

Domain: Expressions and Equations Standard Code: E.E.1 Teacher Name: JanaAnderson, Danielle Bennett, Karrie Smith (FRIS)

Adapted from: Smith, Margaret Schwan, Victoria Bill, and Elizabeth K. Hughes. "Thinking Through a Lesson Protocol: Successfully Implementing High-Level Tasks." *Mathematics Teaching in the Middle School 14* (October 2008): 132-138.

PART 1: SELECTING AND SETTING UP A MATHEMATICAL TASK	
What are your mathematical goals for the lesson? (i.e., what do you want students to know and understand about mathematics as a result of this lesson?)	Goal: To formulate a pattern using exponential growth. EE1: Write and evaluate numerical expressions involving whole number exponents
<ul style="list-style-type: none">• What are your expectations for students as they work on and complete this task?• What resources or tools will students have to use in their work that will give them entry into, and help them reason through, the task?• How will the students work— independently, in small groups, or in pairs—to explore this task?• How will students record and report their work?	Expectations: To find an exponential pattern Materials: Number Blocks, Graph Paper, Colored Pencils, Counting Materials How will they work: To begin (5 minutes), work independently to find one way to solve. Partner Work: Find one other way. How will they record their work: The reports will be individualized depending on the work that they do. They will be asked to display their work using manipulatives, work books, posters, or any other method of displaying their work
How will you introduce students to the activity so as to provide access to <i>all</i> students while maintaining the cognitive demands of the task?	Show a short video from YouTube entitled "Pay it Forward" for the launch http://www.youtube.com/watch?v=CwHcS-XoYbc&feature=player_detailpage Only show about one minute of it. Stop after the diagram.

PART 2: SUPPORTING STUDENTS' EXPLORATION OF THE TASK

As students work independently or in small groups, what questions will you ask to—

- help a group get started or make progress on the task?
- focus students' thinking on the key mathematical ideas in the task?
- assess students' understanding of key mathematical ideas, problem-solving strategies, or the representations?
- advance students' understanding of the mathematical ideas?

- Can you draw a picture of it?
- Have you ever used a phone tree?
- Do you notice a pattern?
- What would this data look like on a coordinate plane?
- When could this numerical growth help you?
- What would happen if the base of the exponent changes?
- What would happen if we chose to give out 10 invitations per person? 20 invitations?

How will you ensure that students remain engaged in the task?

- What assistance will you give or what questions will you ask a student (or group) who becomes quickly frustrated and requests more direction and guidance in solving the task?
- What will you do if a student (or group) finishes the task almost immediately? How will you extend the task so as to provide additional challenge?

Assistance:

- As a teacher, give different ways to represent their data, "Can you show me a picture? Can you show me with manipulatives?"
- Direct students by questions to give assistance

Extensions:

- Have students find out if we passed the invitation to 50 people. How many times till the whole school was invited? The whole town was invited?
- Use anchor activities already set up for unit such as "One Grain of Rice"
- Everyone receives two cards. If you receive a third, you pass your two cards to two different people. See how many cards can be passed out within two minutes. Calculate how many cards were passed out per class. On those papers, you could have students create two math problems to be handed out. Before they can pass on their cards, they must solve the problem given to them.

PART 3: SHARING AND DISCUSSING THE TASK

How will you orchestrate the class discussion so that you accomplish your mathematical goals?

- Which solution paths do you want to have shared during the class discussion? In what order will the solutions be presented? Why?
- What specific questions will you ask so that students will—
 5. make sense of the mathematical ideas that you want them to learn?
 2. expand on, debate, and question the solutions being shared?
 3. make connections among the different strategies that are presented?
 4. look for patterns?
 5. begin to form generalizations?

What will you see or hear that lets you know that *all* students in the class understand the mathematical ideas that you intended for them to learn?

To get the students to quiet down and get ready for the debrief by playing a short clip at: http://www.youtube.com/watch?v=DwO6pmbYDo8&feature=player_detailpage

Share all different ideas that students came up with in this order:

- Pictures
- Manipulatives
- Graphs
- Charts
- Numerical Representation

Questions:

- What patterns do you see?
- What does the picture represent?
- Why did you choose the way you displayed your data?
- Is there a way to use numbers to represent your display?

At the end of the debriefing, read “One Grain of Rice” to the class

How do we know we reached ALL:

- Quick Quiz
- Asking questions as a teacher
- Formative Assessment

EXPONENTS



Sam is having a party tomorrow night. He wants to get the word out fast. He invites two people and asks each person to invite two more people.

- 1) How many times do we need to pass the invitation along to reach the whole classroom?
- 2) How many times to reach the whole school?
- 3) What if Sam started out passing the invitations to four people, how long would it take to reach the whole classroom?

- Show how to solve the problem individually
- Pair up and explain your method to your partner
- Come up with one new method with your partner

 **Pay it forward**

