



# *Refrigeration Fundamentals*

## **Part 1**

### **Heat and Heat Transfer**



# What is Refrigeration?

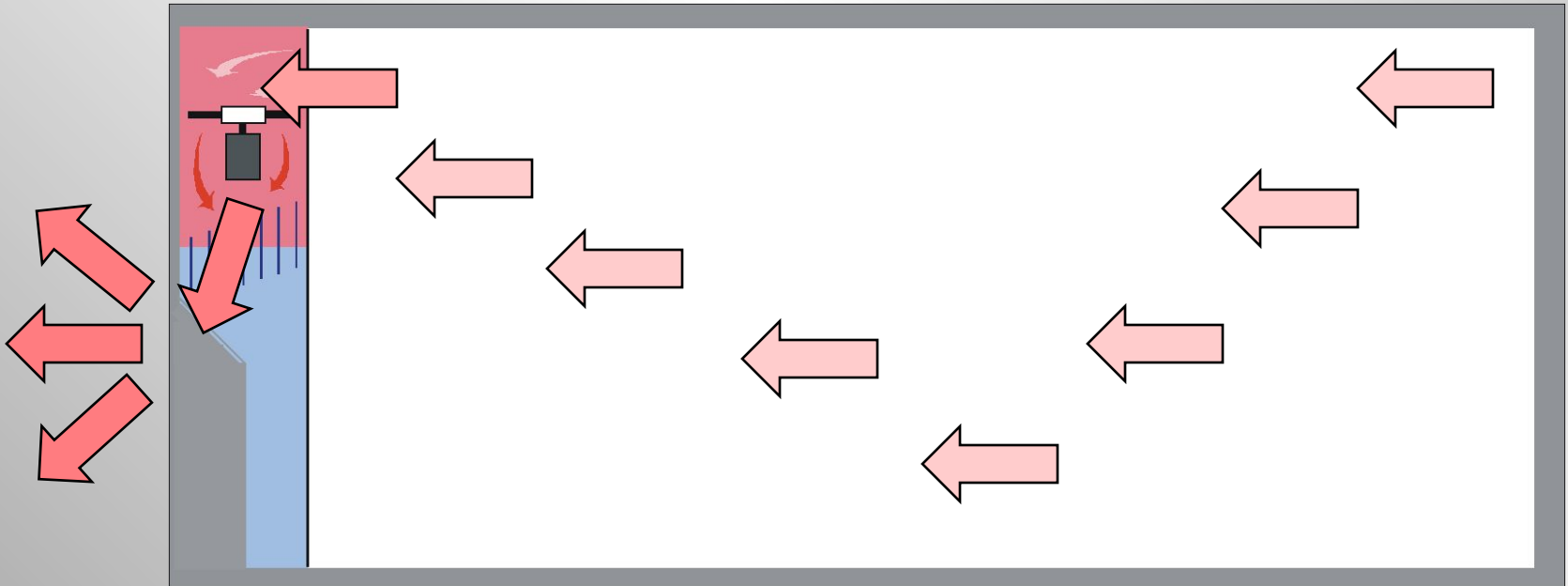


# DEFINITION

**'Refrigeration' ...**

...is the transfer of heat from a place where it is 'not wanted' ...

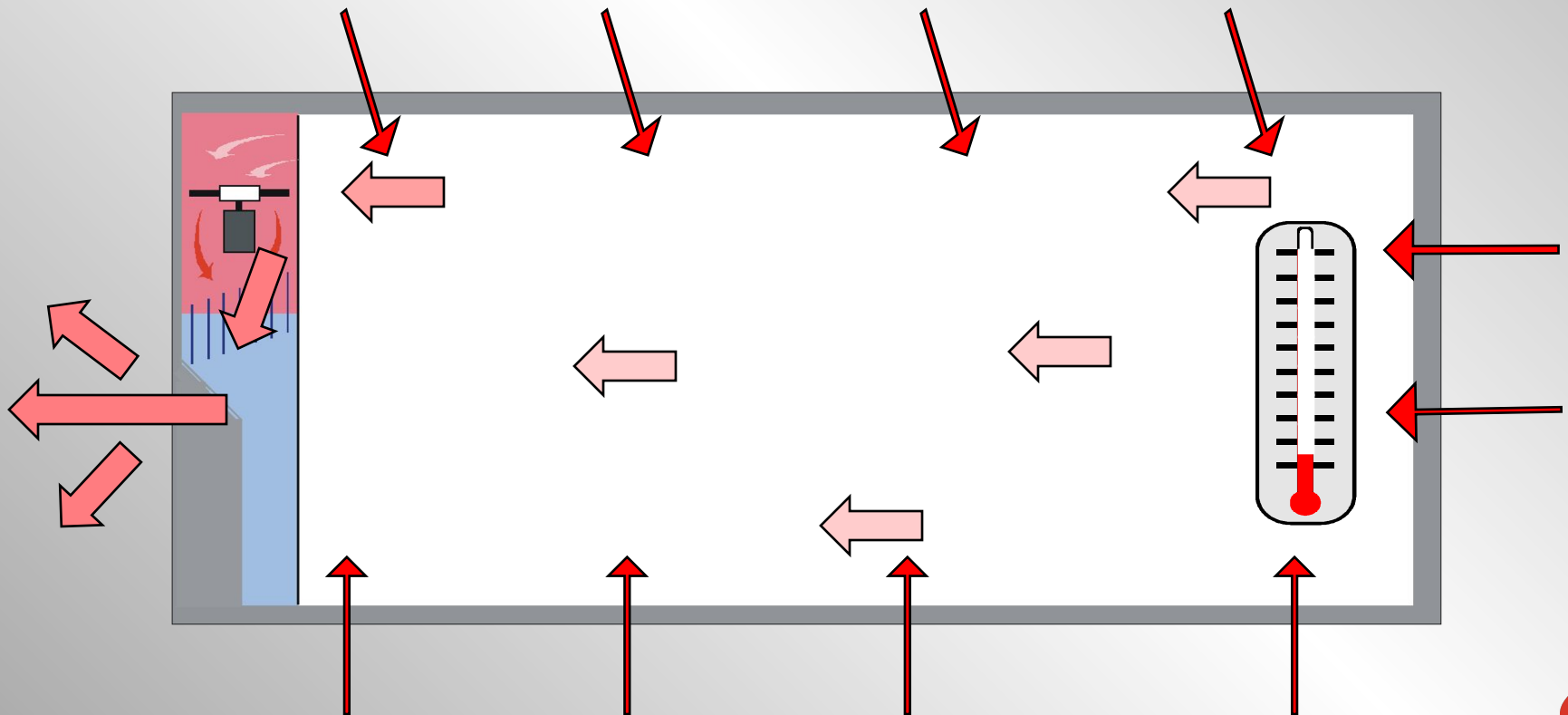
... to a place where it is 'unobjectionable'.





