Pre-Conference Workshop
PBL in Engineering and Physics

Facilitator: George Watson

Institute for Transforming Undergraduate Education

University of Delaware

PBL2002: A Pathway to Better Learning

June 16, 2002

Goals for the Session

- Establish an Engineering/Physics network before conference
- Identify and address participant concerns
- Tap the experiences and resources of the group
- Deal primarily with discipline-specific issues
- Promote interaction among participants

Participant Introductions

Name, institution, experience with PBL, personal goals for the conference.

Form pairs for about 5 minutes and introduce yourselves.

Each person in turn introduces his or her partner to the whole group.

Concerns and Interests of Newcomers to PBL

What are the barriers to getting started with PBL in Engineering and Physical Science?

Form two or three groups where newcomers are distributed among experienced PBL practitioners.

The newcomer's questions and concerns drive the discussion in the groups.

Report out at the end so that everyone can benefit from the separate discussions.

Sharing of Sample PBL Problems

- Science and Technology for Non-Science Majors
- Introductory Physics for Engineering Majors
- Engineering Mechanics for Civil Engineers

Silicon, Circuits, and the Digital Revolution

SCEN103 at the University of Delaware

http://www.physics.udel.edu/~watson/scen103/

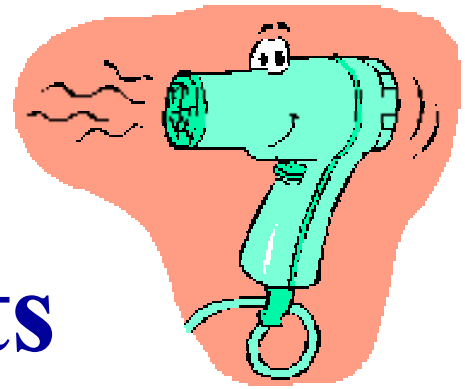
PBL Approach to Simple Electrical Circuits

Incorporating PBL problems,

Other collaborative exercises, and

Hands-on laboratory exercises.

Crossed Circuits



Two roommates argue about perceived use of electrical energy. Who should pay more towards the utility bill?

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Bookmarks Go to: http://www.physics.udel.edu/~watson/phys208/ What's Related

Syllabus

Announcements

Assignments

Resources

PHYS208 -- Spring 1998

Fundamentals of Physics II

Fall 1997

UNIVERSITY OF DELAWARE

Department of Physics and Astronomy

Comments, suggestions, or requests to ghw@udel.edu.

"http://www.physics.udel.edu/~watson/phys208/"

Document: Done

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Syllabus
Announcements
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Classes
Laboratory
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Resources

PHYS208 Fundamentals of Physics II

Group Exercise 1: Battery Testers

The underside of a Duracell Copper Top AA battery tester is shown in the magnified image above, along with the temperature display that is directly above it. Using simple circuit concepts, explain how this battery tester works.

For a related challenge, explain how the 9V tester works.

Related Resources:

Duracell
Energizer

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PHYS208 Fundamentals of Physics II

Group Exercise -- Punkin' Chunkin'

This weekend marks the 13th year of the Punkin' Chunkin' contest held in Sussex County, Delaware. The object of this contest is to propel, without use of explosives, an 8 to 10 pound pumpkin as far as possible; the 1996 record was 2,710 feet set by an air cannon from Illinois. This record was retaken by Delaware's Universal Soldier in 1997 with a launch of 3718 feet. There are several categories available: catapult, centrifugal, human-powered, youth, and longest overall toss.
Source: Wilmington News Jounal, Sunday, Oct. 26, 1997.

I propose a new category -- electromagnetic toss. Using the principles of PHYS208 (and PHYS207), design a punkin' chunkin' rail capable of a one-mile toss. Be as specific as possible, taking into consideration physical properties of the pumpkin, ballistics as realistic as possible, and energy sources and dissipation. *Remember that your device will be firing in the middle of a cornfield...*

Project Guidelines

A Few Additional Resources:

