

# Observing Mathematics Lessons

## What should we focus on?

## Handouts

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## Handout 1: Observing Classroom Activity

**Why do we observe math lessons?**

**What do we focus on when we observe them?**

**How can we use our observations more constructively?**

## Handout 2: Five Dimensions of Mathematically Powerful Classrooms

<b>The Mathematics</b>	How do mathematical ideas from this unit/course develop in this lesson/lesson sequence? How can we create more meaningful connections?
<b>Cognitive Demand</b>	What opportunities do students have to make their own sense of mathematical ideas? How can we create more opportunities?
<b>Access to Mathematical Content</b>	Who does and does not participate in the mathematical work in the class, and how? How can we create opportunities for each student to participate meaningfully?
<b>Agency, Authority, and Identity</b>	What opportunities do students have to see themselves and each other as powerful doers of mathematics? How can we create more of these opportunities?
<b>Formative Assessment</b>	What do we know about each students current mathematical thinking? How can we build on it?

## Handout 3: Two Tasks

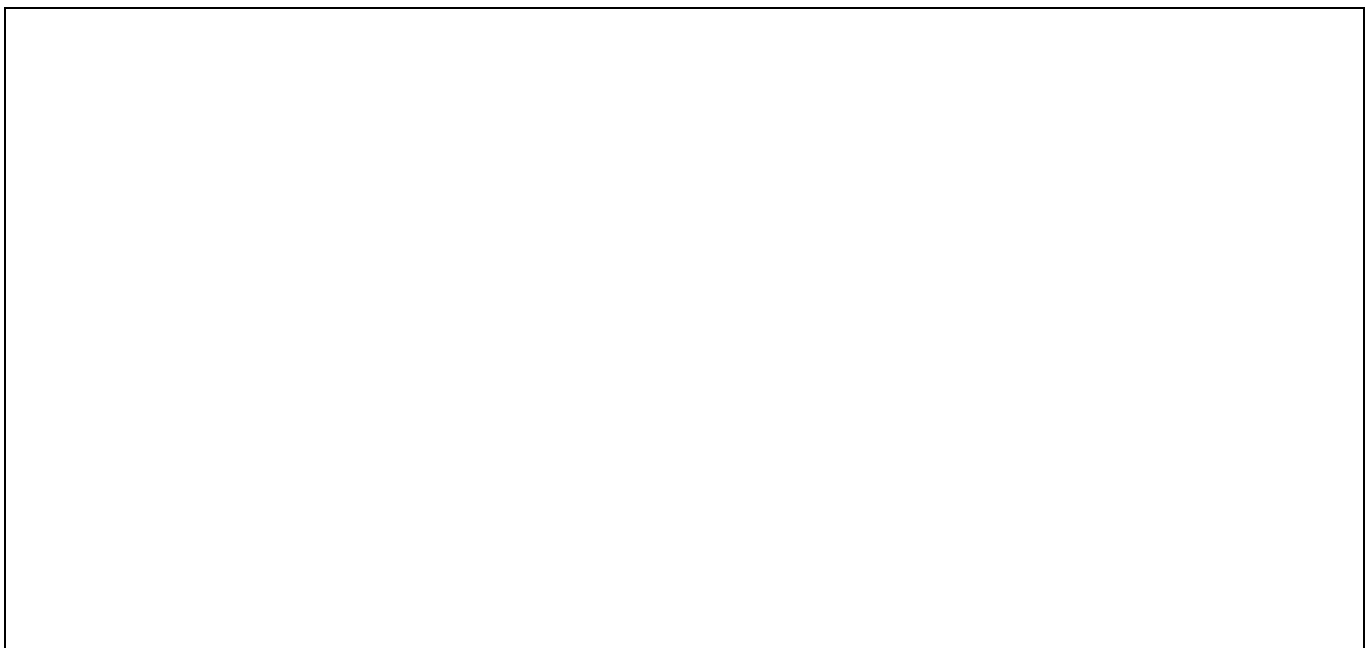
1. Attempt both tasks: 'A Geometry Problem' and 'The Border Problem'.
2. Discuss with your neighbor:
  - the potential of the tasks for student learning
  - how students may solve each problem
  - the challenges they may face

### A Geometry Problem

Find the measure of all angles

The diagrams are as follows:

- Diagram 1: Two intersecting lines. The top-right angle is  $70^\circ$ . The top-left angle is  $b$ , the bottom-left angle is  $a$ , and the bottom-right angle is  $c$ .
- Diagram 2: A horizontal line with a vertical line intersecting it at a right angle. A ray extends from the intersection point into the upper-right quadrant, forming an angle of  $53^\circ$  with the horizontal line. The angle between the vertical line and this ray is labeled  $d$ .
- Diagram 3: A horizontal line with a vertical line intersecting it at a right angle. A ray extends from the intersection point into the upper-right quadrant, forming an angle of  $8^\circ$  with the vertical line. Another ray extends from the intersection point into the lower-left quadrant, forming an angle  $f$  with the horizontal line. The angle between the horizontal line and the lower-left ray is labeled  $e$ , and the angle between the vertical line and the lower-left ray is labeled  $g$ .
- Diagram 4: Two intersecting lines. The bottom-right angle is  $60^\circ$ . The top-right angle is  $h$ , the top-left angle is  $i$ , and the bottom-left angle is  $j$ .



