

## ***Mathematics: The Language of STEM***

Germs are Multiplying!

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### **CONTENT AND TASK DECISIONS**

#### **Grade Level(s): 8th Grade Mathematics**

**Description of the Task:** Students will use Skittles as “germ” manipulatives to develop an understanding of exponential growth. Students will observe and record germ growth by shaking Skittles in a simulation.

#### **Indiana Mathematics Content Standards:**

8.NS.3 - Given a numeric expression with common rational number bases and integer exponents, apply the properties of exponents to generate equivalent expressions.

#### **Indiana Mathematics Process Standards:**

PS.2: Reason abstractly and quantitatively.

PS.7: Look for and make use of structure.

PS.8 - Look for and express regularity in repeated reasoning.

**Mathematics Content Goals:** Students will develop an understanding of exponential growth by studying and modeling multiplying germs with Skittles!

**Language Objectives:** In partners students will list in a table and predict germ (exponential) growth using Skittle manipulatives.

ELD Standard 3 - English language learners communicate information, ideas and concepts necessary for academic success in the content area of Mathematics.

#### **Materials:**

- Skittles (1 regular sized package per group)
- 2 deep, large plates or a pizza box per group to shake the skittles in (maybe 15 needed?)
- Any other supplies students may need (paper, pencils, etc.)

### **THE LESSON**

#### **Before:**

As a hook I would start out by showing the class a YouTube video called “The Sneeze: How Germs Spread.” Here is the site: <https://www.youtube.com/watch?v=yToii3-p-NI> It can also be found under “bacteria multiplication” at this site: <https://www.youtube.com/watch?v=Cilx9zEU2ac>

After showing the video once, start a discussion. Simply ask: What did you notice? And let the kids run wild! It's fun to hear what they notice! Then tell them that you are going to watch it again. This time have them jot down on a scrap piece of paper what they noticed after watching it a second time. (This allows our Special Needs and EL students a chance to not only see something twice, but to hear a discussion about it before being expected to write.)

After students are finished writing a couple of notes have a few students share new things that they noticed after watching the video a second time. During this discussion I would be sure to bring up (if it hasn't already come up) the fact that the bacteria/germs are growing really fast (and therefore are multiplying and growing exponentially).

Now explain to the students the task:

- "We are now going to begin our own germ experiment using Skittles. We will start with one germ (Skittle) and see how fast the germs reproduce, or grow, over time. Our time is going to be represented by shakes. Each time we shake the Skittles (using the pizza box or two plates put together upside down) it will represent 20 minutes of time, because in a perfect reproduction situation (the right darkness and temperature) bacteria/germs can reproduce (grow larger and split in half) every 20 minutes! After one shake each germ will reproduce and the one germ will become two germs (Skittles). Then you will continue this pattern for four shakes. As you are shaking and reproducing bacteria, please be sure to record your data in a chart or table similar to the one shown on the board." An example table to have on the board is below:

Shakes (representing every 20 mins)	Amount of Skittles
0	
1	
2	
3	
4	
5 (predict)	

- You may also want to include a handout with all of the important information as a tool for not only all students, but specifically to assist our English Language Learners and Special Needs students.
- Students will be placed into predetermined partners for this activity. Depending on the type of class you have you may want to have higher level students working with lower level, or you may want to pair similar leveled students together. Use your best teacher discretion. :)

**During:**

This phase of the lesson is to allow the students to explore. LET GO! Allow students to make mistakes. Listen and observe students performing the experiment as you walk around the room. Students should be filling in the table as they go. You may hear words such as patterns, doubling, etc. After they have completed the given table (4 shakes) have them predict what will happen on the 5th shake. Then later on have them predict the 10th shake, etc. Let them try to figure this out on their own for a bit. What do they need to figure out to predict the 5th? If they need some help, remind them to look for patterns. Ask, “What happened? Why do you think that is?” As they’re predicting, ask “Why did you predict that? How did you come to that conclusion?” Ask others if they agree or disagree with that particular student, and why?

- This is the meat of the lesson. How did they figure it out? It is important for students to understand that each shake is representing a germ doubling. Each shake is the number multiplied by itself (3 shakes =  $2 \times 2 \times 2$ ). Each shake represents the exponent (3 shakes =  $2^3$ ).
- Once they grasp this concept a little more, give them a new experiment (with the same idea). This time with every shake the germ will reproduce into threes every 20 minutes (instead of two). Their table could look similar to the following:

Shakes (representing every 20 mins)	Amount of Skittles (reproduces 3 every 20 min)
0	1
1	3
2	9
3	27
4	81
5 (predict)	243

- Again, have them find patterns and predict what will happen on the 5th, 10th, etc. shake. They should grasp that with each shake the number triples or is raised to the third power. (3 shakes =  $3 \times 3 \times 3 = 27$ , or 3 shakes =  $3^3 = 27$ )
- Again ask “How did you come to that conclusion?” Have students agree or disagree and justify their answers.

As an EXTENSION activity you could have each color of Skittle have its own growth characteristic and reproduction population depending on whether their “S” mark on the Skittle itself is showing or not showing. See the chart below for examples:

Skittle Reproduction Growth Characteristics		
green	For every green Skittle with or without a mark showing, add 2 green Skittles	1 green
yellow	For every yellow Skittle with or without a mark showing, add 1 yellow Skittle	1 yellow
orange	For every orange Skittle with a mark showing, add 1 orange Skittle	1 orange
red	For every red Skittle with a mark showing, add 1 red Skittle	2 red
purple	For every purple Skittle with a mark showing, add 1 purple Skittle	5 purple

- Then have students predict what will happen to the reproduction of green Skittles for the first 3 shakes. Then predict which reproduction will be the largest after 10 shakes.
- You could also have students graph the data for each reproduction on the same coordinate system, using different colors to indicate the different reproductions.

**After:**

In this portion of the lesson, students should work as a community of learners, discussing, justifying, and challenging various solutions to the problem all have just worked on. Here is where much of the learning will occur. It is critical to plan sufficient time.

Students will present their patterns, solutions and findings in their partner groups in front of the class on the document camera. It is important to see their work and their thought process and have students articulate and engage in mathematical discourse in order to explain their thinking. This should be a safe zone where it is ok to make mistakes and love mistakes so everyone can learn from them! You can do it one of two ways depending on your class. You can choose which group shares which solution, or allow them to choose which solution (squared or cubed) they would like to share. I would have maybe 3-4 groups present on the first experiment (squared), then maybe 3-4 groups present on the second experiment (cubed), and then if a group completed the extension activity have them present their findings.

Remember to keep the discussion focused on the mathematical goal of understanding exponential growth. You can continue to ask questions such as: How did you come to that conclusion? Why did you predict that? Why do you think that works? What do you notice? Can you make any generalizations? Why? Why? Why? And Justify!!

**ASSESSMENT**

I will observe students gathering evidence and data as they are completing their experiments. I will know students understand the concepts when I observe them presenting their findings to the class. This will help me to see what they have learned. I also plan to collect their recordings with their charts/tables.

Also, the specific questions I will ask students to assess their learning are embedded throughout this entire lesson.