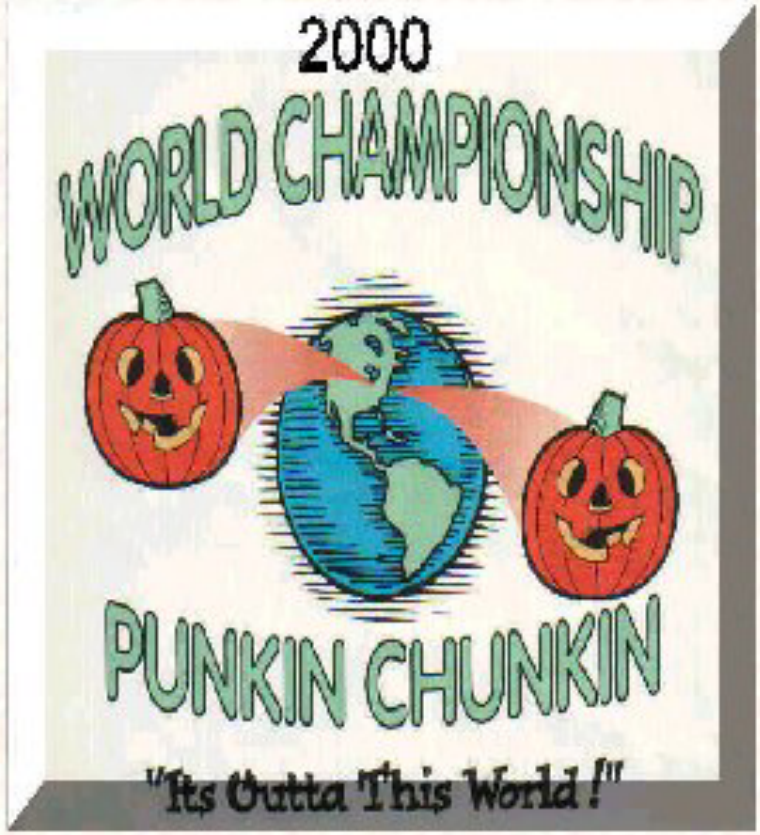
World Championship Punkin' Chunkin' -- official homepage

Snapshots of Punkin' Chunkin'

