Nanobiology:

Biology at the nano to micron scale

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Seeing is believing - When you can visualize things, you can better understand their structure and function. This is also true for biology. Biology happens at very different scales from nanometers to meters; thus, you need the proper tool to visualize biological objects (Fig. 1).

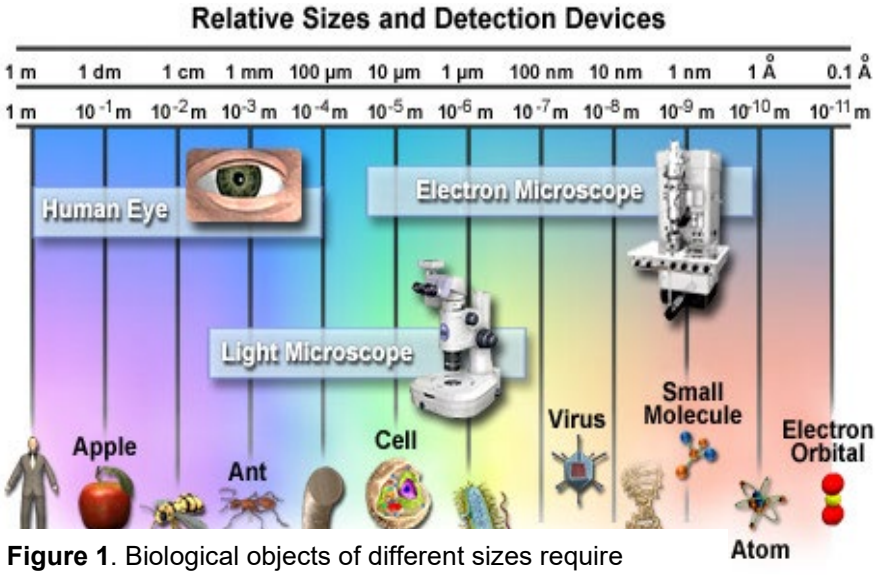

Figure 1. Biological objects of different sizes require different detection devices. http://micro.magnet.fsu.edu.

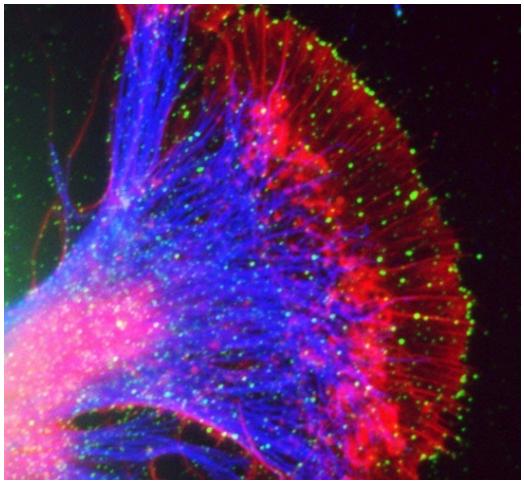

Figure 2. Neuronal growth cone of cultured *Aplysia* bag cell stained for F-actin (red), microtubules (blue) and activated Src2. (green). From Wu et al., 2008.

The Suter Lab is studying the development and regeneration of the nervous system, specifically the growth and guidance of axons, the neuronal extension that send the signals to the next cell. For these studies we often use **light microscopy (LM)**, for example fluorescence microscopy to visualize the neuronal growth cone (Fig. 2). **Activity 1:** Use the rulers to measure the size of different subcellular structures such as actin filaments on the provided images.

Sometimes structures are too small to be seen even with the light microscope. To overcome this limitation, you can use **electron microscopy (EM)** or **atomic force microscopy (AFM)**. AFM uses a small tip to scan over the surface of objects. It allows you to "feel" structures that you do not see by eye or the light microscope (Fig. 3). AFM allows you to get quantitative information about the surface topography and mechanical properties of objects including live cells. For example, we have used AFM to measure the thickness and stiffness of different growth cone regions. **Activity 2:** Use the Nanofeel magnet as an analogy for AFM. Moving the probe strip left to right on the magnet, you will not experience much; however, it will feel different when you move the strip from top to bottom.

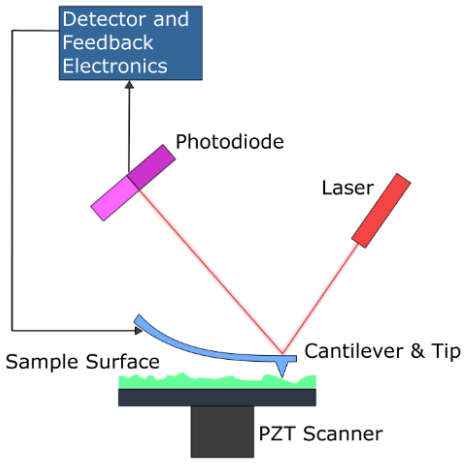

Figure 3. AFM components. https://www.nisenet.org/catalog/exploring-tools-special-microscopes

Future challenges of AFM:

1. Destroying the sample: any imaging technique, including AFM, can alter the sample. Thus, care has to be taken to minimize sample damage to soft biological samples.
2. Lateral resolution: the lateral resolution is limited to 10-30 nm. Vertical resolution is 0.1 nm.
3. Scanning speed: images are made by rastering the across an area which is slow; this limits our ability to witness dynamic events happening at the nano-scale.

Want to learn more?

https://suterlab.bio.purdue.edu/

https://www.nisenet.org/content-keywords/atomic-force-microscope