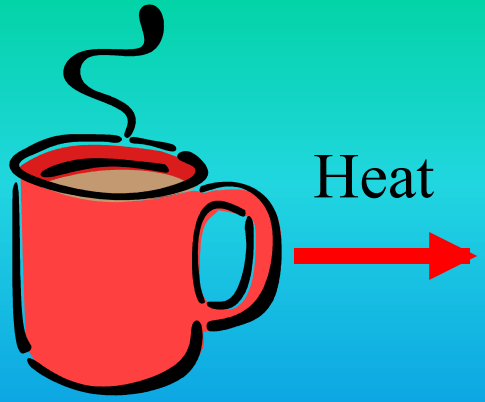
Understanding Heat Transfer:

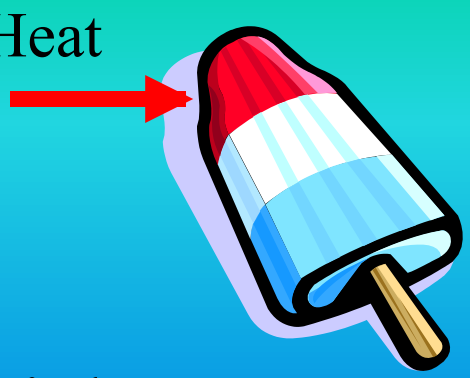
Conduction,
Convection,
and Radiation

Heat Transfer

- Heat always moves from a warmer place to a cooler place.
- Hot objects in a cooler room will cool to room temperature.
- Cold objects in a warmer room will heat up to room temperature.



Question

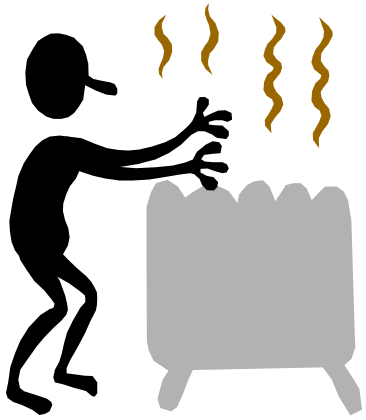


- If a cup of hot coffee and a popsicle were left on the table in this room what would happen to them? Why?

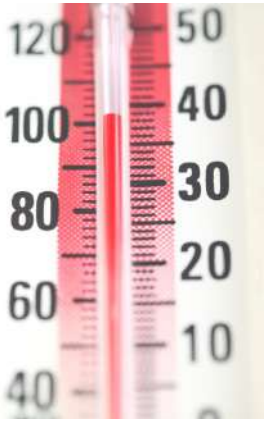
- The cup of coffee will cool until it reaches room temperature. The popsicle will melt and then the liquid will warm to room temperature.

Are heat and temperature the same thing?

- Heat is the transfer of thermal energy from high temp to low temp



- Temperature is a measure of the average KE of the particles of a substance.



