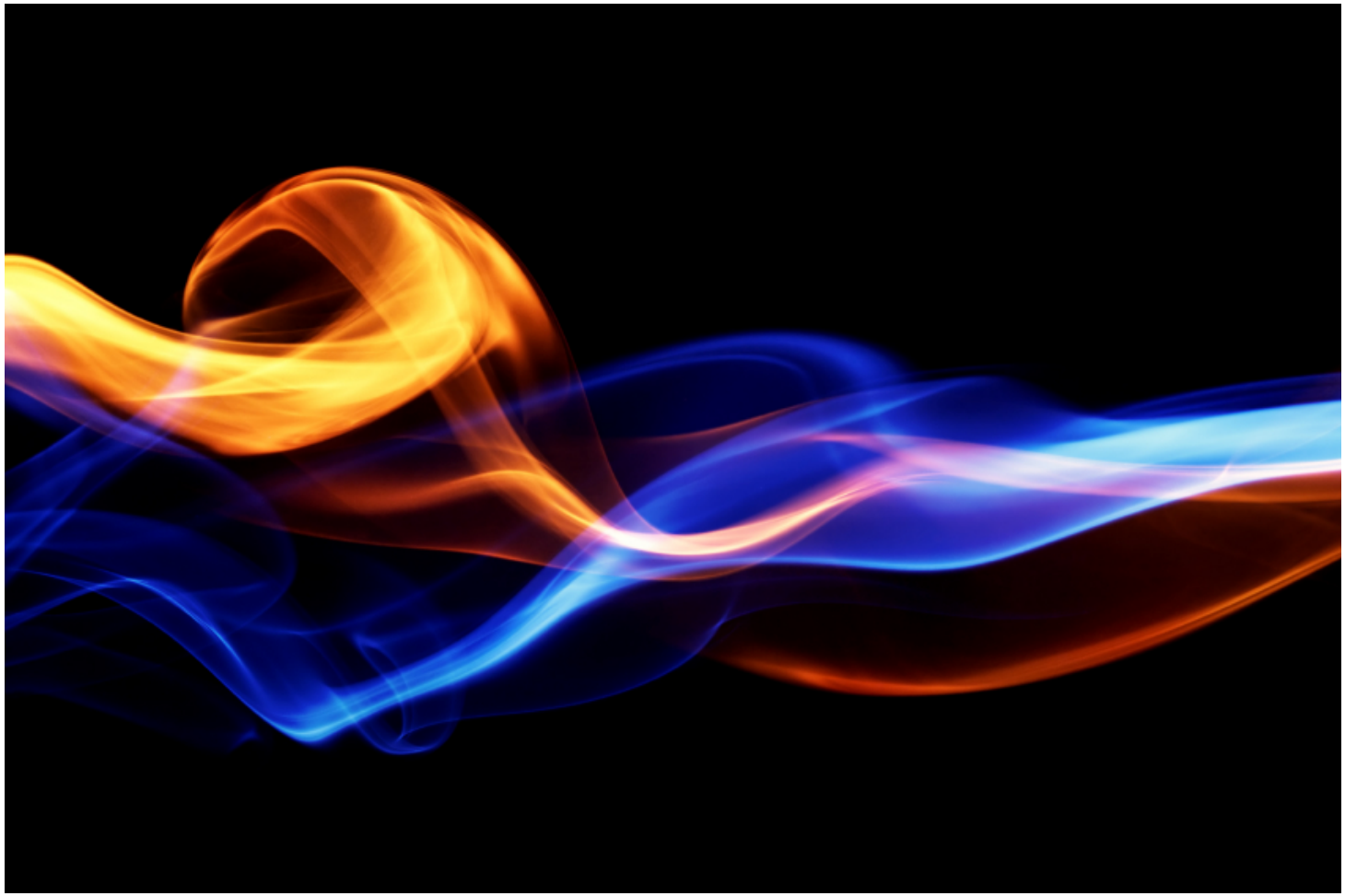
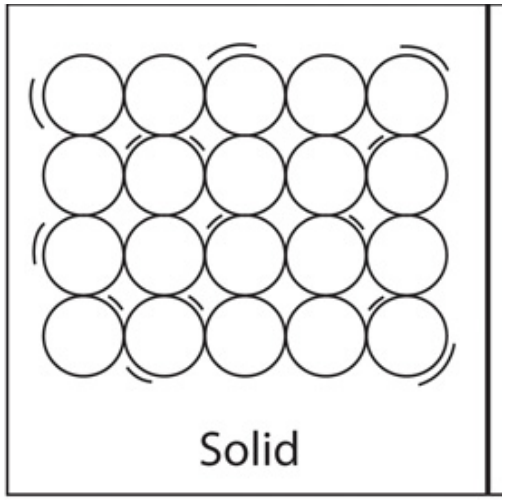
