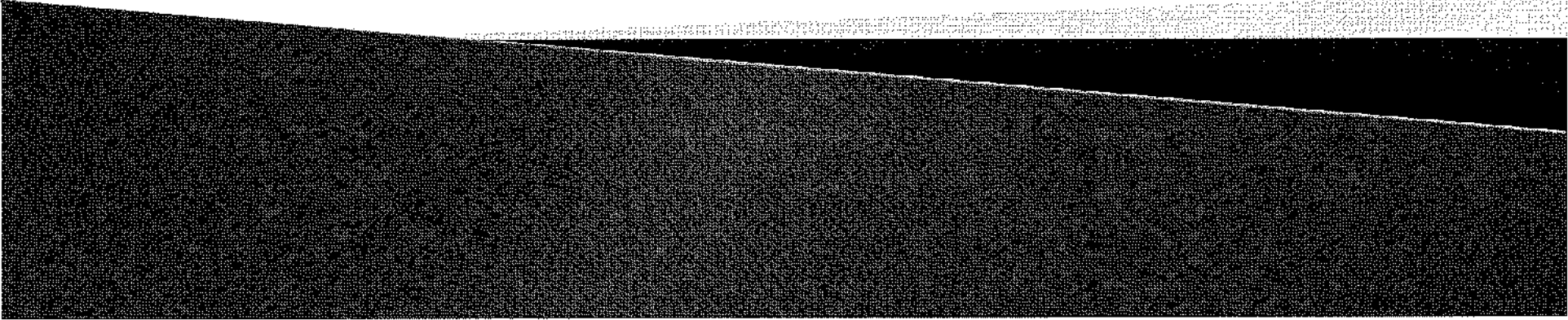# Standards for Mathematical Practice

"A lack of *understanding*
effectively prevents a
student from engaging in the
mathematical practices." (CCSS, p. 8)

Standards for Mathematical Practice

"The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education."
(CCSS, 2010)

Goals for today

- Overview of the standards for mathematical practice
- Address impact on teaching and learning in the mathematics classroom
- Discuss role of school leadership in supporting Standards for Mathematical Practice
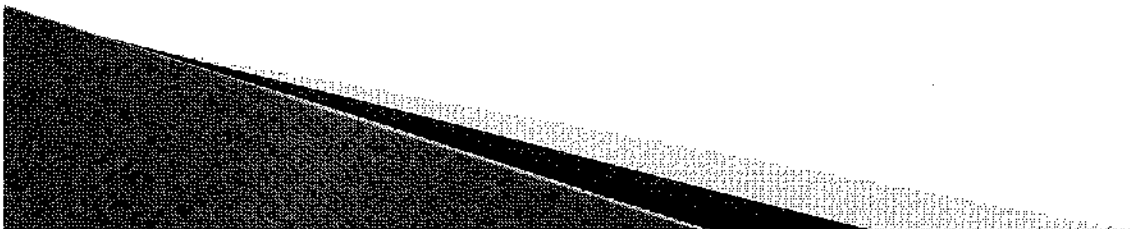
QUESTIONS TO CONSIDER...

1. What do these standards look like in the classroom?
2. What will students need in order to do become 'mathematically proficient'?
3. What will teachers need in order move students toward these behaviors?

Adapted from Kathy Berry, Monroe County ISD, Michigan
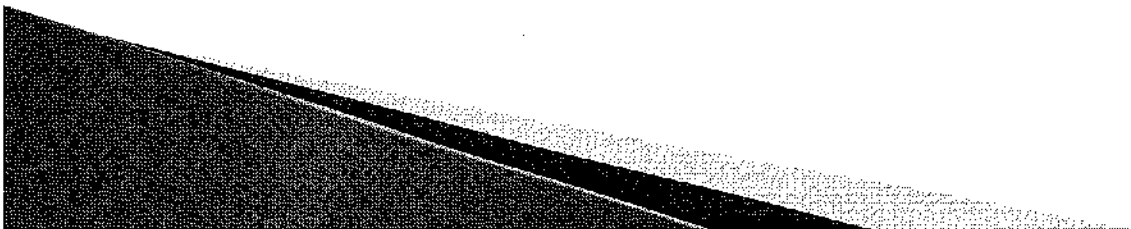
The Standards for Mathematical Practice

Mathematically proficient students:

Standard 1: Make sense of problems and persevere in solving them.

Standard 2: Reason abstractly and quantitatively.

Standard 3: Construct viable arguments and critique the reasoning of others.