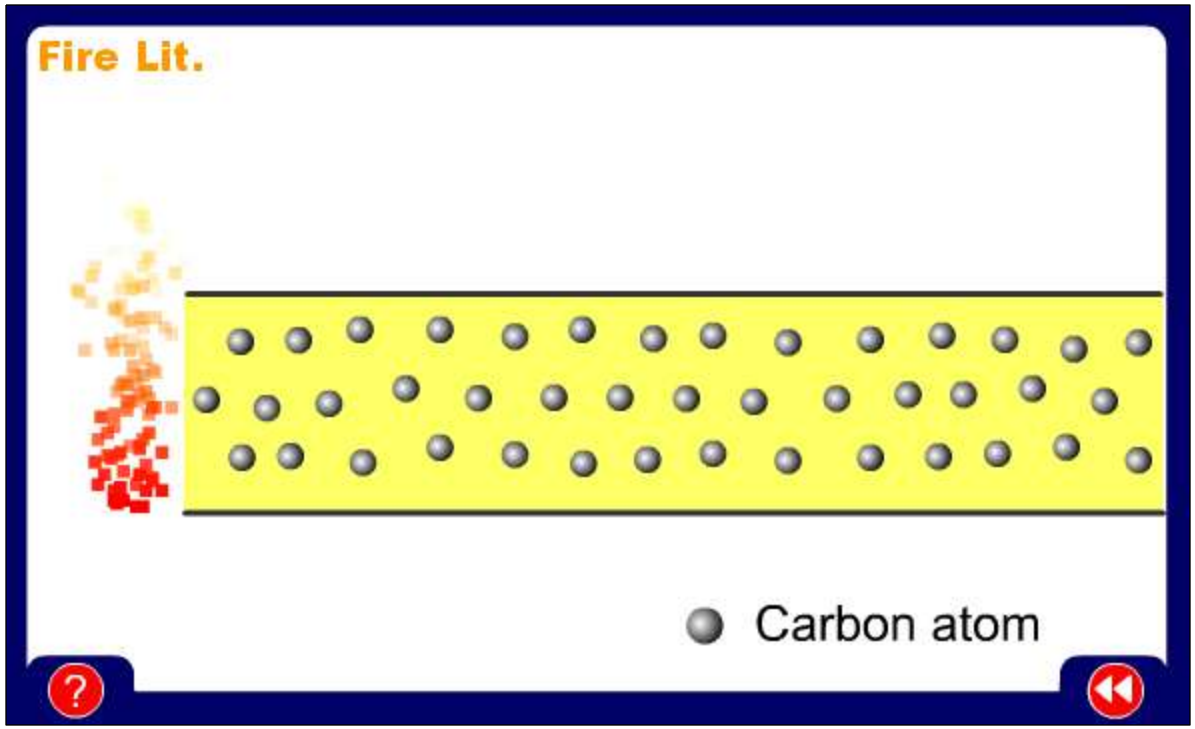
Thermal Equilibrium

- When something warm is in contact with something cool, the warm object transfers heat to the cool object until they both reach the same temperature.

Heat Transfer Methods

- Heat transfers in three ways:
  - Conduction
  - Convection
  - Radiation

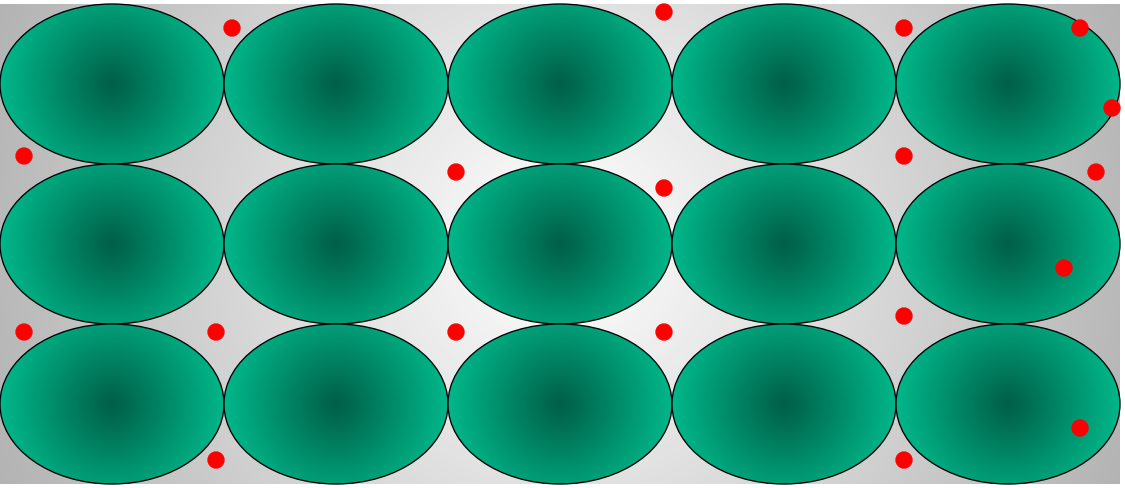
When you heat a metal strip at one end, the heat travels to the other end.



As you heat the metal, the particles vibrate, these vibrations make the adjacent particles vibrate, and so on and so on, the vibrations are passed along the metal and so is the heat. We call this? Conduction

Metals are different

The outer electrons of metal atoms drift, and are free to move.



