# Chapter 7

# Computer-Aided Laboratory Instruction

***Catherine J. Schaap***

Department of Anatomy and Physiology,
Atlantic Veterinary College,
University of Prince Edward Island,
Charlottetown, P.E.I. C1A 4P3
(902) 566-0931, 566-0958 (FAX)
NetNorth: schaap@upei

Catherine Schaap received her Ph.D. from York University for her research on chromosome movement during meiosis. She developed and used a digitizer system for quantifying birefringence along the lengths of individual chromosomal spindle fibers. This was followed by a postdoctoral research fellowship at the University of Alberta during which she studied axonal transport. She is currently at the new Atlantic Veterinary College (AVC), where she has been instrumental in establishing computer-aided instruction (CAI) as a principal laboratory component of the physiology course for veterinary students. As the primary resource person for CAI at the College she has given several workshops in this area.

**Reprinted from:** Schaap. C. J. 1990. Computer-aided laboratory instruction. Pages 101-128, *in* Tested studies for laboratory teaching. Volume 11. (C. A. Goldman, Editor). Proceedings of the Eleventh Workshop/Conference of the Association for Biology Laboratory Education (ABLE), 195 pages.

## Contents



## Introduction

At the Atlantic Veterinary College (AVC) the microcomputer laboratory is used for courses in statistics and epidemiology that traditionally require a lot of computations. It surprises some, however, that the microcomputer laboratory is also extensively used for the teaching of physiology and pharmacology. In fact, for the physiology course our students alternate between traditional "wet" labs using animals and "dry" labs in the microcomputer laboratory using computer simulations. Yes, computer programs can substitute for the less critical uses of animals in the lab, as well as augment the learning experience when animals are used!

At AVC we use software that deals with such diverse topics as acid-base balance, cardiovascular interactions, heart arrhythmias, renal function, respiration, muscle kinetics, electrophysiology, and pharmacokinetics (see Appendix A). Some software even simulates the interaction of physiological systems in the whole animal.

Using this software, students can study the effects of simulated perturbations on the function of a particular physiological system or the response of the animal as a whole. A variety of manipulations can be performed during one laboratory session. Students study the effects of a hemorrhage, a blood or saline infusion, anemia, decreased lung function, kidney disease, dehydration, reduced heart strength, and strenuous exercise. Students can even use the simulations to determine the approximate parameters and conditions for an experiment before doing an actual experiment on animals.

Without simulation, some of these experiments might take days or weeks, require considerable technical prowess, and require expensive laboratory support in addition to the animals involved. Using computer simulation, the experiments can be repeated and changed as often as the student desires. This means that questions can be asked in different ways in order to better understand the functions of the system. In fact, extreme experiments that would otherwise be wasteful of animals or even unethical can be performed on the computer in order to learn fundamental concepts and physiological limits. Computer-aided laboratory instruction means that experiments can be done any time the computer is accessible; no laboratory technical help is required to set up the lab, and the experiment will not fail due to technical inexperience on the part of the students. The learning potential using computer simulation is tremendous!

At the AVC we have found that as well as being a powerful teaching tool on its own, effective computer simulations can decrease the number of animals needed in the teaching laboratory. Routine experiments can be done largely on the computer instead of on animals. They can be done on the "whole" simulated animal or on an isolated system or tissue. For example, entire animals need not be sacrificed just to study the basic behavior of isolated muscle. Experimental limits can

also be determined by using simulations. Various techniques, including some of those involved in anesthesia and surgery, can be practiced on the computer. The software can give immediate corrective feedback to help the student in mastering the principles and steps of the techniques before they are tried on animals. By "running through" a procedure beforehand using simulation, students can be better prepared as to the signs to be looked for when the live procedure is done. Indeed, just as simulation "run throughs" have proven their value in the aerospace industry these techniques may eventually become a standard preliminary practice in hospitals whenever an infrequent technique is called for!

There is currently software that allows one to do dissections by computer. As graphics techniques improve and give more three-dimensional effects and as video disk technology is incorporated into more software, this type of "dissection" will become more realistic and useful. Although it is not likely nor desirable that computers will eliminate the use of animals in the teaching laboratory, they can certainly decrease the numbers used. This is a concept which we at the AVC strongly endorse. We are confident that this alternative approach to learning will expand to more courses in the College. As we become more experienced and expand our technical capabilities, computer-aided instruction will prove to be an ever more effective teaching tool.

Many of the programs given in Appendix A are available to our students via a local area network. This means that the students can have access to the programs at their individual microcomputers by calling them up from a central server computer (the mainframe VAX in this case). This eliminates the need for having multiple diskette copies of the software and means that more control can be exercised over the use of the software. However such an extensive set-up is not necessary and much can be gained by simply having one or two computers available to the students.

At AVC we primarily utilize IBM-compatible computers with at least CGA graphics capabilities. We are finding now that the additional speed of AT-type computers and the enhanced graphics capabilities of EGA and VGA, required by much of the newer software, greatly increase the quality of information that is conveyed. As we expand our technical capabilities at the College, we expect to use CAI even more effectively. For example, we hope to be able to use and develop software that utilizes video disk technology to access superior images and video sequences. Such technology and software already exist (see some of the resources given in Appendix B).

For those who want to develop their own courseware but who are not computer programmers a variety of authoring software is becoming available. Just as word processing software helps one with writing papers, etc., authoring software can help in the development of courseware for non-programmers. We anticipate that we will be utilizing this technology in the future as well.

Many people who might like to use CAI in their teaching programs do not have time to develop their own courseware. Appendix B also contains a list of resources that may help people find suitable courseware to fit their teaching programs.

# APPENDIX A

*A Compilation of AVC Software for Computer-Aided Instruction*

Part 1 of this appendix compiles descriptions of software that we have accumulated or developed for use in our teaching program at the Atlantic Veterinary College (AVC). These descriptions are usually taken from documentation supplied with the program. Some of the programs are used on the local area network in the microcomputer laboratory of our Computer Center. Unless it is otherwise mentioned, the software is for IBM-compatible machines. Some of the programs, however, especially the commercial ones are also available for other types of computers. The program description includes the names of the authors and/or publishers who can be contacted for further details or information on the availability of the programs (addresses are listed in Part 2 of this Appendix). This listing does not include commercial word processing, database management, statistics programs, etc., that we have. If you are interested in developing your own software, I have some information and demonstration diskettes on authoring packages that may make software development easier for the non-programmer.

If you have other software that colleagues might find useful, please let me know about it and it can be included in future compilations of this sort. This compilation was prepared in September 1989.

