

## REVIEW ... Key Concepts

# Unit 3 – Heat and Temperature

### 1.0 Technologies for Obtaining and Controlling Heat

- ❖ Heat technologies have evolved over time
- ❖ Culture and technology are linked
- ❖ Evolution has integrated heat-related materials and technologies
- ❖ Choices about the environment involves individuals and society

### 2.0 Heat Affects Matter

- ❖ Transferring heat to and from matter can cause a change in state
- ❖ The **Particle Model of Matter** explains changes in state and volume
- ❖ **Temperature** is the measure of the average kinetic energy of the particles in a substance
- ❖ **Thermal energy** is the total kinetic energy of the particles in a substance – heat is transferred from an area of high kinetic energy to an area of low kinetic energy
- ❖ **Conduction** (in contact), **Convection** (circular motion) and **Radiation** (waves)

### 3.0 Natural Phenomena and Technology Devices

- ❖ Thermal energy is produced by the Sun, decay, fire and geothermal
- ❖ **Passive** and **Active** solar heating systems use the sun's energy and are environmentally friendly
- ❖ **Thermostats** control temperature in heating systems
- ❖ Insulation helps block unwanted heat transfer (heat loss)

### 4.0 Benefits and Costs of Heat Technologies

- ❖ Non-renewable resources have a limited supply
- ❖ Fossil fuels are the major sources of heating, but degrade the environment
- ❖ Costs of using natural resources: **economic, environmental and societal**
- ❖ Energy Alternatives: **solar, wind, geothermal, nuclear and hydro-electric (gravitational)**

## 1.0 Technologies for Obtaining and Controlling Heat

### ❖ Heat technologies have evolved over time

Before 1600, people believed heat was a combination of fire and air. They thought it was an invisible fluid. What was the fluid called and explain the 'Theory' it was based on?

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Explain the **Particle Theory of Heat**

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### ❖ Culture and technology are linked

How is culture and **heat technology** linked?

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Describe the difference between the units associated with heat. **joule, watt, kilowatt, gigajoule**

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What is the difference between 'needs' and 'wants'?

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❖ Evolution has integrated heat-related materials and technologies

What activities are directly related to **heat related technologies**?  
(eg. staying comfortable in our homes)

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Complete the **Heating Technology Timeline**



❖ Choices about the environment involves individuals and society

What does it mean when we are asked to make **sustainable** choices?

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**2.0 Heat Affects Matter**

❖ Transferring heat to and from matter can cause a change in state

Describe the changes that take place with the transfer of heat to and from water.

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❖ The **Particle Model of Matter** explains changes in state and volume

List the four main principles in the **Particle Model of Matter**

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**Kinetic energy** is the energy of movement. Describe the particles in each state of matter.

**Solid** \_\_\_\_\_

**Liquid** \_\_\_\_\_

**Gas** \_\_\_\_\_

Complete the following Chart that helps to show the relationship between **heat, the particle model and changes of state.**

	Solid	Liquid	Gas
Space between particles			
Volume			
Shape			
Adding heat			
Removing heat			

❖ **Temperature** is the measure of the average kinetic energy of the particles in a substance

❖ **Thermal energy** is the total kinetic energy of the particles in a substance – heat is transferred from an area of high kinetic energy to an area of low kinetic energy

Explain the difference between **thermal energy, heat** and **temperature** in terms of kinetic energy.

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How is temperature measured?

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Complete the **Timeline**, by adding in the dates that are missing ...

### **History Of Thermometers**

<u>Date</u>	<u>Event</u>
200 B.C. →	The first thermometers were called <i>thermoscopes</i> .
_____	<i>Santorio Santorio</i> was the first inventor to put a numerical scale on the instrument.
_____	<i>Galileo Galilei</i> invented a rudimentary water thermometer, which, for the first time, allowed temperature variations to be measured.
1701 →	<i>Ole Romer</i> created one of the first practical thermometers, using red wine as the temperature indicator.
_____	<i>Daniel Gabriel Fahrenheit</i> was the German physicist who invented the alcohol thermometer.
_____	<i>Fahrenheit</i> invented the first mercury thermometer.
_____	<i>Fahrenheit</i> introduced the temperature scale that bears his name - Fahrenheit Scale.
_____	The 1 <sup>st</sup> precise scale was developed by <i>Anders Celsius</i> .
1848 →	<i>Lord Kelvin</i> invented the Kelvin Scale.
_____	The <i>electrical-resistance-thermometer</i> was invented in Germany.
_____	<i>Sir Thomas Allbutt</i> invented the first medical thermometer used for taking the temperature of a person.
_____	<i>Theodore Hannes Benzinger</i> invented the ear thermometer.
_____	<i>David Phillips</i> invented the infra-red ear thermometer.
1990s →	<i>Dr. Jacob Fraden</i> , invented, the Thermoscan® Human Ear Thermometer.