When the metal is heated, this 'sea of electrons' gain kinetic energy and transfer it throughout the metal.

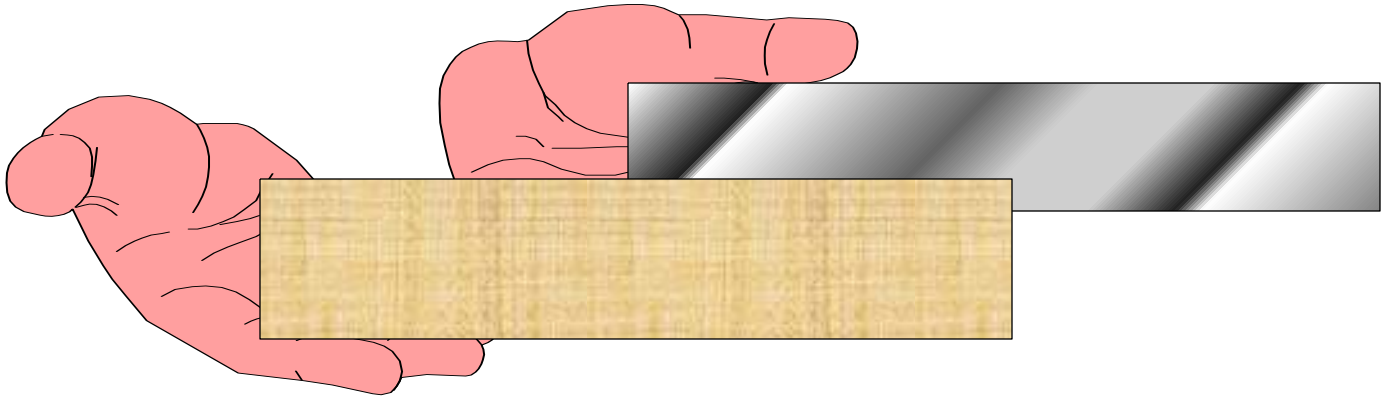
Insulators, such as wood and plastic, do not have this 'sea of electrons' which is why they do not conduct heat as well as metals.

Eureka! Conduction Video

- http://bit.ly/oud8HD

Why does metal feel colder than wood, if they are both at the same temperature?

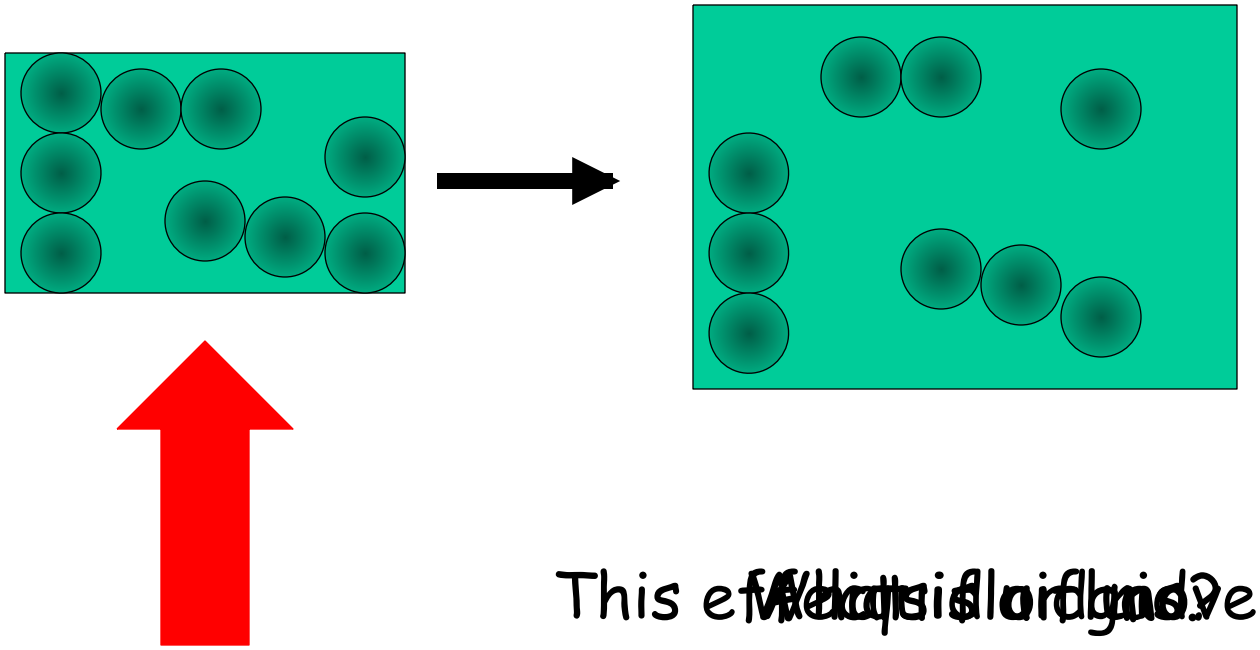
Metal is a ***conductor***, wood is an ***insulator***. Metal conducts the heat away from your hands. Wood does not conduct the heat away from your hands as well as the metal, so the wood feels warmer than the metal.