# HEAT REMOVAL

- ❖ If heat is removed from inside the container 'faster' than it enters...  
...The internal temperature becomes colder.





# WHAT IS HEAT?

- ❖ A Form of Energy
- ❖ It Exists 'Everywhere'
- ❖ It Exists at 'All Temperatures'...Except...
  - **Absolute Zero (-459° F / -273° C)**
- ❖ It can be Moved from 'Place to Place'



# WHAT ARE REEFERS?

Machines that 'Move Heat'



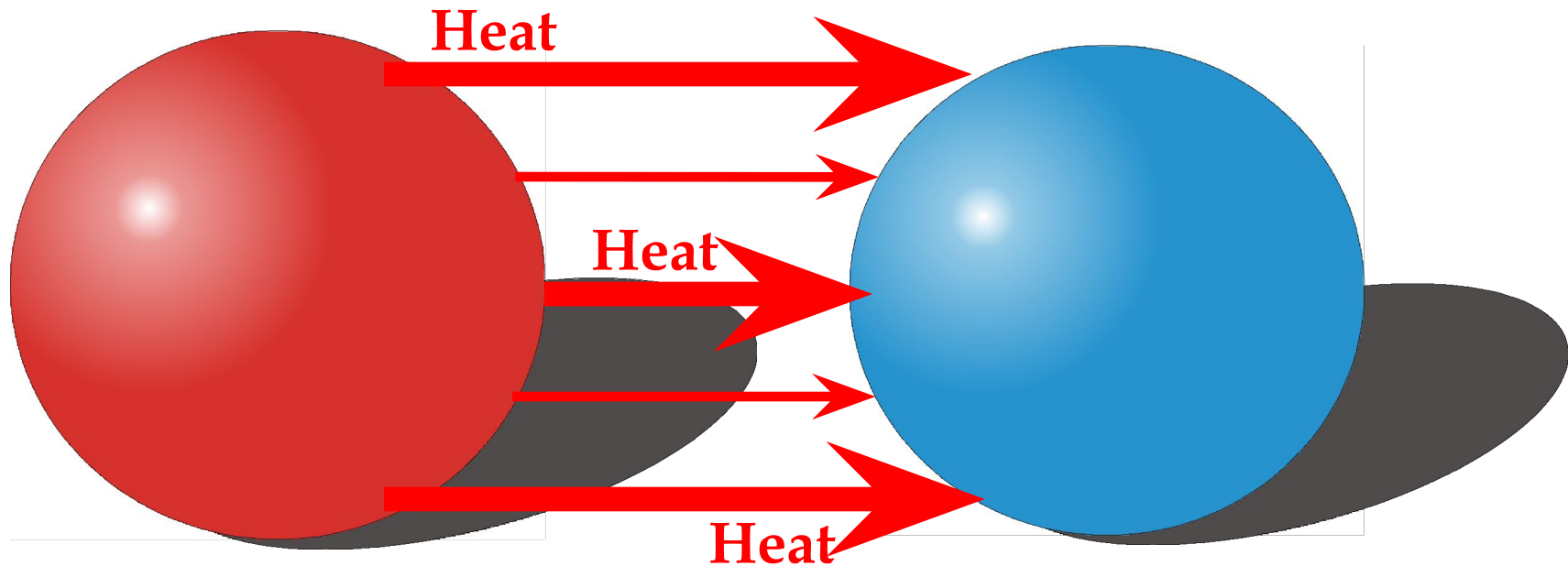


# 'HOW' DOES HEAT MOVE?

❖ Warmer  $\Rightarrow$  Colder - **ALWAYS!!!!!!!**



Faster' with Large Temp. Difference





# 'HOW' DOES IT MOVE?

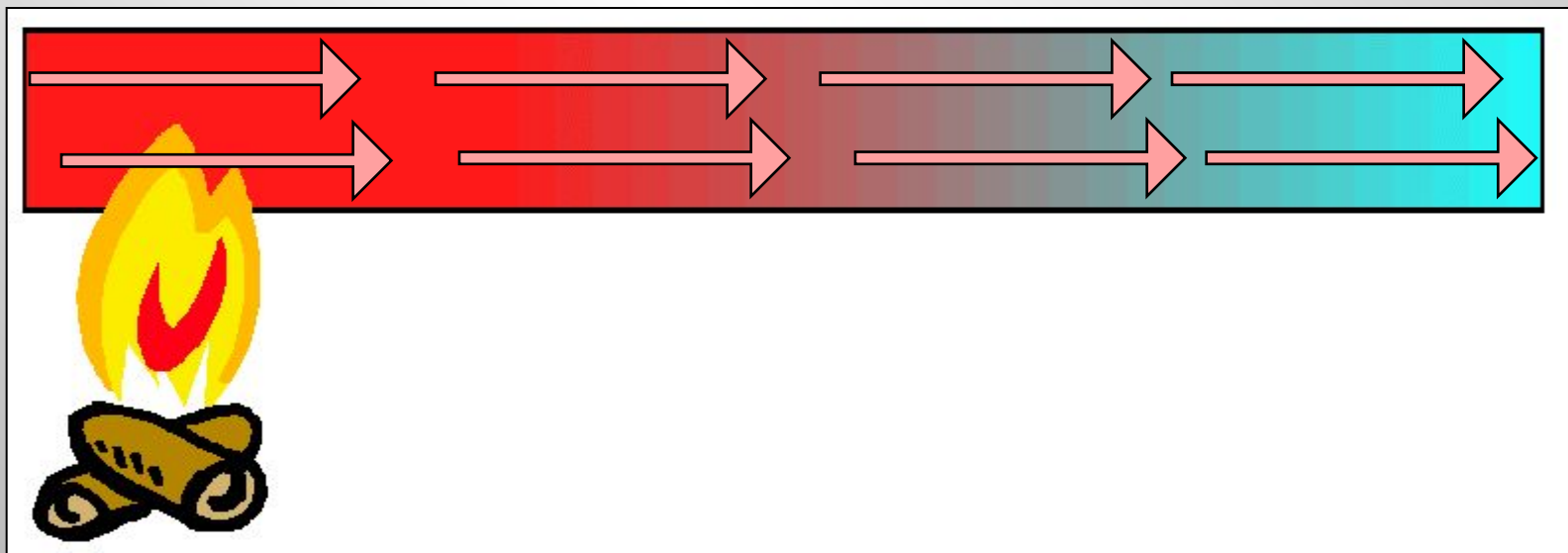
- ◆ **Heat can move three (3) ways....**
  - 1. Conduction**
  - 2. Convection**
  - 3. Radiation**