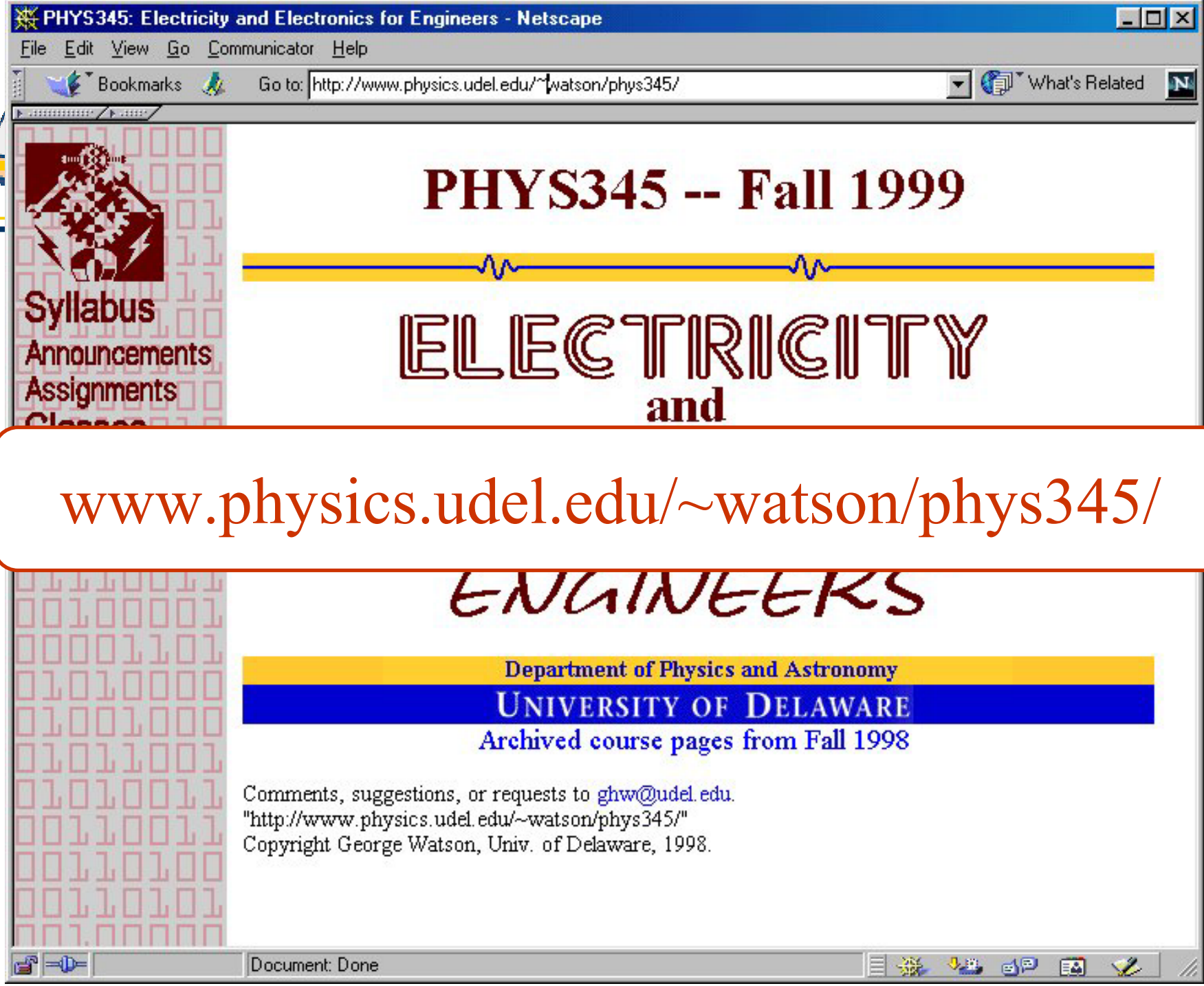
World Championship Punkin Chunkin

November 3, 4 & 5, 2000

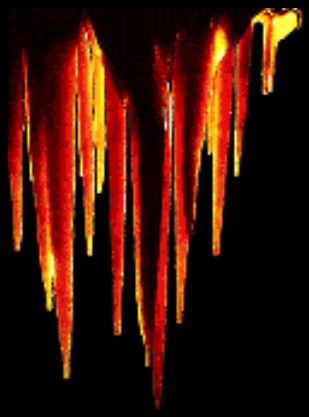
- 2000 Schedule of Events
- 1999 Results "see below for champs!"
- 1999 Scenes
- Accommodations
- Directions
  "Sussex County Delaware"
  "Hollyville Rd. & Harmony Rd near Millsboro"
- Machine Registration
- Official Rules
- World Records from 1986-2000
- The Chunkers"
  (Chunkin websites)
- "Battle of the Bands"
- Punkin' Cookin' Contest
  (email Sandy:)



The 1999 World Punkin Chunkin Champions:
Air category: "Big 10 Inch"
Centrifugal: "Bad to the Bone"
Catapult: "Gene's Machine"



www.physics.udel.edu/~watson/phys345/



Lights Out!

Students attempt to design a flashlight from a 6V lantern bulb and two AAA cells that will last for five hours.

Batteries and internal resistance

Energy capacity

Circuit Design

Examples from Engineering

Prof. 'Tripp' Shenton
Civil and Environmental Engineering
University of Delaware

CIEG311:
Junior-level course on engineering mechanics

Examine project 3, then 2.

Problem-Based Learning and Physics:
Developing problem solving skills in all students

NSF DUE 00-89408 CCLI-EMD

The problem-based learning (PBL) program initiated at the University for reforming undergraduate science teaching is being expanded beyond the University by the development of instructional models and materials made accessible to faculty worldwide through an online clearinghouse. The project is developing a database of problems, instructional models, evaluation tools, and web-based resources that effectively incorporate PBL across the content framework of introductory undergraduate physics courses.

Problem-Based Learning and Physics:
Developing problem solving skills in all students

NSF DUE 00-89408 CCLI-EMD

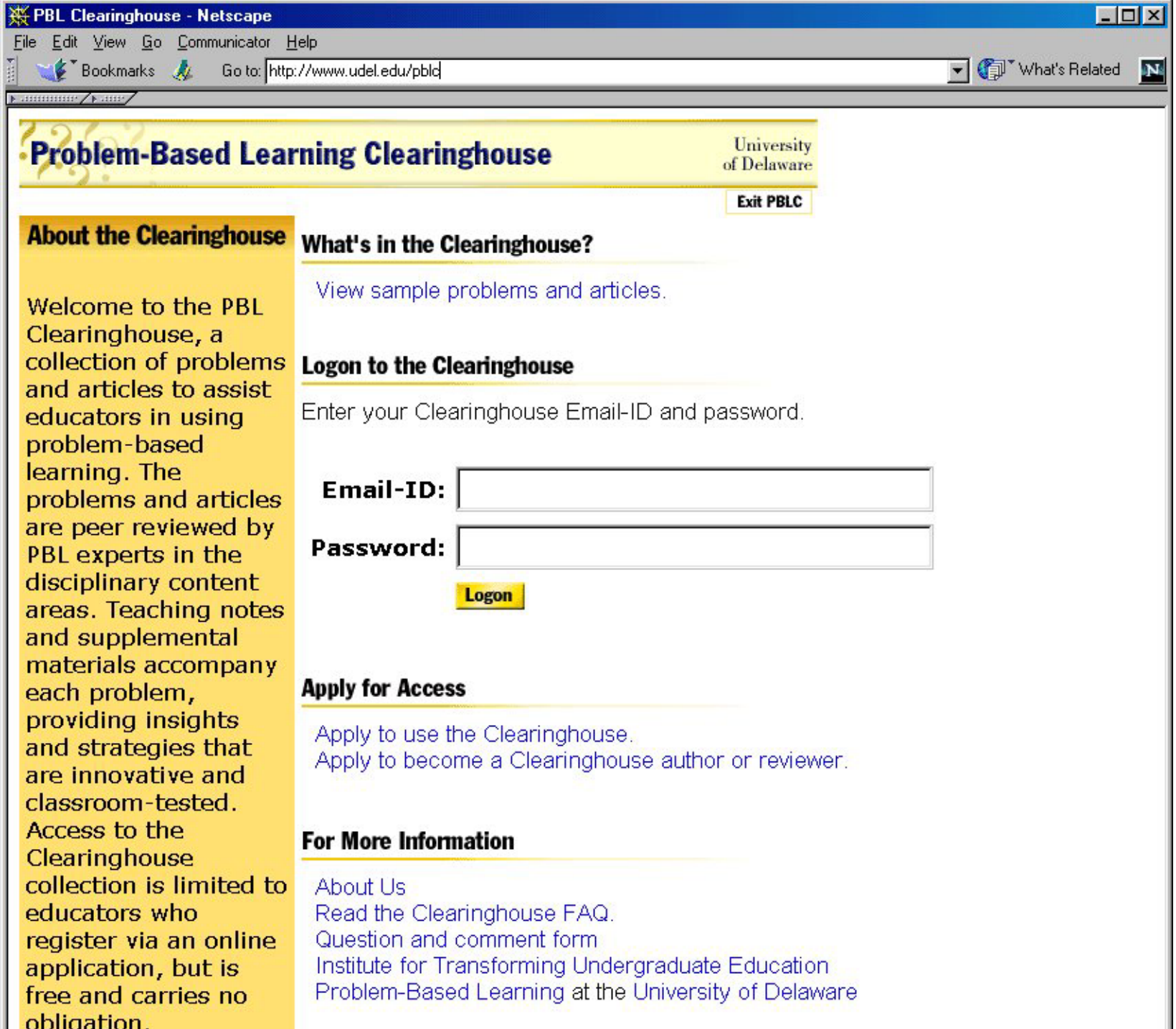
Materials are being collected and reviewed for a wide variety of introductory physics courses, for both science majors and non-science majors, across all levels of instruction and class enrollment. In addition to collecting existing problems and material, the project is implementing problem-writing workshops as an important element in developing the collection of PBL materials needed to cover the different curricula of physics at the college level. Selected clearinghouse problems will also be adapted to the high school setting.

