CMST SCOLLARCITY Lesson Plan Template-Lesson Plan using **TI Technologies** (Due Tuesday, July 27th)

Submit as hard copy AND electronically through ANGEL

Name: **Lorraine Sheck**
Grade level(s)/Subject taught: **11th/12th – Chemistry/sometimes Physics**
Objectives: (Remember…*How will the modeling tool help the student better learn the objective?)* **The objective of this lesson is for students to use the TI-84 graphing calculator to investigate the concept of density.**

Items to include in your TI Technologies lesson plan: (use *your* area/discipline/concepts).

For the math teacher:

1. *Write* the Mathematical Concept or "key idea" that TI Technologies will be used to teach: (e.g. Students use mathematical modeling/ multiple representation to provide a means of presenting, interpreting, communicating, and connecting mathematical information and relationships)

and/or…

For the Science teacher:

1b. *Write* the Science Concept or "key idea" that TI Technologies will be used to teach: (e.g. Organisms maintain a dynamic equilibrium that sustains life).

Students will use the linear regression analysis application on the TI-84 graphing calculator to model the nature of density as a unique physical property of a substance. They will understand that density is a characteristic property of matter that is often used by chemists to identify a substance and as such, the value for the density of a particular substance does not change regardless of how large or small the sample size is.

For your **TI Technologies** lesson and using the following prompts, please provide a rich **one-page, single-spaced** description or a *vision* of your best thinking on a way or ways you might teach the planned lesson using the TI technology. Pay special attention to the modeling package in your description. Also, construct and submit a tentative rubric that you might use with your students. ** see example page 5

"...a rich **one-page, typed, single-spaced**, description or a *vision* of your best thinking…"

Prompts:

1. How will you assess the prior knowledge of the student?
2. How will you begin the lesson?
3. What are the teacher and students doing every 5-10 minutes? (Teacher Actions and Student Actions
4. How will you assess the learning for the lesson?
5. How will TI be integrated into your teaching? (i.e. you may want to discuss a problem or describe how you might use the chosen modeling package in your plan. How does the model/tool help the concept(s) to be taught)?

OVERVIEW: ***Using the linear regression analysis program on the TI-84 Graphing Calculator,*** I plan on having my students investigate a model for determining the densities of several different substances.

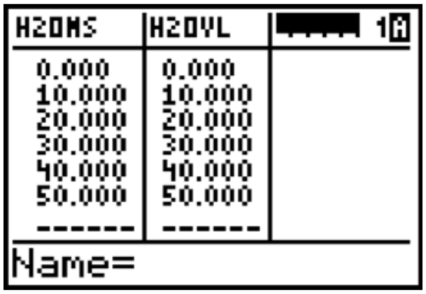
Lesson 1

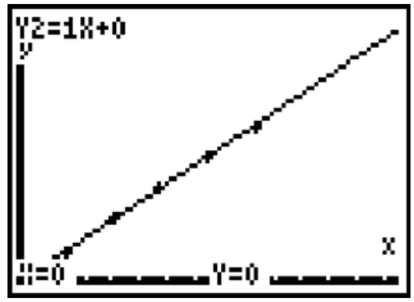
Bellwork (10 min): I would begin the class on modeling density by displaying a 1000 mL graduated cylinder containing four different solids suspended in four different liquids. In a brainstorming session, I would ask students to define density and explain what the solids and liquids in the graduated cylinder are illustrating about density. Their ideas would be written on the chalkboard for later referral.
Desired Outcome: From the positions of the solids and liquids within the graduated cylinder, students should realize that each substance has a characteristic density that can be used to identify it.

