TEACHING SCIENCE in the TWO-YEAR COLLEGE

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Contents

Section III

Teaching Strategies for the Two-Year College

Section IV
Using Information and Communication Technologies

Introduction

Two-year colleges often have unique missions and goals compared to those of four-year or graduate colleges. Likewise, faculty at these institutions face unique challenges. Mission statements for two-year colleges regularly state that the college is richly diverse, comprehensive, and serves the needs of a specific geographic area. In addition, the college has a commitment to provide an accessible and affordable education through a knowledgeable faculty and staff, a responsive and flexible curriculum, and strong community partnerships. There is a fundamental commitment to teaching and learning excellence in both baccalaureate and career-focused educational programs. Some data indicate that about half of our future science teachers will take their first two years of science at a two-year school.

Teaching Science in the Two-Year College examines issues science faculty at two-year colleges frequently face. The articles, drawn from the *Journal of College Science Teaching,* discuss the topics of curriculum, teaching strategies, and the use of educational technologies. The authors provide examples of how they tackled challenges at their institutions.

The uniqueness of teaching science in the two-year college

The first section offers insights about the uniqueness of teaching in a two-year college. *Hello! Is Anybody Out There?* explores one commonality that exists among many two-year colleges—*isolation,* including the social, financial, and political isolation of community college educators. While schools invest in institutional research, this information too often remains sequestered and unused within the institutional archives. The author provides suggestions on how two-year colleges and faculty can better link for their mutual benefit.

Many times, two-year college students are uncertain about continuing their academic pursuits. *The First Day of Class on a Two-Year Campus* explores student apprehensions regarding science classes, explaining that anxiety about science courses can be attributed to lack of prior knowledge and loss of personal control. The authors discuss student perceptions and how to support and encourage student confidence.

While part-time instructors are not unique to two-year colleges, some of their employment issues are. *Adjunct Faculty* provides a multi-dimensional view of the essential work performed by the part-time faculty and looks at the problems and dilemmas posed by this untenured staff.

The Graying of Science Faculty in U.S. Colleges and Universities sheds light on a staffing crisis facing two-year colleges. The authors look at questions such as: Where are the younger faculty who will continue to teach science over the next 20 or 30 years? Who will remain to mentor the younger faculty who will be appointed over the next several years? Will there be enough younger, qualified individuals to fill the need? The article presents a study of age demographics of college science-teaching faculty in the United States, with several recommendations on how to deal with the crisis.

The Counseling/Science Connection explains how the counseling department can be a valuable part of the science instructional team. However, the faculty does not always take advantage of this collaborative opportunity. This article explores some of the advantages that can accrue when a classroom teacher teams up with a counselor. The author, a psychological counselor who had worked closely with a classroom teacher, discusses the role of campus counseling services, the developmental needs of two-year college students, and how to seek counseling assistance.

Curricular issues in the two-year college

Curricular issues in science courses are as common at the two-year college as they are at other postsecondary institutions. While the National Science Education Standards address the K–12 level, they have also generated much interest in two-year colleges. The article *Navigating the Standards* looks at the importance of the Standards for colleges and presents a preview of the book *College Pathways to the Science Education Standards,* published by the National Science Teachers Association.

The curriculum for courses populated by nonscience majors is often routine and bland. *Designing Nonmajors' Science Courses—Is There a Better Way?* presents a different approach to developing science courses for nonscience majors. Instead of making an effort to show the uniqueness of the scientific way of knowing, the author describes how efforts were made to emphasize the similarities between science and nonscience disciplines.

Two-year colleges should offer a variety of science courses aimed primarily at the nonscientists who form the majority of student populations. *Designing Science Literacy Courses* recommends two key methodological ingredients and two key content-oriented ingredients for a successful liberal-arts science course.

Two-year colleges are committed to meeting community needs. The article *Teaching to Learn: Why Should Teachers Have All the Fun?* describes a natural science class that performed a science-learning activity that went well beyond the usual campus boundaries. The authors describe an advanced teaching technique that involves collaborating with a middle school teacher and a community organization.

Teaching adults is different from working with younger people. Two-year colleges have a higher proportion of these so-called nontraditional students than do four-year colleges and universities. Often the curriculum and teaching approach need to be different for these students. *A Practical Application of Andragogical Theory Assumptions in Introductory Biology Courses* describes how teaching strategies must be altered for the adult learner. The author introduces the term *andragogy* and compares it to *pedagogy*. It is a useful piece for those working with nontraditional students.

