MODULE
Physical Properties of Fluids

MODULE TOPIC:
Measuring physical properties of fluid.
Calculate the density of given liquid sample and compare viscosity of the given polymer with various dilutions.

RATIONALE:
In this lesson students perform simple experiment to develop an understanding of physical properties of fluid. They will create written conclusion and answer post lab questions based on experiment and data analysis**.**

STANDARD(S) & INDICATOR(S):
(Note: This section should include all standards listed in the lessons.)
5.1.8.B3. Collect, organize, and interpret the data that result from experiments.
5.6.6.A3. Describe the properties of mixtures and solutions.

OBJECTIVE(S):
(Note: This section should include all objectives listed in the lessons.)
Students will be able to:
- Evaluate the experimental value of density of a liquid
- Compare the viscosity of polymer with different concentrations.

LIST OF LESSONS:
Density of Liquid
Viscosity of glue

BACKGROUND INFORMATION:
In this module students perform simple experiment to develop an understanding of physical properties of fluid. Students create written conclusion and answer post lab questions based on experiment and data analysis**.**

1. Students will create a written conclusion based on the data analysis.
2. Design a procedure to measure density of any liquid and compare the viscosity of polymer at various dilutions.
3. Respond to post lab questions.

LESSON #1
Measure Density of Fluid.

Evaluate the experimental value of density of a given liquid.

STANDARD(S) & INDICATOR(S):
5.1.8.B3. Collect, organize, and interpret the data that result from experiments.
5.6.6.A3. Describe the properties of mixtures and solutions.

OBJECTIVE(S): Students will be able to:
- Measure accurately mass, volume of different samples of liquid to calculate density and compute the percent error.
- To determine the relationship that exists between the mass and volume of a liquid.

BACKGROUND INFORMATION:
The study of a particular phenomenon often suggests that two measured properties are related to each other. An experiment can then be designed to determine this relationship by measuring the effect that changing one property (the independent variable) has on the other (the dependent variable). In this experiment we will study the way the mass and the volume of a liquid are related.

DETAILS OF THE LABORATORY EXPERIMENTS:
Our actual experiment is quite simple. We will measure the volume and mass of several different liquid samples, working first with water and then with an unknown liquid. These measurements will furnish us with the data from which we can make and interpret graphs for the mass volume relationships of water and the unknown.

 In the experiment, students will:
- Learn to use balance, graduated cylinder to record mass and volume.
- Use calculations to measure average values, create a graph.
- Use the equation and
- slope method to compute the density of each fluid.
- Learn to calculate percent error in the experimental values.

1. Mass a clean, dry graduated cylinder to the nearest 0.1 grams.
2. Add water until the level is as close as possible to the 10 mL mark. Read the level and mass again. Make the volume measurement at the bottom of the liquid meniscus.
3. Add another 10 mL of water. Read the volume and mass the cylinder again. Continue in this way to make the volume and mass measurements for every 10 mL up to 50 mL mark. Record all volumes to the nearest 0.1 mL and all masses to the nearest 0.1 gram.
4. Empty and dry the graduated cylinder. Repeat procedure steps 2 and 3 with the unknown liquid. Record your values for the unknown liquid.

CALCULATIONS AND QUESTIONS

1. From the data obtained, calculate the total mass of the water in the cylinder for each of the volumes you measured. Carry out similar calculations for the mass of the unknown liquid (X)for each volume.

2. On graph paper plot the data you obtained for the water samples. Plot mass on the y-axis and volume on the x-axis. You should have a point on the graph paper showing the volume and mass for each sample you measured. When you have completed plotting the data, draw a straight line through the data points in such a way as to minimize the distances the points lie off the line. Your line should go through the origin (why?). Repeat the procedure, plotting the data you found for the unknown liquid, and drawing a line through those data points. Label the first line as WATER, and the other line as UNKNOWN LIQUID.

3. The lines on the graph describe how the volume and mass of each of the two liquids are related. For any given volume, we can find the mass that volume of water, or unknown liquid, would have. Using the line for water on the graph, find the mass of water which would have the following volumes: 5 mL, 15 mL, 25 mL, 35 mL. Then using the line for the unknown, find the mass of the unknown liquid which would have each of these volumes.

4. This method works for certain values of the volume, but what about 14.3 mL or 76 mL. At this point I will show you how to find the density of the liquids from our graph using the slope of the line you drew. This will then allow you to find any values needed if this constant (density for that substance) is known or found as you have in this lab.

ASSESSMENT

- Students synthesize a lab report using scientific procedure including a written conclusion.
- Respond to post lab questions.
- Design procedure for any other fluid to evaluate its density using similar or different parameters.

Data Table

Mass of graduated cylinder = _____ g

Total volume of water	Mass of grad.cyl. and water	Total mass of water
_____ mL	_____ g	_____ g
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Use   a similar arrangement for the data on the unknown liquid.

Total volume of X	Mass of grad.cyl. and X	Total mass of X
_____ mL	_____ g	_____ g
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

LESSON #2
Viscosity of a Polymer

LESSON TOPIC:
Compare Viscosity of different concentration of Polymer solutions.

RATIONALE:
VISCOSITY OF EMULSION POLYMER...GLUE
Investigate if the viscosity of Elmer's glue will change with various dilutions.

STANDARD(S) & INDICATOR(S):
5.1.8.B3. Collect, organize, and interpret the data that result from experiments.
5.6.6.A3. Describe the properties of mixtures and solutions.

OBJECTIVE(S): Students will be able to:
- Differentiate between high and low viscosity.
- Quantitatively measure viscosity of household polymers as a function of concentration.

BACKGROUND INFORMATION, MATERIALS AND DETAILS OF THE
LABORATORY EXPERIMENTS can be found at:
http://www.juliantrubin.com/encyclopedia/physics/elmers_glue.html

Additional Classroom Activity Description:
- Students will graph the time taken by glue and its different dilutions to completely pass through the funnel in a beaker**.**
- Time the rate of flow of polymer through the same funnel and.
- Compare the rate flow or viscosity of above emulsions.
- Create graphs to compare viscosity.

PARAMETERS TO EVALUATE STUDENT WORK PRODUCTS:
- Students synthesize a lab report using scientific procedure including a written conclusion.
- Respond to post lab questions.
- Illustrate the real life applications of viscous properties of fluid.

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Lesson Plan Template
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