5.1: The Nature of Heat (pg 82-85)
Reminder: The Particle Theory of Matter

- Everything is made up of smaller particles.
- All particles are in motion.
- More motion = more energy = \( \uparrow \text{temp} \).

Robert Brown:
In the 1800's, he was looking at pollen grains in a drop of water with a microscope. He noticed that even though the microscope was still, the pollen was "Jiggling". When he increased the temperature, the pollen "jiggled" more.

This Jiggling Motion became known as Brownian Motion.
5.2: Heat and Temperature (pg 86)

The relation between heat (Thermal Energy) and motion.
The more heat, the more motion
The more motion, the more heat
The less heat, the less motion
The less motion, the less heat

Energy and Movement:
Kinetic energy is the energy associated with motion
Kinetic Energy is the measure of amount of momentum particles have.
Chapter 5: Heat and Heat Transfer

**Heat Vs. Temperature**

Temp. is the average of all kinetic energies of all of the particles in an object.

Heat is the sum of all of the kinetic energies of all of the particles in an object.

*Both have same Temp.*

5.3: Transfer of Heat (pg 87-91)

Transfer of heat.

Heat flows from hot to cold, until both objects are the same temp.

Moreheat
Forms of heat transfer:

1) Conduction: (Heat transfer by **contact**)

Molecules of the hot stove vibrate **quickly**. The molecules of the colder pan vibrate **slowly**. When they come into contact, the fast molecules **collide** with the slower ones. This **speeds up** the particles in the pan. The increased **motion** causes an increase in **heat**.

2) Convection: (transfer of heat by **currents**)

Heat is transferred to the air molecules by **conduction**. These air molecules gain **energy**, and vibrate faster and become farther apart. Because the particles are farther apart, this warm air **rises**. Cooler air rushes in to take the place of the warm air. This cycle of air flow continues until all of the air is the same temperature.
3) Radiation (Heat Transfer by waves)

Infrared waves travel from the heat source. When these waves collide with something, they cause the particles to vibrate faster. Therefore increasing heat.

No Air or contact needed.
Questions:

1) Explain the difference between heat and temperature.

2) You place a frying pan on a burner to fry an egg. As the pan gets hotter, describe the kinetic energy of the particles in the pan.

3) The three methods of heat transfer are conduction, convection, and radiation.
   a) which method can only occur in liquids or gasses?
   b) Which method can only occur if there is contact between two surfaces?
   c) Which method can occur in a vacuum or in outer space?

4) A hot object is in contact with a cold object. Explain the flow of thermal energy.
5) As you stand in front of a bonfire, the flames warm you. Use what you know to explain the following:

a) Why the part of your body facing the fire is warmer than the part facing away.

b) why the flames and the smoke rise.
Convection and weather:

Lakes:

In the evening, the air over the water cools more slowly than the air over the land, making this air less dense. This warm air rises and moves towards land, keeping it warmer. This is the same type of motion you saw in the previous demo.

In the daytime the opposite occurs.

Sea Breezes:
A: Sun's rays warm land quicker than they warm water.
B: Warm air is less dense and the warm air rises
C: Air over water is more dense, and sinks
D: Cool air flows towards land to replace the warm air that has risen.
These sea breezes occur close to bodies of water, and are a cool breeze blowing from sea to land.

These occur more on a hot day.

**Land Breezes:**

A: In the evening, the sea loses heat more slowly than the land. The air over the water is less dense.

B: Warmer air over the water rises.

C: The air over the land cools quicker, so it is more dense and it sinks.

D: Cooler air from the land flows towards the water to replace the hot air that has risen.
These land breezes are cooler winds that flow from land to the sea. These are not as strong as land breezes because the difference in temperature isn't as great. These breezes usually occur in the evening.

How oceans help moderate climates:

Because water takes longer to cool than air, they can store large amounts of thermal energy (heat).

Oceans help moderate climate of areas over land. This means they prevent the area from getting too hot or too cold.

In cool weather, the ocean can release heat, without changing too much.

In warm weather, the heat from above the ocean flows into the ocean.

- In warm weather, the ocean can absorb heat.
Questions:

1) On a hot day, which place would be cooler? Explain why.
- A beach beside a large lake
- 20km away from the lake

2) List the differences between a land breeze and a sea breeze.

5.5: Heat transfer and technologies (pg 98-101)

Cooking:

Soup:
- Conduction heats the bottom first.
- The heated soup rises because it is less dense.
- Colder soup at the top sinks because it is more dense. These convection currents make the soup an even temperature.

Baking:
- When an oven is turned on, convection currents move heat in the oven.
- The hot air also heats the sides. These radiate heat in all directions.
- There is also conduction in the pan.
Getting Rid of Heat: Vehicle Engine Cooling
Watch the following Video on how a car cooling system works. Take notes as needed.

https://goo.gl/sRXw8x

Getting Rid of Heat: Summary
Combustion inside an engine produces a lot of heat. If the heat is not removed, the engine will be damaged.

- The cooling system contains a liquid coolant. Heat is transferred from the engine to the coolant.

- The coolant is pumped through the engine block, to the radiator. This is like a metal honeycomb. The metal alloy it is made of is a good conductor and transfers the heat from the coolant to the metal, then to the air.

- Either a fan or the motion of the car forces air through the radiator.
Keeping it Cool:

When you put a little water on your hand, it feels cool. This is because heat from your hand is transferred to the water through Conduction. The water then evaporates and takes the heat with it.

This kind of cooling is called cooling by evaporation.
Refrigerators:
Watch the following video and take notes as needed:

https://goo.gl/gy7E4L
Chapter 5: Heat and Heat Transfer

Review Questions:

1) List the heat transfers involved in boiling a pot of water. Describe each transfer.

2) Explain how the three kinds of heat transfer are used when baking bread.

3) Describe in your own words how to cool a gasoline engine.