PEER-LED TEAM LEARNING: INTRODUCTORY BIOLOGY

INTRODUCTION

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Background

In January 2001 a group of 40 professors, learning specialists and student leaders gathered for a weekend at the University of Miami, Coral Gables, FL to discuss organizing a set of PLTL modules for Introductory Biology courses. Some participants were doing PLTL workshops at their home institutions, others wanted to learn how they might begin to do so. In a series of workshops over two and one half days the participants drew up a list of topics for the workshops, decided on the format for modules, and practiced writing module problems. The work of that weekend has guided the development of this collection.

The editors for this PLTL Biology Collection are Joseph G. Griswold, Ph.D., Professor (retired) The City College of the City University of New York, and Michael Gaines, Senior Associate Dean, University of Miami. Authors of the modules include faculty from about a dozen different institutions who are active in using PLTL.

The PLTL Workshop Project

The following material about Peer-Led Team Learning, adapted from the PLTL website, gives a brief overview of the PLTL workshop model and reviews the six critical components in the model.

In the Peer-Led Team Learning Workshop model, students who have done well in the course in a prior semester become guides and mentors, *Workshop Peer Leaders*, to small groups of six to ten students. These peer-led groups, which meet weekly to work on carefully structured problems, provide a supportive environment that helps each student build understanding of science and other disciplines. The following "critical components" are a set of benchmarks that have been arrived at through the evaluation of the Workshop Project (1995-2000). Successful programs meet all six of them.

<u>The Six Critical Components of the Peer-Led Team Learning Workshop Model</u>

1. The Workshop is integral to the course.
2. Course professors are involved in the selection of materials, training and supervision of peer leaders, and they review the progress of Workshops.
3. Peer leaders are selected, trained and supervised to be skilled in group work as facilitators.
4. Workshop materials are appropriately challenging, directly related to tests, designed for small group work.
5. The Workshops are held once a week for two hours, contain six to eight students per group, in space suitable for small-group activities.
6. PLTL is supported by the department and the institution with funds, course status and other support so that the method has the opportunity to be adopted across courses and disciplines.

<u>Table I - Critical Component Evaluation Matrix for PLTL</u>. This table summarizes the essentials for each critical component. It is useful only in connection with the explanatory materials. Group size, for example, refers to the accepted norm, based on considerable experience, that peer-led team learning work most effectively with groups of about six to eight students.

A summary of key features of each of the critical components for successful PLTL workshops (Table 1)

Critical Components			
1. Integrated with the Course	Students view workshop as important to learning	Leaders are aware of lecture approach	Lecturer refers to workshops
2. Professor's Involvement	Preview of problems with peer leaders	Preparation and review of materials	Available to students and student leaders
3. Leaders	Skilled with groups; facilitator rather than teacher	Training and supervision	Discipline knowledge and problem-solving skills
4. Materials	Fit with course; relate to tests	Engaging and appropriately challenging	Suitable for group activity
5. Organizational Arrangements	Time	Space	Group size Attendance
6. Evidence of Support and Growth	Disciplines and courses	Support	Support
			Developed by Leo Gafney, Project Evaluator, 2000

PLTL programs are active in more than 80 institutions in the disciplines of Chemistry, Biology, Physics, Mathematics, and Geology. They involve hundreds of peer leaders and thousands of students in weekly workshop meetings. Most of the activity is in the original discipline, Chemistry, but there is great promise for large-scale dissemination in the others.

Special Challenges in PLTL Biology

Biology is a relatively new discipline in the PLTL Project and has been able to benefit greatly from the experience and success of PLTL Chemistry. The current challenge in biology is to continue to develop a set of learning materials (modules) for the PLTL sessions. Introductory Biology is the focus of our efforts.

Module developers in Biology face some challenges that are somewhat different from those in chemistry. For example, most introductory chemistry courses are rather uniform in their coverage, following the ACS guidelines and using texts that are very similar to one another. Introductory Biology courses, on the other hand, are highly variable in level, content and organization. Unless departmental courses are offered, individual professors may have different patterns of coverage and emphasis—often related to their own experience and expertise. They use textbooks that are encyclopedic, picking and choosing the chapters they teach. A related challenge is the problem of breadth and depth. With the great potential breadth represented in all introductory books, the tendency is to teach the course with little depth. "A mile wide and inch deep" is a common description. Opportunities for in depth learning of critical topics are unusual.

Enduring Concepts. In response to these dual challenges of course variability and lack of in-depth learning, the faculty group at the Miami 2001 meetings decided that PLTL workshops should

not try to provide a broad review of content in the courses, but rather focus on a group of "***enduring concepts***" in biology. We reasoned that we should develop modules on concepts that are central to the discipline and will appear again and again in biology courses as the students go forward in their studies. In-depth studies of these concepts would complement the survey nature of most introductory courses and best prepare students for advanced work. Further we believed that the development of selected learning/problem solving skills was also vital to students' success, not only in the introductory course, but in all of the sciences (and life!). The development of modules, then, has been guided by these conclusions. The complete topic list provided in the second section below incorporates the set of enduring concepts.

