What's the Size of What You See?

Determine the field diameter of a compound microscope.

By measuring the field diameter of a microscope, you can calculate the real sizes of objects too small to see with the naked eye.

Tools and Materials

- Compound microscope
- Pencil and notepaper to record results
- Calculator
- Clear plastic metric ruler with millimeter markings (copy this template onto a transparency to make your own)
- Optional: microscopic objects to view and measure

Assembly

None needed.

To Do and Notice

Find the total magnification of your microscope. First, read the power inscribed on the eyepiece. You'll find it marked as a number followed by an X, which stands for "times." Record the eyepiece power.

Find the three barrel-shaped objective lenses near the microscope stage. Each will have a different power, which should be marked on the side of the lens. Record the power for each objective.

Find the total magnification for each objective lens by multiplying the power of the eyepiece by the power of the objective.

Lowest Magnification: Eyepiece x Lowest power objective = _____X
Medium Magnification: Eyepiece x Medium power objective = _____X
Highest Magnification: Eyepiece x Highest power objective = _____X

Set the microscope to its lowest magnification. Slide the plastic metric ruler onto the stage and focus the microscope on the millimeter divisions. How many millimeters fit across the circle of light you see (the field of view)? This measurement is the field diameter. Record the field diameter in millimeters.

Repeat this process for medium magnification.

Repeat once more for the highest magnification. What do you notice?

The highest magnification may be tricky to measure because the field of view will probably be less than one millimeter in diameter—too small to directly measure with your ruler. To get a usable reading, move the ruler back and forth a bit to estimate the fraction of a millimeter that fits across the diameter, or use the measurements you've already made along with this handy bit of math:

$$\frac{\text{magnification at highest power}}{\text{magnification at lowest power}} = \frac{\text{field diameter at lowest power}}{\text{field diameter at highest power}}$$

What happens to the field diameter as the magnification increases? This inverse proportional relationship tells us something important about the relationship of magnification to field diameter.

What's Going On?

Magnifying power is a measurement of how much bigger an object appears when viewed through a lens or microscope. The "X" inscribed on each eyepiece and lens stands for "times," so a 10X lens will make an object appear 10 times bigger than it is.

In a compound microscope, the object being viewed is magnified twice: First, the objective lens makes the object appear 5, 10, 40, or even 100 times larger, and then the eyepiece lens magnifies that image an additional 10 times. That's why multiplication is used to find the total magnifying power of an objective-eyepiece combination.

Because magnification is a ratio and has no units, knowing the magnifying power of your microscope alone doesn't tell you the true size of the object you're viewing. Direct measurements are necessary to calibrate your microscope's field of view.

In calculating the size of the high-magnification field of view, it may seem counterintuitive to have the numerators and the denominators of the proportional relationship not "match." As the magnification goes up, the field diameter gets smaller, and vice versa, so the two quantities have an inverse relationship.

Going Further

Once you know the field diameter of each objective of your microscope, you can estimate the size of the things you see. Use a prepared slide, or make a simple one yourself, and try to figure out how many millimeters across your specimens are. One way to do this is to estimate how many of the object would fit across the field of view, then divide the field diameter by this estimate.

Teaching Tips

When students measure the field diameter with the ruler, it may be helpful to have them draw what they see.

Crystals of table salt make a simple small object to observe and measure. Just place them dry on a glass slide.