THINKING WRITING

7.C One Googol Zeroes

Scientific notation will help you think about these two very large numbers.

one googol = 10,000,000,000,000,000,000,
000,000,000,000,000,000,000,000,000,000,
000,000,000,000,000,000,000,000,000,000,
000,000,000,000,000,000,000

1. How many zeroes does it take to write one googol? (Count them!)

one googolplex = 1 followed by one googol zeroes

2. Guess how large a sheet of paper one would need to write one googol zeroes.

a. a sheet the size of a table?

b. a sheet the size of a room?

c. a sheet the size of a school?

d. a sheet the size of a city?

3. Let's assume a zero takes up one square centimeter. How many zeroes could you fit on a piece of paper having area

a. one square meter? (There are 100 centimeters in a meter. Use a sketch to figure out how many square centimeters in a square meter. Hint: There are more than 100 square centimeters in a square meter.)

b. one square kilometer? (There are 1000 meters in a kilometer.)

Notation: cm^2 stands for square centimeter; km^2 for square kilometer.

4. a. The area of California is $4(10^5)$ km^2. How many zeroes could fit on a sheet of paper this size?

b. The area of the United States is nearly 10^7 km^2. How many zeroes could fit on a sheet this size?

5. 30,000 sheets of thin paper make a pile one meter high. How many zeroes could be in such a pile, if each sheet is the size of the United States?

6. a. The moon is less than $4(10^5)$ km away. How many zeroes, if our pile of paper extended that far?

b. The sun is $1.5(10^8)$ km away. How many zeroes, if our pile extended that far?

c. The nearest star is $4(10^{13})$ km away. How many zeroes, if our pile extended that far?

7. What fraction of the total number of zeroes does our pile include?

8. Report Write a report summarizing your answers to problems 3-6 above. Show your calculations and include any sketches that were useful in figuring out answers. Explain your reasoning. Then show how to figure out the correct answer to problem 2.

9. Project Where in the universe would our pile of papers end if it did include one googol zeroes?

The word *googol* was created in 1938 by the eleven-year-old nephew of the American mathematician Edward Kasner. In one sense, a googolplex is the largest number that has a name. But in fact, even without creating any new names, you can name larger numbers. For example, the words *two googolplex* name a larger number.

10. What is the largest nameable number? Explain your reasoning.