## Part 1: Descriptions of Programs

Acid Base Game
Acid-Base Physiology Simulation
Anatomy and Physiology Software from Mississippi State University
Anatomy Pinball
Animal Behaviour Data Simulation
Apanat
Archivist
Arrhythmias Tutorial I and II
Arterial Blood Gases
Arterial Blood Gas Tutorial
Bacterial Identification
BASIC Acid Base Physiology
BASIC Cardiovascular
BASIC Electrophysiology
BASIC Pharmacokinetics
Basic Ventilatory Parameters
CAI: Computer-Aided Instruction
Cardiac Muscle Mechanics
Cardiovascular Interactions
Cardiovascular Physiology Part I: Pressure/Flow Relations
Cardiovascular Physiology Part II: Reflex
Cardiovascular Systems and Dynamics
CIRCSIM: A Teaching Exercise on Blood Pressure Regulation
Data Set Generator (DSG)
DIGITALIS: Pharmacology and Clinical Use

Dose Effect Analysis with Microcomputers
EKG Tutor
Fault Identification Game: A Diagnosis Game
Gas Diffusion in the Lung
Gas Uptake Simulation (GUS)
Gradebk
HUMAN – Microcomputer Version of a Comprehensive Physiological Model
Ileum: Guinea-Pig Ileum Simulation
Lung Volume Calculations
MacDope
MacMan
MacPee
MacPharmacology
MacPuf
MEANCURV – A Program for Averaging Dose-Response Curves
Mechanical Properties of Active Muscle
MICAL: Microbiology Computer-Assisted Learning
Mind Games – Biology
Molecular Basis of Muscle Contraction
Muscle Mechanics: A Computer-Simulated Experiment
Nephros: A Renal Clearance Analysis Program
Using PC Storyboard in the Medical Classroom
Problems in Fluid Compartment Re-Distribution
PSYCAL: Psychiatry Computer-Assisted Learning
Pulmonary Mechanics Lab (PML)
Renal Glomerular Dynamics
Simulations in Physiology: The Respiratory System
Ventricular Action Potential Simulation

**Acid Base Game** by J. Boyle and G. Robinson

This program is an acid-base tutorial in a game format. The user can select a tutorial lesson or the game format at the start of the program. The tutorial provides a review of the Henderson-Hasselbalch equation and the relationship between $PaCO_2$, HCO and pH in the body using a Davenportgram. The tutorial also graphically presents renal tubular mechanisms of $H^+$ and HCO excretion or reabsorption. Acid-base diagnoses are introduced and renal and respiratory mechanisms of compensation are depicted on the Davenportgram. The game portion of the program presents abnormal acid-base conditions by randomly assigning values for $PaCO_2$ and HCO, then calculating the resultant pH. The user can alter body size of the "patient", $O_2$ consumption, hemoglobin concentration and plasma protein. The user gains points by making the correct diagnosis and completely correcting the acid-base condition. Treatment consists of adjusting ventilation and infusing either basic or acidic solutions to correct metabolic imbalances.

Comments: To order contact J. Boyle ($40 US). J. Boyle has other programs that we do not have including some on respiratory physiology and on cardiovascular physiology.

**Acid-Base Physiology Simulation by H. G. Bohlen (1986)**

This program provides students with the opportunity to simulate acute respiratory and metabolic acid-base disturbances and observe the blood buffer system, and respiratory and renal compensation. The compensatory mechanisms can be partially or totally neglected so that the student can determine the relative importance of each mechanism during acute disturbances. The results are present in five simultaneously-available graphic formats, in arterial bicarbonate concentration versus arterial pH and time sequence events, plus a numerical data table. Results from various simulations can be superimposed on the graphic screens to encourage comparisons and contrasts between different situations.

Events simulated: acid infusion; base infusion; increased ventilation; decreased ventilation; and carbon dioxide inhalation.

Parameters available for alteration: glomerular filtration rate; blood volume; hemoglobin concentration; and pulmonary compensation (On or Off).

Comments: Contact author or R. A. Meiss re availability.

**Anatomy and Physiology Software from Mississippi State University by N. Westmoreland**

Dr. N. Westmoreland has kindly sent us a variety of anatomy and physiology applications used in teaching veterinary medicine at Mississippi State. These use either the Hypercard or FileVision applications for the Macintosh computer.

These applications are in the form of tutorials or reviews that allow the student to progress through the material in a non-specified order. For example, the student may want more detail in one aspect but not another. This is possible with this format.

The programs we have are: Hemostasis, Second Messenger, Calcium, Canine Forelimb, Canine Hindlimb, Equine, Lipoprotein, Cardiopulmonary, and Alimentary System.

Comments: Contact author re availability.

**Anatomy Pinball by W. P. Ireland (l989)**

Anatomy Pinball uses a "pinball machine" to select and ask multiple choice questions from a database containing questions on veterinary anatomy. If the student is wrong the program gives the right answer. Scores are kept while the program is running. There are 553 questions.

Comments: Contact author re availability. It is possible to insert a different data bank of questions.

**Animal Behaviour Data Simulation published by Oak Leaf Systems (l987)**

This software offers the potential to make a dramatic impact on how students discover the concepts of animal behavior. The 25 systems simulated are: influence of flock size on vigilance in starlings, selection for color preference by quail chicks, daily migratory activity for three bird genera, daily grazing activity for Australian cattle, phototaxis in adult and tadpole frogs, single gene

mutant and fruit fly memory, Rhesus infant learning with surrogate mothers, shock avoidance and three behaviors in rats, female sexual displays and male testosterone level, shell-dropping and optimal foraging in crows, pigeon flock size and success of attacks by hawks, male size and harem size in pinnipeds, female selection of mates based upon nuptial gift, mate selection in bullfrogs and embryo mortality, repeated mating and progeny in *Drosophila*, bird song frequencies of Central American forests, prairie dog colony size and alarm calls, helper males in the Australian blue wren, wealth and reproduction in polygymous culture, honey bee waggle dance and distance to food, discrimination reversal learning in fish and rats, hummingbird territory and food available, mechanical stimulation and protozoan behavior, maze without odor trails and fire ant performance, and maze learning curve for rats and ants.

Comments: Also available for Apple II and Macintosh. $60 US

**Apanat by W. P. Ireland (l989)**

Apanat asks multiple choice and fill in the blank questions on regional areas of the anatomy of the dog, cat, horse or cow. A menu allows the student to select the regional area and animal to be reviewed in a particular session. Students are "rewarded" for correct answers with a comment on clinical relevance. If the student chooses the "wrong" answer a hint is given and the student can try again before the "right" answer is given. There are 450 questions.

Comments: Contact author re availability. There is also a version of this program written in DAL that runs on Digital computers.

**Archivist published by IRL Press Ltd. (l988)**

Archivist is a free-text database manager specifically designed for bibliographic records and other loosely-formatted textual information. It can be thought of as a compliant utility combining elements of both a database manager and a word-processor.

Comments: We only have the demonstration version. Full version $95 US

**Arrhythmias Tutorials I and II** by E. P. Hoffer and G. O. Barnett (published by Williams & Wilkins, 1986).

Designed to make learning about rhythm disturbances interesting and enjoyable, these two programs (which can be used independently of each other) together provide a complete course in all major arrhythmias. This program challenges students with periodic self-evaluation tests to make sure they understand each section's concepts and has them analyze sample cases (illustrated by over 25 EKG strips in each program).

Tutorial I (Pathophysiology and Supraventricular Arrhythmias) includes: pathophysiology; sinus rhythms and ectopic beats; atrial fibrillation and flutter; supraventricular tachycardias; W-P-W syndrome; carotid sinus pressure; and hypersensitive carotid sinus syndrome.

Tutorial II (Ventricular Arrhythmias and Heart Block) includes: chronic treatment of PVC's; palpations; V fib and V tach; heart block; pacemakers; and PVC's and syncope.

Comments: $80 US for each program. Tutorial I: Order #l68l0-X/Apple — #l68ll-8/IBM. Tutorial II: Order #l68l2-6/Apple — #l68l3-4/IBM.

