NAME _____ DATE _____ PERIOD ___

Packet #1

Unit 10: States of Matter

Central Concepts: *Gas particles move independently of each other and are far apart. The behavior of gas particles can be modeled by the kinetic molecular theory. In liquids and solids, unlike gases, particles are close to each other. The driving forces of chemical reactions are energy and entropy. The reorganization of atoms in chemical reactions results in the release or absorption of heat energy.*

Objectives:

1. Using the kinetic molecular theory, describe and contrast the properties of gases, liquids, and solids. Explain, at the molecular level, the behavior of matter as it undergoes phase transitions.
2. Describe the law of conservation of energy. Explain the difference between an endothermic process and an exothermic process.
3. Recognize that there is a natural tendency for systems to move in a direction of disorder or randomness (entropy).

DATE	Assignment	Pages	√
1.			
2.			
3.			
4.			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			

Chapter 10 States of Matter

Read pages 329-332 in Blue MC text book (302-306 in orange MC)

10.1 The Kinetic-Molecular Theory of Matter

- **We know that matter can exist on earth as solids, liquids, and gases, and while we cannot look at individual particles scientists are able to study large groups of these particles as they occur in solids, liquids and gases.**
- **In this chapter we will study the theory developed in the late 19th century to explain the motion of these particles → especially in gases.**

1. State the kinetic-molecular theory.

_____

_____

_____

2. Describe how it explains certain properties of matter.

_____

_____

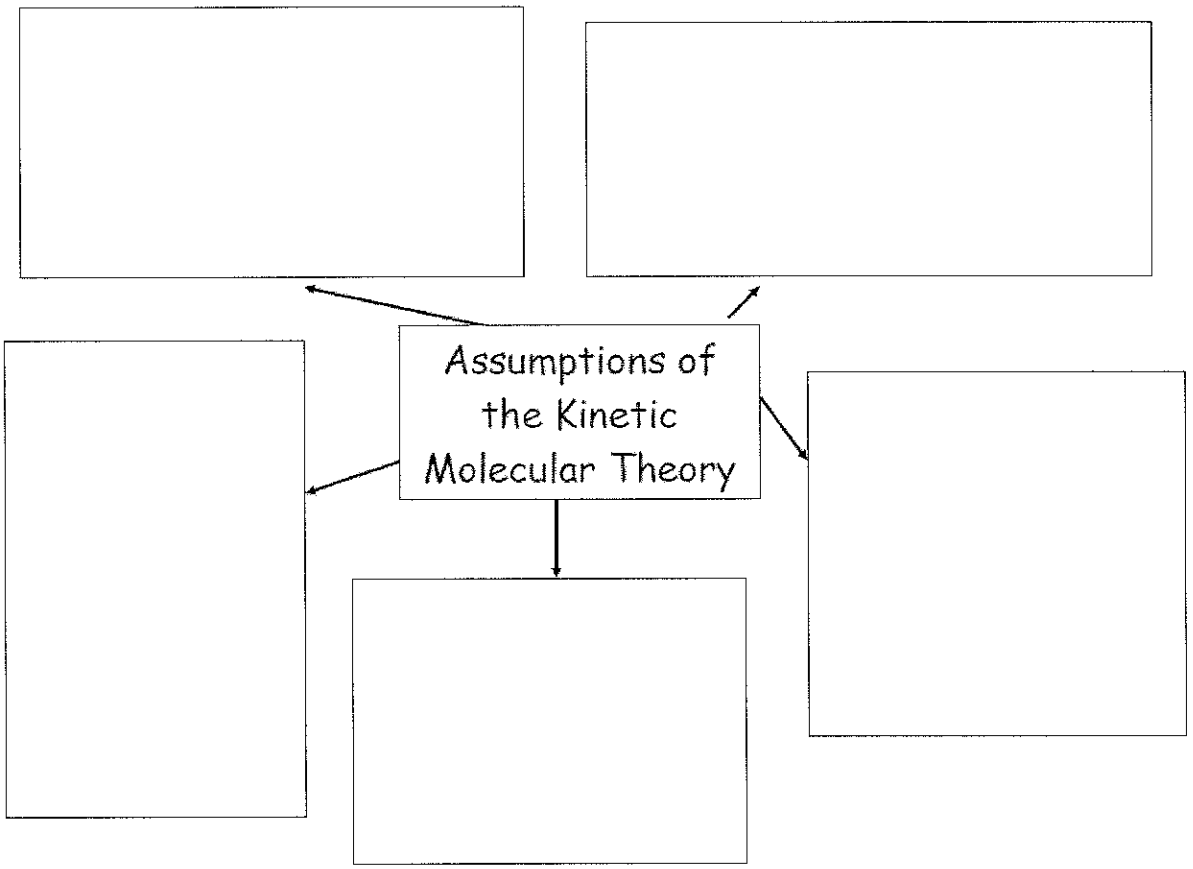
_____

3. What would an ideal gas be?

_____

_____

4. List the five assumptions of the kinetic theory of gases and describe each.



5. What is the formula to calculate the average kinetic energy of any moving particle?

What does the m stand for? _____ What does the v stand for? _____

6. If all gases at the same temperature have the same kinetic energy, how does the average speed of lighter gas particles, like hydrogen, compare to the average speed of heavier gas particles like CO_2 gas?

7. What happens to the kinetic energy of the particles if the temperature of the gas increases or decreases?

8. Describe each of the characteristic properties of gases: expansion, low density, fluidity, compressibility, and diffusion.

   expansion:

   low density:

   fluidity:

   compressibility:

   diffusion:

9. Differentiate between the terms *ideal* and *real gas*.

   When will many gases behave nearly ideally?

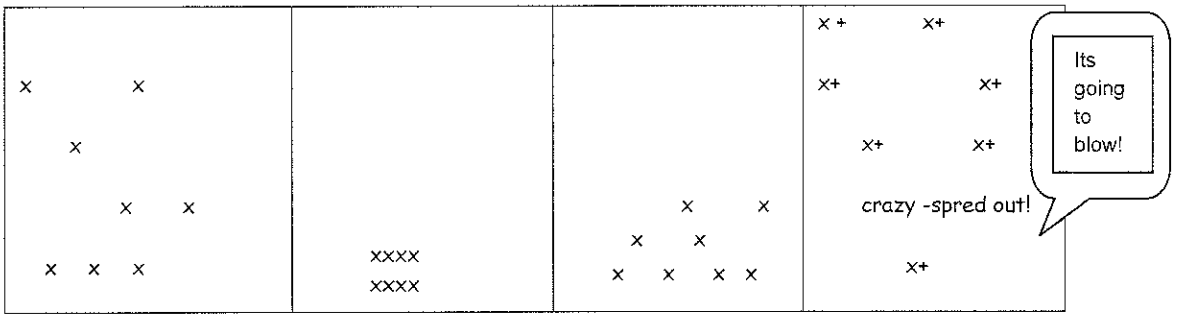
10. Describe the conditions under which a real gas is most likely to behave as ideally.