But where are the problems?

- Typical end-of-chapter problems can be solved by rote memorization, pattern-match, and plug-and-chug techniques
- Good problems should require students to make assumptions and estimates, develop models, and work through the model.
- A source of problems outside the commercial texts needs to be developed.

PBL Clearinghouse

- An online database of PBL articles and problems.
- All material is peer-reviewed by PBL practitioners for content and pedagogy.
- All problems are supported by learning objectives and resources, teaching and assessment notes.
- Holdings are searchable by author, discipline, keywords, or full text.
- Fully electronic submission, review, and publication cycle.
- Controlled access by free user subscription, students excluded.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About the Clearinghouse
Welcome to the PBL Clearinghouse, a collection of problems and articles to assist educators in using problem-based learning. The problems and articles are peer reviewed by PBL experts in the disciplinary content areas. Teaching notes and supplemental materials accompany each problem, providing insights and strategies that are innovative and classroom-tested. Access to the Clearinghouse collection is limited to educators who register via an online application, but is free and carries no obligation.
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Featured Problem

Teetering On the Brink of Extinction?

Driving slowly down a gravel road in southern Florida in the failing late-afternoon light, I was startled by the long tawny form, which loped across the road in front of the car. My glimpse was only a second or perhaps two at most and then it was gone...

(see complete text)

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for Problems and Articles by All

Enter search string:

