**Project Title:** RCN-UBE: Promoting Concept Driven Teaching Strategies in Biochemistry and Molecular Biology through Concept Assessments
**PI:** Ellis Bell
**Awardee:** American Society for Biochemistry and Molecular Biology (ASBMB)
**Award Number:** 0957205

**Summary of Regional Meeting held 3 March 2012 at Moravian College, Bethlehem, Pennsylvania.**

**Meeting Coordinators:** Harold B. White (University of Delaware) and Duane Sears (University of California-Santa Barbara)

**Moravian College Hosts:** Shari and Stephen Dunham

**Site and Time Selection:** The original plan was to have annual regional meetings organized around the six ASBMB Undergraduate Affiliate Network (UAN) regions. The first northeast regional meeting was held 29 January 2011 at Montclair University in northern New Jersey. Given the difficulty posed by distance for a small one-day meeting in some central and western regions of the US, the core planning group decided that having two meetings in the northeast and fewer elsewhere would be reasonable given the density of colleges and universities within driving distance of most possible meeting sites.

Moravian College, in Bethlehem, Pennsylvania, was selected because of its location in eastern Pennsylvania near many liberal arts colleges, its chemistry department’s reputation for promoting and practicing active-learning strategies (POGIL) in undergraduate education, and the willingness of one of its members, Shari Dunham, to host the meeting. The date for the meeting was selected to coincide with the first weekend of Spring Break at Moravian when classrooms and other meeting venues would be available. The other northeast regional meeting was held in New England at Northeastern University in Boston, Massachusetts on 10 March 2012.

**Publicity:** The middle Atlantic region has a long history of local regional meetings in chemistry. The Middle Atlantic Association of Liberal Arts Chemistry Teachers (MAALACT) meets annually to discuss teaching innovations in chemistry education. Similarly, the Middle Atlantic Chemistry Discovery Project (MADCP) has annual meetings devoted to education topics. In addition, the Intercollegiate Student Chemists Conference (ISCC) also provides an annual opportunity for faculty in small schools to meet and interact. Given this tradition and the fact that the ACS added biochemistry as a requirement for a certified Chemistry degree, an increasing number of biochemistry faculty have been hired in regional chemistry departments and attend these meetings. Most of these young faculty are not members of ASBMB and do not sponsor UAN
chapters. Thus, in addition to advertising the Moravian meeting to ASBMB members, biochemistry and molecular biology faculty at regional colleges and universities were identified and invited to attend the meeting. It was promoted as an opportunity for faculty to meet and possibly collaborate on BMB projects with their regional neighbors.

**Demographics of the Registrants:** A total of 37 people registered for the meeting. Three of those who registered could not attend for various reasons. The registrants represented 31 different colleges and universities. The greatest distances traveled were from University of Ohio to the west, St. Lawrence University to the north, and Amherst College to the east—all about 7 hours drive from Bethlehem, PA. Only five registrants, other than the organizers and hosts, were ASBMB members and only four schools represented had UAN chapters. This information was gathered prior to the meeting through an on-line survey that follows, which asked additional questions.

This pre-meeting questionnaire is intended to develop a profile of those attending the Northeast Regional meeting at Moravian College sponsored by the American Society for Biochemistry and Molecular Biology (ASBMB). It is part of a NSF Research Coordination Networks (RCN) Undergraduate Biology Education (UBE) grant to ASBMB. The information collected will help the organizers tailor the meeting for the participants and to plan subsequent meetings.

1. To what scientific societies do you belong?
2. What courses do you teach?
3. What topic(s) or concept(s) in Biochemistry and Molecular Biology do you find most difficult to teach or for students to learn? Provide at least one example.
4. Which of the following pedagogical approaches have you used in your teaching? What is your level of comfort, if used?
   a. Lecture
   b. Laboratory Instruction
   c. Undergraduate Research Training
   d. Problem-Based Learning (PBL)
   e. Process-Oriented Guided Inquiry Learning (POGIL)
   f. Peer-Led Team Learning (PLTL)
   g. Case Studies
   h. Service Learning
   i. Portfolios
   j. Clickers
5. Which of the following assessment strategies have you used?
   a. Multiple Choice Examinations
   b. Essay Examinations
   c. Standardized Examinations
   d. Concept Inventories
   e. Concept Mapping
6. To what extent do you emphasize the following in your teaching?
   a. Facility with mathematics
   b. Writing clearly
   c. Construction of logical arguments
   d. Interpretation of data
   e. Creating pictorial visual models by hand. (reactions/diagrams/graphs)
   f. One or more molecular modeling programs in class
   g. Molecular modeling in lab
   h. Molecular modeling take-home/out-of-class. (What platforms are you comfortable with?)