**Arterial Blood Gases** by E. P. Hoffer and G. O. Barnett (published by Williams & Wilkins, l985)

When the patient's condition requires analysis of ABG data, quick action is vital. This program teaches a simple, four-step approach to the interpretation of ABG data and shows how to calculate the alveolar-arterial gradient. Then students face a series of realistic patient cases in which the interpretation of ABG's is clinically important.

Includes: tutorial on analyzing blood gases; severe gastroenteritis; chest trauma; post-op fever and dyspnea; a Pickwickian patient; worsening COPD.

Comments: Order #l6806-l/Apple — #l6807-X/IBM. $95 US

**Arterial Blood Gas Tutorial** by Dean Hess (published by Medi-Sim Inc., l985)

Tutorial/drill program that deals with the interpretation of acid base status. The program has an interactive test generator which allows a variable number of problems to be encountered. Student scores can be retrieved.

**Bacterial Identification** by T. N. Bryant (published by IRL Press, 1986)

This program offers students a new approach to understanding systematic bacteriology and numerical identification procedures. It compresses the time a student would spend analyzing a test organism in the laboratory—perhaps several days—down to less than an hour on a microcomputer: It will allow many more students to practice identifying a greater number of species than was possible previously.

In each session, the student is allocated an unknown bacterium to identify out of 79 possible bacteria. This can be specified by the instructor or generated at random. The student then selects the most appropriate tests from the 90 available, which are done, as in the laboratory, in batches.

The core of this program lies in its identification data matrix. All the species used occur in the approved list of bacterial names, and in "Bergey." The IBM version of the software has a facility for instructors to modify the matrix to include additional species and to alter their identifying code numbers.

Comments: We only have the demonstration version. $l25 US

**BASIC Acid Base Physiology** by James Randall (l988)

This exercise illustrates the integrative role of the kidneys and the respiratory system in maintaining $H^+$ homeostasis. One simulation plots the arterial bicarbonate and pH changes for either respiratory or nonrespiratory disturbances. The other simulation plots changes in 6 variables over a 6-day period following assorted disturbances.

Comments: Contact the author re availability.

**BASIC Cardiovascular** by James Randall (l986)

This program has four cardiovascular simulations and one of a simplified nephron. One exercise allows the selection of an arbitrary mean electrical axis in the ventricles and then plots a possible QRS vector loop along with the related three limb leads. The cardiac mechanics simulation demonstrates those mechanical factors that influence the stroke volume pumped by the left ventricle. Another simulation shows the mechanical factors influencing the pulse pressure in the aorta. The cardiovascular mechanic simulation illustrates the interaction between cardiac pumping and the physical properties of the pulmonary and systemic vascular beds.

Comments: Contact author re availability.

**BASIC Electrophysiology** by James Randall (l986)

There are four sequential lessons that allow the user to change ionic concentrations and note changes in the forces on ions that are responsible for the currents across nerve and muscle membranes. In addition, there are three other separate exercises: (l) a demonstration of the properties of an action potential based on the Hodgkin-Huxley model, (2) a demonstration of the attenuation of an action potential as it travels from one Node of Ranvier to the next in myelinated nerves, and (3) a demonstration of the accumulation of single-channel responses to a clamped step change in membrane potential.

Comments: Contact author re availability.

**BASIC Pharmacokinetics** by James Randall (l986)

This program has three pharmacokinetic demonstrations. "Plasma Concentration vs. Time": is a single compartment model having first-order absorption and elimination rates. "Two-Component Washout" demonstrates that plasma concentration vs. time following administration of a single intravenous dose of some drugs can be better expressed as the sum of two exponential decay curves. In the "Hydraulic Analog Models" section there are four different demonstrations in which the size of a tank is an analog of a body compartment. Loss is proportional to the amount remaining in the tank.

Comments: Contact author re availability.

**Basic Ventilatory Parameters** published by Medi-Sim Inc. (l985)

Tutorial/drill program that deals with calculating basic ventilatory parameters such as tidal volume, deadspace volume, alveolar volume, minute ventilation, deadspace ventilation, alveolar ventilation, and respiratory rate. The program has an interactive test generator which allows a variable number of problems to be encountered. Student scores can be retrieved.

**CAI: Computer-aided Instruction** by F. R. Jelovsek (l987)

PC-CAI was created to allow faculty to quickly author a computer-aided instruction module or multiple choice test for medical students and resident physicians. It is IBM-PC/compatible software which displays word-processed text files, scores responses, and branches as the author has indicated. Its use in the author's department has resulted in the creation of practice tests for the resident in-training exams and multiple choice questions, with feedback and explanations, for the medical students to supplement the faculty lectures.

Comments: Contact author re availability.

**Cardiac Muscle Mechanics by R. A Meiss (published by COMPress [see Queue], l987)**

This program simulates some aspects of the behavior of isolated cardiac muscle. Two different screen displays are provided. Each one allows the simultaneous plotting of force versus time, length versus time, and force versus length. Keyboard controlled cursors allow changes in the preload (muscle rest length), and the afterload. The work done during each contraction/relaxation cycle is automatically calculated and tabulated on a "pop-up" screen. Three different levels of contractility are provided. Using this program, one may demonstrate the following phenomena: (1) the isometric length-tension curve; (2) the special features of cardiac muscle contraction which arise from (i) unloading the parallel elasticity during isotonic shortening, and (ii) the phenomenon of isometric relaxation, in which restoring forces are provided by the preload and not the afterload; (3) the effect of afterload and muscle length on the work done per cycle; (4) the effect of afterload and muscle length on the velocity of shortening; and (5) the effects of varying contractility on all of the above situations.

Comments: $l25 US

**Cardiovascular Interactions** by C. F. Rothe (l986)

This simulation package is designed to help the student understand and explain:

1. The effect of changes of: vascular resistance on cardiac output; arterial compliance on arterial pressure; heart rate on pulse pressure; and ventricular contractility on blood volume distribution.
2. The VENOUS-RETURN CARDIAC OUTPUT relationship.
3. The consequences of LEFT or RIGHT HEART FAILURE and effective *reflex* compensatory changes.
4. Systemic and pulmonary HYPERTENSION.
5. The cardiovascular effects of vigorous skeletal muscle EXERCISE and effective reflex compensation.
6. The effect of BLOOD VOLUME alterations and effective compensatory changes.
7. The effects of increased INTRATHORACIC PRESSURE.
8. Changes in arterial PULSE PRESSURE.

Comments: Contact author or R. A. Meiss re availability.

**Cardiovascular Physiology Part I: Pressure/Flow Relations** by Allen A. Rovick (l986)

This program is a tutorial exercise that deals with a variety of calculations in the area of hemostatics/hemodynamics.

Comments: Contact author or J. A. Michael re availability.

**Cardiovascular Physiology Part II: Reflex** by Allen A. Rovick (l986)

This program is a tutorial that deals with carotid sinus regulation of blood pressure, and reflex responses in hemorrhage and exercise.

Comments: Contact author or J. A. Michael re availability.