Sometimes new curricular approaches in science for nonscience majors raise questions among colleagues and students alike. *A Path Toward Integrated Sciences—The First Steps* examines the design and implementation of an integrated science course for nonscience majors, organized by an interdisciplinary team of instructors, at one community college. The article presents a review of the objectives, problems, criticism, and the growing pains that occur when attempting to create a non-traditional new course.

Teaching strategies for the two-year college

In addition to curricular issues, science faculty at two-year colleges are concerned with effective teaching strategies. In *Are We Cultivating 'Couch Potatoes' in Our College Science Lectures?* the author recounts an invitation to sit in on a colleague's large biology class at another institution. He describes what he observed and how he was unable to admit to his colleague that the students didn't pay much attention during the lecture and probably didn't learn a great deal. The article reflects on the lecture method and the reluctance of science professors to give up that method and to try other approaches in their classes.

Problems often arise as two-year college teachers move from traditional methods toward innovative ones. *Chaos and Opportunity: Minimizing Obstacles Along the Track to the Constructivist Approach* describes real classroom experiences on the part of the author as he tried to minimize the problems of making the transition from teacher-centered to student-centered instruction. The article identi-

fies several categories of obstacles to innovation and focuses on one of them. Students are one of the obstacles and this article talks about ways to help students adapt to nontraditional teaching methods.

Some two-year college professors have instituted new approaches in their courses, giving up the traditional "lecture method." *Getting There from Here* describes how to make the transition from traditional teaching practices to those that are student-centered. The authors discuss two forms of barriers to this transition and present arguments against these barriers. The article concludes with suggestions on how to use the many resources available to faculty members who want to move their classes away from the standard lecture format to a more active learning environment.

Concerned that science students often fail to understand how science is conducted, and how to interpret communications in science, one professor tried a different method to help students move toward comprehension. In *An Experimental Project Approach to Biology*, this professor describes how he replaced the ecology and environmental science exercises in his biology class with a class experiment that required five weeks to conduct and evaluate. His findings indicate that the project approach helps to develop the interdisciplinary skills used in science.

Other two-year science instructors express concern about students experiencing the "doing" of science, and not just the learning of facts, and want to incorporate project approaches into biology courses. One such project is described in *The Antimicrobial Properties of Red Algae,* which describes a research project in which a professor and student collaborated in the screening of macroscopic algae for antimicrobial properties, and the advantages of such collaboration.

One author conducted a research study to answer questions about incorporating long-term inquiry project experience into a freshman biology course. The article, *Inquiry in the Community College Biology Lab*, examines the inquiry project involving research about crickets. The author explored questions about students' reaction to the project and students' ability to design and carry out a collaborative inquiry project. Other questions central to the research project dealt with students' understanding of the scientific process, the nature of science, and the learning of biology concepts. Students reacted favorably regarding this inquiry experience, and the author presents examples of students' written comments as well as a summary and discussion.

Two-year science faculty often express the belief that it is their responsibility to motivate students—future voters (and funding grantors!)—to think about the importance of scientific enterprises to society. In *A Two-Sided Mirror of Science Education,* the author describes students using critical reflection, the process of thinking about one's opinions and biases, to assume the role of the director of the National Science Foundation and rank five hypothetical government-funded science projects according to funding priority. The author provides positive conclusions about this approach to teaching.

Case studies are another effective way of getting students to be actively involved in the learning of science. *LifeLines OnLine—Curriculum and Teaching Strategies for Adult Learners* gives a step-by-step protocol for using case studies in the classroom. *LifeLines OnLine* was the name of the National Science Foundation–funded workshops at Southeastern Missouri State University. The workshops taught the case study method to two-year college teachers over a three-year period. The Web resources for this technique are still available online at *www.bioquest.org/lifelines.*

Other two-year instructors use case studies in their teaching. *Trouble in Paradise—A Case of Speciation* describes a recovery program for a rodent population on the island of St. Kitts in the Caribbean. Students in introductory biology had to read the case study and formulate their own stories incorporating some of the details and data provided, while also drawing on several evolutionary concepts studied in class. Readers can view examples of student papers done for this case

study by accessing the website for the National Center for Case Study Teaching in Science, included in the article.

