Thematic Inspirations for Labs

Kids these days! Why fight attention spans trained for TV and video games? Help your students appreciate the elegance of the scientific method by retooling the purpose and conclusion of your labs into a theme with a plot.

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RET/MRL presents

Thematic Inspiration for Labs

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5 Guidelines for Successful

5 Guidelines for Successful Thematic Labs

1. Choose a theme with which the students are familiar:

•If you choose contemporary movies, TV shows, celebrities or music, realize that you may have to "up-date" your theme within five years or less. So choose a theme that is easily up-dateable.

•Collaborate with your colleagues to see if there is a theme that could tie in with the present History topic or a book that the students are reading in English at the time.

•Try a theme that incorporates aspects of the student's personalities, hobbies or any defining moments in their lives. (Ex: build a better vote-tallying machine to avoid recounts and become RICH!)

2. Your theme must readily adapt to the purpose of and methods used in the lab, as well the conclusion/assessment and the STANDARDS.

•Think about "out-of-classroom" /"real-life" situations to which the purpose of the lab can be adapted.

*medical emergencies/ assays
*forensic mysteries
*survival scenarios
*fun food/beverage creations
*anything having to do with making money!

•If your story requires constant retooling, it is probably a red flag that you should pick a different theme.

•Avoid far-fetched adaptations such as:

"Using a balance and the water displacement method, identify the location of a plane crash by determining the density and identity of a mineral sample sent to you by a terrorist who claims to have survived the crash."

3. If appropriate, consider using the lab method to determine an UNKNOWN. Give a really good reason why it should be identified.

•Use charts of known physical characteristics (density, heat capacity, melting points, appearance, etc) to locate VALUBLE RESOURCES.

•Use chemical reactions that change colours, bubble, or clearly indicate some change as "MEDICAL ASSAYS" to determine if a "victim" has some kind of pretend disease

4. Include a COMPETITION aspect in the lab

Ex: *The first team to correctly identify which student's blood sample contains traces ofmercury will win a trip to Hawai'i!*

•Give extra-credit
•Nominal prizes (Hershey's Kisses, sodas)
•Bonuses (free tardy or homework assignment, etc)

Make sure that you have easy and clear guidelines for both the students to follow and for you to determine a winner!

5. Use PROPS to realize your theme:

•Background music
•Wear or provide simple costumes
•Decorate your room
•Label the bottles in creative ways
•Use movie clips on the VCR or in PowerPoint
•Invite a guest (such as a policeman or doctor)
•Special team names for lab groups, especially during competitions.

BONUS Guideline: you will be a real hero if you can devise:

•a general theme that can be used for all of your labs!

•a cast of student characters that have specific roles for each lab!

• a decoration theme for you room to act as a backdrop for the labs!

20 point Lab Practicum !

ExP #19: *So How Potent Is That Alien Stomach Acid, Anyway ??!!*

HERE'S THE STORY SO FAR: You, a Nobel Peace Prize recipient in the year 2004 and a world renowned chemist, have been hired as a special agent to assist Scully and Mulder in solving the Mystery of the Week. In the wee hours of Wednesday morning during Spring Break, just behind Lake Cachuma in the San Raphael Wilderness, a pair of backpackers were awoken at about 2:00 AM by a large flash and loud crash just over the next hill.

The next morning they searched and found a tangled mess of metal and trees with what looked like bodies. It could have been an airplane crash, yet the metal in no way supported the long shape of a plane; in fact the metal looked different than any metal they had ever seen. Even more perplexing were the bodies.....were they still alive? The hikers could not get close enough because their shoes began to dissolve as they got too close to the wreckage, in what appeared to be a clear fluid leaking from the injured bodies.

You and Scully and Mulder appear on the scene by Friday morning and with special hard-core investigative suits that are resistant to fire, electrical shock, solvation, acid/base reactions and UV radiation, you find the bodies are alive! And they are NOT HUMAN ! The apparent aliens are removed by government agents to a top-secret hospital where even you are not admitted with your top security clearance, and you and Scully and Mulder never find out if they survived or .....

However, noticing that the soil, manzanita bushes and other chaparral, as well as rocks that came in contact with the clear alien fluid were DISSOLVING, you manage to take some samples of the clear body fluid from each alien. Now you are in the Special Agent Lab analyzing the acidity of this fluid, which you believe came form a cavity not unlike our stomachs.

PURPOSE: Determine the concentration of an aliens' unknown stomach acid using acid/base titration techniques.

MATERIALS/EQUIPMENT:

two burettes two 100 mL beakers
250 mL beaker for waste litmus paper
burette clamp pole stand distilled water
white sheet of paper tape and pen 250 mL Erlenmeyer flask
standardized NaOH base (known M) phenolphthalein solution

Alien's unknown monoprotic stomach acid
from alien (choose cool symbols from picture fonts!)

Day One

PROCEDURE:

1) **PREPARE!** Write the title and purpose. Spend no more than five minutes setting up your data table which should include the spaces for the following data (and could follow the format shown in the demo titration):

You will hopefully complete three trials. For each trial you will record

- the **Molarity** of the BASE (given by Scully or Mulder or your instructor) and the **Symbol** for your ALIEN ACID
- **Initial Volume, Final Volume, Total Volume** for the ALIEN ACID
- **Initial Volume, Final Volume, Total Volume** for the KNOWN BASE
- a space for the **Calculation**
- a space for your **Result**.

2) **CLEAN!**

A•Clean 100 mL beakers, burettes, Erlenmeyer flask, with **three good rinses of tap water** , then **three good rinses with distilled water**. (TIP: use 250 ml beaker to pour into burettes, then remove tips for more rinsing)

B•Dry the two 100 mL beakers (the flask does not need to be dried.)

C•Label the 100 mL beakers **A** or **B**. Get acid and BASE from Scully or Mulder your instructor, and **RECORD** the acid **symbol** and the BASE **molarity**.

D•Rinse the burettes and tips with 15 mL of either acid or BASE and **label** them **A** or **B**.

3) **LOAD YOUR WEAPONS!**

Making sure the stopcocks are closed, put the burettes into the lamp and fill the burettes with the amount of acid or BASE given to you by the instructor.

4) **GET OUT BUBBLES!**

To get any bubbles out of the tip, put the acid beaker under the acid burette and drain acid out until all the bubbles are removed. Pour the acid back into the burette. Do the same for the BASE.

5) **BEGIN!**

Record the initial volumes of each burette. THE BURETTE CAN BE READ TO THE NEAREST **0.01 mL so don't chintz the result**!!! Let out **about** 2 mL of acid into the Erlenmeyer flask and rinse down the tip and flask sides with distilled water.

6) **COLOUR!**

Add three drops of phenolphthalein.

7) **TITRATE!!**

Proceed to titrate with the BASE to a faint pink endpoint that lasts for more than 30 s, remembering to **rinse the sides** of the flask often, **rinse tip** of burette often, use **1/2 and 1/4 drop** technique, and **burette refill** technique, etc. **BACK-TITRATE** if necessary.

*****Don't ever let the volume go below the 50 mL mark!!**

8) **RECORD THE FINAL VOLUMES OF acid AND BASE!!!**

Remember: be accurate!

9) **CALCULATE!**

Use the equation $\mathbf{M_A V_A = M_B V_B}$ to calculate the concentration of the unknown alien stomach acid!

10) Repeat each titration two more times for accuracy and precision.

ANALYSIS and CONCLUSION will be completed INDIVIDUALLY tomorrow as an exam.

You will need a calculator. You should have a working knowledge about pH and neutralization reactions.

GRADING: Your grade, out of 20 pts will be based on the following:

- participation in and execution of the lab procedure on Thursday.
- neatness of your lab write-up. (use straight-edges and no whiteout!!) Don't worry about getting it perfect DURING the lab: you can always rewrite the data table, etc.
- appropriate entry of data with units and accurate readings
- correct calculations according to instructions, with units and accuracy digits in answers
- a conclusion that has everything included in the way explained above
- a logical and well explained discussion of at least two errors possible in the lab.

20 point Lab Practicum !

ExP #19: So How Potent Is That Alien Stomach Acid, Anyway ??!!

PURPOSE: Determine the concentration of an aliens' unknown stomach acid using acid/base titration techniques.

Day Two

ANALYSIS:

1) In the data table you should have calculated the acid's molarity. If at least two out of three of your trials yield similar molarities, then you've got your answer!! If not, do another trial. Take the results that are really close and average them for your final acid molarity. **EX:** Trial 1: 0.55 M Trial 2: 0.67 M Trial 3: 0.57 M are your results: average the two close ones: 0.55M + 0.57M = **0.56M.** PS--make sure you use correct number of accuracy digits!!! 2

2) Now, assuming that the alien's stomach acid is a strong acid, and seeing as you now know the molarity of the acid, calculate the pH of the alien's stomach using the equation **$pH = -\log[H^+]$** .

3) X is an alien element unknown on earth. Assume that the formula of the monoprotic alien acid is HC_2X_2O. Since you used LiOH for the titration, write a balanced equation showing the neutralization reaction that occurs during the titration.

CONCLUSION:

1) Include the equation from analysis step 3. **Below** the formula for the alien acid, list your final averaged result for the alien's stomach acid, and the pH of the alien's stomach.

2) Explain whether the alien's acid is more or less potent than our own stomach acid with pH = 2. How do you know?

3) Why is PHENOLPHTHALEIN the best choice for the indicator of the titration endpoint as compared to the other indicators you experienced in Exp#18 .

4) Besides inaccurate reading of the burettes and other measurement errors, explain how **at least two OTHER** errors can occur in an acid/BASE titration and how these can affect your final results.

If you want to vindicate yourself from a really bad result, this section MUST be detailed and succinct!!!

Red Mushroom Alien
Stomache Acid

Violet Star Alien
Stomache Acid

Green pyramid Alien
Stomache Acid

Blue moon Alien
Stomache Acid

Yellow sun Alien
Stomache Acid

Chemistry Standards Met

Acids and Bases

5.

b. acids are hydrogen-ion-donating and bases are hydrogen-ion-accepting substances.

c. strong acids and bases full dissociate and weakacids and bases partially dissociate.

d. how to use the pH scale to characterize acids and base solutions.

f. how to calculate pH from the hydrogen ion concentration

Solutions

6.

d. how to calculate the concentration of a solute in terms of grams per liter, molarity, part per million and percent composition.

Investigation and Experimentation

1.

a. select and use appropriate tools and technology
b. identify and communicate sources of unavoidable experimental error
d. formulate explanations using logic and evidence
e. solve scientific problems using quadratic equations and simple trigonometric, exponential, and logarithmic functions
l. analyze situations and solve problems that require combining and applying concepts from more than one area of science

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