11. Which of the following gases would you expect to deviate the most from ideal behavior? **A) He B) O_2 C) H_2 D) H_2O E) N_2 F) HCl G) NH_3** _____
    Explain your choice(s):

UNIT 10 STATES OF MATTER INTRO ACTIVITY: NAME: _____

PRE-LAB: DATE: _____ PERIOD _____

1. Using all of your knowledge about **solid, liquid, gas and plasma**, write the word below the boxes that **best describes the state of matter** based on the arrangement of particles.



a._____ b._____ c._____ d._____

2. Imagine you are standing in your kitchen blowing up a balloon for a party. It feels full, hard and ready to pop. All of the sudden you get a crazy thought. What would happen if you put the **balloon full of air at room temperature into the freezer**!!

Write a hypothesis:

_____

_____

3.

Some necessary vocabulary:

States of matter include:_____, _____, _____

and *_____

A phase change is : _____

Examples of phase change are: melting, _____, _____

and _____

4. Complete the ***States of Matter*** simulation Student Activity

5. Look over this sheet to make sure all of your answers are completed correctly!

States of Matter Activity- Student Guide:

Start: 1. Google: PhET states of matter

2. Click on the first link

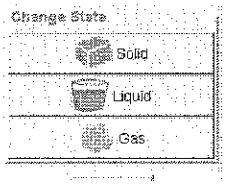
3. Click on the Run Now! button.

