \_\_\_\_\_\_\_\_\_, making the warm current that you \_\_\_\_\_\_\_\_. Cool, denser air rushes in to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the warm air. Because of this continuous air flow, all the air in the \_\_\_\_\_\_\_\_\_ will become warmer. This transfer of heat by movement is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

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| **THINK & WRITE**  In your everyday life, list a minimum of 3 examples where heat has transferred by convection (warm currents) |

**Radiation**

Look at the hand in Figure 5.12. The hand is close to the side of a burner but \_\_\_\_\_\_\_\_\_\_\_\_\_\_ the burner. The front of the hand becomes \_\_\_\_\_\_\_\_\_\_ while the back remains \_\_\_\_\_\_\_\_\_\_\_. The front of the hand is not being heated by conduction or convection. There is no contact with the burner and convection currents of warm air would rise away from the hand. The front of the hand is heated by \_\_\_\_\_\_\_\_\_\_\_\_\_\_. Radiation is produced by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, which are tiny particles present in all atoms. This vibration makes a wave called an electromagnetic wave or \_\_\_\_\_\_\_\_\_\_\_\_\_\_ radiation wave. These waves are similar to the waves your hand can create when it vibrates in calm water. \_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_ run away from your moving hand. Infrared radiation \_\_\_\_\_\_\_\_ travel from the burner. They strike the hand and transfer heat energy to the molecules in the hand. This causes the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the hand to vibrate faster.

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| **THINK & WRITE**  In your everyday life, list a minimum of 2 examples where heat has transferred by radiation |

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| **ILLUSTRATE YOUR KNOWLEDGE:** Draw a campfire in the middle of the space below. Then draw someone roasting a marshmallow. Now you can draw all three forms of energy transfer. | |
| **WORK: Check Your Understanding**  **Page 91**  **All Questions**  **Full sentences, Complete Answers.** |

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| ***Terms and Definitions:***  conduction  convection  radiation |

**5.4 Heat Transfer in Nature**

Convection causes many \_\_\_\_\_\_\_\_\_\_\_\_\_ phenomena, such as winds. You will study that in this section. You will also learn how \_\_\_\_\_\_\_\_\_\_, or average weather conditions based on \_\_\_\_\_\_\_\_\_\_\_\_\_ records, is affected by \_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_.

**Convection Currents and Weather**

Many cottages are on the shores of \_\_\_\_\_\_\_\_\_ where convection currents keep the cottages cool in the daytime and warmer at night. In the evening, the \_\_\_\_\_\_\_ over the water cools more slowly than the air over the land. Warm air from over the water \_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_ toward the land, keeping it warm. This is just like the \_\_\_\_\_\_\_ moving from over the hot plate to the cool end of the cooking pan. During the day, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from the lake moves toward the warm land in the same way that dye moved from the cold end of the cooking pan to the hot end.

**Sea and Land Breezes**

You have demonstrated that warm air rises and cool air sinks. The \_\_\_\_\_\_\_\_\_\_\_\_\_ movement that results was identified as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. All the winds you ever feel start with convection currents. Here is how they work. Land and sea breezes are convection currents of air that occur near a \_\_\_\_\_\_\_\_\_\_\_\_\_. They are both created by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in temperature near the surface of Earth. On a sunny day, \_\_\_\_\_\_\_\_\_\_\_ heat from the Sun strikes Earth’s \_\_\_\_\_\_\_\_\_\_\_\_\_. Heat is absorbed by land and water. But land and water heat at different rates. Land heats quickly, but also cools quickly. Water heats slowly and takes longer to cool.

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| **ILLUSTRATE YOUR KNOWLEDGE:** Draw both Land Breeze and Sea Breeze with labels. Use your textbook. | |
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**How Oceans Help to Moderate Climates**

Oceans are able to store large amounts of \_\_\_\_\_\_\_\_\_\_\_\_ energy. This prevents the area around them from having \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ temperature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Oceans moderate the climate of land areas near them. This means that they prevent the area from becoming either too hot or too cold. Here is how it works:

• In cool weather, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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• As the Sun warms air above the ocean, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

You could say oceans prevent land near them from getting very warm or very cold. Because of this, coastal cities like \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ have moderate climates.

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| **WORK: Check Your Understanding**  **Page 97**  **All Questions**  **Full sentences, Complete Answers.** |

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| ***Terms and Definitions:***  sea breeze  land breeze  moderate |

**5.5 Heat Transfer and Technologies**

Many household technologies either \_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the transfer of heat through conduction, convection, or radiation. That is why metal cooking pots have hard plastic or wooden handles. What other techniques are used to handle hot food?