Convection

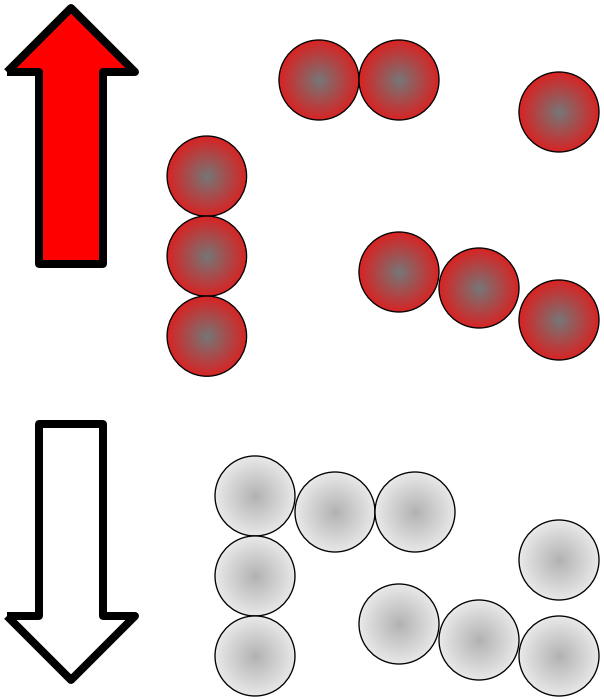
What happens to the particles in a liquid or a gas when you heat them?

The particles spread out and become less dense.



This effect is called convection.

Convection and Fluid Movement



Cooler, more d<u>ense</u>, fluids sink through w<u>armer</u>, less dense fluids.

In effect, warmer liquids and gases r<u>ise</u> up.

