

Using Simulation Software to Create Laboratory Experiences in Lecture Courses

Ruth E. Beattie

T. H. Morgan School of Biological Sciences
University of Kentucky
Lexington, KY 40506
Telephone: 606-257-7647
Fax: 606-257-7647
rebeat1@pop.uky.edu

Ruth E. Beattie is an Assistant Professor of Biology at the University of Kentucky. She received a B.A. and a M.Sc. in Biochemistry from Trinity College, Dublin, Ireland, and a Ph.D. in Biochemistry from Queen's University, Belfast, N. Ireland. She completed two postdoctoral fellowships at the Hipple Cancer Research Center and at Wright State University, both in Dayton, Ohio. She then taught for four years at Ball State University, Muncie, Indiana. In the Fall of 1995, Dr. Beattie joined the faculty at the University of Kentucky as an instructional specialist, where her primary responsibility is teaching large enrollment freshman level biology classes. She has developed a variety of innovative classroom activities, which have been successfully implemented in these large classes.

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Introduction

One of the frustrations of teaching in a lecture-only biology course is that the instructor describes scientific experiments and methodologies related to the course content, but the students never have an opportunity to put this knowledge into practice. This paper discusses the use of simulation software in creating laboratory experiences for students in lecture courses. Two simulation programs, which the presenter has successfully used in the classroom, will be discussed: (a) *Identibacter interactus* - a simulation program for bacterial identification, and (b) *Focus on Environment* - an environmental program.

Materials

***Focus on Environment* CD**

EME Corporation

P.O. Box 1949

Stuart, Florida, 34995

1-800-848-2050

Individual units: \$220.00 US; Lab Pack (10 units) \$660.00 US

A lab pack of 10 units provides enough copies of the software for 300 students to complete a project (out-of-class) in a ten-day period.

***Identibacter interactus* CD**

Allan Konopka, Paul Furbacher, and Clark Gedney, Purdue University

WCB / McGraw-Hill

1-800-338-3987 (for free demo disc)

ISBN: 0-697-37996-5

Site license: \$560.00 US

Purchase of a site license is recommended. This allows the software to be loaded onto an unlimited number of computers on campus. It does not permit the use of a server to distribute copies. When loading the software onto computers you should not load the "Setman" file, as this is the instructor's key to the identity of each unknown.

Computer Requirements

The programs mentioned above will operate on both a Windows and Macintosh platform. Windows NT is not recommended for the *Identibacter interactus*. This version of Windows causes the software to lock-up sometimes.

PC or Mac computer with graphics and sound cards, 4X CD Drive
Video projection unit (for classroom use)

Identibacter interactus

Overview

Identibacter interactus is a computer simulation package written by Allan Konopka, Paul Furbacher, and Clark Gedney of Purdue University and produced by Wm. C. Brown Publishers. "Users of this interactive software identify unknown bacteria by selecting tests from the more than 50 available and interpreting the results as shown in photomicrographs or video. Through this process of selection and evaluation of test results, the user becomes familiar with the organization of the bacterial identification schemes and the utility of specific tests for distinguishing species of organisms." (Wm. C. Brown Publishers, ISBN 0-697-37996-5).

This particular software package has some features that are not found in similar simulation programs.

- The students choose the type of tests (from the 50+ listed) they are going to conduct. An automatic sequence of tests is not a feature of the program. Students decide about each and every test that they conduct.
- The students interpret the test results. The help section contains information on each test and a photograph of sample positive and negative results. At the end of the exercise the students can print out a list of tests they performed and the results of those tests (as interpreted by the student).
- This software offers 57 different species of bacteria for identification. Each student can be assigned a different unknown to identify. The 57 unknowns have been randomized into 100 different sets, which means that a total of 5700 different possible identification numbers can be generated. Each student can be assigned a different number so even though they may be identifying the same organism they are unaware of that fact, as they have been assigned different identification numbers.
- The use of this simulation software is the next best thing to the real laboratory experience. The only component of the identification procedure that the students do not conduct is the actual set-up of the tests.
- This exercise can be conducted outside of the regular class period and doesn't require the presence of the instructor or teaching assistants.

