UNIT 1 | COUNTING POPULATIONS

MILLIONS AND BILLIONS

METHOD

Through riddles, an art project, and small group problem solving, students gain an appreciation for large numbers and specifically, the difference between a million and a billion.

MATERIALS

Part 1:
- None

Part 2:
- Quilt Square Grid (provided)
- Pattern blocks*
- Colored pencils
- *How Much is a Million* by David M. Schwartz (optional)

Part 3:
- Student Worksheet
- 50 sheets of paper
- Meter sticks (1 per group)
- 2 maps of the United States
- Calculators (optional)

*included as a printable or available from any teacher supply store

INTRODUCTION

There are over seven billion people on earth today and over 300 million people living in the United States. By 2050, we are expected to have over nine billion people living on earth! It is often difficult for students and adults alike to understand what is meant by such large numbers. Putting these large numbers into a familiar context like distance, time, or height, can help students visualize just how big they are and see the difference in magnitude between a million and a billion.

PART 1: BIG RIDDLES

PROCEDURE

Try these riddles out on your students. You may want to have them simply guess or give estimates. For more of a challenge, have students figure out the exact answer.

COUNTING ON PEOPLE
K-5 Activities for Global Citizenship

CONCEPT

Millions and billions are big numbers. To understand the impacts of a large population, it is important to be able to conceptualize large numbers.

GRADE LEVEL

Upper elementary

SUBJECTS

Math, Art

OBJECTIVES

Students will be able to:
- Recognize that one billion is a thousand millions, which is a thousand thousands.
- Evaluate the difference between millions and billions.
- Solve math problems using standard measurement conversions and base 10 operations.

SKILLS

Counting, estimating, dividing, measuring time and length, multiplying, creating geometric patterns, converting units of measurement within the metric system and between metric and U.S. system

1. Your rich uncle has died and left you a billion dollars, but there's a catch. In order to accept the money, you must count it for eight hours a day at the rate of one dollar per second. When you are finished counting the billion dollars is yours and only then may you begin to spend it.

a. Do you accept your uncle's offer? Why or why not?

No. It would take too long to count the money.

b. How many years will it take you to count the money?

Over 95 years. [1,000,000,000/60 seconds = 16,666,667 minutes/60 minutes = 277,778 hours/8 hours = 34,722 days/365 days = 95.13 years]

c. What if your uncle offered you a million dollars under the same conditions? How long would it take you to count the money?

About 35 days. [1,000,000/60 seconds = 16,667 minutes/60 minutes = 278 hours/8 hours = 34.7 days] or [34,722 days/1,000 = 34.7 days]

2. a. If you spent a million dollars at the rate of $1,000 per day, how long would it take you to spend it?

1,000 days, or about 2 ¾ years. [1,000,000/1,000 = 1,000 days/365 days = 2.74 years]

b. How long would it take to spend a billion dollars at the same rate?

1 million days, or 2,740 years. [2.74 years x 1,000 = 2,740 years]

3. a. How old would you be if you were a million seconds old?

About 12 days old. [1,000,000/60 seconds = 16,667 minutes/60 minutes = 278 hours/24 hours = 11.6 days]

b. How old would you be if you were a billion seconds old?

About 31 years old. [1,000,000,000/60 seconds = 16,666,667 minutes/60 minutes = 277,778 hours/24 hours = 11,574 days/365 days = 31.7 years] or [11.6 days x 1,000 = 11,600 days/365 days = 31.8 years]

PART 2: SEEING A MILLION

PROCEDURE

Students may have trouble conceptualizing a million or a billion of anything. To help students visualize a million in your own classroom, try the following exercise.

1. Have your students use pattern block manipulatives to design a “quilt square” made of 100 triangles. Use the provided Quilt Square Grid. You may want to extend learning by requesting that students design a repeating pattern on their quilt square or that they calculate the fractions of the shapes or colors on their square upon completion.

2. Students should first place the pattern blocks on the grid to make their design, then color the quilt square to match. (Use colored pencils and color lightly so the triangle outlines can still be seen.)