7. What do you hope to gain or learn by attending the meeting at Moravian?

Program: Registration was held from 9:30 – 10 AM. Each person received a name badge and a binder containing program information and handouts. Included in the binder were the program, a list of registrants, the results of the pre-meeting survey, copies of slides for several presentations, promotional material for the ASBMB and the UAN chapters, as well as the following selected to be relevant to the meeting and of general interest.: 


In addition, each attendee received a copy of *Vision and Change in Undergraduate Biology Education: A Call to Action* (AAAS 2011).

The meeting began at 10AM with a presentation by Hal White in which he provided an overview of the grant to ASBMB and its objectives. He also gave a brief description of an Introduction to Biochemistry course he offers to second-semester sophomore biochemistry majors at the University of Delaware. It is conducted entirely in a problem-based learning format using research articles on hemoglobin and sickle cell anemia as problems.
At 10:30 AM, hosts Shari and Steve Dunham gave an engaging and well-received keynote lecture entitled: “Teaching Visualization Skills in Biochemistry: Discovery-based Visualization Activities for Structure-Function Exploration of Biomolecules”. The presentation highlighted the importance of visualization in understanding biochemistry and the fact that little is done to deliberately improve students’ ability to visualize molecules. They provided several examples of computer-based visualization activities they have developed.

Box lunches were provided over the noon hour which was used as an opportunity for participants to talk among themselves about their teaching experiences.

At 1 PM, co-organizer Duane Sears, spoke on, “Pre-course Assessment of Student Academic Preparation for General Biochemistry at UCSB.” He described a number of assessment-quiz questions he asks his students in the first weeks of his class of around 200 students. The concepts he addresses with these relate to general chemistry, organic chemistry, and introductory biology concepts needed in biochemistry. With this low-stakes pre-course assessment, he hopes to learn what students have retained from prerequisite courses and let students know what the expectations are for a course in biochemistry. Good discussion ensued as to what and how much instructors expect students to know or understand at the beginning of a course, particularly a biochemistry course, and how assessment of student knowledge levels might be achieved in this regard.

The afternoon workshop part of the program was defined by the grant objectives and the timeline proposed there. **Specific workshop goals for 2011-2012 - “Taxonomy of concepts and skills- links to potential revisions of ASBMB recommended curriculum and Active Learning Strategies” - as related to Specific Aim 2 - "Create a taxonomy of these foundational concepts and skills, and link them to topics outlined in the undergraduate curriculum recommendations of ASBMB."

A general outline for the session was established after the core group meeting in Richmond, Virginia, that followed the ASBMB-sponsored meeting, **Student-Centered Education in the Molecular and Life Sciences II Symposium**, there in July 2011. The outline specified that the second year workshops would:

1. Rewrite the core concepts developed in the first year into sentences.
2. Unpackage learning objectives from core concepts.
3. Identify underlying concepts from chemistry, physics, and math that support these learning objectives.

The four working core concepts were:

1. Energy: Fundamental Nature, Utilization and Flow (Groups 1 & 5)
2. Core Concepts in Biochemistry and Molecular Biology are Based on: (Groups 2 & 6)
   a. Objective Measurement
   b. Quantitative Analysis
   c. Critical Interpretation

3. Macromolecular Structure, Function, Regulation, and Storage (Groups 3 & 7)

4. Transformation and Transfer of Information (Groups 4 & 8)

At the beginning of the workshop session, the registrants participated in an activity designed to create 8 diverse working groups of 4 people each. The groups were then assigned to discuss specific core concepts as noted above. The idea was to have maximum involvement, limited focus for each group, and the opportunity to compare the results from groups working on the same topic. While there was some time to compare statements generated for the first assignment, the logistics proved too time-consuming for a discussion of the final two activities. However, the transcripts of each working group were collected and distributed to all participants after the meeting.

