Workshop Biology

Curriculum Development Handbook
Project Staff

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**Resources and Additional Information**

**Labs and software**  
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**Additional info**  
is on our WWW site:  
http://Biology.uoregon.edu/Biology_WWW/Workshop_Biol/

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Using This Handbook

The goal of this handbook is to provide resources, ideas, insights, and models to help you make decisions about your teaching. The resources, ideas, insights, and models in this book pertain primarily to teaching introductory biology to college students who are not biology majors, who will probably never have another biology course. Much of what is presented here, however, is potentially useful in other biology courses and other disciplines.

We have organized documents into five sections—Philosophy and Goals, Course Design, Concept and Investigative Labs, Issues Activities, and Assessment and Teaching Improvement—which are further organized into folders on this disk. The contents and locations of each of these sections are as follows:

Philosophy and Goals (in this section; WB_Intro.pdf): The really distinctive aspect of the Workshop Biology approach is not any particular set of lab activities or method of conducting the course. What underlies its success, its flexibility as well as its coherence, is a philosophy of teaching and learning that then guides us to use certain teaching strategies. The course’s goals, also, are really what makes the course different from other science education programs, as is the fact that our goals for our students are not very different from our goals for ourselves as instructors: being able to make sound decisions. While you can jump ahead and use ideas from the lab activities and assessment methods, they really won’t make much sense without the underlying goals and philosophy.

Course Design (WB_CourseDesign.pdf): This section includes some notes about how we put the course together and how we structure it, and some examples of syllabi from each of the most recent terms. This section is not really well developed yet—your suggestions may help.

Concept and Investigative Activities (WB_Concepts.pdf): This section gives an overview of two of the major components of the Workshop Biology course, concept labs and investigative labs, and the beginnings of a “lab manual” with instructors’ notes and student handouts. Not all of our labs have been written up in this way yet—we do include descriptions of our other labs, so if you’d like more information about these, let us know and we can put those at the top of the priority list.

Issues Activities (WB_Issues.pdf): This section is a guide to developing the third major component of the Workshop Biology course, the Issues Activities. These activities ask students to apply what they’ve learned in concept and investigative labs to current social issues, to analyze and understand issues and make a personal decision about an issue. This has been one of the most successful parts of the Workshop Biology course.

Assessment and Teaching Improvement (WB_Assessment.pdf): A major aspect of the Workshop Biology program has been assessment—finding out what works, and then using that information to make decisions about what to do next. The processes by which we interpret, share, and use this information in decision-making are just as important as the processes by which we gather the information in the first place, so this section integrates suggestions and resources for assessing instruction as well as creating an ongoing, collaborative process for improving teaching within your organization.
This is a work in progress: by us, by you, and by lots of other people. That’s why it’s available both electronically and in a three-ring binder. We’ll be able to send you updates as we improve these materials and add to them, and you can add your own stuff or remove parts that you don’t need. We hope that you’ll send us copies of things you add, so we can share them with others, or if you think changes ought to be made, you’ll let us know.

Before jumping in to all of this, however, we would like to provide a short introduction to what Workshop Biology at the University of Oregon is all about, and then a short summary of our current project, aimed at encouraging collaboration among college faculty at other institutions on science education reform efforts through the use of Workshop Biology strategies. If you are currently contemplating a course/curriculum development project, our project may have something to offer you. These summaries are given in the next document, “Project Summaries.”
Workshop Biology Project Summary

Workshop Biology is a program aimed at improving science literacy among nonscience majors in the context of a major research university. The program has three primary components: development of the Workshop Biology course itself, a three-term lab-based introductory sequence for nonscience majors; evaluation of this new course’s effectiveness as compared with a traditional lecture-based introductory biology course; and the creation of a teaching culture among interested science faculty at the University of Oregon in support of continued teaching improvement. Development of the Workshop Biology curriculum has also included development of a set of inquiry-oriented computer simulations.

