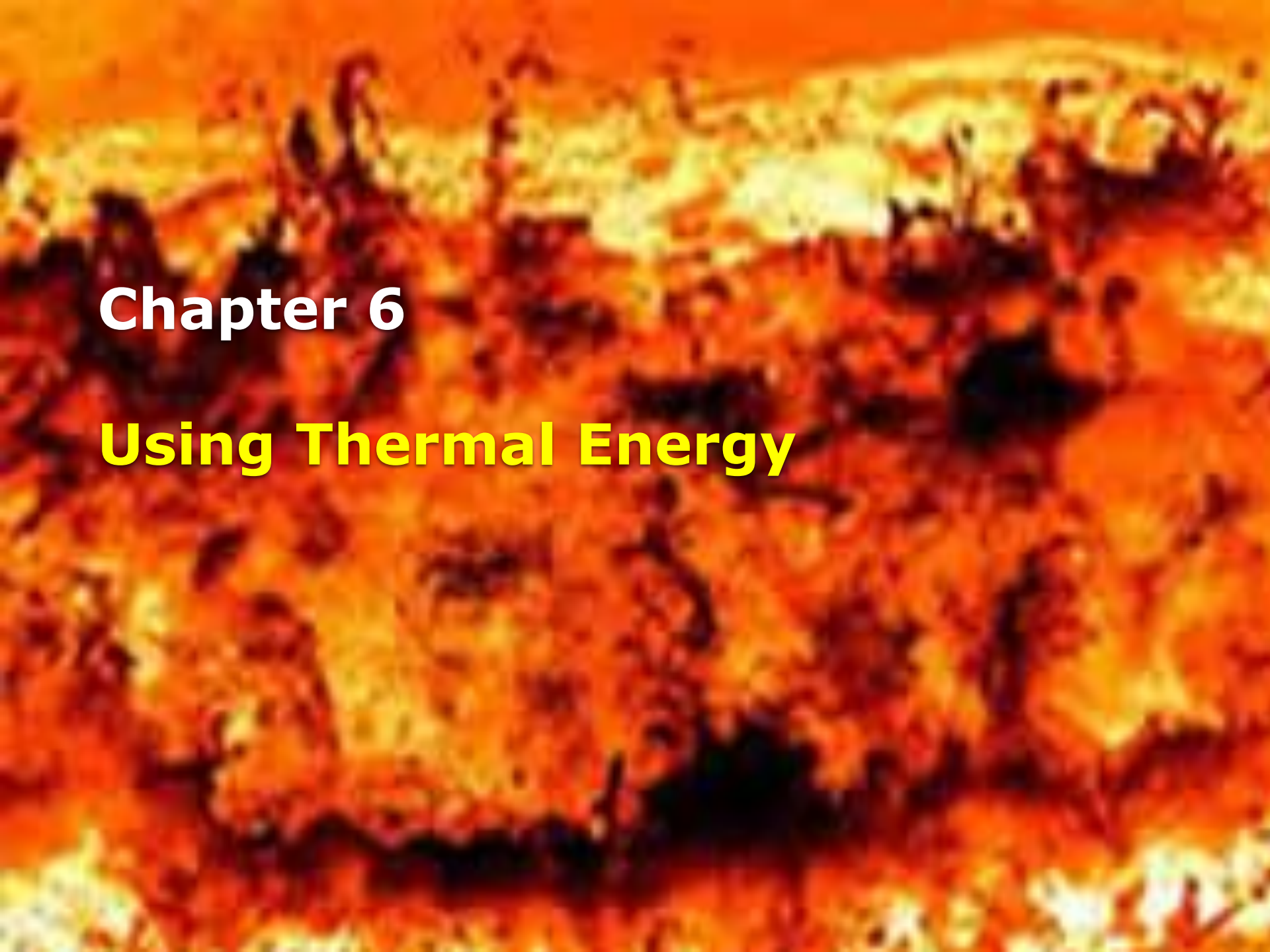
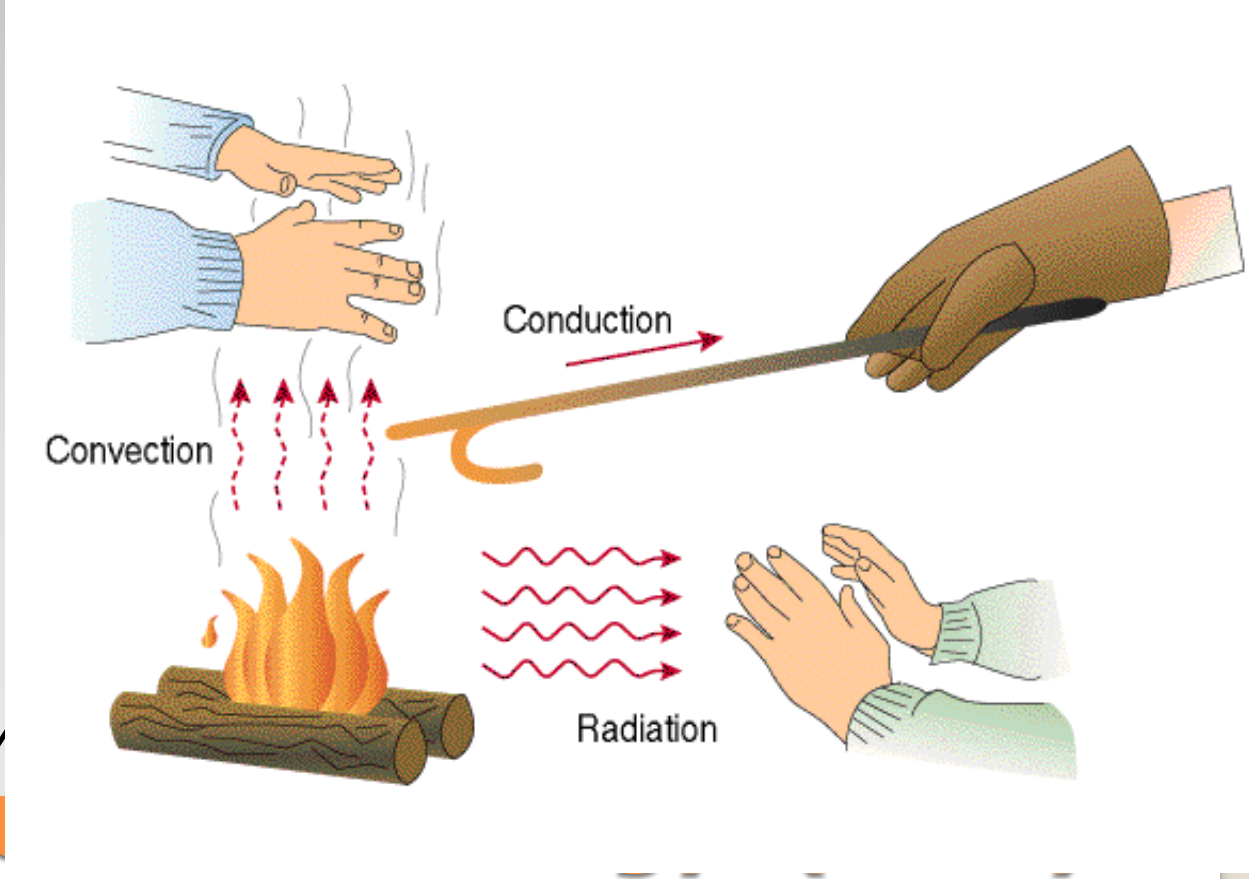

Chapter 6
Using Thermal Energy

- Conduction
- Convection
- Radiation



Know the three main ways that thermal energy is transferred.

