Learning Guide For Lecture 2A – Solids, Liquids, and Gases
Chem 1010

Introduction

What is dry ice?

How cold is dry ice?

What happens when you put dry ice in water?

What do you see coming out?

What would you feel if you put your hand on it?

What would it taste like?

In this lecture, we will talk about the three common states of matter – solids, liquids, and gases.

1. How do the states of matter behave?

2. What happens when matter changes state?

3. At what temperatures do changes of state happen?

1. How do the states of matter behave?

Do they change shape:

Do they change volume:

solid:

liquid:

gas:

To understand what these three states would look like at an atomic level, we will compare them to a pile of tangerines, a bucket of snakes, and a jar of fireflies.

Which of these seems most like a solid?

Which is most like a liquid?

Which is most like a gas?

How do fireflies behave like a gas?

How fast are they moving?

How much space is between them?

Are they organized?

How does a pile of tangerines act like a solid?

How fast are they moving?

How much space is between them?

Are they organized?

How is a liquid like a bucket of snakes?

How fast are they moving?

How much space is between them?

Are they organized?

What evidence is there that the molecules in a liquid and a gas are moving?

different colors of sand:

a drop of food coloring in a glass of water:

the odor of cinnamon in air:

What would this look like with actual atoms?

iron (Fe)		
mercury (Hg)		
helium (He)		

What would it look like with diatomic molecules?

iodine (I_2)		
bromine (Br_2)		
chlorine (Cl_2)		

2. What happens when matter changes state?

What can happen to the state of matter of a substance if the temperature changes?

What are the following changes called? What is an example of each?

solid to liquid:

liquid to gas:

solid to gas:

liquid to solid:

gas to liquid:

gas to solid:

Knowing what the molecules in a solid, liquid, and gas are doing, we can predict what changes need to occur in order for a substance to change states.

	snakes slithering around	

Freezing: What must happen for the snakes to change to a solid?

Boiling: What must happen for the snakes to change to a gas?

		fireflies zipping around

Condensation: What must happen for the fireflies to change to a liquid?

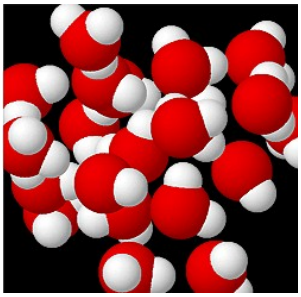
Deposition: What must happen for the fireflies to change to a solid?

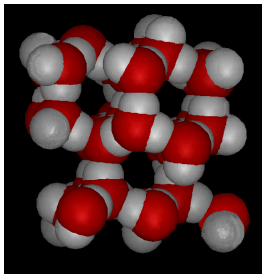
tangerines sitting in rows		

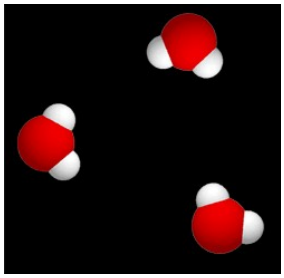
Melting: What must happen for the tangerines to change to a liquid?

Sublimation: What must happen for the tangerines to change to a gas?

Label the changes of state that are occurring at each arrow.







What change of state is occurring in each of the following?

dew	hail
frost	fog
puddle	ice fog
clouds	sleet
snowflakes	freezing rain

3. At what temperatures do changes of state happen?

Different substances have different temperatures at which these changes occur.

Water:

The temperature where a substance changes from a solid to a liquid (or a liquid to a solid):

The temperature where a substance changes from a liquid to a gas (or a gas to a liquid):

What state of matter be at in the following situations?

in the freezer -17^{o}C	outside on a hot day 43^{o}C
in the refrigerator 2^{o}C	in the oven 180^{o}C
at room temperature 25^{o}C	in a fire 900^{o}C

In general, what state of matter will a substance be in:

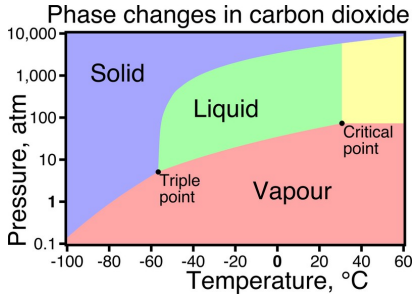
below the melting point:

above the melting point but below the boiling point:

above the boiling point:

What about carbon dioxide?

So, can carbon dioxide never be a liquid?



What are some other examples?

rubbing alcohol

melting point: -89°C

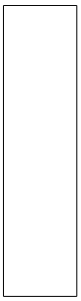
boiling point: 82°C

in the freezer -17°C	outside on a hot day 43°C
in the refrigerator 2°C	in the oven 180°C
at room temperature 25°C	in a fire 900°C

table sugar

melting point: 186°C
(decomposes)

boiling point: none

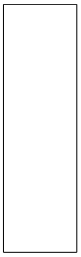


in the freezer -17°C	outside on a hot day 43°C
in the refrigerator 2°C	in the oven 180°C
at room temperature 25°C	in a fire 900°C

carbon monoxide

melting point: -105°C

boiling point: -191°C

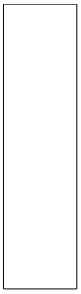


in the freezer -17°C	outside on a hot day 43°C
in the refrigerator 2°C	in the oven 180°C
at room temperature 25°C	in a fire 900°C

table salt

melting point: 801°C

boiling point: 1413°C



in the freezer -17°C	outside on a hot day 43°C
in the refrigerator 2°C	in the oven 180°C
at room temperature 25°C	in a fire 900°C

Why are the melting and boiling points higher for some substances than for others?

1) size – some atoms and molecules are bigger than others

Will a large molecule have a higher or lower melting point than a small molecule?

Use this to explain the states of matter of the following at room temperature:

iodine I_2

bromine Br_2

chlorine Cl_2

Which will have the higher melting point?

table sugar $C_6H_{12}O_6$

rubbing alcohol C_3H_8O

carbon monoxide CO

2) attraction between molecules – some particles are attracted to each other more strongly than others

Why does salt have such a high melting point?