Use

This software is used in an introductory microbiology course at the University of Kentucky, and is a key component of a Bacterial Identification Project, which each student must complete. A copy of the project handout is in Appendix A. At the beginning of the project, the software is demonstrated during a regularly scheduled class period. The instructor explains the objectives and requirements of the project and shows the students how to use the software. Each student is provided with a copy of the software manual. (Note: The manual is part of the packaged program and the authors of the manual have given permission for it to be copied and

distributed to students). Once the project has been explained to the students, they have approximately six weeks in which to complete the project.

Focus On Environment

Overview

This is a 4-unit environmental science program dealing with issues such as air pollution, water pollution, the ozone layer, and the greenhouse effect. We use this program in a non-majors biology course (Human Ecology). Each unit is divided into two sections. The first section provides an introduction to the topic and is used, with the aid of a video projection unit, in a classroom presentation. The second section of each unit consists of a simulation program, which allows the students to manipulate variables and interpret results. For example, in the Water Pollution Unit, students can manipulate conditions (temperature, rate of water flow, rate of dumping, type of waste treatment prior to dumping) to determine whether or not a fish kill would occur in a body of water.

Use

This program is used by 1) the course instructor for classroom presentations and to demonstrate (in class) the use of the simulation component of the software, and 2) the students to carry out the simulation experiments and to review the classroom presentation material. The students, as part of a larger group environmental awareness project, are required to complete a series of simulation experiments which involve making predictions about a) whether a fish kill will occur under the described conditions, and b) how to avoid a fish kill by changing variables such as reducing the rate of dumping, or requiring treatment of waste prior to dumping. The software manual includes an array of student activities related to the use of the software. A sample activity (taken from the manual) and a copy of the graphed results of the simulation are in Appendix B.

Appendix A - Project Handout

Identification of Unknown Project

Assignments submitted by email will not be accepted. Handwritten assignments will not be graded.

Problems associated with printers, computers, parking, traffic, library services, computer labs, over-sleeping or forgetfulness are not acceptable excuses for late submission of assignments. It is **YOUR** responsibility to make sure that assignments are submitted on time. You have more than 6 weeks to complete this assignment.

In this project you will be using the simulation software *Identibacter interactus* to identify an unknown bacterial species. **The instructor will assign unknown code numbers.**

NOTE: Do not leave it to the last minute to complete this project.

For a Macintosh format:

To access the software:

1. Double click on the **Mac-Drive** icon.
2. Double click on **Applications**.
3. In the **Applications** Menu, double click on ***Identibacter interactus***. This will load the software.
4. On the opening screen, fill in the name, identification number, set and unknown number fields, and then continue with the simulation.

This software will be demonstrated in class. A copy of the manual for the software is provided. It is **YOUR** responsibility to give yourself enough time to learn how to use the software.

Assignment of Unknown Code Numbers (consists of set number and unknown number)

Each student will have a different code number so make sure you record both the set number and unknown number correctly. **You will receive zero credit for the assignment if you submit a report detailing the identification of an unknown other than YOUR ASSIGNED UNKNOWN.**

My Set Number	My Unknown Number

Format of Submitted Report

The submitted report must contain the following components:

1. On the front page: (a) Your name, (b) The Code Number of your assigned unknown and (c) The name of your unknown.
2. The program printout of the tests that you ran and your interpretation of the tests.
3. A two-page narrative describing the logic behind the tests you ran: Why did you run this test? What were you testing for? Why did you conduct the tests in this particular sequence? How did the results of one test lead to the choice of the next test? Do not randomly run every test in the program.... Choose each test carefully.

The entire project must be **typed**. Test must be single spaced with 1 inch margins on the left and right, 1 1/2 inch margins on top and bottom. Justify the test. Print must be 12 pt.

Appendix B - Sample Exercise and Resulting Graph

Sample student exercise taken from Focus on Environment Manual, Water Pollution Unit. (Appendix B is reprinted by permission from Focus On Environment, Copyright 1995, EME Corporation, Stuart, FL.)