Using information and communication technologies

Many two-year college instructors incorporate the use of modern information technology into their courses to make the classes more interactive. Others use the technology to offer opportunities for students through distance learning classes. One such example of integrating modern technology into the classroom is presented in *A Computerized Approach to Mastery Learning*. In this article, the author describes a mastery learning approach using computerized quizzes for students.

Distance learning has become quite common in many post-secondary institutions. Instructors often wonder about how successful the learning process can be for students taking courses through distance learning offerings. *Screening Prospective Laboratory Telecourse Students* examines indicators for student success in distance learning (DL) courses. The authors tell how screening students for certain qualities helps improve success in the DL environment. The push for DL courses needs to be tempered by appropriate advisement. This article is about exploring what that advisement ought to be.

Once professor describes the experience of developing and evaluating a distance learning course in *Teaching Introductory Agriculture Courses Through Distance Education Technology at Louisiana State University*. The author explores the mechanics, advantages, and disadvantages of presenting a distance education class to students at a two-year college. The students had no previous formal education in this discipline.

In addition to developing online courses, faculty have to evaluate student performance in the class itself. *Introductory Biology Online—Assessing Outcomes of Two Student Populations* describes one method of online assessment. The author describes how outcomes assessments were conducted with a pretest/posttest design in an online non-majors' biology course that included laboratory and lecture components. Data were compared with those of students at the same two-year college enrolled in the same course with the same instructor on-campus.

Conclusion

The two-year college science instructors whose articles are presented in this collection explore the different facets of the two-year college setting and what makes it unique. The authors express concerns about this uniqueness, issues in curriculum development, different teaching strategies, and the impact of the increasing use of modern information technology. The insights expressed in these articles were the result of personal experiences and research studies.

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Hello! Is Anybody Out There?

M. W. CAPRIO

Editing this column ["The Two-Year College"] for the *Journal of College Science Teaching (JCST)* has given me a national perspective on community colleges that would not have been available to me in any other way. The business of gathering manuscripts and helping the authors prune and shape them to fit the space and objectives of *JCST* has given me a window on the world of two-year schools few other community college teachers enjoy. I have managed to learn a great deal about the rich diversity of these schools and also discovered some of their common characteristics. This column is about one of those commonalities: *isolation*.

The reasons for isolation may be geographical, financial, social, or political—and more likely be a combination of these—but its causes are not the real subject here. The fact is that, in general, two-year schools tend to be somewhat isolated from one another and that may not always be in their best interest. To a point, some isolation may be inevitable because the needs of the service areas of these institutions are frequently highly specialized and are a primary focus (some would say a black hole) for their human and material resources.

There are gains for being so sharply focused. Concentrating the available energy where it is most needed appears, at least in the short run, to be most effective. However, although educators and educational institutions are of the present, they really exist for the future. The impact we have as teachers of young adults is not fully realized in one, two, or even 10 years, and despite the recent cries for accountability—mostly from people who know little about learning, less about teaching, and who usually need results to point to before the next election—teachers do not think in terms of quarterly profits.

When I look at my own academic growth since college I want to reach back to those high school and undergraduate instructors who did so much to shape me into the teacher—and, to a large extent—the person I have become. I would very much like to thank them, but most of them are long dead. Some of the seeds they planted are still sprouting now, while I am contemplating my retirement. So, where do we draw the bottom line to count the profits and losses? Shortsightedness has no place in this business.

The nature of our work requires we take a longer and broader view of what we do, and it seems that the degree to which our myopia increases, the more we manage to isolate ourselves

from one another. This is so, I think, partly because each institution has produced a significant body of educational knowledge that could help to plot the future trajectories of other schools. Each undertakes innovative enterprises from time to time and keeps records—if only anecdotally—of outcomes; there are enrollment figures reflecting which promotional strategies worked and which did not; and efforts made to improve retention are documented, for institutional records or to satisfy the requirements of one granting agency or another.

Every school has an enormous data bank that is the outcome of what we call *institutional research* and which we truly believe is of value only to ourselves. We work in isolation on problems that yield information that may well serve the common good, but we do not often share what we learn—community colleges are woefully under-represented in professional education journals and as presenters at conferences. And schools that do not step back for the grander view to see what is out there upon which they can build are doomed to remain mired in the minutia of solving problems for which solutions already exist.

