

Student handout:

## The Nanofiber Chocolate Factory: An Analogy

Name(s) \_\_\_\_\_ Date \_\_\_\_\_

**Purpose:** In the following activity you will determine what advantages exist in making the size (diameter) of pretzel smaller. See figure 1 below. You will compare the amount of chocolate covering a large diameter pretzel with that of smaller pretzels that take up about the same diameter. You will make the comparison by massing your cup of chocolate before and after you dip the pretzel(s) in chocolate.



Fig 1: Cross sectional view of large pretzel compared to small pretzels.

**Materials needed:** 1 eight ounce paper cup containing chocolate syrup (about  $\frac{1}{2}$  full), 1 large pretzel, about 3 small pretzels, paper towels and a balance (0.1 g).

**Your prediction:** Do you think the large pretzel or the three smaller pretzels will have the most chocolate syrup coating them?

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### Procedure:

1. Weigh chocolate syrup and paper cup together. Write down your value here \_\_\_\_\_ grams.
2. Obtain one large pretzel and 3-4 small pretzels. Check with your teacher to obtain the correct number of smaller pretzels to be equal in diameter to the larger pretzel.
3. Measure from one end of each pretzel to a distance of 5 centimeters and mark the location with marker. 

5 cm	→	
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4. Dip the large pretzel in the syrup up to the 5 centimeter mark. Lift the pretzel up and over the cup. Allow it to stop dripping. Lay the pretzel on the paper towel.

5. Weigh your cup again. The mass is now \_\_\_\_\_grams. The difference between the first weighing and the second is equal to the amount of chocolate on the pretzel. The difference is equal to \_\_\_\_\_ grams.
6. Dip each small pretzel to the 5 centimeter mark as you did before. Wait for it to stop dripping. Do the same thing to the other small pretzels you have. Lay them on the paper towel.
7. Weigh the cup of chocolate again. Its mass is \_\_\_\_\_grams. Take the mass of the cup before you dipped the three smaller pretzels (in number 5) and subtract the final weighing from it. What will this equal in grams \_\_\_\_\_? What does this value stand for?
8. Compare your values with 2 other lab groups. How does your data compare?

**Conclusion:**

1. Write a few sentences describing what you discovered about the amount of chocolate on the large pretzel compared to the three smaller pretzels.
2. If your smaller pretzels could be very small in diameter...the size of a nanofiber and you had enough to equal the diameter of your large pretzel, do you think that the nanosize pretzels of the large diameter pretzel would have the most coating of chocolate on its surfaced?

**Concept: The smaller the fiber, the greater the surface area (i.e. The more surface you can coat with whatever!)**