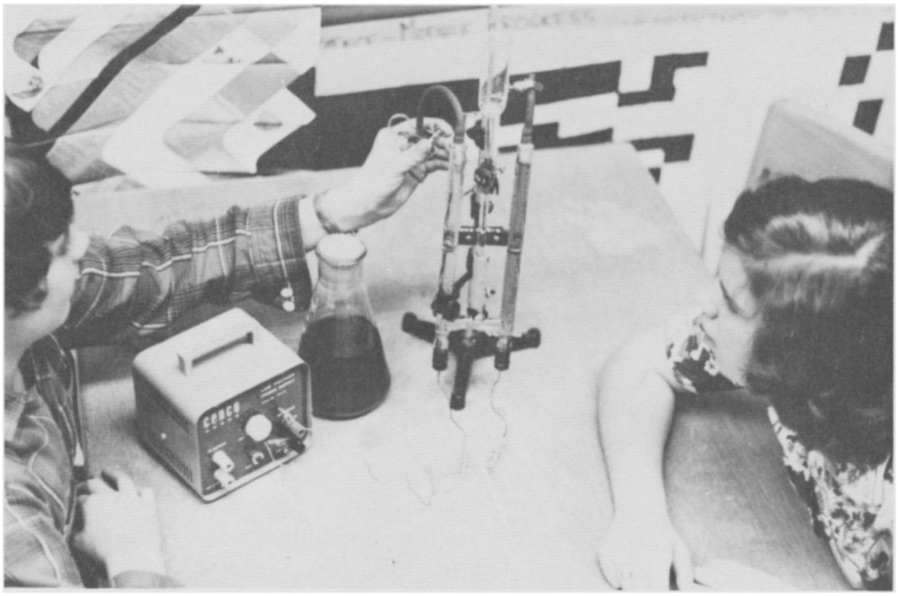


The first day of science class can be fun! See number 1, under "Suggested Activities."

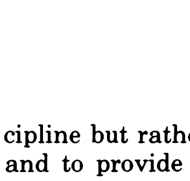
Let's Change the First Day of Science Class

RUSSELL YEANY, JR.

IN MANY SCHOOLS, the first day of science class is spent calling roll, assigning seats, lab partners, and stations, dictating rules, distributing textbooks, making an assignment, and maybe reading through a table of contents while talking about what you are going to do this term. Now, stop and think a minute! These students have probably just gone through the same routine for several periods before coming to science class and can look forward to a couple more of the same. If first impressions are lasting impressions, we are not coming on very strong. Why not give them a change? We often stand there on that first day and tell the students that our class is to be centered around student activities and problem solving. Why don't we allow the first day of class to be student centered, related to problem solving, and truly reflective of the nature of the scientific enterprise? The administrative duties can be handled later. We should give students an impression of science that will draw them in, not tune them out.

The function of any first day science activity should not be to stress any content information of the discipline but rather to demonstrate science as a process and to provide the students with an authority to experience the use of inquiry skills in problem solving. It should require very little formal knowledge of the subject area, because, on this first day of class, most students will have a very limited background to draw from. The activity should be compact enough to allow the students to satisfactorily complete it in one day, in case administrative demands force the teacher to get seating charts, book numbers, or class lists completed by the second day or suffer the consequences.

I would like to offer a few activities that have been used successfully as first day exercises in a variety of science classes. There are many more that could be adapted or developed. And there are undoubtedly better activities to fit a particular group of students or a situation. But these have worked well in the past and are offered here as a catalyst to change the nature of that first day of school.



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Suggested Activities

1. *Electrolysis of water containing a universal acid-base indicator.*

Materials:

Hoffman tube apparatus
Sodium sulfate
Universal acid-base indicator solution
DC power source

Procedure:

1. Add several grams of sodium sulfate to 250 ml of water and stir until dissolved. (This will increase the conductivity of the water.)

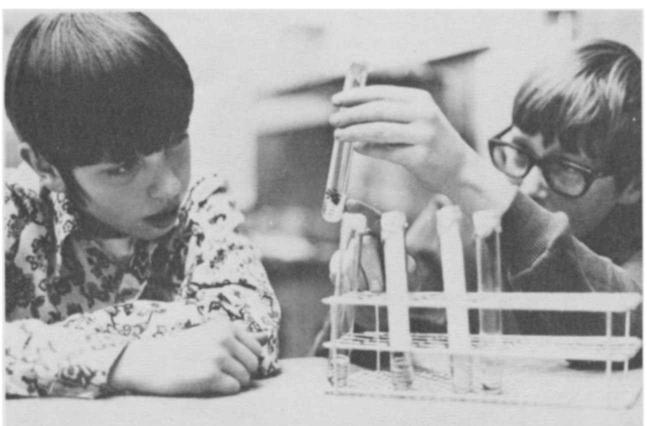
2. Add enough universal indicator to give the water a lime green color. (Neutralize if necessary with dilute acid or base.)

3. Fill the Hoffman tube apparatus with the above solution. If possible, place several tubes around the room for students to observe in small groups.

4. Connect the apparatus to a DC power source (I use 100V but a 9- or 12-V battery will work) and turn it on just as the students begin to make observations. (The presence of H^+ and OH^- ions will cause color changes in the solution.)

5. Have the students list as many observations and assumptions (keep the two separate) as they can while they watch the demonstration.

6. Discuss the observations, entertain inferences, and develop them to the level of class readiness.



Why can't the first day of science class be student centered, related to problem solving, and truly reflective of the nature of the scientific enterprise? See number 2, below.

2. *Inquiry: living thngs in an acid indicator.*

Materials:

Bromthymol blue solution
Test-tube racks (1 for each group)
Test tubes with corks (5 for each group)
Brass screws (5 for each group)
Live insects
Filterpaper
Sprouted pea seed
Yeast solution
Soda straws
HC1

Procedure:

1. Add several drops of bromthymol blue solution to 100 ml of water

2. Before the students enter the lab, the test tubes should be set up as follows:

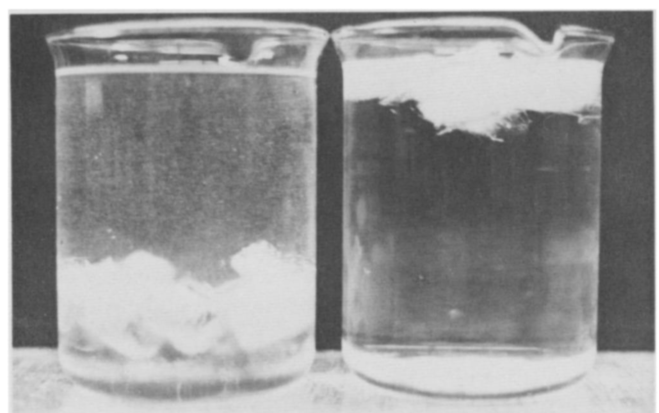
Tube A—screw + 2 ml H_2O containing indicator (control)
Tube B—rolled filter paper + screw + 2 ml H_2O containing indicator
Tube C—filter paper saturated with yeast solution + screw + 2 ml H_2O containing indicator
Tube D—sprouted pea seed + screw + 2 ml H_2O containing indicator
Tube E—insect + screw + 2 ml H_2O containing indicator

3. Acidify tubes C, D, and E so that the indicator is a different color than that in tubes A and B. (Bromthymol blue will appear yellow in acid.) Theoretically the living materials in tubes C, D, and E would produce enough CO_2 to acidify the solution if given enough time.

4. Tell the students that at the time you set the tubes up, they were all the color of tube A. Allow them to list all the differences they see in the tubes. Encourage interaction between students. Most students will fail to understand why tubes A and B are different colors. Encourage them to use all their senses (tube C will smell yeasty).

5. List all hypothesis given for the color change.

6. When the possibilities are narrowed down to the production of waste material by the living things, you may lead them to blowing their breath through a straw into the indicator.



"Funny ice" or "funny water?" See number 3, below.

3. *Buoyancy of ice in different liquids.*

Materials:

Ice cubes
Alcohol
Liter beakers (2)

Demonstration Procedure:

1. Display two beakers containing equal amounts of clear liquids so that the entire class can see them. One should contain water and the other alcohol, but do not

tell the students what the liquids are, or that the liquids are different.

2. Ask the students what would happen if you were to put ice cubes in each liquid. Then place an ice cube in each beaker and ask the students to explain the results. The most typical comment is that the ice is strange or "funny." Interchange the ice cubes. Then the comment will probably be that you must have "funny" water.