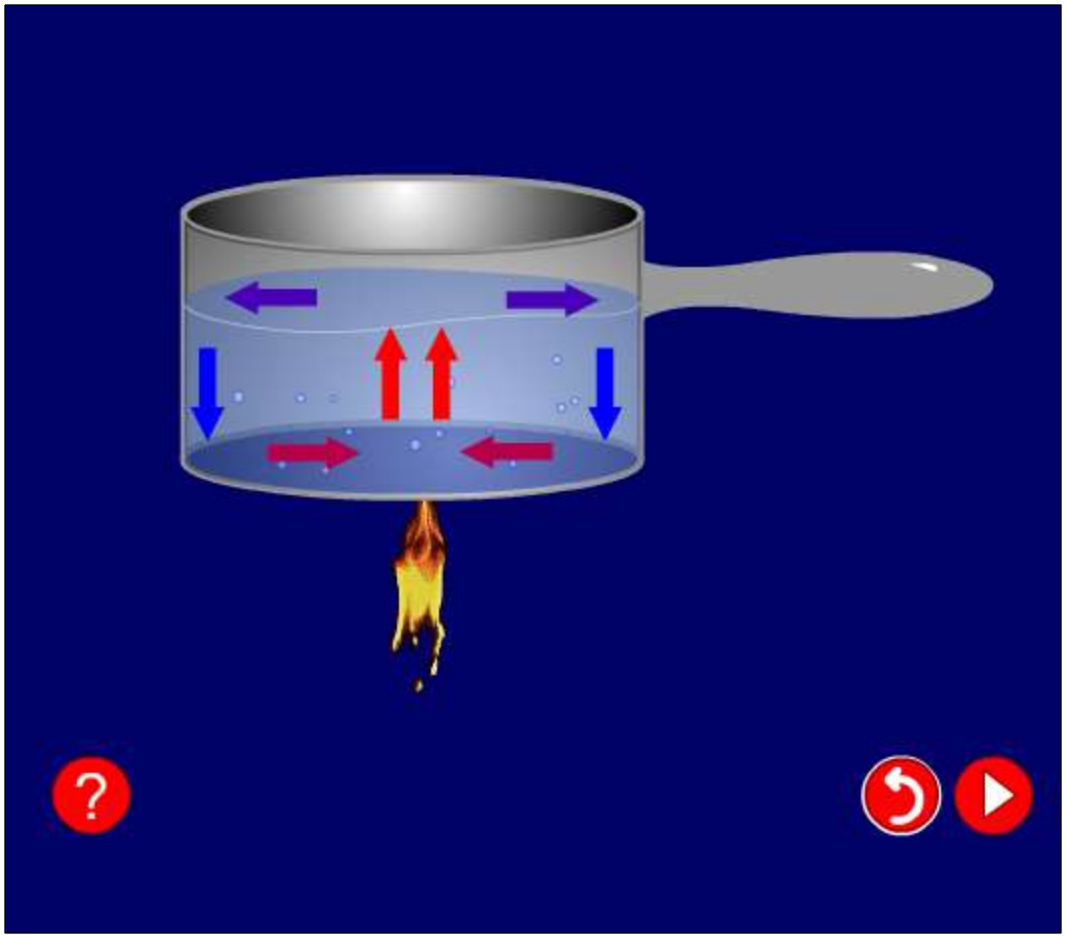
Cooler liquids and gases s<u>ink</u>.

