Noticing: A Mathematical Thinking Routine for Algebra I

> *Mathematics routines develop the behaviors that allow students to do mathematics.*
> ~ Anne Burgunder

Mathematics thinking routines can help teachers incorporate the Standards for Mathematical Practice and Mathematical Habits of Mind into their classroom cultures. Before students can make sense, reason, construct arguments, critique, or model, they must first *notice*. Students need to be able to notice, to see details (both trivial and non-trivial) as they look at a problem. Students can be very capable, with practice, of noticing important information in math problems and making conjectures about those details. Unfortunately, not all students come to us with the skills needed to be observant and persistent problem solvers.

The mathematics thinking routine called noticing is an instructional strategy that can help all students develop and improve their ability to make sense of problems. In *Powerful Problem Solving* by Max Ray, the author states:

> *When students see a question in math class, they tend to go into "get the answer quick!" mode. Students often feel pressure and anxiety around having to get the answer, whether it's competitiveness to show their smarts or fear that they won't be able to answer that stops them from engaging. We've found that leaving off the question and just sharing an initial story/scenario/image increases participation from struggling students because there is no right or wrong answers to "What do you notice?"… It keeps speedy students engaged in creative brainstorming rather than closed-ended problem solving. (Ray, 2013, p. 46)*

Ray (2013) suggests that noticing routines could support students to:

- *Connect their own thinking to the math they are about to do*
- *Attend to details within math problems*
- *Feel safe (there are no right answers or more important things to notice)*
- *Slow down and think about the problem before starting to calculate*
- *Record information that may be useful later*
- *Generate engaging math questions that they are interested in solving*
- *Identify what is confusing or unclear in the problem*
- *Conjecture about possible paths for solving the problem*
- *Find as much math as they can in a scenario, not just the path to the answer. (Ray, 2013, p. 46)*

The discipline of careful noticing requires practices and patience, time to think and write on your own. But learning to notice new kinds of things and see math situations through different, useful lenses requires hearing from others. (Ray, 2013, p. 47) As you enact thinking routines, it is important to provide individual think time, partner work time, and full-group discussion. All noticings are important.

Below is one possibility for enacting a noticing routine in a classroom. This outline is based in part on Ray's (2013) work with slight modifications.

- *Format: Individual, then pairs, then whole group.*
- *Step 1: Think. Give each student a recording sheet* or have then simply use notebook paper. Ask students to write down all of the things they notice. You do not want them to solve anything. We are just notcing. *Students brainstorm privately, recording their thinking on the sheet. When the time is up, students draw a line below their last noticing.*
- *Step 2: Pair. Students turn to their partner and share their list of noticings. Having desks prearranged so students know who their partner is helps make transitions smoother. When one student is sharing the other is recording below the line any noticing his/her partner had that they*

didn't. (Ray, 2013, p. 48) As students are working, you need to move around the pairs noting their observations and making plans for how you order the sharings in the group discussion that will follow.

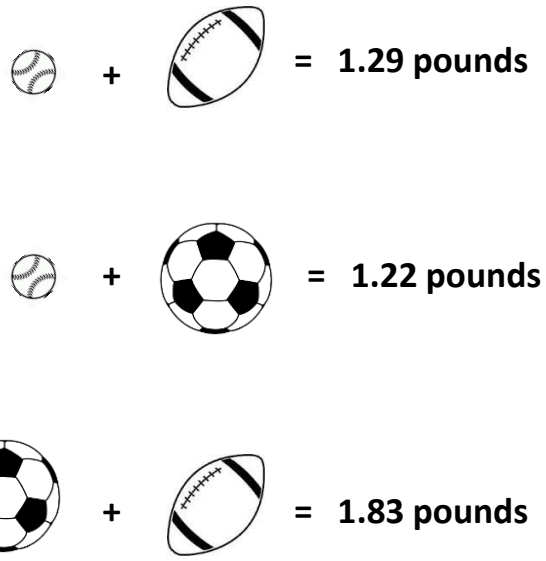
- Step 3: Orchestrate the group share. Strategically call on pairs or individuals to share noticings starting with the obvious (colors, shapes, etc.) and building to more complex noticings. Again, Ray (2013) suggests, *students should add noticings they didn't come up with to their own recording sheets, below the line*.
- Step 4: Ideally, you want to use specific student noticings to make connections with content you are addressing during the rest of the class period or in future periods. If the noticing routine does not connect directly to content, students can still benefit from the experience of observing, connecting, listening, sharing and conjecturing. All of these are qualities we want to develop in our students.