Standard 4: Model with mathematics.

Standard 5: Use appropriate tools strategically.

Standard 6: Attend to precision.

Standard 7: Look for and make use of structure.

Standard 8: Look for and express regularity in repeated reasoning.

Grouping the Standards of Mathematical Practice

1. Make sense of problems and persevere in solving them.

6. Attend to precision.

Overarching habits of mind of a productive mathematical thinker.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

Reasoning and explaining

4. Model with mathematics.

5. Use appropriate tools strategically.

Modeling and using tools.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

Seeing structure and generalizing.

Standard 1: Make sense of problems and persevere in solving them.

What do mathematically proficient students do?

- Explain to themselves the meaning of a problem (task) and restate it in their own words.
- Find an entry point or way to start the task
- Plan a solution pathway rather than simply jumping to a solution attempt
- Monitor and evaluate their progress (ie. If students reach a point where they are stuck, they can re-examine the task and change course in their approach if necessary)
- Make meaning of the solution
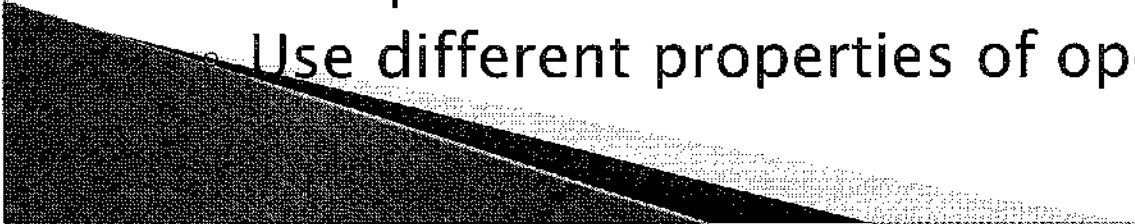- Understand other approaches and see connections among the different approaches

A closer look at SMP #1

- Eva had 36 green pepper seedlings and 24 tomato seedlings. She planted 48 of them. How many more does she have to plant?

- Eva started with 36 green pepper seedlings and some tomato seedlings. She planted 48 of them. If you knew how many tomato seedlings she started with, how could you figure out how many seedlings she still has to plant?

- Eva had 36 green pepper seedlings and 24 tomato seedlings. She planted 48 of them. What questions could be answered from this given information?
  - How many seedlings did she start with?
  - How many seedlings weren't planted?
  - What is the smallest number of tomato seedlings she planted?

Standard 2: Reason abstractly and quantitatively.

What do mathematically proficient students do?

- Make sense of quantities and relationships
- Able to **decontextualize**
  - Abstract a given situation (represent problem symbolically and with numbers)
  - Create a mathematically coherent representation of the problem at hand
  - Manipulate the representing symbols
- Able to **contextualize**
  - Explain what the quantities represent
  - Interpret results in the context of the situation
  - Use different properties of operations and objects

A closer look at SMP #2

> ▸ Use less than, greater than, and equal to as you compare the following:
>
> | | |
> |---|---|
> | 6 | 8 |
> | 12 | 4 |
> | 7 | 7 |

> ▸ Use less than, greater than, and equal to as you compare the following:
>
> | | |
> |---|---|
> | 6 pounds | 8 ounces |
> | 12 nickels | 4 dollars |
> | 7 meters | 7 cm |

> ➢ The school has 99 students that need to be transported by bus. Each bus can transport 44 students. How many buses are needed?

Standard 3: Construct viable arguments and critique the reasoning of others.

What do mathematically proficient students do?

- Construct arguments using objects, drawings, diagrams, etc.
- Explain reasoning to others
- Recognize and use counterexamples
- Justify conclusions and communicate them to others
- Distinguish correct logic from flawed logic
- Listen to or read the arguments of others. Decide whether they make sense and ask useful questions to clarify/improve arguments

A closer look at SMP #3

A class of third graders was asked to compute 203–78

The class got 35, 125, 135, and 205. The most popular answer was 275. Which answers are unreasonable? Why?
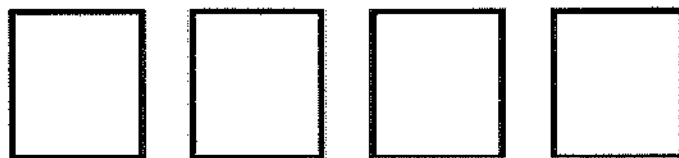
How many ways can you make 28¢?

(Variation: How many ways can you make 28¢ without using dimes or quarters?)