# CONDUCTION

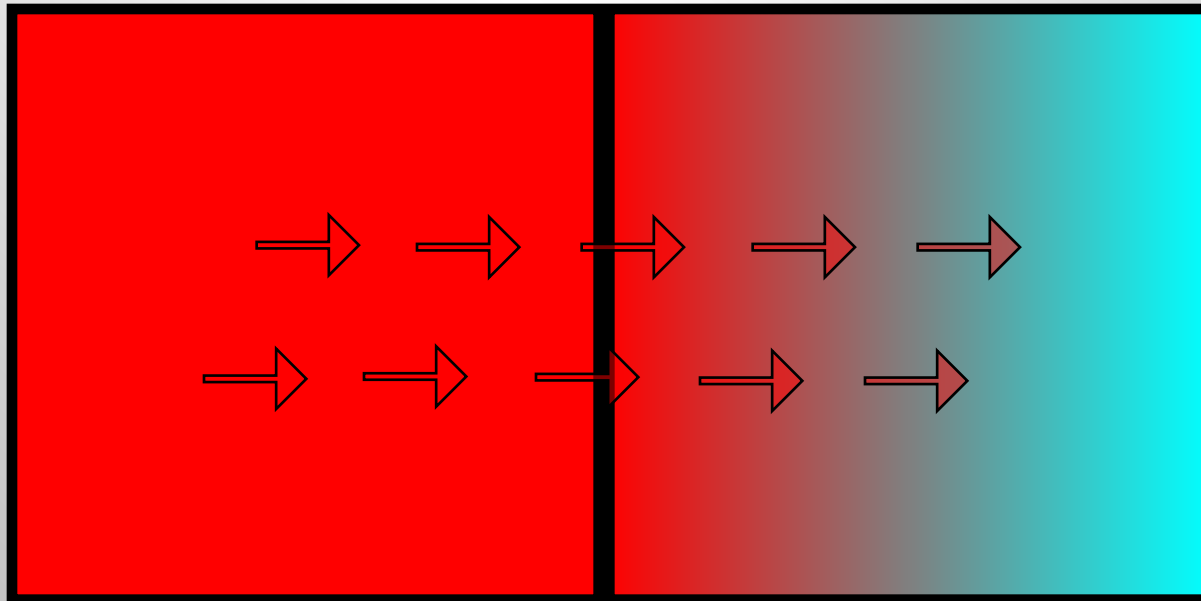
- ❖ Heat moves through Solids & Liquids





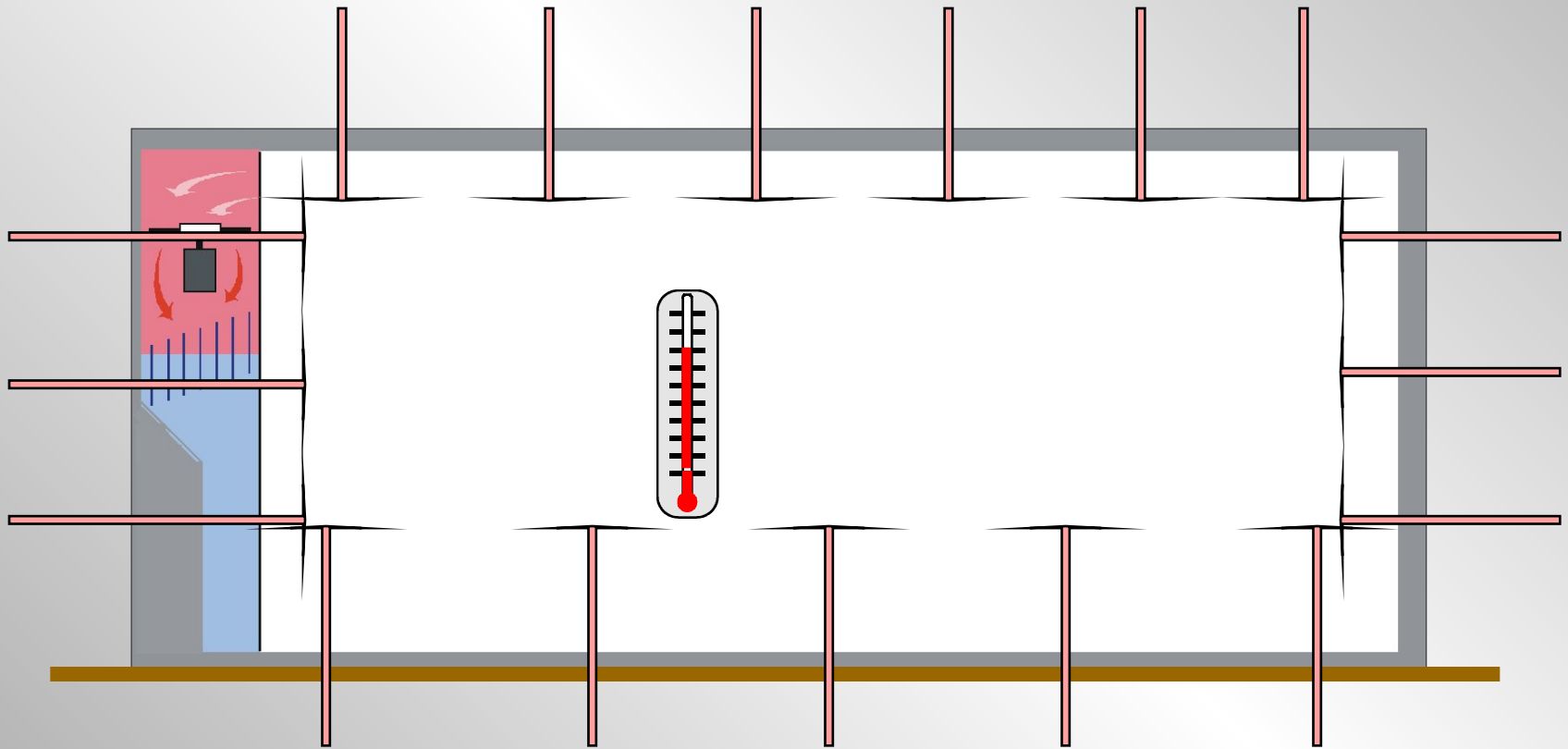
# CONDUCTION

- ❖ Heat will move Between Solids and / or Fluids in direct contact with one another





