



Effect of Temperature Change on a Gas

Four variables describe any gas:

- Volume
- Pressure
- Temperature
- Quantity of particles

If temperature is varied for a fixed quantity of gas:

- volume varies if pressure is constant.
- pressure varies if volume is constant.
- both can vary simultaneously.



Lesson Objectives

By the end of this lesson, you should be able to:

- Relate temperature to the average molecular kinetic energy.
- Describe heat flow in terms of the motion of atoms or molecules.
- Distinguish between exothermic chemical processes and endothermic chemical processes.

Science Practice: Analyze and interpret information about a reaction to classify the reaction as either an exothermic process or an endothermic process.

**Words to Know**

Write the letter of the definition next to the matching word as you work through the lesson. You may use the glossary to help you.

- | | |
|-----------------------------|--|
| <u> C </u> thermal energy | A. a heat transfer that involves direct contact between two substances so there can be collisions between molecules |
| <u> A </u> conduction | B. describing a process that involves the absorption of energy from the surroundings by substances undergoing change |
| <u> B </u> endothermic | C. the kinetic energies of the molecules making up a substance; energy that can flow as heat |
| <u> E </u> temperature | D. the transfer of kinetic energy between molecules as faster-moving molecules collide with slower-moving molecules; energy that flows from a warmer object or substance to a cooler object or substance |
| <u> F </u> exothermic | E. the measure of the average kinetic energy of the molecules making up a substance |
| <u> D </u> heat | F. describing a process that involves the release of energy into the surroundings by substances undergoing change |

Instruction

Heat

Slide

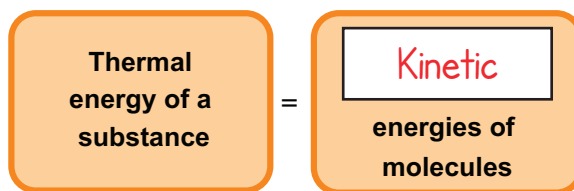
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Lesson
Question

How do chemical reactions affect heat?

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Thermal Energy



Thermal energy differs in each substance. For example, there is:

- low thermal energy in a popsicle.
- **high** thermal energy in a radiator.

Measuring Thermal Energy

Temperature – Measure of the average kinetic **energy** of the molecules making up a substance

- Described by units called degrees
 - Fahrenheit
 - **Celsius**
 - Kelvin
- Low when thermal energy is **low**
- High when thermal energy is high

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Heat

Heat – The transfer of kinetic energy between **molecules** as faster-moving molecules **collide** with slower-moving molecules

- Always moves in the direction from high kinetic energy to low kinetic energy
- Is measured in **joules** or calories

Conduction: Heat Flow at the Molecular Level

Heat flows via **conduction**, heat transfer that involves direct contact between two substances so there can be **collisions** between molecules.

- Hot substances contain faster-moving molecules than cold substances.
- As faster-moving molecules collide with slower-moving molecules, energy is **transferred**.
- Faster-moving molecules slow down.
- Slower-moving molecules **speed** up.

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Heat Flow during Chemical Processes

- **Exothermic** – Process that involves the release of energy into the surroundings by **substances** undergoing change
- **Endothermic** – Process that involves the **absorption** of energy from the surroundings by substances undergoing change

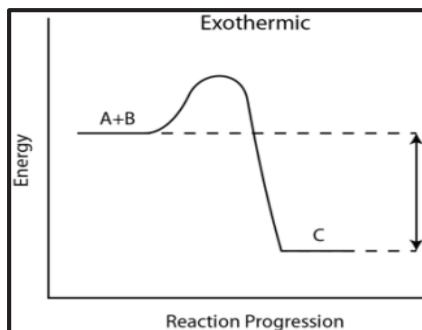
Instruction | Heat

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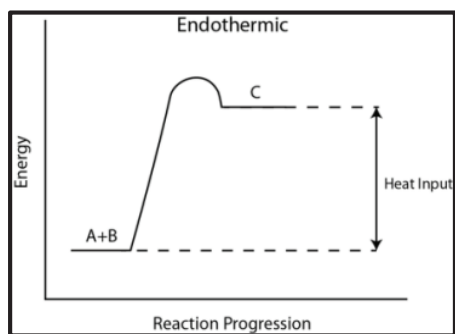
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Heat Flow during Chemical Processes

- Exothermic – Heat flows out to **surroundings**.



- Endothermic** – Heat flows in from surroundings.



Summary

Heat

**Lesson Question**

How do chemical reactions affect heat?

**Answer**

(Sample answer) During chemical reactions, heat can flow out of the reaction in an exothermic reaction, or heat can flow into the reaction in an endothermic reaction.

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Thermal Energy and Temperature

Thermal energy

- The kinetic energy of the molecules of a substance

Temperature

- The measure of a substance's thermal energy, in units of degrees

Fahrenheit

, degrees Celsius, or

Kelvins

- The higher the thermal energy, the higher the temperature

Summary | Heat

Slide

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Distinguishing Heat from Temperature

Heat

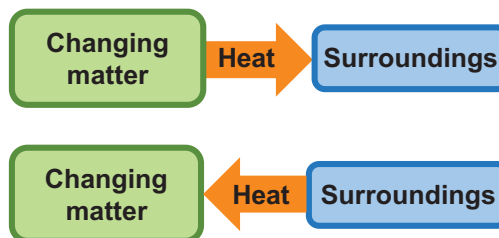
- Kinetic energy that can be transferred between substances
- Described by units called **joules**

Temperature

- Measure of **average** kinetic energy of a substance
- Described by units of degrees Celsius, degrees Fahrenheit, or Kelvins

Heat Flow during Physical and Chemical Processes

- **Exothermic** – Heat flows out to surroundings.
- Endothermic – Heat flows in from surroundings.





Summary

Heat

Use this space to write any questions or thoughts about this lesson.