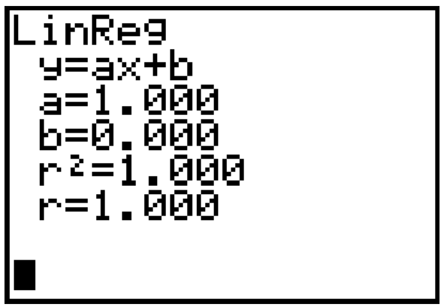
Teacher Presentation (Interactive With Students) on Modeling Density (15 min): My presentation would attempt to help students deepen their understanding of density beyond the visual model, to a mathematical model and finally to a graphical model of this concept. *First*, by adding 500mL and 250 mL graduated cylinders to the display with the same liquids and solids as are in the first graduated cylinder, I would attempt to "coax" students, if necessary, to realize that the liquids and solids lay in the same relative position within all three graduated cylinders although the sizes and amounts of each different kind of sample were different. *Secondly,* after having the students find the density formula in their Regents Chemistry Reference Tables, I would explain the equation as representing a mathematical model of density that shows a direct relationship between the mass of a sample and its volume. *Thirdly,* I would select one of the liquids present in the graduated cylinder demonstration (probably water) and write down their masses and volumes on the chalkboard. I would then ask for three student volunteers to write the density formula and use it to calculate the density of each of the water samples. These calculations would remain on the chalkboard for later referral.
Desired Outcome: Students should realize that based on the equation, the density values for the three samples of water were the same (within experimental error) regardless of how large or small the sample size was.

TI-84 Graphing Calculator Activity (15 min): I would explain that with the help of their graphing calculators, the mass and volume variables of the density equation could be used to develop a graphical model for describing the density of a substance. Students would then be given a table of data listing the masses and volumes of 6 samples of water and charged with the task of graphically displaying the data so as to model the density of water. They would also be provided with a tutorial of detailed instructions for entering lists, setting up and plotting a graph and running and interpreting the linear regression analysis program. Although I would use the TI ViewScreen Panel on the overhead projector to lead them through the calculation, I would also try to pair up students having more calculator experience with students having less experience.

Desired Outcome: By the end of class, students should realize that plotting the mass and volume of the different samples of water produces a straight line function, the slope of which (a = 1.000) represents the density of water. They should also realize that the graphical slope density value is the same as the value calculated from density equation. I would also expect students to display screens similar to those presented below from their TI calculator task.







Lesson 2

Bellwork (10 min): I would begin the second class by reviewing the previous day's lesson. The graduated cylinder demo would be emphasized as a visual model of density. The equation-based calculations on the chalkboard would be emphasized as the mathematical model of density. I would use the TI ViewScreen to display the linear regression analysis as the graphical model of density.

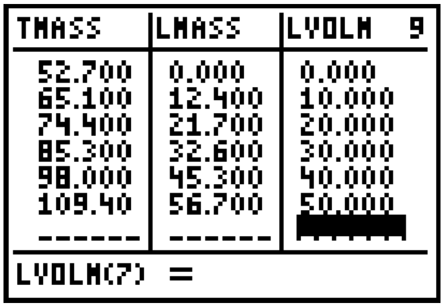
Unknown Liquid Density Determination Lab Activity (30 min): Working in pairs, students will receive a sample of an unknown liquid. Briefly, students will mass an empty graduated cylinder, fill it with a 10 mL volume of their unknown sample and re-mass the graduated cylinder with the sample. Students would continue to add 10 mL amounts to the graduated cylinder, until 20 mL, 30 mL, 40 ml and 50 mL samples of the unknown were massed.
Desired Outcome: Students will generate a list of mass and volume data values for an unknown liquid that can now be entered in to their TI graphing calculators for linear regression analysis.

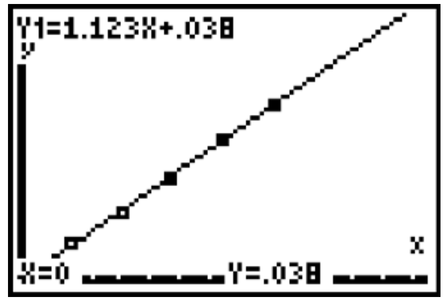
Lesson 3

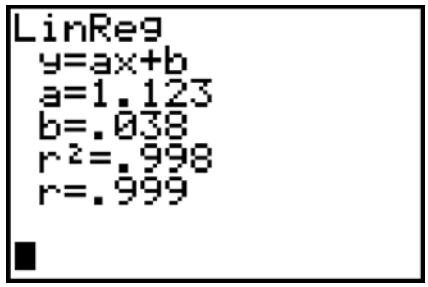
Bellwork (10 min): I would begin the third class by using the TI ViewScreen to review the tutorial on linear regression analysis – how to create lists of data values, how to set up and plot a graph and how to run and interpret the linear regression analysis program.

