Please work on the following problem:
Write number sentences for 10. How many solutions are there?
Make number sentences for 10

Write number sentences for 10. How many solutions are there?

- What are significant features of this task?
  - In grades K-2?
  - In grades 3-5?
- What do these features mean for mathematics instruction?
What is the EML?

A live laboratory for the design and study of teaching:

- 10-day summer mathematics program for 5th grade students from a local school district.
- Setting for the study of teaching, learning, and mathematics by teachers, teacher educators, researchers, mathematicians and many others
- Source of unusual records of practice
Why is it called a “laboratory”?

**Laboratory:**
A planned setting developed for real-time studies of the interplay of instructional design, teaching, and learning

**Features of the laboratory:**
- Teaching that is public, perceptible, and made studyable
- Careful documentation
- Experimentation and interdisciplinary study
A site for collective work on practice

- Opportunity to deliberate collectively about instructional decisions, and to develop and discuss experiments
- Diverse participants with varied interests, areas of expertise, and “lenses” for viewing practice lend different perspectives and expand the range of discussion
What are we studying in the EML?

Ways to unpack and name specific teaching practices with respect to:

- What is involved in teaching specific aspects of the Common Core in mathematics?
- How can students be challenged with complex mathematical work while also filling in “gaps” in their past learning?
- What is involved in teaching mathematics with a deliberate focus on equity?
Overview of the session

① Using a laboratory context to work on the improvement of teaching

② Digging into productive mathematics tasks
   • Exploring tasks from the EML
   • Examining the tasks for features of productive tasks

③ Criteria for choosing high-quality tasks connected to the CCSSM mathematical practices
The mathematics in the EML

Among the mathematical topics emphasized are:

- Fractions
- Equations and operations

Among the mathematical practices emphasized are:

1. Make sense of problems and persevere in solving them.
3. Construct viable arguments and critique the reasoning of others.

An assumption is that work on mathematical practices and topics can be interwoven and that the learning of practices occurs inside of the learning of topics.
Revisiting Number Sentences for 10

Write number sentences for 10. How many solutions are there?

What features of the task make it high-quality and productive?

- Works with a wide range of students
- Allows for multiple solutions (MP3)
- Allows for multiple ways to organize the work (MP1)
- Benefits from collective work on the problem
- Covers significant mathematical terrain
Typical task
TASK 2: THE GRAY RECTANGLE PROBLEM
Task 2: The gray rectangle problem

What fraction of the rectangle below is shaded gray?

Rectangle 1

Rectangle 2
What do the responses reveal about students’ understanding of fractions?  
What features of the problem allow these understandings to surface?
Discussion questions

- What do the responses reveal about students’ understanding of fractions?
- What features of the problem allow these understandings to surface?
- What opportunities are there for students to engage in mathematical practices?
Task features

What fraction of the rectangle below is shaded gray?

Task Features

- Surfaces rather than avoids common patterns of student thinking
  - Common patterns: To name a shaded part of area students count the number of parts (denominator) and the number of shaded parts (numerator), lack of explicit attention to the notion of the whole.
  - Design features: Unequal partitioning, shaded areas are equal but not the same part of the whole

- Intentionally ambiguous to strengthen students’ reasoning (MP1)

- Elicits multiple solutions (MP3) by producing “errors” for collective analysis
Typical tasks

1. Much of the thinking is done for the students (e.g., equal partitioning; shading; labeling)

2. Protect from error -- supports getting “right” answer
TASK 3: THE MINICOMPUTER
Introduction to the minicomputer

(Papy Minicomputer)
Task 3: The minicomputer

Using exactly one positive and one negative checker, find all the numbers that can be represented on this minicomputer board.

Prove your answer and explain why.

(Papy Minicomputer)
The minicomputer - solutions

Using exactly one positive and one negative checker, find all the numbers that can be represented on this minicomputer board.

-7, -6, -4, -3, -2, -1, 0, 1, 2, 3, 4, 6, 7

Prove your answer and explain why.

(Papy Minicomputer)
Highlighting the conditions of the problem

CONDITONS OF THE PROBLEM
1. Use exactly one positive and one negative checker.
2. Must be a number that can be made on the Minicomputer.

Using exactly one positive and one negative checker, find all the numbers that can be represented on this minicomputer board. Prove your answer and explain why.
Task features

Using exactly one positive and one negative checker, find all the numbers that can be represented on this minicomputer board. Prove your answer and explain why.

What features of the task make it high-quality and productive?

- Requires students to analyze the conditions of the problem (MP1) and justify solutions in relation to those conditions (MP3)
- Includes an unusual/novel context
- Provides opportunities to work on more basic and complex content at the same time – layered design
- Includes non-solutions
Taking tasks back to the classroom

CRITERIA FOR TASK MODIFICATION AND SELECTION
Features of mathematically productive tasks

- Works with a wide range of students
  - Multiple entry points, different methods to solve, multiple solutions
- Benefits from collective work on the problem and covers significant mathematical topics and practices
- Provides opportunities to work on more basic and complex content at the same time – layered design
- Surfaces rather than avoids common patterns of student thinking
- Is intentionally ambiguous in order to strengthen students’ reasoning
- Requires students to analyze the conditions of the problem
- Includes an unusual/novel context
Elementary Mathematics Laboratory  
Ann Arbor, MI  
July 28 – August 8, 2014

- Live teaching of an intensive two-week elementary mathematics class by Dr. Deborah Loewenberg Ball

- Real-time availability of plans and classroom artifacts for use in analyzing and studying the work of teaching

- Professional learning opportunities focused on high-leverage teaching practices and ways to support educators’ learning of these practices

To receive information regarding dates and professional learning opportunities, please send an email expressing your interest along with your name and contact information to eml.leadership@umich.edu or visit www.teachingworks.org for more information.