# CONDUCTION





**Any other Examples of  
Conduction?**



# CONVECTION

**Definition** - Heat transfers via the circulation (movement) of a fluid.  
i.e.....

- ***Air*** is a fluid
- ***Refrigerant*** Liquid & Vapor are fluids

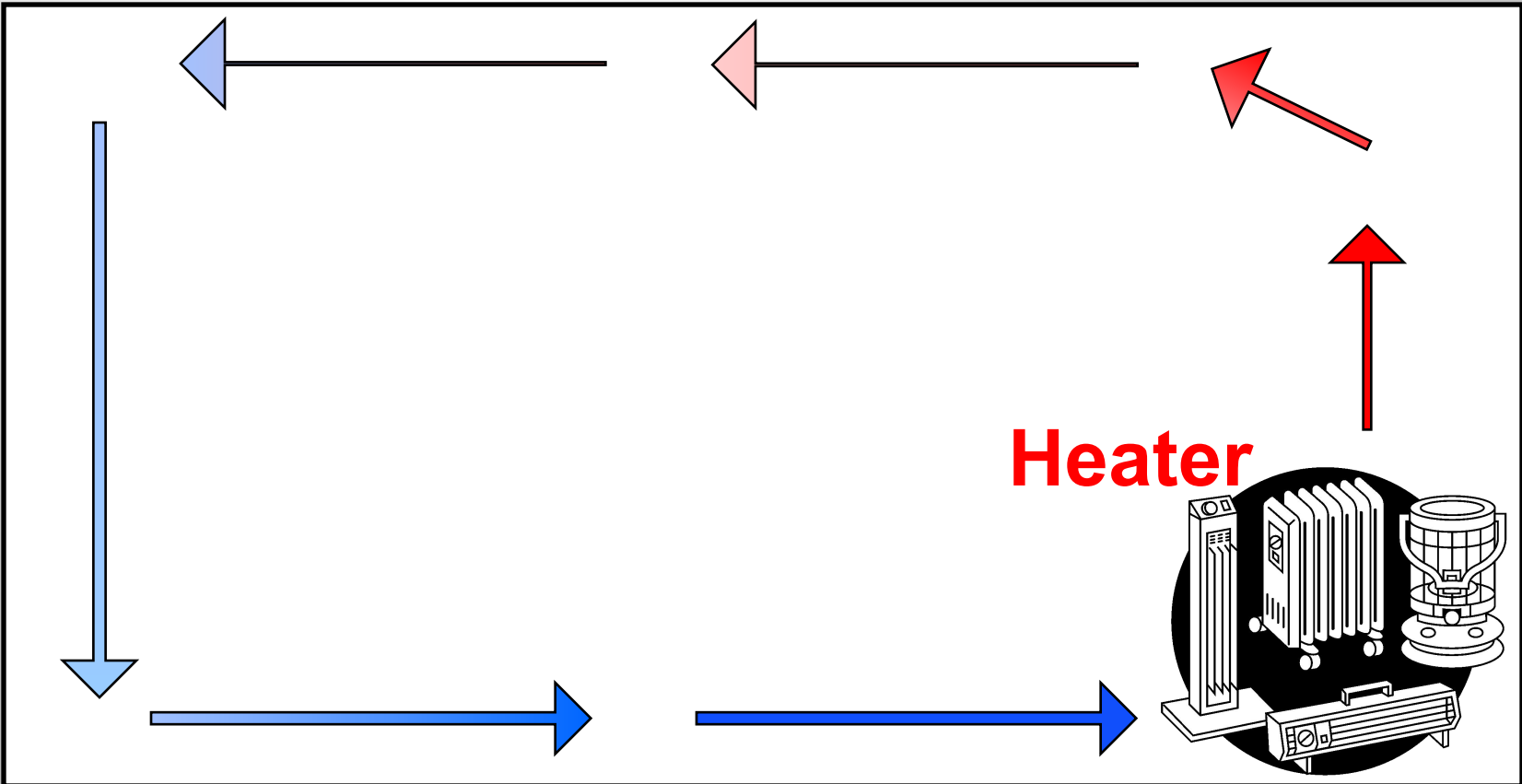
## **Types**

- ***'Natural'*** Convection
- ***'Forced'*** Convection



# 'NATURAL' CONVECTION

**Warm Air Rises**



**Heater**

**Cool Air Falls**

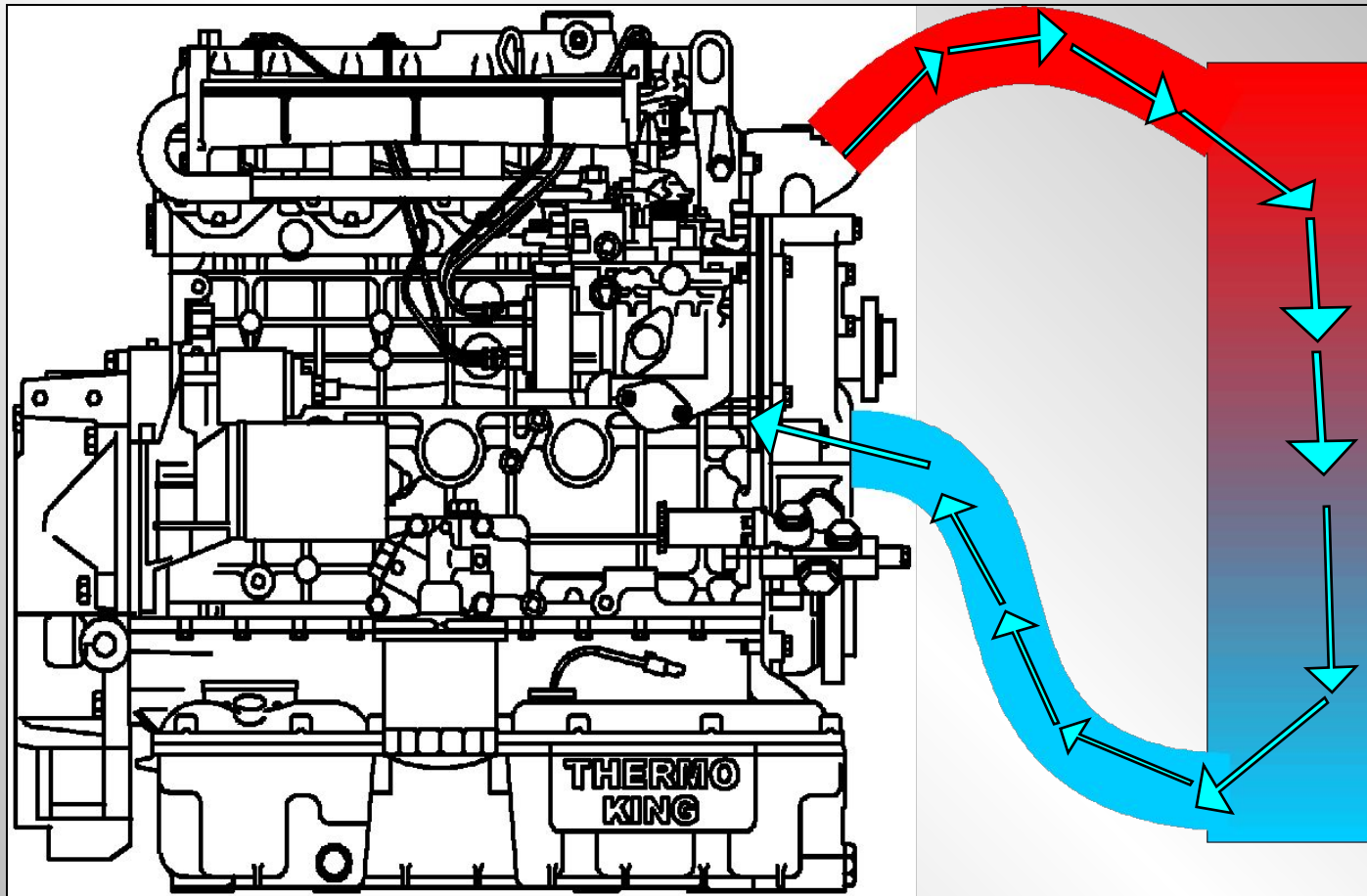


# 'NATURAL' CONVECTION





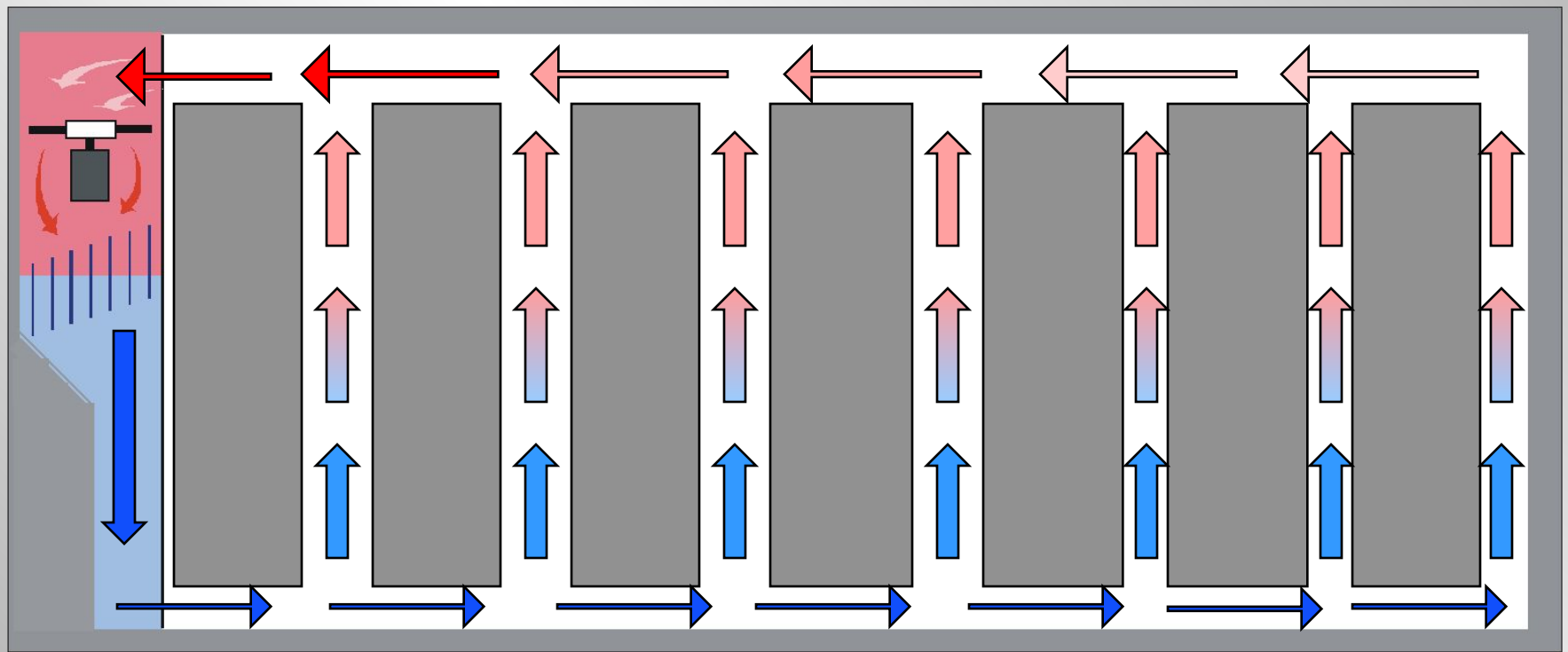
# 'FORCED' CONVECTION







# 'FORCED' CONVECTION





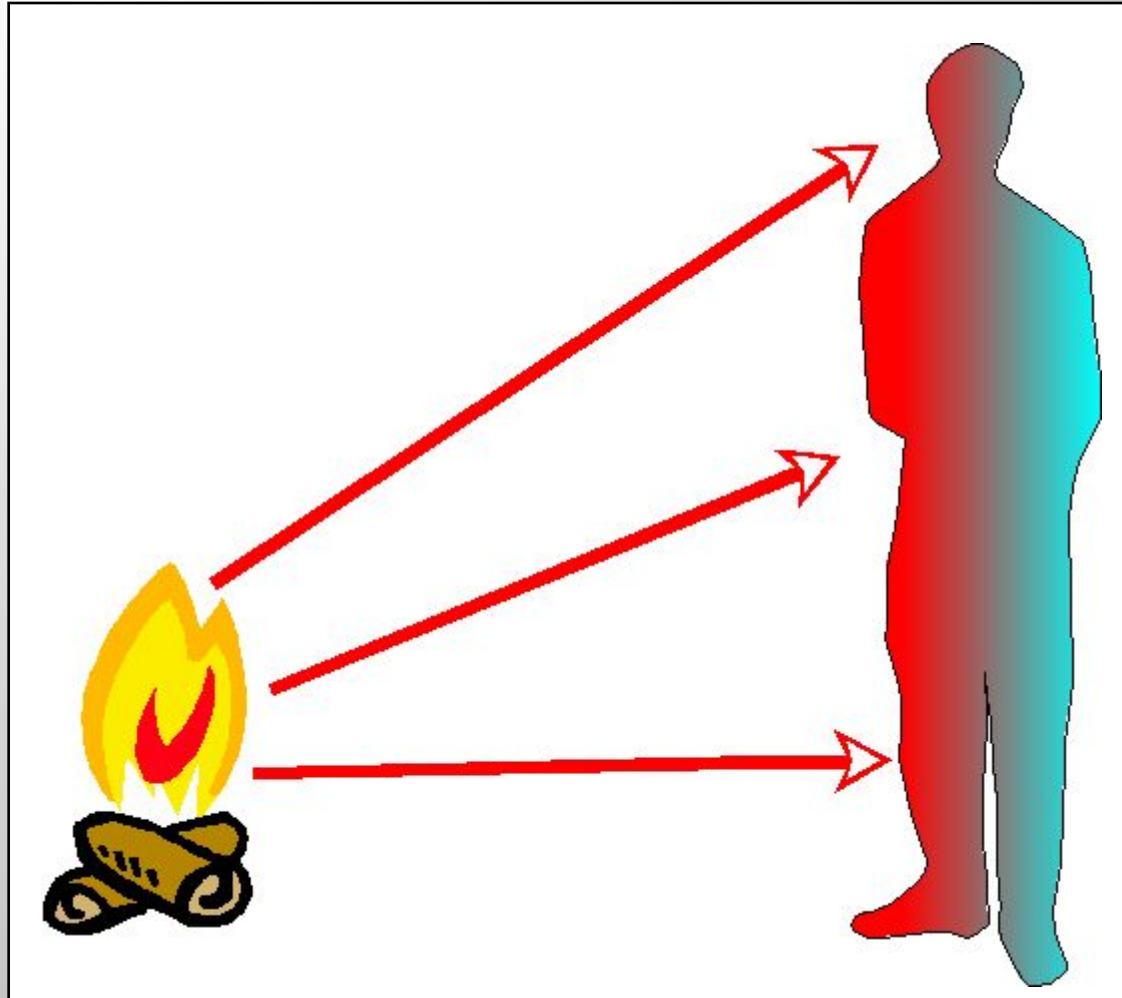