**Cardiovascular Systems and Dynamics** by N. Peterson and D. Armstrong (published by Command Applied Technology, Inc., l986)

This program has four basic experimental set ups that can be used to perform a variety of simulation exercises. The "Isolated Heart Lab" is an isolated left ventricle with controllable filling pressure, heart rate, inotropic strength, and Starling resistor. The "Heart-Lung Lab" adds the right ventricle and pulmonary circulation to the left heart. "Systemic Circulation Lab" uses a pulsatile mechanical pump to replace the heart-lung unit in circulating blood through the peripheral circulatory system. "Cardiovascular System" combines the heart-lung with systemic circulation to provide a full circulatory system model.

Comments: $l20 US

**CIRCSIM: A Teaching Exercise on Blood Pressure Regulation** by Allen A. Rovick and Joel A. Michael (l985)

This is a simulated experiment based on a model of the baroreceptor reflex loop (MacMan: Dickinson et al). Users are required to make predictions about the expected outcomes on seven CV parameters before obtaining the actual results. Prediction errors then serve as triggers for discussion of the physiology involved.

Comments: Contact authors re availability.

**Data Set Generator (DSG)** by I. Dohoo, A. Donald, and J. Clinton (l988)

This program is designed to generate artificial data sets. Some features of the program are:

1. DSG provides data sets useful for practice in descriptive statistics, analysis of variance, multiple regression analysis, contingency table analysis, goodness of fit test, logistic regression and survival analysis.

2. DSG runs in Microsoft Basic, available on IBM and compatible microcomputers.

3. DSG can generate many different data sets from the same basic model and is therefore appropriate for creating take-home projects.

4. DSG writes the data to a disk file that may be printed out, delivered to students on disk or distributed by electronic mail.

5. DSG runs quickly: a 200 case data set with eight variables was created on a Compaq Deskpro 286 in less than 1 minute.

6. The generating programs are reusable and modifiable: a user can generate similar data sets from year to year, or modify the data to correspond with changes in the curriculum.

7. The user specifies the output format.

Comments: Contact A. Donald for further information or to obtain the program ($l0 CDN).

**DIGITALIS: Pharmacology and Clinical Use** by E. P. Hoffer (published by Williams & Wilkins, l985)

Using an interactive tutorial format, this program guides you step by step through the basic and clinical pharmacology of this important but potentially dangerous cardiac medication. The program provides users with a solid understanding of the drug's mechanisms, actions, and interactions, as well as information on dosage and the signs and treatment of digitalis toxicity. Includes: dosage; toxicity; contraindications; inotropic; dromotropic and autonomic effects; metabolic and chemical interactions; arrhythmia use; EKG effect.

Comments: Order #l6808-8/Apple — #l6809-6/IBM. $95 US

**Dose Effect Analysis with Microcomputers** by J. Chou and T. C. Chou (published by

BIOSOFT)

A thoroughly documented series of programs for the quantitation of $ED_{50}$ and $LD_{50}$, synergism, antagonism, low-dose risk, receptor ligand binding and enzyme kinetics using the microcomputer.

This manual/disk combination contains the theoretical background, worked examples and full program listings for a variety of analytical techniques in the pharmacology, toxicology, oncology and biochemistry fields.

Contents include:

1. Michaelis-Menten Kinetics: competitive inhibitions, noncompetitive inhibition, diagnosis of type of inhibitors, etc.

2. Multiple Drug Effect Analysis: mutually exclusive and mutually non-exclusive drugs, multiple drug effect equation, combination index, graphical and tabular representations of synergism, antagonism and summation at different effect levels, determination of applicability of data and statistical considerations, etc.

3. Effect or Risk Assessment: risk assessment for carcinogens, dose required to produce a given risk, risk assessment for radiation, age specific cancer incidence rates in humans, etc.

4. Therapeutic and Safety Indexes: therapeutic index, selectivity index and safety margin, etc.

5. Scatchard Plot

6. Calculator of Receptor K

Comments: $149 US

**EKG Tutor** by K. Friedman, J. Boyle, J. Black, and G.Robinson (l986)

This program utilizes graphics and simulation to teach basic EKG theory, the sequence of cardiac excitation, EKG lead systems and cardiac vectors. The last portion of the program utilizes simulation to show the relationship between vector loops, cardiac size and scalar EKG leads for the six limb leads. The program includes questions to evaluate the student's progress. Wrong answers return the student to the appropriate place in the program for review.

Comments: Contact J. Boyle to order ($50 US). J. Boyle has other programs that we do not have including some on respiratory physiology and on cardiovascular physiology.

**Fault Identification Game: A Diagnosis Game** by N. S. Peterson and S. A. Feiner (l987)

The Fault Identification Game is a practice environment for developing skills at identifying problems within a system. Originally designed as a cardiovascular system diagnosis exercise, the Game can now be used for a wide variety of systems: physiologic, economic, ecologic, electrical, etc. Instructors can create abnormal cases for the system being studied by disturbing (deviating form the "normal" value) one or more of the system's properties. Students attempt to identify which properties are abnormal by requesting data on measurable variables and specifying which properties they suspect are abnormal. The number of unique cases is limited only by the number of deviated property combinations possible.

Comments: This software may be duplicated and freely distributed but may not be sold.

**Gas diffusion in the lung** by R. Rhoades, W. Wagner, H. G. Bohlen and B. Johns (l986)

A model of the transfer of oxygen and carbon dioxide between lung alveolar air and blood is being developed. This model is designed to demonstrate to students the various factors which influence the rate and volume of gas movement and arterial gas tension and content. The model allows the alveolar surface area and cell membrane thickness to be altered to mimic various normal and pathological conditions. In addition, alveolar air and venous blood hemoglobin content can be changed. The final output of the model is given in terms of the alveolar and blood gas tensions at equilibrium.

The following conditions can be independently or simultaneously altered by the student: (l) hemoglobin concentration; (2) oxygen or carbon dioxide (as gas being used); (3) lung surface area (as percent of normal); (4) alveolar membrane thickness (as percent of normal); and (5) venous blood gas tension.

Comments: Contact H. G. Bohlen or R. A. Meiss re availability.

**Gas Uptake Simulation (GUS)** published by Med Ed, Inc. (l987)

GUS simulates anesthetic uptake and distribution using a simplified anatomical and physiological model of the human body. The GUS user can set up several patient parameters controlling physiology, ventilation, and gas delivery (open or closed circuit) in two independent

patients who are simulated in parallel. These variables can be manipulated as the simulations progress.

The user can observe the instantaneous concentrations of any one of nine respiratory and anesthetic gases in any six of twelve compartments in both patients. Alternatively, the user can view a concentration versus time graph for any two compartments over a one hour period. This flexibility is designed to make it easy to compare an "experimental" patient to a "control," and to quickly answer any number of "what if?" questions about uptake and distribution.

Comments: Distributed by Puritan-Bennet Corporation for about $400 US.

**Gradebk** by C. F. Rothe (l986)

GRADEBK, when presented with an ASCII file with student names, identification number and grades plus the l00% scores and weights for each examination, provides a display or printout of the latest score, the standardized score (Mean = 500, SD = l00), cumulative weighted average score, cumulative standardized score, total weights for each student (to indicate excused absences), and class rank. It will print a histogram of the grades, make a file of cumulative average scores and print the grades as used, or sorted by ID number (for posting) or by rank. It is in complied BASIC for use with an IBM-PC, XT or compatible clone with color display, but will work with monochrome monitor. The grade file is created with a word processor or other editor that gives an ASCII file.