This is not a trivial matter. Educators and educational institutions are, in my view, more than merely *for* the future. They play a major role—perhaps *the* major role—in *creating* that future. This is an enormous responsibility that impacts millions of people, and we need to be as clever and creative as we can if we are to do it right. Teachers in two-year colleges—based on the numbers of students we see—shoulder about half this burden. But only half. If we remain locked in a senseless, busy-work present, our visions will grow stale in a future that will not wait for those who cannot learn from others.

Unlike corporate research, there is no profit motive here for sequestering data and conclusions from the community-at-large. Rather, educational institutions probably only rarely consider what they have learned about their own campuses to be of any more than local interest. And the other side of the same coin suggests we might also not be likely to seek solutions to problems of our own campuses in databases compiled by others. Celebrating diversity too enthusiastically may be a kind of hubris that leads to blindness about what we actually do have in common.

Chief among the losses isolation brings are the inevitable redundancies it spawns. For no matter how specialized local needs may be, it is difficult to imagine that there is no other educational institution somewhere that has not already wrestled with—and solved—precisely the same problem or some analog of it. Where resources are limited, isolation may represent hidden operational costs, which may be considerable and which are usually extravagant. Building atop the work of others promises an easier climb and would surely bring the climbers to even greater heights. But scientists have known that for centuries.

Considering the usual readership of this column, it is probably safe to say that, while all of us are clever and creative, none of us is as clever and as creative as we can be when we work together. And reinvention is clearly not one of the more clever things we do. If the cost of rediscovery and reduplicating work is a price we pay for our isolation, it follows that reducing this overhead will lead to greater efficiency in the form of more rapid growth, conserved resources, and recaptured time, all of which can yield dividends when invested elsewhere. R&D may be alive and well at two-year colleges, but if we can improve our connectivity to one another, the future we are creating for our institutions, our students, and beyond will carry a much lower price tag.

Now what?

How can community colleges better link with one another for their mutual benefit? Most—maybe all—answers to this question carry some costs. Of course, a big part of what makes any program affordable has to do with the value we perceive it to have for us and the priority we choose to assign to it. There are many other possibilities, but consider: hosting regional and state

two-year college science conferences; promoting cross-pollination by underwriting programs to exchange faculty between different two-year schools or between two-year schools and universities; obtaining memberships in national professional societies and providing realistic support (*realistic* is a key concept here) for faculty to attend their conventions; and temporarily freeing interested individuals from part of the very heavy teaching load most two-year college teachers have so they can do institutional, educational, and discipline-based research *and* write about it for the professional journals *and* present their work at professional meetings. The expenditures these entail are really investments that reduce redundancies and promote institutional growth.

And then there's the Internet

Attending conferences may not always be possible, but accessing the Internet is becoming increasingly facile because two-year schools across the country are installing the requisite technology and getting on line. The Net is an immense resource, but it immediately poses several questions. The first, and the only one I have space to at least partially address here is: How can community colleges and, more specifically, community college science teachers find one another out there, in cyberspace?

The two most popular things to look for are webpages and listservs. Individuals have their own pages on the World Wide Web (WWW) and so do many community colleges. It is probably easier and more productive to search for institutional webpages first. You can obtain a list of community colleges with a Web presence and the address of each website from a WWW page maintained by the Maricopa Community College District. The URL is:

www.mcli.dist.maricopa.edu/cc/search.html

At this writing it listed over 1,200 two-year colleges in the United States, Canada, and Europe and allowed the visitor to search by geographic region and, for schools in the United States, by state. Each of the schools listed at this site has a webpage, and clicking on the name of the college transports you to its WWW address.

The University of Texas at Austin maintains a similar list. You can jump to it from a link on the Maricopa page or can go directly to:

www.utexas.edu/world/comcol/alpha/

I found 804 U.S. community colleges listed there, and it allowed searching alphabetically or by state. Unlike the Maricopa list, not all the schools listed here are active on the Web, but the ones that have webpages are color coded and you can click on their names and easily jump to their homepages.

When a cyberspace traveler arrives at a homepage there are options to move to related pages. Many schools will have links to their academic departments' pages, campus telephone directories, their college bulletins, and various special projects that are under way, to mention just a few of the more common options.

Once you reach a college's homepage, finding your counterpart at the other school is a simple matter. A short note will quickly let you know if you have someone who can supply the sort of information you need, or if they will be able to direct you to someone on their campus who can. Correspondence begun this way can produce only the desired information exchange. However, it can also result in collaborative projects that may lead to joint presentations at conferences, the formation of articulation agreements between institutions, and sharing of resources. The first step is to talk to one another.
Another way of connecting with others who have common interests is to search for mailing lists, also called listservs. Members of mailing lists e-mail their messages to a server, a specialized computer, which sends the message out to all the other members, who then can respond to the original message. The result is an ongoing dialog on specific topics with other people having common interests.