4. Explore the simulation. Be sure to click on everything.

Write two things you think the simulation is designed to help you learn.

a. _____

b. _____

5. Experiment with the → 

Choose one of the materials from the ***Molecules*** box - **neon, oxygen, argon or water**

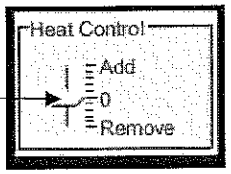
Click on the solid, liquid and gas picture buttons until you can see the differences.

6. Draw a picture to represent the atoms or molecules during each state.

Solid	Liquid	gas

7. Go to the second tab up at the top of your screen. Phase Changes

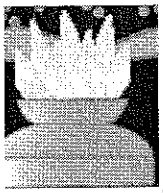
Move the arrow up and down.



Be sure to watch and discuss what is happening to the thermometer and the pressure gauge.

Observations:

Draw arrows (↕) to show what you observed.

When we add energy:  ,

Temperatue:	Speed of molecules	Pressure:
( )	( )	( )

When we take away energy:  ,

Temperature:	Speed of molecules:	Pressue:
( )	( )	( )

What happened to the **speed** and **arrangement** of the molecues as heat was added?

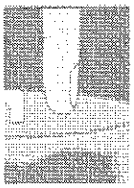
_____

Frame: When heat is added, we noticed that the particles _____.
When heat was taken away, we noticed that the particles _____.

You have finished the initial lesson! Please have the teacher check the ☐

More to Explore:

and There are some interesting features in this simulation.

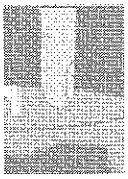


Experiment with them to find out how they "move" and what they do. When you think you have a good idea of how to use each feature, go on to the next step.

Draw arrows (↑ ↓) to show what happens.

Use the  to **add matter**: (you choose the number of pumps! _____)

Temperature:	Pressure:
( )	( )

Use the  to **reduce the space** in the container (or decrease the volume).

Temperature:	Pressure:
( )	( )

Write about two things you discovered:

#1	#2

Name _____ Period _____ Date _____

Liquids & Solids Unit 10 Part 1

- Go to http://msrobbinspnhs.weebly.com/ and click on the Chemistry Notes Page.
- Scroll down to Unit 10 and download the IMF_Pres.ppt
- As you study the PowerPoint take notes below

Intermolecular Forces

A. Definition of IMF

B. Types of IMF

	London Dispersion Forces	Dipole-Dipole Forces	Hydrogen Bonding
Definition			
Diagrams			
Relative Strength			
Other Information			

★ Check out the Animations online

C. Determining IMF - examples

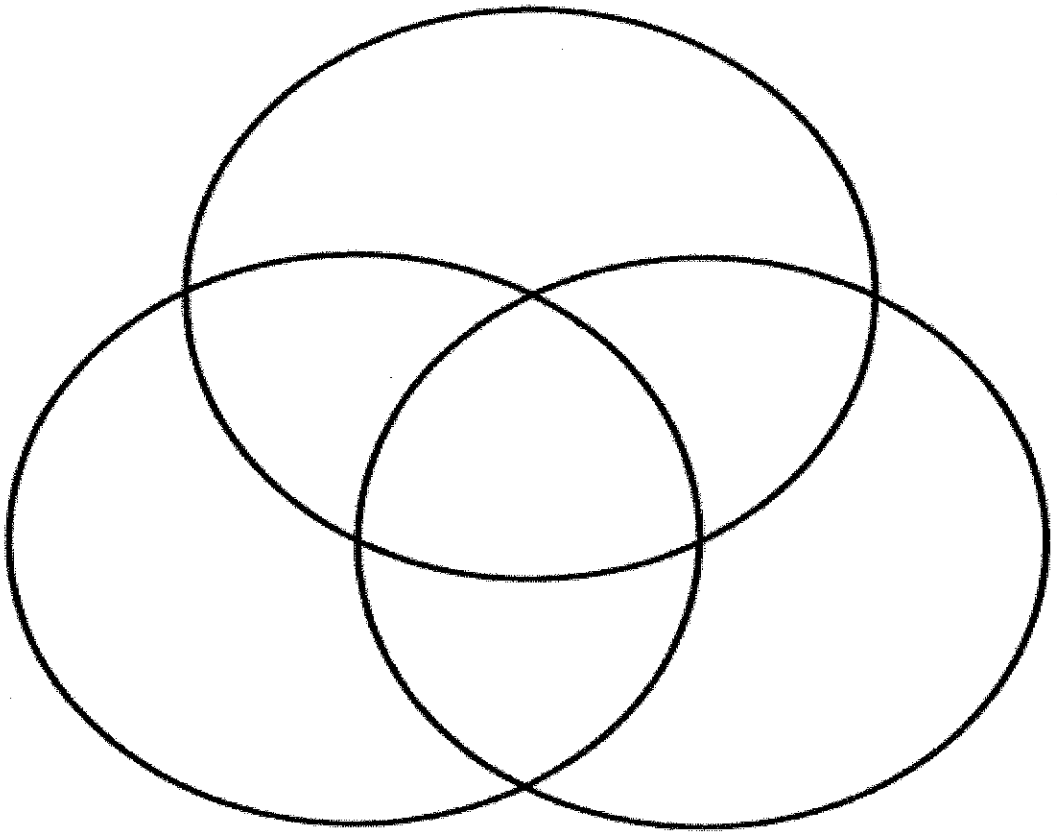
Identify the correct intermolecular force for each of the following descriptions.