Comments: Contact author or R. A. Meiss re availability.

**HUMAN-Microcomputer Version of a Comprehensive Physiological Model** by T. G. Coleman and J. E. Randall (l988)

Human uses computer simulations to teach the integrative aspects of human physiology. The model includes representations of the function of the heart, the kidneys, the peripheral circulation, the respiratory system, the kidneys, body fluids, acid-base balance, control of temperature, muscle metabolism, neural control and a few hormones.

The general procedure is to change a "parameter" (such as inspired gas content) and then to follow the responses through time of computed "variables". Over 200 variables and parameters are updated at selected time intervals.

Comments: Contact J. E. Randall re availability.

**Ileum: Guinea-Pig Ileum Simulation** by I. Hughes (published by BIOSOFT, l984)

ILEUM accurately simulates laboratory experiments which investigate the effects of drugs on the in vitro guinea-pig ileum. The in vitro guinea-pig ileum preparation is commonly used to demonstrate and quantify the actions of drugs on intestinal smooth muscle. It has the advantages of retaining its responsiveness for many hours, of having relatively little spontaneous activity and of containing a great variety of receptor types. Thus the actions of many different drugs can be demonstrated on this tissue.

Drugs available for the ILEUM simulation includes a dozen familiar agonists, which will contract the muscle, together with blockers of various sorts. It is possible to mimic experiments to identify "an unknown compound." For this the computer can select at random one of 20 "unknowns," some of which do not appear in the regular program runs, although a key is given in the manual allowing deductions about the compound(s) to be checked. Random elements are incorporated into ILEUM to simulate the inherent biological variability in the response to the same dose of agonist.

Comments: $80 US

**Lung Volume Calculations** by Dean Hess (published by Medi-Sim Inc., 1985)

Tutorial/drill program that deals with lung volume calculations including; tidal volume, inspiratory reserve volume, expiratory reserve volume, residual volume, total lung capacity, vital capacity, inspiratory capacity, functional residual capacity. The program has an interactive test generator which allows a variable number of problems to be encountered. Student scores can be retrieved.

**MacDope** by C. J. Dickinson, D. Ingram, L. Saunders, K. Ahmed, R. F. Bloch, and G. D. Sweeney (published by IRL Press, l987)

MacDope helps students to understand the time courses of a range of drug types, their fates and dispositions in human subjects. The simulation encourages students to find out about the effects of dose levels—including overdoses—on an enormous variety of possible patients. Students learn both the characteristics of the patients which determine the intensity of drug's action and the properties of the drugs responsible for different patterns of pharmacokinetic behavior. The precision demanded will teach users how to write prescriptions correctly too.

MacDope can handle simultaneously up to four drugs taken from its range of 20 familiar drugs. The model is not preprogrammed with data such as volume of distribution or half-life of drugs. Instead it generates this information by solving equations which combine the patient's characteristics with descriptions of the drug's features. So MacDope will not only teach students the kinetic features of a drug, but also the dependence of these features on the drug's properties.

Comments: $250 US, or $790 for complete Mac series. We also have a demonstration version of this program.

**MacMan** by C. J. Dickinson, D. Ingram, L. Saunders, K. Ahmed, R. F. Bloch, and G. D. Sweeney (published by IRL Press, l987)

MacMan provides a foundation to understanding the behavior of the system formed by the brain, heart, and circulatory system. Students may easily learn the anatomy of the circulation and the way blood passes around it, but MacMan can show them how the system works as an integrated whole, something which many never properly understand. Why does jugular venous pressure go up in cardiogenic shock, and down in hemorrhagic shock? Why is it that positive pressure ventilation causes such profound circulatory disturbances? Why does noradrenaline reduce blood volume and slow down the heart? These are examples of problems that students using MacMan will come to understand.

Comments: $l50 US, or $790 for complete Mac series. We also have a demonstration version of this program.

**MacPee** by C. J. Dickinson, D. Ingram, L. Saunders, K. Ahmed, R. F. Bloch, and G. D. Sweeney (published by IRL Press, l987)

The interaction between circulation, kidneys and body-fluid and electrolyte compartments is so complex that the influence of one factor on another is often not easy to predict. MacPee is designed around the MacMan core, but MacPee concentrates on illustrating those much slower changes in hemodynamic function which are related to changes in the volume and distribution of the contents of the body's fluid spaces. The operation, for example, of the baroreceptor reflex emphasizes, in MacPee, the slow "resetting" which can occur in blood pressure, and which may result in abnormally high or low blood pressure becoming dynamically maintained.

MacPee allows students to perform physiological experiments, e.g., giving water loads, and to analyze clinical situations, such as the complex series of events that follow a leak of albumin or a large hemorrhage. In some measure it substitutes for animal experiments, which are difficult in this area to translate accurately, and simulates human experiments which would be, at least, unethical.

Comments: $250 US, or $790 for complete Mac series. We also have the demonstration version of this program.

**MacPharmacology** by Department of Pharmacology, University of Minnesota (published by Minnesota Medical Edu-Ware, Inc., l987)

MacPharmacology is a series of study and review programs that work as an application of Business FileVision on Macintosh computers. It is designed as an interactive learning program. The program provides several tiers of information and immediate feedback by using three formats: (l) objective "broad format" study and review questions with both specific and review answers; (2) graphic review questions and answers; and (3) electronic drug file cards. There are currently two sections "Neuropharmacology" and "Autonomic Pharmacology."

Comments: These programs run on Macintosh computers. To date we have only the demonstration version of the program ($25 US). Neuropharmacology package and Autonomic Pharmacology package are each $325 US.

**MacPuf** by C. J. Dickinson, D. Ingram, L. Saunders, K. Ahmed, R. F. Bloch, and G. D. Sweeney (published by IRL Press, l987)

MacPuf offers a classical physiological model from which students will gain familiarity with, for example, the management of shock or heart failure, hypoxia, breathlessness, the use of blood gas measurements, cardiopulmonary resuscitation, or oxygen therapy. Especially useful for teaching is the possibility of following the complicated consequences of a failure in the delivery of oxygen in more detail than with a real patient. The main functions, the volumes of body spaces and gas concentrations and pressures in critical sites are all quantified in MacPuf, so that students can study the rates at which changes occur. This computer simulation therefore supplies another—and perhaps more effective approach—to complement traditional laboratory exercises and clinical bedside experience.

Comments: $250 US, or $790 for complete Mac series. We also have the demonstration version of this program.

**MEANCURV – A Program for Averaging Dose-response Curves** by J. R. Carpenter

This program written in BASIC calculates a mean dose-response curve from individual experiments by averaging the doses, rather than responses.

Comments: Contact author re availability.

**Mechanical Properties of Active Muscle** by R. A. Meiss (published by COMPress [see Queue], l987)

This set of six programs allows students to investigate several important areas of skeletal muscle physiology. In the first program, the control of isometric force production can be investigated by varying stimulus strength and repetition rate. The second examines the relationships between muscle length and isometric tension, while the third provides an animated qualitative look at the active force-velocity-length relationship, and the fifth attempts to relate time-dependent myograms to a simultaneous force-length display. Program number six uses a "video-game" format to provide insight into the efficient coupling of human muscle power to a mechanical device, a cyclist rides into a variable headwind and must choose an appropriate gear ratio.