3. Create a class quilt by mounting all students’ quilt squares into one large rectangle.

4. Determine how many triangles are in your class quilt, then measure the length of your quilt. How long would your quilt be if it were made out of a million triangles, with multiple class quilts mounted side by side? What about a billion?

In a class of 20 students, there would be 2,000 triangles in the class quilt. For a quilt of a million triangles, you would need 500 class quilts. To find its length, multiply the length of your class quilt by the number of class quilts (in this case 500). For a quilt of a billion triangles, you would need 500,000 class quilts (1,000,000,000/2,000). To find the length of this billion-triangle quilt, multiply the length of your class quilt by the number of class quilts (500,000 in this example).

5. It can be helpful to put the size in context by comparing it to something in your school. For example, how many hallways or gym walls would you need to display your quilt? An average blue whale is 78 feet long. How many blue whales long would your quilt be?

Note: For younger students, you can simply put 10 stars on a piece of paper. Make 100 copies of the paper and have students hang the sheets around the room – now you have 1,000 stars in your room. You would need 1,000 classrooms just like yours to contain a million stars!

The book *How Much is a Million* by David M. Schwartz has wonderful illustrations of the size of millions, billions, and even trillions. Here are a few highlights:

“If one million kids climbed onto one another’s shoulders, they would be…taller than the tallest buildings, higher than the highest mountains and farther up than airplanes can fly.”

“If a billion kids made a human tower…they would stand up past the moon.”

"If a goldfish bowl were big enough for a million goldfish it would be large enough to hold a whale."

"If you found a goldfish bowl large enough to hold a billion goldfish, it would be as big as a stadium."

In the back of the book, Schwartz explains all of his arithmetic. Kellogg's illustrations really make the math come alive for young and old alike.

PART 3: MEASURING A MILLION

PROCEDURE

Divide the class into groups of four or five. Each group will be responsible for solving one of the following problems. Distribute the Student Worksheet if you want your students to have the benefit of the suggested steps for solving each problem. If you want your students to solve the problems on their own, you can simply write the problems on the board or pass them out on paper. (If you use math journals, you may want students to glue their question to the top of their journal page.) Tell students whether they should solve the problems using meters or feet. After the groups have finished, allow them to share their findings and their problem solving method.

STUDENT WORKSHEET ANSWERS

Group #1: How tall is a stack of a million sheets of paper? How tall is a stack of a billion sheets of paper?

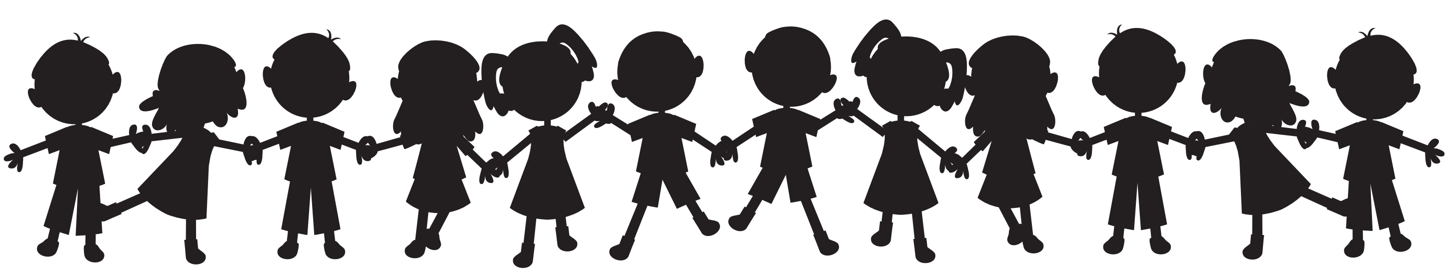
Answers may vary depending on the type of paper measured. Using photocopy paper: a stack of 100 is approximately 1.3 cm high, a million sheets is 130 meters high, and a billion sheets is approximately 130,000 meters. A billion sheets is the height of a 43,333 story building. (That's all the way to the upper atmosphere and the same as almost 425 Empire State Buildings stacked on top of each other!)

Group #2: What is the length of a million people holding hands? What is the length of a billion people holding hands?