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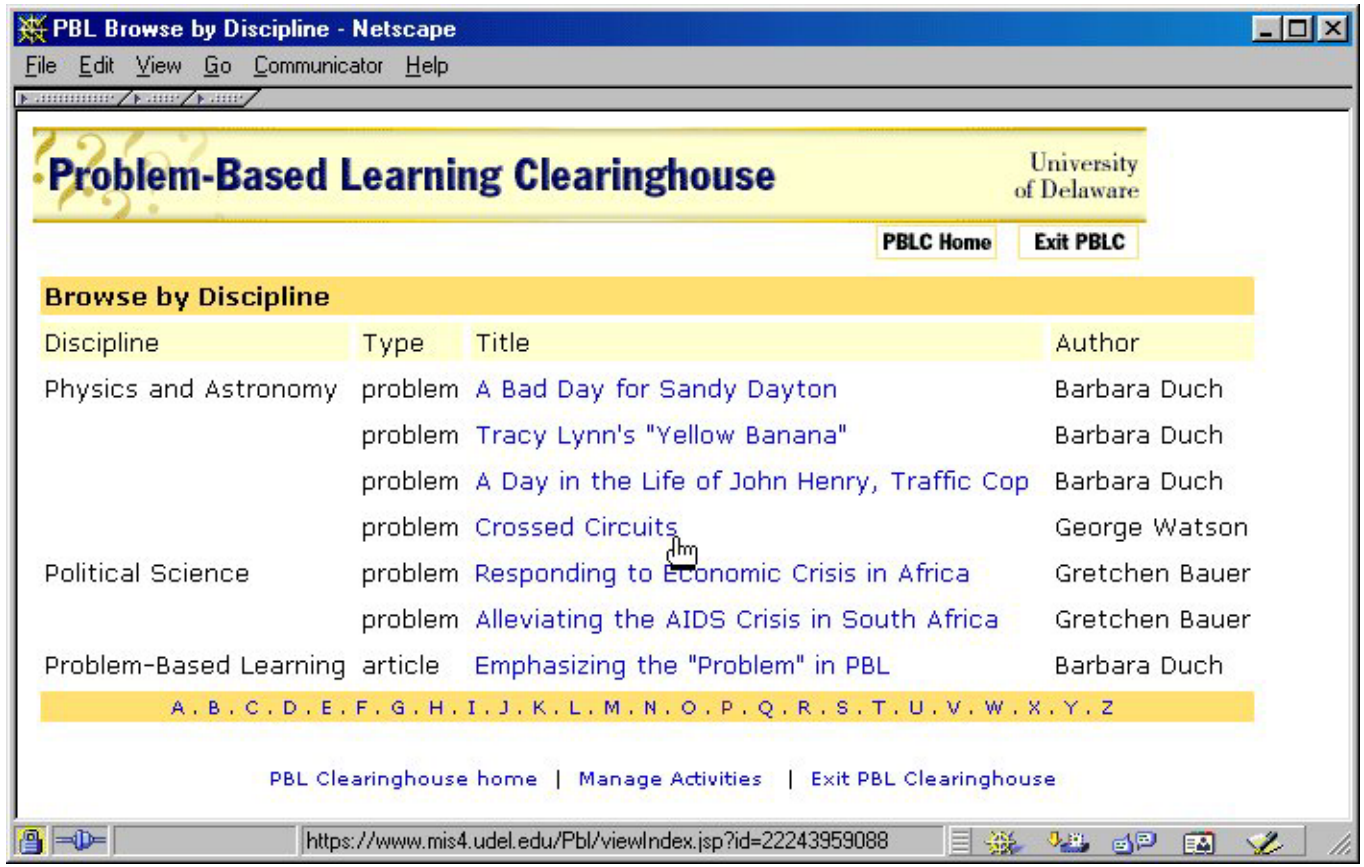
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Problem Detail

Title: Crossed Circuits

Author: George H Watson
Department of Physics and Astronomy
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Newark, DE 19716
ghw@physics.udel.edu

Discipline: Physics and Astronomy

Target Audience: Introductory, non-majors

Keywords: circuits, electric energy, electric power, electricity

Length of Time/Staging: one class/all at once

Abstract: Two roommates argue about each others use of energy. Which roommate should pay a utility premium? How much extra?

Date Submitted: 10/2/2000

Date Published: 1/5/2001

Problem content: Problem Statement

Supporting Materials: Format of Delivery
Student Learning Objectives
Student Resources
Instructor Resources
Author's Teaching Notes
Assessment Strategies
Solution Notes

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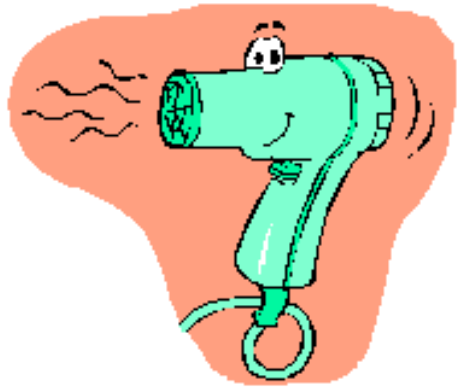


Crossed Circuits

"How long does it take you to dry your hair?" came Chris's scream from the kitchen. "I'm trying to concentrate on my physics homework!"