Comments: $70 US

**MICAL: Microbiology Computer-Assisted Learning** by W. Levinson and A. Gardner (published by Upjohn Company, 1986)

MICAL is a set of patient simulation programs in infectious diseases. These programs are clinical correlations designed to reinforce concepts taught in medical microbiology and in addition review skills of taking medical histories and interpreting the results of physical examinations. The definitive diagnosis is determined by the results of microbiology and serology lab tests selected by the student. The case histories of eight patients are presented with this problem-solving approach.

Comments: Upjohn provides this program to medical schools and its students. It may be freely copied.

**Mind Games – Biology** by James D. Lehman (published by Diversified Educational

Enterprises, Inc., 1985)

Mind Games is a computer "Trivial Pursuit" type game that draws on a bank of multiple choice questions. One to four players can be accommodated and scores are tallied. One can put in one's own questions and so design useful student review sessions in any topic area. The questions with the program are on general biology.

Comments: Also available for Apple. $40 US

**Molecular Basis of Muscle Contraction** by A. G. Booth and T. J. King (published by IRL

Press, l985)

A tutorial with animated color graphics that introduces students to the structure of muscle, the mechanism of contraction and the control of contraction. Animated simulations are effectively used to illustrate ATP hydrolysis and the interaction of actin and myosin both on a "microscopic" and a "molecular" level. There are also multiple choice review questions.

Comments: $45 US

**Muscle Mechanics: A Computer-Simulated Experiment** by Joel A. Michael (l987)

In this simulated experiment the user can determine either the length-tension or the force-velocity relationship of a skeletal muscle.

Comments: Contact author re availability.

**Nephros: A Renal Clearance Analysis Program** by M. S. Simonson (published by

BIOSOFT, l985)

Nephros is a computer program for acquiring, calculating and storing data from renal clearance studies. It calculates the renal clearance of any compound in humans using conventional and constant infusion methods.

Comments: $60 US

**Using PC Storyboard in the Medical Classroom** by R. A. Meiss (l986)

This program is a demonstration describing how PC Storyboard (IBM) can be used to enhance lectures with graphics and slides. It outlines some of the advantages and disadvantages of giving computer-assisted lectures.

Comments: Contact author re availability.

**Problems in Fluid Compartment Re-Distribution** by Joel A. Michael (l986)

This tutorial exercise develops an approach to the solution of simple problems of fluid compartment changes in the face of perturbations.

Comments: Contact author re availability.

**PSYCAL: Psychiatry Computer-Assisted Learning** by H. Goldman, B. Goldman, and

A. Gardner (published by The Upjohn Company, 1986)

PSYCAL is a set of patient simulation programs. These programs are clinical correlations presented in an interactive problem-solving manner designed to reinforce concepts taught in psychiatry courses. The programs demonstrate how to apply psychiatric principles while conducting a thorough patient evaluation. Psychiatric diagnosis follows the criteria of the Diagnostic and Statistical Manual of Mental Disorders (Third Edition).

Comments: Upjohn provides this program to medical schools and its students. It may be freely copied.

**Pulmonary Mechanics Lab (PML)** by Stephen Feiner and Nils Peterson (published by

Command Applied Technology, 1986)

PML is a simulated laboratory environment for teaching human respiratory physiology, it consists of a four level hierarchy of laboratories designed to emphasize the integrative aspects of the respiratory system. The "Isolated Alveolus Lab" allows exploration of alveolar behavior as determined by elastic and surface tension properties acting separately or in combination.

The "Alveolar Recruitment Lab" provides insight into the action of the isolated whole lung by examining the contribution of alveolar recruitment to pulmonary P-V behavior. The "Respiratory Engine Lab" focuses on compliance properties of the isolated whole lung, the isolated chest wall, and their interaction.

In addition to static behaviors of the isolated lung and chest wall, dynamic performance can be studied. The "Respiratory Dynamics Lab" displays standard spirometric and pleural pressure graphs. Students may compare simulation data to measurements taken on themselves. They may also create disease states, altering airway resistance, pulmonary compliance, and surfactant properties.

Comments: $150 US

**Renal Glomerular Dynamics** by G. A. Tanner (l986)

This simulation is adapted from the paper by Leon C. Isaacson, "An iterative algebraic simulation of renal glomerular dynamics" (*Journal of Bio-Medical Computing,* l5:37l-380, l984). Control values for the human kidney, based on actual measurements or estimates, are used. The model divides the glomerular capillary into 20 consecutive segments, and the program calculates the point-to-point values for plasma protein concentration, plasma colloid osmotic pressure, glomerular capillary hydraulic pressure, glomerular plasma flow, glomerular filtration rate, and filtration fraction. It also calculates the total glomerular filtration rate, afferent glomerular blood flow, overall filtration fraction, mean glomerular capillary hydraulic pressure, and ultrafiltration pressure gradient at the efferent end of the glomerular capillary.

The students are asked to examine and explain the effects on glomerular filtration rate of each of the following: (l) increases or decreases of arterial blood pressure; (2) changes in plasma protein

concentration; (3) changes in preglomerular resistance; (4) changes in efferent arteriolar resistance; (5) changes in glomerular ultrafiltration coefficient; (6) increases in proximal tubular pressure; and (7) increases in renal venous pressure.

Comments: Contact author or R. A. Meiss re availability.

**Simulations in Physiology: The Respiratory System** by H. I. Modell (published by

NRCLSE, l986)

The program consists of a set of l2 simulation exercises designed to increase proficiency in respiratory physiology.

Mechanics

1. Static Relationships: elastic properties of the lung, chest wall, and total respiratory system.
2. Dynamic Relationships I: effects of lung compliance and airways resistance on tidal volume development.
3. Work of Breathing: oxygen cost of elastic, resistive, and total work during inspiration.
4. Dynamic Relationships II: respiratory dynamics of the total respiratory system.

General Gas Exchange

5. Alveolar Gas Exchange: gas exchange between atmosphere and alveolar reservoir.
6. $O_2$ and $CO_2$ Dissociation Curves: interrelationships between the $O_2$ and $CO_2$ dissociation curves.
7. Exchange from Atmosphere to Tissues: influence of alveolar ventilation, cardiac output, and anatomic shunt flow on arterial blood composition and gas exchange at the tissues.
8. Chemoregulation of Respiration: $O_2$ and $CO_2$ response curves.

$V_A/Q$ Relationships

9. Gas exchange in a Single Alveolus: effects of ventilation-perfusion ratio and inspired gas on exchange in a single exchange unit.
10. The Non-Uniform Lung: gas exchange from atmosphere to tissues with $V_A/Q$ mismatching in the lung.
11. Overall Gas Exchange: gas exchange from atmosphere to tissues with $V_A/Q$ mismatching and a true shunt.

Acid/Base Balance

12. Acid-Base Balance: acid-base balance from a Base Excess viewpoint.

Comments: $l00 US; also available for Apple II and Macintosh computers.

**Ventricular Action Potential Simulation** by D. Bose (l986)

These programs allow one to set the resting membrane potential of the ventricular muscle cell and the level of depolarization of the membrane with an applied stimulus. The effect of this change

on several membrane currents can be seen. The changing values of the currents can be constantly displayed.

