##### EDCI 62700 Summer, 2011

**Special Topics in Educational Technology:**

**Problem-based Learning in the Science and Math Classroom**

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| Class Monday-Thursday, 9:00 PM – 3:30 PM June 13 – June 23  Friday, June 24, 9-1:30 Prerequisite: None Graduate Assistants Sarah Freemyer, [sfreemye@purdue.edu](mailto:sfreemye@purdue.edu)  Nicole Cook, cook45@purdue.edu  Ayesha Sadaf, asadaf@purdue.edu  Chelsey Dankenbring, [cdankenb@purdue.edu](mailto:cdankenb@purdue.edu)  Jerilyn Smith, [jerilynsmith@tds.net](mailto:jerilynsmith@tds.net) Undergraduate Assistant Julie McGee, mcgeeja@purdue.edu | Instructor **Peg Ertmer**  Phone: 765-494-5675 pertmer@purdue.edu  **Research Goes to School** Project Manager  **Lisa Kirkham**  Phone: 765-494-2424  lkirkham@purdue.edu | InstructorKari Clase Phone: 765-494-4649 kclase@purdue.edu |
| Course BlackBoard Vista Site http://www.itap.purdue.edu/tlt/blackboard/index.cfm | | |

# Course Description

# *Problem-based Learning in the Science and Math Classroom* is a project-based approach to learning how to use problem-based learning to teach specific math and science content. Students in EDCI 62700 engage in authentic problem- and project-based learning activities to facilitate their growing understanding of how to plan, implement, and evaluate a PBL unit in their own classrooms.

# Required Textbook and Readings:

# Buck Institute for Education (2003)*. Project-based learning handbook: A guide to standards-focused project based learning* (2nd ed.). Navato, CA: Author. Go to: <http://www.bie.org>. Also, be sure to take advantage of all the additional resources on the BIE site by registering as a user (registration is free)!

# Course Objectives and Methods of Evaluation

The overall goal of the course is the development of an authentic PBL unit, specifically related to the research content activities of the C3Bio Energy Frontiers Research Center, which can be implemented successfully within your own classroom. To achieve this goal, you will:

* Increase your knowledge of sustainable energy sources including wind, solar, water, biofuels and the research content of the C3Bio Energy Frontiers Research Center
  + Methods of Evaluation: Participation in class discussions and hands-on content activities; class interactions with sustainable energy and C3Bio energy research experts, and small group presentations of the viability of a specific energy source for Indiana
* Develop an understanding of methods and strategies of PBL as an instructional approach.
  + Methods of Evaluation: Participation in class discussions; submission of and reflection about the following: the driving question, curricular objectives, and standards; student activities and scaffolds; and final PBL unit presentation.
* Effectively plan for the implementation and evaluation of a PBL unit.
  + Methods of Evaluation: Submission of and reflection about: the materials and resources incorporated into the PBL unit, and PBL unit implementation and evaluation plans.
* Develop a website that supports students’ PBL work and allows you to disseminate this approach to other teachers.
  + Methods of Evaluation: Development and presentation of your PBL unit website.

# Format of Course

This course is designed to engage you in effective problem- and project-based learning (PBL) activities that facilitate and sustain meaningful student learning. Integrating PBL into the K-12 classroom requires tremendous change on the part of educators; obviously this is not an easy task. In order to support your efforts, we interlace three primary strategies (modeling, reflection, and collaboration) that have proven effective in supporting teacher and school change. Everything we do in this class will be based on the use of one or more of these three strategies. For example, we will introduce you, via video and websites, to a number of model teachers, we will engage you in ongoing reflective conversations (both written and verbal), and we will require group collaboration for the completion of course projects.

This class is oriented toward projects. The primary project for the course will be done in small groups, although you are each expected to contribute. In-class activities also may be augmented with asynchronous online discussions. We will use Blackboard to post readings related to class topics and, if needed, continue discussions begun during our face-to-face meetings.

**Course Policies**

*Expectations/Penalties.* All assignments are expected to be **on time**, **word-processed**, and of the **quality** appropriate to graduate study. **Late assignments will be penalized 20% of the total possible points**.