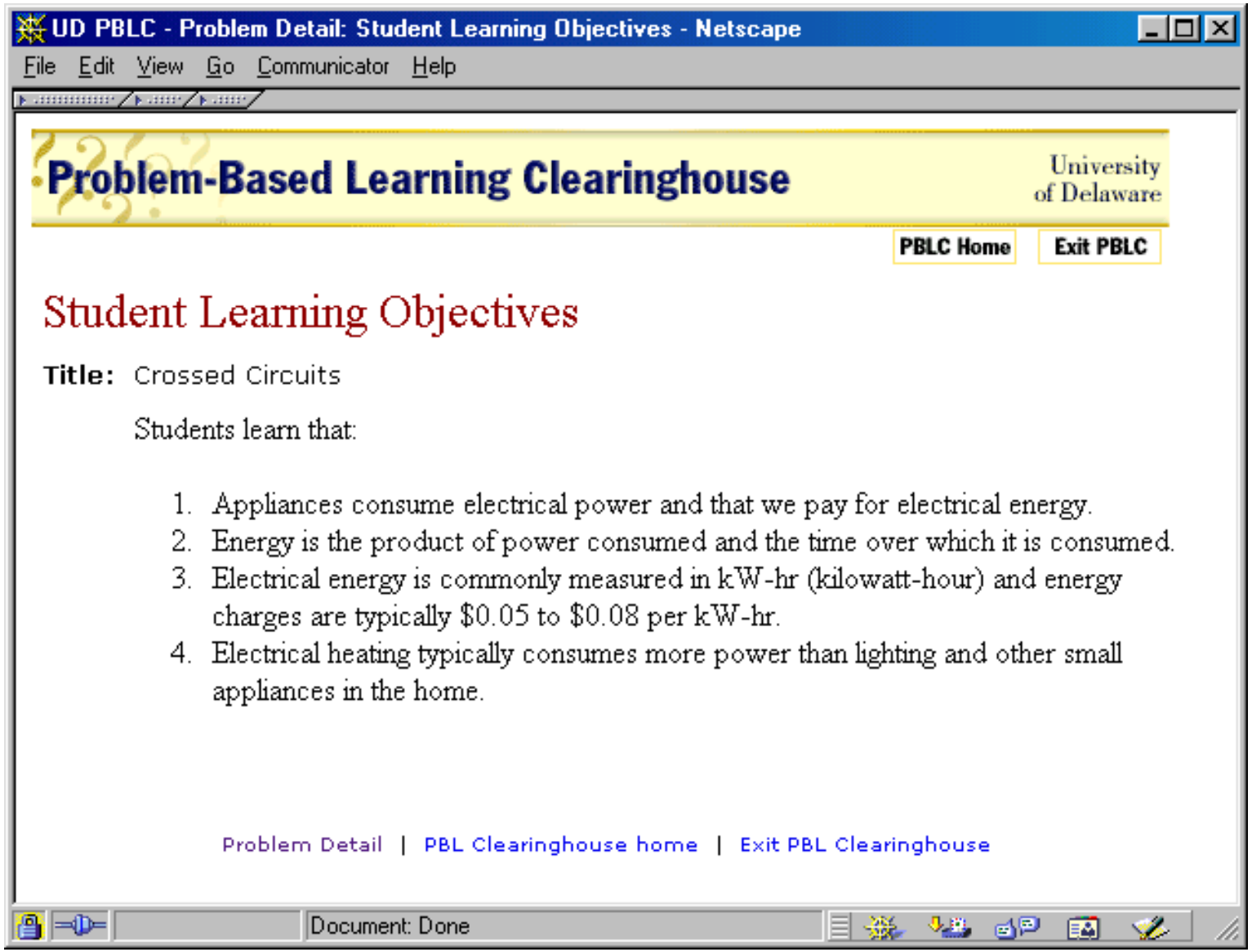
"Do you want the answer as a fraction of a year?" came Pat's retort from the bathroom." Then you can have fun looking up the conversion to minutes in the back of your textbook!"

"You've been at it for at least 20 minutes. You know, you should have to pay extra toward the electric bill. I bet you spend an hour a day drying your hair. I think $5 extra each month would be about right."

"You've gotta be kidding me. With you and your night light burning all night long, I bet you use much more electricity than me! What are you afraid of anyway?"

"Yeah, but sometimes you fall asleep with your TV blaring. I bet that uses much more than my little night light."

