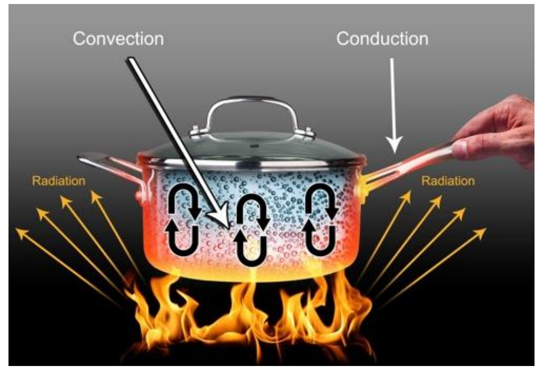
UNIT 2 HEAT Chapter 6 NOTES

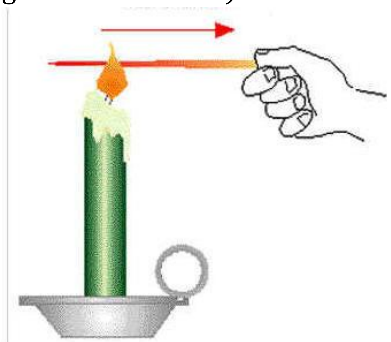


<u>Three methods of heat transfer:</u>

1. conduction
2. convection
3. radiation

<u>Conduction</u>

- the transfer of thermal energy that occurs when warmer particles come in contact with cooler particles and **<u>transfer energy to the cooler particles</u>**
- <u>DIRECT CONTACT</u> is necessary (things have to TOUCH)



- **<u>Examples of conduction</u>**
  - **- cookware on the stove**
  - **- ice pack on an arm**
  - **- welding metal**

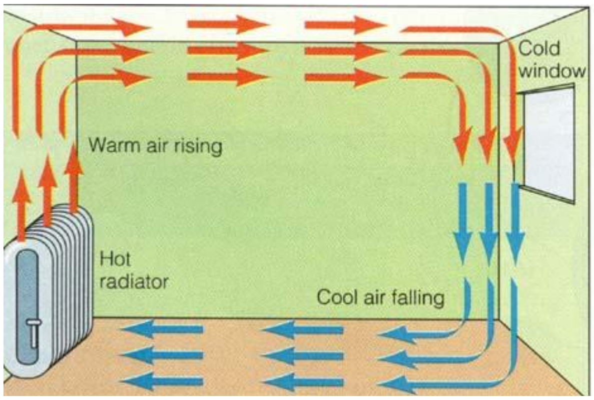
- Conduction can occur in **<u>all three states of matter</u>**

  In SOLIDS – GREAT CONDUCTION
  In LIQUIDS – good conduction
  In GASES - least amount of efficiency of transfer of energy

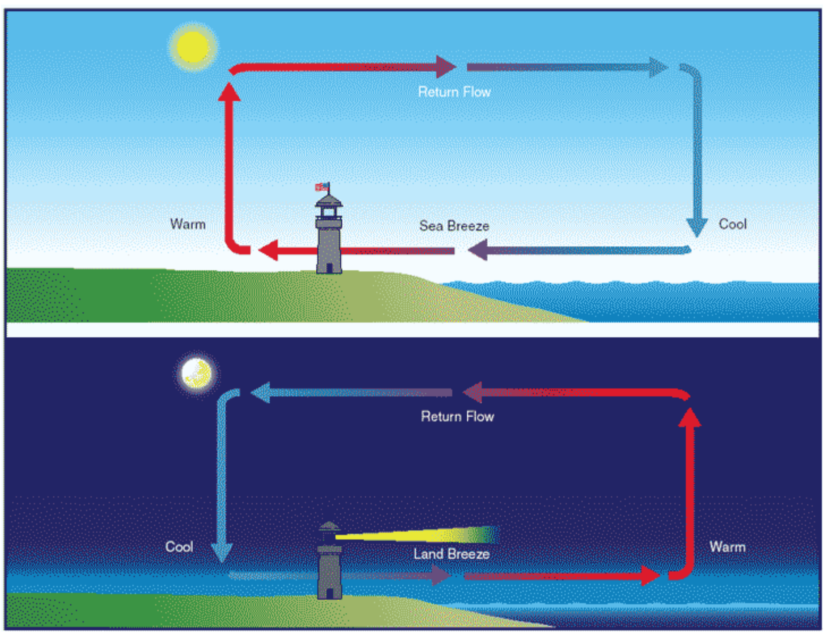
Convection

- the process in which a **warm gas or liquid** moves from one place to another, **carrying heat with it**
- **Remember:** **Hot air – rises** **Cold air –sinks**

CONVECTION in AIR (ROOM)



Convection in AIR (breezes)

