**Nanometer Scaling Activity**

**Introduction**

A meter is the base unit of measuring length in the metric system. Based on this unit, prefixes are added to signify a larger or smaller unit of length. It is easy to visualize a meter since it is fairly similar to a yardstick (about 3 feet). When you get down to a nanometer, it can be harder to visualize. A nanometer is 1 billionth of a meter. How small is that?

*Examples include*

Our fingernails grow at a rate of 1 nanometer per second.

A head of a pin is approximately 1 million nanometers across.

Human hair is about 80,000 nanometers in diameter.

The transistor of a latest-generation Pentium Core Duo processor is 45 nanometers.

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| **Unit** | **Symbol** | **Magnitude (in meters)** | **About How Big?** |
| Megameter | Mm | 106 = 1 000 000 | Approximately the distance from New York City to Chicago |
| Kilometer | km | 103 = 1 000 | A little over half a mile |
| Meter | m | 100 = 1 | A bit bigger than a yardstick |
| Centimeter | cm | 10-2 = 0.01 | Width of a fingernail |
| Millimeter | mm | 10-3 = 0.001 | Thickness of a dime |
| Micrometer | µm | 10-6 = 0.000 001 | A single cell |
| Nanometer | nm | 10-9 = 0.000 000 001 | 10 hydrogen atoms lined up |
| Angstrom | Å | 10-10 = 0.000 000 000 1 | 1 large atom |

Table 1. Common size units and examples (NanoSense)

In this activity you will explore the relationship between the length of a nanometer and a meter.

**Procedure**

You will be selecting an item of your choice to represent 1 nanometer (nm). Your goal is to determine how long 1 meter would be if the item you chose equaled 1 nanometer.

Make that length for 1 meter into something more concrete such as the how many trips between Los Angeles and New York City that would be or how many trips up and down Mount Everest.

**Questions to Consider**

1. How did you compare the size of a nanometer to a meter before and after this activity?
   1. Was the length of 1 meter larger or smaller than you expected when you used your item to represent 1 nanometer?
2. There are multiple ways to approach this problem. What approach did you take to completing this activity?
   1. What other ways can this activity be approached?
3. How could you help your students understand the relationship between a nanometer and meter?

**References**

<http://nanosense.sri.com/activities/sizematters/sizeandscale/SM_Lesson2Student.pdf>

<http://www.nano-link.org/nano-infusion-project/nanoscience-fundamentals> (free registration before download)

http://nanoyou.eu/attachments/188\_Module-1-chapter-1.pdf