Four Kinds of Thinking in the Biology Classroom

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Presented by the author at the NABT sessions with the AIBS at Purdue University, August, 1961, he tells how thinking can be divided into four essential types.

If we first define the ability to think as the ability to solve problems, we can then say that man is the only animal that can think. Despite all of the publicity given to talking dogs and horses who can add numbers, man remains as the only animal who depends not on his instincts, but on his brain. Each time that we come to a choice between two or more courses of action, we are confronted by a problem that must be solved.

The Method of Tenacity

We solve problems in four basic ways or methods. The first, and lowest on the hierarchy, is called the method of tenacity. By using this method, we solve a problem in a certain manner just because we have always solved this problem in this manner. For example, when we drive from City "A" to City "B" we usually take the same road, although there may be several other choices. Why? Because we have always traveled this road. In the recent presidential elections, many citizens voted not for the man, but for the party, simply because it was a habit with them.

Can we utilize this method in the classroom? We all try. We try to teach the students to keep the room clean, put away their equipment, and do their homework just because they have always done this. It might be argued that this is a type of conditioned response, but for the purposes of this paper, it might also be called solving a problem through the method of tenacity.

The Method of Authority

The second type of thinking or problem-solving is the method of authority. In this method we solve problems because someone of consequence or status has dictated that we take a course of action, or we read an answer to a question in a book. Many people eat a certain type of breakfast food merely because a baseball player tells them to do so in an advertisement. Many people, in the recent election, voted for a candidate because their newspaper told them to.

In the classroom, it would be rather difficult to teach such concepts as the food chains existent in the African jungles or the effect of outer space on our bodies without getting most of the information from reading or interviewing—our field trip budget will go only so far. Another thing that we find in the classroom through the use of the method of authority might be the study of the lives of scientists. Without personal interviews, this must be vicarious.

The Method of Intuition

The third method, and the most maligned one, is the method of intuition. There are enough jokes about this method to make it unnecessary to define it. Some of us use this method to pick race horses, others to pick presidential candidates, but it is put third on the list because there is a great deal of previous experience involved in selecting answers to questions through this method.

In the classroom, we hope to teach some social values through this procedure. We want students to aquire some social grace or respect for others. This problem cannot be solved in any other way than through the method of intuition, since the students will not say "please" and "thank you" because some authority has told them to, nor will they do this because they have always done it—they haven't. If they demonstrate social skills, it is because they have intuitively said to themselves that other people should be treated with respect.

The Method of Science

The final, and most complex of the methods of problem-solving is the method of science. John Dewey outlined this age-old method in a series of steps. They were (1) isolate the problem; (2) set up hypotheses;

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(3) test hypotheses; (4) draw conclusions. When we budget our paychecks, we are forced to use this method. When a student carries out his own experiments to a conclusion, he is forced to use this method. The method of science is often called the most intellectual of all methods because it is the only one of the four that can possibly admit to an error.

It is extremely important that we teach students to formulate facts, concepts, and principles through the use of this procedure. The first reason for this is that most of their important decisions for the rest of their lives cannot be reached satisfactorily in any other way. Many of us are tired of hearing about how people select candidates, budget money, and select wives and husbands through the use of the methods of tenacity, authority, or intuition. Secondly, students must be taught to use the method of science because there are literally hundreds of thousands of people in this country who are trying to prevent their using it. This may sound insidious, but basically all people involved in the advertising business, in politics, and in many other fields try to convince people that their product is best, or their candidate is best, through the use of established habits, the voice of authority, or appeals to emotion. We want our students to be able to pierce through these arguments and arrive at conclusions that are scientific. The third reason for helping students to use this method is that we have found through research that one does not necessarily improve his ability to solve problems scientifically as he grows older. It is a skill and thus must be practiced.

Many students today find that the best instruction that they receive in schools is found in the music, art, shop, and driver training classes. Why is this so? Primarily because in these classes they are permitted to act as musicians, artists, craftsmen, and drivers. A musician plays an instrument, an artist paints a picture, a craftsman builds a desk, and a driver drives a car. When it is time for their history, literature, or biology class, however, they are not generally permitted to behave as historians, critics, or biologists. In the biology class, for example, are they permitted to formulate their own experiments and discover something new to them? Generally not. Rather they are treated as if they were science historians and should merely review science history from a book, then go to the laboratory to find out if what they learned from the book was accurate. What we need to do for these students is to let them behave as biologists, and this can only be done through the use of the method of science.