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| **THINK & WRITE**  In your everyday life, think of 6 devices, or tools, or objects you own that keeps you safe by not letting you get burned or frozen. (these could be everyday objects or specific to a future job) |

Most cooks want to control how food is heated. Consider what happens when heating soup on a stove. The pot is heated by conduction through contact with the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The soup at the bottom of the pot heats up \_\_\_\_\_\_\_\_\_ through conduction. Heated soup \_\_\_\_\_\_\_\_\_\_ to the top because it is less dense. Colder soup near the top of the pot flows to the \_\_\_\_\_\_\_\_\_\_\_\_ because it is denser. A circular motion in the soup results. These convection currents in the pot heat the soup to a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ temperature.

When an oven is turned on, convection \_\_\_\_\_\_ currents move heat \_\_\_\_\_\_\_\_\_ the oven. Air at the bottom of the oven is \_\_\_\_\_\_\_\_\_\_\_\_\_\_ by burning gas or an electric element. Heated air becomes less dense and rises to the top of the oven. Cooler air sinks to the bottom. The hot air heats the oven walls. These walls then \_\_\_\_\_\_\_\_\_\_\_\_ heat in all \_\_\_\_\_\_\_\_\_\_\_\_\_\_. In this way, food in the oven is cooked by both convection and radiation. There is also \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from the baking pan.

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| **THINK & WRITE**  write a sentence that explains why a furnace should be installed in the basement, and not in the attic. THEN, draw a quick sketch that shows what you mean. |

**Getting Rid of the Heat**

Combustion of fuel inside an engine produces a \_\_\_\_\_\_\_\_\_\_\_\_\_ quantity of thermal energy. If this energy were not removed, the engine would \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and be \_\_\_\_\_\_\_\_\_\_\_\_.

Here is how the engine is protected:

• The engine’s cooling system contains a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Heat is conducted from the engine to the coolant.

• The coolant is \_\_\_\_\_\_\_\_\_\_\_\_\_ through the engine block to the \_\_\_\_\_\_\_\_\_\_\_\_\_. A radiator is a honeycomb made of a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The metal alloy is a good \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Heat from the coolant is conducted through this alloy to air.

• Either a fan or the motion of the vehicle forces this air \_\_\_\_\_\_\_\_\_\_\_ the radiator. Heat is transferred to the air that rushes through the radiator. These three techniques use conduction to protect engines from heat damage.

**Keeping It Cool**

When you put a little water on the back of your hand, your hand becomes cool. That is because thermal energy \_\_\_\_\_\_\_\_\_\_\_\_\_\_ from your hand to the water through conduction. Water absorbs heat from your hand and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Evaporation removes thermal energy as the water molecules leave the water droplets and move into the air. Your hand \_\_\_\_\_\_\_\_\_ cooler. This form of cooling is usually called cooling by evaporation. Evaporation caused the cooling, but the cooling action started with conduction of heat \_\_\_\_\_\_\_ from your hand.

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| **WORK: Check Your Understanding**  **Page 101**  **All Questions**  **Full sentences, Complete Answers.** |

**Write the correct term to complete the following sentences:**

(a) The sum of all the kinetic energies of an object is its \_\_\_\_\_\_\_\_\_\_\_\_\_ .

(b) The average of all the kinetic energies of an object is its \_\_\_\_\_\_\_\_\_\_\_\_\_ .

(c) The energy due to motion of particles in an object is its \_\_\_\_\_\_\_\_\_\_\_\_\_ .

(d) A process of heat transfer that occurs when two objects are in contact with each other is \_\_\_\_\_\_\_\_\_\_\_\_\_ .

(e) The process that releases heat when two objects rub together is \_\_\_\_\_\_\_\_\_\_\_\_\_ .

(f) The first person to observe a sign of molecular motion was \_\_\_\_\_\_\_\_\_\_\_\_\_ .

(g) A process of heat transfer that involves the circular flow of air or liquids is called \_\_\_\_\_\_\_\_\_\_\_\_\_ .

(h) A process of heat transfer that involves electromagnetic waves is called \_\_\_\_\_\_\_\_\_\_\_\_\_ .

(i) A wind that occurs as a result of air flowing from the land to the sea is called a \_\_\_\_\_\_\_\_\_\_\_\_\_ .

(j) Oceans keep land near them from having temperature extremes. We say that oceans \_\_\_\_\_\_\_\_\_\_\_\_\_ temperatures.

(k) A wind that occurs as a result of air flowing from the sea to the land is called a \_\_\_\_\_\_\_\_\_\_\_\_\_ .

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| **WORK: Chapter 5 Review**  **Page 102-103(Questions 2-12)** |

(l) A jiggling motion of small particles in water is called \_\_\_\_\_\_\_\_\_\_\_\_\_ .

