

**The IDR<sup>2</sup>eAM Project**  
**Investigating Differentiated Instruction**  
**and Algebraic Reasoning in Middle School**  
<http://www.indiana.edu/~idream/>

Amy Hackenberg: [ahackenb@indiana.edu](mailto:ahackenb@indiana.edu)

Fetiye Aydeniz: [faydeniz@indiana.edu](mailto:faydeniz@indiana.edu)

Ayfer Eker: [ayeker@indiana.edu](mailto:ayeker@indiana.edu)

Robin Jones: [robijone@indiana.edu](mailto:robijone@indiana.edu)

**Welcome to our presentation. Before we tell you about our project, we invite you to work on the following problems. Our middle school students were given instructions to choose one of the two problems, but we ask you to work on both and consider how students might respond to them.**

<b>Heights of Plants and Trees</b>
------------------------------------

I. There is a tomato plant and stalk of corn growing in the garden, each of unknown height. The height of the stalk of corn is 5 times the height of the tomato plant.

- Draw a picture of this situation and describe what your picture represents.
- Write an equation for this situation that relates the two heights. **Explain what your equation means in terms of your picture.**
- Can you write another, different equation that relates the two heights? **Explain what your equation means in terms of your picture.**
- If you wrote an equation using division, can you write it with multiplication? **Explain what your new equation means in terms of your picture.**
- Let's say that the stalk of corn's height is 150 cm. Using your picture, find the height of the tomato plant.  
Then use this example to check all of your equations.  
If an equation does not work, see if you can change it so that it does.  
Explain any changes that you make.

II. Next to the school are two trees, each of unknown height. The crabapple tree is  $\frac{3}{5}$  the height of the maple tree.

- Draw a picture of this situation and describe what your picture represents.
- Write an equation for this situation that relates the two heights. **Explain what your equation means in terms of your picture.**
- Can you write another, different equation that relates the two heights? **Explain what your equation means in terms of your picture.**
- If you wrote an equation using division, can you write it with multiplication? **Explain what your new equation means in terms of your picture.**
- Let's say that the maple tree's height is 20 feet. Using your picture, find the height of the crabapple tree.  
Then use this example to check all of your equations.  
If an equation does not work, see if you can change it so that it does.  
Explain any changes that you make.

The following transcript is from a discussion that happened during our first design experiment in the fall of 2013. The discussion is our first activity for the episode; students are discussing work done during two episodes held the previous week.

T stands for Tim, a 7th grade student

S stands for Stephanie, a 7th grade student

G stands for Gabriel, an 8th grade student

C stands for Connor, a 7th grade student

AH stands for Amy Hackenberg, the teacher

**Transcript for video clip of whole group discussion, Episode 11, 10/15/13:**

T: Approximate.

AH: Approximate.

T: Five tomatoes equals approximately corn stalk height.

AH: Approximately?

T: Yeah.

AH: Hmm. Why do you say that?

T: Because we don't know that. We don't know what anything is. We don't know what height it is [gestures with hands], we don't know what width it is [overlapping talk, possibly with G], we don't know what it is.

G: It did say that five,

T: The corn stalk it said.

G: Yeah, but still, uh

T: But not the tomato.

G: We may not know the actual value, but we do know that it's five times.

T [gesturing to Gabriel]: Exactly! We don't know it.

[Gabriel throws his hands up in the air.]

AH: So Tim brings up a good point that other groups talked about last time a little bit. Can you, if both of the heights are unknown, the corn stalk's height is unknown, and the tomato plant's height is unknown, can the five be exact? Can the relationship between the two of them be exact? [G's hand is raised.] Or is that also unknown?

G [hand raised; AH points at him]: We don't necessarily know what the values are, but we do know how the relationship between those two things are. So, we know...

[T gets up and goes to the board.]

AH: Is that possible? Gabriel has weighed in and he believes it's possible. But I want to know what other—

T [at board, looking at his picture]: I did not put it. I did not put it. [Turns around and comes back to his seat.] I thought I did.

AH: Okay. I think you had it on a different piece of paper, when you guys were working with the example [Stephanie's hand goes up]. Stephanie, do you want to add?

S: Um, in the question, we're still doing [question] one—

AH: Uh-huh [yes], yeah.

S: Um, it says the height of the stalk of corn is five times the height of the tomato plant? So it is five times.

AH: [Connor's hand goes up; Tim also moves.] Okay. What do you guys think about that? Is it okay?  
Connor?

C: Yeah.

AH: So, you think we can have a definite relationship between the two [Gabriel's hand goes up, and he points down as AH continues talking] even if we have indefinite heights?

[Gabriel's hand comes down across the table, pointing, and he says yes.]

AH [pointing to match Gabriel's gesture]: Gabriel is saying yes.

C: Can I sa—

AH: But I don't know what other people really think, be honest.

T: Say it again.

AH: Can we have a definite relationship, a known relationship, between two heights even though the heights themselves are unknown? [pause] We don't know for sure how tall the two plants are,

T: We can make an estimate.

AH: ...how tall each one is. [C's hand is up again.]

G [looking toward/at Tim]: Well, for example I mean, so we know that five of these green sharpie pens [holds up a green pen] is say, a jumbo [laughter] green sharpie pen. I mean, we know that, but we don't know the actual measurement of this [holding green pen], [pause], precisely. I mean, to—

T: Well that's giving you like more information. [pause] Because you don't know what size the jumbo pen is, but if you were to, ah—

G: But we do know it's five times the length of this [holding up the green pen].

T: That's what I was saying, I mean, you can still sort of like find it out in a ways. Like if you found out the, uh, pen and it equals five of [overlapping talk with C].

C: The height of the corn stalk it's 150 [cm], doesn't it say that [on the worksheet]?

G [looking at C]: Well yeah, but we're just assuming it is. Just to plug into our equation.

T: ...and if you add them all together that would equal the jumbo height [gesturing with hands]. So basically you'd find it all out so you'd never, so technically you would know each measurement 'cause if you had a pen right in front of you, you could instantly measure it out. But as for this [holding up the worksheet], you don't know the corn stalk height, you don't know the tomato plant height. So you don't know anything. That's what I was trying to point out.

G: Yeah. But, okay. [Gestures with his arm—picks up it and lets it fall—as if he is not sure what to say].

## **IDR<sup>2</sup>eAM Study Group for Teachers 2015-2016**

We are currently seeking middle school teachers in the state of Indiana who want to explore differentiating instruction with us! We are interested in teachers who are open to trying new ideas. We are not that concerned with amount of teaching experience, although being in the study group might be too much for most teachers in their first or second year of teaching. Being in the study group will require exploring student thinking in your classroom and being willing to experiment with new ideas and strategies.

### **Structure of IDR<sup>2</sup>eAM Teacher Study Group:**

1. A professional development workshop in summer 2015.
2. Monthly meetings during the 2015-2016 academic year.
3. Preparation for monthly meetings, which include readings, examining student work and bringing it to the meeting, etc.
4. A commitment to try out some aspect of differentiating instruction in your classroom during the 2015-2016 school year, and to write about your exploration.

Course credit or stipends will be provided. If you are interested in participating, please email Amy Hackenberg at [ahackenb@indiana.edu](mailto:ahackenb@indiana.edu)