The design of this course emphasizes class discussions and small group activities. Consistent attendance is crucial to your success. It will be virtually impossible to complete course assignments satisfactorily without cumulatively developing the knowledge base addressed during class meetings. Furthermore, given the relatively short timeframe for the course (8.5 days), missing one class is the equivalent of missing 2 weeks of classes (6 hours of instruction) during a normal semester. Missed classes cannot be made up.

*Incompletes*. “I” grades will be given only in unusual circumstances. To receive an “I” grade, a **written request must be submitted prior to 06/23/11** and approved by the instructors.The request must describe the circumstances, along with a proposed timeline for completing the course work. You will be required to fill out and sign an “Incomplete Contract” form that will be turned in with the course grades.

***University******Policies***

*Special Needs*. If you are eligible for academic accommodations because you have a documented disability that will impact your work in this class, please schedule an appointment with us as soon as possible to discuss your needs. Students with disabilities must be registered with Adaptive Programs in the Office of the Dean of Students (SCHL 207, phone: 494-1747) before classroom accommodations can be provided.

*Academic Integrity.* Purdue prohibits “dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty.” [Part 5, Section III-B-2-a, University Regulations <http://www.purdue.edu/univregs/>] Furthermore, the University Senate has stipulated, “the commitment of acts of cheating, lying, and deceit in any of their diverse forms (such as the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest.” [University Senate Document 72-18, December 15, 1972]

Plagiarism, whether intended or unintended is an extremely serious offense in academia. Be absolutely sure you are properly citing all references. Please complete the following tutorial on plagiarism: <http://www.indiana.edu/~istd/> and submit a completion certificate to the instructors. Upon request, we will also make available SafeAssign in Blackboard, if you would like a computer software application to review your work and check for possible instances of plagiarism. With these available resources, there should be no excuse for plagiarism in this course.

While this class encourages cooperation and the exchange of ideas, you are expected to do original work, to do your own work except for group projects, and to properly reference sources when using information from others. Any single instance of academic dishonesty will result in failure of the assignment in question. More than one instance will result in failure of the course. ***Any incidents of plagiarism, intended or not, will be documented with the Dean of Student’s Office.***

*Campus Emergencies*. In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. There are numerous ways to get information about changes in *this* course including the Blackboard course web page, our email addresses: [pertmer@purdue.edu](mailto:pertmer@purdue.edu), [kclase@purdue.edu](mailto:kclase@purdue.edu); and our office phones: 494-5675 (Dr. Ertmer); 765-494-4649 (Dr. Clase).

***Grading***

Grades will be based upon application of concepts, drawn from class readings and discussions, to the development of a PBL unit that will be implemented in your classroom next year. The points associated with each activity/assignment are given below. See the schedule for specific due dates.

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| --- | --- |
| **Activity/Assignment** | **Points** |
|  |  |
| **Problem-Based Unit and Web Site, Part I** (Planning) |  |
| Driving Question, Curricular Objectives, and Standards | 40 |
| **Individual Reflection on DQ, Curricular Objectives, and Standards** | 10 |
| Student Activities (student investigations, grouping strategies, scaffolds, etc.) | 40 |
| Unit Materials and Resources | 12 |
| **Individual Reflection on Student Activities; Materials and Resources** | 10 |
|  |  |
| **Problem-Based Unit and Web Site, Part II** (Implementation and Evaluation Plans) |  |
| Implementation/Management Plan for Problem-Based Unit (timeline, questioning and debriefing strategies, etc.) | 20 |
| Evaluation Plan (specific plans, rubrics, etc. for self, peer, and teacher evaluation); additional measures for data collection (surveys, journals, etc.) | 28 |
| **Individual Reflection on Implementation and Evaluation Components** | 10 |
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| **Final PBL Unit Website** | 30 |
| TOTAL | 200 |

*Grading Scale:* At the end of the summer session, grades will be assigned according to the following scale:

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| --- | --- | --- |
| A+ | 194 – 200 points | (97 – 100%) |
| A | 188 – 193 points | (96 – 94%) |
| A- | 180 – 187 points | (90 – 93%) |
| B+ | 174 – 179 points | (87 – 89 %) |
| B | 168 – 173 points | (84 – 86%) |
| B- | 160 – 167 points | (80 – 83%) |
| C+ | 154 – 159 points | (77 – 79%) |
| C | 148 – 153 points | (74 – 76%) |
| C- | 140 – 147 points | (70 – 73%) |

**Course Requirements**

Assignments for this course reflect the importance of both individual and team work. While you will work on teams to develop your PBL units and websites, you will each submit reflections on the individual components (e.g., driving question, resources, etc.). This enables you to develop the skills and knowledge needed to develop a PBL unit, while reflecting on your own individual PBL development needs. Team scores will be given for required PBL components (all team members get the same score); individual scores will be given for the project reflections.

# Problem-Based Learning Unit and Web Site (due in increments)

As the primary course activity, you will work as part of a team to develop a problem-based learning unit. The primary emphasis, this semester, is on **planning** the unit. Implementation will occur in fall 2011 or spring, 2012. Your unit, and the website, should describe, in language appropriate for public dissemination, the PBL unit you will implement. It should contain the following components:

* **Driving Question, Curriculum Objectives, and Standards (Draft due Monday, June 20, 2011; Revision due Tuesday, June 21, 2011)**

The driving question anchors the unit you will facilitate. A good driving question: fits the overall content theme, is meaningful to your students, is broad enough to permit students to develop their own questions and investigations, includes relevant content, involves authentic problem-solving activities, and lends itself to collaboration (among students, among teachers, among schools, and with members of the community). Simply stated, a good project relates to the real world AND to the school curriculum. It engages students in authentic problem-solving, using standards-based content appropriate for the subject matter and students’ grade level.

Answer the following questions:

* What is the driving question that will guide your unit?
* What do you expect your students to learn in this unit? What important discipline-based concepts/standards will it address? What knowledge, performances, and dispositions do you expect your students to acquire? What 21st century skills will they gain?
* How does this unit relate to/integrate with your existing curriculum?
* What makes your question meaningful and authentic to your students?
* How will students collaborate to address this question?

*Reflection (2-3 pages)*: Describe your specific learners (grade level, course title, number and gender mix of students, etc.). Describe how this driving question relates to the curriculum you need to teach to these learners. How is this similar to or different from the ways in which you have met these curricular standards/objectives in the past? Present a rationale for why you chose the question you did and why you think this is a good way to meet these standards. What are the possible challenges you will encounter teaching this content using this approach?

* **Student Activities and Scaffolds; Materials and Resources (Due: Wednesday, June 22, 2011)**

Student-designed and conducted investigations are at the heart of problem-based learning. While you should not dictate these in advance, you can anticipate the kinds of investigations students are likely to conduct given the driving question, allotted time, and available resources.

* How you will prepare the students?
* What kinds of investigations do you expect your students to develop?
* How will students be grouped? How will you assure effective group work (group contracts, learning logs, etc.)?
* How will you assure that students are learning important content?
* Where are students likely to have difficulty? What **scaffolds** will you use to assist them (**include specific examples**)?
* What strategies will you use to help students reflect on what they have learned?
* How can technology be used to gather, analyze, and present information from student investigations?
* What other resources will you use (e.g., books, print materials, videos, websites)? What other special supplies or materials will you use?

*Reflection (2-3 pages)*: Describe what visitors would see if they peeked into your classroom during the implementation of this PBL unit. How would the classroom be set up and what would students be doing? Describe how these activities, materials, and resources will enable students to reach the unit goals. What are the possible challenges you will encounter finding and using these activities and resources?

* **Implementation/Management Plan and Assessment Tools (Due: Thursday, June 23, 2011)**

Describe your specific plans for implementing your PBL unit in your classroom and the assessments you will use to measure student learning. Answer the following questions:

* When will the unit be taught and how long will it last?
* How will you promote inquiry and engagement among your students? What facilitation and questioning strategies will you use (**include specific examples**)?
* How will you use technology and manage the classroom during these activities?
* What evidence/artifacts will your students produce to demonstrate the desired learning? When will each of these products be due?
* How will you assess students’ processes and products (e.g., rubrics, checklists, presentations, exams)? **Provide samples of the assessment measures** you will use.
* How will students monitor their development as team players and problem-solvers?

*Reflection (2-3 pages)*: What are the possible challenges you will encounter implementing these activities in the allotted timeframe? What facilitation challenges do you anticipate encountering? What strategies will you use to monitor the development of your own facilitation and classroom management skills? Describe how these assessment activities compare to those you have used/encountered in the past. Present a rationale for why you think these measures are appropriate. What are the possible challenges you will encounter implementing these measures?

**Final Presentations of PBL Units/Websites (Due: Friday, June 24, 2010)**

Present your PBL unit/website to the class. Be sure to include the following information:

* Team members
* Driving question(s)
  + Where does this unit fit into your curriculum and how will this approach help students learn important content in authentic ways?
* Unit outcomes
  + Content standards
    - Knowledge
    - Skills
  + 21st century skills
* Student Activities
  + Preparing students
  + Potential student investigations
  + Grouping strategies
  + Scaffolds
* Required equipment, technology, resources, materials
  + List of relevant weblinks, book titles, video titles, etc.
* Project logistics
  + Facilitation strategies
  + Timeline with associated learning products
* Formative and Summative Assessment measures - Possibilities include:
  + Rubrics
  + Checklists
  + Quizzes/Exams
  + Group Presentations

**TENTATIVE COURSE SCHEDULE**

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| --- | --- | --- | --- | --- | --- |
| **Week/Date** | **Topic** | | | **Assignment/Readings**  **(due at the beginning of class)** | **Supplemental Resources** |
| **Week 1** |  | | |  |  |
|  | **Morning Activities** | **Lunch** | **Afternoon Activities** |  |  |
| 6/13 | Introduction to the course  • Warm-up activity • Introduce PBL energy activity | Guest speaker Madhi Abu-Omar: C3Bio Overview | • Visit wind farm  • Begin to develop driving question for energy investigation | * [Intro to PBL video](http://www.youtube.com/watch?v=LMCZvGesRz8&feature=player_embedded) * BIE (pp 3-10) * Global Energy Flows (binder) | BIE Online Resource(s):  [What is PBL?](http://pbl-online.org/About/whatisPBL.htm)  Video Example:  [The Watershed Project: Overview](http://www.youtube.com/watch?v=9OVzs8x2QfM&feature=channel) |
| 6/14 | • Debriefing  • Review DQs  • Lab on solar energy  • Criteria for Week 1 investigations | Guest speaker  Bill Hutzell  Visit Solar House | • Debriefing  • Mini content discussion  • Mini PBL discussion  • Group work | * Find an example of a PBL unit relevant to your content * Savery (2009) * Solar Energy activity: “Cooking with the Sun—Creating a Solar Oven”(binder) |  |
| 6/15 | • Debriefing  • Lab on water energy  • Small group work | Guest speaker  Jerry Woodall —Water energy | • Debriefing  • Mini content discussion  • Mini PBL lecture (Building motivation; Assuring content learning; Facilitation strategies)  • Small group work | * BIE (pp. 97-102) * Kolodner et al. (2003) * Water energy activity: “Calculating the Potential Energy of Flowing Water” (binder) |  |
| 6/16 | • Debriefing  • Lab on biofuel energy  • Small group work | Guest speaker  Dr. Juan Sesmero – Economics of energy | • Small gp presentations  • Introduce task for Wk 2 | * Biofuel activity: Fermentation in a Bag and Lifecycle Assessment of Biofuels | BIE Online Resource:  [PBL Video Library](http://pbl-online.org/video/video.htm) |