**Science 14 Name: \_\_\_\_\_\_\_\_\_\_\_**

**UNIT B- “The PHYSICS Unit” CHAPTER 6**

**6.1 Absorbing and Losing Heat**

In Chapter 5, you learned that water \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the temperature of the land around it. In this section, you will learn another reason why that happens. The following activities investigate how different materials \_\_\_\_\_\_\_\_\_\_\_\_ heat at \_\_\_\_\_\_\_\_\_\_\_\_ rates. This is referred to as heat absorption.

**Specific Heat Capacity**

Each substance requires a unique amount of \_\_\_\_\_\_\_\_\_\_\_\_\_ gain or loss to change its temperature. Specific heat capacity measures a substance’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_ to absorb or lose heat. Specific heat capacity is measured in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ per gram degrees Celsius.

This is often written as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The specific heat capacity for \_\_\_\_\_\_\_\_\_\_\_\_\_\_ is 4.19 J/g•oC. This means that:

• One gram of water \_\_\_\_\_\_\_\_\_\_\_\_\_ 4.19 joules of heat to raise its temperature 1°C.

• One gram of water \_\_\_\_\_\_\_\_\_\_\_\_ 4.19 joules of heat to lower its temperature 1°C.

In the Find Out activity, you confirmed that the amount of heat needed to change the temperature of a specific amount of water does not change, regardless of the starting temperature of the water.

The specific \_\_\_\_\_\_\_\_\_\_\_\_ capacity of \_\_\_\_\_\_\_\_\_\_\_ is 0.66 J/g•oC. To increase the temperature of 1 gram of sand by 1oC would require 0.66 J of energy.

Look at these two numbers:

Specific heat capacity of water = 4.19 J/g•oC

Specific heat capacity of sand = 0.66 J/g•oC

As you can see from the numbers, the specific heat capacity of water is a lot \_\_\_\_\_\_\_\_\_\_\_\_ than that of sand. It takes more energy to increase the temperature of water than it does to increase the temperature of sand. No wonder sand on a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is much warmer than the shallow water nearby.

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| **THINK & WRITE**  write list of 5 liquids that you will then look up the specific heat capcities. Yes, you can use your personal devices to do so in class. |

**Warming Up and Cooling Down with Oceans**

In Chapter 5, you learned that oceans \_\_\_\_\_\_\_\_\_\_\_\_\_ shore areas. In this chapter, you learned that water has a high specific heat capacity. Oceans store \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy or thermal energy than you might expect!

Add this new knowledge to what you know about sea breezes and land breezes. With its \_\_\_\_\_\_\_\_\_\_\_ specific heat capacity, water can \_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_, or \_\_\_\_\_\_\_\_\_\_\_\_\_\_ much more thermal energy than land. That is another reason for land heating and cooling quicker than lakes and oceans.

**Specific heat capacity affects climate in other ways.**

• On a hot day, water will \_\_\_\_\_\_\_\_\_ heat. This \_\_\_\_\_\_\_\_\_\_the rise of temperatures in the surrounding area.

• At night, water will \_\_\_\_\_\_\_\_\_\_\_\_ heat. This slows cooling in the surrounding area.

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| ***Terms and Definitions:***  heat absorption  specific heat capacity |

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| **WORK: Check Your Understanding 6.1**  **Page 110**  **All Questions**  **Full sentences, Complete Answers.** |

**6.2 - Keeping Heat at Home**

Heat moves from hot toward cold all too well during Canadian winters. Heat \_\_\_\_\_\_\_\_\_\_ through windows, doors, walls, and roofs. Proper \_\_\_\_\_\_\_\_\_\_\_\_\_\_ can help this problem. Insulation slows heat transfer.

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| **THINK & WRITE**  write a list of 3 materials that would be good to cover a plastic cup filled with hot chocolate in order to keep it as warm as possible for as long as possible. What are your top three picks? |

With insulation you get two benefits for the price of one. The same insulation that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in during the winter keeps heat out on a hot summer day. Knowledge of heat transfer teaches you how to keep your home warm in the winter and cool in the summer. But what makes a good insulator?

**R-value**

Air transfers heat when it is moved by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ currents. Air is an \_\_\_\_\_\_\_\_\_\_\_\_\_\_ insulator when it is held still. Take a look at the insulating materials in Table 6.2.

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| **THINK & WRITE**  Which of the materials have pockets of air? |

R-value is a\_\_\_\_\_\_\_\_\_\_\_\_\_ of how well an insulating material slows heat transfer. Materials with high R-values are better insulators than those with low R-values. An insulation of R-12 loses heat faster than one with R-16.

When materials are used together, the total R-value is the \_\_\_\_\_\_\_\_\_ of the R-values of each material used.