Discussion:

1. In what way is the water "funny?" The discussion should lead the students to realize that one liquid supports the ice the way water does and the other does not. The first liquid then probably is water and the second liquid, which does not support ice, must in some way be different from water.

2. The fact that ice floats in the water and not in the alcohol is the basis for establishing a relative density scale. Ask the students to list the three materials in order of increasing density.

Teaching Processes . . .

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Another alternative might be to use a two-semester design to allow for the slower pace of these students.

One student, a freshman, appeared to be generally less motivated toward learning and less able to carry out independent study. In discussions this student tended to avoid rigor, was ill-prepared, and frequently detracted from the subject matter. Therefore, we feel that a more successful experience can be achieved when admission to the course is limited to either upper or to lower classmen and also when screening is done to select for motivated mature students. It is clear that separation into majors and nonmajors as well as into upper- and lower-level students would simplify the course design and the time commitment of the faculty. However, our experience has shown that, with the highly specialized research material studied (which biology majors have most likely not had in lectures), highly motivated nonmajors can achieve an understanding of the processes of biological science equal to the understanding of a biology major. As Laetsch (1967) has observed,

> Biology does not consist of a hierarchy of increasingly sophisticated concepts in the manner of physics and mathematics. This means that a student can come to grips with the foundations of biological concepts soon after his initial exposure to the subject. If students are reasonably diligent, they can even criticize the very basis for such concepts. It is through biology that society has its best chance of understanding science. Biologists have not begun to take advantage of this opportunity, and there is no guarantee that the opportunity will exist indefinitely.

In addition, we observed that both the biology and the nonbiology majors benefited from working together, and we hope to clarify the parameters of this interaction and to improve its quality in a later project in which the parameter of class level is eliminated.

We recognize that the small student–faculty ratio in this class, no doubt, has helped to increase student enjoyment of the pilot course. However, our observations in this course as well as in our individual readings and research courses indicate that this course design in itself has significant value for improving the undergraduate's learning experience. In fact, one of our best students reluctantly suggested that the learning experience would have been improved if the class contained a larger number of students in order to improve the student-directed discussion and to minimize faculty tendencies to talk too much. Parameters which we hope to clarify in later projects include (i) differences in design for a lower level class versus an upper level class; (ii) optimal number of research topics to cover per semester; (iii) whether a one- or a two-semester course is optimal; and (iv) whether the proportion of time spent in discussion versus in laboratory is optimal.

Our experience has convinced us that this teaching technique is of benefit to both biology students and nonmajors as well as to both upper and lower classmen in increasing excitement for and understanding of biological science. We are particularly convinced that, while this learning experience is not a substitute for traditional courses, it does add an important dimension to a biology major's undergraduate education. We would urge that a research paper–laboratory experience be included in the curriculum for all biological science majors. This technique has the added advantage of allowing a researcher to devise an exciting learning experience for his undergraduates with minimal preparation because the "course" can involve his own research projects.

We have also concluded from our study that the research paper–laboratory experience is of value for nonmajors, in that it exposes them to the beauty and excitement of scientific discovery and removes the feeling of mysticism and enormous complexity which they frequently associate with the workings of scientists.

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REFERENCES

EPSTEIN, H. T. 1970. *A strategy for education.* Oxford University Press, New York.

HOLT, C. E., P. ABRAMOFF, L. V. WILCOX, Jr., and D. C. ABELL. 1969. Investigative laboratory programs in biology. *BioScience* 19(12):1104.

JEVELI, E., and R. J. STEVENS. 1975. Team teaching as a model for teaching the process of science in introductory biology. *Journal of College Science Teaching* 4:183.

LAETSCH, W. M. 1967. College biology and the captive nonmajor. *American Biology Teacher* 29(4):297.

LEE, H. H., R. E. SHORE, A. EHMANN and C. GANO. 1970. Merging research and teaching in developmental biology: adaptation of current scientific research papers for use in undergraduate laboratory exercises. *BioScience* 20(1):34.

RASMUSSEN, F. A. 1970. Matching laboratory activities with behavioral objectives. *BioScience* 20(5):292.

SHELL, L. C. 1962. Junior-senior research as a teaching method in the liberal arts college. *American Biology Teacher* 24(8):587.

———, and D. J. HAWES-DAVIS. 1965. Learning biology at the college freshman level. *American Biology Teacher* 27(1):26.

TAYLOR, I. E. P. 1971. The elective laboratory. *BioScience* 21(23):1173.