Regents Exam Review Panel
Living Environment
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A panel of scientists and science educators met on November 8, 2002 to review and discuss the Living Environment Regents Exam. Our group included professional researchers, curriculum specialists, and university professors, including department chairs (full list attached).

I. CONTENT VERSUS CONCEPTS

Our discussion reflected a general consensus that the study of any science will always include content specific to that discipline. However, we had a number of serious reservations about the content-heavy approach of the exam.

First, we were concerned that, as one panelist put it, the exam "requires memorizing bold-face terms" but doesn't require genuine scientific understanding. Hubert Dyasi said that he had often had the experience of students who were fluent in the vocabulary of science without being able to explain the underlying concepts. "A simple example. Things fall down because of gravity. Fine. But what do you mean by gravity? What do you understand by gravity? Then that's a different story."

Hubert Dyasi also observed, "I didn't get the sense that there's a distinction of levels of usefulness or relevance of information or scientific facts. . . . It seemed to me if I studied for this exam, every fact would be of equal importance. And I think that's a distortion of how scientists do things."

Second, a number of panelists who work with high-school students daily emphasized that the exam's focus on memorizing detailed content will not engage students. If students cannot get excited about learning in general and about science in particular, then they will perceive the content, in David Thaler's words, as "abstract, useless, and boring."

We also discussed the idea that specific content was not the point of communicating and teaching how science is done. In the independent projects that many students do in alternative schools, they end up mastering a large body of content associated with their experiments, but that content grows out of the context of their own work and questions rather than being pre-determined by a rigid curriculum. Adriana Aquino, a Content Specialist from the American Museum of Natural History's Department of Education, said, "What's more important is making them excited about science, about books, making them be exposed to experiences so that something will happen within them, making them want to learn. It's not just about putting that content in their minds. I think that's one of our main commitments at the museum: making them excited *beyond* the content. Because in science, the content changes every day."

Finally, we found that the Living Environment exam does not reflect the reality that the content of science is constantly changing. One panelist with a specialty in evolution remarked that while the questions in other disciplines had seemed fine to her, the questions on evolution were "forty years out of date," and full of "content errors." She thought it likely that specialists in other disciplines might find similar problems in their own areas.

Partly because the body of knowledge is so subject to change, a number of panelists felt the emphasis on an accumulation of specific facts was badly misplaced. In that context, David Helfand described a new introductory science course he is designing, which will be mandatory for all Columbia freshmen: "The purposes -- and therefore the purposes that one should teach to in high school -- are number one, to excite them with current science, which is radically different from their high-school experience of memorizing bold-face words. The second is to teach a few basic underlying scientific habits of mind, to use Dewey's phrase, which are: estimation; correlation and causation, and the difference between them; reading graphs and graphical representations of data, a little bit of probability and statistics, so that they have some way of making judgments about issues they will be facing. So the content is irrelevant. We're changing the lectures every semester to completely different subjects because the content is irrelevant. What's relevant is whether they learn to think in the way a scientist thinks."

II. EFFECT ON CLASSROOM PRACTICE

All of us, as working scientists and science teachers, want to see students excited by science, not turned off to it. David Burney expressed the general concern that the Living Environment exam would contribute to "what I refer to as the process in our education system of vaccinating students against a love of learning."

The sheer amount of material covered on the exam was troubling to many of us. One panelist said, "The fact part of the exam, the first thirty-five questions, is a tremendous amount of material, very broad-based; certainly you would have to devote an entire year teaching to the test." Another panelist, who had been educated in the British system, observed that this curriculum covered in one year what they had done in four. Ro Kinzler also doubted that teachers trying to cover all this material would have the time to introduce students to the time-consuming methodology of observing the natural world, "looking for patterns, and then going back to the natural system you're observing and seeing if those patterns make sense, or help you understand it more."

The test does not expressly prohibit the kinds of interactive, hands-on, experiential learning that is both central to an understanding of science and likely to excite kids, but both experimental and observational science require the key element of time, which is at a premium with such an extensive body of content to cover. "We all know," said Ro Kinzler, "if you want inquiry to be meaningful, it's not a cookbook. It's not something that works in forty minutes. It takes time."

We worried that because the breadth of content would be difficult to cover in a single year, this would be likely to preclude many valuable, indeed central, aspects of science education: collaborative learning experiences, class discussions, and the kind of teamwork and joint problem-solving necessary to laboratory science.

John Davis said, “My concern is about the way this exam is influencing the way instruction is taking place. I’m going to take the key words: excitement and curiosity, communication, observation. I think instruction is the key to all of that for the students. If curiosity is being removed from instructional technique and what’s happening in the class, if excitement is being taken out, you’re really destroying a huge pool of students who could ultimately enter the field of science . For me that would be enough to say, ‘Can the exam.’ Not many people go into the field in the first place, compared to other fields. But you’re eventually destroying that whole area -- if not destroying, really hurting it. If the exam really is changing the way people are teaching in class, there is less of a curiosity or bringing out and using the students’ curiosity as a teaching base, if excitement is gone, engagement is gone, then it’s a bad exam, then it’s not doing what you want it to do. It may speak to this [holding up Learning Standards] but it’s not speaking to the future of science.”

III: TEST-TAKING SKILLS VERSUS UNDERSTANDING SCIENCE

David Burney introduced the idea that “this test, or any test, is a perfect measure of a person’s ability to take that particular test.” Students who are good test takers (or who can be taught to be good test takers) could pass this test without a real understanding of science. We were largely in agreement that a good test-taker could nevertheless have an astonishingly poor understanding of science. Noel Goddard commented that “All the kids I've worked with were in the top 10% of their class at Stuyvesant and all of them are extraordinary test takers. But when they were not given a ‘canned’ question, their ability to apply this supposed ‘knowledge,’ and their overall sense of curiosity and enthusiasm were lacking. Research requires thinking outside the box. Teaching science in its most broad sense should inspire asking questions, not mastering the textbook.”

David Helfand spoke of the contrast he sees daily between successful test-taking and genuine understanding. “I have such a jaundiced view of tests as a result of teaching at Columbia, which is now the second most selective college in the country, mean SAT scores of 1500, 95 % of students in the top five per cent of their class. A significant fraction of them do not understand division . . . . They’ve expended an enormous amount of resources on preparation for tests. And they get 1500, and they don’t understand how to divide. So I have completely lost any confidence in the notion that standardized tests have any great meaning.”

IV: SCIENCE EXAM OR READING COMPREHENSION TEST?

We felt that many questions on the exam were reading-comprehension questions, which did not require an understanding of science to answer. David Helfand was “pleased that there were graphs in this exam, but otherwise I thought it was a disaster. I was struck

by the fact that it looked like the English SAT: you have a paragraph and it asks you three questions about the paragraph. The paragraph could have been about the French Revolution . . . .It had nothing to do with the way a scientist thinks. It looks like it was written by an English professor." John Davis found the exam "totally focused toward reading"; Noel Goddard's "first feeling after reading it was that it was a language exam." Adriana Aquino felt that what you needed to pass the test was "very good reading comprehension skills in addition to the ability to articulate the answer in the case of the writing parts." While no one suggested that these were not valuable skills, the question did arise whether a reading-comprehension test should in fact be called a test of scientific understanding.

While the exam contains graphs and pays "lip-service" to developing hypotheses, solving problems and writing about science, the panel found the graphing and writing sections of the exam "very directed." Barry Fox, a veteran of thirty years of high-school teaching, pointed out that on the graphs, the data was set up for students; the "essays" required only four sentences and provided all the words the student needed to include. He further observed that the graphs were not particularly challenging (most were untitled), making it possible for the student to earn most or all points for the graph without understanding how scientists construct and use them.

Where the exam nominally tested for concepts as well as content, we found the approach not very useful as a test of genuine understanding. We were sure that teachers could teach students test-taking strategies to pass both the multiple choice and the reading and writing questions but we did not confuse this with genuine science education. Adriana Aquino also raised the possibility of a student "who actually knows a lot about science, but maybe he can't articulate his ideas on paper, and maybe he won't pass the exam."

V: IS THE TEST AN APPROPRIATE HIGH-SCHOOL GRADUATION REQUIREMENT?

Many panelists felt that, at least as far as topics covered, the exam was at a college-preparatory level. (Some of us would prefer to see students enter college having had a deeper, more conceptual and hands-on classroom experience.) However, few of us felt that this exam was appropriate for students who were not intending to go on in science at the college level. "I don't think it tests what I consider to be high-school science," said one participant. "It's a tragedy to me that you're keeping kids from getting diplomas at the age of 17 or 18, which could enable them to further their education, even if it's at the community college level, taking one class to better themselves. I think we can all agree it's a tragedy that there are going to be kids who fall through the system." John Davis went further, pointing out that in the minority scientist program, he has taught any number of students who've come in poorly prepared and needing remediation who have gone on to MD-PhD programs, and that he would hate to see their options foreclosed too early.

