



General Chemistry Collection

Lake Study for Windows

Windows—compatible computers

User's Guide

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Lake Study for Windows

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Abstract

Lake Study for Windows is a two-part simulation designed to involve students with the scientific method. It allows them to collect data, formulate hypotheses, and test the hypotheses with controlled experiments. It is based on an Apple II program of the same name (1, 2). This version is an update of the previously published Windows program (3) that addresses several problems and provides better graphics. A Macintosh version is also available (4). Inclusion of the update in *JCE Software Series D* also gives the program the added convenience of a Windows Setup program to install the software.

In the first part of the simulation students are asked to discover why young fish in a lake have difficulty breathing and consequently are dying. They can collect samples of the lake water (see Figure 1), analyze them for metals, dissolved oxygen, and pesticides, obtain library references on toxicities of the various pollutants, look at the fish themselves, or talk to a simulated colleague about what they have found. Having done this students can develop a hypothesis about the problem; however, there are randomly chosen differences in the information provided that lead some students to a different hypothesis from others.

In the second part of the simulation students can do controlled experiments to determine which of the two hypotheses is more likely (see Figure 2). The fact that different students reach different initial hypotheses is a good mechanism for inducing classroom discussions about the facts that support each hypothesis and their logical interpretation. Student hand-out guides are provided for each of the two parts of the simulation.

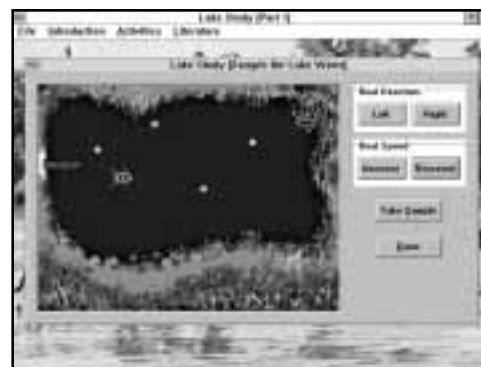


Figure 1. Screen for Lake Study showing students "sampling" the lake water for analysis.

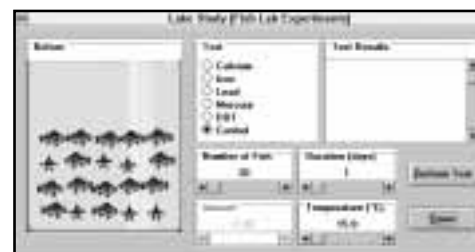


Figure 2. Screen from Lake Study showing simulated fish-tank experiment.

Hardware and Software Requirements

Hardware and software requirements for Lake Study for Windows are listed in Table 1.

Table 1. Hardware and Software Requirements for Lake Study.

Computer	CPU	RAM	Drives	Free Disk Space	Graphics	System	Other
Windows compatible	\geq 80386	\geq 8 MB	Hard drive, High-density (1.44 MB) 3.5-in. floppy drive	3 MB	640 × 480 \geq 256 colors	Windows 3.1x or Windows 95	–

Getting Started



Start Lake Study as you would any Windows program, by double clicking its icon in the *JCE Software* program group in the Windows 3.1 Program Manager or by double clicking its file name, LAKESTUD.EXE, in the File Manager. If using Windows 95, click the **Start** button, then select **Programs**. In the list of programs, select the **JCE Software** folder and click **Lake Study**.

When you start Lake Study, you first see a splash screen introducing the program. Click **OK** to continue. Next you are asked which part of the simulation you wish to run. If you have not done Part I: Lake Water Sampling and Analysis, choose it by clicking the mouse on that option. If you have already done Part I and are returning to do Part II, click on the Part II option.

Once you have chosen the part of the simulation you desire, in the dialog that appears click the number of students using the program (1 or 2), then enter your names and click the **OK** button. You then begin the simulation (See Figures 3a. and 3b.).

If you find that you have chosen the wrong option and are not in the part of the program you need to use, you must exit the program (choose **Quit** from the File menu) and restart it.



Figure 3a. The opening screen of Part 1 shows investigators sampling the lake.



Figure 3b. The opening screen of Part 2 shows the analytical laboratory.



When you quit the program, all work you have done is lost. It is not possible to save your data and return to complete your analysis later.

On-screen help is available by selecting **Talk to a Colleague** from the Activities menu.

menu bar. The menu bar contains four items, File, Introduction, Activities, and Literature. If the item has a triangle next to it at the right side of the menu, moving the cursor over that item produces a submenu. Choose an item from a submenu by releasing the mouse button with the desired item highlighted. A check mark to the left of a menu item shows that you have already completed that action.