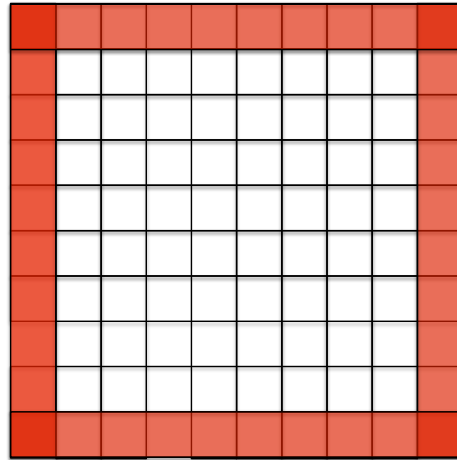
## The Border Problem

### The Border Problem

Here's a 10 x 10 grid.

Without counting  
them all one by  
one,  
how can you figure  
out the number of  
border tiles?

What about other  
sizes?



## Handout 4: Looking at Tasks

		A Geometry Problem	The Border Problem
<b>The Mathematics</b>	<p>Does the task address important mathematics? Please explain.</p> <p>Are there opportunities for meaningful connections?</p>		
<b>Cognitive Demand</b>	<p>Is the task challenging? Please explain.</p> <p>Does the task require reasoning or only recall?</p>		
<b>Access to Mathematical Content</b>	<p>Does the task have an easy entry point? Please explain.</p> <p>Does it have a ramp of difficulty?</p>		
<b>Agency, Authority and Identity</b>	<p>Does the task offer opportunities for students to make decisions and give explanations?</p>		
<b>Formative Assessment</b>	<p>Does the task offer opportunities for students to compare and assess a range of different methods? Does the teacher follow up student responses?</p>		

## Handout 5: Looking at Lessons

While watching the two videos, take notes on what you see. Focus from the point of view of the students.

		A Geometry Problem	The Border Problem
<b>The Mathematics</b>	How did students actually engage with important mathematical ideas in this lesson?		
<b>Cognitive Demand</b>	How long do students spend on each prompt?  Do they engage in productive struggle?  Do teacher questions invite explanations or answers?		
<b>Access to Mathematical Content</b>	Who explains most: the teacher or the students?  Do the students give extended explanations?		
<b>Agency, Authority and Identity</b>	Does the teacher follow up student responses?  Does the teacher vary the lesson in the light of student responses?		
<b>Formative Assessment</b>	Does the task offer opportunities for students to compare and assess a range of different methods? Please explain.		

## Handout 6: The Five Dimensions in More Detail

### The Mathematics

Core Question: How do mathematical ideas from this unit/course develop in this lesson/lesson sequence?

Students often experience mathematics as a set of isolated facts, procedures and concepts, to be rehearsed, memorized, and applied. Our goal is to instead give students opportunities to experience mathematics as a coherent and meaningful discipline. This means identifying the important mathematical ideas behind facts and procedures, highlighting connections between skills and concepts, and relating concepts to each other—not just in a single lesson, but also across lessons and units. It also means engaging students with centrally important mathematics in an active way, so that they can make sense of concepts and ideas for themselves and develop robust networks of understanding.

### The Mathematics

Pre-observation	Reflecting After a Lesson	Planning Next Steps
How will important mathematical ideas develop in this lesson and unit?	How did students actually engage with important mathematical ideas in this lesson?	How can we connect the mathematical ideas that surfaced in this lesson to future lessons?

*Think about:*

- The mathematical goals for the lesson.
- What connections exist among important ideas in this lesson and important ideas in past and future lessons.
- How math procedures in the lesson are justified and connected with important ideas.
- How we see/hear students engage with mathematical ideas during class.
- Which students get to engage deeply with important mathematical ideas.
- How future instruction could create opportunities for more students to engage more deeply with mathematical ideas.



## Cognitive Demand

Core Question: What opportunities do students have to make their own sense of mathematical ideas?

We want students to engage authentically with important mathematical ideas, not simply receive knowledge. This requires students to engage in productive struggle. They need to be supported in these struggles so that they aren't lost, but at the same time, support should maintain students' opportunities to grapple with important ideas and difficult problems. Finding a balance is difficult, but our goal is to help students understand the challenges they confront, while leaving them room to make their own sense of those challenges.

## Cognitive Demand

Pre-observation	Reflecting After a Lesson	Planning Next Steps
What opportunities will students have to make their own sense of important mathematical ideas?	What opportunities did students have to make their own sense of important mathematical ideas?	How can we create more opportunities for students to make their own sense of important mathematical ideas?