When the program is started, three choices are presented: (1) display of transmembrane potential and membrane currents (INa, ICa, IK and Ix), and maximum values of Ina and Ica; (2) display of transmembrane potential and its first derivative; and (3) display of transmembrane potential alone (vertical scale expanded).

Comments: Contact author re availability.

## Part 2: Addresses of Authors/Publishers

**Barnett, G. O.**

Massachusetts General Hospital, Harvard Medical School Department of Continuing Education, Boston, MA, USA

**BIOSOFT**

P.O. Box 580, Milltown, NJ 08850, USA

**Bohlen, H. Glenn**

Department of Physiology and Biochemistry, Indiana University School of Medicine, 635 Barnhill Dr., Indianapolis, IN 46223, USA

**Booth, A. G.**

Department of Biochemistry, University of Leeds, England, UK

**Bose, Deepak**

Department of Pharmacology and Therapeutics, University of Manitoba, 770 Bannatyne Ave., Winnipeg, Manitoba, Canada R3E 0W3, (204) 788-6554

**Boyle, Joseph**

University of Medicine and Dentistry of New Jersey, New Jersey Medical School, 185 South Orange Ave., Newark, NJ 07103-2757, USA

**Bryant, T. N.**

Faculty of Medicine, University of Southampton, Southampton, UK

**Carpenter, J. R.**

Department of Pharmacology, Therapeutics and Materia Medica, University of Manchester, Manchester Ml3 9PT, UK

**Coleman, Thomas G.**

Department of Physiology and Biophysics, University of Mississippi Medical Center, Jackson, MS 392l6, USA

**Command Applied Technology, Inc.**
West 400 Main St., P.O. Box 5ll, Pullman, WA 99l63-05ll, USA, (509) 344-6l45; David D. Barbee (President)

**Diversified Educational Enterprises, Inc.**
725 Main St., Lafayette, IN 47901, USA

**Dohoo, Ian**
Department of Health Management, Atlantic Veterinary College, University of Prince Edward Island, Charlottetown, P.E.I., Canada ClA 4P3, (902) 566-08l8

**Donald, Alan**
Department of Health Management, Atlantic Veterinary College, University of Prince Edward Island, Charlottetown, P.E.I., Canada ClA 4P3, (902) 566-0846

**Feiner, Stephen**
Dept. of Computer and Information Science, University of Oregon, Eugene, OR 97403-1202, USA, (503) 686-4408

**Goldman, Howard**
Associate Professor of Psychiatry, University of Maryland, School of Medicine, Baltimore, MD, USA

**Hoffer, E. P.**
Massachusetts General Hospital, Harvard Medical School Department of Continuing Education, Boston, MA, USA

**Hughes, I.**
Department of Pharmacology, The University of Leeds, Leeds LS2 9JT, UK

**iMedEd, Inc.**
The Quadrangle, Suite 205, 2701 E. Camelback Rd., Phoenix, AZ 85016, USA, (602) 381-0013

**Ireland, William**
Department of Anatomy and Physiology, Atlantic Veterinary College, University of Prince Edward Island, Charlottetown, P.E.I., Canada ClA 4P3, (902) 566-0663

**IRL Press**
P.O. Box Q, McLean, VA 22l0l-0850, USA, (703) 437-3334 (collect)

**Jelovsek, Frederick R.**
Department of Obstetrics and Gynecology, University of Arkansas for Medical Sciences, Little Rock, AR, USA

**Lehman, James D.**
Purdue University, Lafayette, IN, USA

**Levinson, Warren**
Professor of Microbiology, University of California, San Francisco, School of Medicine, San Francisco, CA, USA

**King, T. J.**
Magdalen College School, Oxford, UK

**Medi-Sim Inc.**
Computer Assisted Instruction, 660 S. 4th St., P.O. Box 13267, Edwardsville, KS 66113, (913)

441-2881

**Meiss, Richard A.**
Department of Physiology and Biophysics, Indiana University School of Medicine, l02A Medical Research Facility, l00l Walnut St., Indianapolis, IN 46223, USA, (3l7) 274-8l74

**Michael, Joel A.**
Department of Physiology, Rush Medical College, Rush Presbyterian – St. Luke's Medical Center, Chicago, IL 606l2, USA, (3l2) 942-6426

**Minnesota Medical Edu-Ware, Inc.**
2902 E. Superior St., Duluth, MN 558l2, USA

**Modell, Harold I.**
School of Medicine, University of Washington, Seattle, WA 98l95, USA, (206) 548-6244; Director of NRCLSE (see below)

**NRCLSE**
National Resource for Computers in Life Science Education, P.O. Box 51187, Seattle, WA 98115-1187, USA, (206) 522-6045

**Oakleaf Systems**
P.O. Box 472, Decorah, IA 52101, USA, (319) 382-4320

**Peterson, Nils**
Department of Computer and Information Science, University of Oregon, Eugene, OR 97403-l202, USA, (503) 686-4408

**Puritan-Bennett Corporation**
9401 Indian Creek Parkway, Overland Park, KS 66225, USA, (913) 661-0444

**Queue**
338 Commerce Dr., Fairfield, CT 06430, USA, (800) 232-2224, (203) 335-0908

**Randall, James E.**
Medical Sciences Program, Indiana University School of Medicine, Bloomington, IN 47405, USA, (8l2) 335-l574

**Rothe, Carle F.**
Department of Physiology and Biophysics, Indiana University School of Medicine, Medical Sciences Building Room 330, 635 Barnhill Dr., Indianapolis, IN 46223, USA

**Rovick, Allen A.**
Department of Physiology, Rush Medical College, Rush Presbyterian – St. Luke's Medical Center, Chicago, IL 606l2, USA, (3l2) 942-6547

**Simonson, Michael S.**
Department of Medicine, Case Western Reserve University, Cleveland, OH, USA

**Tanner, George A.**

Department of Physiology and Biophysics, Indiana University School of Medicine, 635 Barnhill Dr., Indianapolis, IN 46223, USA

**The Upjohn Company of Canada**

Medical Sciences Liaison Co-ordinator, 865 York Mills Rd., Don Mills, ON, Canada M3B 1Y6, (416) 441-9600

**Westmoreland, Nelson**

Department of Anatomy and Physiology, College of Veterinary Medicine, Mississippi State University, Drawer V, Mississippi State, MS 39762, USA, (60l) 325-3432

**Williams and Wilkins**

Electronic Media, P.O. Box 1496, Baltimore, MD 2l203, USA, (30l) 528-4223 (collect), (800) 638-0672 (USA)

## APPENDIX B
*Suggestions on How to Find Instructional Software*

### Part 1: Useful General Guides and Resources

**College Biology Software: An annotated bibliography (1987)**

Distributed by The Annenberg/CPB Project, 1111 Sixteenth St. N.W., Washington, DC 20036, USA; mine came free upon request. One problem with this directory is that there are no addresses included for the publishers but most of these can be found in the **Directory of Software Sources for Higher Education**.

**Computers in Life Science Education**

Published by the National Resource for Computers in Life Science Education (NRCLSE), P.O. Box 51187, Seattle, WA 98115-1187, USA; annual newsletter subscription for 12 monthly issues available for $40 US. Contains regular features on where to find software, listings of current relevant literature, and directories of colleagues interested in computer-aided instruction.

**Computer Use in Psychology: A directory of software**

By Michael L. Stoloff and James V. Couch; published by the American Psychological Association, Inc., 1987; order from Order Department, P.O. Box 2710, Hyattsville, MD 20784, USA; ISBN 1-55798-029-2. Some of the software described is also useful for biologists!

**Directory of Software Sources for Higher Education: A resource guide for instructional applications**

Compiled by the Educational Software Library of Carnegie Mellon University for the EDUCOM Software Initiative; Peggy Seidon, editor; 1987; published by Peterson's Guides, Inc.; $25 US; ISBN 0-87866-679-6. It contains chapters on: (1) Commercial Sources; (2) Noncommercial Sources; (3) Directories and Other Listings; (4) Evaluation Sources; (5) Journals, Part 1: Educational Computing Journals, Part 2: Scholarly and Professional Journals with a Regular Computing Feature; and (6) Organizations, Part 1: Scholarly and Professional Associations, Part 2: Consortia and Software Development Centers. This is a useful guide for determining "Where's the Software?"

**The Educators' Handbook to Interactive Videodisc**

By Ed Schwartz; 1987; published by Association for Educational Communications and Technology, 1126 16th St. NW, Washington, DC 20036, USA; also available in microfiche form from ERIC Document Reproduction Service, (ERDS) 3900 Wheeler Ave., Alexandria, VA 22304-5110, USA, for $1 US plus shipping (I simply enclosed $2 or $3 US with my letter of request). This book provides an overview of videodisc technology. It includes information on hardware, software, vendors, conferences, and relevant organizations.

**Information System for Advanced Academic Computing (ISAAC)**

ISAAC, m/s FC-06, University of Washington, Seattle, WA 98193, USA, (206) 543-5604, Bitnet: isaac@uwaee. This is a free computer network bulletin board system that "provides information about IBM-compatible software and hardware for higher education and research. Developed and maintained at the University of Washington and funded by IBM."

**1988 Medical Disc Directory**

Stewart Publishing Inc., 6471 Merritt Court, Alexandria, VA 22312, USA; $90 US. This directory lists over 300 videodisc and CD-ROM projects developed for the health sciences.

**National Library of Medicine Learning Center for Interactive Technology**

The Learning Center/Lister Hill Center, National Library of Medicine, Bethesda, MD 20894, USA, (301) 496-0508, Bitnet: tlc@mcs.nlm.nih.gov. This is a "hands on" laboratory in which one can experiment with a collection of hardware and educational software. They will also provide a listing of software and courseware.

**Software for Health Sciences Education: A resource catalog (1987)**

Available from Learning Resource Center, The University of Michigan Medical Center, 1135 E. Catherine, Ann Arbor, MI 48109-0726, USA; (313) 763-6770; $40 US or $45 if paying by purchase order. This resource describes over 120 programs for the health sciences. It has indexes by author, subject, audience, computer system and distributor.

**Wisc-Ware Catalogue (1987)**

Distributed by Wisc-Ware, Academic Computing Center, University of Wisconsin, 1210 West Dayton St., Madison, WI 53706, USA, (800) 543-3201 (outside Wisconsin), (608) 262-8167, Bitnet: wiscware@wiscmacc. Wisc-ware is a distribution network for research and instructional software developed for IBM-type microcomputers.

## Part 2: Vendors

The catalogues from the major suppliers of educational scientific supplies (e.g., Boreal, Carolina Biological, Sargent Welch, Wards, etc.) often contain sections on software. Some of the major book publishing companies also publish software. Some vendors include:

**Bio Learning Systems, Inc.**, Route 106, Jericho, NY 11753, USA

**Biosoft**, P.O. Box 580, Milltown, NJ 08850, USA

**Biosource Software**, 2105 S. Franklin Suite B, Kirksville, MO 63501, USA

**Cambridge Development Laboratory, Inc.**, 42 4th Ave., Waltham, MA 02154, USA

**Conduit**, The University of Iowa, Oakdale Campus, Iowa City, IA 52242, USA

**Cross Educational Software, Inc.**, 1802 N. Trenton St., P.O. Box 1536, Ruston, LA 71270, USA

**Educational Images Ltd.**, P.O. Box 3456, West Side, Elmira, NY 14905, USA

**Exeter Publishing, Ltd.**, 100 North Country Rd., Building B, Setauket, NY 11733, USA

**HRM Software**, Room Z1 01 02 03 04, 175 Tompkins Ave., Pleasantville, NY 10570-9973, USA

**IRL Press Ltd**, P.O. Box Q, McLean VA 22101-0850, USA

**Kinko's Academic Courseware Exchange**, 4141 State St., Santa Barbara, CA, 93110, USA

**Life Science Associates**, 1 Fenimore Rd., Bayport, NY 11705, USA

**Medi-Sim Inc.**, 660 S. 4th St., P.O. Box 13267, Edwardsville, KS 66113, USA

**Oakleaf Systems, Quality Educational Software**, P.O. Box 472, Decorah, IA 52101, USA

**Queue, Inc.**, 338 Commerce Dr., Fairfield, CT 06430, USA

**Videodiscovery**, P.O. Box 85878, Seattle, WA 98145-1878, USA

## Part 3: Organizations

### Association for the Development of Computer-Based Instructional Systems

Miller Hall 409, Western Washington University, Bellingham, WA 98225, USA

### CONVINCE (Consortium of North American Veterinary Interactive New Concept Education)

President: Dr. Waldo F. Keller, A128 East Fee Hall, College of Veterinary Medicine, Michigan State University, East Lansing, MI 48824-1316, USA; (517) 355-7624, electronic mail:

12612WFK@MSU.BITNET

### Medical Interactive Video Consortium

Office of Medical Education, School of Medicine and Biomedical Sciences, 40 CFS Building, State University of New York at Buffalo, Buffalo, NY 14214, USA

### MDR Videodisc Consortium

Stewart Publishing Inc, 6471 Merritt Court, Alexandria, VA 22312, USA

**Society for Applied Learning Technology**

50 Culpeper St., Warrenton, VA 22186, USA

**Society for Computers in Psychology**

Contact: Dr. Jonathan Vaughan, Department of Psychology, Hamilton College, Clinton NY 13323, USA

## Part 4: Journals

The following is a list of journals that may be helpful for identifying software sources or learning about new instructional technology and it's incorporation into the classroom/laboratory:

American Biology Teacher
ATLA: Alternatives to Laboratory Animals
Behavior Research Methods Instrumentation and Computers
Biochemical Education
British Journal of Educational Technology
Classroom Computer Learning
College Teaching
Collegiate Microcomputer
Computer Applications in the Biosciences
Computer Methods and Programs in Biomedicine
Computers in Nursing
Computers in Biology and Medicine
Computer Education
Computers in Education
The Computing Teacher
Education and Computing
Educational Technology
Interactive Learning International
Journal of College Science Teaching
Journal of Continuing Education in the Health Professions
Journal of Computer Based Instruction
Journal of Instructional Development
Journal of Nursing Education
Journal of Medical Education
Journal of Research and Development in Education
Medical Education
Medical Teacher
Science Teacher
Teaching Psychology
Techtrends
Videodisk Monitor