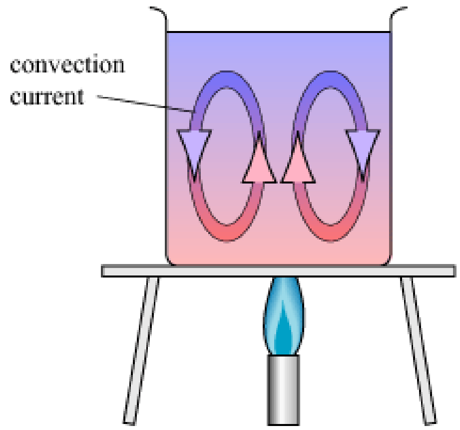


REMEMBER: Hot liquid particles – rises Cold liquid particles –sinks

CONVECTION in a LIQUID

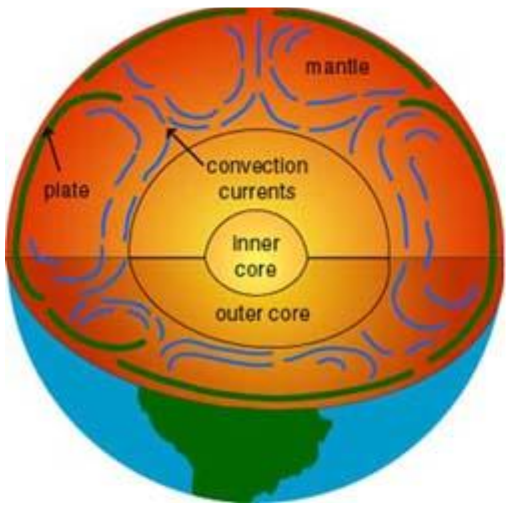
Colder particles- SINK

Warmer particles - RISE



- <u>Examples of convection</u>

  - air current from hot air furnaces
  - heating a liquid such as soup
  - magma in the mantle



radiation

- the transfer of energy in a electromagnetic wave-like form
- Radiant energy is

  heat energy that is transmitted by electromagnetic waves
  that DO NOT need matter in order to travel.
- Unlike conduction and convection, radiant energy CAN travel through a vacuum (no particles)
- Examples of radiation

  - fireplace
  - sunlight (visible light)
  - cell phones (hazardous)
  - X-rays
  - microwaves
- NOTE:
  Dull and/or dark surfaces absorb radiant heat energy better than shiny and/or light surfaces.

2.27 Provide examples of heat technologies used past and present to heat homes in Newfoundland and Labrador. Include:

(i) wood stove

- Many years ago, homes in Newfoundland and Labrador were often heated with a **wood stove**.
- Stoves were often **black** which made them **efficient radiators of heat.**
- The **room** in which **the stove was located** could be very warm on even the coldest days.

(ii) **electric heat**

- Electric heating is any process in which electrical energy is converted to heat.
- An **electric heater** is an electrical **appliance that converts electrical energy into heat.**

  The **heating element** inside every electric heater is simply an **electrical resistor** that converts electrical energy into heat energy.

(iii) **wood/oil furnace**

- During the first half of the 1900s, people began to install **furnaces in basements with ducts running to all of the rooms**.
- **Coal** was burned in most of the early furnaces.
- In the mid 1900s, many **furnaces were converted to oil or gas**.
- **Air was drawn into the furnace and heated** and **fans would blow the warm air through the ducts and into the rooms.** This system is sometimes called **forced air heating**.
- **Wood furnaces** work in the same fashion. Forced air is still used in many homes.

(iv) **air to air heat pump**

- **Reason for the need**
  1. the cost of fuel increases
  2. pollution from the burning of fossil fuel threatens the environment
- Works very much **like a refrigerator**. A fluid is contained inside a system of pipes as **shown in Figure 6.13 pg 186.**
    - In the SUMMER, the fluid absorbs heat from the inside of the house and pumps it to the outdoors.
    - In the WINTER, the heat pump is reversed. The fluid absorbs heat from the outside air and pumps it into the house.

WHY THIS WORKS? How can a fluid remove heat from cold air?

- The fluid and the system of pipes have some **very special characteristics**.
- When a **fluid is allowed to expand rapidly and evaporate from a liquid to a gas**, it absorbs heat from the surroundings.
- To **remove the heat**, the gas is compressed and converted back into a liquid. This process causes the **heat to be released**.

(v) **hot water radiation**

- In some houses, water was used to transfer water from the furnace to the rooms.
- A system of pipes carried water into the furnace where it was heated. Pipes passed through all of the rooms where the heat was transferred to the room air. Hot water heating is still used in many homes.

(vi) **geothermal**

- A **geothermal heat pump** is similar to an air-to-air heat pump.
- Instead of exchanging heat with the outside air, **it exchanges heat with the ground**.

  Although it is much more expensive to install, **it is more efficient**.
- Just a **few metres below the surface of the ground**, the temperature stays the same throughout the year.

  In SUMMER: The **temperature underground** is **COOLER** than **the air**

  In WINTER: The **temperature underground** is **WARMER** than **the air**
- As shown in **Figure 6.14 pg 187**, a series of pipes are buried in the ground near a house or other building.
  - In the **SUMMER**, **heat is pumped from the house to the ground**.
  - In the **WINTER**, **heat is pumped from the ground to the house**.

