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Every science teacher soon discovers that the intuitions students use to solve problems are frequently at variance with the critical thinking skills required by science. The exercise presented here focuses on the value of making scientific hypotheses and then attempting to falsify rather than confirm them.

When challenged to test a hypothesis, intuitive thinkers tend to show a confirmation bias, i.e., they will propose a test in which the results will be a positive instance of the hypothesis (Einhorn and Hogarth, 1978; Wason, 1960). Scientists, on the other hand, know that tests are specific instances that cannot inductively "prove" the hypothesis. Instead, scientists follow the lead of Karl Popper (1959), who formulated the logic of falsification. Popper asserted that support for a hypothesis is always provisional. Hypotheses cannot ever be conclusively proven. They can, however, be disproved. A negative test in which the hypothesis is not supported should cause the scientist to discard the hypothesis and try another.

The difference between the confirmation bias and the logic of falsification can be illustrated by the following classroom demonstration. The teacher begins by writing three names on the blackboard, let's say *Arthur, Alfred, Ann.* Following the names is a blank line where the next name will be written. The teacher gives the class the following task: *Here is a scientific problem for you to solve. I am thinking of a rule that tells me which names are right for this group and which are wrong for this group. I am not going to tell you the rule right away. Rather, I want you to form a hypothesis about what the rule might be. When you have formed your hypothesis, test that hypothesis by suggesting a name to go into the blank space. If your guess is consistent with the rule, I will say "Yes." If your guess is not consistent with the rule, I will say "No."* Chances are that students will hypothesize that the rule is "Names beginning with A." If they show the confirmation bias, they will suggest names such as *Andrew* and *Amy*. But the rule is not "Names beginning with A." The rule is "Names beginning with vowels." Because *Andrew* and *Amy* begin with vowels, the teacher will say "Yes" after each one is suggested, and students may go on to further think of names beginning with A. The teacher may allow this hypothesis confirmation to go on for several names, and then ask a student to state the rule. With some confidence the student will say "Names beginning with A," to which the teacher replies, "No, that's not it." The students may exhibit surprise.

At this point in the demonstration, the teacher should point out to the students that the tests of the hypothesis they had formed were all tests to confirm the hypothesis. The teacher should suggest that the students try again, only this time attempt to generate tests that disconfirm their hypothesis. Now students will generate names like *David* (no), *Elizabeth* (yes) and so on. By this method, they may eventually get to the rule "Names beginning with vowels."

The lesson can be repeated with numbers. The teacher begins by writing the numbers *2, 4, 6* on the board, followed by a blank line. The teacher repeats the instructions. Students are to form hypotheses about the rule that governs the numbers and suggest a number that follows the trio on the board. Although they will be tempted to believe that the rule is "Count by two's," students will be more wary than before. They may suggest *8* for the next number, but students who have learned the lesson will not continue to generate *10, 12, 14, etc.* Instead, they will attempt to disconfirm their hypothesis. By disconfirming they may eventually discover the rule, which is "The number has to be larger than the preceding number."

It is useful to repeat the lesson in several ways so the students do not dismiss the logic of falsification as a simple and unimportant trick. After using names and numbers, the interested teacher may be able to create a third example using concepts within the content area of the science course. One could attempt to test hypotheses about species of plants or elements in the periodic table, for instance. A further refinement of the process may occur if it is possible for the students to have access to a laboratory. For example, students could be given a sample of an unknown powder (see Bluhm, 1991) and asked to generate tests for the hypothesis that the powder is sugar. Students still operating under a confirmation bias might suggest tasting the powder because the confirmatory point of view predicts the powder will taste sweet. But if the powder is in reality not sugar, it could be very unpalatable; students would learn the hard way to keep falsification in mind.

As a final step, it may be useful to have the students turn their new-found talent at the logic of falsification to the study of a current problem in science. Students could consider questions regarding global warming or the demise of the dinosaurs. The value of the exercise would not be in arriving at a final answer, but in applying the logic of falsification to currently popular hypotheses about phenomena.

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