"Oh, please! That only happens once a month. Your Winnie-the-Pooh light is on every night! Besides, how about your incessant showering. You take at least twice as long in the shower as I do. That must cost much more than running my hair dryer. What do you do in there anyway?"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Student Learning Objectives
Title: Crossed Circuits
Students learn that:
1. Appliances consume electrical power and that we pay for electrical energy.
2. Energy is the product of power consumed and the time over which it is consumed.
3. Electrical energy is commonly measured in kW-hr (kilowatt-hour) and energy charges are typically $0.05 to $0.08 per kW-hr.
4. Electrical heating typically consumes more power than lighting and other small appliances in the home.
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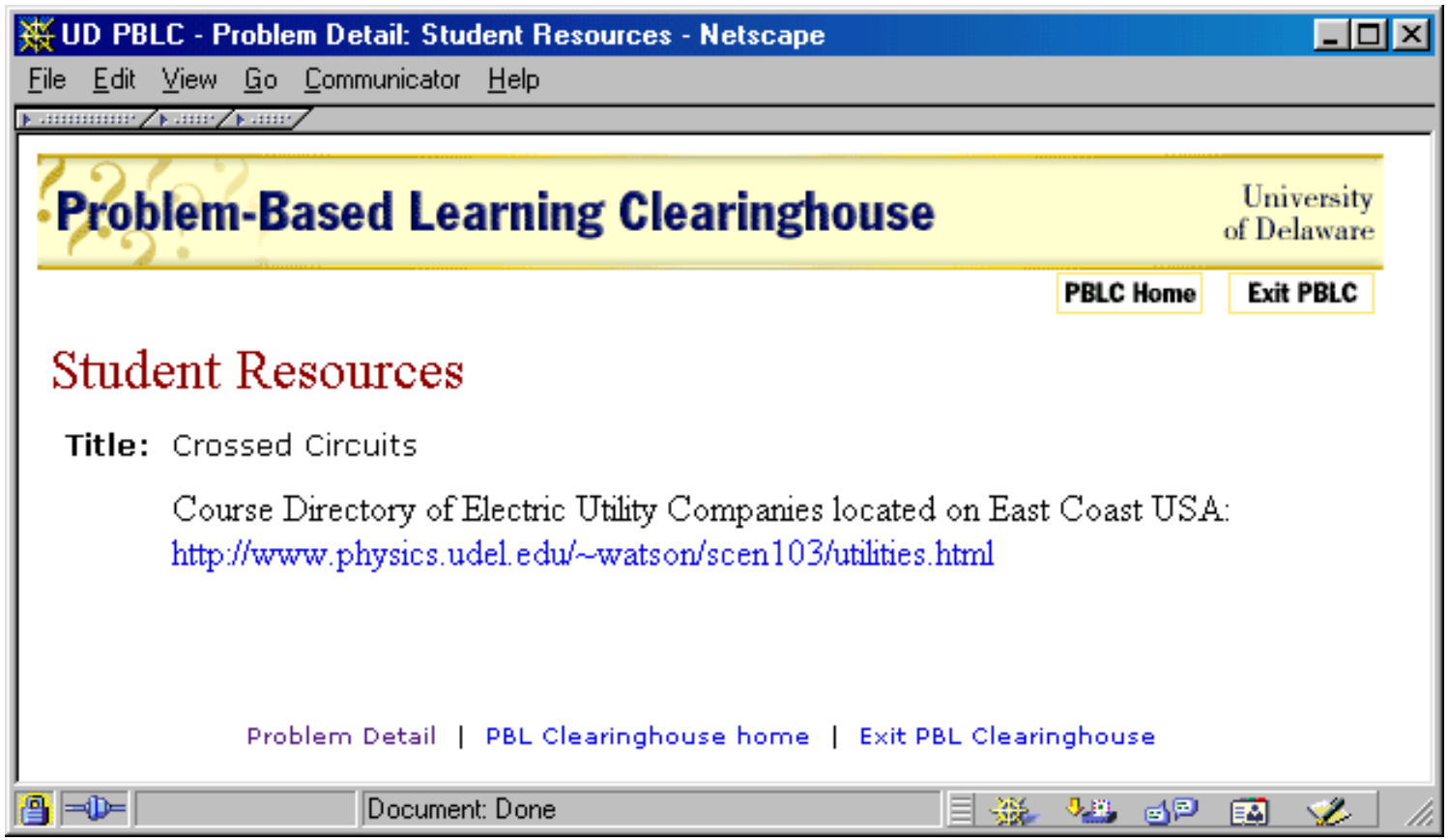
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Student Resources
Title: Crossed Circuits
Course Directory of Electric Utility Companies located on East Coast USA:
http://www.physics.udel.edu/~watson/scen103/utilities.html
Problem Detail | PBL Clearinghouse home | Exit PBL Clearinghouse
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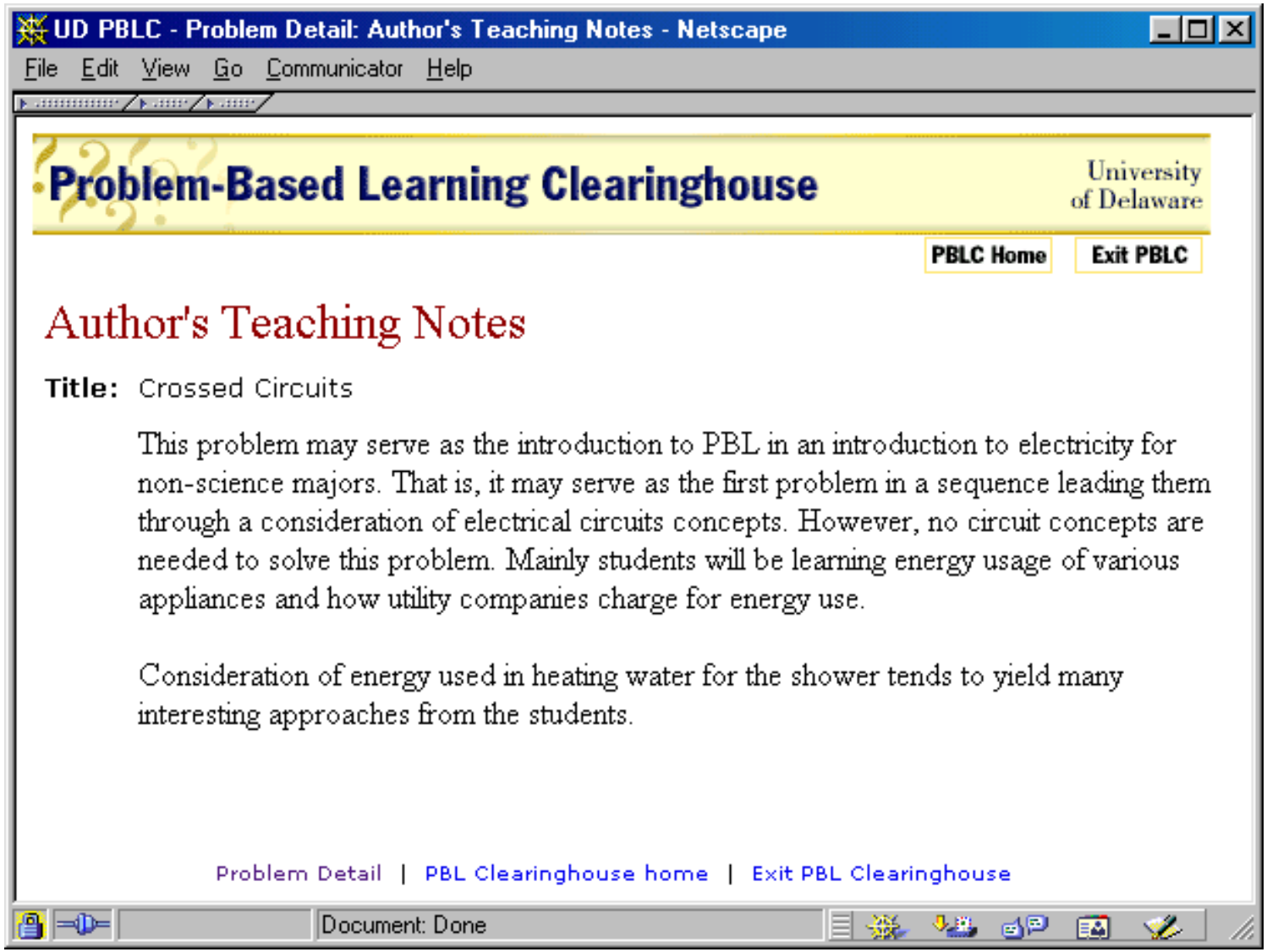
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Author's Teaching Notes
Title: Crossed Circuits
This problem may serve as the introduction to PBL in an introduction to electricity for non-science majors. That is, it may serve as the first problem in a sequence leading them through a consideration of electrical circuits concepts. However, no circuit concepts are needed to solve this problem. Mainly students will be learning energy usage of various appliances and how utility companies charge for energy use.
Consideration of energy used in heating water for the shower tends to yield many interesting approaches from the students.
Problem Detail | PBL Clearinghouse home | Exit PBL Clearinghouse
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Solution Notes