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| **CIRCLE THE MATERIAL WITH THE HIGHER R-VALUE:**   1. Solid Wood vs. Concrete 2. Clay vs. Urethane Foam 3. Wood Shavins vs. Concrete 4. Fiberglass vs. One Thichness of Glass 5. Concrete vs. Clay |

**Other Ways to Keep the Heat in Your House**

The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ between the inside and outside wall of a house is called a wall \_\_\_\_\_\_\_\_\_. Filling the cavity with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ stops convection currents. When insulation fills a wall cavity, there are many pockets of trapped, still air. In Conduct an Investigation 6–B, you likely noticed that materials that trap air helped prevent the ice cube from melting. Foam pellets and poured insulation work in this way.

The activity below provides other ideas that may help keep you warm. In doing this activity, you might experiment with which way to place the aluminum foil.

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| **THINK & WRITE**  Should the shiny surface face in or out? |

**Windows and Doors That Keep Heat In**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are two weak points when you try to keep a house warm. A single pane of glass is a poor insulator. Heat \_\_\_\_\_\_\_\_\_\_\_\_\_ quickly through glass. To make matters worse, leaks develop around the \_\_\_\_\_\_\_\_\_\_\_\_ and around the edge of the windows.

Older houses use double windows and doors — called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ — to keep heat in. Today’s exterior doors and windows use double \_\_\_\_\_\_\_\_\_\_\_\_. This provides a space of still air. Insulation value of this still air is improved when air is mixed with a gas such as argon.

Exterior doors used to be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Modern doors are \_\_\_\_\_\_\_\_\_\_\_\_\_\_ filled with insulation. Some are metal covered. To prevent heat transfer, there is a break in the metal between inside and outside. Take a look around your school and home. What else is done to keep heat leaking from windows and doors?

**Controlling Heat Transfer**

Knowledge of heat transfer is also used to keep things in your house warm. Pizza parlours keep pizza warm by transporting it in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ containers. As well as limiting heat transfer, the envelope must be washable. This limitation prevents the use of some of the materials you used in Investigation 6–B.

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| **THINK & WRITE** What material would you use if you were designing a pizza envelope? Would foil be a good choice? Explain. |

A vacuum bottle uses several of the same technologies that keep your house warm in order to keep food and beverages warm.

• Inside is a double glass jar. One jar is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ — similar to windows with a double pane.

• Some \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from between the two jars. That is where the name comes from. The space is a partial vacuum.

• The jars are painted with a silver \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ coating.

• Rubber or plastic keeps the glass away from the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

• The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is insulated.

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| **THINK & WRITE** Can you point to where the vacuum bottle prevents the following types of heat transfer?  (a) conduction  (b) convection  (c) radiation  **USE ARROWS** |

**Kitchen and Workshop**

Like your house, large appliances — stoves, refrigerators, freezers, even dishwashers — are \_\_\_\_\_\_\_\_\_\_\_\_\_. Insulation slows heat transfer, keeping ovens hot and freezers cold.

In Chapter 5, you found that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are good insulators. Wooden and plastic handles on pots and pans allow you to pick them up from a hot element. Toasters are often encased in plastic or have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for the same reason. Soldering irons and torches use \_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_ to protect your hands from the heat. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_ are worn in both shop and kitchen to protect the body and hands from heat transfer. You would no more imagine taking a pizza from the oven barehanded than you would consider arc welding without gloves, apron, and mask.

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| **WORK: Check Your Understanding 6.2**  **Page 119**  **All Questions**  **Full sentences, Complete Answers.** |

**6.3 - Keeping Yourself Warm**

The same techniques that keep a house warm also keep our bodies warm. On cold days, wear several layers — underwear, shirt, sweater, pants, and jacket. Choose inner layers for their open weave and thickness. Air trapped in the material serves as insulation. A windproof outer layer keeps warm air from escaping.

Some of the warmest winter clothes contain \_\_\_\_\_\_\_\_\_\_\_\_\_\_. Birds grow \_\_\_\_\_\_\_\_\_\_\_\_\_, down f\_\_\_\_\_\_\_\_\_\_ under the feathers you see. These feathers keep birds warm. Down is often quilted between the outer shell and inner lining of a vest or jacket. When down is fluffed, it \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in place. The jacket material keeps air from blowing through the down and changing cold air for warm. Remember that a dry body is a warm body. Vigorous activity causes sweat.

In Chapter 5, you were reminded how water causes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ as it evaporates. When working or playing outside, you want to protect yourself from getting and staying damp. When you start to sweat, remove one layer, possibly another. This allows heat to \_\_\_\_\_\_\_\_\_\_\_\_\_\_ out and your body to stay at the right temperature. As soon as you stop moving, replace those layers of clothing.

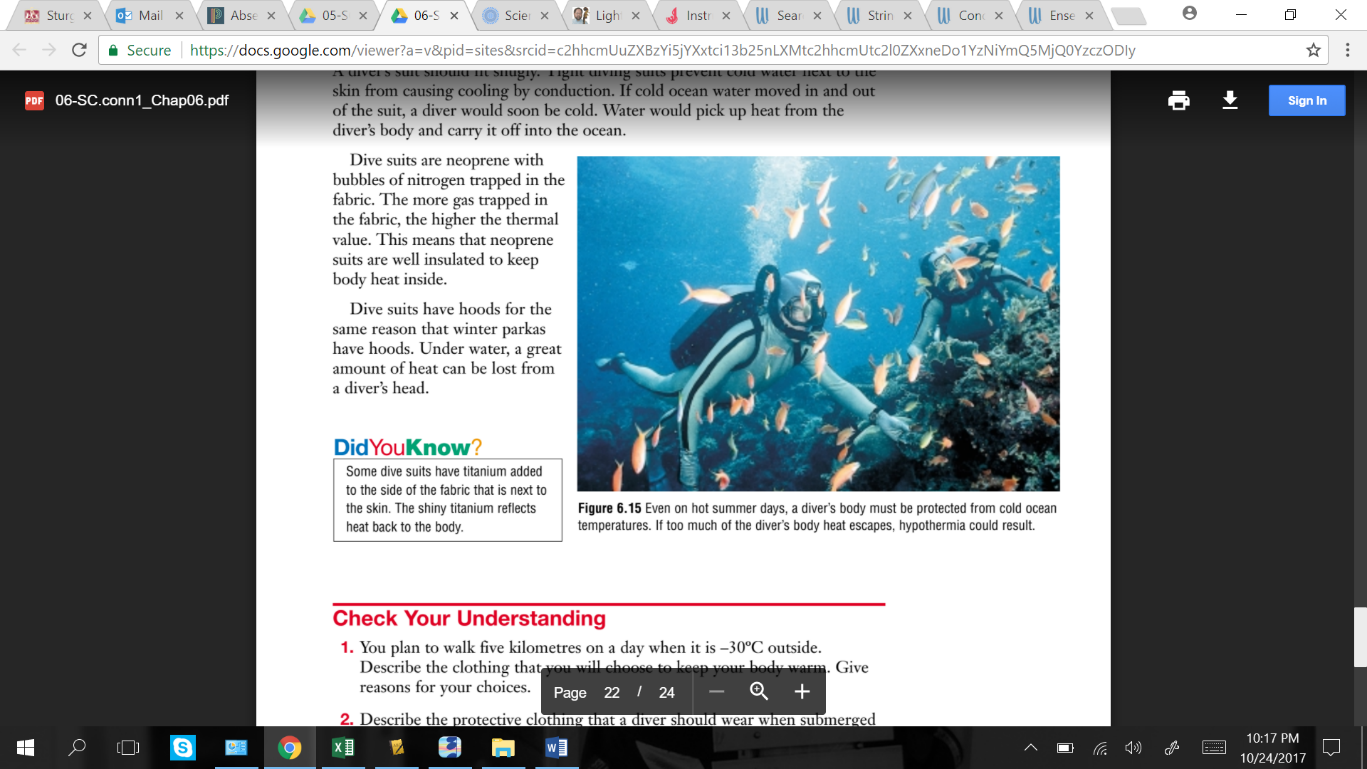
**People of the North**

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| **THINK & WRITE**  Read the page about what these children are dressed in, what materials are used and why?  Page 121… |

**Keeping Cool**

Are you surprised to see that people in hot areas wear so many clothes? They do this to \_\_\_\_\_\_\_\_\_\_\_\_ heat transfer. Long, thick robes protect bodies from the Sun’s rays. Light-coloured clothes reflect heat from the environment, and allow body heat to escape.

Oven mitts work in a similar manner. Their quilted material \_\_\_\_\_\_\_\_\_\_\_\_\_\_ heat transfer. Some include \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ material that also reduces heat transfer.

**Dressing for Intense Heat — or Cold**

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| **FIREFIGHTERS**  Describe the types  of clothing used in  firefighters clothes. | **SCUBA DIVERS**  Describe the types  of clothing used in  divers clothes. |

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| **WORK: Check Your Understanding 6.3**  **Page 125**  **All Questions**  **Full sentences, Complete Answers.** |

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| **WORK: Chapter 6 Review**  **Page 126-127(Questions 1-11)** |

**Science 14 Name: \_\_\_\_\_\_\_\_\_\_\_**

**UNIT B- “The PHYSICS Unit” CHAPTER 7**

**7.1- All Kinds of Energy**

Figure 7.1 The bungee jumper has stored \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy due to her position above the surface of Earth. As she \_\_\_\_\_\_\_\_\_\_\_, she gains the energy needed to stretch the bungee cords.