Moving of t

*

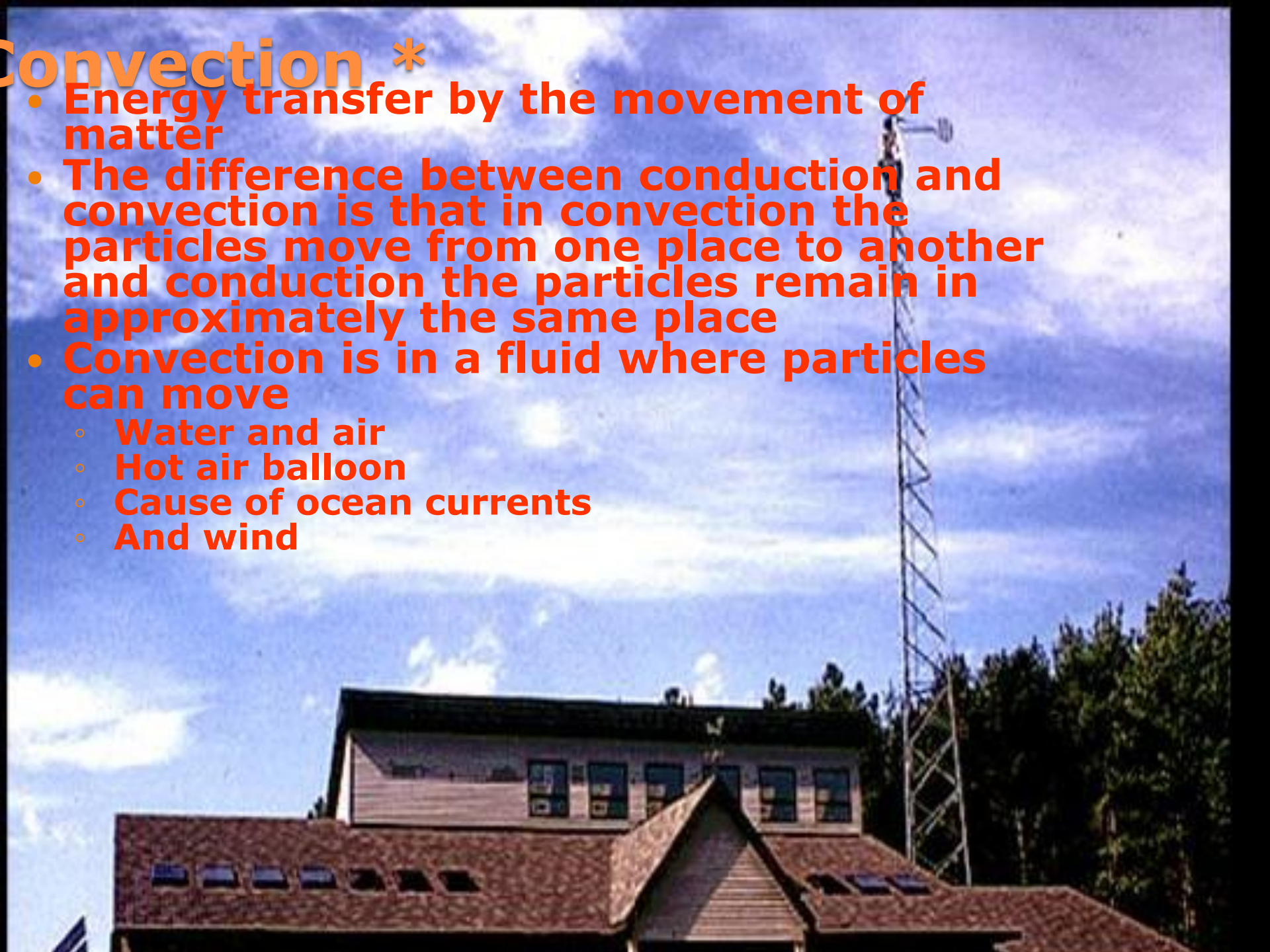
- transfer of energy by direct contact of matter
- Result of one particle colliding with another
- Conduction takes place best when particles are close together
- Some solids are better conductors than other.
  - Metals are better conductors than nonmetals*

What materials are good conductors?

Conduction *

Convection *

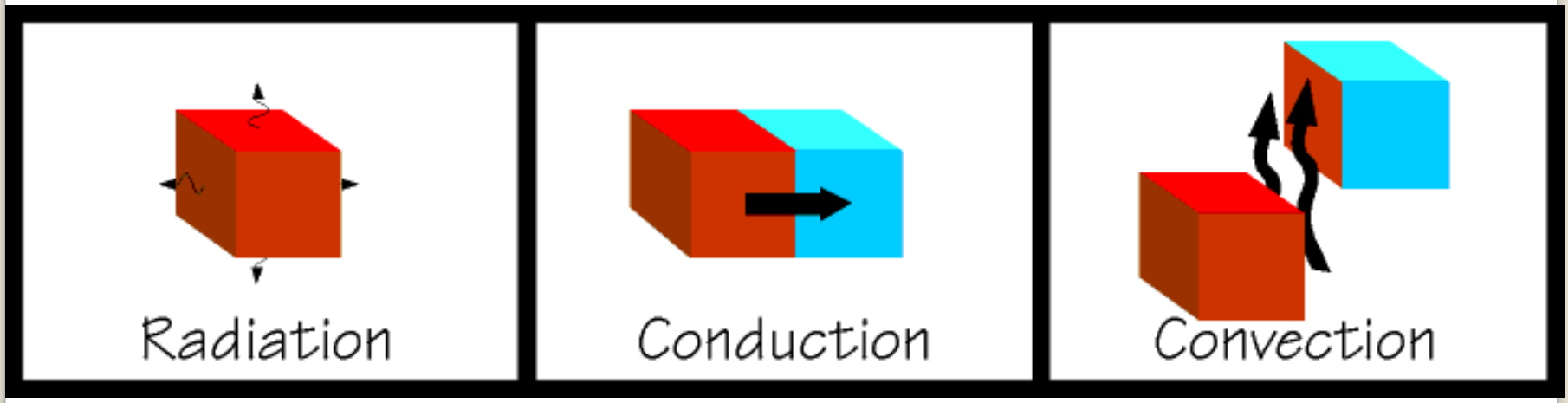
- Energy transfer by the movement of matter
- The difference between conduction and convection is that in convection the particles move from one place to another and conduction the particles remain in approximately the same place
- Convection is in a fluid where particles can move
  - Water and air
  - Hot air balloon
  - Cause of ocean currents
  - And wind



Radiation*

- Transfer of energy in the form of waves
- The absorbed radiant energy is turned to thermal energy*
- Some energy is reflected
- Different material absorb energy different
- Shiny reflect radiant energy
- Dark absorb radiant energy
- Anything above 0 Kelvin emit radiation
- Energy gets from the sun to the earth by radiation*

  What is required in conduction and convection, but not in radiation?*


Radiation
Conduction
Convection

Insulators*

- Do not allow heat to move easily
- Insulators are usually a combination of air pockets and reflective material
- Air pocket stop or slow
- Reflective surfaces help stop radiation
- Nonmetals make good insulators

How does a good insulator stop conduction, convection, and radiation?*

- Wood, plastics, glass, foam etc . . . . .

ulators

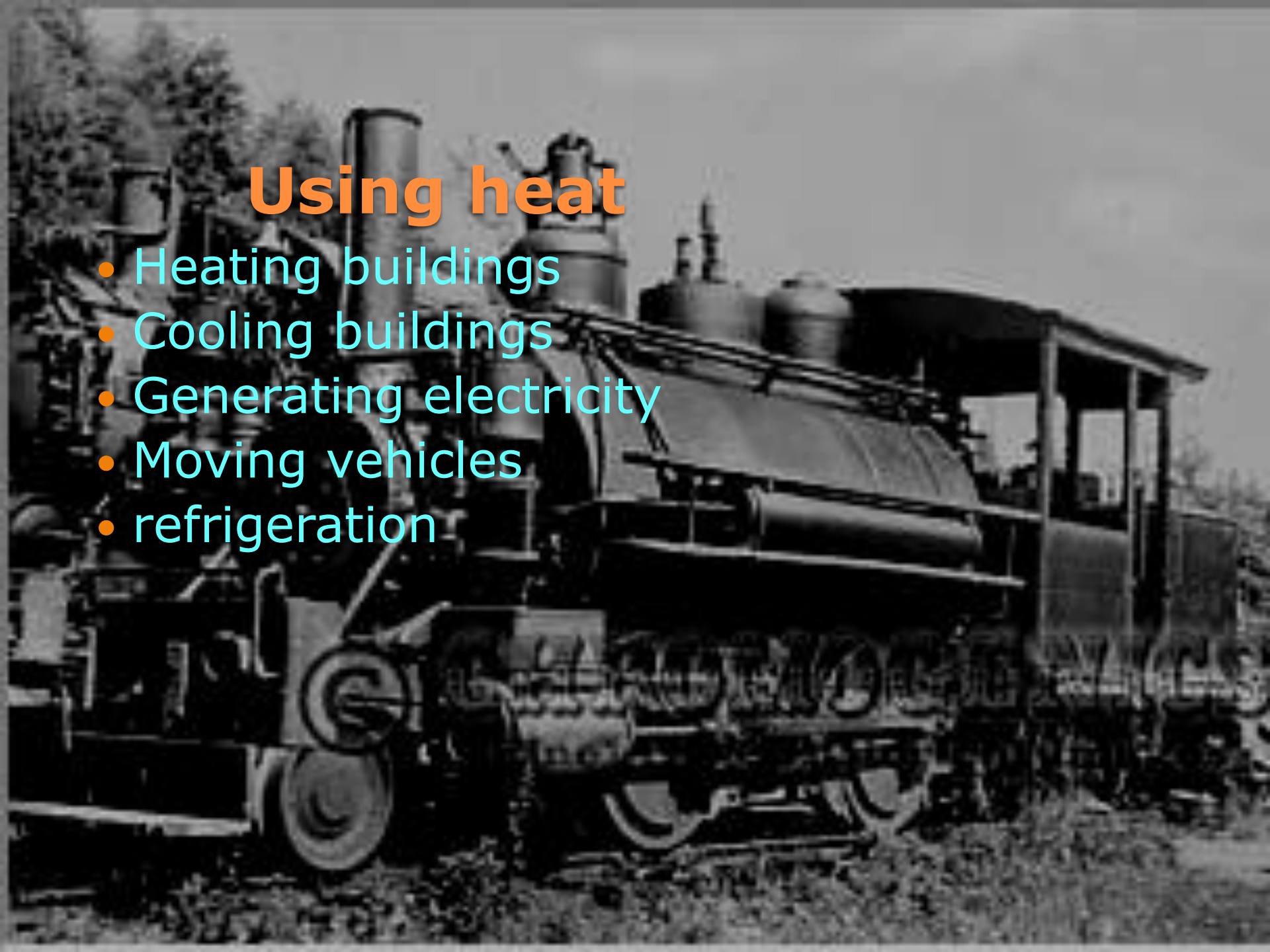
Insulation ratings

- R values are the resistance to heat flow*
- R value is the resistance of 1 m by 1 m of material for each cm thickness
- R value needed in the wall is 19 and in the roof is 30-40
  - Windows have a low R factor
- R value table p 157

Explain R-factor.

Why is higher R-Value needed in the ceiling than the walls?

Description	Detail	R-Value
Batt & Blanket - Uncompressed	Approx. 1"	2.55 - 2.92
Batt & Blanket - Compressed	1"	3.08 - 3.14
Cellular Glass Insulation Board	1"	2.86
Glass Fiber Insulation Board	1"	4.00
Expanded Perlite Board, Organic	1"	2.78
Expanded Rubber Insulation Board	1"	4.55
Polystyrene Board Extruded - Molded	1"	3.85 - 5.00
Polyurethane/Polyisocyanurate Board - Gas	1"	5.56 - 6.25
Cellular Impermeable Facers	1"	7.20
Perlite Insulation Board	1"	2.63
Foamed Urethane Board	1"	7.15
Perlite Urethane Board	1"	5.00
Fiberglass Urethane Board	1"	5.56
Loose Fill	**1"**	2.00 - 2.18
Perlite Loose Fill	1"	3.05
Vermiculite Loose Fill	1"	2.13 -2.27
NOT PUBLISHED IN MANUAL:		
Icynene Spray In Place	**1"**	**3.84 ****
Icynene Pour In Place	**1"**	**4.14**
Rigid Polyurethane Insulation Spray In Place	**1"**	**6.33 - 7.15**



Using heat

- Heating buildings
- Cooling buildings
- Generating electricity
- Moving vehicles
- refrigeration

Quiz

1. How does a good insulator stop conduction, convection, and radiation?
2. Explain R-factor or R-Value.
3. What is required in conduction and convection, but not in radiation?
4. What are the three main ways that heat is transferred?
5. What type of material is a good conductor?
6. How does energy get from the sun to the earth?

