Heat & Temperature

Unit: Thermochemistry (Heat)

MA Curriculum Frameworks (2016): HS-PS1-4

Mastery Objective(s): (Students will be able to…)

- Explain the difference between heat and temperature.
- Describe what is happening at the molecular level when a system is in thermal equilibrium.

Success Criteria:

- Explanation accounts for total energy as well as direction of energy flow ("driving force").
- Description accounts for and relates macroscopic observations to microscopic phenomena.

Tier 2 Vocabulary: heat, temperature

Language Objectives:

- Explain the difference between heat and temperature.

Notes:

heat: energy that can be transferred when moving atoms or molecules collide with each other.

temperature: a measure of the average kinetic energy of the particles (atoms or molecules) of a system.

thermometer: a device that measures temperature, most often via thermal expansion/contraction of a liquid or solid.

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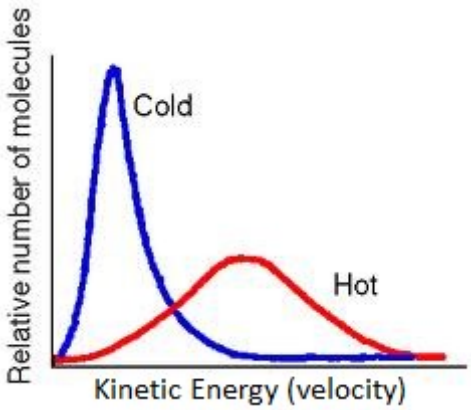
Note that heat is the energy itself, whereas temperature is a measure of the "quality of the heat"—the average of the kinetic energies of the individual molecules:



When objects are placed in contact, heat is transferred when the molecules collide. Molecules that have a lot of energy tend to transfer more energy than they receive. Molecules that have little energy tend to receive more energy than they transfer. This means two things:

1. On a macroscopic scale, heat always transfers from objects with a higher temperature (more kinetic energy) to objects with a lower temperature (less kinetic energy).
2. If you wait long enough, all of the molecules will have the same temperature (*i.e.,* the same average kinetic energy).

In other words, the temperature of one object relative to another determines which direction the heat will flow.

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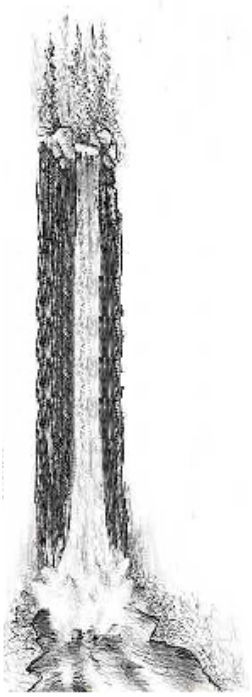
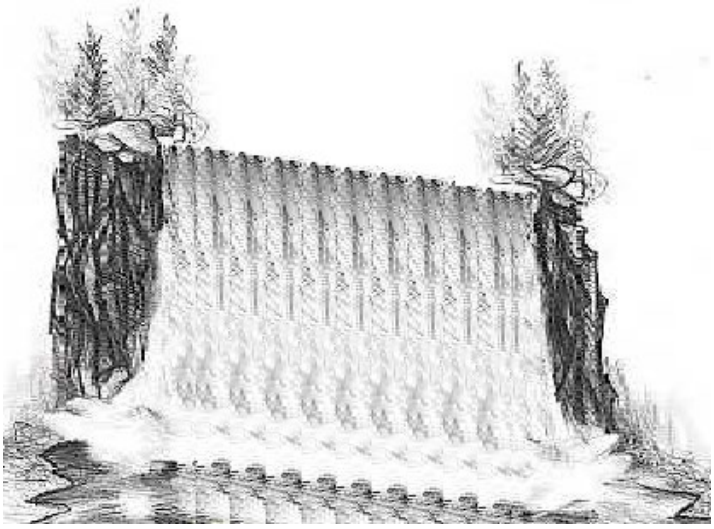
As an analogy, heat transfer is a lot like flowing water.

- Water flows from a higher elevation to a lower one, just like heat flows from a higher temperature to a lower one.
- The total energy of the water going over the waterfall depends on both the height of the waterfall (the average gravitational potential energy of the water molecules) and the total mass of water going over it. Similarly, the total heat (energy) contained in an object depends on both the mass of the object and its temperature.





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