Scale of a Eukaryotic Cell

Measurements of eukaryotic cell organelles are usually given either in micrometers (μm) or nanometers (nm). These units are so tiny, it's hard to visualize the relative size of the various cell components. Because some cell components are so tiny, most cell models and drawings are not to scale, yet it's good to get an idea of the relative size of cellular components.

1 mm = about the size of a small fingernail clipping or a pencil lead
1 μm = 1/1000 mm
1 nm = 1/1 000,000 mm = 1/1000 μm

The following are size ranges for the various components of eukaryotic cells. For easier comparison, the measurements in blue are all in nanometers:

- Eukaryotic cells: 10-100 μm = 10,000-100,000 nm
- Nucleus: 5 μm = 5000 nm
- Space between the nuclear membranes: 20-40 nm
- Nuclear pores: 100 nm
- Ribosomes (eukaryotic): 25-30 nm
- Mitochondria: 1-10 μm = 1000-10,000 nm
- Chloroplasts: 3-6 μm = 3000-6000 nm
- Microtubules: 25 nm diameter (15 nm lumen)
- Microfilaments: 7 nm
- Intermediate filaments: 8-12 nm
- Motile cilia: 0.25 μm diameter × 2-20 μm long = 250 nm × 2000-20,000 nm
- Flagella: 0.25 μm diameter × 10-200 μm long = 250 nm × 10,000-200,000 nm
- Plasma membrane: 8 nm thick

Visualize a eukaryotic cell
In this thought exercise, you imagine you are building a scaled model of a eukaryotic cell in which 1 nm = 1 mm. So the model will be a million times larger than the average eukaryotic cell. Go through each of the components above and figure out how large they would be at this scale. Try to think of real, live examples of objects that would compare to the actual size of the cellular component. For example, a nuclear pore would end up being about 10 cm across in our model, so about the size (and shape) of a donut. A ruler and a meter stick are helpful in this exercise.