The Workshop Biology course: The goal of the course is to help students actively address important scientific issues and learn to make informed, critical decisions that are consistent with their values. The course is a three-term sequence that focuses on open-ended, interactive laboratory activities and de-emphasizes lectures and demonstrations. Students spend most of their class time in a lab environment with groups of 30 or less, and less time in the large lecture setting. The workshops provide concept-oriented, investigative, and issue-oriented activities to give students hands-on experience with important biological concepts, the process of scientific inquiry, critical thinking and decision-making, and the relationship of scientific knowledge to social issues. We have replaced standard lectures with “assemblies,” which use a variety of presentation techniques and small-group activities to help students make connections and explore other applications of concepts presented in the workshops.

Evaluation and assessment: We have continued to offer the traditional lecture-based version of the course as a comparison group. In making comparisons, we use: pre- and posttesting on concepts, scientific reasoning skills, and values and attitudes toward science and science classes; frequent student evaluation of course activities and goals; analysis of student work; classroom participant-observation; and tracking of enrollment and demographics. Overall, workshop students tend to display more improvement in conceptual learning and scientific reasoning ability, a greater appreciation of science and its role in their lives, and greater motivation and involvement in learning activities than students in the traditional course.

Teaching improvement: Our goals for ourselves as teachers mirror our goals for our students. We must improve our instructional decision-making by reflecting on our values and critically evaluating the data we gather about students’ learning. The faculty and staff involved in Workshop Biology meet regularly and communicate electronically to share specific ideas and resources for teaching the course and reflect on the course’s philosophy and goals. Faculty not currently teaching sit in on classes and provide concrete feedback to the instructor. We have also instituted a science education “journal club” which is attended by other faculty and graduate students from biology and other departments. The Workshop Biology staff has organized university-wide workshops on teaching effectiveness and assessment, and has presented the results of the Workshop Biology project at regional and national meetings.

Software: We have developed several software modules which support the Workshop Biology philosophy. These are interactive simulations which confront students’ misconceptions about basic concepts and then allow them to design their own investigations of phenomena related to important social issues. This software is available on the BioQUEST CD.
Dissemination Project Summary

Though the number of innovative models for science education, like Workshop Biology, is growing, college teachers' frequent isolation and lack of confidence that new ideas will work often discourages them from trying new models. Further, the limited support and resources available makes changes difficult to maintain. The Workshop Biology project has helped us overcome these barriers to change, allowing us to build a set of resources and decision-making methods that others can use, and a community of "scientist-teachers" in which others can participate.

The primary goal of this dissemination project is to improve student learning in general education science courses in other institutions, by helping instructors formulate and clarify their educational goals, implement learning experiences designed to achieve these goals, and assess their progress toward these goals. The Workshop Biology project provides models for goals, teaching strategies, and assessment methods, as well as processes for developing new ones. Our dissemination goals mirror the goals of the workshop course. Faculty, like students, need to be able to make informed, reasoned choices that are consistent with their values. Just as students do not develop these abilities through "cookbook" labs, we cannot rely on "cookbook" lab manuals. We, like our students, need practice in information-gathering, hypothesis-testing, and model-building, and in applying these abilities with confidence in new teaching situations.

In the first year of the project, instructors at five institutions, including a private liberal arts college, a private comprehensive university, a state university with a large teacher education program, and two community colleges, began implementing new laboratory activities and assessment techniques in their introductory biology courses. This year, these participants and our project staff will work with new participants, organize a summer workshop, and continue developing a set of curriculum development materials. Assessment has proven to be a major need; we now have a set of assessment tools and techniques that other college teachers can use, and the resources to help them plan a coherent assessment program that will meet their needs. The main areas in which we can provide assistance are:

- Collaborating on developing and/or adapting course materials and teaching strategies
- Developing an assessment plan, developing/adapting assessment methods, and analyzing data (yes, if there are tests or surveys you want to administer, we can do a lot of the initial data entry and analysis)
- Customizing some of the software simulation modules we have developed to better fit your needs (most of this software is currently available on the BioQUEST CD-ROM, but we can get you beta-test copies free of charge)
- Providing feedback on other projects you may be working on, such as a grant proposal
- Helping with dissemination, including setting up a WWW site, disseminating ideas via our newsletter, Biology Education Review, or working together on conference presentations.