*Think about:*

- What opportunities exist for students to struggle with mathematical ideas.
- How students' struggles may support their engagement with mathematical ideas.
- How the teacher responds to students' struggles and how these responses support students to engage without removing struggles.
- What resources (other students, the teacher, notes, texts, technology, manipulatives, various representations, etc.) are available for students to use when they encounter struggles.
- What resources students actually use and how they might be supported to make better use of resources.
- Which students get to engage deeply with important mathematical ideas.
- How future instruction could create opportunities for more students to engage more deeply with mathematical ideas.
- What community norms seem to be evolving around the value of struggle and mistakes.

## Access to Mathematical Content

Core Question: Who does and does not participate in the mathematical work of the class, and how?

All students should have access to opportunities to develop their own understandings of rich mathematics, and to build productive mathematical identities. For any number of reasons, it can be extremely difficult to provide this access to everyone, but that doesn't make it any less important! We want to challenge ourselves to recognize who has access and when. There may be mathematically rich discussions or other mathematically productive activities in the classroom—but who gets to participate in them? Who might benefit from different ways of organizing classroom activity?

## Access to Mathematical Content

Pre-observation	Reflecting After a Lesson	Planning Next Steps
What opportunities exist for each student to participate in the mathematical work of the class?	Who did and didn't participate in the mathematical work of the class, and how?	How can we create opportunities for each student to participate in the mathematical work of the class?

*Think about:*

- What range of ways students can and do participate in the mathematical work of the class (talking, writing, leaning in, listening hard; manipulating symbols, making diagrams, interpreting graphs, using manipulatives, connecting different strategies, etc.).
- Which students participate in which ways.
- Which students are most active when, and how we can create opportunities for more students to participate more actively.
- What opportunities various students have to make meaningful mathematical contributions.
- Language demands and the development of students' academic language.
- How norms (or interactions, or lesson structures, or task structure, or particular representations, etc.) facilitate or inhibit participation for particular students.
- What teacher moves might expand students' access to meaningful participation (such as modeling ways to participate, providing opportunities for practice, holding students accountable, pointing out students' successful participation).
- How to support particular students we are concerned about (in relation to learning, issues of safety, participation, etc.).

## Agency, Authority, and Identity

Core Question: What opportunities do students have to explain their own and respond to each other’s mathematical ideas?

Many students have negative beliefs about themselves and mathematics, for example, that they are “bad at math,” or that math is just a bunch of facts and formulas that they’re supposed to memorize. Our goal is to support all students—especially those who have not been successful with mathematics in the past—to develop a sense of mathematical agency and authority. We want students to come to see themselves as mathematically capable and competent—not by giving them easy successes, but by engaging them as sense-makers, problem solvers, and creators of mathematical ideas.

## Agency, Authority, and Identity

Pre-observation	Reflecting After a Lesson	Planning Next Steps
What opportunities exist in the lesson for students to explain their own and respond to each other’s mathematical ideas?	What opportunities did students have to explain their own and respond to each other’s mathematical ideas?	What opportunities can we create in future lessons for more students to explain their own and respond to each other’s mathematical ideas?

*Think about:*

- Who generates the mathematical ideas that get discussed.
- Who evaluates and/or responds to others' ideas.
- How deeply students get to explain their ideas.
- How the teacher responds to student ideas (evaluating, questioning, probing, soliciting responses from other students, etc.).
- How norms around students' and teachers' roles in generating mathematical ideas are developing.
- How norms around what counts as mathematics (justifying, experimenting, practicing, etc.) are developing.
- Which students get to explain their own and respond to others' ideas in a meaningful way.

## Uses of Assessment

Core Question: What do we know about each student’s current mathematical thinking, and how can we build on it?

We want instruction to be responsive to students’ actual thinking, not just our hopes or assumptions about what they do and don’t understand. It isn’t always easy to know what students are thinking, much less to use this information to shape classroom activities—but we can craft tasks and ask purposeful questions that give us insights into the strategies students are using, the depth of their conceptual understanding, and so on. Our goal is to then use those insights to guide our instruction, not just to fix mistakes but to integrate students’ understandings, partial though they may be, and build on them.

## Uses of Assessment

Pre-observation	Reflecting After a Lesson	Planning Next Steps
What do we know about each student’s current mathematical thinking, and how does this lesson build on it?	What did we learn in this lesson about each student’s mathematical thinking? How was this thinking built on?	Based on what we learned about each student’s mathematical thinking, how can we (1) learn more about it and (2) build on it?

*Think about:*

- What opportunities exist for students to develop their own strategies and approaches.
- What opportunities exist for students to share their mathematical ideas and reasoning, and to connect their ideas to others’.
- What different ways students get to share their mathematical ideas and reasoning (writing on paper, speaking, writing on the board, creating diagrams, demonstrating with manipulatives, etc.).
- Who students get to share their ideas with (e.g., a partner, the whole class, the teacher).
- How students are likely to make sense of the mathematics in the lesson and what responses might build on that thinking.
- What things we can try (e.g., tasks, lesson structures, questioning prompts such as those in FALs) to surface student thinking, especially the thinking of students whose mathematical ideas we don't know much about yet.
- What we know and don't know about how each student is making sense of the mathematics we are focusing on.
- What opportunities exist to build on students’ mathematical thinking, and how teachers and/or other students take up these opportunities.