Water movement

Cools at the surface

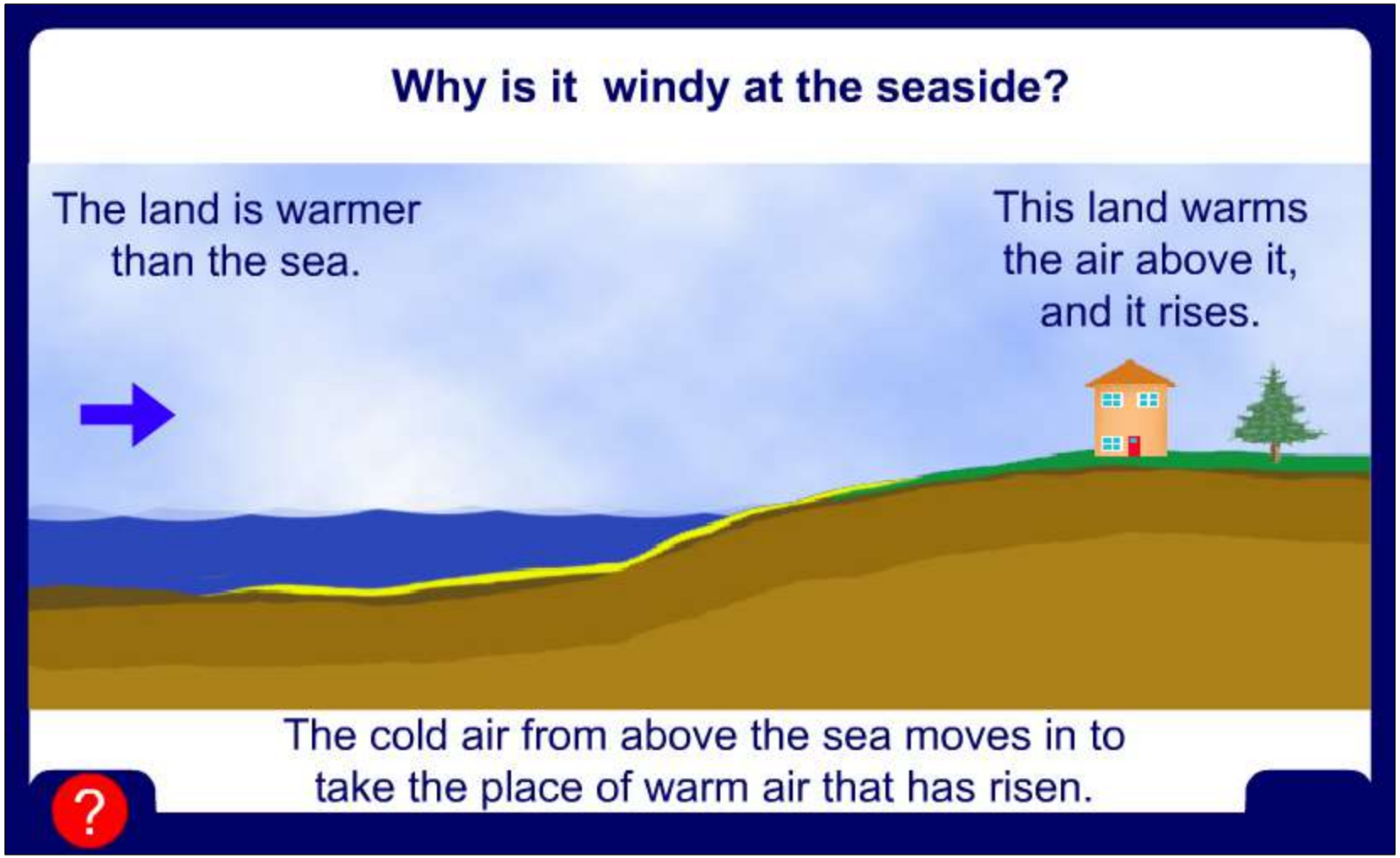
Convection current

Cooler water sinks



Hot water rises

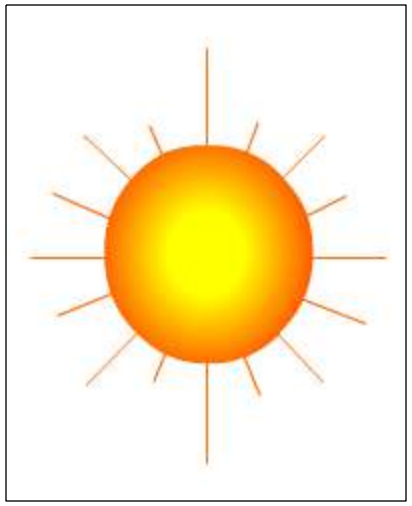
Why is it windy at the seaside?



Eureka! Convection Video

- http://bit.ly/pLEvAh

How does heat energy get from the Sun to the Earth?



?

There are no <u>particles</u> between the Sun and the Earth so it CANNOT travel by conduction or by convection.

RADIATION

The transfer of heat through waves.

Eureka! Radiation Video

- http://www.schooltube.com/video/e457892b960b7be589b9/Eureka!%20Episode%2029%20-%20Radiation%20Waves

Radiation

Radiation travels in straight lines

True/~~False~~

Radiation can travel through a vacuum

True/~~False~~

Radiation requires particles to travel

~~True~~/False

Convection questions

Why does hot air rise and cold air sink?

Cool air is more dense than warm air, so the cool air 'falls through' the warm air.

Why are boilers placed beneath hot water tanks in people's homes?

Hot water rises.

So when the boiler heats the water, and the hot water rises, the water tank is filled with hot water.

Radiation questions

Why are houses painted white in hot countries?

White reflects heat radiation and keeps the house cooler.

Why are shiny foil blankets wrapped around marathon runners at the end of a race?

The shiny metal reflects the heat radiation from the runner back in, this stops the runner getting cold.

1. Which of the following is not a method of heat transfer?

A. Radiation

B. Insulation

C. Conduction

D. Convection

3. How does heat energy reach the Earth from the Sun?

A. Radiation

B. Conduction

C. Convection

D. Insulation