Jane and Tom are playing number card games. They have the four cards shown below.

| 3 | 9 | 6 | 4 |

Show how they arrange the four cards to make the number that is nearest to **5000**.

| | | | |

Explain how you figured it out.

Standard 4: Model with mathematics.
What do mathematically proficient students do?

- Apply the math they know to problem situations
- Represent problem situation using numbers, symbols, mathematical language, pictures, charts, lists, etc.
- Write a mathematical statement to describe a situation or tell a story problem for a given equation
- Analyze mathematical relationships to draw conclusions
- Use approximations to simplify a complicated situation

A closer look at SMP #4

- **There were 28 cookies on a plate.**

    - Five children each ate one cookie.
    - Two children each ate 3 cookies.
    - One child ate 5 cookies.
    - The rest of the children each ate two cookies.
    - Then the plate was empty.
    - How many children ate two cookies? Show your work.

- **About how many children are in our school? 50? 200? 1000? To figure that out, we could count, but that's a lot of work. Besides, we don't need to know exactly. How can we come reasonably close, just sitting here in our classroom?**
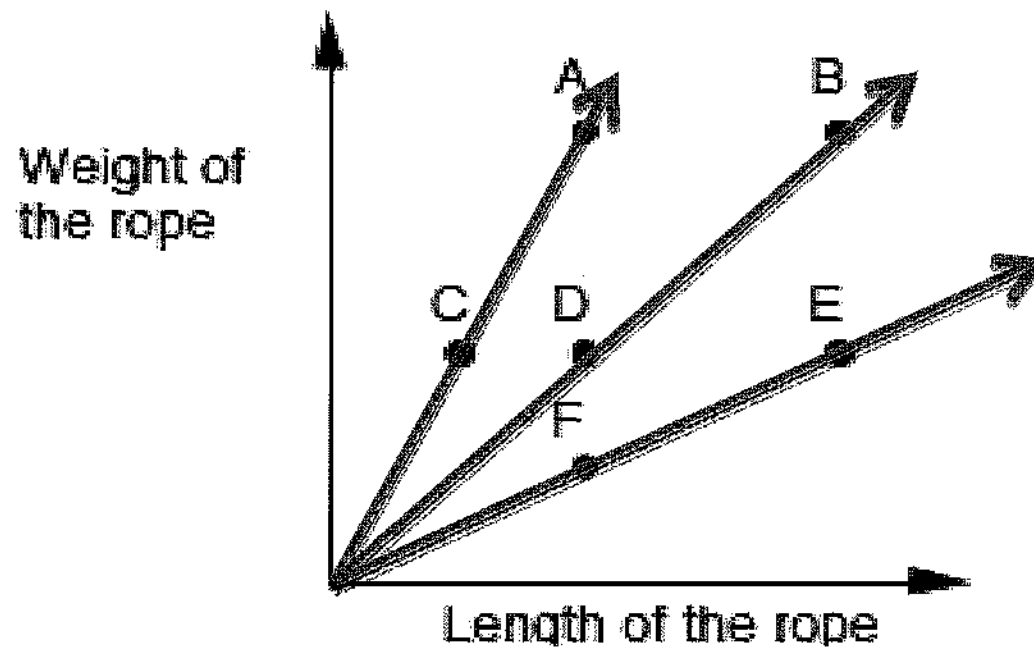
Standard 5: Use appropriate tools strategically.

What do mathematically proficient students do?

- Consider available tools when solving a mathematical problem
- Make sound decisions about when the different tools might be helpful
- Detect possible errors using estimation**
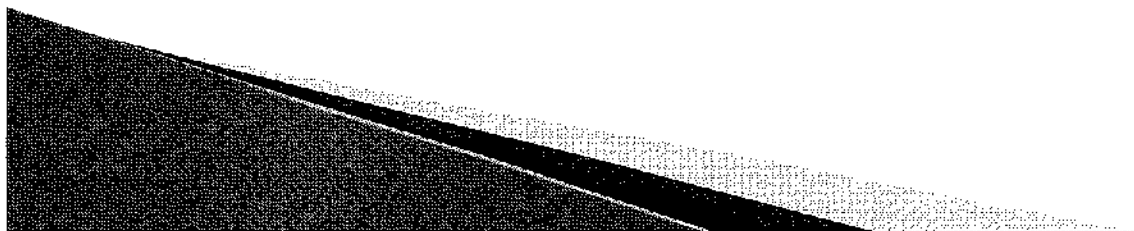
A closer look at SMP #5

Which ropes are 'Thin'?
Which ropes are 'Medium'?
Which ropes 'Thick'?