Answers will vary depending on how students hold hands. Example: If four students holding hands is 3 meters long:

A million students holding hands would be 465 miles long. [1,000,000/4 = 250,000 groups x 3 m = 750,000 meters/1,000 meters = 750 km x 0.62 km = 465 miles]

A billion students holding hands would be 465,000 miles and circle the earth 18.6 times. [465 miles x 1,000 = 465,000 miles/25,000 = 18.6]



Group #3: If you take a million steps, starting from the door of the room, where will you be? If you take a billion steps, how far would you travel?

Answers will vary based on how far students travel in 10 steps. Example: Assume that 10 steps = 15 feet:

> *A million steps would take you 284 miles. [1,000,000/10 steps = 100,000 sets x 15 feet = 1,500,000 feet/5,280 feet = 284 miles]*
>
> *A billion steps would take you 284,000 miles and circle the earth 11.4 times. [284 miles x 1,000 = 284,000 miles/25,000 = 11.4]*

Group #4: You love to eat bananas and can eat them at the rate of one banana per minute. If you ate them non-stop, and didn't sleep, how long would it take you to eat a million bananas? How long would it take you to eat a billion bananas?

It would take you 1.9 years to eat a million bananas. [1,000,000/60 minutes = 16,667 hours/24 hours = 694 days/365 days = 1.9 years]

It would take about 1,900 years to eat a billion bananas. [1.9 years x 1,000 = 1,900 years] With an average lifespan of 70 years, it would take about 27 lifetimes to eat a billion bananas.

Group #5: If you stacked a million markers end-to-end, how tall would they reach? How tall would a tower of a billion markers be?

A standard Crayola marker is 5.5 inches tall. 100 markers would be 550 inches tall and a million markers would be 5,500,000 inches tall. This would be 458,334 feet or 86.8 miles. A billion markers would be 458,334,000 feet or 86,800 miles high. It would take 825,827 Washington Monuments to reach as high as a billion markers. [458,334,000/555 feet]

DISCUSSION QUESTIONS

1. There are over seven billion people living on earth. Is this a little or a lot? How does this compare with the over 300 million people living in the United States?

The world population is about 22 times the size of the U.S. population. The United States is the third most populated country in the world.

2. If you lived in a city with a million people, what might there also be a million of?

Answers will vary but may include: houses, cars, televisions, chairs, tables, cell phones, etc.

3. Do you think it would be possible to collect a million of something? What about a billion? Why or why not?

Answers will vary.

4. Can you think of somewhere where there might be a million of something in one place? What about a billion?

Answers will vary. Ideas could include blades of grass in a football field, fish in the ocean, windows in a city, popcorn kernels served during a professional baseball game, stars in the sky, etc. If possible, you could challenge students to verify one of their guesses by doing research and calculations.

MEASURING LEARNING

To gauge understanding, observe students working in their small groups and review the Student Worksheet when completed.

FOLLOW-UP ACTIVITIES

1. Invite students to come up with their own millions and billions riddles. They should record their calculations and can illustrate their riddle, drawing inspiration from the pictures in *How Much is a Million* by David M. Schwartz. This could also serve as an assessment project.

2. As a class, collect a million of something. (This would have to be a small object, and ideally, something that could be used after the collection process.) Host a large numbers night for your students' families where you showcase your collection, your class quilt, and your millions and billions riddles.

MILLIONS AND BILLIONS
STUDENT WORKSHEET

Name: ______________________________ Date: ______________________________

Problem 1:

A) How tall is a stack of a million sheets of paper?

B) How tall is a stack of a billion sheets of paper?

Process:

1. I would estimate that the height of a stack of a million sheets of paper would be _________ meters.

2. The height of 100 sheets of paper is ___________ millimeters or _____________ centimeters.

3. Based on the information in #2, the height of 1,000,000 sheets of paper is _______ mm or _______ cm or _____ meters.

4. Based on the information in #3, the height of 1,000,000,000 sheets of paper is __________ meters. (Remember: A billion is a million multiplied by a thousand.)