**Any other Examples of  
Convection?**



# RADIATION

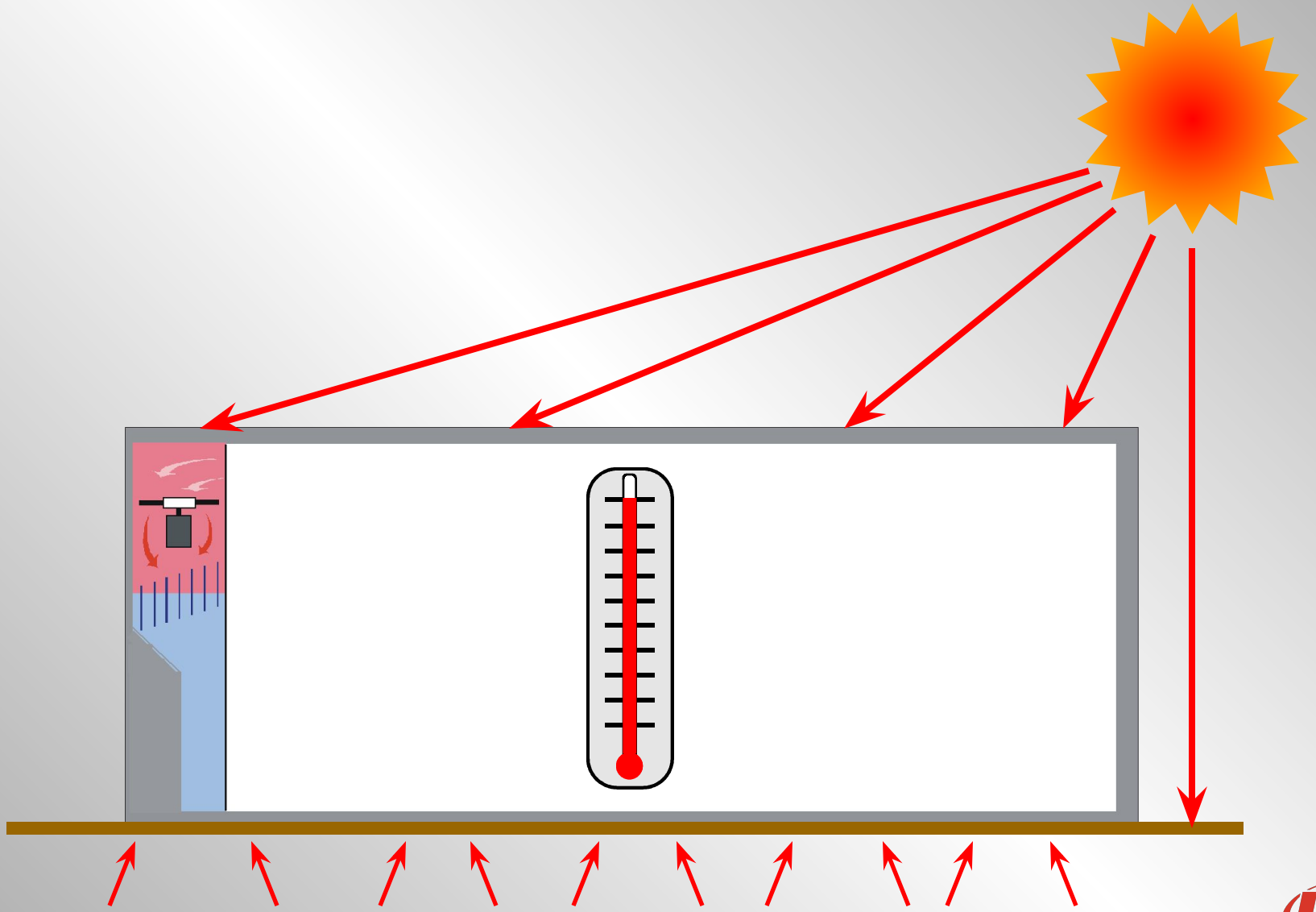
- ❖ Moves in Straight Lines... like light
- ❖ Does not heat the air it passes through
- ❖ Raises temperature of the substance that absorbs it
- ❖ Dark colors absorb 'more' heat...
- ❖ Light colors absorb 'less' heat

