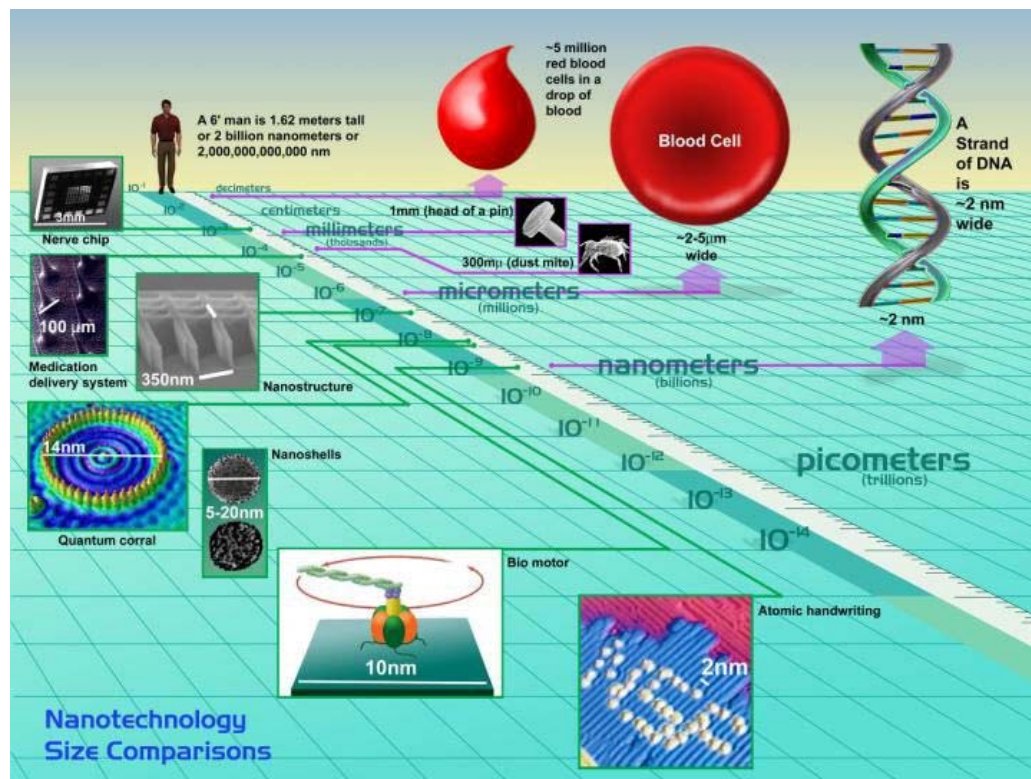


# CHAPTER 2 – SIZE AND SCALE



Powers of 10 Scale

## INTRODUCTION

As you know, atoms are the basis of all normal matter. However, it can be difficult for students to visualize this because the size of an atom is so unfamiliar. Using dramatic analogies, this chapter aims to provide students with an intuitive feel for nano and atomic scales. Students will also test their mathematical skills by using proportions and powers of ten to make estimates about sizes.

Using both the traditional “Powers of Ten” movie by Charles and Ray Eames and the newer “Universcale” website by Nikon, students can explore the size relationships between various objects. The question of how to represent vastly different sizes on the same scale is also addressed.

The mathematical mechanics of exponents and scientific notation are reviewed for the students before using their experience with the websites to perform some ordering tasks themselves.

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Finally a series of analogies is used to connect the students understanding of macroscale relationships to micro, nano and astronomical sizes. The students are expected to integrate the knowledge from the previous activities to create their own analogies for various size relationships.

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## SIZE AND SCALE LEARNING GOALS

By the end of this chapter, students should be able to:

### ORDER BENCHMARK OBJECTS BY SIZE

Students should be able to recognize the order of magnitude of some benchmark objects (atom, cell, human, earth, solar system) and correctly arrange objects of different orders of magnitude in increasing size.

### RECOGNIZE THAT CHANGES IN SCALE ARE NOT DISCONTINUOUS

Recognize that separate “worlds” (atomic, micro, nano, astro) are not discontinuous. When ordering objects by size, students place all objects on the same line rather than different lines for different scales (micro, atomic, etc).

### CORRECTLY TRANSFER BETWEEN SCIENTIFIC AND DECIMAL NOTATION OF NUMBERS

Correctly transfer numbers between two different notations.  
Identify situations (very large or small numbers) where scientific notation is most useful.  
Using a simple calculator (no exponent function), correctly calculate values of numbers (not just ten) raised to an exponent.

### DISCERN BETWEEN LOGARITHMIC AND LINEAR SCALES

Recognize that there are multiple ways of representing relationships between numbers of different sizes.

Identify the logarithmic scale (or “powers of ten” or “proportional” scale) as a good method of representing numbers that vary greatly in size.

Identify the linear scale (or “absolute” or “difference” scale) as a good tool for comparing numbers that are close (within 2 orders of magnitude or so) in size.

### RECOGNIZE PROPORTIONAL RELATIONSHIPS BETWEEN OBJECTS OF DIFFERENT ORDERS OF MAGNITUDE AND GENERATE APPROPRIATE COMPARISONS