Problem Based Learning

What is it?

Problem Based Learning (PBL) is, in short, a means of learning through solving problems. There are no lectures, teachers do a minimum of "presentation" of ideas. Instead, students work problems then discuss them, with the guidance of another student. The answers are not at the center of the work, the process of discussion is what's important. The discussion should focus on the ***connection between ideas*** – based on questions such as:

- What is the underlying idea in the problem?
- How is this problem similar to something we've seen?
- Is there a generalization we can make?
- What vocabulary have we learned or enhanced our understanding of?
- What is the likely next evolution of the underlying idea?

What resources will we use?

We will use the Math 4 curriculum from Phillips Exeter Institute (2009-10 edition).

What will the homework be like? Will we have more homework?

We will work sequentially through the Math 4 book, beginning on page 1. Students will work on somewhere between 6 and 8 problems for each class session. Sometimes this will take more time than in previous years, other times less. Plan on spending around one hour45-60 min on math homework each evening. We will adapt the number of problems as we go along.

What will the daily flow of class look like?

On a given day, a student will lead the discussion of one problem. *We will cycle through students in a repeated fashion, so you will know in advance which problem discussions you will be leading.* If you are absent, it is your responsibility to trade with another student so that all problems get presented.

How is my grade determined? How do assessments work?

Your grade will be based on:

- **Problem Presentations**: You will receive a score between 1 and 5 marks for each problem you present. The scoring rubric for presenting problems is given below.
- **Notebook Reviews**: I will regularly assess the quality of the work in your notebook. See below for expectations.
- **"HW" Quizzes**: Like the "Quick Quizzes" that you are familiar with, I will, on occasion, give short quizzes at the beginning or end of class. I will grade these and enter them in MB as part of your overall course grade.
- **Cumulative Tests**: Several times in the semester I will give more broad based assessments covering a significant number of ideas to determine your level of mastery. These will

What is expected in my notebook?

- Beyond doing the problems clearly and fully, you are expected to take notes, highlight formulae, include references to other pages with relevant ideas and, in short, create a working resource that someone else could use as a guide through the problems. This will be a new experience for most of you – be prepared to rethink what "taking notes" or "doing problems" means.

Assessment Rubric for HW Problem Presentations

Mark	Description
0	Did not present problem at all.
1	***Little or no*** indication of having attempted the problem before class. ***Weak or little*** effort or engagement in presentation. ***Reluctance*** to attempt or explain the problem. ***No*** expansion of the ideas beyond the problem presented
2	***Little or no*** indication of having attempted the problem before class. ***Reasonable*** effort or engagement in presentation. ***Willingness*** to attempt or explain the problem. ***No*** expansion of the ideas beyond the problem presented
3	***Little or no*** indication of having attempted the problem before class. ***Strong*** effort and engagement in presentation. ***Enthusiasm*** when explaining the problem. ***Minimal or no effort*** to expand the ideas beyond the problem presented
4	***Reasonable*** attempt at doing the problem before class; evident in notebook ***Good*** effort and engagement in presentation. ***Minimal or no effort*** to expand the ideas beyond the problem presented
5	***Solid*** attempt at doing the problem before class; evident in notebook ***Good*** effort and engagement in presentation. ***Clear effort*** to expand the ideas beyond the problem presented
6	***Strong*** attempt at doing the problem before class; evident in notebook ***Good*** effort and engagement in presentation. ***Clear effort*** to expand the ideas beyond the problem presented
7	***Thorough*** attempt at doing the problem before class; evident in notebook ***Excellent*** effort and engagement in presentation. ***Thoughtful*** expansion of the ideas beyond the problem presented

From Exeter's introduction to the student Math 4 book:

To the Student

Contents: Members of the PEA Mathematics Department have written the material in this book. As you work through it, you will discover that algebra, geometry, and trigonometry have been integrated into a mathematical whole. There is no Chapter 5, nor is there a section on tangents to circles. The curriculum is problem-centered, rather than topic-centered. Techniques and theorems will become apparent as you work through the problems, and you will need to keep appropriate notes for your records — there are no boxes containing important theorems. There is no index as such, but the reference section that starts on page 201 should help you recall the meanings of key words that are defined in the problems (where they usually appear italicized).

Comments on problem-solving: You should approach each problem as an exploration. Reading each question carefully is essential, especially since definitions, highlighted in italics, are routinely inserted into the problem texts. It is important to make accurate diagrams whenever appropriate. Useful strategies to keep in mind are: create an easier problem, guess and check, work backwards, and recall a similar problem. It is important that you work on each problem when assigned, since the questions you may have about a problem will likely motivate class discussion the next day.

Problem-solving requires persistence as much as it requires ingenuity. When you get stuck, or solve a problem incorrectly, back up and start over. Keep in mind that you're probably not the only one who is stuck, and that may even include your teacher. If you have taken the time to think about a problem, you should bring to class a written record of your efforts, not just a blank space in your notebook. The methods that you use to solve a problem, the corrections that you make in your approach, the means by which you test the validity of your solutions, and your ability to communicate ideas are just as important as getting the correct answer.

About technology: Many of the problems in this book require the use of technology (graphing calculators or computer software) in order to solve them. Moreover, you are encouraged to use technology to explore, and to formulate and test conjectures. Keep the following guidelines in mind: write before you calculate, so that you will have a clear record of what you have done; store intermediate answers in your calculator for later use in your solution; pay attention to the degree of accuracy requested; refer to your calculator's manual when needed; and be prepared to explain your method to your classmates. Also, if you are asked to "graph $y = (2x - 3)/(x + 1)$", for instance, the expectation is that, although you might use your calculator to generate a picture of the curve, you should sketch that picture in your notebook or on the board, with correctly scaled axes.