FLINN SCIENTIFIC

Name_____

Ruby-Red Colloidal Gold Worksheet

1. The line drawn on the side of this page is 220 mm long. Assume that this line represents the average diameter of a red blood cell, which is 1 micrometer or micron (1 μm = 1×10^{-6} m). (a) What is the diameter of a red blood cell in *nanometers* (1 nm = 1×10^{-9} m)? (b) Calculate the length of the line segment in *millimeters* that would be needed to represent an object that is one *nanometer* in diameter on this line.

2. Mark off line segments of the appropriate length on the line to represent (a) the average size of the influenza virus (100 nm), (b) a colloidal gold nanoparticle (40 nm), and (c) the width of the DNA double helix (2 nm).

3. The colloidal gold in this demonstration was prepared starting with 20 mL of 1×10^{-3} M $HAuCl_4$. (a) How many grams of gold (Au = 197 g/mole) are contained in the flask of colloidal gold? (b) At a current price of $580 per troy ounce (1 troy ounce = 31.1 g) for gold, how much is the gold in the flask worth?

4. *Estimate* the number of gold atoms in a single gold nanoparticle that is 40 nm in diameter. Use the following assumptions: (a) The atomic radius for gold is 0.15 nm. (b) Both particles are the shape of a sphere. The volume of a sphere is $4/3\pi r^3$, where r is the radius. (c) Only 74% of the total volume of the nanoparticle is physically occupied by gold atoms. (The rest of the volume is "empty space" between atoms. 74% is the maximum "packing efficiency" of spheres in any crystal lattice.)

Red blood cell (Scale 1 μm = 220 mm)