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| **Week 2** | **Planning a PBL Unit** | | | **Assignment/Readings** | **Supplemental Resources** |
|  | **Morning Activities** | **Lunch** | **Afternoon Activities** |  |  |
| 6/20 | • Creating a successful PBL unit  • Putting your units on the web  • Peer review of driving questions | Continued review of driving questions | • Guest speaker and lab tour: Hilkka Kenttamaa, *C3Bio* *Mass Spec Analysis Integration with ChemE Pyrolysis* | Barell – Curricular Overview  [21st Century Skills](http://www.p21.org/index.php?option=com_content&task=view&id=254&Itemid=119)  BIE – pp. 13-22  BIE tutorial – [Crafting the Driving Question](http://pbl-online.org/driving_question/drivingquestion.html)  Bioenergy: “Quantitative Modeling of Biofuels Life Cycles” (binder)  **Draft Driving Question due** | BIE Online Resource(s):   * [Project Essentials Checklist](http://www.bie.org/tools/useful_stuff/project_essentials_checklist) * [Completed Sample Planning Forms](http://www.bie.org/tools/useful_stuff/pbl_starter_kit_sample_planning_forms) * [PBL Handbook: Project Planning Forms](http://www.bie.org/tools/useful_stuff/pbl_handbook_project_planning_form) |
| 6/21 | • Mini PBL lecture (creating lesson activities; developing scaffolds)   * Tour of Bindley Bioscience Center and Birck Nanotechnology Center-Thomas Sors, Center Project Manager for BBC will host | Guest speaker –  Nathan Mosier, *1st Generation Biofuels and Progress in Advanced Biofuels* | • Mini PBL lecture  (developing/locating materials and resources)  • Providing constructive feedback on each other’s web sites  • Group work | Ertmer & Simons (2006)  BIE Idea Bank – 83-87  **Driving Question, Objectives, Standards (with reflection) due** | BIE Idea Bank (pp. 88-89)  BIE Project Resources Form (pp. 92-93) |
| 6/22 | • Mini content lecture: “Quantitative Modeling of Biofuels Life Cycles”  • Mini PBL lecture (managing PBL units- grouping strategies; facilitation guidelines) | Working lunch | • Mini PBL lecture  (assessing student learning)  Small group work | Barell –  • How to respond to students’ questions;  • Teachers’ quality responding;  • Assessment  BIE Idea Bank  • 118-119  • 105-111  • 151-175  MacDonald  **Activities, Scaffolds, Materials, Resources (with reflections) due** | BIE [Proj Management Forms](http://www.bie.org/tools/useful_stuff/pbl_starter_kit_project_management)  BIE IdeaBank (pp. 118-119)  BIE IdeaBank (pp. 105-111)  BIE Online Resource(s):   * [PBL Handbook: Creating Rubrics](http://www.bie.org/tools/useful_stuff/pbl_handbook_creating_rubrics) * [PBL Handbook: Sample Rubrics](http://www.bie.org/tools/useful_stuff/pbl_handbook_sample_rubrics) * BIE IdeaBank (pp. 61; 70-80) |
| 6/23 | • Maureen McCann Grand Challenge Science in Renewable Energy, Role of C3Bio and Multidisciplinary Science  • Tour – Biomass farm tour: Nicholas Carpita will host | Working lunch | • Final PBL Reflections  • Peer feedback on units/websites  • Small group work | **Management Plan, Assessment Tools (with reflection) due** |  |
| 6/24 | • Small group presentations of PBL units and websites | Working lunch | • Wrap up and dismissal | **Final PBL unit presentation**  **PBL unit website due** |  |

# Required Readings

Week 1

Buck Institute for Education (2010). Project-based Learning Explained. Accessed online at: http://www.youtube.com/watch?v=LMCZvGesRz8&feature=player\_embedded

Kolodner, J. L., Camp, P. J., Crismond, D., Fasse, B., Gray, J., Holbrook, J., Puntembakar, S., & Ryan, M. (2003). Problem-based learning meets case-based reasoning in the middle-school science classroom: Putting learning by design into practice. *The Journal of the Learning Sciences, 12*(4), 495 – 547.

Savery, J. (2009). Problem-based approach to instruction. In C. M. Reigeluth & A. Carr-Chellman (Eds.), *Instructional design theories and models, Vol III: Building a common knowledge base* (pp. 143-165). New York: Routledge.

Week 2

Barell, J. (2007). Assorted chapters. From *Problem-based learning: An inquiry approach*. Thousand Oaks, CA: Corwin.

Ertmer, P. A., & Simons, K. D. (2006). Jumping the PBL implementation hurdle: Supporting the efforts of K-12 teachers. *The Interdisciplinary Journal of Problem-based Learning. 1(1)*40-55. Available: <http://docs.lib.purdue.edu/ijpbl>

Macdonald, R. (2005). Assessment strategies for inquiry and problem-based learning. In T. Barrett, I. MacLabhrainn, & H. Fallon (Eds.), Handbook of inquiry and problem-based learning (chp 9). Dublin, IR: Center for Excellence in Learning and Teaching. Retrieved May 12, 2010, from http://www.nuigalway.ie/celt/pblbook/

Partnership for 21st Century Skills (2004). *Framework for 21st century learning*. Washington DC: Author. Retrieved May 21, 2011, from http://www.p21.org/index.php?option=com\_content&task=view&id=254&Itemid=119