The groups struggled with the actual meaning, explanation, and placement of some of the "talking points" associated with the four "working core concepts," particularly #2 - Core Concepts in Biochemistry and Molecular Biology are Based on: a) Objective Measurement, b) Objective Analysis; and c) Critical Interpretation - which many thought represented a list of skills and not the definition of a "core concept."

The meeting ended at 5 PM after a general discussion, much of which centered around the primary topic of frustration many faculty feel about the science culture at many colleges and universities, which seems to devalue teaching in the reward structure. An assessment form was completed by almost all of the attendees.

The main messages that emerged from the evaluations are that the meeting was appreciated by everyone, they like the opportunity to network with regional like-minded faculty, Shari and Steve Dunham's presentation on visualization was a hit, and the afternoon workshops were useful, but more guidance was desired.

**Meeting Coordinators’ Assessment:** We believe that the meeting was very successful in bringing together a sizable group of regional biochemistry and molecular biology educators and promoting discussion on topics related to the grant’s goals. Some participants did not realize the nature of the meeting and were surprised to be enlisted in the afternoon workshops to be workers on the grant objectives rather than being in an audience listening to others as is often the case at other meetings. While we tried to structure the meeting such that second-year
goals could be addressed, the limited time available precluded a full exchange and discussion of the conclusions of the breakout groups.

The time constraints we encountered seemed to stem mainly from a few logistical problems that other regional meeting directors might want to consider when planning future meetings. First, our mechanism for collecting and sharing the group reports after each breakout session were ineffective and time-consuming. We attempted to rely on a mixture of computer documents and written summaries that ultimately were difficult to collect and collate, particularly as the meeting neared its end. Thus, the group report summaries were not always effectively and fully shared after the breakouts. There are possible solutions that could be tried out in future meetings. Second the agenda for the meeting might have been too ambitious, thereby squeezing the available time for each individual activity. In retrospect, for a full day meeting like this one, it might have been better to eliminate one activity – for example have only one plenary talk (instead a morning and afternoon talk) and 3 breakouts, or have two plenary talks and only 2 breakouts with longer reporting and discussion times after each breakout. Otherwise, the meeting went exceptionally smoothly with particularly acknowledgement to Weiyi, for all of her help with the meeting planning, and Shari, Stephen, and Moravian College for creating an exceptionally collegial and environment for a stimulating meeting.

We each have a feeling of unease as we look forward to the third year of our grant, because it represents a transition from gathering information to developing and evaluating appropriate assessment tools for the topics we discussed at the Moravian meeting and elsewhere. This will be a major undertaking and one that few if any of the principals on this grant have expertise. Clearly, people with those talents must be recruited in order for us to keep on schedule.

This sense of unease is further underscored by the nature of the output generated by this meeting alone. As with other regional meetings, a sizeable body of important, interesting, and potentially useful information and ideas emerged from the meeting that could easily fit into the overall objectives of the grant. However, much of the raw data generated by this meeting is yet to be collated into a coherent package that could then be assembled and packaged with the outcomes of other regional meetings. Just reading through the group reports and the workshop evaluations for this meeting alone, one finds a significant level of redundancy, which has both a positive and negative side to it. On the positive side, the redundancy of ideas is a sign that many are on the “same page.” On the negative side, someone will eventually have to identify and distill out the common, mutually compatible, and most important ideas from this workshop and the other workshops before the next phase of the project can be tackled – that
of developing and evaluating appropriate assessment tools, which at this point seems like a particularly daunting task.

While it is beyond our charge and responsibilities, our experience at the Moravian meeting clearly shows that there is a large group of biochemistry and molecular biology teachers who are not affiliated with the ASBMB and who can contribute to the society’s educational mission. Addressing the interests and engaging this population seems to be an opportunity for the attention of the ASBMB Education and Professional Development Committee.

Separate files associated with this report include:
1. Summary of the preconference survey of registrants
2. Compilation of the responses of the eight working groups to the workshop tasks
3. Transcription of the evaluation forms received from 30 participants.

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