

Unit 3 - Heat and Temperature Study Notes

Topic 1 - Using Energy for Heat

Thermal energy: (heat) is the total energy of all of the particles in a material or object.

Throughout the ages people have invented a variety of devices to help create and capture heat for use.

Topic 2 - Measuring Temperature

Thermometer: Mechanical or electrical devices for measuring temperature. Early Thermometers were invented by **Galileo**.

Scale: A series of equally measured sections that are marked and numbered for use in measurement.

Celcius Scale: temperature system most commonly used in Canada and many other parts of the world. Unit of temperature is called a degree.

Freezing Point: 0 degrees at sea level on the Celcius scale, the temperature at which water freezes.

Boiling Point: 100 degrees at sea level on the celcius scale, the temperature at which water boils.

Kelvin Scale: a scale used for measuring temperatures in scientific experiments. On the Kelvin scale, water freezes at 273 K and boils at 373K, the coldest possible temperature (also known as absolute zero) is 0 K. Most thermometers contain these components:

1. Sensor: a material which is affected by changes in some features of the environment, such as temperature.

2. Signal: information about temperature, such as an electrical current

3. Responder: a pointer, light, or other mechanism that uses the signal in some way.

Thermocouple: wires made of two different metals are twisted together so that a small electrical current is generated, the strength of the current depends on temperature. Used to measure high temperatures.

Bimetallic Strip: two different metals joined together firmly. When heated, one metal expands more than another does and the strip curls up. (commonly used in thermostats in homes).

Recording Thermometer: bimetallic strip connected to a writing device and paper which records temperature fluctuations over time.

Infrared Thermogram: records infrared radiation, (heat sensor) as different colors according to their temperature.

Topic 3 - The Particle Model. Temperature, and Thermal Energy

The Particle Model:

- All substances are made of tiny particles too small to be seen
- Particles are always in motion
- Particles have spaces between them
- The motion of particles increases as temperature increases and decreases as temperature decreases.

*Temperature indicates the average speed of particle motion in a substance.

Energy: is a measure of something's ability to do work.

Two Principles apply whenever change occurs:

1. Changes happen when there is a difference in energy
2. Energy is always transferred from a high-energy source to something with a low energy source.

Law of Conservation of Energy (important)

Energy cannot be created or destroyed, only transformed from one type to another or passed from one object to another.

Know the three steps for calibrating a thermometer (look it up on page 195 of the text).

Topic 4 - Expansion and Contraction

Contract: decrease in volume

Expand: Increase in volume

Temperature changes cause things to expand and contract

Heated - usually causes expansion

Cooled - usually causes contraction

Usually more drastic changes in gases, then liquids, then solids.

Topic 5 - The Particle Model and Changes of State

Heat Capacity: amount of thermal energy that warms or cools the object by one degree Celsius

Specific Heat Capacity: amount of thermal energy that warms or cools one gram of a material by one degree Celsius.

♦See Table 2 pg. 218 Changes of State

-Sublimation

-Solids

-Gas

-vaporization

-Melting (also called fusion)

-Freezing (also called solidification)

-Condensation

-Liquid

Melt: turn from a solid to a liquid

Freeze: turn from a liquid to a solid

Evaporate: turn from a liquid to a gas

Condense: Turn from a gas to a liquid

Sublimation: turn from a solid to a gas or a gas to a solid.

Evaporative cooling: a process in which the faster-moving particles on the surface of a liquid evaporate and escape into the air, the slower ones are left behind creating a lower average kinetic energy (cooling it).

Particles are less organized as the energy increases. This means the warmer the substance, the more disorganized the particles.

Phase Changing

During a change from solid to liquid or liquid to gas the average temperature does not change even though heat is being added, the name for the heat that is added is Latent heat

Topic 6 - Transferring Energy

There are three Main ways to transfer energy

- Radiation
- Conduction
- Convection

Energy Source: an object or material that can transfer its energy to other objects.

Radiation: the transfer of energy without any movement of matter.

Radiant energy: (also known as electromagnetic radiation or EMR for short) Energy that is transferred by radiation.

All of the forms of Radiant energy share several characteristics:

- They behave like waves
- They can be absorbed and reflected by objects
- They travel across empty space at the same very high speed 300000 km/s

Conducting Energy Through Solids

Thermal Conduction: the process of transferring thermal energy through direct collisions between particles.

Heat Insulators: are very poor conductors

Fluid: Materials that can be poured or that flow from place to place.

Convection: A warm fluid, moves from place to place, carrying thermal energy with it.

Convection Current: a moving fluid.

* Know Energy Transfer Diagram (Figure 3.26 on pg. 232)

Topic 7 - Sources of Thermal Energy

Energy appears in many forms.

Potential energy: Stored energy

Two examples of this type are:

- gravity (a rock sitting on a counter)
- elastic (pulled back and ready to be shot).
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Kinetic energy: Energy of motion (the energy present in a moving object)

Chemical energy: is the kind used by our body (complex sugars are broken down to provide your muscles with energy). It can also be found in batteries (which also have potential energy).

Different forms of energy can be converted into another form.

e.g. a candle can convert chemical energy into heat and light (candles are energy converters)

Energy Converters: Devices that convert or change energy from one form to another.

Mechanical Forces- is a source of thermal energy caused by friction (car engine)

Geothermal Energy: energy that can we harness from the Earth's interior. Electrical

Converters- Generate electrical Energy

Dams: Gravitational potential energy of water held in reservoirs converted into electrical energy

Coal: Chemical energy is turned into thermal, which converts into electrical energy

Solar Energy - 2 types:

1. Passive Solar: using materials and in the structure to absorb, store and release solar energy.

2. Active Solar: Convert light energy absorbed by solar collectors into electrical (much like plants do)

Wind Energy: the energy of moving air which can be harnessed through the use of windmills

Fossil Fuels: chemicals made from plants and animals that died and decomposed millions of years ago and have preserved deep underground.

Problems with Fossil Fuels:

-Pollution

-Non-renewable

Global Warming: when fossil fuels are burned and released into the air, the CO concentrations increase, which trap heat.

Thermal Pollution: accidentally warming up the environment.

Cogeneration: using waste heat to heat needed areas, generate electricity and do other useful tasks.

Topic 8 - Conserving Our Fossil Fuel Resources

There are many things that we can do to conserve energy

-Insulate homes and water lines

-Reduce the amount of energy we use (take shorter showers etc.)

-Install a programmable thermostat

-Carpool

-Many other things

♦See Figure 3.43 on page 252 to learn how a refrigerator works.