It’s important to realize that we see this project as encouraging two-way collaboration; our aim is not to preach about the best way to teach (although sometimes we do let this slip!), but to help you share your good ideas and tap into the many resources and potential collaborators that are out there.
Teaching Philosophy and Goals

Principles for Improving Instruction

Our purpose here is not to present the “correct” way to plan and teach classes, so a list of “rules” would certainly not be appropriate. Most effective people, however, have a set of principles that guides their behavior. The ideas in this handbook is based on several key principles:

• **Just as "cookbook" labs don't work for students, "cookbook" curricula don't work for instructors.** Much of what we do in our biology course is aimed at helping students think more critically, to base important opinions and decisions on thoughtful, rational analyses rather than on habit, hearsay, prejudice, or authority. Instructors, too, need to have good reasons for their important instructional decisions. A major goal of this book is to provide you with resources and insights to help you make these decisions.

• **The learning models we apply to students apply equally well to instructors.** Models such as active learning, learning cycles, Perry’s model of intellectual development, Bloom’s taxonomy of educational objective, and the decision-making model we will present later apply to instructors improving their teaching as well as to students learning. For example, we believe that **anyone** faced with learning a new concept or skill will benefit from working with it in hands-on activities, practicing it, getting feedback, and applying it in different situations. This is true of a student learning about protein synthesis and an instructor learning about classroom assessment.

• **Teaching is both a creative art and a rational science.** We advocate rationality in teaching because this is how we know if what we’re doing is working. To do this, we need both data and theory. We collect our own data every day, when we talk with students in class, collect their work, and administer tests, but we often don’t think of it as such. In the light of theory, we can consider the questions we’re asking about our students’ understanding, develop methods to gather information we can use to address these questions, and make sense of what we find.

With all of the evidence that our current educational methods are not working, “change” has become more of an assumption or expectation than a solution in most educational institutions. While we believe that everyone can improve, and that you probably bought this book with intentions of changing the way you teach, we have a few caveats to add about change:

• **Don't assume you have to change the way you teach—just be sure you know why you do what you do.** We say this because so many teachers we have met seem to assume that change, any change, is always necessary. Change for change’s sake alone is likely to waste your time and your students’. As we have said before, if you have examined your current methods, determined that a change is in order, and have ways to determine if your change is effective, you are much more likely to be successful. Remember, though, that it’s easy to swing too far in the opposite direction and become paralyzed with indecisiveness. Part of what we want to teach students is that most real-life decisions must be made with inadequate or conflicting information. The same is true of our teaching decisions.
On the other hand...

• Try first, think later. Sometimes in order to get enough information to make a decision, we just have to jump in and try something.

• Don’t try to make too many new changes at once. This principle has both a scientific and a practical basis. First, introducing too many new variables at once makes it difficult to separate their effects. While a strictly controlled experiment is not the goal (and is impossible, anyway), it’s easier to understand a system with a few modified variables than many. Secondly, making gradual, incremental changes is easier and less frightening than a sudden and complete overhaul of a course. You’ll be more likely to keep doing those things that work, and less likely to be overwhelmed and throw the whole thing out, successes as well as failures.

On the other hand...

• Small, incremental changes may fail when they come into conflict with other aspects of the learning environment. Sometimes our students’ expectations, the bureaucratic functioning of our institutions, or even the classroom atmosphere we ourselves have created, create barriers to our efforts to change. Sometimes we can’t do anything about these barriers, but just recognizing them can help. Sometimes we can do something to eliminate or alleviate them; sometimes just being patient, and starting over with the next class, is necessary. While recognizing that there may actually be something wrong with what you’re trying to do, don’t immediately assume that it’s a failure because it failed once. Give it another shot, and consider the possible barriers and how to get around them.

College teaching can be a lonely task. When we give seminars or workshops on our teaching methods, the participants tell us that the most useful thing about them is not just the information, but the recognition that there are other people out there dealing with the same problems they are. You are not alone, which leads us to the next principle:

• You can't do it alone. Well, maybe you can, but it's much more productive, rewarding, and fun working with others. Again, this is true of students and instructors alike. We are much less likely to give up, revert to our old habits, or lose faith in our efforts to become what we want to be, when we have others to help us, and others who depend on us.