1. Weak attraction between instantaneous dipoles. _____
2. Exists in all polar molecules. _____
3. Exists in all atoms and molecules. _____
4. The strongest intermolecular force. _____
5. Increases in strength as molar mass increases. _____

6. Indicate which intermolecular forces are present in the following substances by checking the appropriate boxes. You need to determine whether each molecule is **polar** or **nonpolar** first.

Substance	Dispersion Forces	Dipole-Dipole Forces	Hydrogen Bonding
Br_2			
PCl_3			
BF_3			
C_2H_5OH			

7. Compare and contrast the 3 intermolecular forces above. Which are stronger?



Name _____ Period _____ Date _____

Liquids & Solids Unit 10 Part 2

- Go to http://msrobbinspnhs.weebly.com/ and click on the Chemistry Notes Page.
- Scroll down to Unit 10 and download the liquid-solids_prop_pres.ppt
- As you study the PowerPoint take notes below

Physical Properties of Liquids and Solids

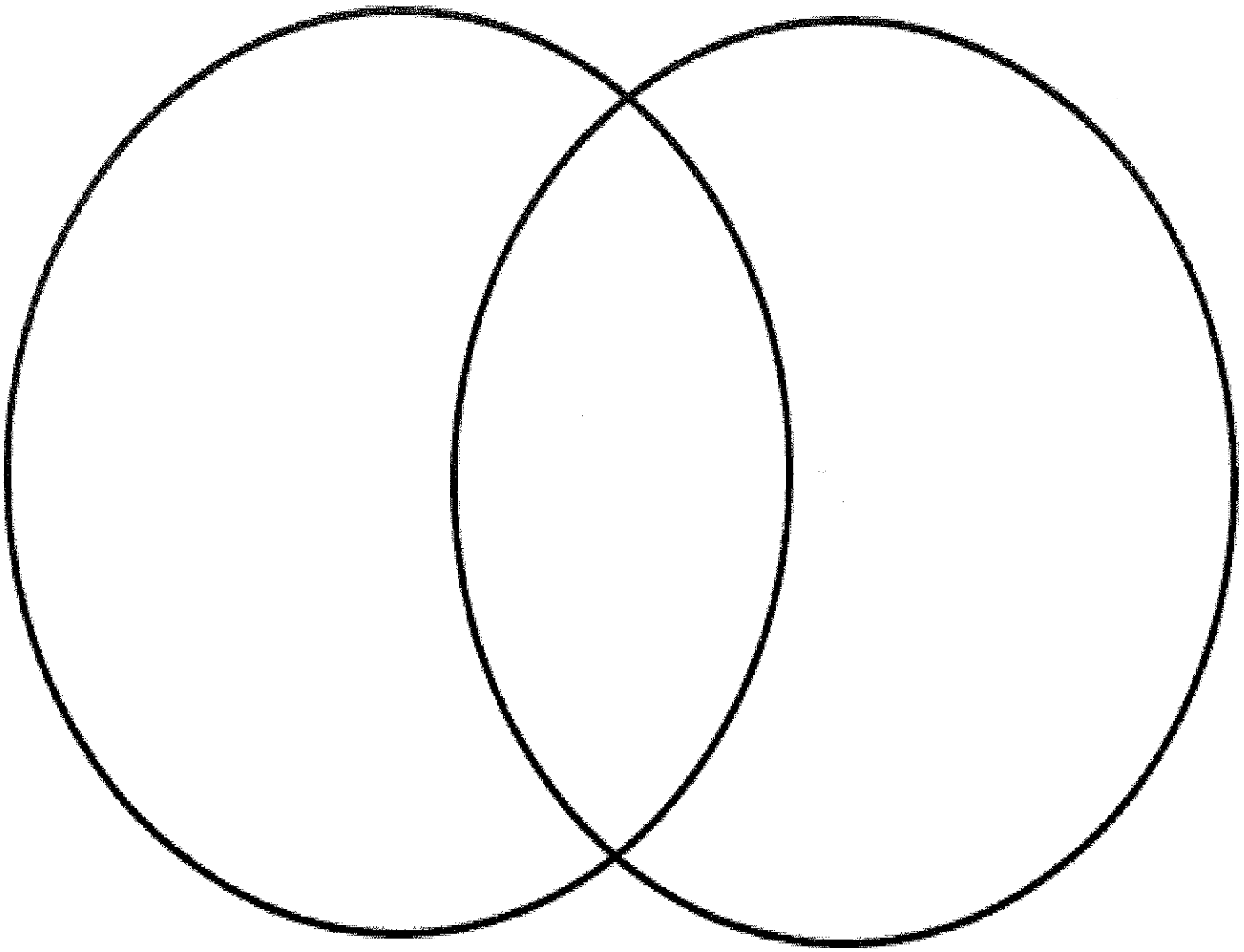
A. Liquids vs. Solids

	Liquids	Solids
IMF Strength		
Fluid		
Density		
Compressible		
Diffusion		

B. Liquid Properties with Diagrams (Also use pages 333 – 336 in the Blue Modern Chemistry Text from the Bench-top Computers' Desktop or at home)

C. Types of Solids with Diagrams (Also use pages 337 – 341 in the Blue Modern Chemistry Text from the Bench-top Computers' Desktop or at home)

8. Compare and contrast the properties of **liquids** and **solids**.



9. What property causes water to bead up on the hood of a freshly waxed car? _____

10. What property causes oil to travel up the wick of an oil lamp? _____

Identify the correct type of crystal for each of the following descriptions.