Explain your reasoning.

Standard 6: Attend to precision.
What do mathematically proficient students do?

- Communicate precisely to others
- Use clear definitions in discussions with others and in their own reasoning
- State meaning of symbols and use consistently and appropriately
- Calculate accurately & efficiently; express answers with a degree of precision appropriate to for the problem context
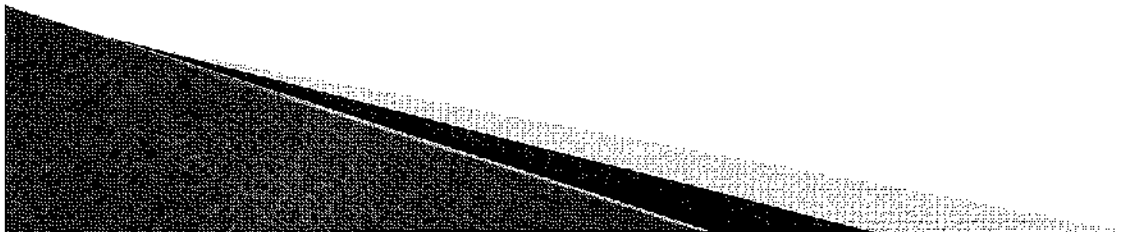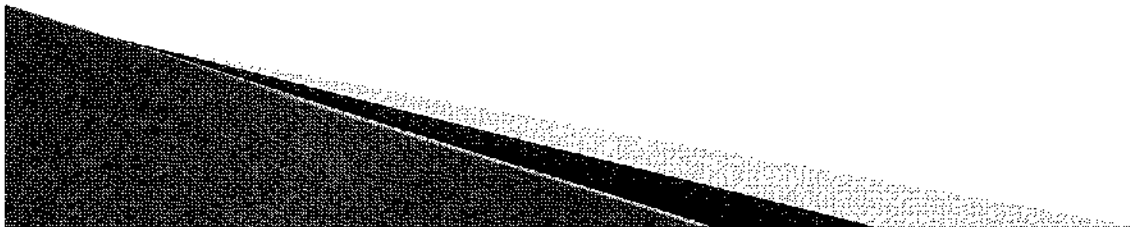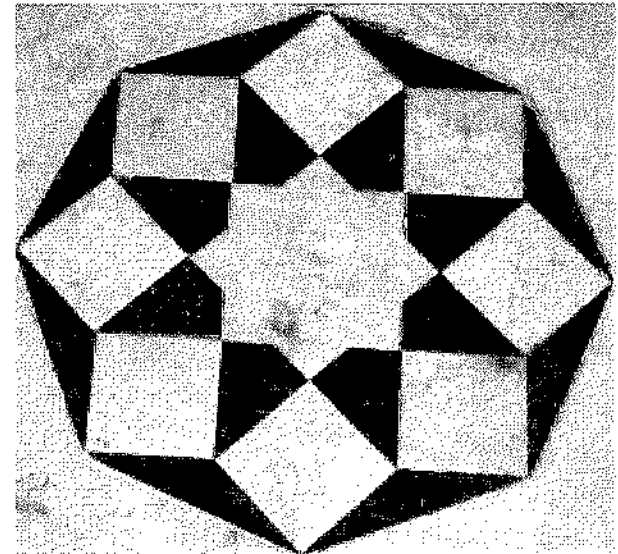
A closer look at SMP #6

Imagine that you have just discovered
this ancient floor tiling pattern in Syria.

You telephone New York to tell them
about this exciting discovery.

Describe the pattern as accurately as you can,
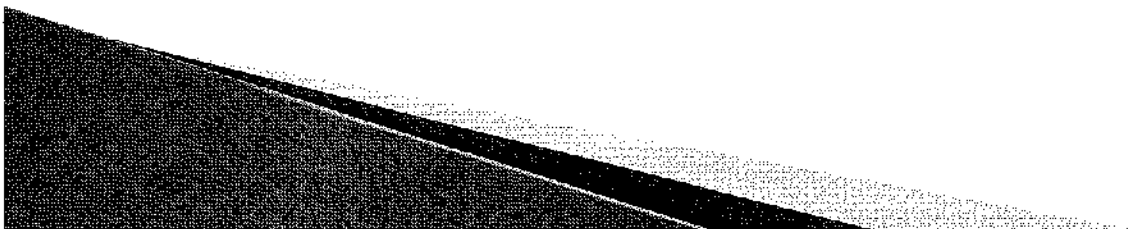so that someone else can draw it without seeing it.

