

A close-up photograph of a gas stove burner. The burner is a circular metal ring with a black knob in the center. A ring of blue flames is visible around the burner. The background is dark.

Heat and Heat Technology

Section 2 What is Heat?

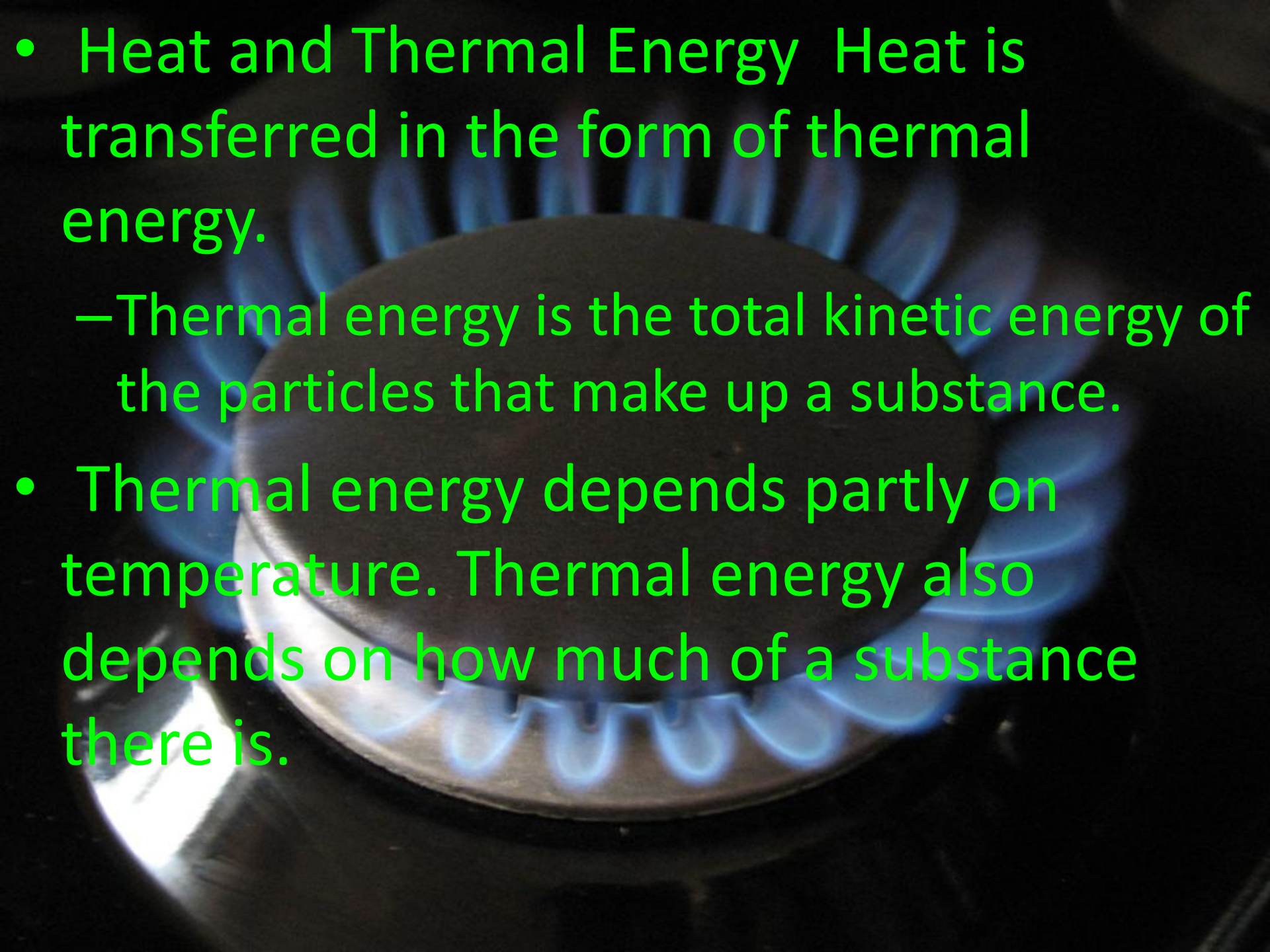
Section 2 – What is Heat?: Objectives

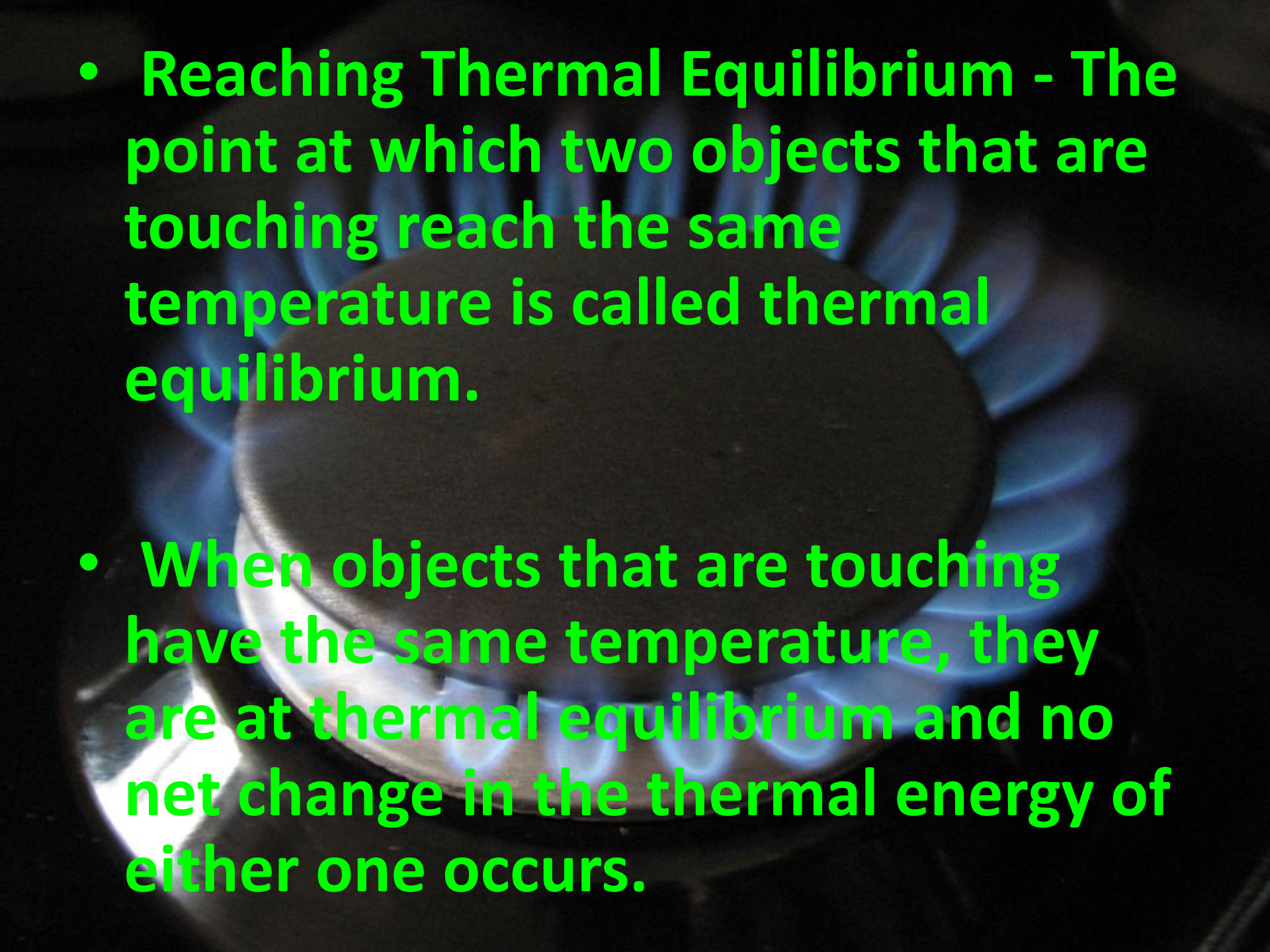
- Define *heat* as thermal energy transferred between objects at different temperatures.
- Compare conduction, convection, and radiation.
- Use specific heat capacity to calculate heat.