- Geothermal heat pumps have been installed in more than 30 000 buildings in Canada. **See Figure 6.15 pg. 187)** The **new Forest Centre building at Sir Wilfred Grenfell College in Corner Brook** is the **first building in Canada**, other than a residential house, **to use geothermal heat pump for heating and cooling.**

(vii) **solar**

Using LIGHT ENERGY (from the SUN) and converting it to electrical energy we can use

Solar Heating

- A process whereby heat from the sun is **absorbed by collectors** and **transferred by pumps or fans to a storage unit** and used to heat a building's interior directly.

Two groups of SOLAR HEATING:

1. **Active solar heating**

   uses pumps which move **air or a liquid from the solar collector**

   into the building or **storage area.**

2. **Passive solar heating**

   does not require electrical or mechanical equipment

   may rely on the **design and structure of the house**

   to collect, store and distribute heat throughout the building

   passive solar building design

A man in Colliers, Newfoundland and Labrador invented and manufactures the solar panels that are shown in the photograph. A fan draws cool air from an inside room and sends it into the 15 cylindrical columns. The curved plastic covering focuses the Sun's rays on the dark-coloured columns.
As the air passes through the columns, it is warmed by the solar radiation.Warm filtered air is then directed back into the room.

2.28 Identify different approaches taken to solve the problem of heating homes during cold times of the year
2.29 Make informed decision about the various technologies used to hear our homes, taking into account potential advantages and disadvantages
2.30 Provide examples of how the technologies used to heat homes have improved over time
2.31 Provide examples of how our understanding of evaporation and condensations of liquids resulted in the develoment of heat pumps

The STSE component, "Heat Pumps: An Alternative Way to Heat Homes" covers the outcomes above.

2.32 Describe how various surfaces absorb radiant heat.

2.33 Design and conduct an experiment to test identified questions, state a hypothesis, identify and control major variables.
2.34 Use experimental apparatus and tools safely.
2.35 Organize and display data using tables and graphs.
2.36 State a conclusion, based on experimental data, and explain how evidence gathered supports or refutes an initial idea.

The Laboratory outcomes above are addressed by completing CORE LAB 6-1d "Absorb That Energy".

2.37 Distinguish between thermal conductors and insulators.

Thermal conductors

- materials that are good conductors of heat
  they allow electrons to move freely through it and have weak bonds between particles
- GOOD conductors: METALS(aluminum, copper, gold, iron, silver, nickel)

thermal insulators

- Materials which DO NOT allow electrons to move freely
- materials that are **very poor conductors of heat**.
- EXAMPLES: **air, paper, rubber, silk, wool, thermos bottles, styrofoam, fibreglass insulation** in houses

QUESTIONS…

1. Why do birds fluff their feathers in the winter? Traps air/ insulator

2. Why are igloos used in the arctic? Holds in heat/insulator

3. Why is rubber used in the bottom of winter boots? Air trapped between hairs /INSULATOR

4. Why is wool used in socks for the winter? It's an INSULATOR of heat (holds heat in so its warmer)

5. Why do contractors use styrofoam insulation outside a house's concrete basement? holds in heat/insulator
Houses LAST so do Styrofoam(environment)

6. Why are animal furs used as fur coats and bedding in colder temperatures? warmth/insulator

7. Why was grass SOD used in the past to stuff between logs in a cabin and used as bedding or roofing materials?

traps heat/insulator

8. What do a thermos do? Keeps things warm or cold

9. Why do tiles on the floor feel COLDER to your feet than carpet? Carpet better insulator

2.38 Provide examples of insulating technologies used today and in the past. Include:

(i) animal fur - fur coats worn for warmth or bedding

(ii) sod - laid down for bedding, roofing, or for stuffing between logs in a log cabin

(iii) fiberglass - used in household insulation

(iv) thermos - keeping drinks and foods warm or cool. (Coffee)

2.39 Compare, in qualitative terms, the specific heat capacities of some common materials. Include:

(i) water - 4.18 J/g .°C

(ii) ice - 2.093 J/g .°C

(iii) aluminum - .900 J/g .°C

(iv) concrete - low

(v) steel - .500 J/g .°C

This means that in order to warm an equal mass of water and aluminum (1g), water will require more energy (4.18 J - .900 J = 3.300J) to raise its temperature by the same amount (1_oC).
Higher heat capacity substances will take more energy to raise the temperature.

2.40 Distinguish between heat and temperature.

Heat

- a **form of energy** that flows between two samples **of matter** because of their differences in temperature.

temperature

- a relative measure of how hot or cold something is; the **average kinetic energy of the particles in a substance**

2.41 Define specific heat capacity.

specific heat capacity

- the amount of energy required to raise the temperature of **1.00 g of a substance 1.00°C**

2.42 Describe how our needs related to heat can lead to developments in science and technology

Canadian Winters - survival and survival kits (blanket), first aid treatments (heat/cold technologies) to deal with injuries such as sprains, shock and hypothermia. (ie. Cold packs, heat packs, foil blankets), clothing past and present, home insulation past and present.

2.43 Identify examples of science- and technology-based careers that are associated with heat and temperature.

Examples could include health care workers, furnace service technicians, light bulb manufacturers, and blacksmiths.

Personal Notes: