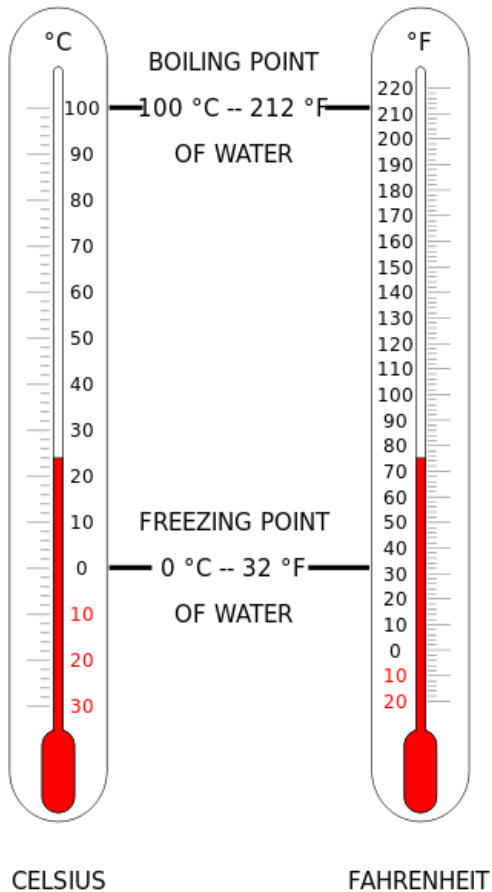# *What Is Heat?*

What Will Happen?

If you leave a hot drink on the table and wait for a while, *does the drink heat up or cool off?*
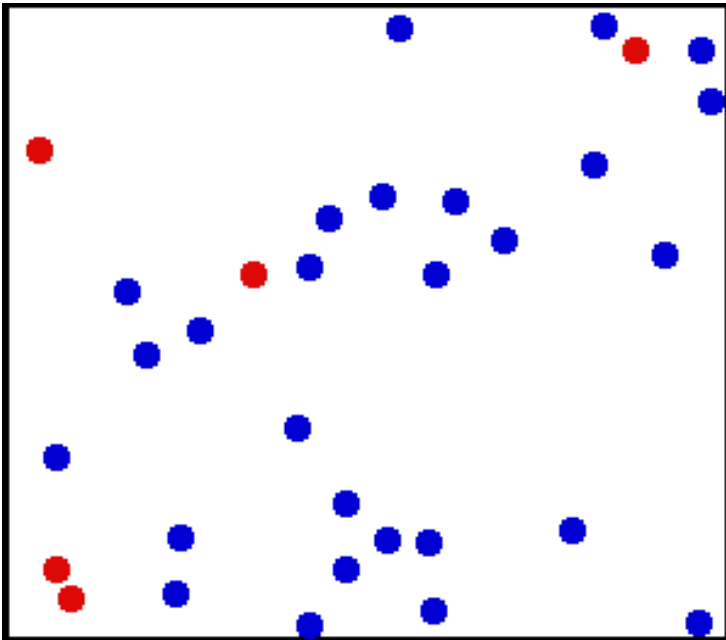
If you leave a cold drink on the same table and wait for a while, *does the drink heat up or cool off?*
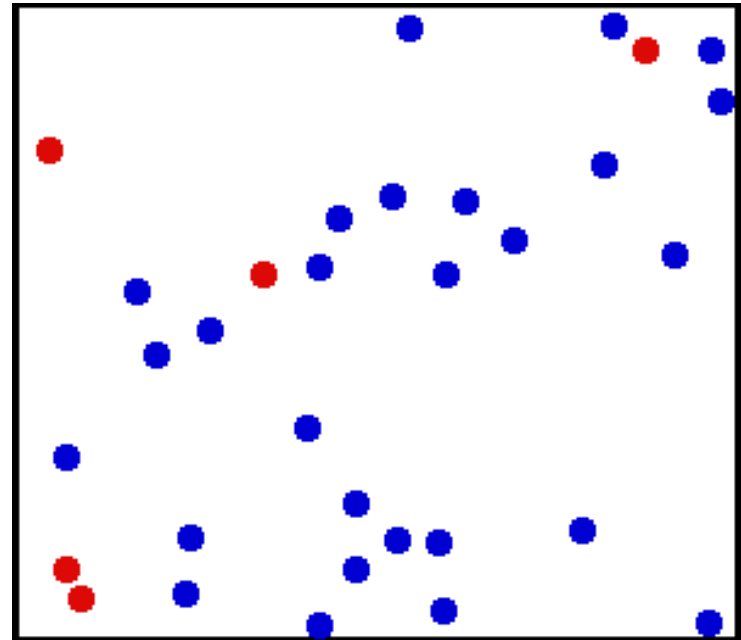
Thermal Energy

The atoms inside of everything are always jiggling and bouncing around. They have kinetic energy.

A thermometer can measure this kinetic energy and tell us the temperature of something.

The more jiggling, the higher the temperature.

cold water   hot water
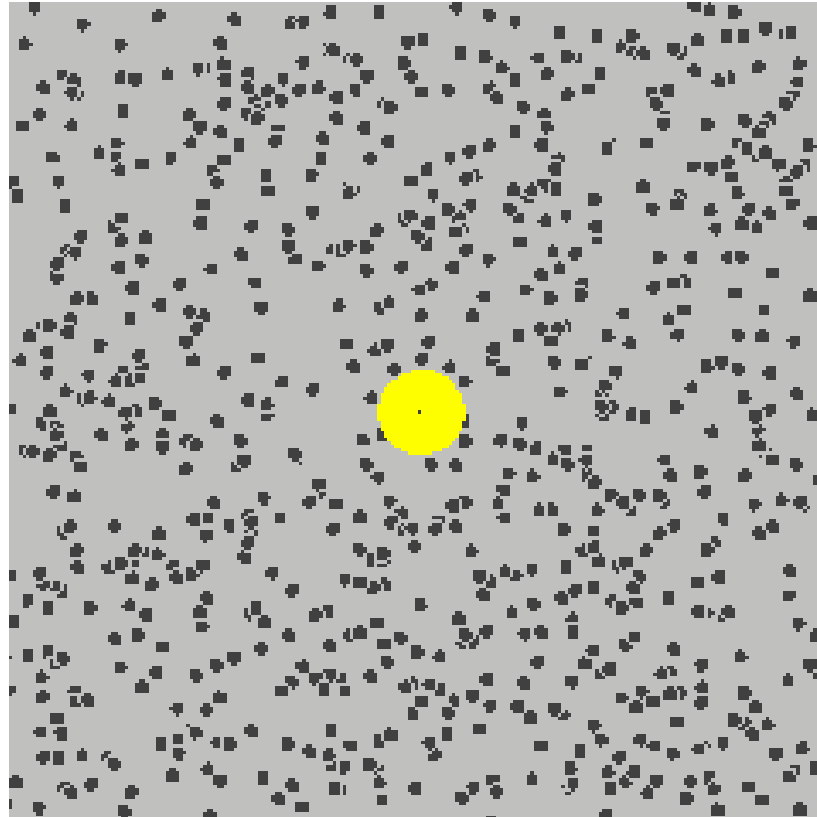
Let's watch thermal energy

cold water

hot water

food coloring

Remember, the molecules in the hot water are jiggling around more than the cold water.

What Happened?

The faster jiggling hot water molecules bounced around the dye molecules much more quickly.

Thermal Energy

Everything in this room has thermal energy because it has mass and its temperature is above ABSOLUTE ZERO.

Absolute zero is the lowest temperature anything can ever be. It is -273 °C.

The coldest outside temperature recorded on Earth was -90 °C in Antarctica.

This molten iron has a great amount of thermal energy. ➔

How would you know this?

Heat

Energy flows "downhill."

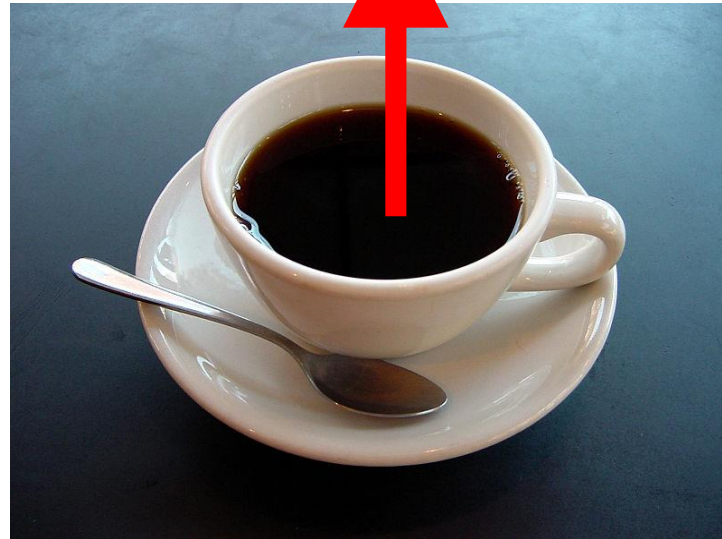**When you ski, you go down, not up.**

Thermal energy does the same thing. It flows down a "temperature hill."

Flowing thermal energy is called <u>HEAT</u>.

Heat ALWAYS flows from hot to cold.
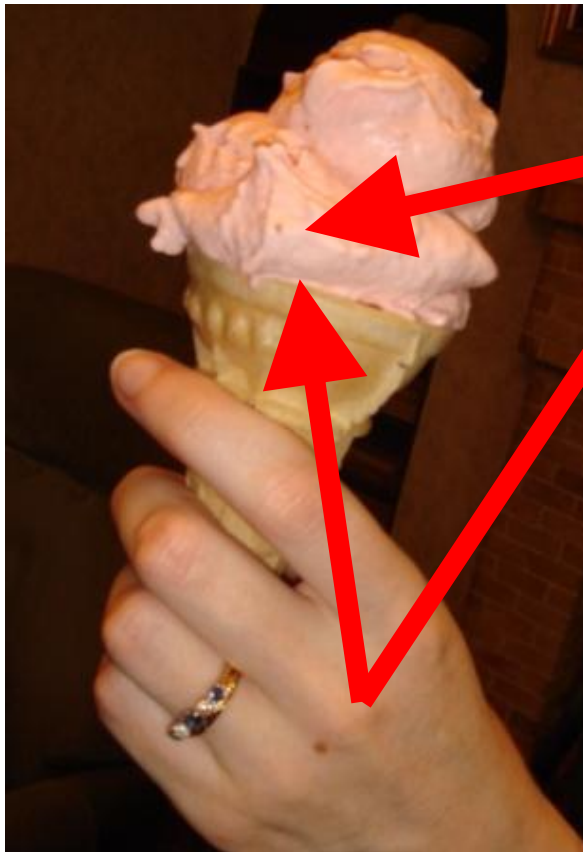
Heat Example

COLD room air
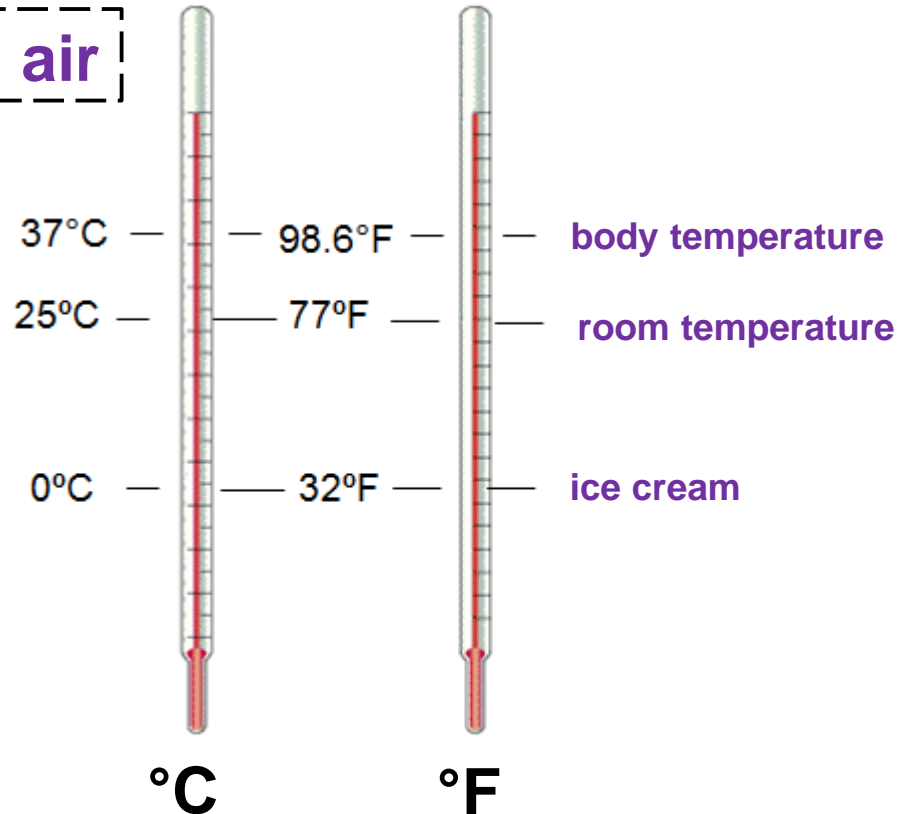
HOT coffee

Heat *always* flows from hot to cold!

Heat Example

You are holding an ice cream cone in room temperature air.

How does heat flow between the ice cream, hand and air?

room air

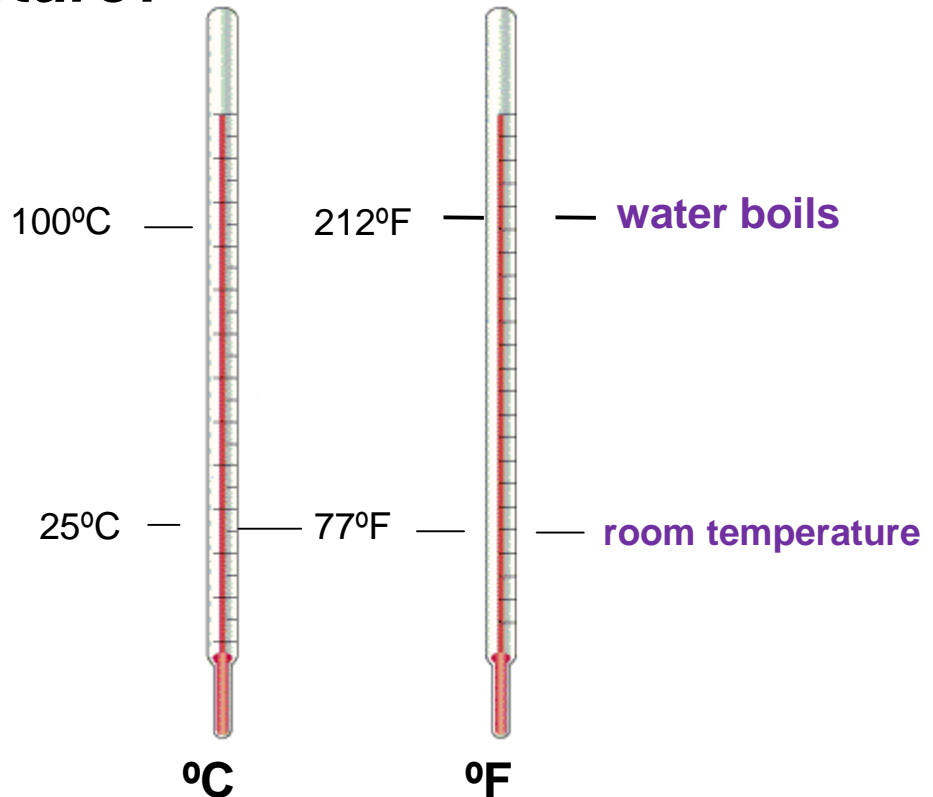|		
37°C —	— 98.6°F —	body temperature
25°C —	— 77°F —	room temperature
0°C —	— 32°F —	ice cream

°C   °F

Heat Example

Water is boiled on the stove in a teapot.

How does heat flow in this picture?

A methane flame is off the charts at 1,000 °C

room air

100ºC — — 212ºF — — water boils

25ºC — — 77ºF — — room temperature

ºC   ºF

Heat Example

You are holding two ice cream cones together. They are both at exactly 0 °C.

Does any thermal energy flow between the two ice cream scoops?
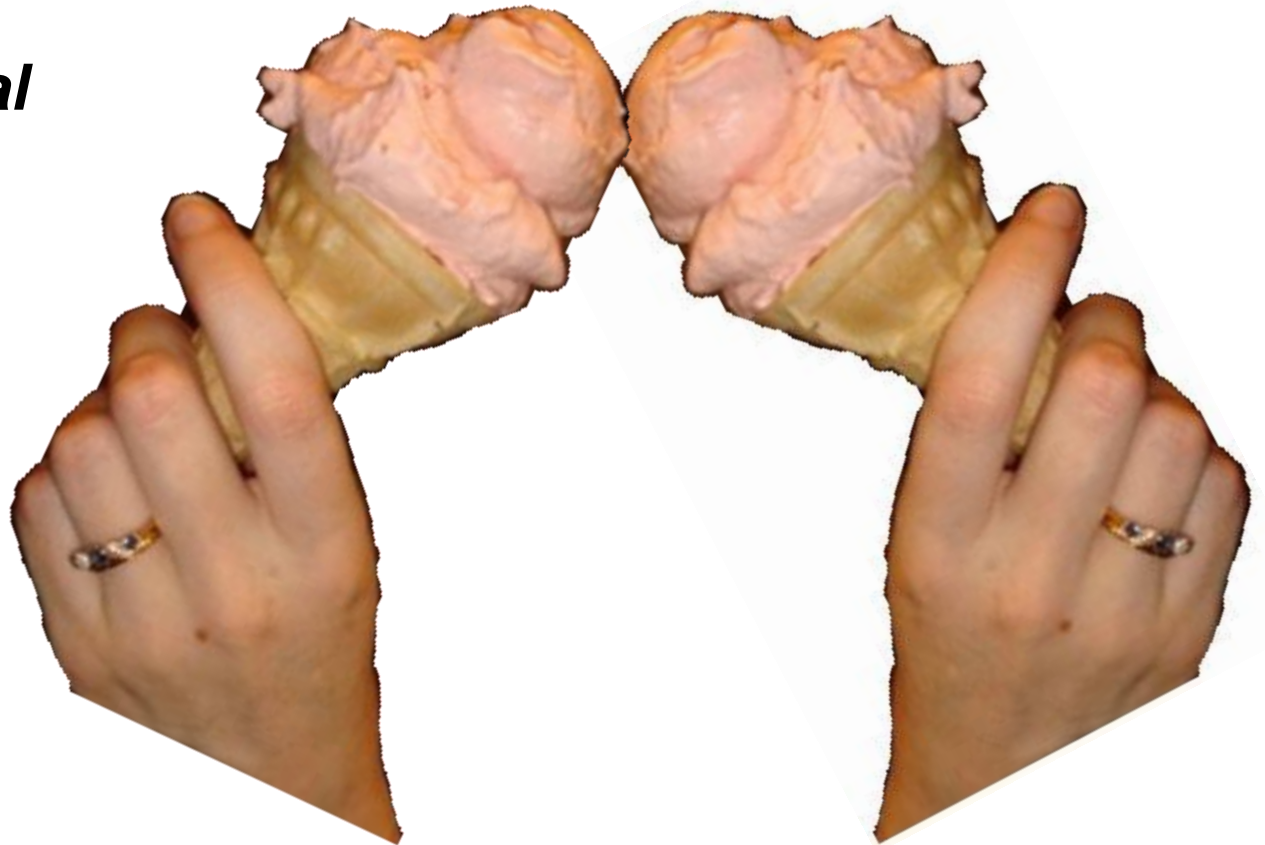
Heat Transfer

What does it mean to "transfer" something?

In this case, we are talking about movement of thermal energy.

Three types of heat transfer:
- conduction
- convection
- radiation

No matter what type of heat transfer, it always flows from HOT to COLD

Thought Experiments

How would your hands feel if you held a bowl of hot soup?

How would your hands feel if you were holding a snowball?

What would happen if you touched an object that is the same temperature as your hand? Would any heat transfer happen? (…remember the ice cream)

Conduction

Conduction is heat transfer within or between solid objects.

Can you think of another example? What is happening?

More Heat Transfer

A cup of hot chocolate is in your hands and you really want to drink it now, but it is too hot.

How might you cool it without using ice or a refrigerator?

More Heat Transfer

On a hot summer day, *would you feel cooler if you stood under a ceiling fan? Why?*
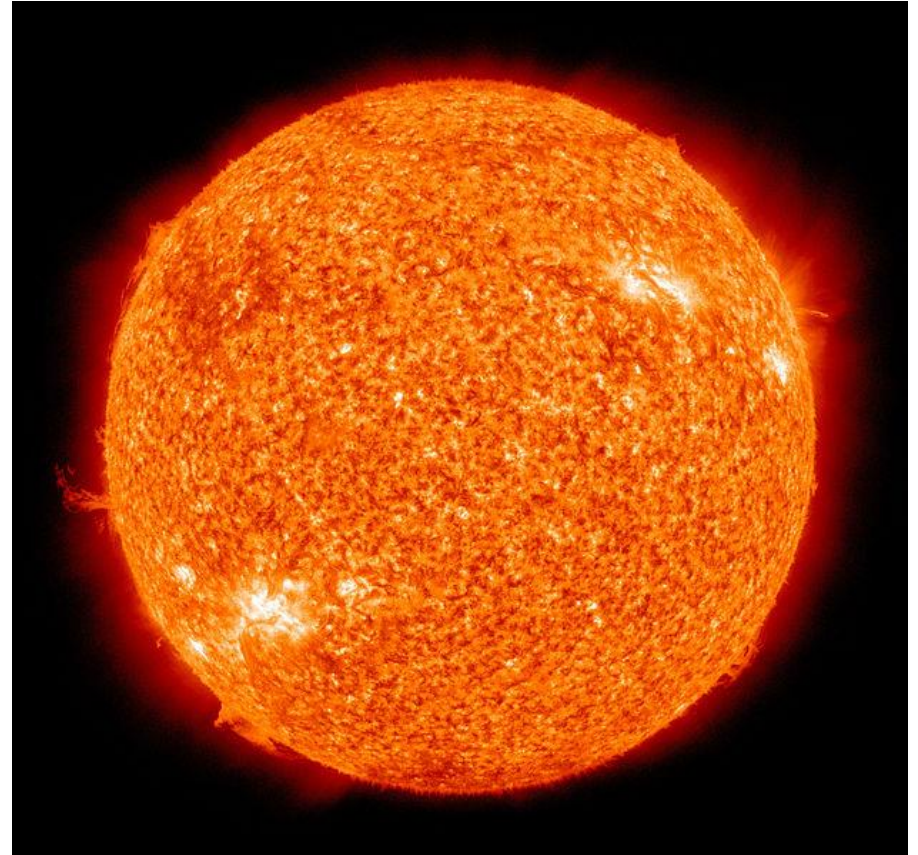
Convection

Convection is heat transfer into or out of moving fluids.

The Sun

No air exists between the Earth and the Sun—so *how does solar energy get to the Earth to keep us warm?*

Little packets of energy called photons zip through space, bringing the Sun's energy to Earth.

Radiation

Warm air rises, so how does the thermal energy get to you, standing BELOW this heater?

Radiation is heat transfer due to packets of energy that can travel through many substances, including empty space.

Most heat transfer occurs from radiation at high temperatures (like the flame in this patio heater).

Insulation

Insulation is a material that slows heat transfer.
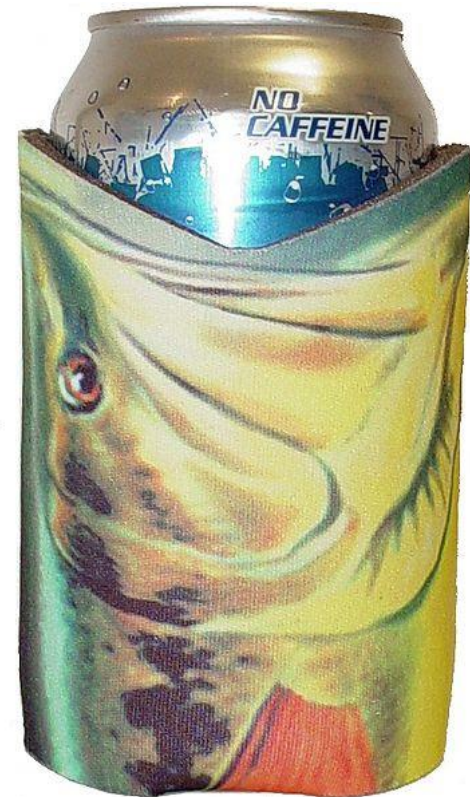
Almost all engineered products have insulation.
Can you think of more examples?

Review

Heat: A form of energy transferred by a difference in temperature.

Heat flows from _____ to _____.

Conduction: Heat transfer within or between solid objects.

Convection: Heat transfer to or from a gas or liquid.

Radiation: Heat transfer that can occur through empty space.

Insulation: Material that slows heat transfer.