Transferred Thermal Energy



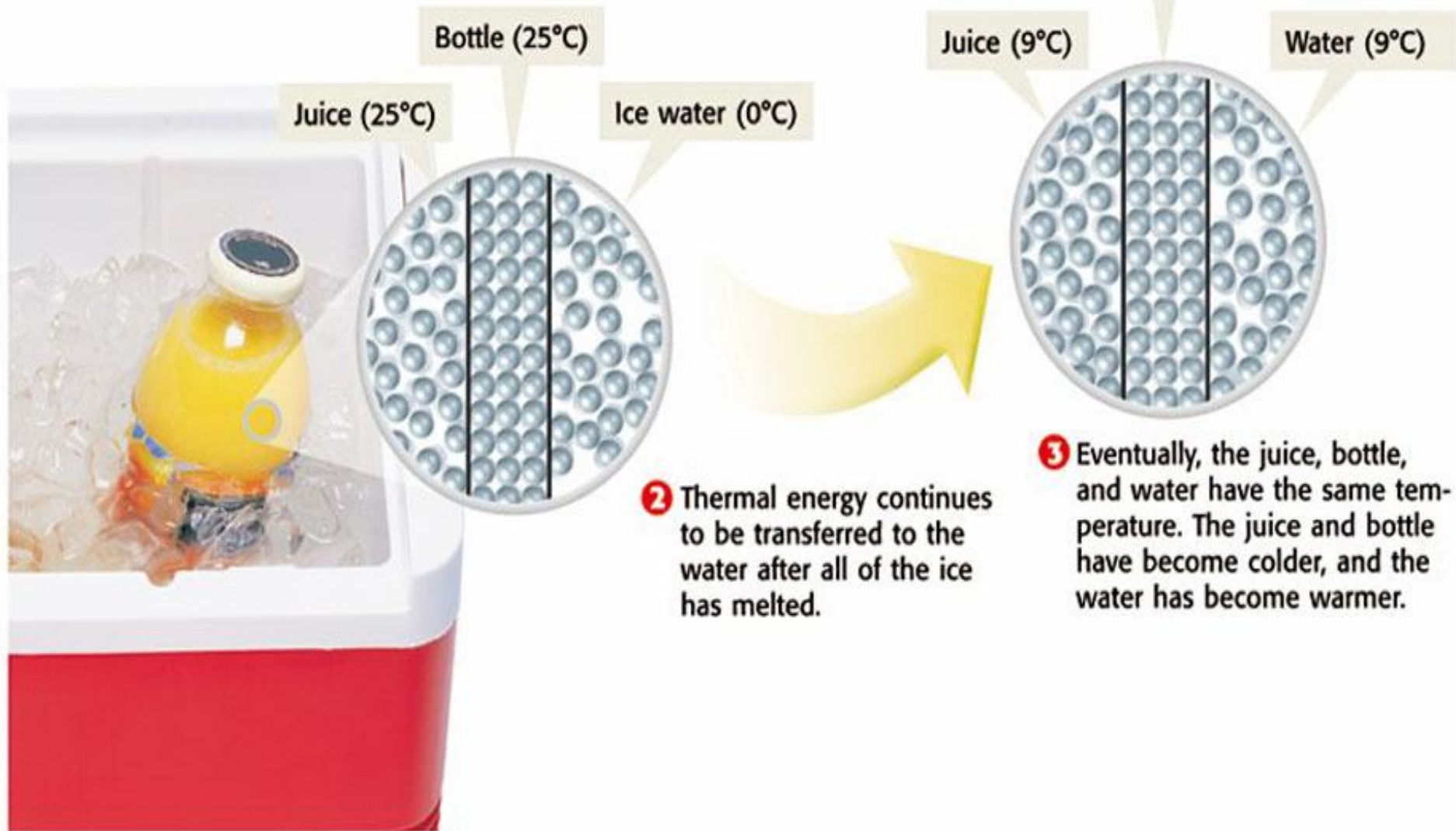
- Heat is the energy transferred between objects that are at different temperatures.
- When two objects at different temperatures come into contact, energy is always transferred from the object that has the higher temperature to the object that has the lower temperature.

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- Heat and Thermal Energy Heat is transferred in the form of thermal energy.
 - Thermal energy is the total kinetic energy of the particles that make up a substance.
 - Thermal energy depends partly on temperature. Thermal energy also depends on how much of a substance there is.

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- **Reaching Thermal Equilibrium - The point at which two objects that are touching reach the same temperature is called thermal equilibrium.**
 - **When objects that are touching have the same temperature, they are at thermal equilibrium and no net change in the thermal energy of either one occurs.**

Transfer of Thermal Energy

- 1** Energy is transferred from the particles in the juice to the particles in the bottle. These particles transfer energy to the particles in the ice water, causing the ice to melt.