It would be great if we could have called this handbook, “Seven Effortless Ways to Make Your Biology Courses Perfect.” Unfortunately, one final principle is more of a recognition of reality than a high ideal: this is not going to be easy, for you or your students. You will have failures, and usually at the most difficult time: the beginning of your efforts. What other reason could there be for the failure of most reform efforts at all levels of our educational system, but that they are difficult and risky. Easier, safer methods are always available: easier because they don't require as much time or effort, and safer because they are less likely to reveal mistakes, problems, and failures. If we can be truly committed to teaching improvement, however, we can recognize that failures are only failures if we fail to learn from them. Look at it this way: you stand to learn more from approaching your teaching in this way than you ever have before!
Goals of Workshop Biology

The primary goal of the Workshop Biology course, as we believe should be true of all general education courses, is to improve students' decision-making abilities. We have found that improving students' decision-making abilities requires explicit attention to three factors: their epistemological perspectives and background knowledge, their critical thinking skills, and their values. We have developed a model of decision-making (see diagram below) that describes these elements and the relationships between them, in order to better formulate clear objectives and understand barriers they and their students may face in achieving them.

Traditional models of student learning, as demonstrated by traditional college teaching practice, have emphasized the acquisition of knowledge. Even when innovative teaching strategies are introduced, the primary goal is often to enhance knowledge acquisition. Attention paid to students' motivations, personal interests, learning styles, and other characteristics often serves specifically to engage students' interest in the material and remove hindrances to learning it. These practices are critical to effective education; however, the model presented here should make it clear that conceptual learning is but one part of a larger whole.

Outline of the Model

Science educators have spent a great deal of time debating the relative importance of content and process. The epistemology portion of the model, however, encompasses both, acknowledging that little conceptual or procedural learning can take place in isolation from the other. In addition, students' views of scientific knowledge as tentative or absolute, fractured or integrated, theory-based or fact-based (Lederman & O'Malley, 1990), have serious ramifications for how they approach the study of science. More broadly, the theories of intellectual development (Belenky, et al., 1986; Perry, 1970), describe the core beliefs students hold about knowledge and knowing which affect their approach to learning across disciplines.

Since we include process skills in the epistemology element of the model, the critical thinking element represents meta-level thinking, the means by which an individual evaluates his or her own thought processes. Critical reflection on one's values and ways of knowing, the other two elements of the model, are also important aspects of this kind of thinking.

How students value thinking and learning, different kinds of learning experiences, and the subject matter of different disciplines, affects everything they do in college and in their lives. They must be able to decide which problems are important enough to warrant their time and energy, and which of many alternative solutions are worth implementing. These are purely value judgments. Personal, social, and cultural values initiate and inform the decision-making process from beginning to end.
Important qualities of the model

- It represents a system of educational goals that are related in complex and mutually reinforcing ways. Particularly important is this system’s ability to subsume the traditional distinction between content and process, as stated previously.

- All of the elements and their relationships represent potential dependent variables in the educational process, as opposed to the more common view of students’ values and views of knowledge as independent variables, affecting students’ learning but not themselves subject to reflection or change.

- The model works equally well for students and instructors. Instructors, too, need to be able to make sound instructional decisions based on their knowledge and epistemological perspectives, critical thinking skills, and values. This is the underlying philosophy of our dissemination efforts.

- Focusing on decision-making as the superordinate goal ensures that students’ learning will be relevant to real-life concerns.

This model serves as the basis for all of the workshop course's goals, which can be summed up in the following statement:

We want students to be able to make informed, critical decisions that are consistent with their values.

In order to help our students achieve these goals, we felt that our course had to: address students’ misconceptions that could hinder further learning; allow students to experience scientific inquiry firsthand; and ask students to use what they learned to effectively make decisions that they may actually face now or in the future. The next section, on Course Design, gives an overview of the three primary components of a workshop course, concept activities, investigative activities, and issue activities, which are each designed to achieve one of these objectives, and how these are integrated into the overall course design.
References