"Testing (of) the industrial waste discharge of Slick Oil Refinery shows 12 ppm/day entering the 18 degree Celsius waters of a slow river.

- Will a fish kill occur? _____ If so, predict which day? _____
- Is water treatment necessary to protect the fish life? _____
If so, which treatment?

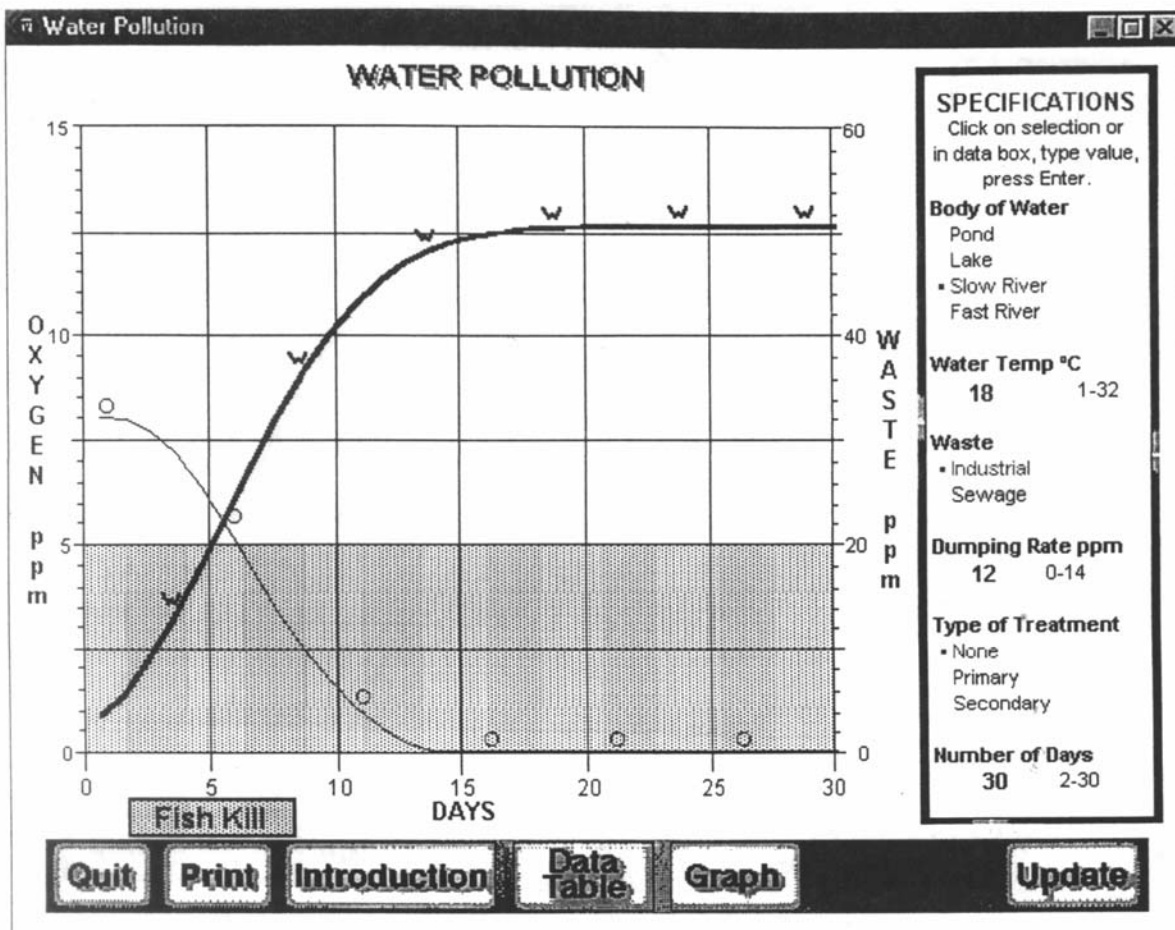


Figure 1. Print out of a graphed data. NOTE: Fish kill occurs on day 6.