It is not easy to teach students to think scientifically—they have had nine, ten, or eleven years of resistance to this method in their backgrounds, but it is profitable if you desire to have a group of students who are excited about biology in your room. First of all, they will have difficulty in formulating problems. Any teacher who has tried the project method knows that this is true, and any teacher who has had a student faint from malnutrition in the middle of a unit on nutrition can confirm this. But we should remember that any legitimate question asked by a student represents a problem that can perhaps be solved. Sometimes the teacher must supply the problems in the form of thought-provoking questions, but in either case the teacher stops the process of problem-solving when he answers these questions directly. Unless there are problems of time, expense, or energy, the students should be encouraged to solve their own problems.

Upon occasion, they will be unable to set up hypotheses, also. Here the teacher must make some suggestions from time to time. Testing hypotheses is difficult, and the teacher must help with this, too. Finally, there will be problems involved in acting upon the conclusion reached, so continual reminders must be given. After a time, however, we will find that the students, for the most part, will be eager persons behaving as biologists and liking it.

In conclusion, we must expect to be disappointed at times. There is the story of a class of biology students who were studying public health and disease. They formulated problems and hypotheses, checked them with doctors, nurses, dentists, public health officials, investigated films, filmstrips, and encyclopedias for information; they visited the local college's bacteriology department, studied bacteria under the microscope, and cultured virus in eggs. Finally, when the

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unit test was given, they all scored in the nineties. The teacher was pleased. The next week they took a field trip to a farm, and the farmer gave them some apples to take back to the school. When they were back safe in the room, the apples were passed out and eaten. Not one student washed his apple!

There are disappointments, but for the teacher who would rather end the day exhausted from helping students learn than exhausted from fighting students, we can recommend that they teach students to think scientifically.

Rainy Monday Biology

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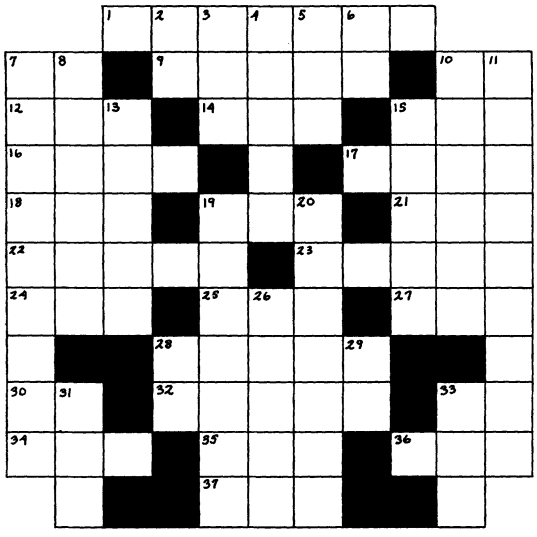
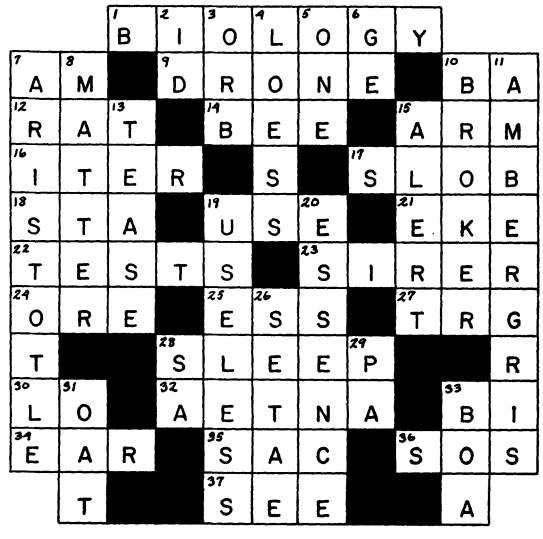


Across

1. The study of living things.
7. Present indicative of be.
9. Male bee.
10. Symbol for barium.
12. Rodent.
14. Hymenopteran.
15. Body part between wrist and shoulder.
16. Brain pathway.
17. Slovenly (slang).
18. Station (abbr.).
19. Employ.
21. Barely scratch out existence.
22. "Skeletons" of sea urchins.
23. One who fathers.
24. Metal-bearing rock.
25. Earthworm.
27. Teddy Roosevelt's grandfather (abbr.).
28. Nyctitropism.
30. The shorter microscope objective.
32. Stove (var.).
33. - - lateral symmetry (as in man).
34. The better to hear with.
35. Small, anatomical bag.
36. Ship's distress call.
37. Observe.

Down

2. Subconscious of Freud.
3. Eye.
4. Fine, unstratified loam deposit.
5. Number of ventricles of frog.
6. Symbol for germanium.
7. "Father" of biology.
8. Occupies space and has weight.
10. Dealer in securities.
11. Waxy secretion from sperm whale.
13. To delicately separate fibers.
15. Keen.
19. Without value.
20. Perfume.
26. Bristles of earthworm.
28. South American (abbr.).
29. What Ma calls her husband.
31. A grain.
33. Constricting snake.



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