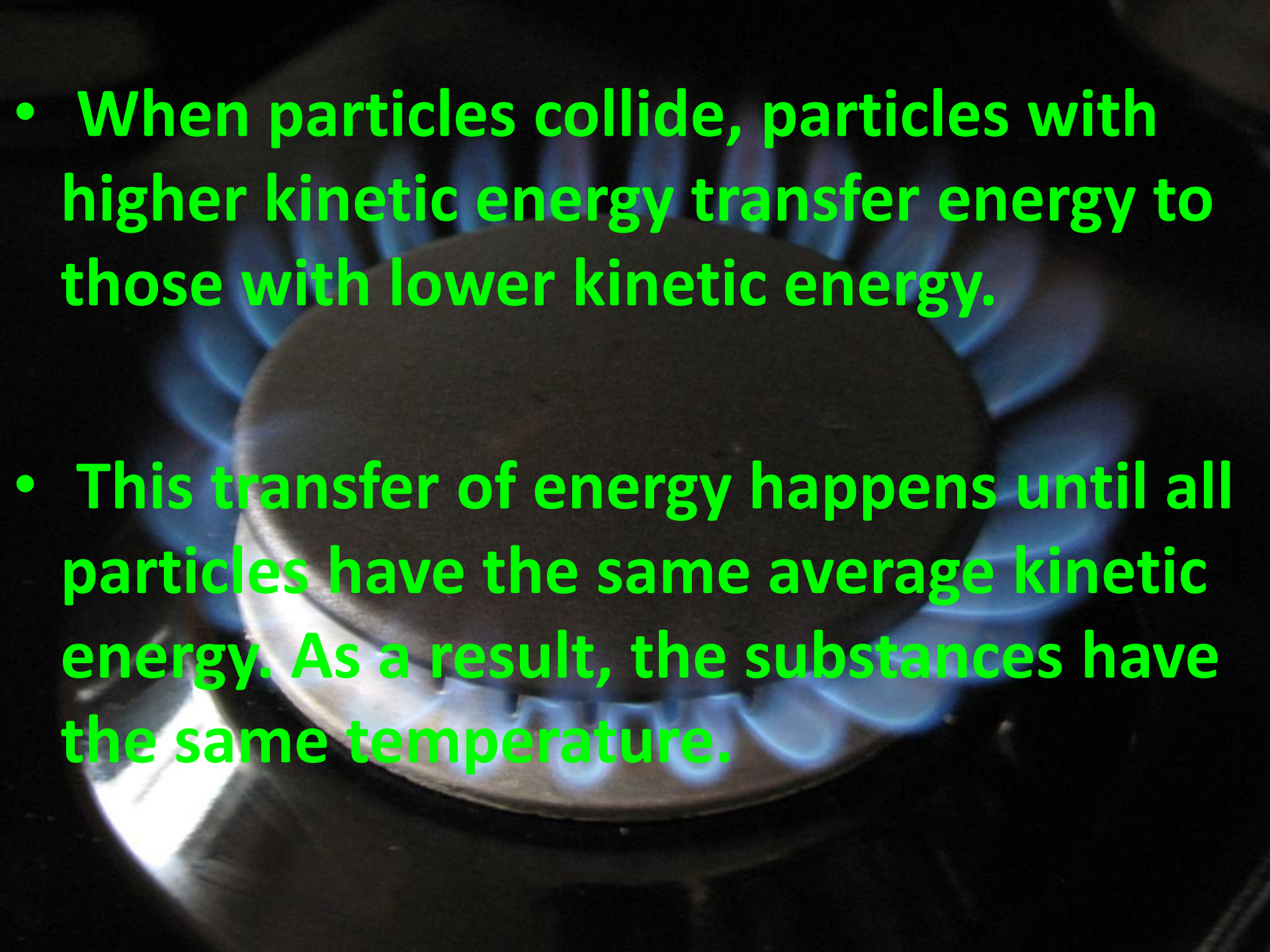
- 2** Thermal energy continues to be transferred to the water after all of the ice has melted.

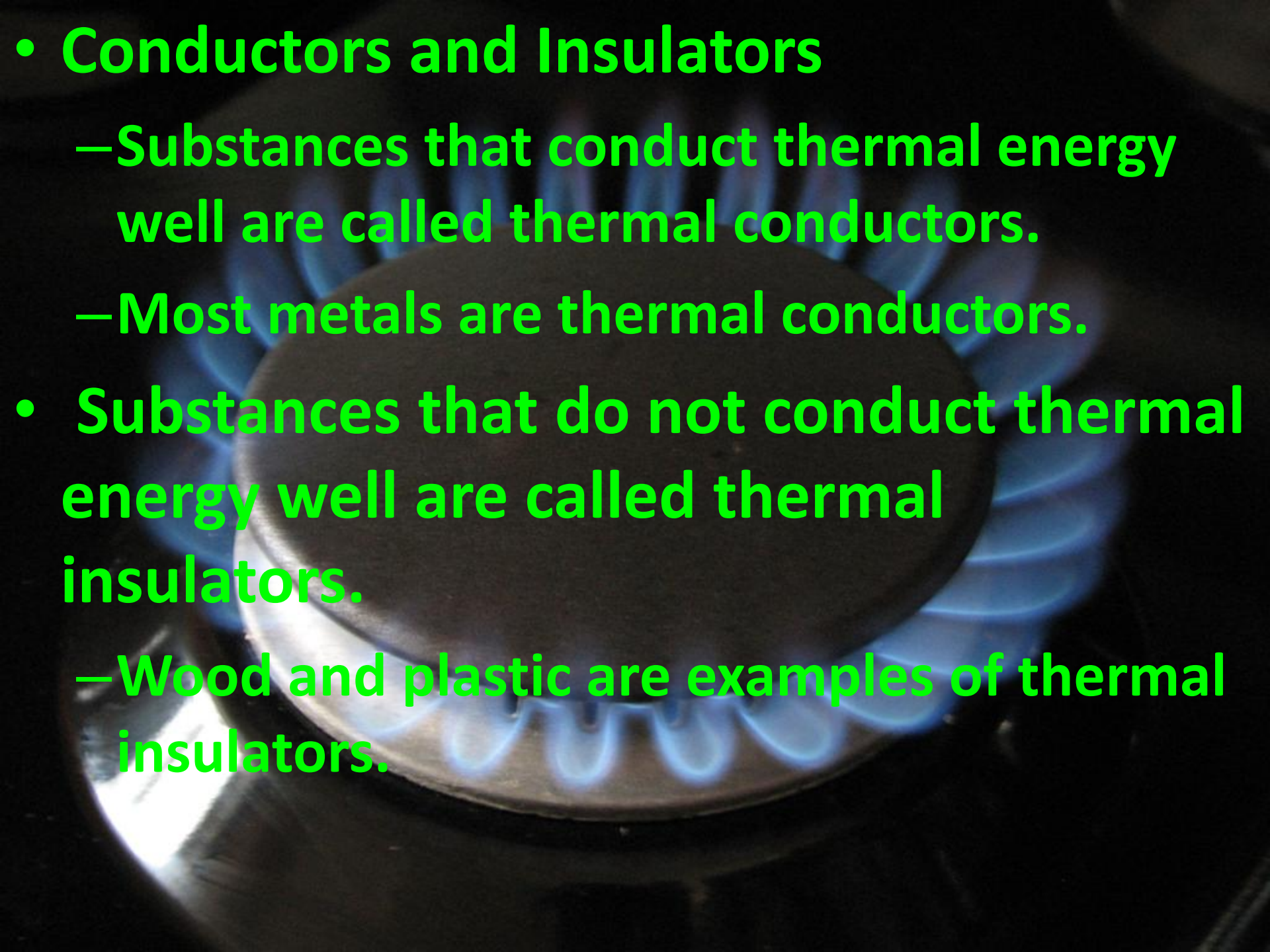
- 3** Eventually, the juice, bottle, and water have the same temperature. The juice and bottle have become colder, and the water has become warmer.