TI Calculator Activity Using Student Lab Data (15 min): Students will work in groups of three pre-planned so that each student's lab data representing a different unknown liquid. From yesterday's lab activity, students will enter their mass and volume data as lists into the TI, set up and plot a graph and do linear regression analysis to determine the density of their unknown sample. As the students work with their calculators, I will write a table of liquids and their known densities on the chalkboard. When students complete their linear regression analysis, they will be asked to identify their unknown liquid by comparing their density value with those listed on the chalkboard.

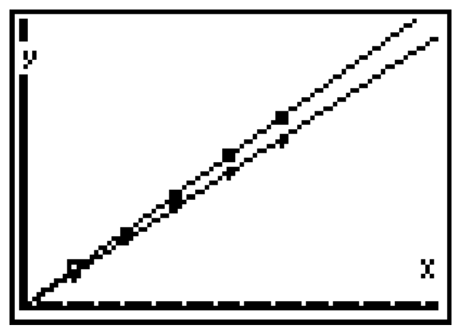
Desired Outcome: In addition to identifying their unknown liquid, students should display their lists, graph and linear regression screens, similar to the ones below.



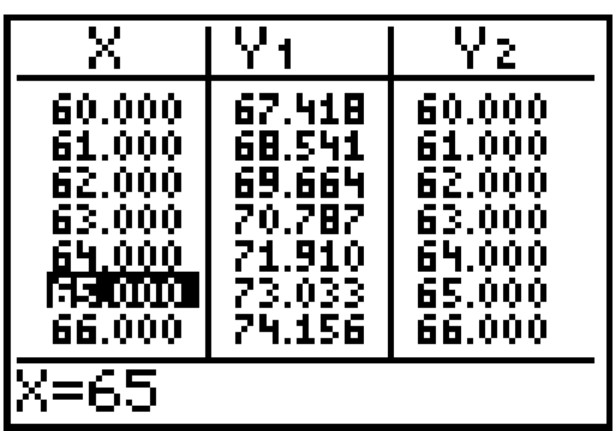




Concept and Data Analysis Activity (15 min): In this final activity, students will compare TI information from the tutorial water samples with their unknown sample data. The two different "a-values" from the linear regression analyses as well as a view of the two graphical models plotted together (as shown to the left) should make the concept that each different substance has its own characteristic density value more understandable to the students.



Students will then use the 2nd [Table] key to display a table of values for x, y_1 and y_2 (as is shown below). Since the values in the table have been generated based on the linear regression analyses best fit straight line, students can select any x value (representing the volume of the liquid) and find (predict) the corresponding value of y (representing its mass). The x and y values can then be used to calculate the density of the substance.



EXAMPLE: for x =65.000, y1 = 73.033

If D = m/V, then 73.033/65.000 = 1.124 = density value of the unknown liquid.

EXAMPLE: for x=60.000, y1 = 67.418

If D = m/V, then 67.418/60.000 = 1.124 = density value of the unknown liquid.

Desired Outcome: Modeling the concept of density with the TI-84 graphing calculator should help students to understand and better conceptualize this physical property of matter. Graphing lines with different slopes illustrates that each different substance has a characteristic density that can be used to identify it. Selecting a specific volume value (x) and its corresponding mass value (y) can be used to predict volumes and masses not actually measured in the experiment. Finally, several of these corresponding x and y values can be substituted into the D = m/V equation to calculate the density of a substance. Since the calculated density values will all be the same for a given substance, students should realize the understanding that each substance has only one density value no matter how large or small the sample size is.

Suggested Rubric:

Students will be evaluated with a score from 5 to 0 for each task listed in the table below.

Target	Acceptable 5 4 3	Unacceptable 2 1 0
Student participated in graduated cylinder demonstration		
Student was able to use the density equation to calculate density, given a mass and volume		
TI-84 Tutorial -student entered data + displayed lists -student set up + displayed graph -student did + displayed Lin Reg Anal		
Student gathered reasonable mass + volume data on unknown sample		
TI-84 Analysis of Lab Data (give rating for each step) -student entered data + displayed lists -student set up + displayed graph -student did + displayed Lin Reg Anal -student could explain the scientific significance of the slope of the line from the Lin Reg Anal -student could use TI-84 graphs and tables to predict corresponding mass and volume values not measured		
Student can explain the relationship among the visual, mathematical and graphical models of density		
Student can explain how the TI-84 was helpful in modeling aspects of density		