Temperature and Heat in the Atmosphere

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CHAPTER 1 Temperature and Heat in the Atmosphere

- Explain the relationship between temperature and heat.

A candle flame or a bathtub full of hot water: which has higher heat and which has the higher temperature?

The flame has higher temperature, but less heat because the hot region is very small. The bathtub has lower temperature, but more heat because it has many more vibrating atoms. Which has greater total energy? The bathtub.

Temperature

Temperature is a measure of how fast the atoms in a material are vibrating. High temperature particles vibrate faster than low temperature particles. Rapidly vibrating atoms smash together, which generates heat. As a material cools down, the atoms vibrate more slowly and collide less frequently. As a result, they emit less heat. What is the difference between heat and temperature?

- Temperature measures how fast a material's atoms are vibrating.
- Heat measures the material's total energy.

Heat

Heat energy is transferred between physical entities. Heat is taken in or released when an object changes state, or changes from a gas to a liquid, or a liquid to a solid. This heat is called **latent heat**. When a substance changes state, latent heat is released or absorbed. A substance that is changing its state of matter does not change temperature. All of the energy that is released or absorbed goes toward changing the material's state.

For example, imagine a pot of boiling water on a stove burner: that water is at 100^{o}C (212^{o}F). If you increase the temperature of the burner, more heat enters the water. The water remains at its boiling temperature, but the additional energy goes into changing the water from liquid to gas. With more heat the water evaporates more rapidly. When water changes from a liquid to a gas it takes in heat. Since evaporation takes in heat, this is called evaporative cooling. Evaporative cooling is an inexpensive way to cool homes in hot, dry areas.

Substances also differ in their **specific heat**, the amount of energy needed to raise the temperature of one gram of the material by 1.0^{o}C (1.8^{o}F). Water has a very high specific heat, which means it takes a lot of energy to change the temperature of water. Let's compare a puddle and asphalt, for example. If you are walking barefoot on a sunny day, which would you rather walk across, the shallow puddle or an asphalt parking lot? Because of its high specific heat, the water stays cooler than the asphalt, even though it receives the same amount of solar radiation.

Summary

- Temperature the speed of vibration of the molecules that make up a substance. Heat is the energy transferred between physical entities.
- Latent heat is released or absorbed when a substance changes states.
- Specific heat is the amount of energy needed to raise the temperature of one gram of the material by 1.0^{o}C (1.8^{o}F).

Review

1. How does evaporative cooling work? Why do you think it is only effective in hot, dry areas?
2. What happens to the temperature of a substance as it changes state from liquid to solid? What happens to its latent heat?
3. As a substance changes state from liquid to solid, what happens to the molecules that make it up?

Explore More

Use this resource to answer the questions that follow.

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1. What is temperature?
2. What determines heat?
3. How is temperature measured? How does this work?
4. What is heat?
5. What is kinetic energy?
6. What does temperature measure?