Lecture Notes

What are the six different changes of state?

<table>
<thead>
<tr>
<th>Change</th>
<th>Name</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid → liquid</td>
<td></td>
<td></td>
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<tr>
<td>Solid → gas</td>
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<tr>
<td>Liquid → gas</td>
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<tr>
<td>Liquid → solid</td>
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<tr>
<td>Gas → liquid</td>
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<tr>
<td>Gas → solid</td>
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</table>

What causes a change in state?

________________________________________________________________________

________________________________________________________________________
Demonstrations/lecture:

Sublimation of iodine

BB Board

Crystals vs. amorphous substances

In the space below list some properties of liquids with a brief description of each. Try to explain which of these properties apply to the experiments below.

Notes
Kinetic Theory of liquids

**Purpose:** To develop a theory that explains why liquids and solids behave the way they do.

**Procedure and Observations and Data:**
- In this lab you will work in groups of three. Go to each station (not necessarily in order) and follow the directions on the instruction card.
- Record observations and give a brief explanation for each station.
- Draw a diagram (model) for stations 2, 5 and 6 showing at the molecular level, what the particles are doing.

**Stations**

**Station one:** Drops on a penny
**Materials:** Beaker of de-ionized water and a beaker of soapy water, droppers in each and 2 pennies.

**Challenge:** Put as many drops of de-ionized water on one of the pennies and then as many drops of soapy water on the other penny.

**Observations:**

<table>
<thead>
<tr>
<th>How many drops of pure water fit onto the penny?</th>
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<tbody>
<tr>
<td>__________</td>
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<tr>
<td>How many drops of soapy water fit onto the penny?</td>
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<tr>
<td>__________</td>
</tr>
<tr>
<td>Explain the difference</td>
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<tr>
<td>------------------------------------------------</td>
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<tr>
<td>------------------------------------------------</td>
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<tr>
<td>What property(s) of liquids is/are demonstrated here? How?</td>
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<td>------------------------------------------------</td>
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</tbody>
</table>

Station two: Boyle’s law apparatus noncompressibility of liquids
Materials: 2 Boyle’s Law apparatus, (syringes): one with water, and one with water and air.

Procedure: Try pressing on the two blocks. (Don’t press too hard)
Observations:

________________________________________________________________________
________________________________________________________________________

What is the difference between the two?
________________________________________________________________________
________________________________________________________________________

What causes the difference between the two?
________________________________________________________________________
________________________________________________________________________

What property(s) of liquids is/are demonstrated here? How?
________________________________________________________________________
________________________________________________________________________

Black box diagram of liquids in syringe
Chem. 105 Experiment  4

Station three: Drops on a microslide
Materials: 6 microslides, two droppers, a 100 ml beaker of water, and a 100 ml beaker of soapy water
Procedure:
Put two dry microslides together and then pull them apart.
Put a drop of water on two slides. Place them together and then pull them apart.
Put a drop of soapy water on two slides place them together and then pull them apart.

Observations:
______________________________________________________________________________
______________________________________________________________________________
What was it like pulling the three different pairs of microslides apart?
Explain the difference.
______________________________________________________________________________
______________________________________________________________________________
What property(s) of liquids is/are demonstrated here? How?
______________________________________________________________________________
______________________________________________________________________________

Station four: Floating a paper clip on water
Materials: 2-600 ml beakers, one with de-ionized water and one with soapy water, 4 paper clips
Procedure: Using one of the opened paper clips, try to make another paper clip float on the surface of the water in the beaker.

Observations:
______________________________________________________________________________
______________________________________________________________________________
Was it easier to float the paper clip in one of the beakers? Explain why.
______________________________________________________________________________
______________________________________________________________________________
What property(s) of liquids is/are demonstrated here? How?
______________________________________________________________________________
Station five: Food coloring in hot and cold water
Materials: Hot plate, beaker tongs, 2-1000 ml beakers, ice, 2 - 250 ml beakers, food coloring

Procedure: Using the beaker tongs, pour some hot water from the beaker on the hot plate into one of the empty beakers. Pour some of the ice water (without pouring any ice) into the other empty beaker. Add one drop of food coloring to each of the beakers you poured water into. Remember to add clear de-ionized water to the hot beaker and a little ice to the ice water beaker.

Record your observations.

What property(s) of liquids is/are demonstrated here? How?

Black Box diagram:

<table>
<thead>
<tr>
<th>Food coloring in hot water</th>
<th>Food coloring in cold water</th>
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</thead>
<tbody>
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</table>
Station six: marbles in 3 different liquids
Materials: Three marbles each in a labeled and sealed jar/bottle of water, oil, and glycerin

Procedure: Invert the three flasks and watch the marbles go to the bottom of each bottle

Observations:

Did the marbles fall through the liquids at the same rate? Explain

Draw 3 black box diagrams that show at the molecular level why the marbles fall at different rates in the different liquids:

<table>
<thead>
<tr>
<th>Alcohol</th>
<th>Water</th>
<th>Glycerin</th>
</tr>
</thead>
</table>

What property(s) of liquids is/are demonstrated here? How?
Station seven: Dragging drops
Materials: 2 sheets of wax paper, two eyedroppers, beaker of de-ionized water and a beaker of soapy water.

Procedure: Put drops of water from each beaker onto the separate pieces of wax paper (do not contaminate the beakers by switching droppers.)

Try to drag the drops around with the dropper
Observations:

How many drops of the soapy water could you drag? _______

How many drops of the de-ionized water could you drag? _______

What property(s) of liquids is/are demonstrated here? How?

_____________________

_____________________

Station Eight: Observing Crystals
Materials: Examples of several crystals, models of crystals.

Make some observations about the crystals.

_____________________

_____________________

_____________________

_____________________

_____________________

How are they different from each other?

_____________________

What property(s) of solids is/are demonstrated here? How?

_____________________

_____________________

Look at the models of the crystals. What do you observe? What is the major difference between liquids and solids?

_____________________

_____________________

_____________________

_____________________
Questions and Answers:

What properties of liquids are different from gases?

What causes this difference?

Do you like to have a lecture and then a hands-on activity or do you like the reverse order when you learn a difficult concept?

Draw a black box diagram that shows the difference between gases solids and liquids.

<table>
<thead>
<tr>
<th>Gases</th>
<th>Liquids</th>
<th>Solids</th>
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<tbody>
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Conclusions and Reflections

How do experiments at different stations help you learn?

Explain how the Black box diagrams help you better understand the concept behind the definitions? If they do not help your understanding, why?

1. Assessment: Mystery Liquid (Instructor’s option)
   Tray of Ooblek (Corn starch and water)