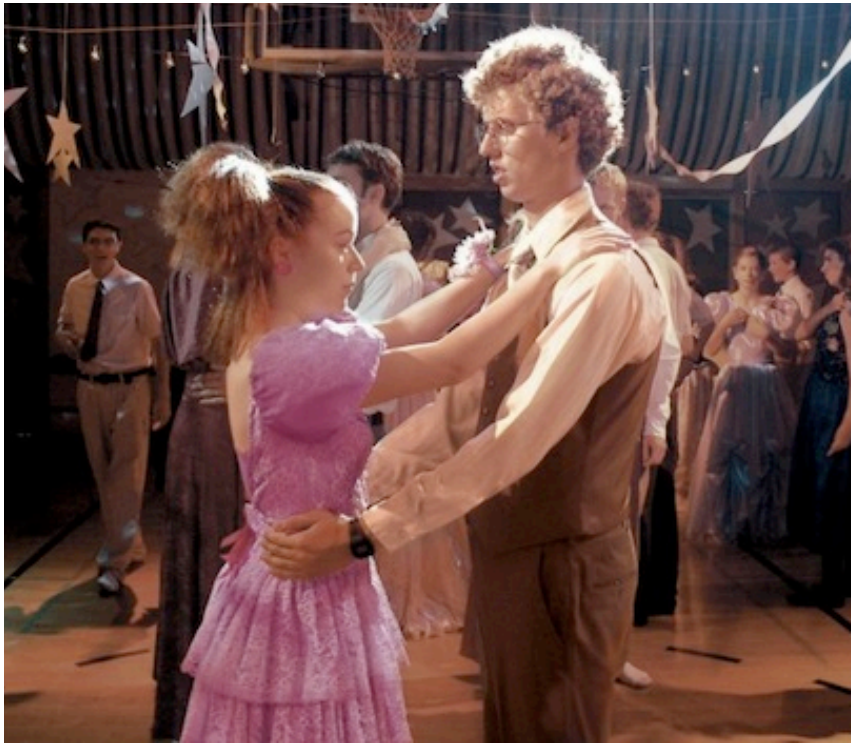
Section 16.2
Thermal Energy



