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?

Setting the Scene: Designing Your Problem-Based Classroom

New Tech Network

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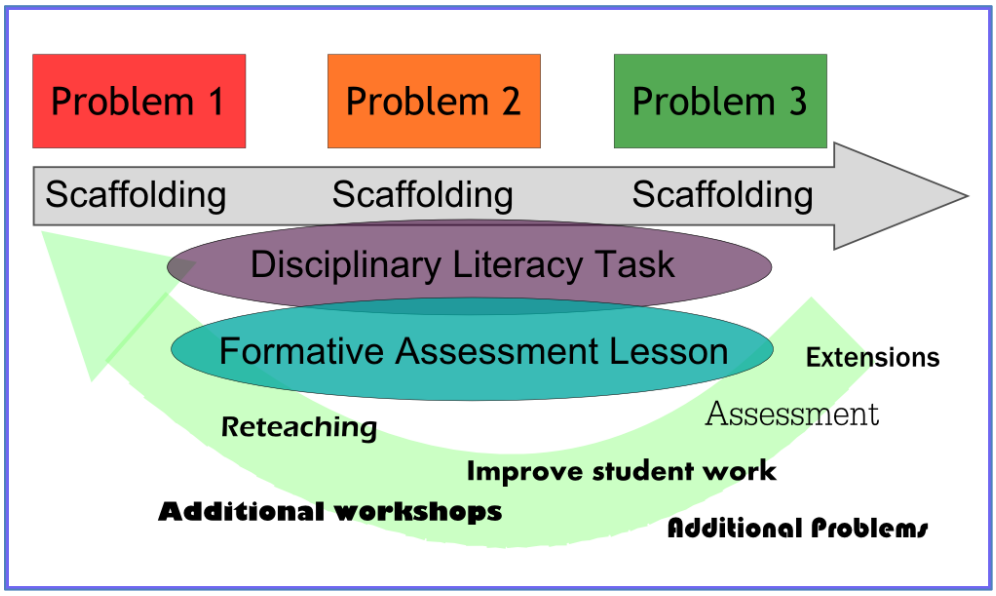
Problem Based Learning (PrBL) creates mathematical experiences by steeping students in a variety of mathematical scenarios throughout a Unit. Generally, PrBL Units have about three to five problems, each with associated entry events, need-to-knows, and scaffolding.



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

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.

Attributes of a quality problem:

- Multiple entry points/solution paths
- Immediately engaging and interesting
- Low barrier of entry, high ceiling
- The math is unavoidable!

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?

Sample Unit Calendar – Linear Equations (Grade 8) CCSS: 8-EE.5,6,7, 7a; 8-F.A.12,3,4; 7-RP.2,3

Day 1 Problem 1: Gas Mileage Knows/Need to knows *workshop – classifying lines	**Day 2** Warm Up (Evaluate) Presentations Journals –Identifying the slope of a line	**Day 3** Matching Game (scaffolding activity) Exit Ticket	**Day 4** Problem 2: Snack Shack *workshop – slope intercept form	**Day 5** Mini-Quiz: Slope Problem 2 work time
Problem 1			Problem 2	
Day 6 Problem 3: Puzzle Problem (Part 1) Problem Solving Framework	**Day 7** Linear Equations Scaffolding Activity Workshop- *Ordered pair solutions to linear equations*	**Day 8** Warm Up – Translating scenarios into equations Problem 3: Puzzle Problem (Part 2)	**Day 9** Problem work time *Workshop - Linear equation word problems* Problem Presentations	**Day 10** Literacy Task – Everything I know about …
Problem 3				Literacy Task
Day 11 FAL: Lines and Linear Equations (Shell Centre) Pre-Assessment	**Day 12** FAL Day 2: Lines and Linear Equations FAL Post-Assessment	**Day 13** Warm Up – Graphing Stories Practice Day Workshops – Linear equations	**Day 14** Problem 4: Do the Harlem Shake Workshops – One step inequalities	**Day 15** Problem Poster Gallery Walk Group Discussion: Linear Inequalities
Formative Assessment Lesson (FAL)			Problem 4	
Day 16 LAB: Motion and Equations Echo Journal Write – Conclusions from lab – provide questions that must be answered.	**Day 17** Problem 5: Do the Crabwalk Knows/Need to knows Group Time	**Day 18** Cumulative Poster Journal: Reflection on Linear Equations Unit	**Day 19** Summative Assessment	
	Problem 5			