Convection heating systems

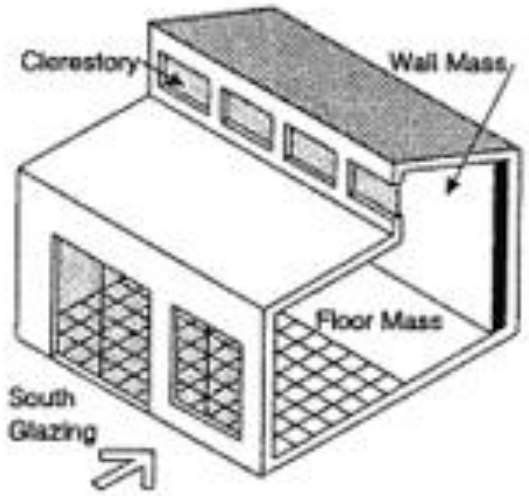
- Radiator systems
- Radiator is a device with a lot of surface area designed to heat the air near it by conduction
- Convection currents then circulate the heat in the room
- Usually hot water or steam but can be electric
- Forced Air
- Electrical heating systems
- Some use conduction and radiation to create convection currents

*Why do pipes in a steam-heating system need to be insulated?**

Solar Heating

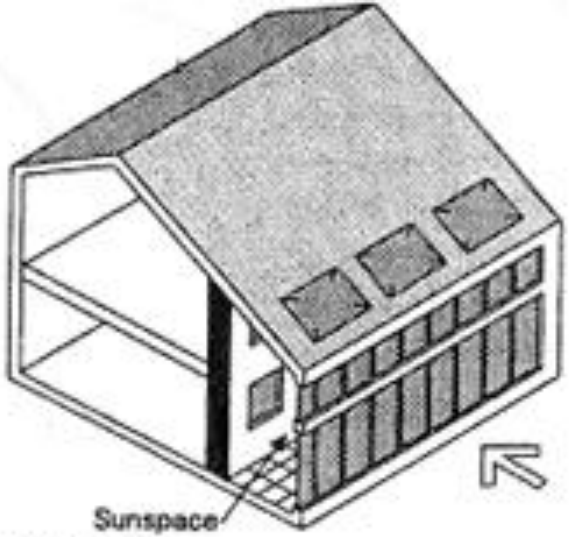
- Use of the sun to heat the building
  - Passive solar heating
    - Uses no fans or mechanical devices to move heat
  - Active solar heating
    - Uses fans, pumps or whatever is needed to move energy to the building from the solar collector

*What is the difference between passive and active solar heating?**



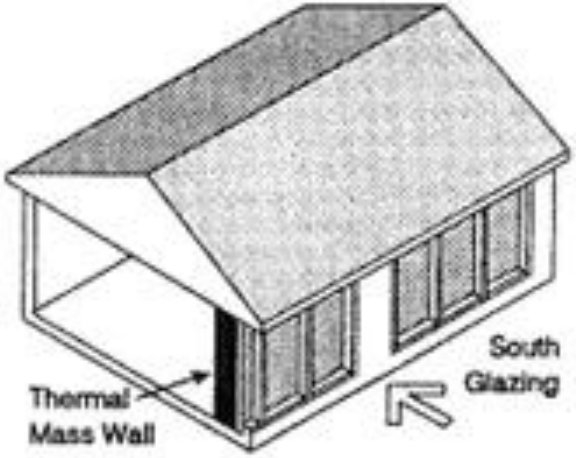
Direct Gain

Direct gain is the most common passive solar system in residential applications



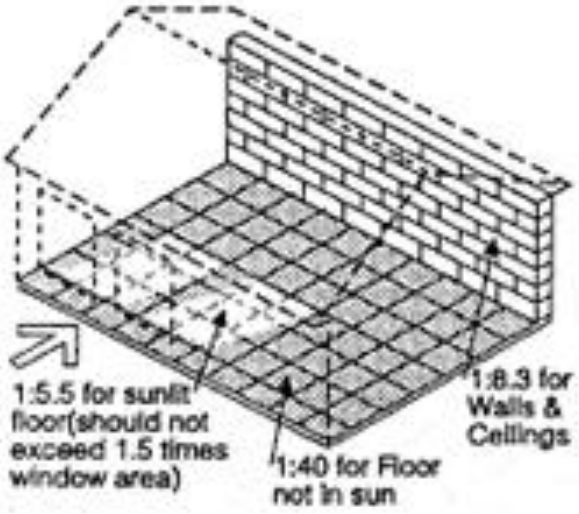
Sunspaces

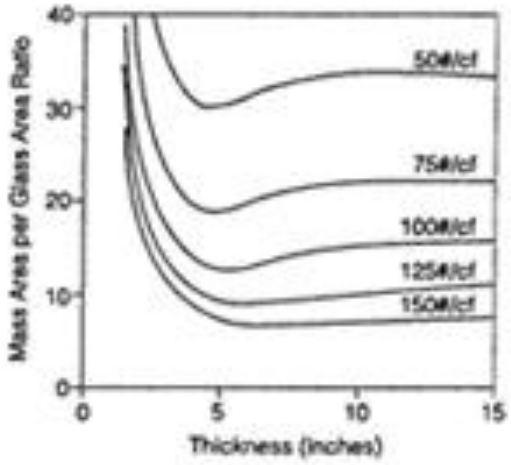
Sunspaces provide useful passive solar heating and also provide a valuable amenity to homes.



Thermal Storage Wall

A thermal storage wall is an effective passive solar system, especially to provide nighttime heating.



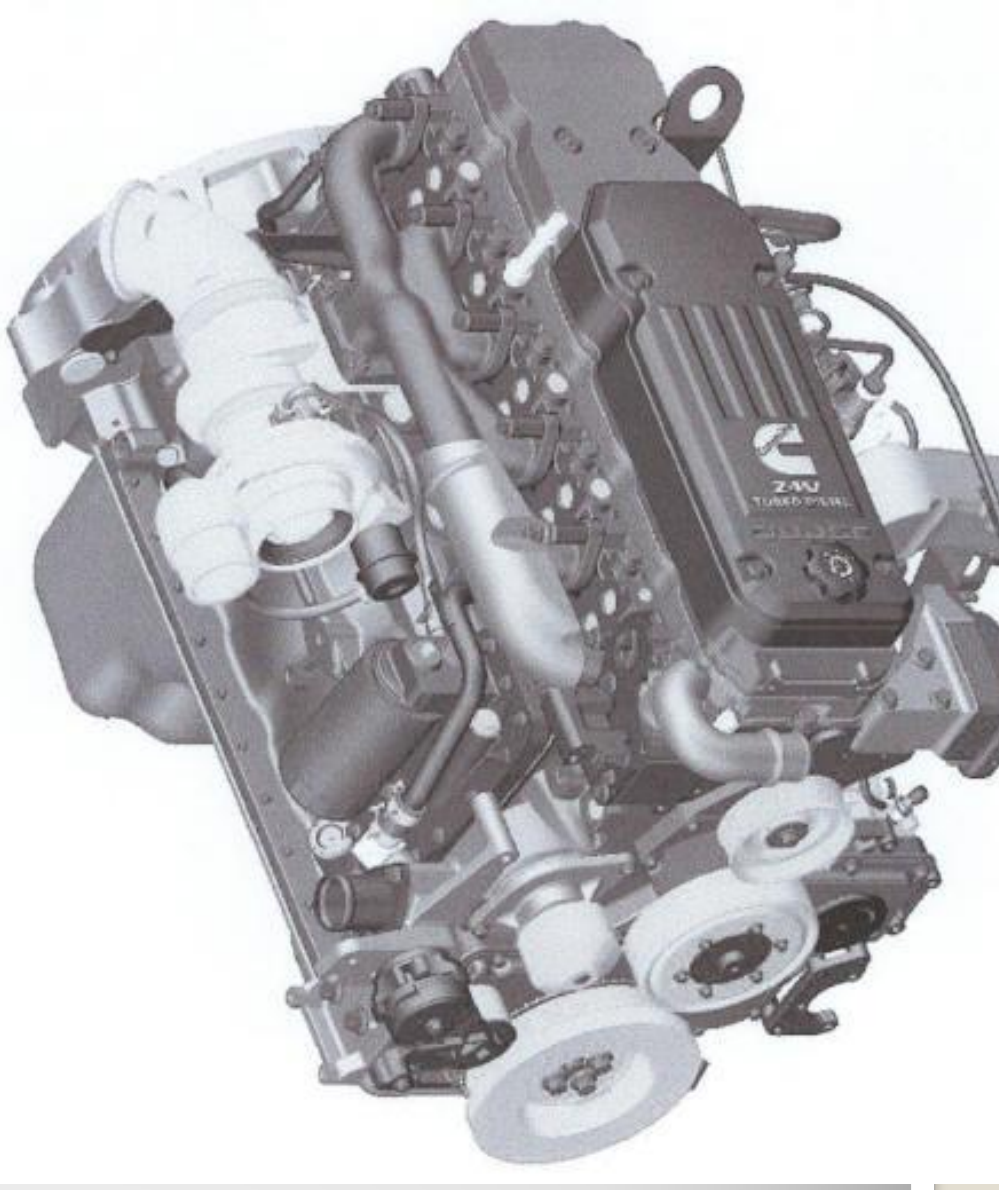


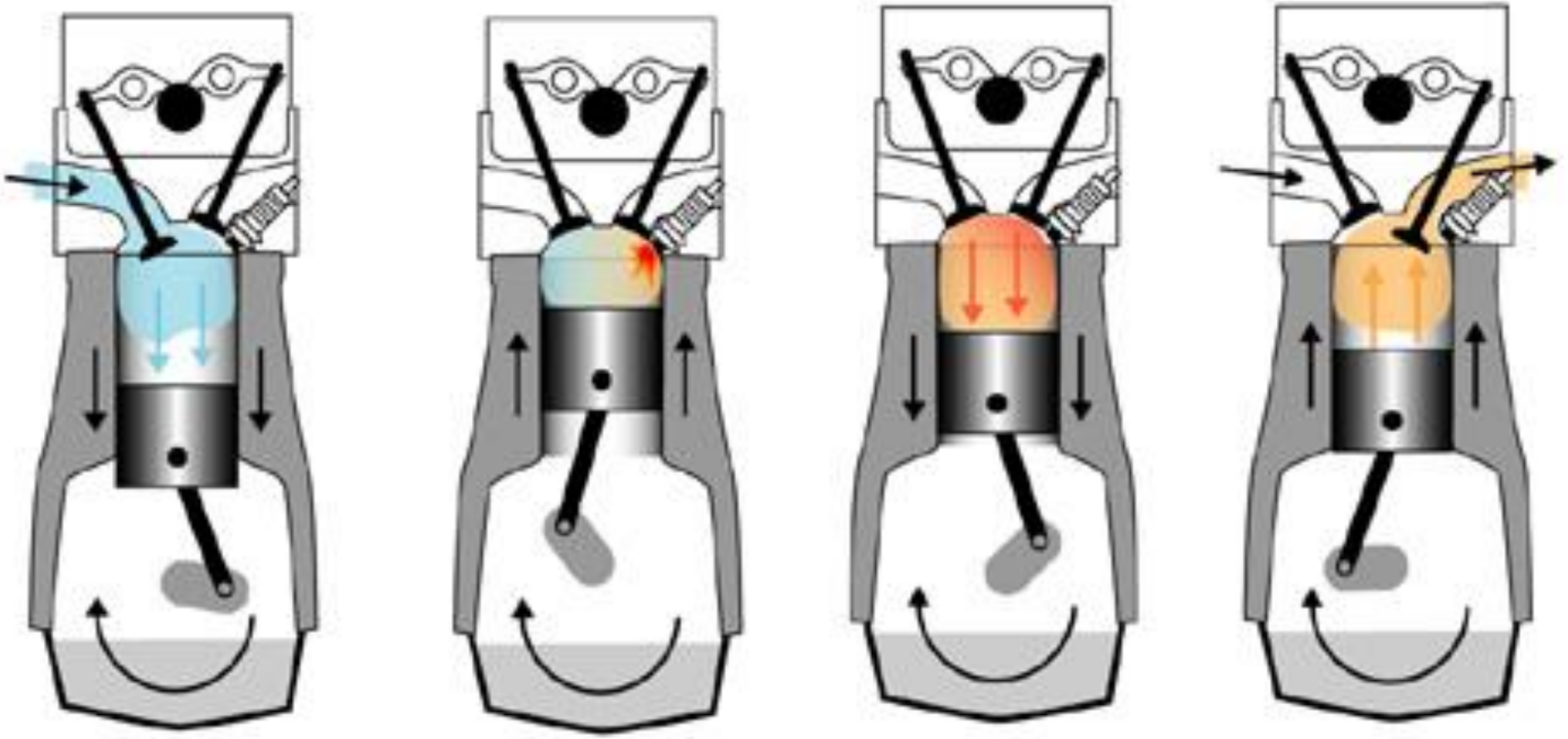
Using heat to do work

Heat Engines

- Heat engines are devices that convert thermal energy into mechanical energy
  - Internal combustion engines
    - Fuel is burned inside the engine to expand the air to do the work
      - Diesel (more efficient than gasoline)*
        - Doesn't have a spark plug*
      - Gasoline
        - Has a spark plug*
  - External combustion engines- fuel is burned outside engine to cause expanding gases to move piston or turbines

