Title: Making Chemistry Relevant Via a Connection to Biotechnology

Research has shown that chemistry is often perceived as irrelevant in the eyes of students (Kracjik et al., 2001; Osborne and Collins, 2001: Pak, 1997; Sjoberg, 2001; WCS, 1999; ICASE,2003). With such perception comes indifference or even worse, a loathing of the subject. In my opinion, that's because in its attempt to cover all the basic concepts such as atomic structure and chemical bonding, a typical chemistry curriculum puts the concepts first and the applications a poor second. Throughout my teaching career, I have observed that the more relevant the material taught is to student lives, the environment, and to areas of future employment, the more receptive students are to learning and as a result, the more academically successful they are.
So one goal I set for myself is to seek relevant connections and this is often difficult.
That's why when I was presented with the opportunity to attend a two week course in Biotechnology at the University of Florida in the summer of 2010 I jumped at the chance, hoping I'd come away with something that helped bring relevance to my classroom.

One of the labs we do is on pH where the students make solutions of different pH values and test them with an indicator. In the past, my students made solutions using graduated cylinders. But solutions can also be prepared with a micropipette, a tool used throughout recombinant DNA protocols in the field of Biotechnology. And there lies the relevance that I so desperately seek!

Description of Teaching Unit

1) Notes and sample problems: solution Molarity and pH
2) Lab: Indicators
3) Application: Biotechnology: introductory power point and student posters
4) Assessment: Unit Test

Indicator Lab

1) Introduce students to a micropipette using the following internet sites

Pdf file:http://www.usc.edu/org/cosee-west/Jun07Resources/PipetteUsetraining.pdf
Video: http://www.youtube.com/watch?v=LcRIuIaiTNo&feature=related

2) Provide students with a P-50 micropippette, one vial of 1 M HCl, one vial of 1 M NaOH, once vial of distilled water, and two well plates and have them make solutions ranging in pH from 0-14 by following this diagram.

Plate #1

	Wells	Solutions
start →	A pH 0	10 μL of 1M HCl from vial
	B pH 1	9 μL water + 1 μL from solution in well A
	C pH 2	9 μL water + 1 μL from solution in well B
	D pH 3	9 μL water + 1 μL from solution in well C
	E pH 4	9 μL water + 1 μL from solution in well D
	F pH 5	9 μL water + 1 μL from solution in well E
	G pH 6	9 μL water + 1 μL from solution in well F
end →	H pH 7	10 μL water

Plate # 2

	Wells	Solutions
end →	I pH 8	9 μL water + 1 μL from solution in well J
	J pH 9	9 μL water + 1 μL from solution in well K
	K pH 10	9 μL water + 1 μL from solution in well L
	L pH 11	9 μL water + 1 μL from solution in well M
	M pH 12	9 μL water + 1 μL from solution in well N
start →	N pH 13	9 μL water + 1 μL from solution in well O
	O pH 14	10 μL of 1 MNaOH from vial

3) Provide students with a P-10 micropippette, a beaker, red cabbage leaves, and a hot plate. Students boil red cabbage leaves in a beaker of water then using a micropipette, transfer 5 μL of the red cabbage juice into each well of both plates.

4) The students record the color that the cabbage juice (the pH indicator) turned in each well. Here are the results to expect
pH 0-3 red 4 pink 5 purple 6-8 blue 9-11 green 12-14 yellow

5) Give students solutions of 6 unknowns to test with cabbage juice and predict their approximate pH values.

6) After discussing the lab results, give students a presentation of the use of micropipettes in the field of Biotechnology. Then assign the following project that students present to the class.
Research one of the following areas of Biotechnology, create a poster, and give a 2 minute presentation to the class:
Biotechnology and disease
Biotechnology and agriculture
Biotechnology and the environment
Biotechnology and forensics

To test the effectiveness of my activities I will give students the following pretest and posttest:
1) How relevant is using a micropipette in a chemistry lab to the real world?
A) not relevant B) relevant
2) Explain the use of micropipettes in the field of Biotechnology
3) Explain the impact of Biotechnology in each of the following areas: medicine, agriculture, environment, and forensics.

I will not need any materials because I am going to borrow the micropipettes from the AP Biology teacher and have access to all the remaining pieces of equipment.

Generally, biology laboratories use very small volumes of DNA and reagents. Dispensing these volumes require the use of adjustable micropipettes. Micropipettes come in many different models and volume ranges…as little as one microliter (μL) -- a millionth of a liter!

Metric Conversions Involving Small Volumes

Familiarize yourself with metric units of measurements and their conversions. We will use the volume measurement (base unit: liter) but the prefixes we learn would also apply to mass (base unit: gram) or linear measurement (base unit: meter). The two most prevalent units of liquid measurement in molecular biology are the milliliter (mL) and the microliter (μL).

1 mL = 0.001 liter or 1/1,000 liter 1,000 mL = 1 liter

1 μL = 0.000001 liter or 1/1,000,000 liter 1,000,000 μL = 1 liter

1 μL = 0.001 mL or 1/1,000mL 1,000 μL = 1 ml

Purpose

This laboratory activity introduces the proper use of the micropipette, a tool used throughout the recombinant DNA protocols (procedures) that follow these general technique labs. Learning the proper use of this tool will be important for obtaining good results. You will also learn how to use a microcentrifuge.

CAUTIONS **Using Micropipettes**

Set pipette volume only within the range specified for that

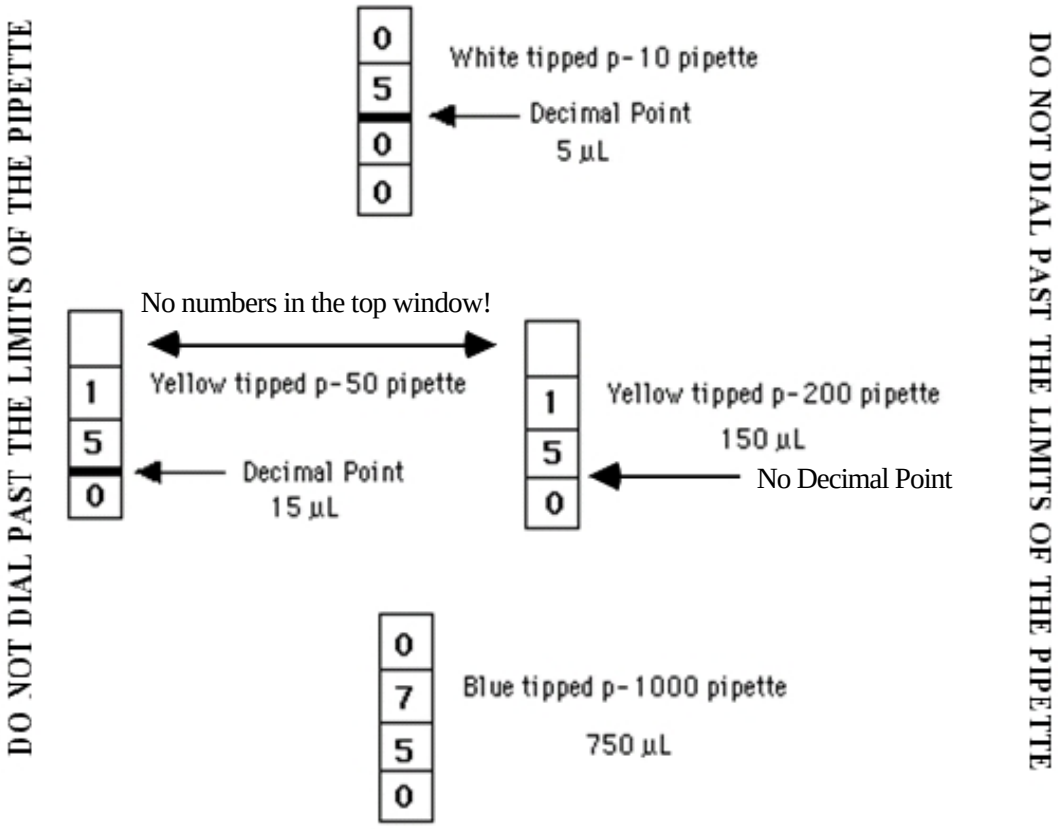
micropipette. Do not attempt to set a volume beyond the pipette's minimum or maximum values. This will damage the micrometer gears!

When using a micropipette, first apply a tip. Forgetting to do this would ruin the precision piston that measures fluid volume.

Always keep a micropipette in a vertical position when there is fluid in the tip.
Do not allow liquid to accidentally run back into the piston.

Use your thumb to control the speed at which the plunger rises after taking up or ejecting fluid. Letting it snap back damages the piston!

DO NOT DIAL PAST THE LIMITS OF THE PIPETTE



DO NOT DIAL PAST THE LIMITS OF THE PIPETTE

Setting t he M_ icropipette_

1. Check that you have the right micropipette. There are four sizes in the lab -- a "P-10" (for 0.5 to 10 µL), P-50" (for 10 to 50 µL), a "P-200" (for 40 to 200 µL), and a "P-1000" (for 200 to 1000 µL).

2. Dial the desired volume**. LOOK AT THE CHART ABOVE!** Do you understand how to read the scale? If not -- ASK!

3. Push the end of the pipette into the proper-size tip. The clear tips are for the P-10; yellow tips are for the P-50's and P-200's; the larger blue tips are for P-1000's.

Student Guide

Your teacher will demonstrate the proper procedure for drawing and expelling a sample with the micropipette. The steps are listed below for you to follow.

Part I: How to Take Up Sample with a Micropipette (use safety goggles!)

1. Before picking up the micropipette, open the cap or lid of the tube from which you are taking fluid. (Or, have your lab partner do this).

2. Hold the micropipette in one hand, almost vertical; hold the tube in your other hand. Both should be at almost eye-level.

3. **Depress** the plunger of the micropipette to the **first** stop, and **hold** it in this position, **then...**

4. Dip the tip into the solution to be pipetted.

5. Draw fluid into the tip by slowly releasing the plunger.

ADDITIONAL NOTES:

Part II: How to Expel a Sample From the Micropipette (use safety goggles!)

1. Open the cap or lid of the tube into which you are ejecting the fluid.

2. Hold the micropipette in one hand, almost vertical; hold the tube in your other hand. Both should be at about eye-level.

3. Touch the micropipette tip to the inside wall of the reaction tube into which you want to expel the sample. This creates a tiny surface tension effect which helps coax fluid out of the tip.

4. Slowly depress the plunger of the micropipette to the second stop to expel the last bit of fluid, and **hold the plunger down** in this position.

5. Slowly remove the pipette out of the tube, keeping the plunger depressed to avoid sucking any liquid back into the tip. When the tip is free of the tube, release your thumb pressure.

6. Always change tips for each new reagent you need to pipette or if you touch any other liquids in the reaction tube. To eject a tip, depress the large gray button on the top of the micropipette.

ADDITIONAL NOTES: