Algebra I Rich Task
The Ludlow Invitational

Task Overview
The Ludlow Invitational task provides opportunities for students to build physical models to help make sense of the problem.

Mathematical Big Ideas:
Variable – Students explore what a variable represents when used in an expression (e.g. the side length of the pool). In the border problem, the variable is the side length of the square pool and the expression calculates the number of tiles needed to surround the pool. This expression will work for any possible dimension of a square pool.

Common partial understanding – For most students, their initial experiences with variables are as a specific unknown. Students have typically solved an equation to determine the value of the variable. In this case, students may try to (incorrectly) solve for variable.

Equivalence – Any quantity or expression can be expressed in an infinite number of ways. Some ways may be more useful than others, depending on the context and purpose. In this task, students will see several different but equivalent expressions for calculating the number of tiles in the border. In many cases, **the expression tells a story about the structure** of the context or how the mathematician sees the context. Some forms may provide a simpler way to do the calculation.

Standards for Mathematical Practice:

- SMP #7: Look for and make use of structure
- SMP #4: Model with mathematics
- SMP #1: Make sense of problems and persevere in solving them
- SMP # 2: Reason abstractly and quantitatively

Cognitive Demand
This task requires students to make connections between and among mathematical ideas. Research has shown that using high cognitive demand tasks in ways that support rigor will lead to increases in student learning. A critical component of a high cognitive task is that students are invited to explain their thinking, make new connections, describe their process, and/or critique the ideas of others. Make sure the focus is on connections and sense making and not solely on answer getting.

Resources/Tools

- Unifix or Omnifix Cubes
- Paper/pencils/pens
- Expo markers and white boards (or desktops)

Expectations for Students as They Complete the Task

- Students will work on the task in pairs.
- Students will record their model and answer(s) to question posed.
- Students will have the freedom to approach the problem any way that makes sense.
- Students will label their models (See photos below for examples.)

The Ludlow Invitational Task

The Ludlow Invitational
Mr. Wolfe and Mr. Caudill are racing on Elm Street. Mr. Caudill knows he is faster than Mr. Wolfe, so he gives him a head start. When the race begins, Mr. Wolfe is 10 meters ahead of Mr. Caudill. Mr. Caudill runs at 3 meters per second and Mr. Wolfe runs at 2 meters per second. If they tied, how long was the race?

Teacher Note: the question “how long was the race” is purposefully vague. Students may focus on length in meters or they may focus on elapsed time. Rich discussions can result from student discussions of why they interpreted the question in the manner they chose.

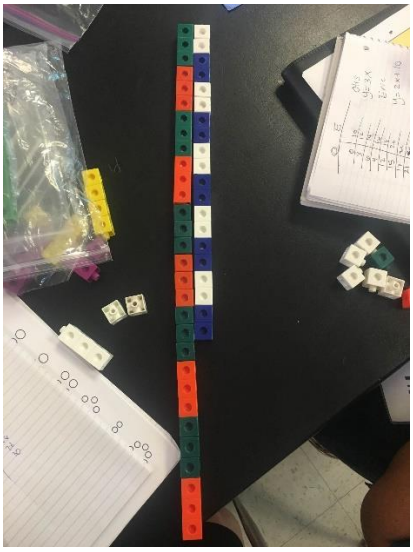
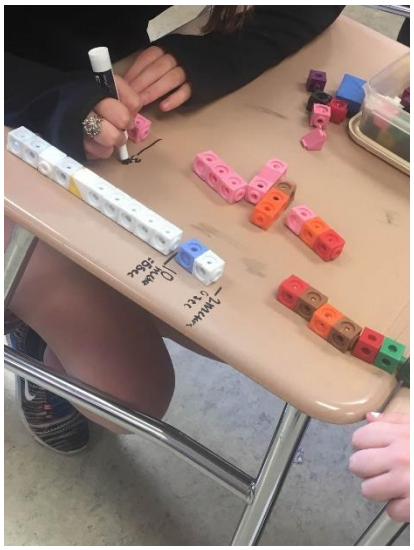
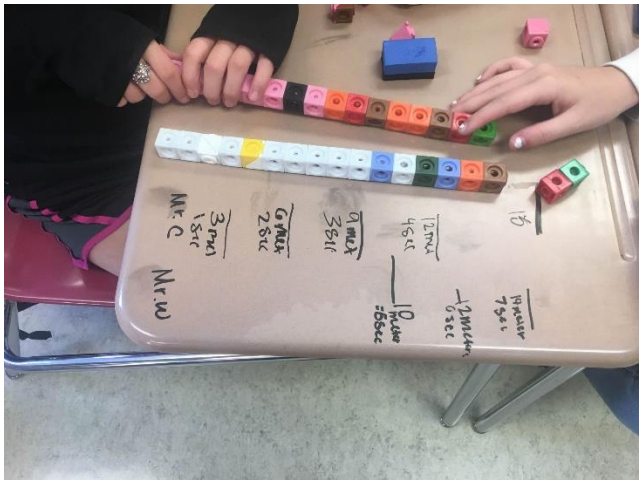
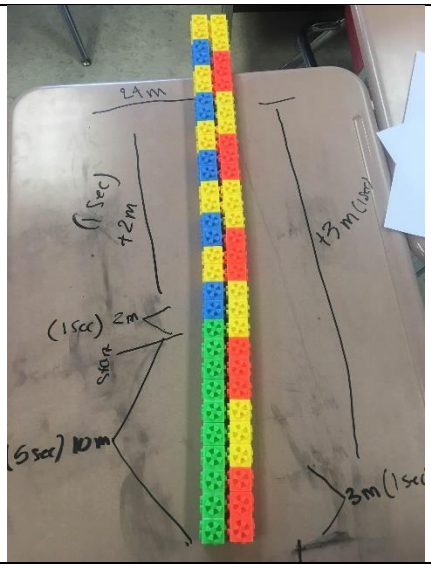
Making Sense of the Problem

1) Hand out the task to student pair groups. Each student gets a copy of the task. Project the activity onto the board if possible.
2) Have the students do a quiet read of the problem.
3) Have the students rewrite the task in their own words.
4) Have students turn the paper over and talk to each other about what the task is.
5) Come together and ask the class, “What are we being asked to do?” Students share what they know about the problem and what they want to find out.

Task Productive Struggle

6) Using cubes, have students work in pairs to show (model) how the race played out and find the answer to the question “How long was the race?”

Examples of Student work:

<table>
<tr>
<td>  </td>
<td>  </td>
</tr>
<tr>
<td>  </td>
<td>  </td>
</tr>
</table>

Supporting Students' Exploration of the Task
As students work in pairs, ask questions as needed to focus their work. For example,

- What are showing with your model?
- What do you think this section shows?
- How can you show this on paper?
- If students produce a function table as a representation, ask the pair if they can show it another way.

Sharing and Discussing the Task
Orchestrate the discussion: Allow students to show their models and explain their thinking to other students. A powerful teacher move is to be very purposeful in the selection and order of the student shares. Use this sharing as an opportunity to help develop students' understanding of the lesson focus, i.e., defining quantities for modeling, creating equations to represent relationships, and graphing the equation.