Three States of Matter

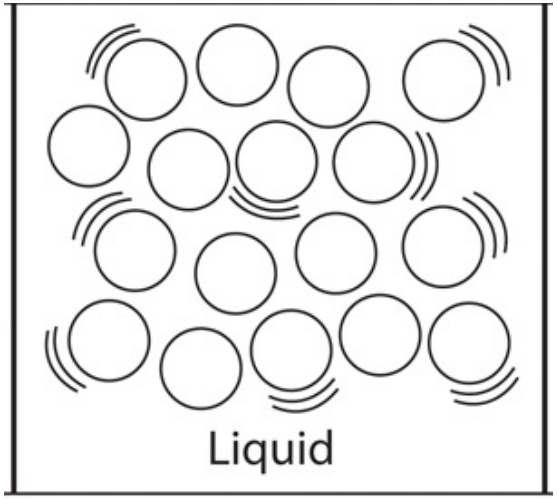


Low Energy



High School Dance Slow Song

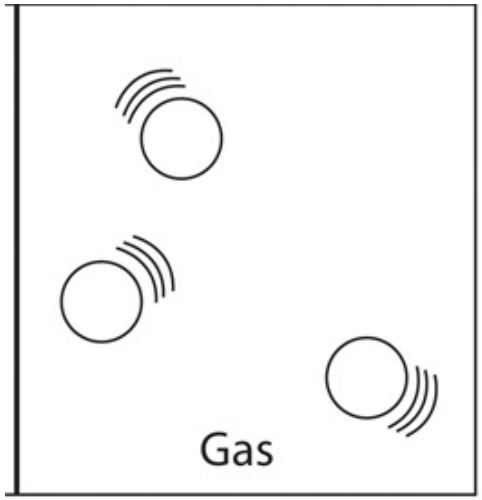
Three States of Matter



Medium Energy

High School Dance
Fast Song

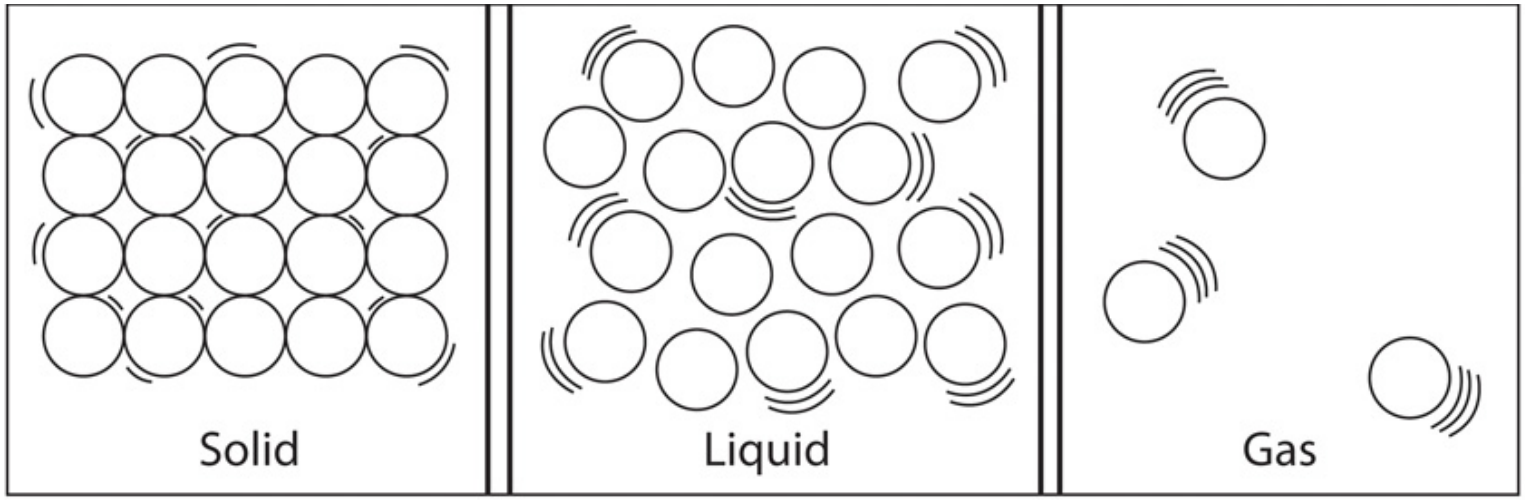
Three States of Matter



High Energy

High School Dance Mosh Pit

Three States of Matter



Low Energy

Medium Energy

High Energy

Thermal Energy

Thermal Energy

The total potential and kinetic energy of all the particles in an object

Three things that thermal energy depends on:

1. **Mass of object**
2. **Temperature of the object**
3. **Phase of the object (solid, liquid, gas)**

Temperature

- The measure of how hot or cold an object is compared to a reference point
- Measured in Celsius
- Measures the average kinetic energy of the particles in a substance.
- Kinetic energy is directly related to the speed of the molecules.
- The faster the particles/molecules are moving the higher the temperature.

Temperature

Important

You must understand that as objects are heated and gain energy that the molecules in that object move faster and tend to spread out

As we add heat to a solid block of ice, the molecule speed up and spread out and create a liquid, water. If we take heat away, molecules slow down and will create a solid, ice

Heat

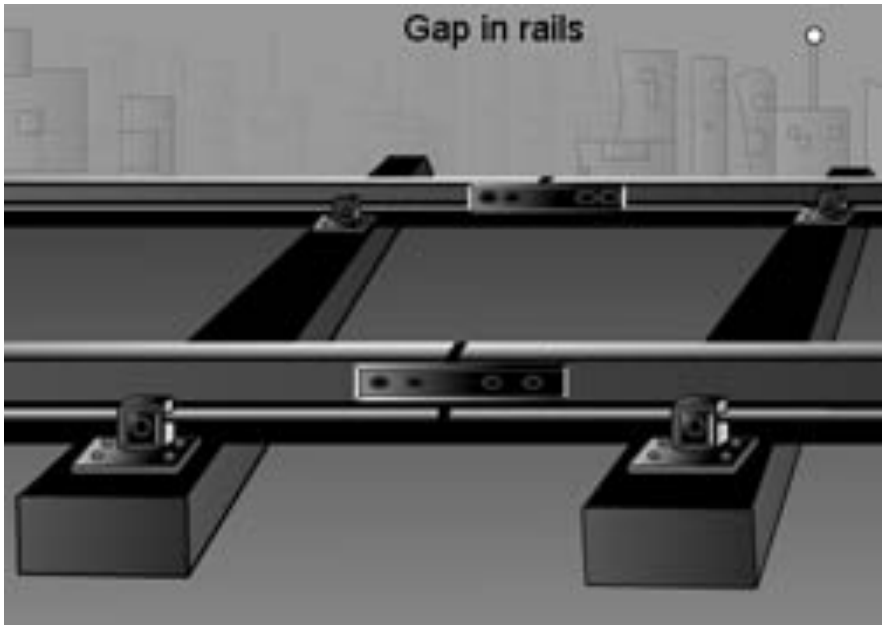
- Heat is a measure of energy (Joules)
- Transfer of thermal energy from one object to the next because of temperature difference.
- Heat flows naturally from hot objects to cold objects.
- HEAT and TEMPERATURE are NOT the same thing.
- *Ex. A cold Lake Superior has more heat energy than a boiling pot of water.*

Thermal Expansion

Thermal Expansion

An increase in the volume of a material due to a temperature increase.

Thermal expansion occurs when particles of matter move farther apart as temperature increases.


Gap in rails

Specific Heat

Specific Heat

The amount of heat needed to raise the temperature of 1 gram of a material by 1º Celsius.

Formula

$$Q = m \cdot c \cdot \Delta t$$

Q = Heat (Joules)
m = mass (grams)
c = specific heat (J/g·ºC)
Δt = change in temperature (ºC)

Specific Heat

Example #1

How much heat is needed to raise the temperature of 100 grams of water by 85ºC? The Specific heat of water is 4.18 J/ g·ºC

$Q = m \cdot c \cdot \Delta t$

$Q = 100\ g \cdot 4.18 \cdot 85°C$

$Q = 35{,}530\ J$

Specific Heat

Example #2

How much heat is absorbed by a 750 gram iron skillet when it's temperature rises 100ºC? The Specific heat of iron is .449 J/g·ºC

$Q = m \cdot c \cdot \Delta t$

$Q = 750\ g \cdot .449 \cdot 100°C$

$Q = 33{,}675\ J$

Assessment

Take the next few minutes to answer the questions in your packet. We will review the information after 10 minutes.

Note:

This information may be on your pop-quiz next week!!

Assessment

Heat always flows from:

Hot to Cold

Assessment

How are temperature and thermal energy different?

Temperature

Measure of how hot or cold an object is compared to a reference point

Thermal Energy

Total potential and kinetic energy of all particles

Assessment

Complete the following with the words: slow, medium or fast.

If something has a high temperature then the molecules of that object are moving:

Fast

If something has a low temperature then the molecules of that object are moving:

Slow

Assessment

Complete the following with the words: slow, medium or fast.

If something is a solid then the molecules of that object are moving:

Slow

If something is a liquid then the molecules of that object are moving:

Medium

If something is a gas then the molecules of that object are moving:

Fast

Assessment

Complete the following with the words: close, spaced out, very spaced out

If something is a solid then the molecules of that object are:

Close

If something is a liquid then the molecules of that object are:

Spaced out

If something is a gas then the molecules of that object are:

Very Spaced Out

Assessment

Mr. Holbrook blows up a balloon. He puts the balloon in the freezer and observes the changes. He puts the balloon next to the heater then observes the changes.

What would happen to the size of the balloon after he put in into the freezer? Explain.

The balloon would shrink because the molecules would slow down and move closer together.

Assessment

Mr. Holbrook blows up a balloon. He puts the balloon in the freezer and observes the changes. He puts the balloon next to the heater then observes the changes.

What would happen to the size of the balloon after he put in near the heater? Explain.

The balloon would expand because the molecules would speed up and move farther apart.

Assessment

Calculate the Heat Transferred (Q) for each of the following:

The Specific heat of iron is 0.449 J/g·ºC. The mass of the iron skillet is 500 grams and the temperature change is 95 degrees Celsius. What is the heat transferred?

$Q = m \cdot c \cdot \Delta t$

$Q = 500\ g \cdot 0.449 \cdot 95°C$

$Q = 21{,}327.5\ J$