### ❖ **Conduction** (in contact), **Convection** (circular motion) and **Radiation** (waves)

What happens to the volume of different materials when heat is added? (Give two examples)

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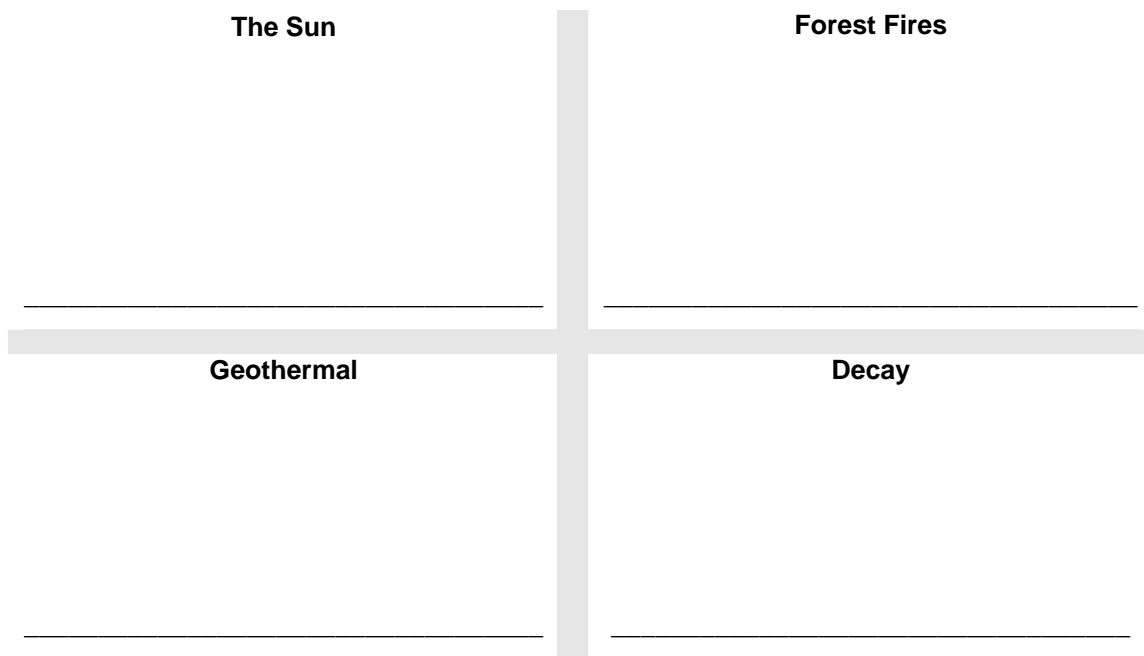
Complete the Chart for each type of **Heat Transfer**

	Conduction	Convection	Radiation
<i>States of matter</i>	solid	liquid, gas	
<i>Volume change (heat added)</i>			increases
<i>Volume change (heat removed)</i>	decreases		
<i>Particle motion</i>			waves
<i>Conduction / Insulation</i>		Heat transferred by convection current – needs space	
<i>Reflect</i>			shiny
<i>Absorb</i>	In contact		

### 3.0 Natural Phenomena and Technology Devices

❖ Thermal energy is produced naturally

Illustrate and describe 4 **natural sources of Thermal Energy** that are available to us.



❖ **Passive and Active** solar heating systems use the sun's energy and are environmentally friendly

Explain the component parts of the different applications of Solar Energy - used for heating and generating electricity.

	Passive	Active
<b>Techniques and Technologies</b>	<hr/> <hr/> <hr/>	<hr/> <hr/> <hr/>
<b>Advantages / Disadvantages</b>  <b>or</b>  <b>Costs / Benefits</b>	<hr/> <hr/> <hr/>	<hr/> <hr/> <hr/>

Describe what a **solar array** is and where it could be used \_\_\_\_\_

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❖ **Thermostats** control temperature in heating systems

Illustrate the component parts of a **thermostat** and explain how it works

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Describe how a **bimetallic strip** can be used as a switch.

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Describe each of the two types of heating systems: **Local Heating** and **Central heating**

**Local Heating System** \_\_\_\_\_

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**Central Heating System** \_\_\_\_\_

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Compare and contrast the differences and similarities between the two types of central heating systems.

Forced-Air	Hot-Water
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The basic parts of a cooling system are: \_\_\_\_\_

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❖ **Insulation** helps block unwanted heat transfer (heat loss)

The **thermal conductivity** of a material reflects \_\_\_\_\_

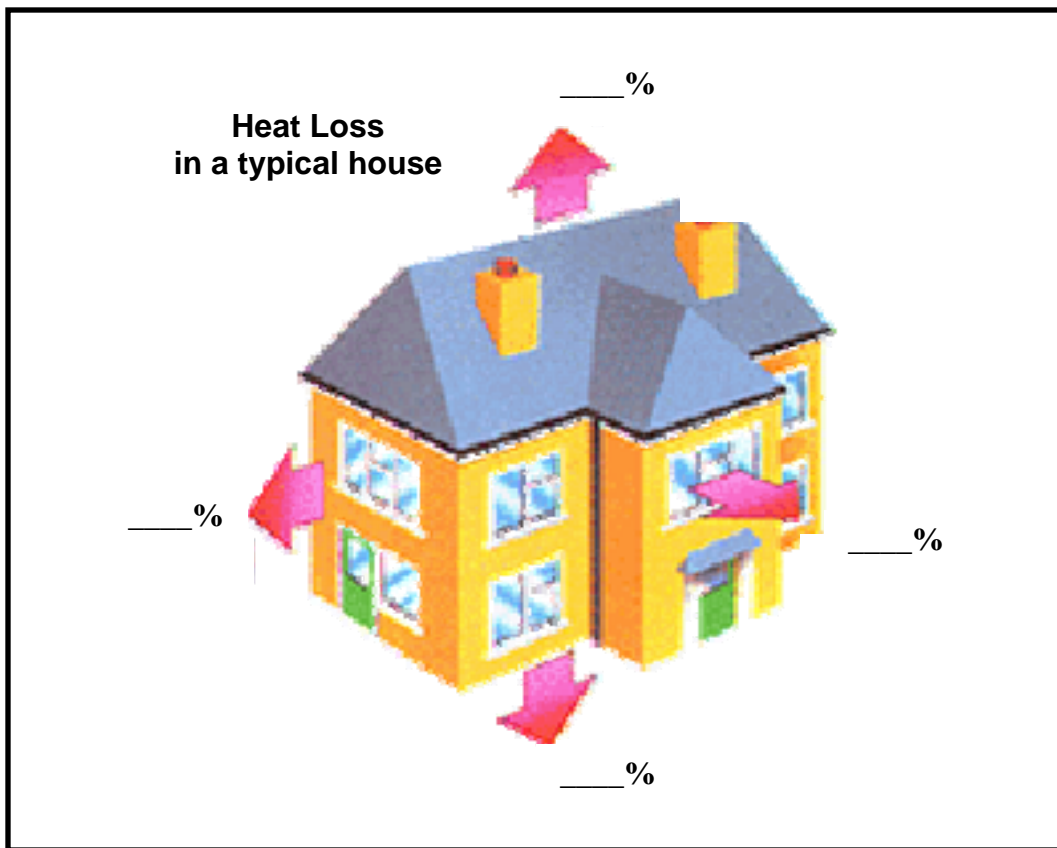
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**R-Value** indicates insulating value of a particular type of material. Explain what it means.

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Identify the **% of heat loss** in a typical house.



Describe some types of **insulation material** that are used in Alberta

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#### 4.0 Benefits and Costs of Heat Technologies

- ❖ **Non-renewable resources** have a limited supply

What is the difference between **renewable** and **non-renewable** energy sources?

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- ❖ Fossil fuels are the major sources of heating, but degrade the environment

- ❖ Costs of using natural resources: **economic, environmental and societal**

Explain the '**COSTS**' of using fossil fuels.

**Economic Costs** \_\_\_\_\_

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**Environmental Costs** \_\_\_\_\_

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**Societal Costs** \_\_\_\_\_

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- ❖ **Energy Alternatives:**

Describe the **costs and benefits** of these **alternative thermal energy technologies**.

**Solar** \_\_\_\_\_

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**Wind** \_\_\_\_\_

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**Geothermal** \_\_\_\_\_

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**Nuclear** \_\_\_\_\_

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**Hydro-electric (gravitational)** \_\_\_\_\_

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What does this symbol represent?

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Describe ways in which energy can be used wisely in the following places:

**Home**

**Transportation**

**Industry**

_____	_____	_____
_____	_____	_____
_____	_____	_____