# RADIATION





# RADIATION



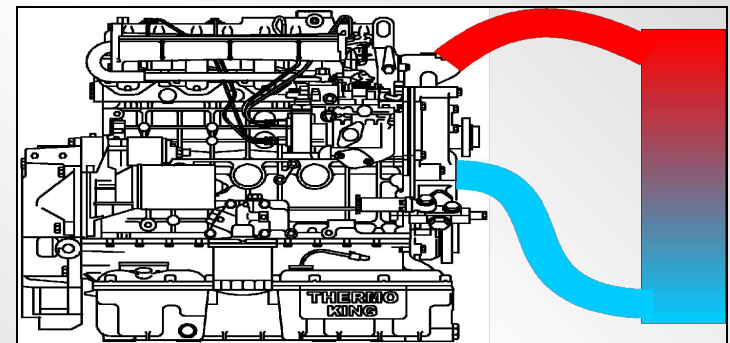
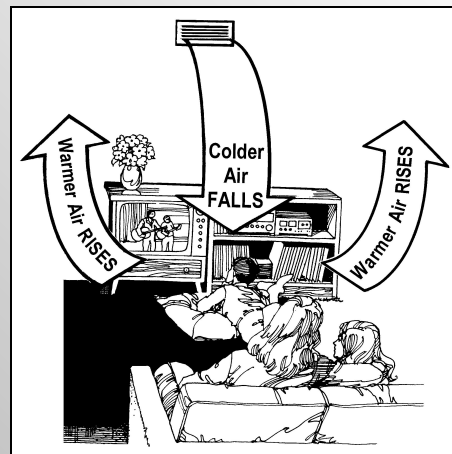
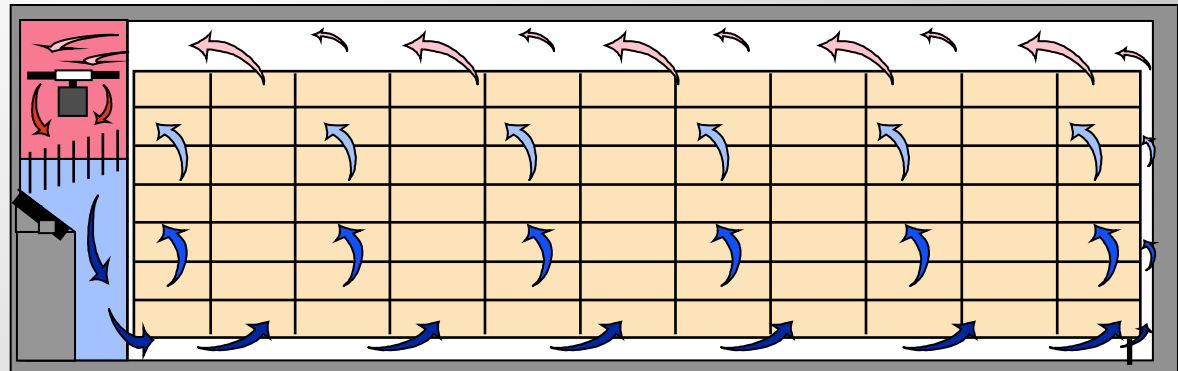


**Any other Examples of  
Radiation?**



# HEAT TRANSFER SYSTEMS

- ❖ Usually combine 'Conduction' AND 'Convection' to move heat. i.e....





# TERMS TO REMEMBER

- ◆ Refrigeration
- ◆ Heat
- ◆ Box
- ◆ Conduction
- ◆ Convection
- ◆ Radiation





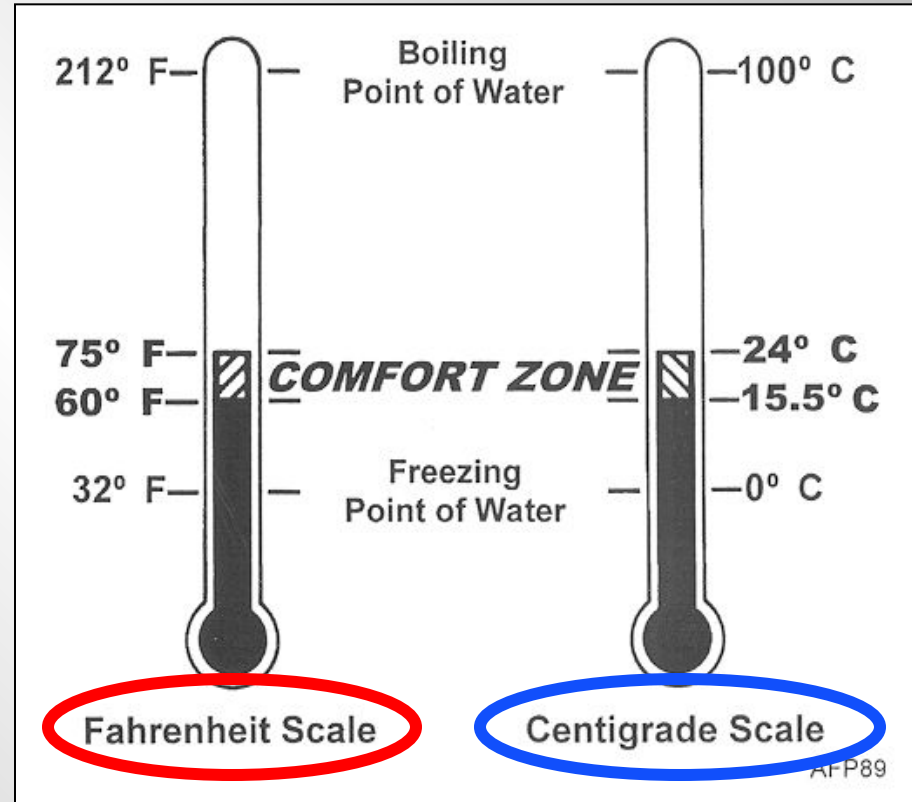
# HOW IS HEAT 'MEASURED'?