Figure 7.2 The baseball has \_\_\_\_\_\_\_\_\_\_\_\_\_ energy due to its motion.

Figure 7.3 The stove element is a source of heat or \_\_\_\_\_\_\_\_\_\_\_\_ energy.

Figure 7.4 The outlet is a source of \_\_\_\_\_\_\_\_\_\_\_\_ energy.

Figure 7.5 The light bulb emits \_\_\_\_\_\_\_\_\_\_\_ energy.

Figure 7.6 The speaker is a source of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy.

Figure 7.7 Some chemicals have stored \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy.

Figure 7.8 Enriched uranium used in a nuclear power plant has \_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy.

We usually think of energy in terms of fuel. You can see from the figures on this page, however, that there are many kinds of energy. We need a definition of energy that includes all of these.

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| **THINK & WRITE** What do sound, light, a moving baseball, and a nuclear power plant have in common? |

**What Is Work?**

In science, a force is a \_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_. Work is done when a force \_\_\_\_\_\_\_\_\_\_\_ an object. You were doing work when you pulled or lifted the block of wood to the top of the pile of books. The amount of work done is recorded in various ways.

• A newton-metre (N•m) is the work done when one newton of \_\_\_\_\_\_\_\_\_\_ is used for a \_\_\_\_\_\_\_\_\_\_ of one metre.

• A joule (J) is the standard way of reporting work done. One \_\_\_\_\_\_\_\_\_\_ is equal to one newton-metre.

Work force distance or W= F • d

Force is measured in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (N). Distance is measured in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (m).

To find out the amount of work done, multiply the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ something moved by the amount of \_\_\_\_\_\_\_\_\_\_\_\_\_\_ it took to move it. The formula will help you remember. Use this knowledge to calculate how much work was done in the Find Out activity on page 131.

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| **THINK & WRITE**  Calculate the following questions:   1. How much work happens when 50N travels 2 meters? 2. How much work happens when 150N travels 4 meters? 3. If an object with 500J of energy has moved 10 Meters, what was its force while moving? 4. If an object with 200J of energy has moved 8 Meters, what was its force while moving? |

**Ramps Are Everywhere**

Simple machines have one movement. The movement of an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a slide. The inclined plane or \_\_\_\_\_\_\_\_\_\_\_ is probably the oldest simple machine. Game trails and old paths use inclined planes, as do \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. You use ramps when you bicycle. Going back and forth across a steep hill helps you climb with less effort. You also use ramps in many hidden ways. The threads of a screw-top bottle are a form of ramp. So is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ pattern on wood screws and metal bolts. These are circular inclined planes.

**You Know You Are Working When ...**

The scientific definition of work may surprise you. In science, work is done when both of the following occur.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ — A person pushing against a solid wall is not working. The wall does not move. No work is being done.

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| ***Terms and Definitions:***  Equilibrium:  energy:  thermal energy:  force: | work:  newton-meter:  joule:  simple machines:  inclined plane: |

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| **WORK: Check Your Understanding 7.1**  **Page 133**  **All Questions**  **Full sentences, Complete Answers.** |

**7.2- Just Prying into Things**

Can you lift a 10 kg object vertically using five kilograms of effort? You can if you use a \_\_\_\_\_\_\_\_\_\_\_\_, which is another simple machine. Levers are bars that pivot on a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The object that the lever moves is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_. The force required to move the object is the \_\_\_\_\_\_\_\_\_\_\_. Look at Figure 7.12.

• The distance from the fulcrum to the load is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (a).

• The distance from the fulcrum to the effort is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (b).

There are three classes of levers. You can tell what class a lever belongs to by where the parts are. In this section, you will look at the three kinds of levers and see where the various parts are located in each. As you go through, notice what happens to the effort distance and load distance when the fulcrum is moved.

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| **THINK & WRITE**  Using a straight line (plank), a triangle (fulcrum), Box (load) and an arrow (Effort) please draw the 3 types of levers that we will be studying this chapter.  **1st Class Lever:**  **2nd Class Lever:**  **3rd Class Lever:** |

**First Class Levers**

In a first class lever, the fulcrum is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the load and effort. You use a first class lever when you pry the lid off a paint can or use a long-handled fork to pick up a heavy load of hay or manure.

First class levers are used for \_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_, and \_\_\_\_\_\_\_\_\_\_\_\_\_\_. In a pair of scissors, for example, the fulcrum is the screw that holds the scissor blades together. Your hand gives the effort. Cutting is the load. Pliers work in much the same way. In this simple machine, the effort applied to the handles is used to grip or hold the load. Other examples are all around you. Put a piece of paper in a binder or clipboard and you have used a first class lever. Most light switches and lawnmower speed controls also use first class levers. Watch how many you use at home tonight.