11. All atoms are covalently bonded together. _____

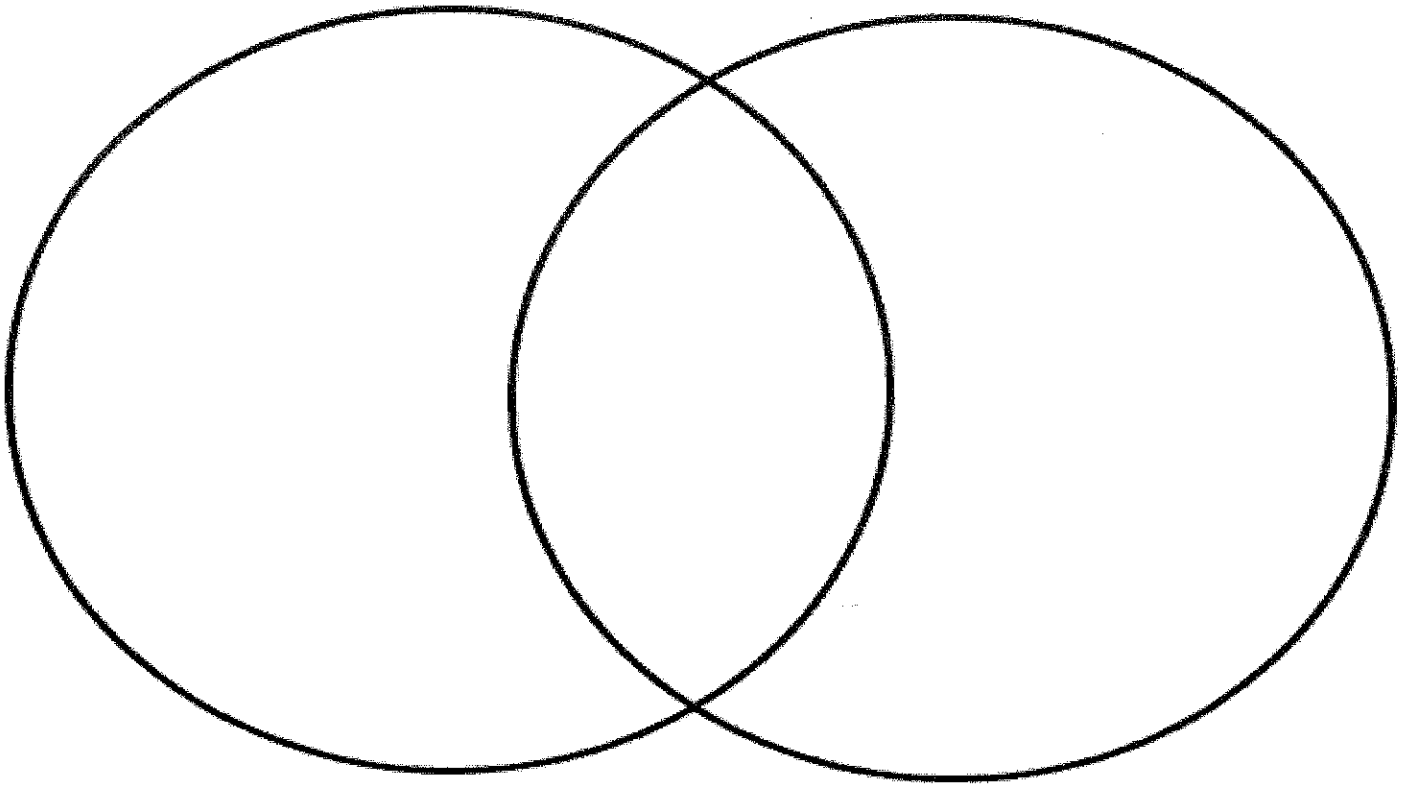
12. Molecules are held together by intermolecular forces. _____

13. Charged particles are arranged in a geometric pattern. _____

14. Atoms are surrounded by a sea of electrons. _____

15. Results in the highest melting point. _____

16. Compare and contrast crystalline and amorphous solids.



17. Give some examples of both types of solids

Chemistry: Form N6.2A

Name _____

PHASES OF MATTER

Date _____ Period _____

Physical Phase - Review

Aim

- to compare solids, liquids, and gases

Notes → Things to know

Definition - Physical phase = solid, liquid, or gas

Characteristics

- ★ Solid - has a definite shape and volume (ie. Shape and volume are not determined by the container)
- ★ Liquid - has a definite volume, but no definite shape (ie. Takes the shape of its container)
- ★ Gas - has no definite shape and no definite volume
  - ☆ Takes the shape of its container
  - ☆ Spreads out to fill its container

Kinetic molecular theory

- ★ Matter is composed of particles that are in constant motion (kinetic energy)
- ★ There are forces of attraction between particles that depend on the distance between the particles
  - ☆ The further apart the particles are, the smaller the forces of attraction between them are
- ★ The higher the temperature (average kinetic energy) is, the faster the particles move

Kinetic molecular theory explains phases

- ★ Solid - the forces of attraction between particles are larger than in other phases
  - ☆ Particles are held in fixed positions
  - ☆ Particles vibrate back and forth
  - ☆ Particles are relatively close together
  - ☆ Therefor the shape and volume are not determined by the container
- ★ Liquids - the forces of attraction between particles are moderate compared to other phases
  - ☆ Particles can move from place to place but cannot separate from each other and move independently
  - ☆ Particles roll and slide over each other
  - ☆ Particles are pulled downhill by gravity causing the liquid to seek its own level
  - ☆ Therefor the shape is determined by the container but the volume is not
- ★ Gases - the forces of attraction between particles are weaker than in other phases
  - ☆ Particles can move from place to place independently of each other because they do NOT attract or repel each other
  - ☆ Particles are relatively far apart. The volume of the particles is small compared to the space between them.
  - ☆ Particles tend to spread out to fill their container
  - ☆ Therefor both the shape and volume are determined by the container