The Introduction menu contains an Introduction item that allows you to read a brief introduction to Lake Study and the problem you are asked to solve. The information is in a window with a scrolling text box, see Figure 4. When you have read all the text in the box, click the Done button.



Figure 4. The Lake Study Introduction is an example of a window with a scrolling text box.

Items in the Activities menu for Part I allow you to Talk to a Colleague, Sample the Lake Water, Check the Fish, go to the Analytical Lab to analyze water samples for Metals, Pesticides, or Dissolved Oxygen, and view a summary the Experimental Results of the tests you perform. The experimental results can be printed by clicking the Print button visible while they are displayed.

In Part II, the Activities menu contains a Run Experiments on Fish item that allows you to do just that. By clicking the controls shown in Figure 5, you can

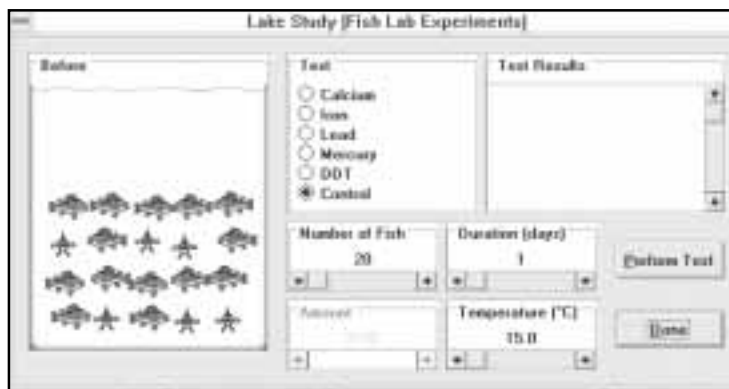


Figure 5. The Fish Experiments window shows a tank of fish and controls you can use to select experimental conditions. In the upper right corner, the mortality rate for the fish in the experiment is reported.

select the number of fish you wish to test (20–40), expose them to several chemicals you may have found in the lake water at concentrations you choose, and specify the temperature and the length of time of the test (1–7 days). The program will report the mortality rate (how many and what percent of the fish tested did not survive the experiment). You may also consult a colleague at any time for advice on how to proceed.

The Literature menu takes you to the library where you can choose items to get

an Introduction to the problem at hand, and information about Metals (such as Calcium, Iron, Lead, and Mercury), Dissolved Oxygen, Pesticides, and Concentration units.

You can proceed through the program however you desire by choosing items from the menus described above. As you do so, be sure to take note of pertinent information in your lab notebook. Good luck!



If you are not sure what to do, you can get some ideas by asking a colleague. Select Talk to a Colleague from the Activities menu. Read what the scientist has to say and try his or her suggestions.

Student Handout: Lake Study, Part I

This part of the simulation is devoted to collecting and analyzing data to form a hypothesis about what is causing the breathing problems in the fish. Because of the suspicion that something in the water is leading to the breathing difficulties that the fish are experiencing, your supervisor suggests that you go to the lake and sample the water for later analysis. She mentions a number of potential causes for the problem.

1. **Dissolved Oxygen:** If the levels of dissolved oxygen in the lake are too low, the fish would have trouble breathing and may die.
2. **Metals:** The presence of dissolved metals in the lake may cause problems if the metal concentrations are high enough.
3. **Pesticides:** High levels of pesticides have been shown to be harmful to fish.

Your assignment is to discover which of these possibilities (if any) is the cause of the fish dying.

The Fish and Wildlife Service has a number of resources available to help you solve the mystery.