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| **THINK & WRITE**  Create a list (that you can come back and fill out later) of 6 examples for ***first class levers***:  1-  2-  3-  4-  5-  6- |

**Second Class Levers**

A wheelbarrow is an example of a second class lever. In this type of lever, there is a bar with the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ at one end, an effort at the other end, and a \_\_\_\_\_\_\_\_\_\_\_\_\_ in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Sketch how you can use this kind of lever to lift heavy objects. Some can openers, bottle openers, and nutcrackers are second class levers. Others are first class levers. Check any you have around the house and see if you can classify them.

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| **THINK & WRITE**  Create a list (that you can come back and fill out later) of 6 examples for ***Second class levers***:  1-  2-  3-  4-  5-  6- |

**Third Class Levers**

A fishing pole is an example of a third class lever. As with the second class lever, the fulcrum is at one end. Unlike the second class lever, the effort in a third class lever is between the load and the fulcrum. Third class levers are often used when the job calls for \_\_\_\_\_\_\_\_\_\_\_. Axes, rackets of all kinds (for example, tennis, squash, and badminton), and hockey sticks are examples of third class levers that use this speed advantage.

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| **THINK & WRITE**  Create a list (that you can come back and fill out later) of 6 examples for ***Third class levers***:  1-  2-  3-  4-  5-  6- |

**Your working body!**

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| THINK & WRITE  Use your text book, or just stop and move your body around, and think about what type of levers exist in your body already. ***Describe Three Examples of levers in your body.***  1-  2-  3- |

**Distance Multipliers**

Fishing rods and hockey sticks are simple machines that work as distance multipliers. When you make a cast, the end of the fishing rod \_\_\_\_\_\_\_\_\_\_\_\_\_\_ more than a meter as your wrist flicks and hardly moves at all. A distance multiplier moves a load through a large \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ but requires a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ effort distance. Third class levers are common distance multipliers. When distance is multiplied, it provides a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. During a good cast, the tip of the fishing rod moves far and fast. During a good smash, the head of a tennis racket also moves fast. Besides sports equipment, axes and mallets are common distance multipliers.

**Force Multipliers**

A force multiplier is a simple machine that easily moves a large load. A small force on the effort end of the lever puts a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on the load. Force is multiplied. What happens with the distance that the force and load move? Think back to the Find Out activity on page 137. When the effort end moves a great distance, the load moves a small distance. If the load distance is small, the lever is a force multiplier. \_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_ class levers tend to be force multipliers.

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| ***Terms and Definitions:***  Fulcrum:  Load:  effort load:  distance:  effort distance: | | first class lever:  second class lever:  third class lever:  distance multiplier:  force multiplier: |
| **WORK: Check Your Understanding 7.2**  **Page 139**  **All Questions**  **Full sentences, Complete Answers.** |

**7.3 Wheels, Pulleys, and Blocks**

Anyone who enjoys cycling, inline skating, or riding a ski lift will agree that the wheel is a most important human discovery. A pulley is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. When there is a rope threaded around the pulley, it is a simple machine. The \_\_\_\_\_\_\_\_\_\_ is attached to one end of the rope. Effort is applied at the other end. When the effort can just support the load, the system is in equilibrium.

**Fixed and Moveable Pulleys**

Single pulleys like the one in Figure 7.19 are used to change the direction of effort. This is what raises a flag or adjusts a curtain. The rope that you pull is threaded through a pulley \_\_\_\_\_\_\_\_\_\_ at the \_\_\_\_\_\_. In a fixed pulley, effort force is \_\_\_\_\_\_\_\_\_\_\_\_ to load force. You used this type of pulley in Part 1 of Investigation 7–B.

Moveable pulleys are like the ones you tied to the block of wood. Moveable pulleys move with a load. Review the results of Investigation 7–B. In Part 1, the block of wood was supported at one point. In Part 2, the block of wood was supported at two points — at the hook and at the pulley. \_\_\_\_\_\_\_\_\_\_ as many supports meant \_\_\_\_\_\_\_\_\_ the effort to lift the weight.

**Turning and Turning: The Wheel and Axle**

Every time you turn a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, you rotate a simple machine known as a wheel and axle. The doorknob, a large wheel, turns the axle. Have you ever tried to turn the shaft and open the door when the knob is missing? If you have, then you know the large doorknob is easier to turn than the small axle.

