

From the Loch Ness Monster to the Killer Lake of Cameroon: An Approach to Stimulate Student Interest, Critical Thinking, Problem Solving, Outside Reading, and Communication Skills

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Main Goals of the Educational Process

The main goals of the educational process are to teach students to: (1) communicate clearly, (2) study regularly, (3) master basic math and problem-solving skills, and (4) think logically. The acquisition of these four fundamental skills is more important than the subject matter of many courses that serve primarily as a vehicles for the mastering of the four fundamental skills.

Communication

Some Faculty lower their students' grades because of their writing, telling students that if they don't write well as professionals they will lose more than just letter grades. An MIT study showed that about 30% of all industrial professional activities involved writing. If students can't explain material in complete grammatically correct sentences, their mastery of the material is incomplete. The fact is, of course, that the abilities to read carefully, to think analytically, and to communicate with both economy and precision have always been marketable skills.

I try to develop communication skills, in part, by incorporating essay questions on all one-hour examinations and on most daily quizzes. My essay questions are usually one of two types: (1) Write a paragraph explaining how to solve a problem, and (2) Write a paragraph explaining an unusual and interesting question in chemistry.

Essay Questions on Problem Solving Logic

I have developed a problem-solving technique, which includes verbs and nouns along with traditional units. The following are two examples of this technique:

Problem #1: Bob buys six candy mints. Each mint costs 5 cents. How much do the mints cost Bob?

$$(6 \text{ candy mints bought}) \frac{(5 \text{ cents cost})}{\text{candy mints bought}} = 30 \text{ cent cost}$$

Translation (Essay Format):

Six candy mints were bought. Since it costs 5 cents for every candy mint bought, then it costs 30 cents.

Problem #2: When 500 students were questioned, 10 percent said they liked Pepsi. How many of these students like Pepsi?

Expanded Dimensional Analysis Solution:

$$(500 \text{ students were questioned}) \frac{(10 \text{ students like Pepsi})}{100 \text{ Students were questioned}} = 50 \text{ students like Pepsi}$$

Translation (Essay Format):

Five hundred students were questioned. Because 10 students said that they liked Pepsi out of every one hundred students questioned, then 50 of the questioned students liked Pepsi.

Students more easily follow my solutions and students are forced to think a little more deeply using this approach. An additional and important benefit to this approach: Solutions are easily translated into written responses as shown in the examples.

Essay Questions on Unusual and Interesting Phenomena

This author has published a repertoire of some 500 engaging chemistry-related mysteries that can be used to stimulate student interest. For example, when discussing temperature conversions, rather than giving students problems with meaningless, random numbers, why not ask students to find the temperature at which Hell freezes over in degrees Fahrenheit or in Kelvins? If teachers don't have time to explain how they know Hell's temperature, teachers can give a reading assignment such as, "Read how to determine the temperature at which Hell freezes over. Tomorrow, an essay quiz will be given that requests the logic used in this determination." I profess that many (if not most) teachers will accept that daily essay practice using this or any material in combination skills.

Other examples of interesting topics include the Loch Ness Monster and the Killer Lake of Cameroon. Questions and answers related to these and other topics are available upon request from the author and on the World Wide Web <http://www.educationcenter.org>.

Regular Study

I try to develop regular study habits by giving daily quizzes, which count 30% of the final grades.

Basic Math Skills

I try to develop basic math skills by developing both estimation skills and scientific calculator and computer proficiency. Examples of estimation skills that should be mastered include performing calculations such as $398 \text{ ft} \times 2076 \text{ ft} = 8 \times 10^6 \text{ ft}^2$ (by converting to exponential notation with one significant digit), and determining that $\sin(1) = 0.8$ (by sketching).

Logical Thinking

In addition to the use of essay questions, I try to develop thinking skills by asking pre- and post-solution questions such as, "Does the problem make sense?" and "Does this answer make sense?"

Summary

As chemistry teachers, we must realize that the rigors of our discipline are but one facet of our students' overall education. There are also general and universal concerns that need to be addressed, e.g., the development of regular study habits and the honing of communication and thinking skills.