A way to locate mailing lists is to point your Web browser at the following URL:

www.tile.net/lists

This website is a searchable list of mailing lists. You can do keyword searches to find topics of interest. For most entries, the search returns the name of the list; its country of origin; where it is located; an e-mail address for the computer administrator, to whom you will send your commands to subscribe or to unsubscribe, for example; an e-mail address for the human administrator, who will answer your questions; and directions of how to subscribe. Here are a few examples of the output of this website.

MODELING
Physics Modeling Workshop
Country: USA
Site: University of Illinois at Chicago, Chicago, IL, USA
Computerized Administrator: listserv@listserv.uic.edu
Human administrator: modeling-request@listserv.uic.edu
You can join this group by sending the message "sub MODELING your name" to listserv@listserv.uic.edu

L-ACLRNG
Active and Collaborative Learning
Country: USA
Site: Pennsylvania State University
Computerized Administrator: listserv@psuvm.psu.edu
Human administrator: l-aclrng-request@psuvm.psu.edu
You can join this group by sending the message "sub L-ACLRNG your name" to listserv@psuvm.psu.edu

NCPRSE-L
Reform Discussion List for Science Education
Country: USA
Site: East Carolina University, Computing and Info Systems, Greenville, North Carolina
Computerized Administrator: listserv@ecuvm.cis.ecu.edu
Human administrator: ncprse-l-request@ecuvm.cis.ecu.edu
You can join this group by sending the message "sub NCPRSE-L your name" to listserv@ecuvm.ecu.cis.edu

COMMCOLL
No title defined [discussion of community college issues]
Country: USA
Site: None given [University of Kentucky Community College System]
Computerized Administrator: listserv@lsv.uky.edu
Human administrator: commcoll-request@lsv.uky.edu
You can join this group by sending the message "sub COMMCOLL your name" to listserv@lsv.uky.edu

Once you get the information about the lists of interest, you might want to write to the human administrators to verify the kinds of posts that are appropriate for them before you subscribe. The listserv (computer administrator) will verify your subscription and send you instructions for communicating with the list as well as the commands you will need to "speak" with it to control mail flow. Be sure to download those instructions and save them for future reference.

Mailing lists can take us well beyond our campus boundaries to interact with colleagues across the country and even around the world without ever getting on an airplane. And, they are fun.

The First Day of Class on a Two-Year Campus

What Students Really Want Us to Know about Their Science Classroom Experiences

M.M. COWAN AND K.W. PIEPGRASS

During the course of a three-year study of science attitudes among nonscience majors at two, two-year regional campuses of Miami University (Ohio), we found our ideas about student anxiety did not always coincide with the reality painted for us by the students.

While some of the anxiety-provoking factors identified by the students in the study were expected and have already been documented in literature (e.g., lack of preparedness, unfamiliar vocabulary), one issue that was repeatedly "penciled-in" by the students, since we did not address it on our surveys or in our interviews, was the first day of class. Students reported that this earliest experience plays a very important role in determining the level of anxiety in physics, microbiology, and chemistry courses. Once again, here is an example of the students teaching the teachers.

Our study distinguished between two types of nonmajors: the science-related nonmajor (SR), who is often enrolled in allied health degree programs such as nursing or physical therapy, and the general studies student (GS), who majors in an unrelated field and takes science courses to fulfill the university's liberal education requirements.

The academic profile of the student body at these Miami University branch campuses reflects the trend in higher education toward "nontraditional" students: Many have returned to school after an absence of some years (59 percent were 22 years of age or more), many reported having poor (or no) science preparation, a significant number were considered "at-risk" students, and many had multiple job/family/home responsibilities in addition to their school demands.

> *I know not anything more pleasant, or more instructive, than to compare experience with expectation, or to register from time to time the difference between idea and reality.*
>
> —*SAMUEL JOHNSON, 1758*

Anxiety and the two-year student

In our study, 12 percent of 436 respondents reported high to very high anxiety about their science courses at the beginning of the semester (Cowan and Piepgrass, 1997). To determine the causes of this angst, we convened focus groups consisting of volunteers from six introductory courses (three GS and three SR courses) in three departments early in the semester. Students were solicited with the promise of pizza and the chance to comment on their science courses.

