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Choosing an Instrument

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Researchers employ a wide variety of highly sophisticated microscopes to explore at the nanoscale. All these instruments produce images that are indirect representations of matter too small to see. Scientists began using electron microscopes in the 1930s and scanning probe microscopes emerged in the 1980s, but newer technologies do not necessarily replace older instruments. Rather, each type of microscope offers a different set of tools for gathering information, and the information revealed spurs researchers to ask new questions.

**scanning probe microscope**

These microscopes scan the movement of a tiny probe tip as it travels over a sample's surface. They create three-dimensional images that visualize individual atoms. These instruments also provide researchers with immediate feedback as they modify samples. This allows operators to manipulate atoms and build tiny structures. Common types of scanning probe microscopes include the scanning tunneling microscope (or STM) and the atomic force microscope (or AFM).

**electron microscope**

Developed in the early twentieth century, electron microscopes produce images by focusing a beam of electrons on the specimen. This technique allows for imaging at a much greater magnification than with an optical microscope. Whereas scanning electron microscopes (or SEMs) shoot a beam of electrons off of samples to produce brilliant three-dimensional images, transmission electron microscopes (or TEMs) send a beam of electrons through samples to achieve images at a very high resolution.

**optical microscope**

The modern optical microscope is a direct descendant of Leeuwenhoek's 17th-century invention. It uses light rays and lenses for focusing images. Early modern optical microscopes now incorporate computer algorithms that allow scientists to manipulate images through automatic focusing or rendering multiple images into a single view. Two benefits of optical microscopes include their low cost and the ability to view living cells.

**COMPARING MICROSCOPES**

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**COMPARE & CONTRAST:** See how different microscopes produce distinct images of red blood cells.