

PBL in the Life Sciences



*Institute for Transforming
Undergraduate Education
University of Delaware
&*



*National Center for
Case Study Teaching in Science
University at Buffalo, SUNY*

PBL2002: A Pathway to Better Learning

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Case Studies

“Are stories with an educational message”

Stories with a message can unfold in:

- 1. Lecture**
- 2. Discussion**
- 3. Small group activities**
- 4. Individual activities**



“The principal idea behind PBL is that the starting point for learning should be a problem, a query, or a puzzle that the learner wishes to solve.”

Boud (1985)



What are the Common Features of PBL?

Learning is initiated by a problem.

Problems are based on complex, real-world situations.

All information needed to solve problem is not initially given.

Students identify, find, and use appropriate resources.

Students work in permanent groups.

Learning is active, integrated, cumulative, and connected.

From ITUE, “PBL: Experience It Yourself”



PBL: The Process

**Resolution of Problem;
(How did we do?)**



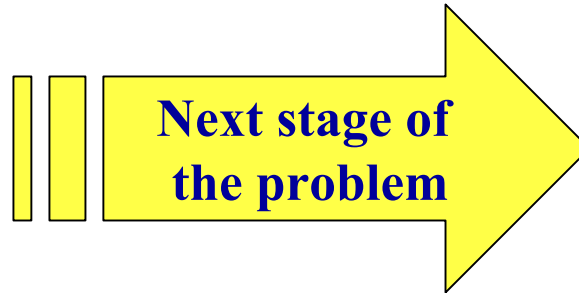
**Integrate new
Information;
Refine questions**



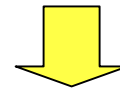
**Reconvene, report
on research;**



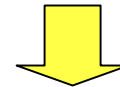
**Research questions;
summarize;
analyze findings**



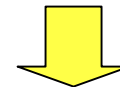
Presentation of Problem



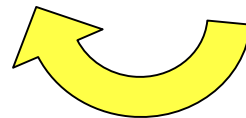
**Organize ideas and
prior knowledge
(What do we know?)**



**Pose questions
(What do we need
to know?)**



**Assign responsibility
for questions; discuss
resources**





PBL and the Case Study Method

What's the Difference?

***PBL**

Student-centered

Small group

*Problems before
concepts*

*Earliest models

***Case Study**

Instructor-centered

Whole class

*Cases as extension,
application of concepts*



Question for Groups

What are the advantages and disadvantages of using a problem/case study “up front?”

What are the advantages and disadvantages of using a problem/case study in summative fashion?

Be prepared to report out in 10 min.



Our Answers

Advantages of using problems/case studies up front:

- Learning and remembering are better
- Initially very motivating
- Promotes development of problem-solving and reasoning skills
- Provides students with something tangible, concrete
- Challenges instructor to identify essential concepts
- Resembles process of science, as model for majors
- Resembles how non-majors will encounter science later on
- Ownership develops early on
- Gives students practice at learning independently



Our Answers

Disadvantages of using problems/case studies up front:

- **Makes it hard to control content, especially that required for subsequent courses**
- **Students may go off on content tangents**
- **Challenging to implement in large class or settings with more diversity in background, maturity, ability**
- **“Rocks the boat” for students, particularly ones who have been academically successful**
- **Students unfamiliar with PBL might not know what to do**
- **Difficult to devise good problems and questions**
- **Requires new teaching skills (particularly for group dynamics)**



Our Answers

Disadvantages of using problems/case studies up front (continued):

- **Loss of instructor control**
- **Some students value content density - may equate it with wisdom**
- **Colleagues, administrators may not value and support it, or know how to interpret course evaluation information**
- **Traditional course evaluation forms are not helpful**
- **Paradigm shift for students and teachers**
- **Mismatch between instructor and student perceptions of teaching/learning process, with respect to grades, sources of authority (“Why don’t you just tell us the answer?”)**



Question for Groups

What are the major implementation issues encountered when using PBL strategies in life science courses?

Be prepared to report out in 5 min.



Our Answers

Major issues in PBL implementation:

- Classroom configuration, scheduling
- Faculty development
- Assessment, especially large class
- Content coverage - how to write problems that meet objectives
- Group monitoring
- Adequate preparation of students for next courses
(content-wise, but also if PBL process objectives not incorporated into next courses)
- Student learning of the PBL cycle



Course Models for PBL - UD Examples*

Introduction to Biochemistry - H. White
research articles as problems

Molecular Biology - F. Schmieg
4 problems per semester (2 ½ periods each)

Introductory Biology - L. Dion
2 lecture sessions, one PBL session per week

Genetics - D. Sheppard
bioinformatics problems for laboratories

*See handout for PBL2002 presentations about additional models



Course Models for PBL - UD Examples (cont).

Introductory Biology - D. Allen

Two-semester course for freshman majors

6-7 problems per semester

Lecture on a need-to-know basis (~10% of class time)

Advanced undergraduates as group facilitators

General Biology - D. Allen & S. Fifield

Medium-large enrollment gen. ed. course

*Problems as centerpieces of 5 instructional units,
which also include short lectures and active
learning activities*



Sample PBL Problem: The Geritol Solution

John Martin discovered that high nutrient, low chlorophyll (productivity) ocean waters are missing an essential micronutrient: iron. *“Give me a tanker full of iron, and I’ll give you another ice age.”*



Original decision: Should the government fund attempts to test the effectiveness of the “Geritol solution” at reducing the impact of excess CO₂ emissions?

Newest decision: Should for-profit companies be allowed to lease or own portions of the ocean to sell sequestered carbon? Who owns the rights to “the solution?”



Activities Related to The Geritol Solution Problem

- **Based on a global environmental issues that continue to evolve**
- **Research into photosynthesis, carbon and energy cycles, marine ecosystems, global climate treaties - summarize each stage before moving to the next**
- **Make a concept map to tie biology concepts together midway through problem**
- **Discuss/debate issues in groups and whole class. Write a position paper on consensus decision or dialogue based on discussion of pros and cons**
- **Write a letter to the editor concerning position on “ownership” of the Geritol solution**





Sources of Biology Problems & Cases

UD PBL Clearinghouse

<https://www.mis4.udel.edu/Pbl/index.jsp>

Problem-Based Learning at UD - has links to other sites

<http://www.udel.edu/pbl>

National Center for Case Study Teaching in Science

<http://ublib.buffalo.edu/libraries/projects/cases/case.html>

Thinking Towards Solutions: Problem-Based Learning Activities for General Biology. Allen and Duch.

http://www.brookscole.com/cgi-brookscole/course_products_bc.pl?fid=M2&topic_code=2BC2&discipline_number=22&product_isbn_issn=0030250331