5. If each story of a building is 3 meters high, how many stories would be in a building that is the same height as a billion sheets of paper? ___________________________ stories

Problem 2:

A) What is the length of a million people holding hands?

B) What is the length of a billion people holding hands?

Process:

1. I would estimate that a million people holding hands would stretch _________ miles.

2. Measure the length of four people standing holding hands. The length is ________ meters.

3. How many groups of 4 are in a line of 1,000,000 people? There are _____________ groups of 4 in a line of 1,000,000 people. Multiply this number by the length of 4 people holding hands (your answer in #2). A line of 1,000,000 people would be ____________ meters long.

4. There are 1,000 meters in a kilometer. A line of 1,000,000 people is ________ km long.

5. 1 km = 0.62 miles. A line of 1,000,000 people is ____________miles long.

6. Look at a map of your state or country. Can you find a distance between two cities that is about the same length as a million people holding hands? _______________

____

7. How many miles long would a line of a billion people holding hands be? __________ miles (Remember: A billion is a million multiplied by a thousand.)

8. The circumference of the earth is roughly 25,000 miles. A line of a billion people holding hands would circle the globe how many times? _______________

Problem 3:

A) If you take a million steps, starting from the door of the room, where will you be?

B) If you take a billion steps, how far will you travel?

Process:

1. In which direction do you plan to travel? _____________

2. Where do you estimate you will be after taking a million steps in this direction?

____

3. Have one person in your group take 10 steps. Use a meter stick to measure how many feet are traveled in 10 steps. Since step sizes aren't always the same, you may want to do this several times and then find the average distance. 10 steps = __________ feet

4. How many sets of 10 steps are in a million steps? 1,000,000/10 = ___________

5. If a person travels ________ feet in 10 steps, then they would travel ________ feet in a million steps.

6. 1 mile = 5,280 feet. How many miles equal a million steps? ___________ miles

7. Look at a map of your area. Use the same direction that you used for your estimate and see how close you came. If I traveled a million steps in the direction that my group chose, I would be in ________________________ .

8. Now that you know how many miles you would travel after taking a million steps, how many miles would you travel after taking a billion steps? (Remember: A billion is a million multiplied by a thousand.) ___________________________

9. The circumference of the earth is roughly 25,000 miles. Taking a billion steps, how many times will you circle the earth? _________________________

Problem 4:

A) You love bananas and can eat them at the rate of one banana per minute. If you ate them non-stop, and didn't sleep, how long would it take you to eat a million bananas?

B) How long would it take you to eat a billion bananas?

Process:

1. How long do you estimate it would take you to eat a million bananas at the rate of one banana per minute? ________________________

2. At the rate of one banana per minute, you could eat a million bananas in a million minutes.

3. There are ________ minutes in an hour. So a million minutes is __________ hours.

4. Divide your answer in #3 by 24 to find out how many days are equal to a million minutes. A million minutes is ____________ days.

5. There are 365 days in a year. Divide your answer in #4 by 365 to find out how many years are equal to a million minutes. A million minutes is _________ years, so I could eat a million bananas in ________ years.

6. How many years would it take you to eat a billion bananas at the same rate? (Remember: A billion is a million multiplied by a thousand.) ________________ years

7. If the average life span is 70 years, how many lifetimes would one need in order to eat a billion bananas? _____________ lifetimes

Problem 5:

A) If you stacked a million markers end-to-end, how tall would they reach?

B) How tall would a tower of a billion markers be?

Process:

1. I would estimate the height of a million markers to be _______ feet.

2. The height of one marker is ________ inches. So, a tower of 100 markers is _________ inches.

3. A million is 10,000 groups of 100. Multiply the height of 100 markers by 10,000 to find the height of a million markers. A million markers are ___________ inches tall.