Would it take more or less effort to open the door if the knob were very small? A screwdriver operates on the wheel and axle principle. The handle of a screwdriver is large compared to the diameter of a screw. The fat handle acts like the wheel; the screw is the axle. As you rotate the \_\_\_\_\_\_\_\_\_\_\_\_\_, the screw moves a \_\_\_\_\_\_\_\_\_\_\_ distance. The circumference of the handle moves a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

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| ***Terms and Definitions:***  pulley:  fixed pulley: | moveable pulley:  wheel and axle: |

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| **WORK: Check Your Understanding 7.3**  **Page 144**  **All Questions**  **Full sentences, Complete Answers.** |

**7.4- Spinning Our Wheels: Energy and Efficiency**

When your car is stuck in a drift, usually it does not help to spin your tires. It \_\_\_\_\_\_\_\_\_\_\_ energy, and often gets you stuck even worse. Despite this fact, all machines spin their wheels to some extent. When you worked with the inclined plane, you found that it took \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to move the block up the plane than to lift the block to the same height.

Using the machine was easier but it took more work. This is true of all machines.

Remember that Work F • d.

When a load of 100 N is lifted 5.0 m, it requires 500 J of work. The 500 J of work must be done whether a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is used or \_\_\_\_\_\_\_ lift the mass yourself.

When a machine is used, the machine itself will \_\_\_\_\_\_\_\_\_\_ energy through:

• \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ between any two moving parts that touch each other, such as between a piston and the cylinder wall of an engine, or between a tire and the road;

• \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_that is given off by the cooling system or through the exhaust and is therefore not used to do the work; and

• \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (if it uses fuel) — when an engine is poorly tuned, some of the fuel is not burned but given off as smoke or carbon particles.

The amount of work input is always greater than the amount of useful work output.

**Efficiency**

You get compliments on your efficiency if you complete a task \_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_.

A machine’s efficiency is a comparison of the work the machine does with the \_\_\_\_\_\_\_\_\_\_\_ it uses to do that work. **No machine is 100 percent efficient**. The work output does not equal the work input. For example, when you push a car, all of the work you do does not help to move the car forward. Your feet may slide backward — that is work. Similarly, you pant and sweat, which are ways of using energy. When you use a burner to cook food, the food being cooked does \_\_\_\_\_\_\_\_ receive all of the energy put out by the burner. Some of the heat moves from the burner into the air by way of convection. Convection currents also move some of the heat from the pot to the air. Only a \_\_\_\_\_\_\_\_\_\_\_\_\_ of the heat supplied by the burner actually reaches the food.

**Efficiency Around the House**

Does anyone around your house complain when someone leaves the doors \_\_\_\_\_\_\_\_\_\_\_\_ in winter, the \_\_\_\_\_\_\_\_\_\_\_ on, or the stereo \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on high? The cost of energy has risen — and continues to rise. Efficiency is a way to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy and money. Conserving energy also helps the environment. The table below will begin to give you an idea about where you can start conserving.

Household appliances and machines vary in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Electric appliances are quite efficient; gasoline engines are not. Where could you replace inefficient non-electric engines with efficient electric ones? Also consider your use of light bulbs. Light bulbs are very inefficient because they waste a lot of energy making \_\_\_\_\_\_\_\_\_\_\_\_\_.

**The Bigger Problem**

One obvious benefit to using less energy is lower monthly \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Another reason to use less energy is that it benefits the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Most of the energy used in Canada comes from burning fossil fuels.

There are two environmental concerns related to the use of fossil fuels:

• burning \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ contributes to global climate change and air pollution, and

• fossil fuels are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

How can we deal with these problems? Fortunately, there are two ways.

1. \_\_\_\_\_\_\_\_\_\_\_\_ the amount of energy you use, either by using machines less or by changing to more efficient machinery.

2. Use energy from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The photos on these pages provide several ideas for conserving energy.

***BE SURE TO READ THE REST OF THE CHAPTER FOR IDEAS ON HOW TO ANSWER YOUR REVIEWS***

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| **WORK: Check Your Understanding 7.4**  **Page 149**  **All Questions**  **Full sentences, Complete Answers.** |

**MATCH THEM!!**

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| Side A | Side B |
| (a) a rod attached to  (b) when a force moves an  (c) a push or a pull on an object  (d) rope on a grooved wheel  (e) load moves farther than object  (f) the ability to do work  (g) small effort moves heavy load  (h) a wheelbarrow is one  (i) fulcrum is in the middle  (j) a comparison of work input to work output  (k) it has no moving parts  (l) pulley attached to load  (m)it has only one movement  (n) a hockey stick, for example | i. distance multiplier a wheel  ii. pulley  iii. energy  iv. wheel and axle  v. work  vi. force  vii. simple machine  viii. first class lever  ix. second class lever  x. moveable pulley  xi. third class lever  xii. force multiplier  xiii. efficiency  xiv. inclined plane |

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| **WORK: Chapter 7 Review**  **Page 150-151 (Questions 1-8)** |