- ❖ **Four (4) Ways.....**
  - 1. Temperature**
  - 2. Sensible Heat**
  - 3. British Thermal Unit (BTU)**
  - 4. Specific Heat**



# TEMPERATURE

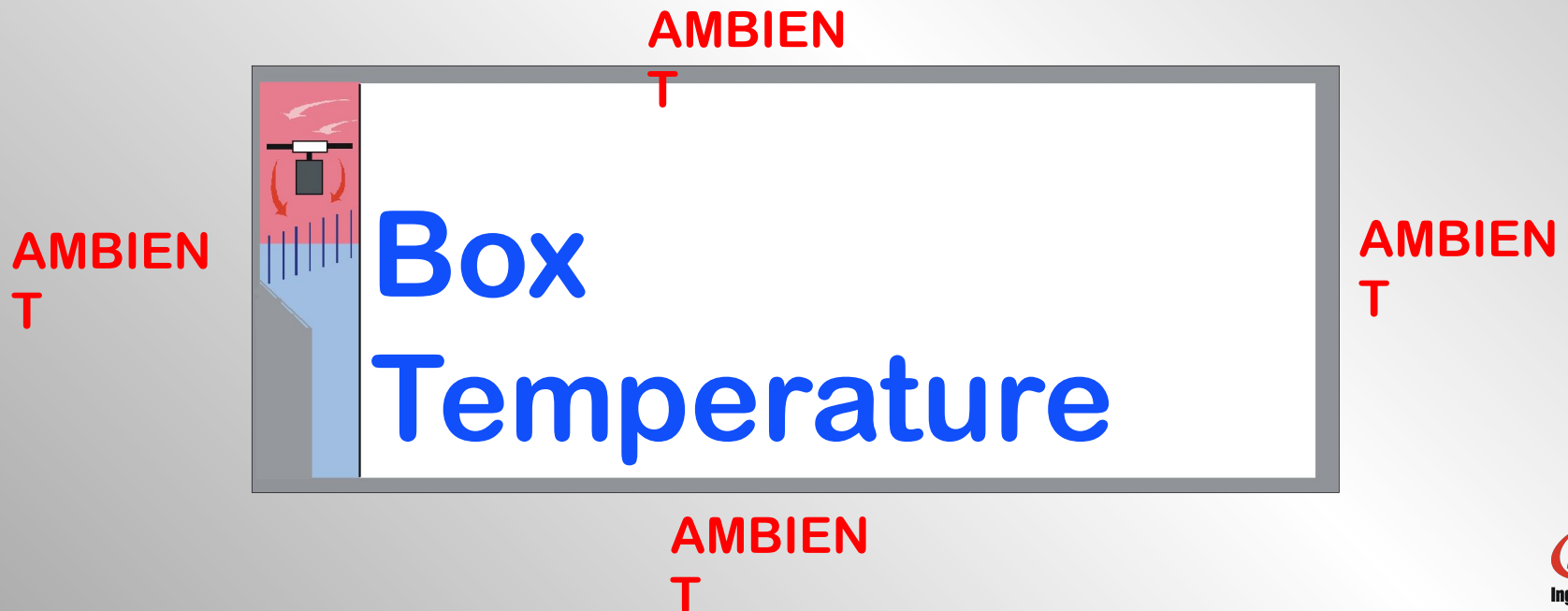
- ◆ Is the Level or Intensity of heat energy
- Is measured in degrees Fahrenheit or Centigrade
- Can be 'Felt' or 'Sensed'





# TEMPERATURE

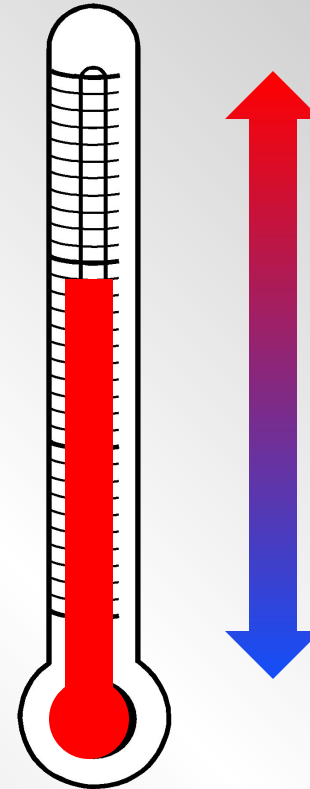
- ❖ The temperature inside the controlled space (container) is called....
- The temperature surrounding the Container is called...





# SENSIBLE HEAT

- ◆ Is Heat you 'Can Feel'
- Is measured with a Thermometer
- Causes a change in Temperature

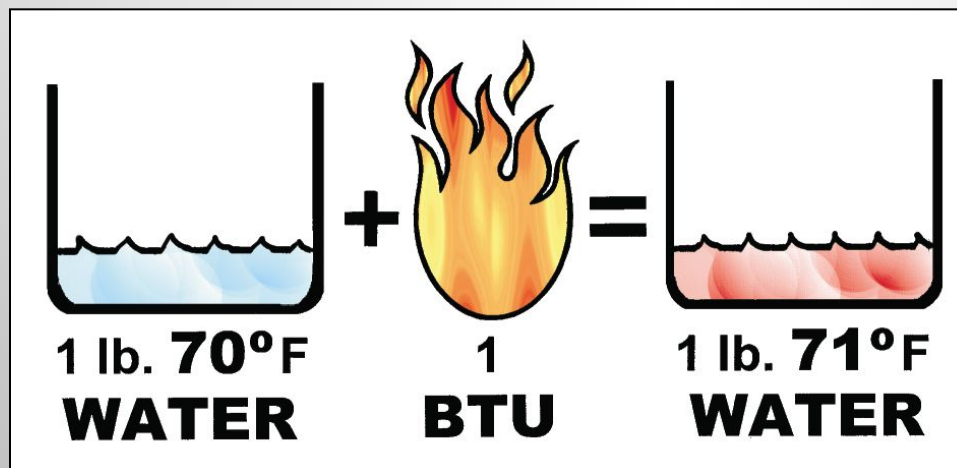




# BRITISH THERMAL UNIT

- ❖ Measure of the quantity (amount) of heat energy

**Definition:** A Btu is the amount of heat required to raise the temperature of one (1) pound of water one (1) degree F





# SPECIFIC HEAT

- ❖ Amount of heat required to raise the temperature of one (1) pound of a 'Specific Substance' one (1) degree F. **i.e. 0.75**
- Compared to Water (1.0)
- The less heat required to change substance temp., the lower the Specific Heat
- The more heat required to change substance temp., the higher the Specific Heat





# SPECIFIC HEAT EXAMPLES

- ❖ Water - 1.0
- ❖ Aluminum - .22
- ❖ Honey - .35
- ❖ Cheese - .50
- ❖ Fresh Beef - .75
- ❖ Vegetables - .90
- ❖ Cucumbers & Watermelon - .97



# TERMS TO REMEMBER

- ❖ Temperature
- ❖ Box Temperature
- ❖ Ambient Temperature
- ❖ Sensible Heat
- ❖ Btu
- ❖ Specific Heat





# Questions?