Heat Transfer Summary:
• The second law of thermodynamics states (in one form): “If a temperature difference exists between two places, heat energy will naturally flow from the higher temperature place towards the lower temperature place, until thermal equilibrium is achieved.” Natural heat transfer happens in three ways:
  • Convection
  • Conduction
  • Radiation

Conduction:
• Basic Idea: Neighbouring atoms or molecules tend to transfer their thermal energy. If a solid object has a temperature gradient, then heat will flow through the it from the high temp side towards the low temp side.
  • The rate of heat transfer is proportional to temperature difference times the thermal conductivity.
  • Thermal conductivity is a property of all materials. (ie) copper has a high thermal conductivity. Styrofoam has a very low thermal conductivity.
**Convection:**

- Basic Idea: Most fluids are less dense when they are at higher temperatures, this results in an upward buoyancy force: natural convection.
- In other words, “hot air rises”. This gives rise to most weather phenomena, currents in boiling water, etc.
- The rate of heat transfer is complicated and cannot be computed unless the fluids are modeled numerically. (This is why it is so hard to predict the weather!)

**Radiation:**

- Basic Idea: The surfaces of objects can absorb and radiate electromagnetic radiation (ie light, infrared, radio, etc). If the object is a higher temperature than its environment, it will radiate heat energy to the environment.
- How fast the heat is transferred is determined by the temperature and colour of the surface. Blacker objects both absorb and radiate more efficiently than whiter objects.
2 most relevant laws of thermodynamics

1st: Conservation of Energy.
   "Energy cannot be created or destroyed." (Car will not go without fuel)

2nd Law (physicist's form):
   Entropy in any closed system naturally increases with time.
   "Entropy = "Disorder" (your room will naturally increase the large amount of entropy.)

- Creating heat creates entropy.
- Entropy can also be increased by mixing.
- Heat transferring from a hot object to a cool object is like mixing - it increases the entropy of the universe.
- All processes in real life create heat - but you can cool a local area.
How does an air conditioner or refrigerator work?

- Local removal of heat from cooler region.
- Entire apparatus consumes power → compressor, and pump create heat, heat of the universe is increased.
- Also called a "heat pump" schematic.

The opposite process (thermodynamically) is called a "heat engine" schematic.