Organization and rationale for modules. The Miami 2001 faculty also developed a plan for the organization of the modules. The elements to be included in the modules include the following.

a. Title

b. Author(s) and affiliations

c. Introduction. A brief introduction to the topic (1 or 2 paragraphs) is followed by a set of performance goals, *benchmarks*, that identify what the student must do to demonstrate mastery of the workshop material.

d. Pre-Workshop Activities. These are mainly low level learning items that emphasize vocabulary, simple relationships, diagrams, etc. They are done by individual students to prepare for the workshop.

e. Workshop Activities. These begin with a brief review of concepts in the pre-workshop and "ramp up" from concept understanding to integration and problem solving.

f. Post-Workshop Activities. These self-testing items emphasize difficult concepts, and higher level learning from workshop. They provide practice for the individual.

g. Diagrams, props, etc. that go with the three previous sections.

h. Rubrics. These italicized directions give suggestions for the professor and student leaders about how to implement the activities in the workshops.

i. References: Web links that provide further information for instructors and students are provided, some with annotations.

A few special features of the modules merit further comment. We decided, in collaboration with our colleagues in chemistry and learning specialists, to design activities that actively engage the students with the material and with one another. Our attempt is to "ask, don't tell" whenever possible and to write multi-part problems that generate cooperative efforts. Second, because Biology learning requires the mastery of a great deal of new terminology, we decided to start each module with small concepts (terms) and ramp up to relationships, integration and application. This pattern would allow instructors teaching biology at various levels to pick and choose how far their students are required to go. We strove to avoid a "one size fits all" collection of modules. Third, we recognize that in any population of students a variety of learning styles is represented. We strove to write activities that are engaging to this broad range of styles.

Finally, we have chosen a group of learning and problem solving skills for special emphasis in the collection. These are skills that, in our opinion, are vital to successful mastery of the biology content itself. They are also skills with much broader application. Among them are following written directions, comprehending and analyzing diagrams and figures, representing information in a variety of ways (diagramming, flow charting, concept mapping, etc.), solving quantitative and non-quantitative problems, doing simulations, modeling, and working through the very complex process of scientific investigation.

Complete Topic List. We propose that a total of 30 modules are needed for the PLTL Introductory Biology Collection. The modules presented in this Fall 2005 version are the completed modules as an outgrowth of the Miami 2001 meeting. While other modules were written, they have not been included because they were either too advanced or not yet in the common format. A complete list of proposed modules for both semesters is shown below.

First Semester Topics

1. Chemistry of Life
2. Biological Molecules

3. Cell Structure and Function
4. Cell Membranes & Transport
5. Energy Flow in Cells: Respiration
6. Photosynthesis
7. DNA, RNA, Protein
8. Mitosis & the Life Cycle of Cells
9. Meiosis and Gametogenesis
10. Mendelian Genetics 1
11. Mendelian Genetics 2
12. Scientific Discovery in Biology
13. Immune Systems
14. Homeostasis & Blood Sugar
15. Neurons: Membrane Potentials

Second Semester Topics

1. Nervous systems
2. Muscles, skeleton & movement
3. Animal Behavior
4. Circulatory systems
5. Animal Nutrition
6. Animal Reproduction
7. Animal Development
8. Plant structure and function
9. Plant reproduction & development
10. Micro-evolution
11. Macro-evolution
12. Biosystematics
13. Population ecology
14. Community & ecosystems ecology
15. Scientific Reports in Biology

Goals of the Project

Our general goal is to provide an effective tool for teaching and learning in Introductory Biology. There are four groups of potential users for this publication and we have listed the specific objectives for each.

1. Faculty:
    - to provide an instructional tool, and support for using it, that helps instructors be more effective in enabling students to achieve content mastery in selected (enduring) topics in biology and to develop essential thinking/learning skills;
    - to make the learning materials flexible enough to integrate with their current courses.
2. Peer leaders:
    - to provide a means of reviewing and deepening understanding of the content and skills in preparation for facilitating workshops;
    - to provide rich materials at several levels of difficulty to be the basis of the workshop sessions;
    - To provide experience with an alternative model for teaching and learning science.
3. Students:
    - to provide a superior tool for learning the content and skills of biological science that leads to higher levels of content mastery for selected topics;
    - to motivate students to extend their studies of science by enabling them to become better thinkers and problem solvers and improve their course performance;
    - to introduce and provide practice with an alternative approach to learning science.
4. PLTL Resources:

- to provide a critical tool for dissemination of PLTL in Biology;
- to provide a resource for faculty development through which PLTL encourages faculty to move toward:

  a) active learning;

  b) collaboration vs. competition;

  c) higher order learning of critical topics in biology to complement the traditional survey approaches;

  d) forming learning communities among faculty, peer leaders and students.

Next Steps

Although drafts of the modules in this collection have been reviewed and revised from the comments of "beta-users" (whom we thank for their input), this is a work-in-progress. We trust that the development of these materials will help spur interest in the creation of further modules, which will encourage more use of peer-led team learning in biology. We welcome your comments.

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