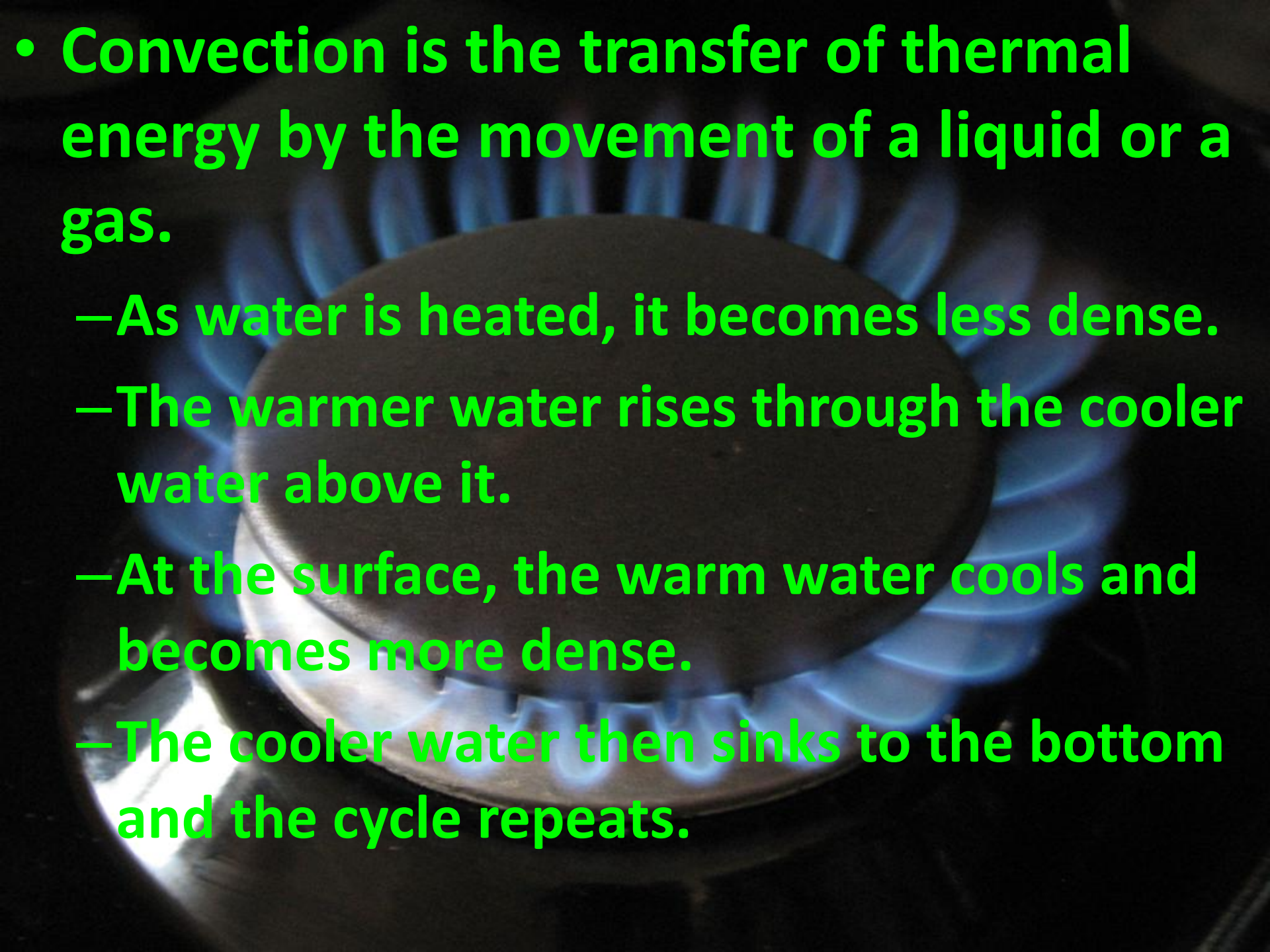
Conduction, Convection and Radiation

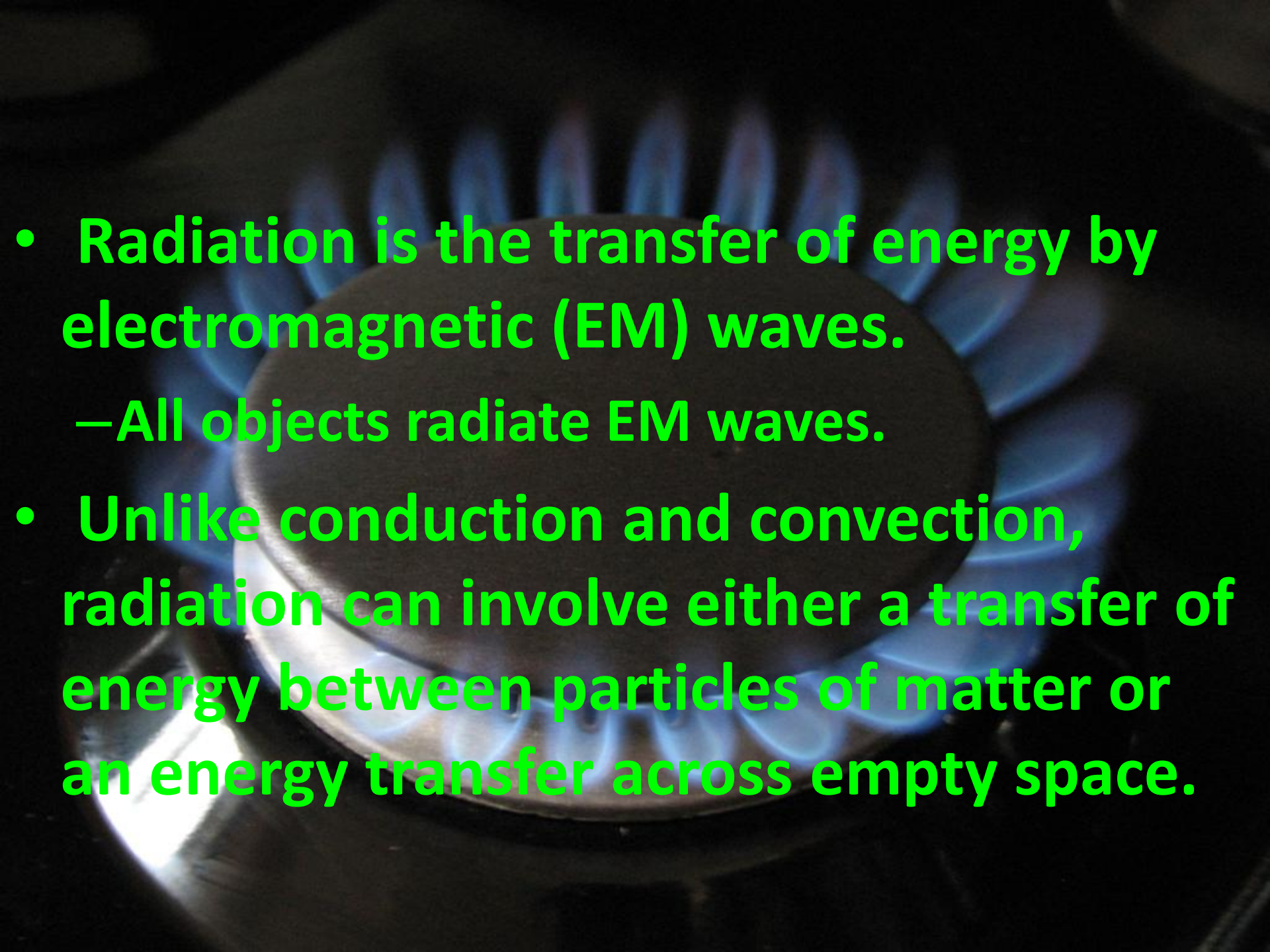


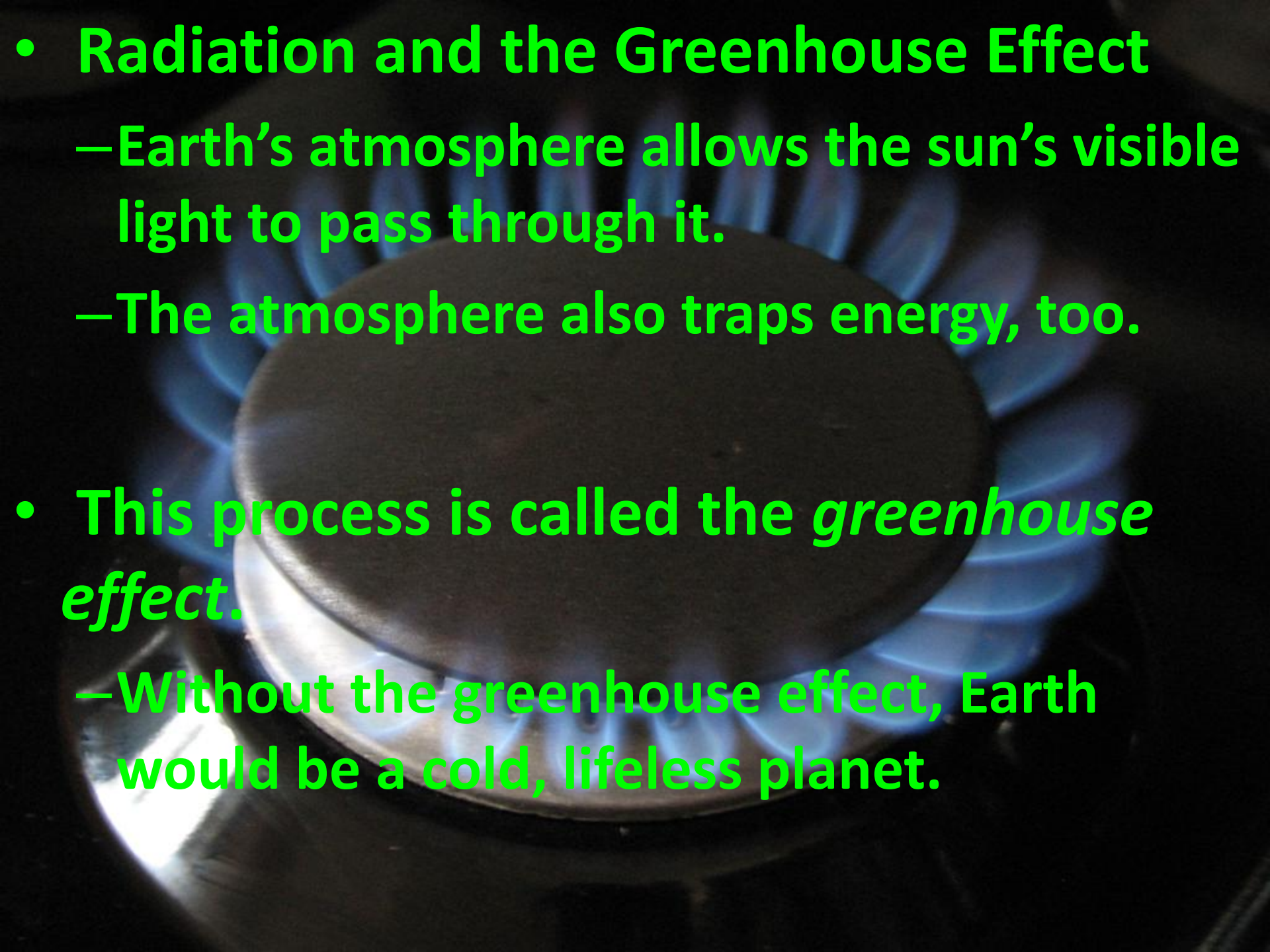
- **Thermal Conduction** - transfer of thermal energy from one substance to another through direct contact.
 - Conduction can also occur within a substance.
- The particles of substances at different temperatures have different average kinetic energies. When such substances touch, their particles collide.

