

on a separate computer at their own speed. I use an overhead display panel to show them how to enter text and how to manage the math mode. Some of the commands are really not very intuitive, as they are unique to MathCAD. Here is an example of how one student carried out the assignment this year.

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Purpose: To use the Rydberg-Balmer equation to calculate the initial energy level for the hydrogen spectra as determined in Experiment 13.

λ = wavelength
 x = Balmer Constant
 n = initial energy
 i = counter

$$i := 1..3$$

$$x := 1.097 \cdot 10^7$$

$$\lambda_i :=$$

$435 \cdot 10^{-9}$
$490 \cdot 10^{-9}$
$660 \cdot 10^{-9}$

$$n_i := \frac{1}{\sqrt{\frac{1}{4} - \frac{1}{\lambda_i \cdot x}}}$$

n_i

4.973
3.954
2.99

The graphing assignment is coming soon, but I have changed it from what was done last year. That assignment was for the students to set up templates to graph Conc. vs time, ln Conc. vs time, and 1/Conc vs time for five sets of kinetics data. Then for the equation that showed a straight line they were to determine the order, the rate, and the rate constant for each set. This year they will have only one of this type of problem. They will also be asked to graph $V/T = k$ and $PV = k$, where k is a constant, using a minimum of 5 points for each. In addition, they will be given in $P = A \cdot \Delta H_{\text{vap}}/RT$ and values for vapor pressure and temp and determine the

value of ΔH_{vap} . Lastly, they will be given solution concentrations in molality and boiling points and after graphing conc. vs b.p., determine the slope to obtain K_b . I had my classes do this assignment on Kaleidagraph for several years to help them learn that graphing software, but since almost all of them are quite proficient at it when they come into chemistry, this seems like an excellent way to provide experience in graphing with MathCAD.

The specific directions that are given out to the students pertaining to MathCAD itself and the assignment details can be viewed at the website given above. I want to acknowledge the help of the math faculty at the Governor's School who showed me how to use MathCAD and who developed the student directions for the various assignments. Thanks go to Julie Taibbi, Susan Kennedy, John Cannaday, and Ken Weddle.

ELECTRONIC CLASSROOMS

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You can't see atoms or molecules. Students have to establish a mental picture of atomic and molecular structure to understand chemistry. During the last year and a half we have been experimenting with the use of Pentium and Macintosh electronic classrooms in organic chemistry and biochemistry instruction. We find that the use of visualization software is an excellent tool to help students understand molecular structure.

Bridgewater State College has recently completed the John Joseph Moakley Center for the Application of Technology to Education. The building has two 26 seat Pentium electronic classrooms and one 24 seat Mac electronic classroom. Each classroom has two microcomputers set up for wheelchair access, and the building also houses an adaptive computing room where special software is provided. Each electronic classroom has a faculty station consisting of a cart equipped with a microcomputer with CD-ROM, a video visualizer, a VCR, a laser disc player and a network connection. All of these are connected to a Sony three-gun projection TV system through an audio/video switch, and an Extron converter box. The individual microcomputers also have 4X CD-ROM drives and network

connections.

In organic chemistry we have used software in two ways; as a lecture aid to help students understand the geometry of molecules and orbitals (PCMODEL) and as self-contained teaching modules (IR-TUTOR). We would be very happy to have more software of the same quality as IR-TUTOR to cover other areas of organic. The ability to rotate a computer visualization of a molecule in PCMODEL really seems to help students to conceive of molecules as three dimensional.

We have used MOBY and RASMOL in biochemistry to help students to understand protein and nucleic acid structure, and to understand how proteins can recognize large and small molecules. It is gratifying to see the improvement in student's understanding of three-dimensional structure that starts in organic chemistry make the transition to large biomolecules. The ready on-line access to biomolecular structure from the Brookhaven Protein Data Bank (FTP or FETCH) makes the display of proteins, nucleic acids, and the recognition of DNA by proteins easy. RNAFOLD and PROTYLZE can be used to predict RNA and protein structure, and the predictions can be compared with reality. This is important as the predictions are not always that good.

We have been using STN EXPRESS to teach students to access the chemical literature on-line. A Pentium electronic classroom is particularly well-suited to do this economically, as the instructor can demonstrate techniques useful to narrowing a search before the student goes on line. (You can also demonstrate how to narrow the search too much.) Counting "hits" shows the student the effect of operations like the logical AND. STN has run a seminar for faculty and students that was very valuable- I recommend it highly.

A plan of one of the tiered Pentium classrooms accompanies this article. We made a few minor mistakes- Rear Screen projection is a waste of time, space and money, and the lecturer's station should probably be a fixed podium, since by the time you get it connected to the projection TV, power, and the network it is essentially fixed in position. The omission of 35mm slide projectors was also a mistake, although presentation software can make up for some of this. But the projection TV system still has poorer resolution than the microcomputer screen or a 35mm projector. Partially for this reason, we are investigating the use of screen control systems and will be trying out software from ROBOTEL next year, in one of the Pentium classrooms that has been expanded to 35 microcomputers by ripping out the projection TV area.

Technology will never replace good teaching;

but visualization techniques and high quality instructional software can certainly improve undergraduate education. An investment of time and effort in these areas is most certainly worth the effort. I feel that the people who are "bashing" technology in the classroom need to use better software.

Hardware summary:

Macintosh Classroom

Powewmac 7100AV (80 mhz)
16 MB RAM
700 MB Hard drive
4X CD-ROM Drive
nubus AV card
System 7.5

Pentium Classroom

Compaq Pentium 90
16 MB RAM
420 MB Hard drive
4X CD-ROM
sound card
Windows NT 3.51 workstation

Lecturer Station ("front end")

same microcomputer as student stations

stations

Canon RE-650 MH IIN Video visualizer

visualizer

Pioneer LDV4400 Laser Disc player
Sharp two-head VCR
Audio/Video switch
Exxtron RGB 105 converter
Amplifier TCA Series 900, mono, NOT

stereo

Sony Multiscan VPH 1252Q three gun

projection TV

Custom designed cart from Anthrocart

A Web Page in Chemical Education

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For several years I have been using e-mail in courses with the dual goals of adopting electronic communication as a pedagogical tool and inducing students to become familiar with e-mail for its