

21. Life Sciences

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During the NSF-funded project, Rock Valley College (RVC) faculty worked each year with faculty from Northern Illinois University and the teachers of the Rockford district to examine articulation from high school to college (either directly to the university or first to the community college and then to the university). Additionally, two sessions were held each year involving faculty representatives from RVC and the teachers. The first of these was a discipline update and the second involved a hands-on workshop.

Articulation Workshop

The goal of the workshop was to compare middle school, high school, and college science instruction. This was to include an examination of

- knowledge, competencies, and skills taught
- content and procedures of assessments
- technology use by student and teacher
- teaching pedagogy
- Illinois state learning standards

We identified no significant gaps in curriculum content, but there were significant gaps in student performance from one level to the next. Ideally, the intrinsic redundancy of knowledge and skills would work to reinforce content from one education level to the next and enable quickly moving to a deeper examination of the material. Unfortunately, this is not always seen because teachers at all levels feel that they must re-teach the basics. The gap between taught and demonstrated knowledge in introductory college science courses can be attributed to the time between taking the comparable high school course and the introductory college course.

The community college and university instructors felt that incoming students often lacked critical thinking skills and believed that all that was needed to succeed in a college science course was to memorize definitions of terms. Related comments from the articulation sheets include:

- We are often trying to teach higher-order skills, but assessing lower-order skills.
- We do need to design assessment tools that will assess the higher-order skills.
- We do a good job of assessing content.

It is *assumed* that students have mastered the previous level prior to moving on to a higher level. However, 20% of first-year college biology students will fail; only 15% will earn an

A. Therefore, we, as a group, wanted to stress an overall focus on reading, science, and study skills, at all levels.

The articulation sessions could not pinpoint specific weaknesses at any level. They were, however, able to highlight the common goals and the limitations all encounter in developing student learning and thinking to the desired level. This discussion also provided the college instructors with a chance to hear firsthand many of the challenges of the middle and high school teachers: the amount of time that must be spent on non-learning activities, the lack of technology and equipment in many schools, the lack of time to set up (and clean up after) a laboratory experiment, and the necessity to cover all of the material dictated by the Illinois learning standards.

Discipline Update

The life science discipline update was an informal exchange of information. The foundation of the discussions was the preceding week's local newspaper and national magazines (such as *Time*, *Newsweek*, and *Discover*). We discussed the science behind the reporting. This facilitated an examination of the method of scientific inquiry, the technology being applied, the characteristics of any organism (viral, bacterial, animal, or plant) involved, and the bioethical questions raised by many scientific advancements.

A number of non-biology middle and high school faculty were present during these sessions. The questions they raised were excellent springboards to further discussion and exchange of ideas. It appeared that all, both biology and non-biology instructors, enjoyed the ability to explore these advances in a relaxed intellectual discussion.

Workshops

During each of the three years of the project, we offered "Meet the Microbes" as a three-hour session. The goals of the workshop were to:

- Provide Rockford teachers with easily conducted experiments that required minimal supplies and could be used to introduce students to the microbial world
- Illustrate how microorganisms could be used to reveal characteristics of living things
- Increase awareness about the role microorganisms play in our daily lives
- Provide participants with resource materials
- Relate activities with both National Science Educational Standards and New Standards™ Student Performance Standards
- Relate microbiology and literature through the display of fiction and non-fiction books based on microbial actions
- Provide interdisciplinary resources related to bioterrorism
- Develop an awareness of resources available at Rock Valley College that teachers could use in their instruction.

Each exercise was tied to both the National Science Educational Standards and the New Standards™ Student Performance Standards. Some of the experiments came from *Meet the Microbes through the MicrobeWorld Activities*, developed by the National Association of

Biology Teachers, with funding from the National Science Foundation, the Department of Energy, and the American Society for Microbiology. Several of these experiments had been performed by the workshop presenter with middle school girls as a part of the pilot study prior to publication. (These experiments are also available at www.microbeworld.org/home.htm.) Additional experiments came from *Science and Our Food Supply*, written by the U.S. Food and Drug Administration Center for Food Safety and Applied Nutrition and the National Science Teachers Association, available at www.cfsan.fda.gov/~dms/tchcuric.html. During the second and third years of our project, material related to bioterrorism was made available to participants.

Workshop participants also included non-science teachers. Even so, all were expected to take part in several hands-on experiments that used readily available resources in an investigation of sugar and sugar substitutes in gas and calorie production. Experiments included investigating microbes as they affect human lives, the ubiquity of microorganisms, and the transmission of microorganisms and resulting diseases. The workshops moved from general background to specific concepts, while maintaining a comfort level for the participants, to show that many microbiological studies could be performed without a lot of equipment and apply in a multitude of disciplines.

Each participant received a manual of the performed experiments and resources. All exercises available on the Web were linked; the remaining resources were written by me and are available from me. Each of the exercises was tied to National Science Educational Standards and New Standards™ Student Performance Standards.

Outcomes

The collaboration led to better understanding of the general science curriculum at all levels and increased the interaction between the Rockford teachers and RVC faculty. Further, an RVC faculty member made presentations to several middle school science classes, discussed the content of an elective microbiology course she was developing with a high school science teacher, shared bacterial cultures with a high school biology teacher, discussed providing a dual-credit anatomy and physiology course in the local high schools, and renewed discussions between the biology faculties of Northern Illinois University and RVC, resulting in greater use of NIU graduate students as adjuncts in the Life Science Division at RVC.

Recommendations

I would make the following recommendations:

- Continue the learning team made up of Rockford teachers and RVC faculty. This would provide the teachers with a point person for collaboration, foster understanding of the depth of content taught at each level, and build bridges between the two faculties.
- Continue to provide a workshop day where participants would be encouraged to participate in activities outside their own discipline. Much was gained by the interaction of science and non-science teachers during the workshops. This also opens the door to interdisciplinary projects and assignments.

- Conduct the workshop in two sessions, one week apart. This would allow more time for cultures to grow and results to be more observable, thereby reinforcing the need to understand microorganisms. The changed format would also allow more flexibility for preparation and discussion.