worksheets or guidelines to accompany these tutorials; otherwise, students proceed as if playing computer games!

Another important component is the liquid crystal display (LCD), used to project concepts which are being taught to the total class when software is not available or appropiate for small group or individual instruction. The LCD is used for introducing technology or equipment that the students will be using, such as spreadsheeting and graphing. The graphics program which is used to design "concept stories" is IBM's Storyboard Plus. Included is a list of teacher-made concept stories which have been developed with the project. Pictures, diagrams, definitions, and descriptions in a series of frames teach the following concepts.

1\Bonding
2\Density
3\Exo- and Endothermic
4\History of Atom
5\Mass Spectrometer
6\Forming Sodium Ion
7\Phase Diagrams (CO2 and H2O)
8\Colligative Properties
9\Molecular Model
10\Use of Buret
11\Heating Curve
12\Simple Orbitals
13\Part 1 Equilibrium (Qualitative)
Part 2 Equilibrium (Quantitative)

The concept stories can be utilized by the individual student, but usually they are used in large group instruction because they are not interactive.

Harrison High School has Microsoft Works on its network. Students use word processing for lab reports and summary reports on current topics in chemistry, but students are not required to word process throughout the course. Using/making spreadsheets and graphing is the aspect from Microsoft Works that is most used in our chemistry classes. Included is a list of spreadsheet templates which have been developed with the project.

One advantage of spreadsheeting is that students can readily relate a large collection of data to the concept the lab is teaching. Initially students enter individual data for the spreadsheet; they also have access to all other students' data as well. This allows them to understand the experiment more clearly. Eventually they construct the spreadsheet and learn to graph the data from it. The spreadsheet also makes it easier for the instructor to check the students' lab results.

Another feature of our technology is the purchasing of Personal Science Laboratory, which has improved the laboratory interfacing capabilities. The thermistor is used to determine such concepts as heating curves, heat of fusion, and heat of reaction. One major use of the pH probe is to plot the neutralizaion curves involving various combinations of strong/weak acids and strong/weak bases.

For the instructor the Excelsior Grade Book is a most useful and powerful management tool. Keeping students informed of their continual progress, whether for eligibility for extra curricular activities, or for their own curiosity, is most efficient. Questions on attendance can be answered quickly. Statistics on graded material can be determined instantaneously.

Through our project we have gained a better insight of how the tools of technology can enhance traditional instruction, providing still another method of teaching. A second advantage is that "Classroom Without Walls" increases students' opportunities to work with technology that many will face in future education and/or employment.

Sources of Software

Storyboard Plus from IBM
Microsoft WORKS for IBM PC's and Compatibles
PSL(Personal Science Laboratory) from IBM
COMPRESS(tutorials)
P.O. Box 102 Wentworth, NH 03282

(KC? Discoverer)
Journal Chemica Education Software University of Wisconsin-Madison, Dept of Chemistry 1101 University Avenue Madison,WI 53706

Excelsior Software, Inc.(grades)
P. O. Box 3416
Greeley, CO 80633

Can the Organic Laboratory be Computer Assisted?

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This is the question I posed at the 12th Biennial Conference on Chemical Education in August. It is the question I want to pose now to the readers of this newsletter.

In this brief paper, I would like to suggest some ways computers have been or could be used to make the Organic Laboratory experience more effective. My examples are drawn mostly from software available for the Macintosh®. If readers have suggestions or comments, I would like to hear from them and will prepare a future column summarizing such comments in this newsletter.

Some possible uses and software are given in Table I.

Table I
Software Samples

Graphing	Searchable Data Bases
CA-Cricket Graph	STN, HODAC
Graphical Analysis III	HSDB, TOXNET
Kaleidagraph	TOXLINE, TOXLIT

Drawing, Structure Building & Presentation		Nomenclature/Simple Reactions
ChemDraw	CHEMINTOSH	Beaker
LabVision	CHEMDRAFT	Jay Hawk
Molecular Editor	Desktop Molecular	Organic Rxns.
Alchemey III	Modeller	
MacStereo	Moby	
CHEMWINDOWS	Chem 3D Plus	

Spectral Information	Qualitative Organic Analysis
Instrumental Software	MacSQUALOR
SpectraDeck	MacQual
Proton NMR Simulator	
Mock NMR	

Math Expressions/Equations	Spreadsheets
MathType	Excel
Expressionist	Full Impact
MathCAD	Lotus 1, 2, 3
TK Solver Plus	Wingz

Table II
Preparing for Lab

Needs	Types/Names
Structures and Names	Beaker
Reactions Byproducts Mechanisms	Beaker
Stereochemistry	3D Drawing program/Spatial Display/Structure Building
Physical Properties, etc.	Searchable Data Base STN
Toxicity, Hazards, Disposal	Searchable Data Bases TOXNET, HSDB
Preliminary Calculations	Spreadsheet Excel, Lotus 1, 2, 3 Wingz, Full Impact