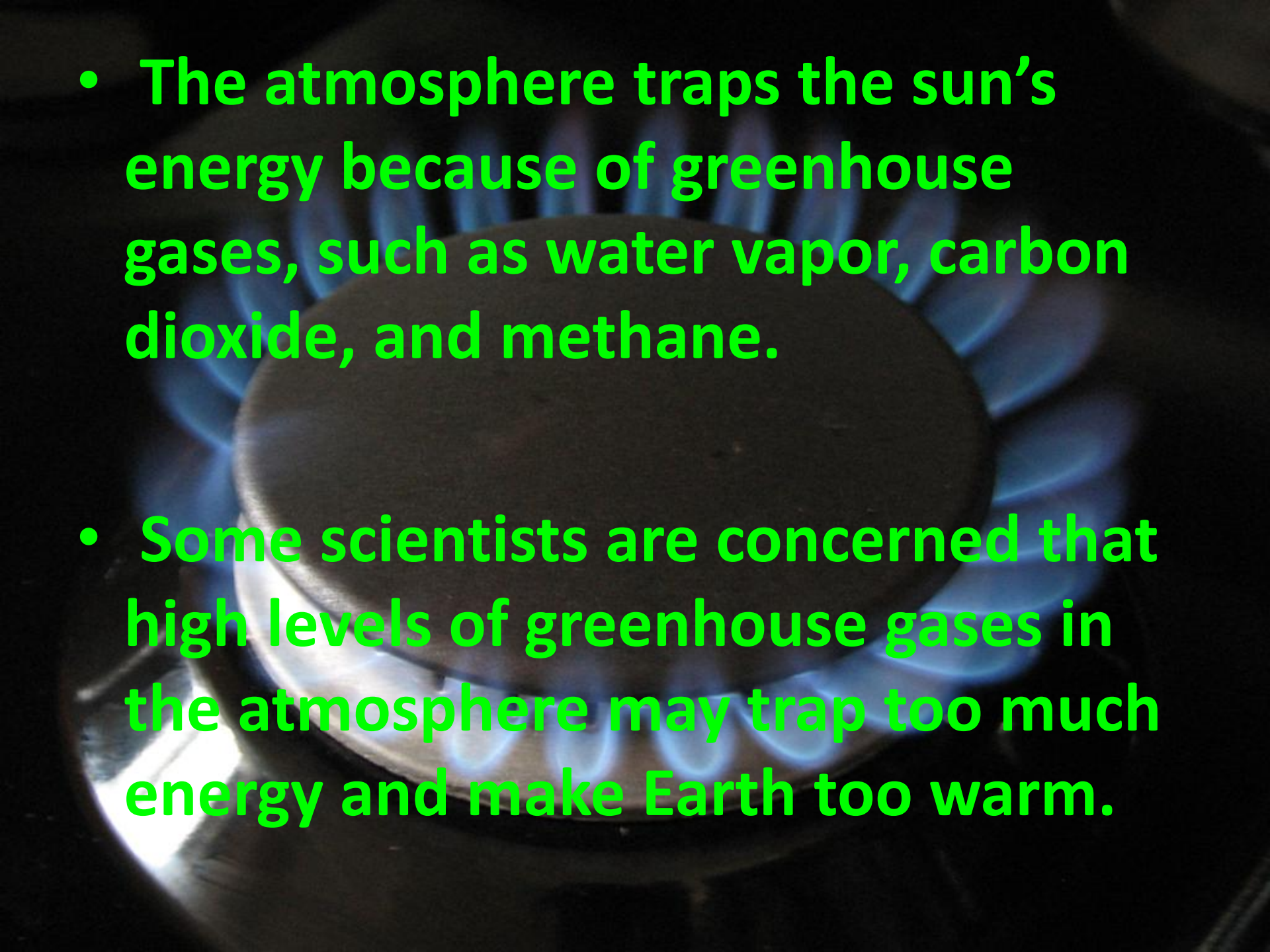
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- When particles collide, particles with higher kinetic energy transfer energy to those with lower kinetic energy.
 - This transfer of energy happens until all particles have the same average kinetic energy. As a result, the substances have the same temperature.

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- **Conductors and Insulators**
 - Substances that conduct thermal energy well are called thermal conductors.
 - Most metals are thermal conductors.
 - **Substances that do not conduct thermal energy well are called thermal insulators.**
 - Wood and plastic are examples of thermal insulators.