1. **Boat:** You may take a boat out to the lake to collect samples of the lake water to be returned to the lab for later analysis.
2. **Analytical Laboratory:** A laboratory is available in which you can analyze the water samples. Three types of analysis are available.
 - a. **Dissolved Oxygen:** You can titrate for dissolved oxygen. The results are reported in ppm oxygen (1 ppm = 0.001 g/liter).
 - b. **Metals:** You can analyze for four different metals: calcium, lead, mercury, and iron. The method used for metal analysis is atomic absorption (AA) spectroscopy, a modern analytical method using an instrument. In an atomic absorption spectrophotometer a liquid sample is introduced into a flame. When the sample enters the flame, the water immediately evaporates and the metals in the sample vaporize. This produces a high concentration of metallic atoms in the flame. A beam of light is directed through the flame and the metallic atoms absorb some of this light. The amount of light that is absorbed tells you the concentration of metals originally dissolved in the liquid sample. A summary of the method follows:
 - i. Unknown sample is introduced into flame.
 - ii. Flame vaporizes metals in sample producing metallic atoms.
 - iii. Metal atoms absorb part of a light beam shining through flame.
 - iv. Light absorbed is measured to determine how much metal was in sample.The AA results are reported in parts per million, ppm (1 ppm = 0.001 g/liter), except for mercury, which is reported in parts per billion, ppb (1 ppb = 0.000001 g/liter).
 - c. **Pesticides:** An extremely important analytical method called Gas Liquid Chromatography (GLC) is used to determine the pesticide levels in the water. Three common environmental contaminants DDT, Dieldrin, and PCB's are

determined. In GLC, a liquid sample containing a mixture of pesticides is injected into the instrument with a syringe. Inside the instrument the pesticides move through a column at different rates, which separates them from each other so that they exit the column at different times. When the pesticides come out of the column, they pass through a detector which sends a signal to a recorder. The signal is registered as a peak on a piece of moving chart paper. The position of the peaks tells you what the substances are and size of the peaks tells you how much of each is in the mixture. Pesticide levels are reported in parts per trillion, ppt (1 ppt = 0.000000001 g/liter).

3. **Library:** You may use the Service's library to look up references for the chemicals you analyze. This is useful in choosing the proper analytical methods and interpreting the results of your analyses.
4. **Colleagues:** An important source of information and inspiration in scientific work is conversation with one's colleagues. Since they seldom are working on a project exactly like yours, it is unlikely that they can tell you exactly what the solution to your problem is, but they may be able to give you hints and ideas about what to do next. If you are stuck and don't know what to do next, talk to a colleague. He or she will probably have some helpful advice.

Assignment

1. Using the experimental information about the lake water and literature information from the library, develop a hypothesis about what is causing breathing difficulties for the fish in the lake.
2. Report the results of your findings and hypothesis to your supervisor. (Your instructor will play the part of supervisor.) Your report should include:
 - a. all experimental data from the samples of the lake water and the analyses performed;
 - b. any relevant literature information, not everything you found in the literature only those items important to the experiment;
 - c. your hypothesis about the cause of the breathing difficulties, supported with experimental data and literature information.

Student Handout: Lake Study, Part II

After some initial experiments the cause of the breathing problems has been narrowed to the presence of either iron or lead in the water of the lake. The results of these experiments are not clear-cut however, so some additional controlled experiments in which the conditions are known must be done to try to establish the culprit.

This week's analyses of the lake water show results in the following ranges:

Temperature	17–20 °C
Calcium	20–26 ppm
Lead	0.6–0.72 ppm
Mercury	2–4 ppb
Iron	1.2–1.8 ppm
Pesticides	low (fractional ppt range)
D.O.	more than adequate for aquatic life

In this part of the experiment you can go to the laboratory again. This time there are fish tanks available to allow you to observe the fish under controlled conditions to see how they behave (in particular, if they die). The number of fish who die in a tank under a given set of conditions can be compared to a tank that has all the same conditions except for the variable being tested. As an example, if you wanted to test the effect of a 100 ppm concentration of Ca on fish at 20 °C, you could look at two tanks: a control tank containing plain water at 20 °C and another tank containing water with 100 ppm Ca at 20 °C. If significantly more fish die in the 100 ppm Ca tank than in the control tank, we would suspect that 100 ppm Ca is toxic to fish.

Assignment

1. Run controlled tests on the fish under appropriate conditions to decide whether iron or lead is causing the breathing problems.
2. Record all relevant information in your lab notebook.
3. Write up a scientific report describing your experiments (from both Part I and Part II of the Lake Study simulation) and stating your conclusions. Your conclusions should be supported by data from your experiments.

Troubleshooting

If you experience any difficulty in running Lake Study for Windows first verify that you have the minimum hardware and software required to run the program. Hardware and Software requirements for Lake Study for Windows may be found on Page 3-2. Second, consult the relevant section of the User's Manual for assistance. Sections with page numbers beginning "3-" refer specifically to Lake Study for Windows.

Problem Reports

If the problem is not addressed in the manual and all required hardware and software are present and in working order, contact the *JCE Software* office for technical assistance. For quickest response, call, send a FAX, or an Email message.

Acknowledgments

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Citations

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