Ray, M. (2013) *Powerful Problem Solving: Activities for Sense Making with Mathematical Practices*. Portsmouth, NH: Heinemann.

Any visual or graph could be used for the noticing routine. You want students to notice everything from obvious to complex observations. Below are examples of noticing routines focused on algebraic reasoning:

Annotated Example

What do you notice?



Possible noticings:

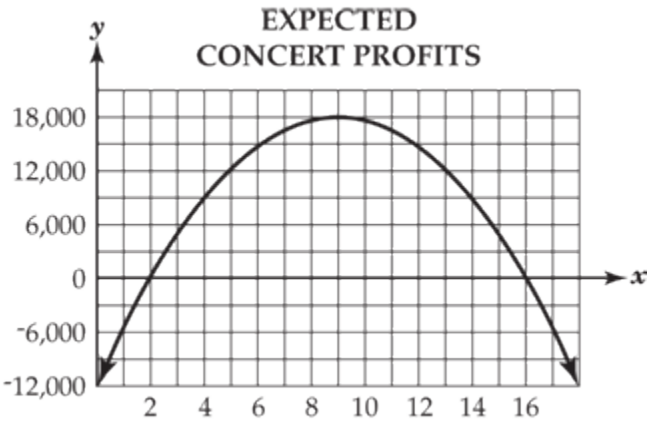
- There are balls
- These are drawings of balls (not photos)
- The drawings are in black and white
- Three types of balls
- Baseball, football, soccer ball
- There are equations
- Three total weights are shown for different combinations of two balls
- We don't know how much the balls weigh individually
- The soccer ball and the football together weigh the most
- The baseball and the soccer ball weigh the least
- You could figure out how much each ball weighs
- The football weighs more than the soccer ball – This noticing is evidence of a more analytical observation. If you get this noticing, pause and challenge the partner pairs to figure out, "Why

would someone believe that the football weighs more than the soccer ball?" "How much more?" [If you don't get this noticing, then say something like, "In one of my other classes someone said, 'the football is heavier than the soccer ball.' Talk with your partner. Why would they say that?"]

Note that solving the problem could be a next step, but the noticing routine is not about solving or answer getting. Rather, it is about building observation skills that are necessary for reasoning mathematically and in this case algebraically.

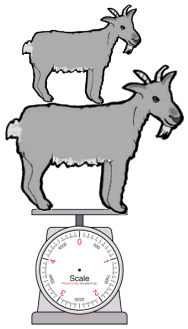
Other Visual Examples for Algebraic Noticing Routines

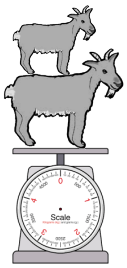
1) What do you notice?

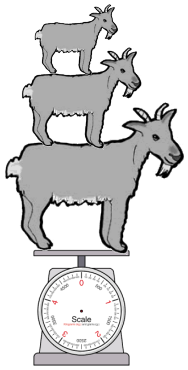


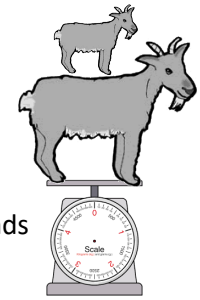
Source: http://mdk12.msde.maryland.gov/instruction/clg/public_release/algebra_data_analysis/G1_E2_I4.html

2) What do you notice?

