

The What and Why of Problem Based Learning (PBL)

What is Problem Based Learning (PBL)?

In science course taught using PBL, students work collaboratively in teams to solve (or better understand) scientific, social, environmental, and technological issues, problems or queries with the goal of learning how to find, evaluate, apply and communicate relevant scientific information. Class discussions, activities, and occasional lectures help to build a conceptual framework, and to guide efforts to learn to think critically, contextually, and connectedly.

Problem Solving - Effective learning is much more than memorizing information to answer questions on examinations. Learning (is) a process that culminates in the ability:

- to ask the right questions and frame problems
- to acquire information and evaluate sources of information
- to critically investigate and (re)solve problems
- to make choices among many alternatives
- to generalize to new situations
- to clearly explain concepts to others (both orally and in writing)

Problems or case studies are used to introduce various ideas or topics and to serve as focal points for learning new material. Students sometimes find this a bit unusual since it is customary to work on problems or explore relevant issues after the pertinent concepts have already been thoroughly presented in a lecture or reading. The purpose of PBL is to have the problem/issue/query provide a context and reason to learn the material, and to serve as a contextual focal point that guides knowledge acquisition. Students are not expected to be able to come up with a solution or understand all facets of the problem instantly. Instead problems or case studies are meant to encourage a dialogue about what knowledge or insights students bring to the situation, what information is collectively still lacking, and where to find that information.

The rate of generation of new information in the scientific and technical sectors is truly staggering. Information becomes outdated rapidly and is updated constantly. Much of what our students will need to know following graduation has not yet been discovered! Thus identifying when new information is needed, where to find it, how to analyze it, and how to communicate it effectively are essential skills to learn in college. These skills are essential for our students' success in their personal, civic and professional lives following graduation.

The general process for solving problems:

- Much of the learning process is collaborative in small teams, similar to most professional working environments.
- The major concepts needed to solve the problem or resolve the issue are not immediately given. Instead, students come to learn how to identify what information is needed to proceed through the problem, and where to find this information as the course progresses.
- Each problem begins with a short introductory lecture, case study reading or film clip that may provide an overview of, or frame the problem or issue, provide suggestions for getting started, and identification of potential pitfalls.
- The problem solving process is supported through readings, research, team-based activities, and discussions that encourage students to elaborate on knowledge, synthesize concepts and apply them to the problem or issue we are working on.
- Teams present their "solutions" in one of many possible oral or written formats. Presentation expectations will be explained when the problems are assigned.

- Each problem will be concluded with a whole class discussion or activity that will help clarify concepts that may still not be understood and to allow teams to share recommendations for possible solutions.

Roles and Responsibilities - In a PBL course, student and instructor roles and responsibilities may differ somewhat from more traditionally-taught courses. Students assume more responsibility for their learning, while the instructor is more of a facilitator of learning. Facilitators generally design an environment that fosters learning, rather than simply explaining topics or disseminating knowledge or information. As a general guideline, students are expected to:

- Come to class prepared and on time.
- Participate in team discussions, problem solving, and lab investigations.
- Fulfill responsibilities assigned by your team, and course instructor.
- Listen to others' expression of their opinions and ideas.
- Provide and be receptive to constructive feedback so that teams work effectively.

The course instructor is expected to:

- Provide a challenging learning environment for the class.
- Support students as they work in teams to explore and elaborate on knowledge needed to resolve problems.
- Guide students to appropriate learning resources and strategies.
- Listen to student views and concerns and take appropriate action.
- Answer students' questions (when and as appropriate).

Why PBL?

- Courses taught exclusively through lecture promote passivity, short term “surface” learning, and send a clear, albeit unintended message, that knowledge is something that is given to students, rather than something they must actively seek out.
- In our project evaluation, students report that the active, contextual, and collaborative nature of learning that occurs in PBL courses facilitates long-term learning, more meaningful understanding.
- PBL courses stimulate interdisciplinary thinking and help students see the connections not only between different areas of science but also between economics and the environment, between social values and genetics, between politics and pollution and a host of other connections to science.
- PBL courses stimulate critical thinking by anchoring learning to problems or issues that will challenge students' current worldviews and require them to explore other paradigms, & search for deeper meaning and understanding.
- PBL courses are meant to help students understand that the purpose of learning is to help them function more effectively both in and perhaps more importantly to our world.

Credits: In these sections on problem-based learning and working in teams, I have borrowed liberally from the writings and syllabi of Deb Allen (Biological Sciences), and George Watson (Physics) and others at the University of Delaware's Institute for Transforming Undergraduate Education (<http://www.udel.edu/inst/>).