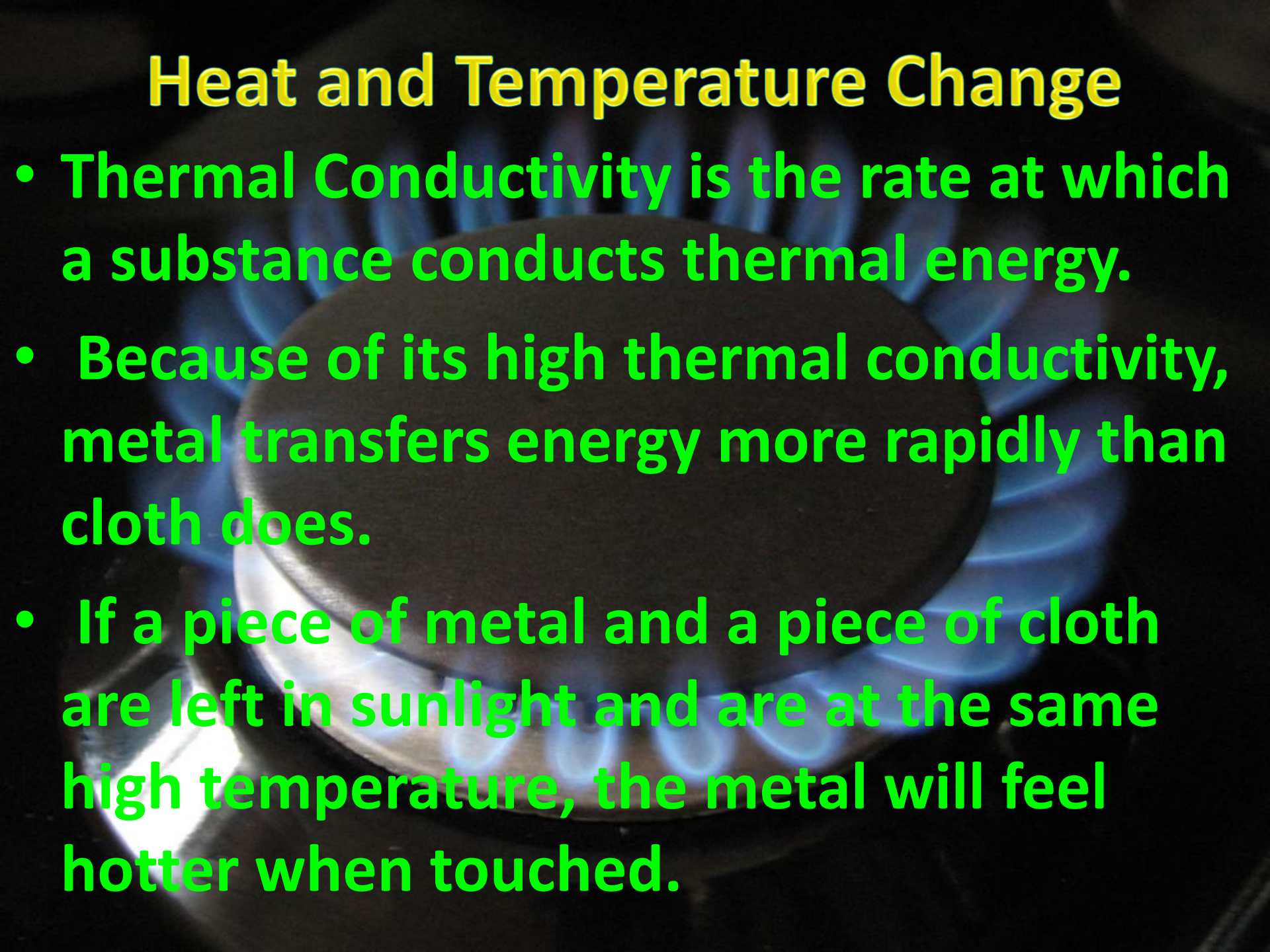
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- **Convection is the transfer of thermal energy by the movement of a liquid or a gas.**
 - **As water is heated, it becomes less dense.**
 - **The warmer water rises through the cooler water above it.**
 - **At the surface, the warm water cools and becomes more dense.**
 - **The cooler water then sinks to the bottom and the cycle repeats.**

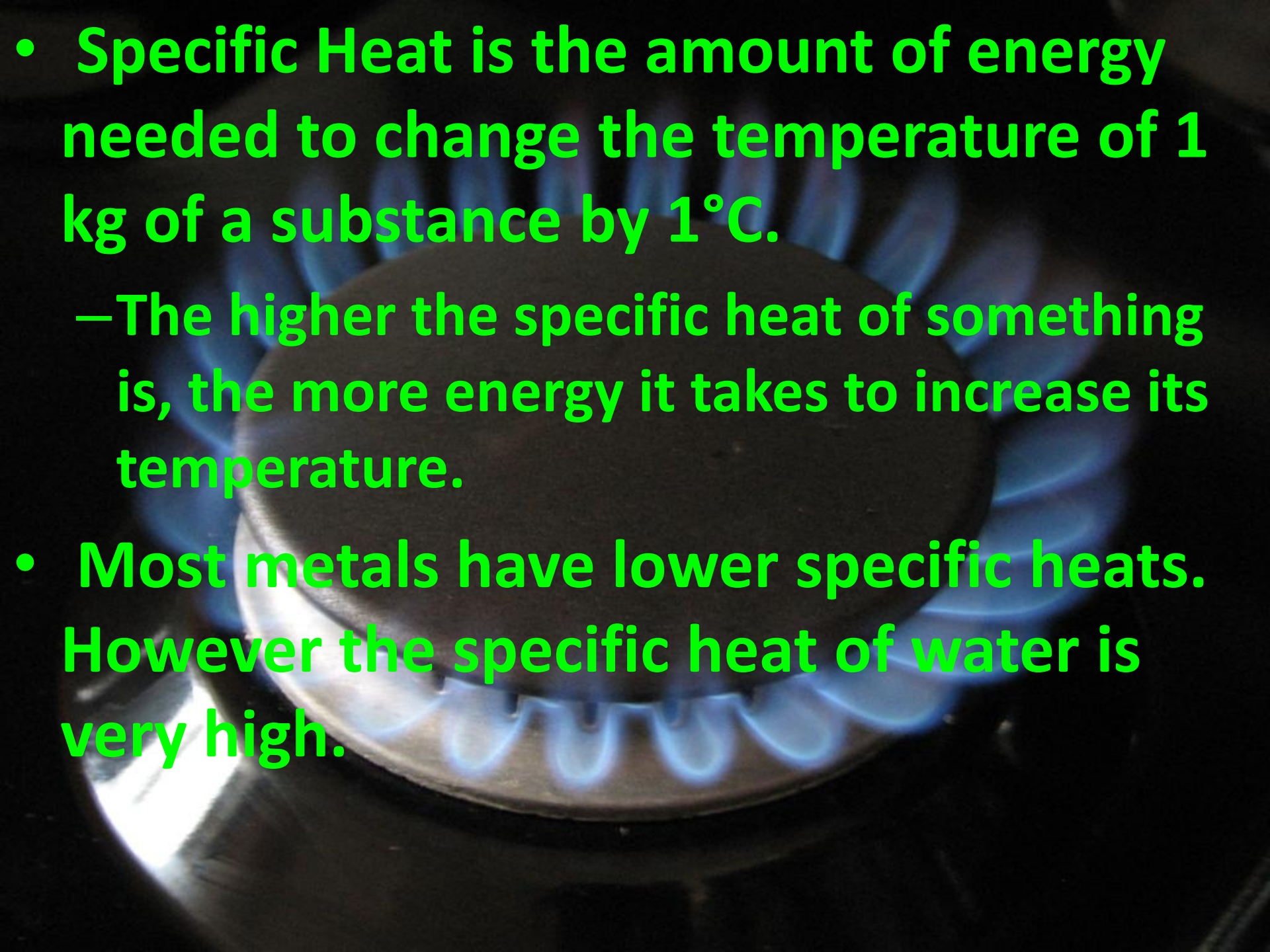
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- **Radiation is the transfer of energy by electromagnetic (EM) waves.**
 - All objects radiate EM waves.
 - **Unlike conduction and convection, radiation can involve either a transfer of energy between particles of matter or an energy transfer across empty space.**

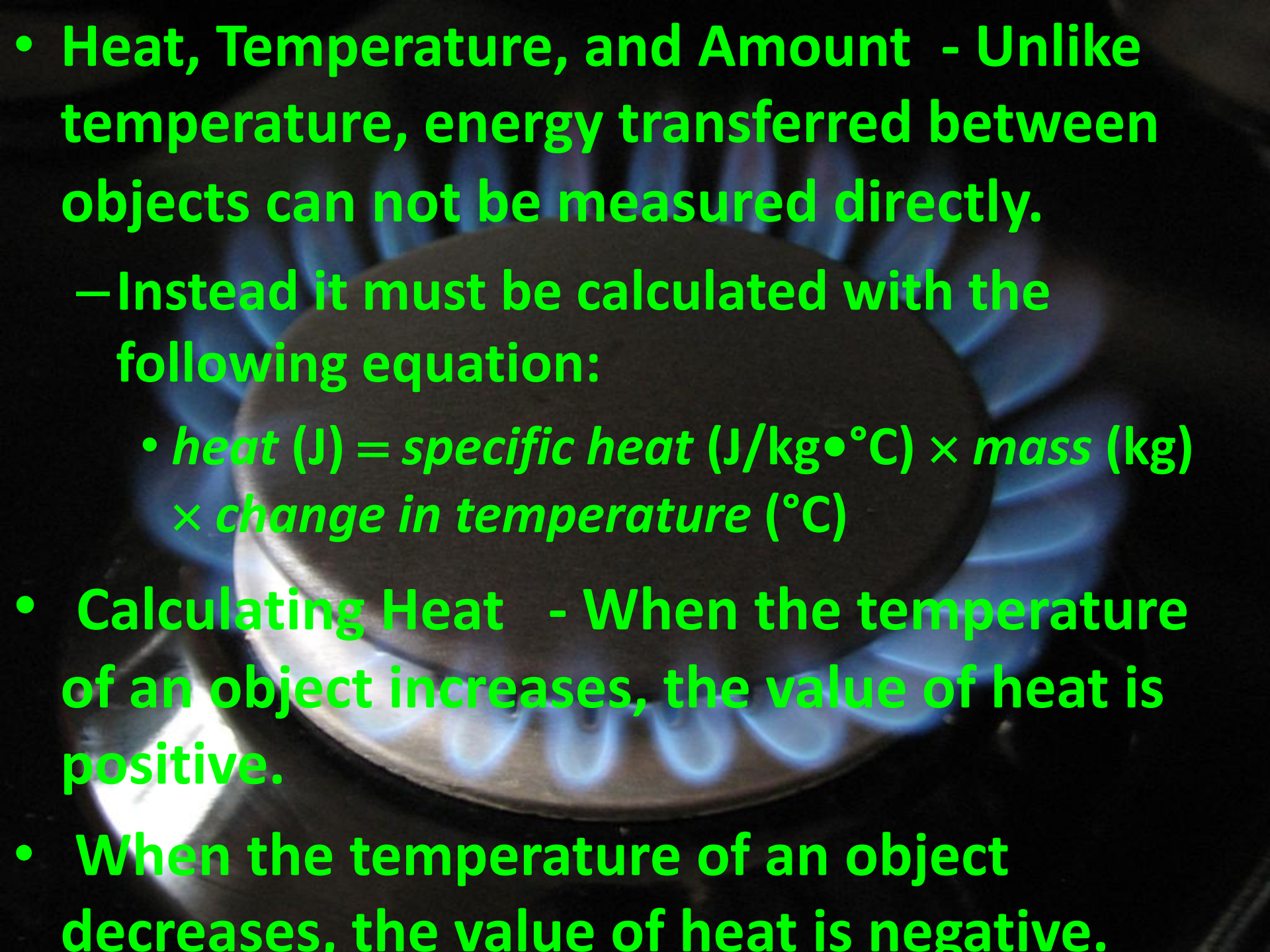
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- **Radiation and the Greenhouse Effect**
 - Earth's atmosphere allows the sun's visible light to pass through it.
 - The atmosphere also traps energy, too.
 - This process is called the *greenhouse effect*.
 - Without the greenhouse effect, Earth would be a cold, lifeless planet.

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- The atmosphere traps the sun's energy because of greenhouse gases, such as water vapor, carbon dioxide, and methane.
 - Some scientists are concerned that high levels of greenhouse gases in the atmosphere may trap too much energy and make Earth too warm.

Heat and Temperature Change

- Thermal Conductivity is the rate at which a substance conducts thermal energy.
 - Because of its high thermal conductivity, metal transfers energy more rapidly than cloth does.
 - If a piece of metal and a piece of cloth are left in sunlight and are at the same high temperature, the metal will feel hotter when touched.
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- A close-up photograph of a gas stove burner. The burner is a circular metal grate with a black knob in the center. Blue flames are visible around the burner, indicating it is turned on. The background is dark, making the burner and flames stand out.
- **Specific Heat is the amount of energy needed to change the temperature of 1 kg of a substance by 1°C.**
 - The higher the specific heat of something is, the more energy it takes to increase its temperature.
 - **Most metals have lower specific heats. However the specific heat of water is very high.**

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- **Heat, Temperature, and Amount** - Unlike temperature, energy transferred between objects can not be measured directly.
 - Instead it must be calculated with the following equation:
 - *heat (J) = specific heat (J/kg•°C) × mass (kg) × change in temperature (°C)*
 - **Calculating Heat** - When the temperature of an object increases, the value of heat is positive.
 - When the temperature of an object decreases, the value of heat is negative.