Title: Crossed Circuits

The night light and TV are of no consequence in the argument. The students' focus should be hairdryer *vs.* shower.

The hairdryer calculation is unambiguous: assume a power for the hairdryer: say 1200W. 20 minutes is 1/3 hr, so the energy used each time by the hairdryer is the product of 1200 W and 1/3 hr; that is, 0.4 kW-hr. 30 days would yield 12 kW-hr per month. Assuming $0.07 per kW-hr would net a charge of about $1 per month ($0.84).

The hot water charge is less definitive and the students must rise to the challenge of finding an approach. A number will incorrectly look at the power rating for a typical electric hot water heater and multiply by the time of the shower -- hopefully the group will realize that the "hot" shower ends when the hot water held in the storage tank of the hot water heater is emptied ***and*** that it takes longer to heat the new water than it did to empty the tank during the shower. One suitable approach is to find out the storage capacity of a typical hot water heater and use lessons learned in freshmen chemistry to calculate the energy needed to raise that quantity of water from the temperature of tap water to the temperature suitable for showering.

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Featured Problem

A Day in the Life of John Henry, Traffic Cop

Last Friday at 13:20, a frantic call was received at the local police station. A serious automobile accident had occurred at the intersection of Main St. and State St., with injuries involved. Lt. John Henry arrived at the scene 10 minutes after the phone call and found that two cars had collided at the intersection.

(see complete text)

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Institutional Change: Convincing Colleagues

What are the institutional barriers and challenges for adoption and continued use of PBL in your discipline/ department?

Wrap-up, Questions and Answers

Does the group want to reconvene on Thursday Morning?