

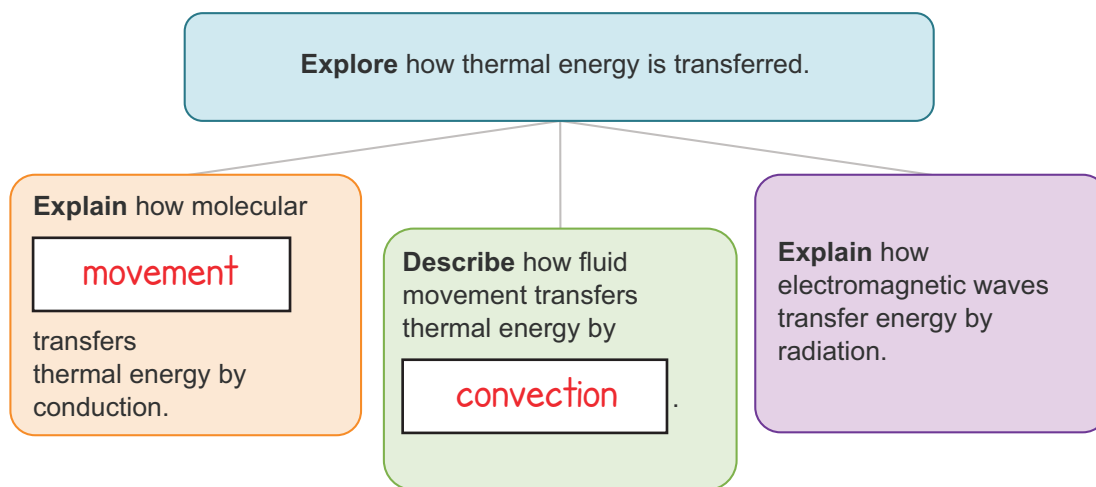


**Lesson Question**

How is thermal energy transferred?



**Lesson Goals**



**Words to Know**

Fill in this table as you work through the lesson. You may also use the glossary to help you.

convection currents	the flow of a fluid due to density differences
wave	a disturbance that carries energy from one place to another
convection	the transfer of thermal energy by fluid movement
radiation	transfer of thermal energy by electromagnetic waves
conduction	the transfer of thermal energy by molecular movement
electromagnetic wave	a wave composed of electric and magnetic fields that radiates out from a source at the speed of light



### Internal Energy, Thermal Energy, and Heat

- Internal energy is the total **potential** and kinetic energies of the molecules in an object.
- Thermal energy is the part of internal **energy** that can be transferred from one object to another.
- Heat is the thermal energy that flows from one substance to another due to a **temperature** difference.

# Instruction | Heat Transfer

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## Law of Conservation of Energy

- The law of conservation of energy states that energy cannot be created or **destroyed**.
- Energy is **transferred** from one substance to another. It flows from a warmer substance to a cooler substance as **heat**.

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## Conduction

- Conduction is the transfer of **thermal** energy by the movement of molecules.
  - Thermal energy is transferred when faster-moving molecules in the warmer object **collide** with slower-moving molecules of the cooler object.
  - Molecules must be in direct contact with each other to **transfer** energy by conduction.

## Conduction in Real Life

Conduction can be used for cooling and **warming** objects.

- Conduction occurs when water is used as a **cooling** agent.
- Conduction occurs when food is in a heated pan.

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## Convection

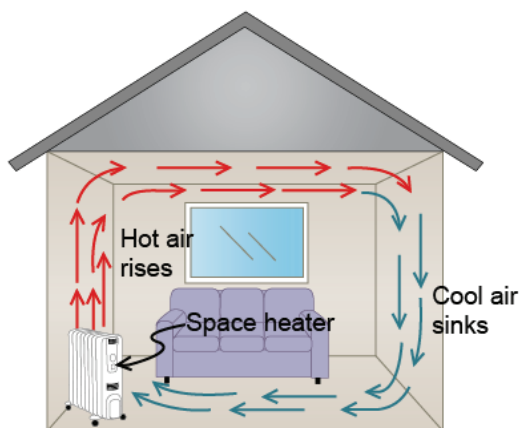
- **Convection** is the transfer of thermal energy by the movement of a fluid.
  - Warm, less dense fluid **rises**.
  - Cool, more dense fluid sinks.

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### Convection

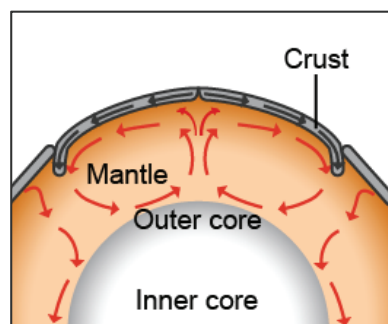
- A space heater warms up the air near it.
  - Warm air expands, becomes **less** dense, and rises.
  - The air cools, becomes more dense, and falls.
- The movement of a fluid due to **density** differences is called a **convection current**.



### Convection in Real Life



The oil in a lava lamp **rises** and falls due to convection.



Tectonic plates move due to convection currents in **molten** rock under Earth's crust.

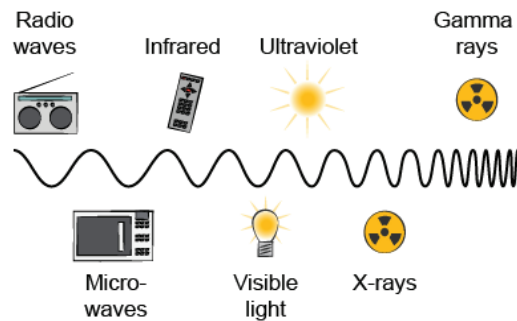
# Instruction | Heat Transfer

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## Electromagnetic Waves

- A **wave** is a disturbance that carries energy from one place to another.
- An **electromagnetic wave** is composed of electric and magnetic fields and radiates out from a source at the speed of light.
  - Electromagnetic waves do not need **matter** to transfer energy.



## Radiation

- **Radiation** is the transfer of thermal energy by electromagnetic waves.
  - Thermal energy from the Sun is carried by **electromagnetic** waves through space, where there is little or no matter.

## Radiation in Real Life

- Radiation warms your face on a summer's day.
- Radiation is used to warm up food in a **microwave**.

## Summary

## Heat Transfer

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## Lesson Question

How is thermal energy transferred?

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## Answer

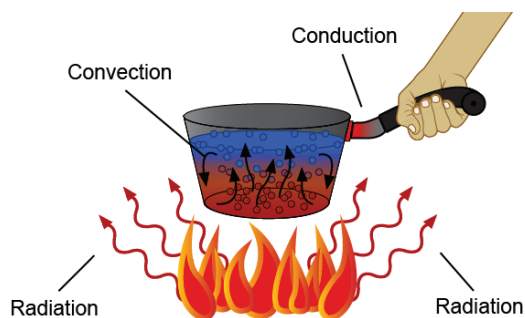
(Sample answer) Thermal energy is transferred when molecules bump into each other through conduction. When a fluid is warmed, thermal energy is transferred through convection currents that are a result of density differences within the fluid. Where there is no or little matter, thermal energy is transferred through radiation by electromagnetic waves.

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## Review: Key Concepts

- Conduction is the **transfer** of thermal energy by molecular movement.
- Convection is the transfer of thermal energy by **fluid** movement.
- **Radiation** is the transfer of thermal energy by electromagnetic waves.





# Summary | Heat Transfer

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

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