Columbia's David Helfand said that to impose this exam as a "barrier to a step one must go through in order to become a member of society is completely absurd. The fact that I can't answer all the questions on this test means I'm not a good scientist? Or that I'm not a literate citizen? So how can we make this the standard and say everyone has to do it this way?" Marty Grossel said the emphasis on college-level biology was inappropriate for many students. "Does not passing this exam mean that you can't be a contributing member of society?"

Panelists were even more distressed to learn that this exam was typically given after 9th grade, and that recall of a body of detailed content appropriate for a college freshman was an excessive demand to place on a high-school freshmen. Hubert Dyasi, a leader in the field of science education, said that the level of the exam was completely developmentally inappropriate: "This is totally against what we know about the capacity of humans to learn at that age and to assimilate all of that kind of information."

Jeannette Kim, who works regularly with high-school students, observed that "You're expecting that students know a certain level of knowledge, by the time they reach 9th grade, when the Living Environment Regents comes, that they know x number of details, and you're just adding to that knowledge. But that's not the case in the majority of schools in New York City. The middle school is not preparing kids for high school. The elementary school is not preparing kids for middle school. The 9th-grade teacher gets the kid and says, 'We're just going to cram every single bit of information into your head because you now need to pass the test.'"

We concluded that an exam-driven curriculum would not encourage teachers to teach the scientific "habits of mind" that all students will need to make informed decisions about the scientific issues they will face in today's world. "We want them to be able to vote on stem cells," said Marty Grossel, "to be able to know what the toxic waste dump next to them is doing to their health." We worried that a curriculum preparing students for this exam will not prepare them to be thoughtful members of a democracy.

Ro Kinzler summed up: "I can't imagine that anybody here believes it's a good idea for the state to enforce one means of assessing kids."

VI: ALIGNMENT TO THE STATE LEARNING STANDARDS

Adriana Aquino broke down the questions on the exam by Learning Standard, and saw that "all of them are more or less well represented." However, she also observed that the Standards themselves had some serious limitations: " Fifteen out of 16 standards require them just to be able to 'explain' or 'describe' the concept addressed by the key idea: there is no acknowledgment of any inquiry-based, deductive or inductive reasoning, elaboration of their own conclusions, individual research, critical thinking, or devising their own way of coming up with ways to resolve or observe what the key idea proposes."

Since these are all essential elements of the practice of science, their absence from the Learning Standards suggests that a test aligned to the Standards may still not be a good test of scientific understanding. John Davis suggested that we “look at the reality. The reality is -- what do the students actually have the ability to do afterwards?”

VII: CONCLUSIONS:

The exam does not reflect how scientists think or how scientists use their curiosity to investigate natural phenomena. The exam conveys the idea that science is about answers, not about questions. But scientists are constantly evaluating what they don’t know, and are often motivated by the unknown.

As one panel member stated, nothing in the test gave students insights into "basic underlying scientific habits of mind." These include a wide variety of creative skills: developing deductive reasoning; stating and testing hypotheses; asking relevant questions; solving problems; understanding estimation and the difference between correlation and causation; and recognizing and understanding patterns that unfold within naturally occurring phenomena.

Given the disjunction between the content of the exam and the practice of science, the panel fears that the exam will negatively affect teachers, students, and ultimately the practice of science education in New York State.

We emphasize that the most important aspect of science education is getting students to think like scientists -- to take advantage of their natural curiosity through exciting and engaging experiences. The Regents exam reflects a forced curriculum that assumes all students will learn the material in the same way at the same time. We recommend expanding options to include other means of evaluating student learning -- instruments that encourage students to learn to think like scientists and to become excited about science.

Signed:

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John W. Davis, Chairperson, Department of Biology and Medical Laboratory Technology, Bronx Community College.

Hubert Dyasi, professor of science education at the City College, CUNY; Director of the City College Workshop Center, a science teacher development institution.

Barry Fox, Science consultant; master teacher, recipient Rockefeller University fellowship awarded to outstanding high school science teachers; author *Animal Behavior*, a case study of inquiry methodology.

Noel Goddard, Ph.D. Research Fellow at Rockefeller University in Physics and Biology.

Martha J. Grossel, George and Carol Milne Assistant Professor of Zoology at Connecticut College.

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