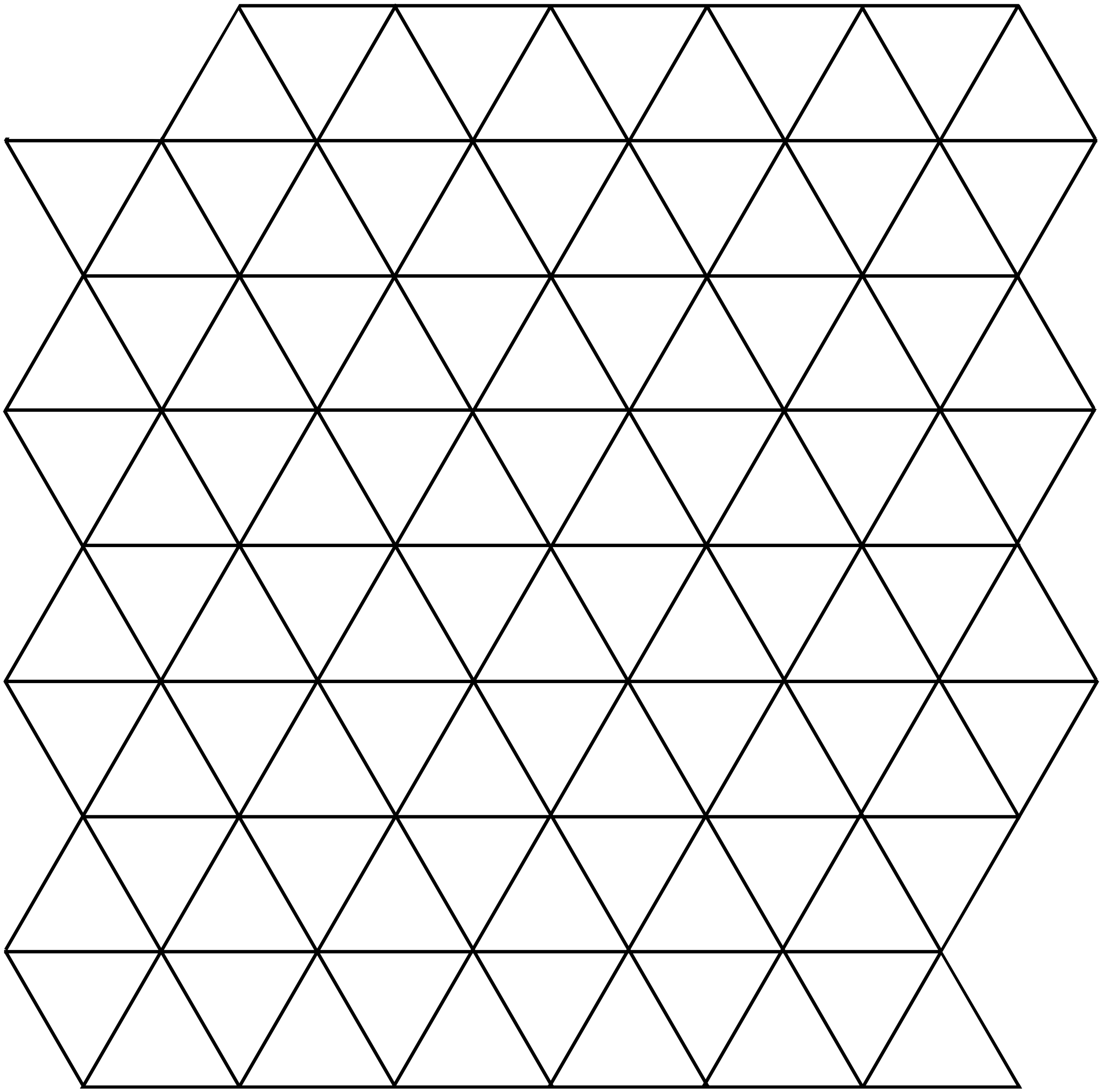
4. There are 12 inches in a foot. A million markers are______________ feet tall.

5. There are 5,280 feet in a mile. So, a tower of a million markers would be ________ miles high.

6. How tall would a tower of a billion markers be? (Remember: A billion is a million multiplied by a thousand.) ________________ feet or _________________ miles

7. The Washington Monument is 555 feet tall. How many Washington Monuments would you need in order to match the height of a billion markers? ________________________ Washington Monuments

QUILT SQUARE GRID



PRINTABLE PATTERN BLOCKS