

REFLECTING ON TEACHING AND LEARNING

An Exploratory Process for Science Educators

*"To each one is given a marble to carve for the wall
A stone that is needed to heighten the beauty of all
And only your soul has the magic to give it grace
And only your hands have the cunning to put it in place
Yes, the task that is given to each one, no other can do
So the errand is waiting; it has waited through ages for you
And now you appear, and the hushed ones are turning their gaze
To see what you do with your chance in the chamber of days."*

Edith Highman

When we began the APS Science Teacher Research in Physiology program in 1990, we thought that the program's greatest impact would be in broadening teacher's understanding of who biomedical researchers are and what they do. We hoped that teachers would gain a better understanding of what research is all about. **What we didn't anticipate was that many of the teachers began wondering, "What is science education about? What is the connection between what happens in scientific research and what happens in the science classroom?"** Many felt that the "science" they were experiencing in the laboratory bore little resemblance to what their students were experiencing in the classroom. As a result, a number of teachers began to rethink how their science curriculum was structured, the teaching strategies they employed, and the goals they had for their students.

Several of these teachers' encouraged us to challenge our Summer Research Teachers to consider these issues...to think about the goals they have in mind for their classroom and the teaching and learning that happens there. As the saying goes, "If we don't know where we're going, how will we know when we get there?" Throughout the week, we'd like you to take time to write down some of your thoughts on where you would like your teaching, curriculum, and classroom to be "going." Throughout the week, we'd like you to share your thoughts with us.

Please note: Your responses are confidential and will not be printed or cited with your name associated.

REFLECTION #1 VISUALIZING THE IDEAL!

For the next 10-15 minutes, set aside the constraints of shrinking budgets, curbs on field trips, standardized tests, etc. Think about your ideal classroom, in terms of..

the teaching strategies you employ (e.g., inquiry, problem-solving, cooperative learning/teaming, encouraging equity, etc.); and

the curriculum you implement and the curricular materials (including printed materials, AV, computer, etc.) you utilize;

the physical facilities you use (including not only equipment but the larger community and global resources).

Write a description of your ideal; use extra sheets of notebook paper as needed (please number your pages). If you prefer, this can be for only one of the courses you teach. If so, indicate the course title and what the overall focus of the course is.

Take approximately 15-20 minutes to do this exercise...we'll be adding to your description as the week goes on.

REFLECTION #2
INTEGRATING INQUIRY INTO THE CLASSROOM...
IS THERE A PROBLEM?

One former APS Summer Research Teacher (we'll call her Karen) described how her research experience caused her to identify with her own students. She said that when she entered the lab, she felt that she didn't understand the background content for the work she was about to do, that she didn't have any experience with the tools or methods she was about to use, and that there was no guarantee she would be successful in this venture. She suddenly realized that her own students must feel this way when they come into her class in the fall.

In the tape, Ann Haley-Oliphant said that it took time for her students to warm up to the inquiry process and to leave behind the "memorize and regurgitate" method that had served them well in the past -- especially the students who had been successful using this method!

Your summer research experience is heavily focused on inquiry (research) and is very different from most students' experiences with science. How do you think your students would react (or how have they reacted) to an inquiry or research approach to science education in your classroom?

What would be the reaction of administrators? of parents?

What barriers exist to implementing this type of approach?

What ideas come to mind for eliminating some of these barriers?

REFLECTION #3
INTEGRATING INQUIRY INTO THE CLASSROOM...
HOW DO I ASSESS LEARNING?

Karen (our former SRT) also realized during her research experience that her students were missing out on the most exciting part of science -- the exploration and discovery. Most of her students' laboratory time was spent learning how to do a particular procedure or use a specific piece of equipment. Her students never had opportunity to USE those skills to explore and experiment...the part of the research experience that she had found exciting!

As you are probably learning during your research experience, there are a number of ways in which a researcher's work is monitored and assessed. A graduate student, postdoc, or research teacher reviews his/her results with the faculty member. Results are also reported and discussed at lab meetings or departmental seminars. At a national and international level, researchers present papers and posters and their methods and results are reviewed and questioned by colleagues. When submitting a research paper to a journal, researchers expect to receive detailed reviews and questions from colleagues who are acting as reviewers and editors. The researcher must clearly answer these questions before the paper is published.

When we utilize cooperative groups/teams and students engage in inquiry or open-ended problem-solving activities, how can we assess learning?

What strategies have you tried? What worked? What didn't?

What assessment ideas would you like to try in the future?

Are there any "barriers" you need to remove before you implement these ideas? How could you remove them?

REFLECTION #4
"WEEDING" AND "REPLANTING" IN YOUR CURRICULUM
...AN ONGOING PROCESS

After her research experience, Karen (our former SRT) decided that she would begin to rethink and redesign her curriculum. **Over several years**, she began to eliminate lab activities that were there primarily due to tradition. She began to replace them with opportunities for her students to use the experimental skills they had gained to develop their own hypotheses, design their own experiments, and discover their results. This was a gradual process, but the benefits have been tremendous in terms of student achievement and motivation. Karen compensates for the additional time required by inquiry approaches by "layering" concepts...students work on multiple projects and content concepts at one time, all centered around a central theme.

Think about the courses you have taught in the past few years.

Do you have a list of criteria in terms of content and pedagogy that you use to judge each laboratory activity? If so, what are they?

If not, what criteria come to mind?

Using these criteria, what labs/activities come to mind that definitely meet the criteria? Can you think of labs/activities that you'd label "Maybe"?

Are there labs/activities that definitely do not meet your criteria?

What can you do to improve or replace them?

Are there laboratory activities that you include primarily because "it's always been done?" Is this a sufficient criterion on which to judge the usefulness of a lesson, lab, or activity? Why or why not?

REFLECTION #5

SCIENCE FOR EVERY STUDENT

Every class includes students with diverse learning styles, backgrounds, motivations, etc.

For most teachers, classes include students from both genders and from more than one racial/ethnic group. Traditionally, female students and students from certain racial/ethnic groups in the United States (especially African-Americans, Hispanics, and Native Americans) have been underrepresented in elective science courses in high school; science and engineering majors in college; and science and engineering careers. Research has shown that certain teaching strategies, including:

- * the incorporation of role models into the curriculum;
- * cooperative (small group) learning; and
- * hands-on, problem-solving, and inquiry approaches

can increase motivation, participation, and achievement among these groups.

What types of diversity are present in your classroom and/or the student body at your school? In terms of gender, racial/ethnic group, primary language, and socio-economic status? Write down your description on the Needs/Action table on the following page.

What particular needs might these groups have concerning science education? Are there questions you need to ask to determine whether these groups have particular needs? (e.g., do you know how well female students are represented in upper level elective science and mathematics courses? How about students from various racial/ethnic groups?) (Write your ideas on the Needs/Action table.)

How can you begin to meet those needs in your classroom? (Your classroom will not, of course, meet all needs or solve all problems...but it can make a contribution!). What ideas come to mind that you could do to address equity/diversity issues? Generate 1-3 ideas and write them on your Needs/Actions table. You may NOT have an action for every need you wrote!

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Now share your reflections on the three questions above with the members of your discussion group...if you hear ideas that appeal to you, add them to your Needs/Action table.

REFLECTION #6

LOOKING BACK...LOOKING FORWARD

On the first day of the Summer Institute, we asked you to describe your ideal in terms of curriculum, pedagogy, and facilities. During the course of the week, we asked you to examine the barriers and benefits to incorporating inquiry, problem-solving, and alternative assessments into your teaching.

Go back and re-read your description of the ideal classroom/course. Have this week's discussions and/or your summer research experience had any impact on your image of the ideal, that is, have they expanded it, reinforced it, changed it, etc.? If so, please describe how.

Based on your reflections, the discussions you've had with teachers and researchers here, and the information provided during the Institute, WHAT THREE SHORT TERM GOALS CAN YOU SET FOR YOURSELF FOR MOVING YOUR CLASSROOM TOWARD THE IDEAL YOU DESCRIBED? These should be goals that can be implemented or initiated in the coming school year.