The students themselves determined the format of the early focus group meetings. The leader simply stated that members of the science faculty wanted to hear from students about the environment in science courses at this campus and whether they felt any anxiety. Later sessions sometimes included a handout with three questions typed on a sheet of paper that was used to spark discussion (e.g., Do you feel anxiety? What causes the anxiety? How could the course/instructor reduce anxiety?). Someone other than the course instructor conducted the focus groups, with the promise of anonymity, and we informed participants that the session was not meant to be a "gripe session" about particular instructors.

Invariably, each group contained a minority of students who reported no anxiety. However, the students who did report anxiety were eager to name its causes. During these sessions and on open-ended questionnaires administered in class, clear differences emerged on the reported origins of anxiety among science-related nonmajors and general studies nonmajors, although both types of students volunteered that first-day issues (which were not mentioned by the group leader or on the questionnaires) were uppermost on their list as a cause or a source of relief from science anxiety. This unexpected outcome was made more compelling because it was brought up in every session by one or more students, and once it was mentioned, most individuals expressed strong feelings about it.

Science teachers at two-year colleges know that anxiety in the classroom can be palpable in the initial days of a semester. There are good reasons for student uneasiness to appear early, although it may have less to do with a student's degree of self-confidence than a lack of framework of prior knowledge (Anderson and Clawson, 1992). Anxiety is also aggravated by students' perceived loss of personal control. Perceived personal control is linked to factors such as depression, crowding, marital relations, academic achievement, health, aging, and stress (Perry, 1991). On two-year campuses such as those of Miami University, students are likely to have both a weaker framework of prior knowledge and problems in one or more of the areas linked to perceived personal control. Indeed, two-year campuses often experience high levels of science attrition as well as student fear and dissatisfaction associated with science courses.

Researchers have also well documented the effects of anxiety on student performance (reviewed in Hembree, 1988). We discovered in our study that anxiety was negatively correlated with first exam scores among GS students (Cowan and Piepgrass, 1997).

Low levels of perceived personal control may be stable or transient, and thus can be influenced by the teacher and other environmental factors (Perry, 1991). Studies have shown that the classroom context and manner in which courses are packaged by faculty could evoke more positive attitudes in students (Everson, 1994; Okebukola, 1986). The surveyed students agreed that the first day of class was an important part of that packaging.

Our study found that the anxiety reported by the two types of nonmajors had different sources (Table 1). Data in Table 1 represent answers to the open-ended, first-day survey question, "What, if anything, makes you feel anxious about this class?" Not unexpectedly, GS students found the subject itself anxiety provoking. Science-related majors, however, stated that anxiety was triggered less often by the subject than

Table 1.
Source of Anxiety for Nonmajors (adapted from Cowan and Piepgrass, in review)

	General Studies n=194	Related Majors n=242
Subject Specific	50%	42%
top 3 responses	last science not recent "I'm bad in science" hard topic	hard topic last science not recent "I'm bad in science"
Other	14%	35%
top 3 responses	need a good grade test anxiety unprepared	hearsay need good grade returning student

Table 2.
First Day of Class Strategies

- Keep students the whole period, but don't give any "testable" material.
- Give them an informal introduction to your discipline (slide show, newspaper articles).
- Teach specific science-reading skills.
- Hand out a non-intimidating yet complete syllabus.
- Be clear about course expectations and procedures while providing flexibility for SR students.
- Remind students how much they already know by giving pre-tests geared towards everyday scientific knowledge and asking for personal essays about infections, kitchen chemistry, etc.
- Put your course in a context that's meaningful to students; Bring in a tape from TV, such as *20/20* or *The X Files* that uses concepts from your discipline.
- Tell your own story of some struggle you had with science sometime in your academic career.
- Tell a story of your success! (Students like to hear about instructors' experiences.)

for the general studies students. SR students reported more of what could be called general anxiety (e.g., "I'm a returning student," "I've heard this is hard"). The latter comment, which we call hearsay, is one science instructors hear constantly (Schwartz, et al., 1985). We believe it is a major nonspecific contributor to anxiety—and one that can be addressed on the first day.