Describe the shapes as completely as you can.

Standard 7: Look for and make use of structure.

What do mathematically proficient students do?

- Discern patterns and structures
- Use strategies to solve problems (ie. decompose and recombine numbers and expressions)
- Step back, see overview and shift perspective

A closer look at SMP #7

When Aaron plays the numbers game, he needs to decide which numbers belong in each set. Here is another game for you to play.

2. All of these numbers are Grogs.

| 123 | 789 | 456 | 345 |

None of these numbers are Grogs.

| 121 | 81 | 246 | 5678 |

Which of the numbers below are Grogs? Draw a circle around each Grog.

234   56   678   989

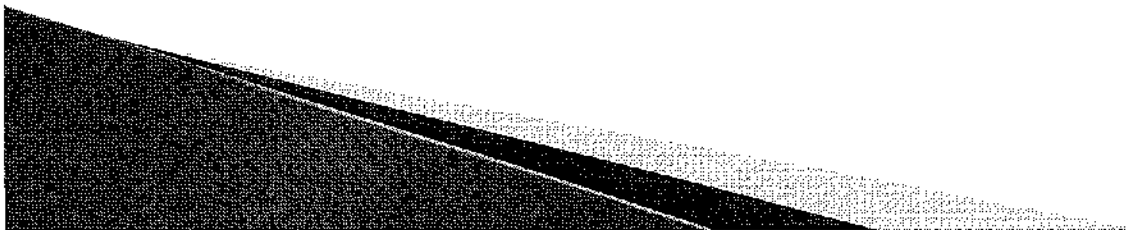Explain how you know which numbers are Grogs and which are not.

# Standard 8: Look for and express regularity in repeated reasoning.
What do mathematically proficient students do?

- Notice repetitive actions in computation
- Look for strategies to be more efficient in computations
- Continually evaluates the reasonableness of their results

A closer look at SMP #8

- ▸ There are 8 crayons in the box. Some are red and some are blue. How many of each could there be?
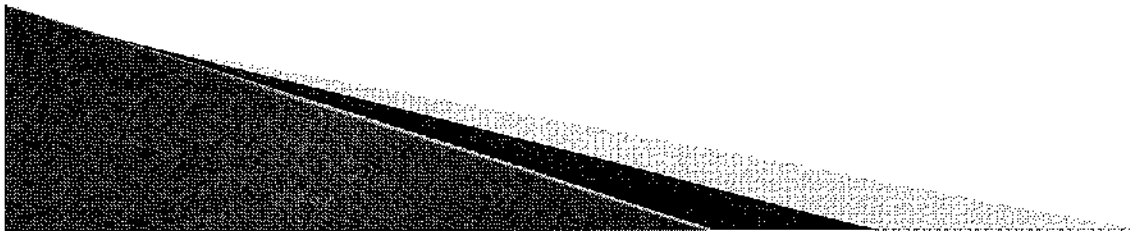
Implications for Teachers

- Teachers are responsible for creating mathematically proficient students
  - Select worthwhile mathematical tasks
  - Utilize effective questioning strategies
  - Incorporate instructional strategies that encourage exploration of mathematical processes
  - Planning must include how practice standards are 'happening' in their classrooms
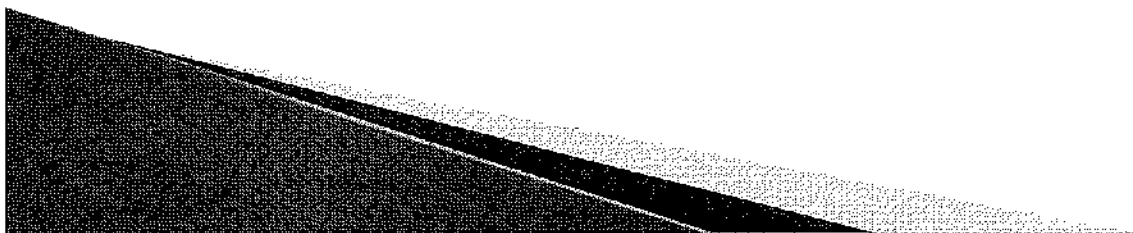
Implications for Principals

- Walkthroughs/observations
  - Are students evidencing mathematical practices?
  - Are teachers encouraging/providing opportunities for students to develop mathematical practices?

- Professional development/coaching to support instructional practices

- Assessments