Problem Based Learning (PrBL) creates mathematical experiences by steeping students in a variety of mathematical scenarios throughout a Unit. Generally, PrBL Units have about three to five problems, each with associated entry events, need-to-knows, and scaffolding.

The Problem Process

**Problem Launch**

Students are introduced to the problem in the form of a formal or informal Entry Event.

- Activate prior knowledge
- Be sure the task is understood
- The Know/Need-to-Know or other question-prompting process
- Brainstorm potential strategies / next steps
- Discuss how they will know if their solution is reasonable

**Problem Development / Student Work**

Students begin working on their solutions in their groups. The next-steps may initially be used as a guide for groups to begin their work.

- Let go!
- Listen actively
- Ask probing questions
- Suggest extensions or generalizations
- Offer scaffolding as needed

**Problem Debrief or Plenary Discussion**

This is where the teacher promotes cognitive connections. Students are prompted to make generalizations based on their work.

- Share out multiple strategies / solutions
- Engage the class in discussion about strategies
- Highlight key ideas / skills / vocabulary
- Reinforce with practice
- Offer follow-up scaffolding, reteaching, or additional problems as needed

Discuss!

What unique challenges and opportunities does mathematics provide in an inquiry-based environment?

How might these challenges and opportunities point towards a Problem Based approach in mathematics?

What are some goals you’d like to establish for your mathematical classroom this year? What are some supports you could use to achieve those goals?

FAQs

**Question:** How can I solicit NTKs about mathematical concepts when students haven’t ever seen the concept?

**Answer:** While students may not use the mathematics terminology during the NTK process, the problem scenario should prompt questions about the concept. For example, for a problem about projectile motion, they may not use the term “quadratics” but the problem should prompt students to ask about the path an object takes.

**Question:** How long do I allow students to productively struggle in a problem before I offer scaffolding?

**Answer:** Ten to fifteen minutes, depending on the amount of perplexity in the room.

**Question:** What should I ask during the debrief?

**Answer:** Were there any differing solution strategies? Can you generalize or extend the problem? To what else can this mathematical concept apply? Can you summarize other groups’ work?
Steps to Problem Planning

**Step 1: Begin with the math**
- Clearly articulate the ideas you want students to learn as a result of the activity
- Determine the essential knowledge and skills that you will assess

**Step 2: Consider your students**
- What do your students know and understand about this topic already?
- What prerequisite skills do they need? Are they ready to tackle this topic?

**Step 3: Decide on a task**
- Consider a real world application of the essential ideas / skills
- Create an open problem with multiple entry points / multiple solution methods

**Step 4: Predict what will happen**
- What do you think their need-to-knows will be? What strategies might they use to solve the problem? What obstacles might they encounter along the way? What probing questions can you use to help and/or push them deeper?

**Step 5: Articulate student responsibilities**
- What are your expectations for students to document and present their work?
- What are your expectations for students working in their teams?

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**Sample Unit Calendar – Linear Equations (Grade 8)**

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
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<tbody>
<tr>
<td><strong>Problem 1: Gas Mileage</strong>&lt;br&gt;Knows/Need to knows&lt;br&gt;*workshop – classifying lines</td>
<td><strong>Problem 2: Snack Shack</strong>&lt;br&gt;Presentation&lt;br&gt;Journals – Identifying the slope of a line</td>
<td><strong>Problem 3: Puzzle Problem (Part 1)</strong>&lt;br&gt;Linear Equations Scaffolding Activity&lt;br&gt;Workshop – Ordered pair solutions to linear equations</td>
<td><strong>Problem 2: Snack Shack</strong>&lt;br&gt;*workshop – slope intercept form&lt;br&gt;Exit Ticket</td>
<td><strong>Day 5</strong>&lt;br&gt;Mini-Quiz: Slope Problem 2 work time&lt;br&gt;Problem 2 work time</td>
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<th>Day 6</th>
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<tr>
<td><strong>Problem 3: Puzzle Problem (Part 2)</strong>&lt;br&gt;Problem Solving Framework</td>
<td><strong>Day 8</strong>&lt;br&gt;Warm Up – Translating scenarios into equations</td>
<td><strong>Problem 3: Puzzle Problem (Part 2)</strong>&lt;br&gt;Problem Presentations</td>
<td><strong>Day 9</strong>&lt;br&gt;Problem work time&lt;br&gt;Workshop - Linear equation word problems</td>
<td><strong>Day 10</strong>&lt;br&gt;Literacy Task – Everything I know about ...&lt;br&gt;Problem Presentations</td>
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<tr>
<th>Day 11</th>
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<th>Day 15</th>
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<tr>
<td><strong>Day 12</strong>&lt;br&gt;FAL: Lines and Linear Equations (Shell Centre)&lt;br&gt;Pre-Assessment&lt;br&gt;FAL Day 2: Lines and Linear Equations&lt;br&gt;FAL Post-Assessment</td>
<td><strong>Day 13</strong>&lt;br&gt;Warm Up – Graphing Stories Practice Day&lt;br&gt;Workshops – Linear equations</td>
<td><strong>Day 14</strong>&lt;br&gt;Problem 4: Do the Harlem Shake&lt;br&gt;Workshops – One step inequalities</td>
<td><strong>Day 15</strong>&lt;br&gt;Problem Poster Gallery Walk&lt;br&gt;Group Discussion: Linear Inequalities</td>
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<tr>
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<tr>
<td><strong>Day 16</strong>&lt;br&gt;LAB: Motion and Equations&lt;br&gt;Echo Journal Write – Conclusions from lab – provide questions that must be answered.</td>
<td><strong>Day 17</strong>&lt;br&gt;<strong>Problem 5: Do the Crabwalk</strong>&lt;br&gt;Knows/Need to knows Group Time</td>
<td><strong>Day 18</strong>&lt;br&gt;Cumulative Poster&lt;br&gt;Journal: Reflection on Linear Equations Unit</td>
<td><strong>Day 19</strong>&lt;br&gt;Summative Assessment</td>
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**Attributes of a quality problem:**
- Multiple entry points/solution paths
- Immediately engaging and interesting
- Low barrier of entry, high ceiling
- The math is unavoidable!

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**Sample Unit Calendar – Linear Equations (Grade 8)**

| CCSS: 8-EF.5,6,7, 7a; 8-F.A.12,3,4; 7-RP.2,3 |

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**Places to find good problems:**
- Yummymath
- Dan Meyer's Three Act Tasks
- Robert Kaplinsky's Lessons
- Illustrative Mathematics
- Shell Centre Math Tasks & Lessons
- 101qs.com

Tip: Try facilitating the Need-to-Know or “What questions do you have?” process with your non-math colleagues to get a sense at what questions the problem will elicit.

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