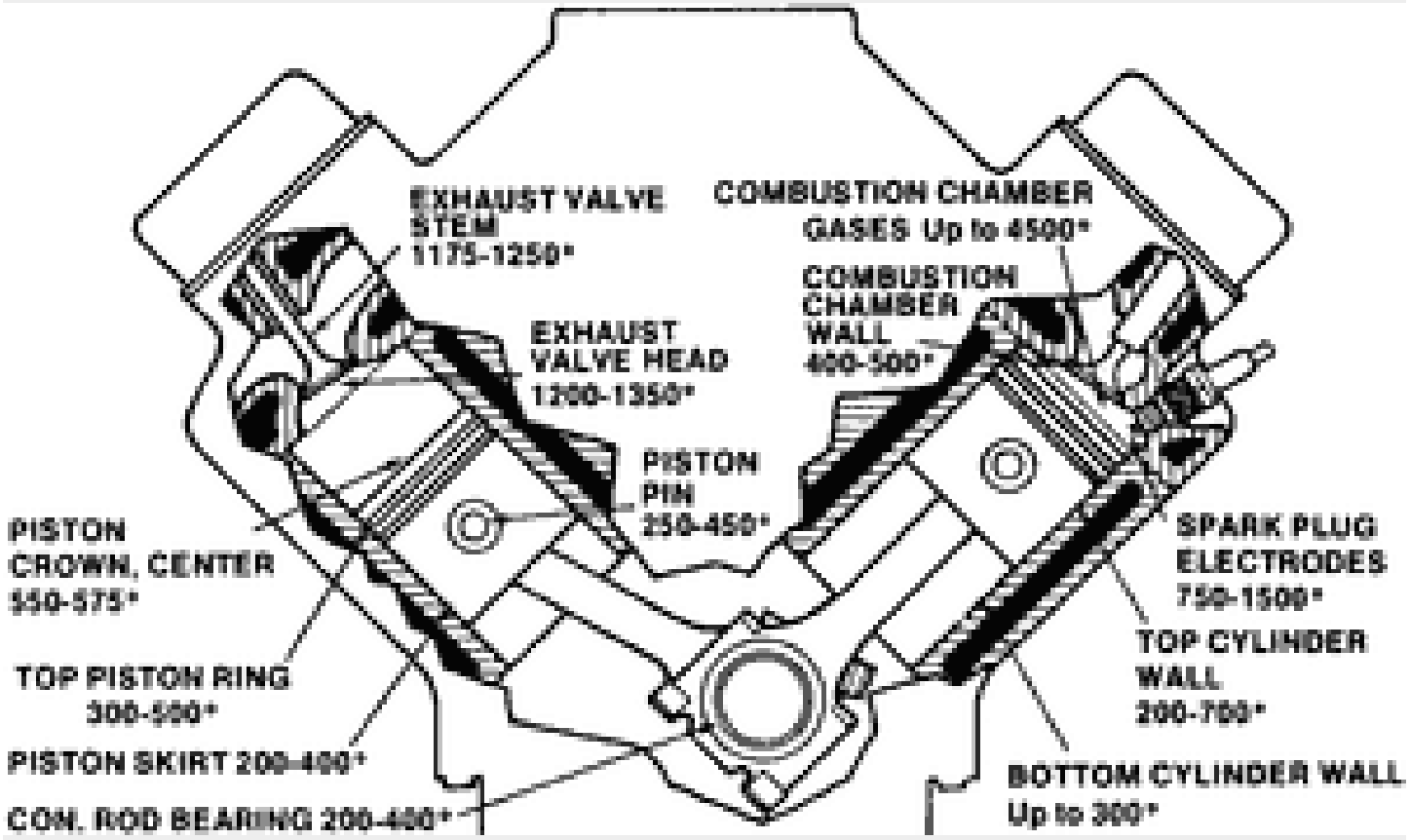
    *What is the difference between internal and external combustion engines?**