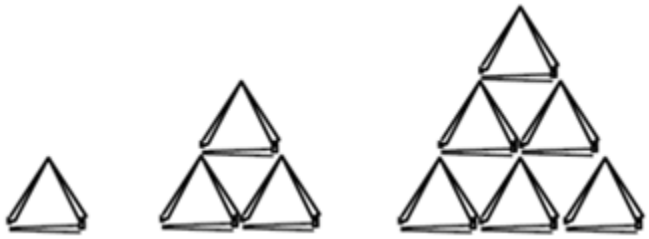
317.8 pounds 

148.4 pounds 

353.6 pounds 

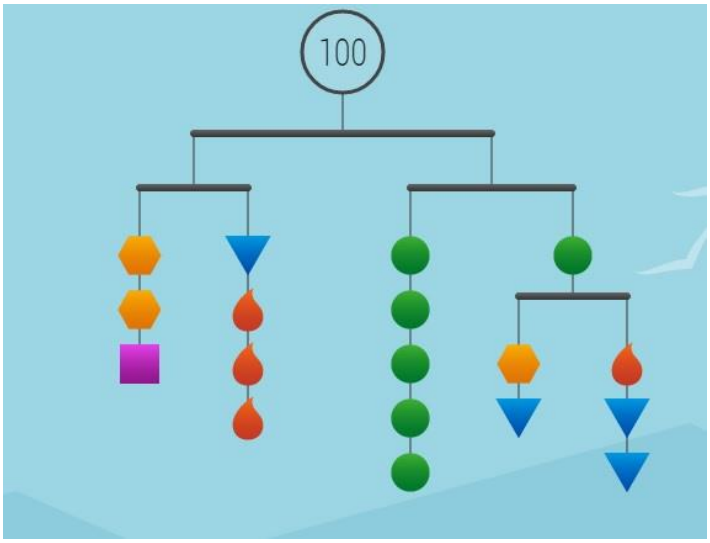
241.0 pounds 

3) What do you notice?



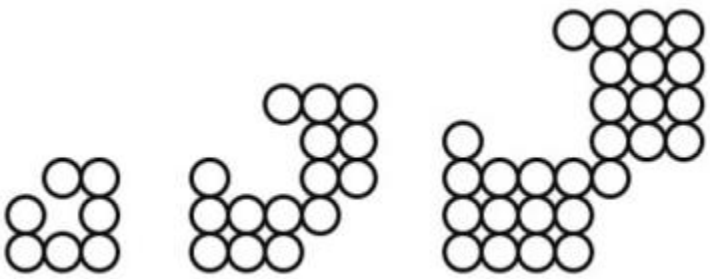
Source: http://www.visualpatterns.org/

4) What do you notice?



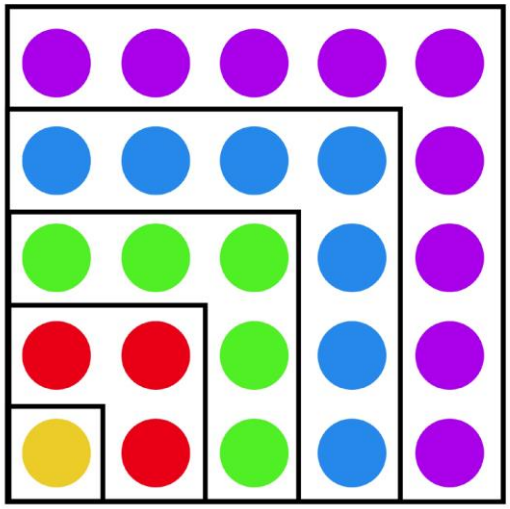
Source: http://www.resourceaholic.com/2014/12/gems17.html

5) What do you notice?

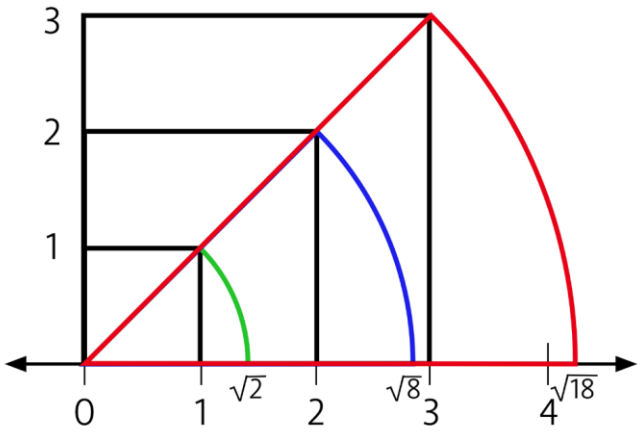


Source: https://mathybeagle.com/tag/visual-patterns/

6) What do you notice?



7) What do you notice?



Source for #7 & #8: https://bhi61nm2cr3mkdgk1dtaov18-wpengine.netdna-ssl.com/wp-content/uploads/2016/04/Visual-Math-Activities-VF_visual_mathematics.pdf