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

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

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:** \( \text{cm}^2 \) stands for square centimeter; \( \text{km}^2 \) 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 \( 1.5(10^9) \) 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.