

# What is Temperature?

- A property of matter
- Matter: atoms and molecules
  - Molecules: two or more atoms bound together
  - Examples: H<sub>2</sub>O (water), N<sub>2</sub> (nitrogen), O<sub>2</sub>(oxygen), CO<sub>2</sub> (carbon dioxide)
- Atoms and molecules are in constant, random motion
  - vibrating
  - rotating
  - (in a gas) moving from place
- A form of energy is associated with these random motions
  - kinetic energy—energy of motion
- **Temperature:** a measure of the *average* kinetic energy of random molecular motions in a substance

# What is Heat?

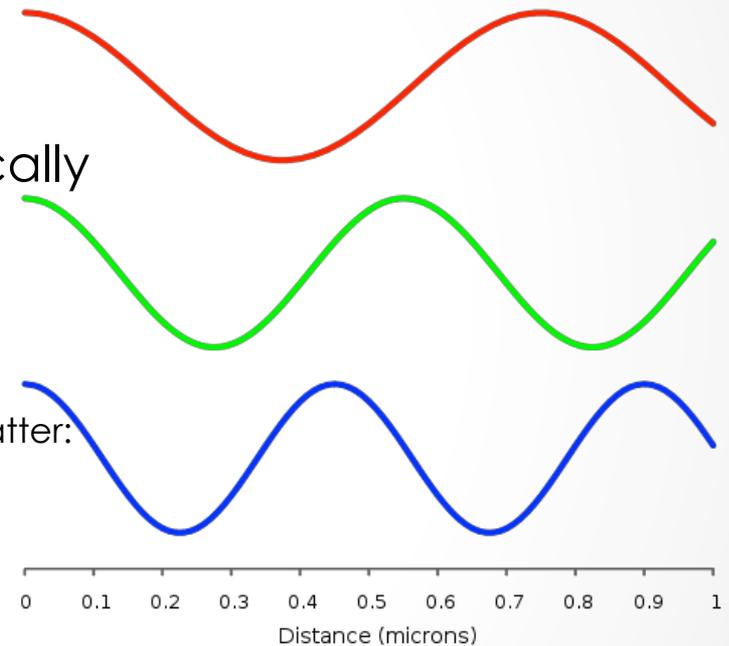
- Heat is a form of energy
- Also tied to matter
- **Heat:** the *total* energy of random molecular motions in a piece of matter
  - For a given temperature, the more molecules there are in a piece of matter, the more heat that matter has
    - Example: a cup of water taken from the ocean has the same temperature as the water from which it was just taken, but the ocean has far more heat in it than the cup of water does because the ocean has far more molecules
  - For a given piece of matter, the higher its temperature, the more heat it has
- Heat is the form of energy that we can feel in our skin

# What Other Forms of Energy Are There besides Heat?

- Electromagnetic radiation

- Emitted and absorbed by electrically charged atoms and molecules
- Exhibits wave-like behavior as it travels through space
- Characterized by wavelength
  - Determines how radiation interacts with matter: absorbed, reflected, transmitted, etc.
- Groups of wavelengths get names:
  - Ultraviolet (UV)
  - visible
  - near-infrared
  - Longwave infrared (LWIR)
  - Etc.

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Longer wavelengths



# What Other Forms of Energy Are There?

- A number of others (some will be introduced later)

# Principle of Conservation of Energy

- Energy cannot be created or destroyed
- However, energy can be *transformed from one form to another*
  - Example:

