LESSON TITLE:  *PLOP...PLOP...FIZZ...FIZZ* Activity

TOPIC:  Logarithms

CONTENT LEVEL:  Algebra II/Advanced Math

TIME:  1 class period

MATERIALS:  Each cooperative team will receive:
1 TI-83 Plus Graphing Calculator with program CHEM loaded in
1 CBL System
1 Vernier pH Meter System with CBL-DIN Adapter
1 8-oz. Cup
Distilled Water (about 4 oz. per trial)
Lemon Juice (about 10 drops per trial)
Eyedropper
Antacid Tablets (one per trial)

BACKGROUND SKILLS:  Ability to use the following statistical features of the graphing calculator: data entry (lists), stat plots and calculating regression equations. Students should have previous knowledge of mathematical modeling, correlation coefficients, the logarithmic function \( y = \log x \), and effects of transformations (e.g. translations, scale changes) on the logarithmic function.

OBJECTIVES:
1. Students will collect and organize data from a real world experience.
2. Students will represent data in tables, on graphs, and using the lists on the graphing calculator.
3. Students will develop a logarithmic formula modeling the pH in the stomach over time.
4. Students will test their model, making appropriate adjustments to find the curve of best fit.
5. Students will study the effects of changing the parameters of the experiment on their model.
NORTH DAKOTA MATHEMATICS CONTENT STANDARDS:

North Dakota Math Content Standard 1: Number and Operation

12.1.4 Understand the properties and basic theorems of roots, exponents, and logarithms.

North Dakota Math Content Standard 3: Data Analysis, Statistics and Probability

12.3.6 Use regression techniques to determine and interpret the curve of best fit.

North Dakota Math Content Standard 4: Measurement

12.4.1 Understand attributes, units, and systems of measurement.

North Dakota Math Content Standard 5: Algebra, Functions and Patterns

12.5.3 Represent and describe relations algebraically, numerically, and graphically.
12.5.8 Understand the basic ideas about convergence, limit of functions, and infinite series.

NCTM MATHEMATICS PROCESS STANDARDS:

Problem Solving:

- Build new mathematical knowledge through problem solving.
- Solve problems that arise in mathematics and other contexts.
- Apply and adapt a variety of appropriate strategies to solve problems.

Reasoning and Proof:

- Make and investigate mathematical conjectures.

Communication:

- Use the language of mathematics to express mathematical ideas precisely.

Connections:

- Recognize and use connections among mathematical ideas.
- Recognize and apply mathematics in contexts outside of mathematics.

Representation:

- Use representations to model and interpret physical, social, and mathematical phenomena.
DESCRIPTION:
The activity is best done in a lab-type setting (or with desks centered into pods) with students working in cooperative teams of 3-4 students per team (this can be done randomly or at the instructor's discretion). Have each lab station ready with the necessary equipment and supplies. The CBL CHEM program can be downloaded to a calculator from the World Wide Web site.

http://www.ti.com/calc
ftp://archive.ppp.ti.com/pub/graph-ti/cbl/programs

Begin the activity discussing with students the effects of eating or drinking something acidic. The presence of excess acid in the stomach can result in an upset stomach or indigestion. To alleviate the discomfort, people will often chew an antacid tablet or drink Alka-Selzer® to neutralize the acid in the stomach and raise the pH level. Tell the students they will be modeling the effect of an effervescent tablet on a solution that is acidic.

At this point, teams are ready to begin the activity. The activity is designed such that the instructor acts as a facilitator, and the students direct their own learning. The activity provides directions for the set-up of the experiment and the data collection process.

Teams are then ready to collect and analyze their data. The experiment should simulate a modified logarithmic curve. Students will find the equation for the curve and test their equation using the graphing features of the calculator.

Students will also test the effects of adding more lemon juice at the beginning of the experiment, and adding more than one effervescent tablet to the solution. They will determine what variables in the equation are affected.

ASSESSMENT: Completion of the PLOP…PLOP…FIZZ…FIZZ… Activity handout.

REFERENCES: Explorations, Texas Instruments: Activity 14 (Sour Chemistry)