Table III During the Lab

NEEDS	TYPE/NAME
Collecting & processing data (personal) Collecting & processing data (class)	Spreadsheet Excel, Full Impact Lotus 1,2,3, Wingz
Electronic Notebook	Spreadsheet/Word Processing See above
Graphic data (in progress) Kinetics, Titrations Calibration curves, etc.	Graphics Graphic Analysis III CA Cricket Graph Kaleidagraph
Spectral data Matching Teaching Impurities	Instrument software, Spectra Deck, Mock NMR, Proton NMR Simulator
Dry Lab Teaching Stereochemistry Spectral Analysis	3D Drawing and Manipulating See above
Planning New Experiments Source of Experiments Synthesis	Searchable Data Bases Synthesis Planning Programs
Qualitative Organic Analysis Preparation Simulation	MacQual and MacSQUALOR
Waste Disposal	Searchable Data Base HSDB

Table IV After the Lab

NEEDS	TYPE/NAMES
Report Writing Calculations	Word Processing Spreadsheets Excel, Full Impact Lotus 1, 2, 3, Wingz
Equations Chemical	Drawing Beaker, ChemDraw CHEMINTOSH
Mathematical	MathCAD TK Solver Plus
Expressions	MathType
Plotting and Interpreting Data	Graphics Graphic Analysis III Cricket Graph Kaleidagraph

Tables II, III, and IV suggest some uses before, during, and after the lab.

Graphing results from kinetic experiments, titrations, and apparatus and instrument calibration during the lab will suggest how effective the work has been or whether it should be repeated. Searching for spectra to compare to observed spectra would give feedback as to how successful a synthesis had been. Some students might keep electronic notebooks.

Computer stored or generated spectra and molecular modeling programs could be used for preparatory assignments or dry labs. We have had students use qualitative organic analysis simulation to increase the efficiency and effectiveness of unknowns in the lab.

Students are asked to come to the Organic lab having done prior preparation. This preparation usually includes finding the chemical and physical properties of the substances to be used or prepared. Now we need to add to that, information on toxicity and methods of disposal. Computer searchable data bases could facilitate this process.

Participants at the conference in August were asked to fill out a related questionnaire. A few did. The questions were:

1. What software programs do you use in conjunction with teaching the Organic lab?
2. How would you like to use the computer in this activity?
3. Do or should your students have access to computers "in" the Organic lab as they do to IR and GC?
4. How would you like your Organic lab students to use computers?
5. What stands in the way of more use of computers in the Organic lab?

Responses for question 1 included different spectral programs (mentioned by all but one responder and one of these mentioned the Sadtler Library Search program), Beaker, word processing, and drawing programs. One respondent said they had a qual organic search program for compound identification containing data for 6000 compounds stored on their IBM mainframe.

Suggestions for question 2 included input data and check calculations or receive suggestions (i.e. error, possible compounds), analysis of gas chromatographic data, simulations, modeling, lab notebook, and to identify spectral unknowns before doing qual. The responder with the ID file said their students get a list of possible compounds. That sounds interesting.

Answers in response to question 3 range from no response through yes (several) to one lab which is connected by cable to mainframe with input from the lab.

Question 4 drew responses expanded from #2. They include: Preview lab set-up, compare and average class results (Good for discovery labs!), grade their own preparations with IR and NMR as resources, write lab reports, spectral searches and simulators, and using the library that comes with FT-IR.

In response to number 5, almost all said space and/or money. One threw in the administration. No one mentioned concern for damage to the computers. One honest responder spoke for all of us—"my inertia."

Don't let your inertia get in the way. Write today if these topics are of interest to you. If people are interested, I would be willing to act as a clearinghouse and seek to air your ideas and concerns (quality of software, software needed, ways to use them, successes, etc.) in print.

Windows and Networks: Lowering the Activation Energy for a Chemistry Department Microcomputer Facility.

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Abstract

A synergistic combination of a window-oriented user environment and high-speed local and wide area networking is the technological basis for a successful faculty-student computer workstation room in a university chemistry department. This paper describes the equipment, software, organization, operation, and application of the facility.

A. Introduction

How can a university chemistry department make the best use of modern personal computer technology to help support its teaching, research, and service mission? There is no question that computers can perform many useful tasks for the scholar and researcher, but how can we insure that the technology will be utilized in an effective way and will actually contribute to productivity? It is essential that the real benefits to the users be weighed against the increased burden of complexity that unavoidably accompanies any high technology development. Ours is a large research-oriented department of chemistry and biochemistry with 45 full-time faculty members, 200 graduate students, and 400 chemistry and biochemistry undergraduate majors. Students and faculty in our