Answer the questions below by circling the number of the correct response

1. Which 5.0-milliliter sample of NH_3 will take the shape of and completely fill a closed 100.0-milliliter container?
   (1) $NH_3(s)$ (3) $NH_3(g)$
   (2) $NH_3(\ell)$ (4) $NH_3(aq)$

2. Which of the following has the strongest forces of attraction?
   (1) $CO_2(s)$ (3) $CO_2(g)$
   (2) $CO_2(\ell)$ (4) $CO_2(aq)$

3. Which of the following can be compressed under pressure?
   (1) $I_2(s)$ (2) $I_2(\ell)$ (3) $I_2(g)$ (4) $I_2(aq)$

4. Which 1.5-liter sample of salt does *NOT* take the shape of its container?
   (1) NaCl(s) (3) NaCl(g)
   (2) NaCl(ℓ) (4) NaCl(aq)

5. A 25.0 mL sample of water is poured from a 50.0 mL graduated cylinder to a 100.0 mL graduated cylinder. The volume of the water
   (1) increases
   (2) decreases
   (3) remains the same

INVESTIGATING LIQUIDS & SOLIDS

NAME:_____

DATE: _____ PERIOD: ___

LEARNING GOALS:

- Using the kinetic molecular theory, describe and contrast the properties of gases, liquids, and solids.
- Identify how hydrogen bonding in water affects a variety of physical, chemical, and biological phenomena (e.g., surface tension, capillary action, density, boiling point).

ACTIVITY 1

1. Add water to a small beaker. Dip the capillary tube (small glass tube) open-end-down in the water.
2. What happened?

3. Compare the water level inside the tube to the water level outside the tube.

ACTIVITY 2*

1. Rinse a penny thoroughly with water and dry it with a paper towel.
2. Set the penny face up on the table. Place one drop of water on it. What does the drop look like?

3. Count how many drops you can add before the water spills over the edge of the penny. _____ Describe the appearance of the water as you continue to add drops.

4. Dry the penny. Put one drop of dishwashing liquid on the penny. Rub it with your fingers to cover the entire surface. Wipe off any excess, leaving a film of liquid on the penny.
5. Repeat steps 2 and 3. How did the addition of the dishwashing liquid change things?

* *Journal of Chemical Education*. Vol. 75, No. 2, February 1998, p.176B.

ACTIVITY 3*

1. Place the piece of plastic on a sheet of white paper on the table. Use a crayon to draw six small squares no more than 1 cm on each side on the plastic. Make the lines thick, about 2-3 mm.
2. Half-fill a cup with water. Add 2-3 drops of food coloring. Swirl to make a uniform, intensely colored solution.
3. Place a drop of the solution inside one of the squares. What shape is the drop? _____ Add water a drop at a time until the edge of the water drop reaches the crayon lines. Be careful not to allow the water to overflow the square. Repeat in two more squares. What do you see?

4. Now add a few drops of dishwashing liquid to the colored water and swirl to mix. Repeat step 3 using the three remaining squares. Wait a few minutes and compare the shapes in the squares. How does adding dishwashing detergent change things?

ACTIVITY 4**

1. In an empty cup, place two level spoonful of cornstarch and one spoonful of water. Stir to mix until a gooey fluid-like consistency is achieved.
2. Scoop up some putty and open your hand. What happens to the putty?

3. Rub some putty between your fingers. How does it feel?

4. Quickly slice the putty with a plastic knife. What happens?

5. Roll the putty into a ball. What happens to the shape?

6. Gently press your finger into the putty. What happens?

7. Pound the putty with your finger as hard as you can. What happens?

8. Is this putty a solid or a liquid? Explain.

9. Clean up your hands and your station.

** Institute for Chemical Education. University of Wisconsin-Madison.