How the first day can help—and hurt

The aspect of the first day of class mentioned most often and in equal numbers by both GS and SR students as causing anxiety surprisingly involved not starting lecture from the first meeting. Here's a hot button! Ask a dozen instructors and you will get a dozen different opinions, usually strong ones, about lecturing immediately. Many feel that the "tyranny of content" demands that lecture begin in that first hour. Others feel that it sets the tone for the course, initiating a culture of rigor. Of course it does set the tone, but if the tone is interpreted as hostile, foreign, or intimidating it may have major implications for student success. In one case, a professor who distributed a lengthy syllabus on the first day of

class found that information overload and disenfranchisement of the students occurred (Smith and Razzouk, 1993). Diving in on the first day could result in similar student responses, though there is little data about first-day behavior in literature. Interested readers should refer to a study by Wieneke (1981), a commentary by Dorn (1987), and proceedings from a symposium on the topic (Schwartz et al., 1985) for more information.

The GS students offered the following first-day suggestions for easing student fears: make the syllabus specific and full of dates and details about the course management, and do something exciting! We should infer from this last suggestion that students will need their imaginations sparked before they can be motivated to succeed in an unfamiliar field. In fact, a meta-analysis of attitude and achievement among elementary and college-age students found that interest was at least as closely correlated with achievement as attitude (i.e., anxiety) (Willson, 1983). The request for detail on the syllabus may suggest that students feel little desire for autonomy with a subject that is foreign to them. Two of the three focus groups also did not want instructors to act in a condescending manner toward them. Although "being babied" did not contribute to their anxiety, they stated that it did decrease their investment in the course.

In contrast, science-related majors were more interested in having a voice in the management and content of the course, suggesting that some room for negotiation be left on the syllabus. These students also asked for explicit training in how to learn science, how to read the text, etc. Finally, they identified instructor organization as important, saying they "felt nervous about the amount of material" required in a class. However, seeing that the instructor had planned ahead and ordered the information into manageable chunks put them at ease.

In summary, our focus group participants pleaded for a different approach to the first day of class. Those who had a science-related major were most anxious about general issues and suggested that instructors spend the first day soliciting student input about course content and management and specifically in explaining how to learn the subject matter. General studies students had more subject-specific anxieties and sought additional structure as well as some convincing that the material would be worth their time. Both groups asked for time to acclimate themselves to the course. Table 2 summarizes possible first-day strategies suggested by the students themselves and by researchers who have identified methods that address the specific sources cited by our study population. If it is, indeed, necessary to recognize emotional as well as cognitive obstacles to learning (Mallow and Greenburg, 1983), understanding these self-reported student barriers from the first day of class should help us to assist students to uncover their own capacity to learn.

References

Anderson, G.A., and K. Clawson. 1992. Science Anxiety in Our Colleges: Origins, Implications and Cures. *The Education Resources Information Center, ED* 354 813:1-28.

Cowan, M.M., and K.W. Piepgrass. 1997. Attitudes about science among non-majors at a two-year campus of a liberal arts university. ERIC document 411 034

Dorn, D.S. 1987. The first day of class: Problems and strategies. *Teaching Sociology* 15:61-72.

Everson, H.T., S. Tobias, H. Hartman, and A. Gourgey. 1994. Test Anxiety and the Curriculum: The Subject Matters. The Education Resources Information Center, ED 366 598:1-19.

Hembree, R. 1988. Correlates, causes, effects, and treatment of test anxiety. *Review of Educational Research* 58:47-77.

Mallow, J.V., and S.L. Greenburg. 1983. Science anxiety and science learning. *The Physics Teacher* 21:95-99.

Okebukola, P.A. 1986. Reducing anxiety in science classes: An experiment involving some models of class interaction. *Educational Research* 28:146-149.

Perry, R.P. 1991. Perceived control in college students: Implications for instruction in higher education. In *Higher Education: Handbook of Theory and Research,* pp. 1-56. New York: Agathon Press.

Schwartz, A.T., C. Schrader, K. Dombrink, B.G. Smith, H.A. Bent, and D.W. Brooks. 1985. The first day of class—A DIVCHED symposium. *Journal of Chemical Education* 62:601-605.

Smith, M.F., and N.Y. Razzouk. 1993. Improving classroom communication: The case of the course syllabus. *Journal of Education for Business* 68:215-221.

Wieneke, C. 1981. The first lecture: Implications for students who are new to the university. *Studies in Higher Education* 6:85-89.

Willson, V.L. 1983. A meta-analysis of the relationship between science achievement and science attitude: Kindergarten through college. *Journal of Research in Science Teaching* 20:839-850.