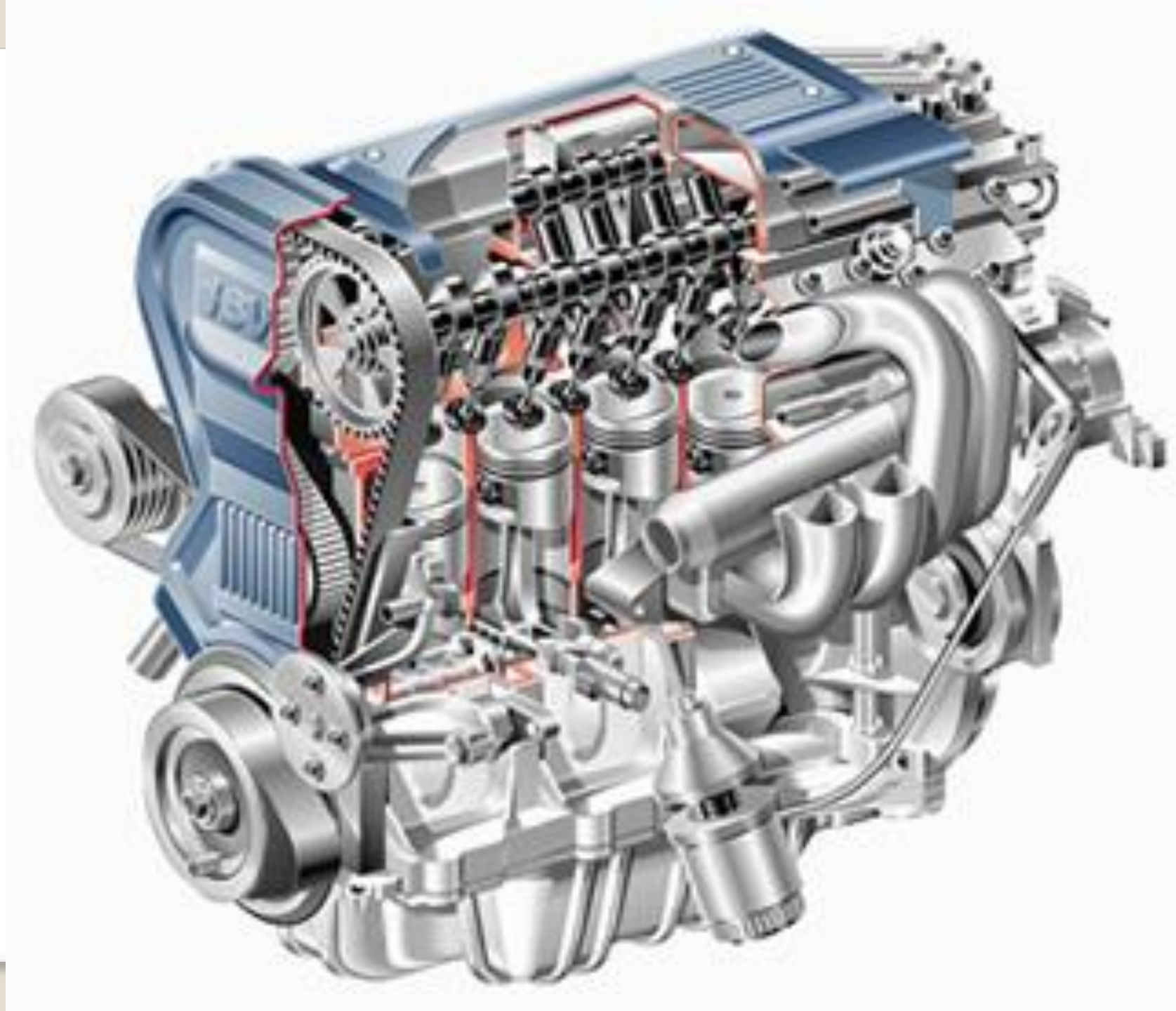




Intake Compression Ignition/power Exhaust

*List the steps of a four stroke engine in order.**


EXHAUST VALVE STEM 1175-1250°
COMBUSTION CHAMBER GASES Up to 4500°
COMBUSTION CHAMBER WALL 400-500°
EXHAUST VALVE HEAD 1200-1350°
PISTON PIN 250-450°
PISTON CROWN, CENTER 550-575°
SPARK PLUG ELECTRODES 750-1500°
TOP CYLINDER WALL 200-700°
TOP PISTON RING 300-550°
PISTON SKIRT 200-400°
CON. ROD BEARING 200-450°
BOTTOM CYLINDER WALL Up to 300°



Steam Engine
http://www.animatedengines.com/locomotive.html
4 Stroke Gasoline
http://www.animatedengines.com/otto.html
Two Stroke
http://www.animatedengines.com/twostroke.html
Diesel
http://www.animatedengines.com/diesel.html
Stirling engine
http://www.animatedengines.com/vstirling.html

Wankle Engine

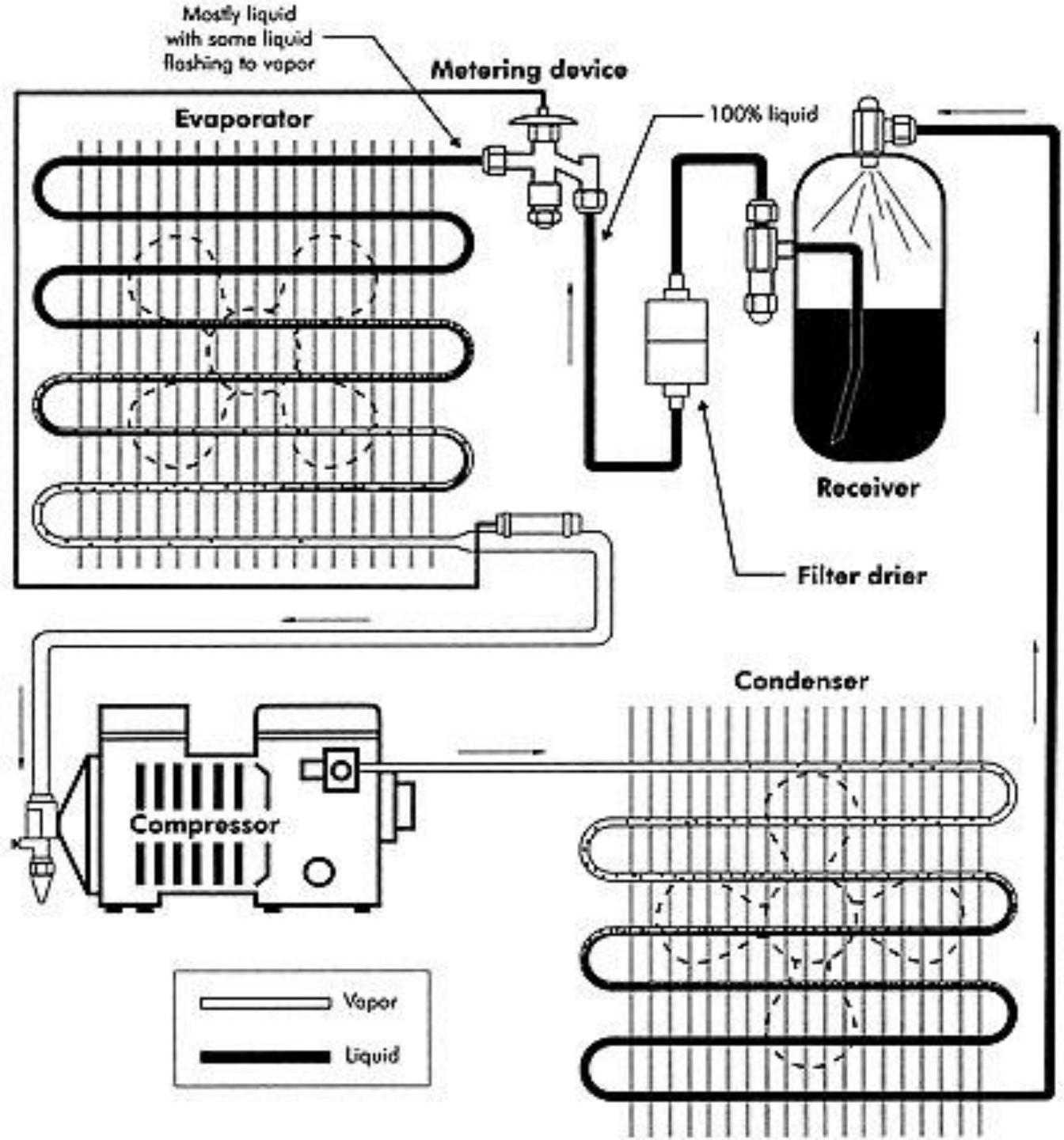
Wankle Rotary
http://www.animatedengines.com/wankel.html

Heat movers

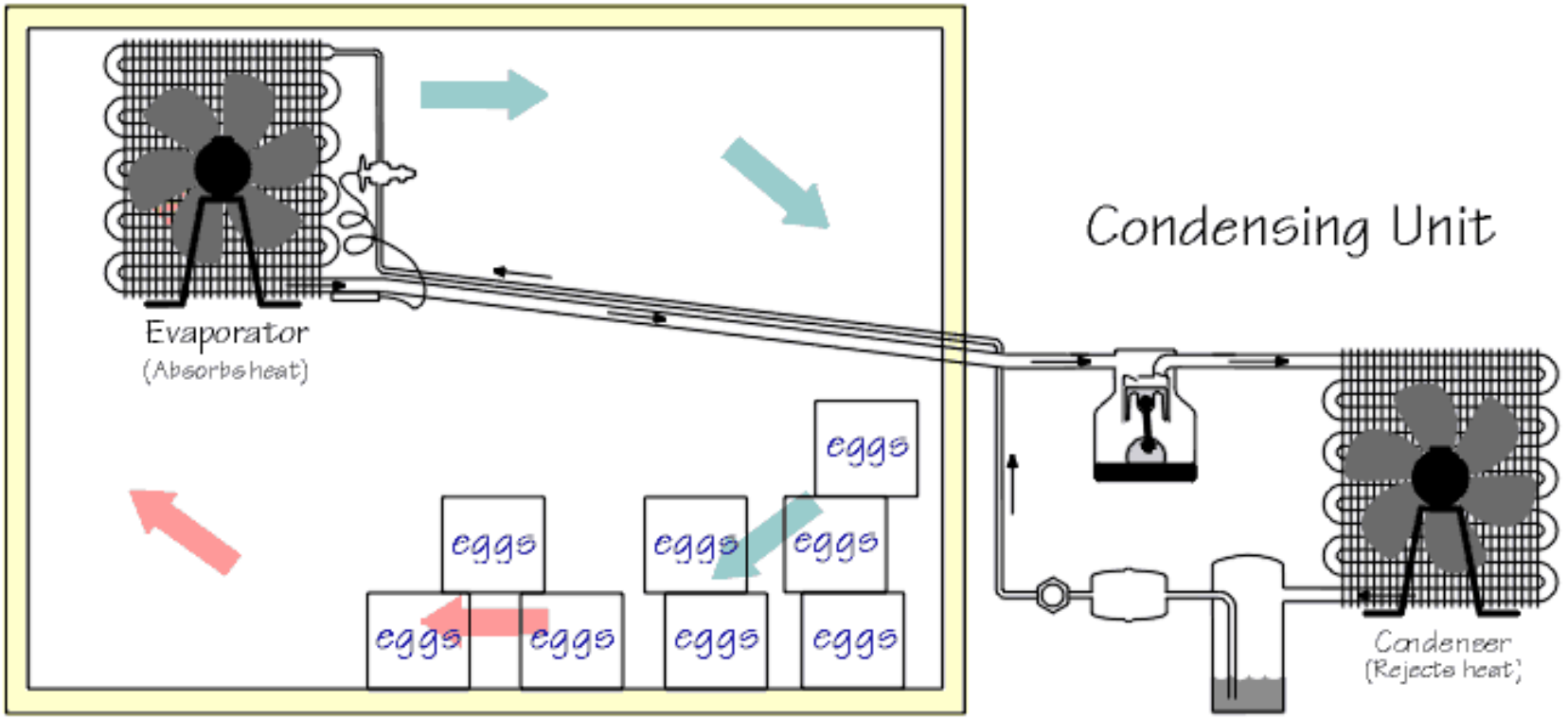
- a device that moves heat from one place to another
  - Refrigerator
  - Air Conditioner
  - Heat pump
- Sweat the human heat mover

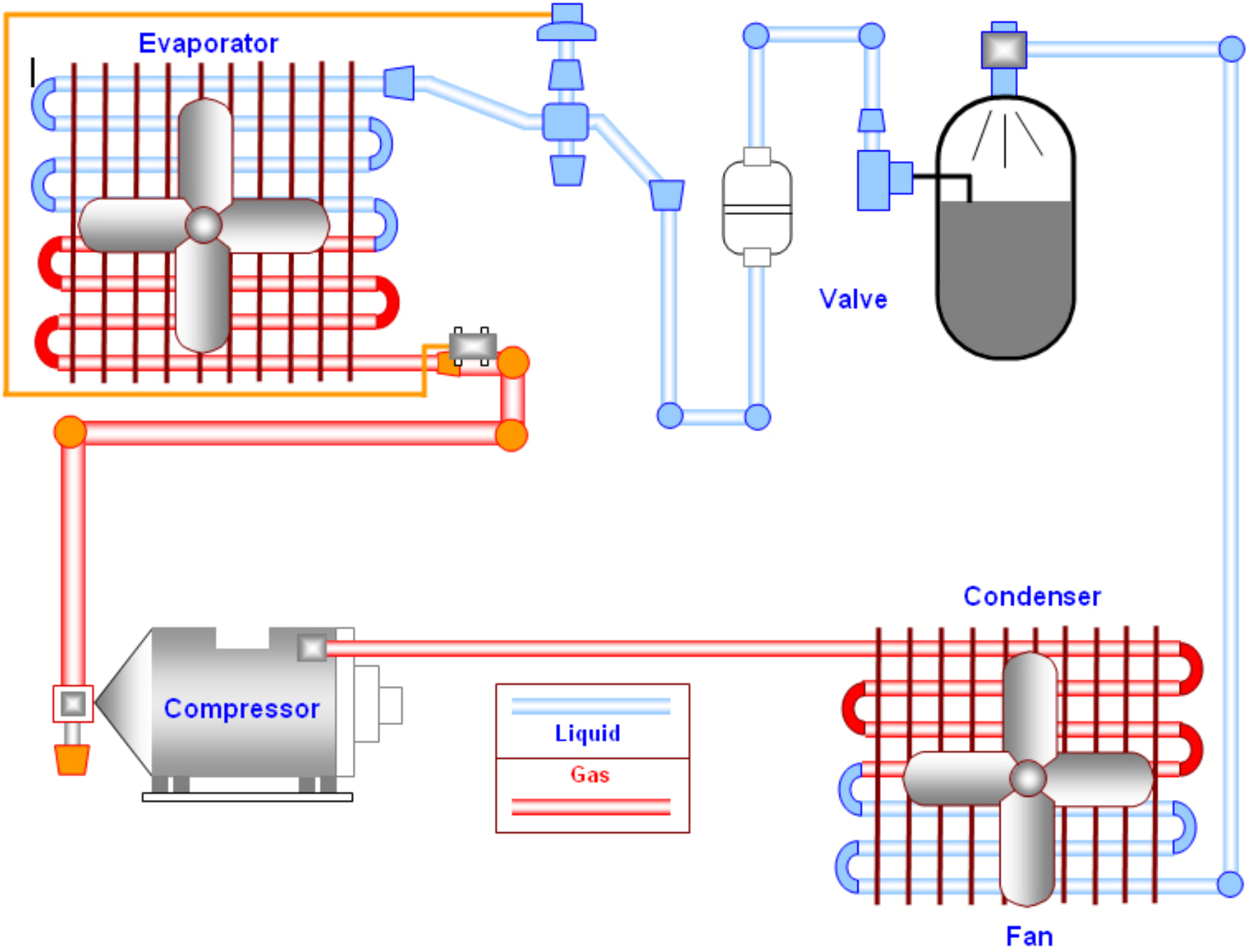
How does sweat cool the body?

Be able to give examples of heat move



How does a heat mover like a refrigerator work?


Condensing Unit
Evaporator
(Absorbs heat)
eggs
eggs
eggs
eggs
eggs
eggs
eggs
eggs
Condenser
(Rejects heat)


Evaporator
Valve
Condenser
Compressor
Liquid
Gas
Fan