Name _____

Date _____ Class _____

5. Microscope Magnification

Objectives

After completing this worksheet, you will be able to determine the magnifying power of a microscope and the size of the field of view. You will be able to estimate the size of the specimen you are viewing, in micrometers (μm).

Magnifying Power

A compound microscope has two sets of lenses. The lens you look through is called the **ocular.** The lens near the specimen being examined is called the **objective**. The objective lens is one of three or four lenses located on a rotating turret above the stage, and that vary in magnifying power. The lowest power is called the **low power objective (LP)**, and the highest power is the **high power objective (HP)**. You can determine the magnifying power of the combination of the two lenses by multiplying the magnifying power of the ocular by the magnifying power of the objective that you are using. For example, if the magnifying power of the ocular is 10 (written 10×) and the magnifying power of an objective is 4 (4×), the magnifying power of that lens combination is 40×. If an object is magnified 40 times, the image you see is 40 times larger than the object would appear if viewed with the unaided eye at a distance of about 25 cm.

Field of View

The **field of view** is the maximum area visible through the lenses of a microscope, and it is represented by a diameter. To determine the diameter of your field of view, place a transparent metric ruler under the low power (LP) objective of a microscope. Focus the microscope on the scale of the ruler, and measure the diameter of the field of vision in millimeters. Record this number.

When you are viewing an object under high power, it is sometimes not possible to determine the field of view directly. The higher the power of magnification, the smaller the field of view. The diameter of the field of view under high power must be calculated using the following equation.

$$\frac{\text{diameter (LP)} \times \text{magnification of LP objective}}{\text{magnification of HP objective}} = \text{diameter (HP)}$$

For example, if you determine that your field of view is 2.5 mm in diameter using a 10× ocular and 4×objective, you will be able to determine what the field of view will be with the high power objective by using the above formula. For this example, we will designate the high power objective as 40×.

$$\frac{2.5 \text{ mm} \times (4\times)}{(40\times)} = .25 \text{ mm, or } 250 \text{ μm}$$

Estimating the Size of the Specimen Under Observation

Objects observed with microscopes are often too small to be measured conveniently in millimeters. Because you are using a scale in millimeters, it is necessary to convert your measurement to micrometers. Remember that 1 µm = 0.001 mm.

To estimate the size of an object seen with a microscope, first estimate what fraction of the diameter of the field of vision that the object occupies. Then multiply the diameter you calculated in micrometers by that fraction. For example, if the field of vision's diameter is 400 µm and the object's estimated length is about one-tenth of that diameter, multiply the diameter by one-tenth to find the object's length.

$$400 \ \mu m \times \frac{1}{10} = 40 \ \mu m$$

Practice Exercise

1. What is the total magnification of a microscope with a 15× ocular and a 40× objective?_____

2. A student determines that the field of view with a 10× ocular and a 4× objective is 2.5 mm in diameter. What is the diameter with the same ocular and a 10× objective?_____

3. What is the diameter of the field of view with a 10× ocular and a 40× objective? _____

   _____

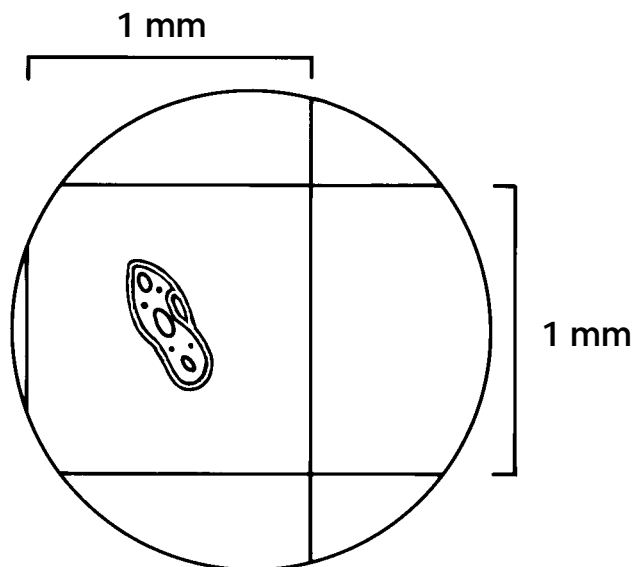4. If the diameter of the field of view under a microscope is 2.5 mm, what are the approximate dimensions of the amoeba in the illustration below?

   _____

Figure 1

1 mm

2 mm
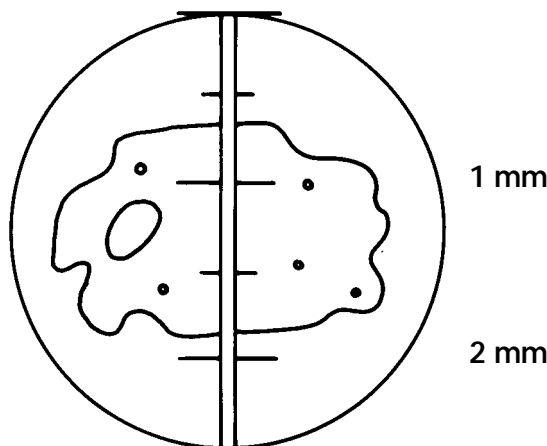
5. Estimate the length of the organism in the field-of-view illustration below.

_____

Figure 2

1 mm

1 mm

6. The illustration below is a sample view of the organisms you might see in a drop of lake water, using a 10✕ ocular and 10✕ objective. Three of these organisms are indicated by A, B, and C. Using the back of this page, draw each organism. Describe each organism as completely as you can, including its shape and dimensions, the magnifications used, and the diameter of your field of view. Give all dimensions in micrometers.

Figure 3
*Microscope field
of view of lake
water sample*

A

B

C

1 mm
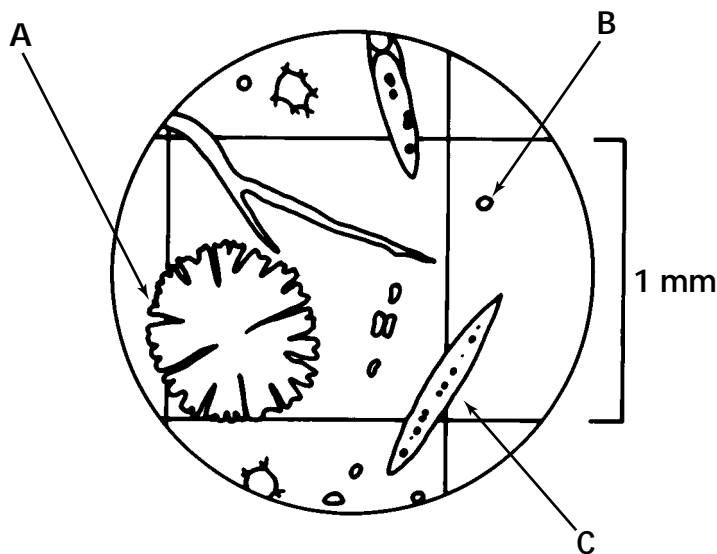
Basic Skills Worksheets
5 *Microscope Magnification*

Practice

Exercise

1. $600\times$
2. 1 mm or 1,000 μm
3. 0.25 mm or 250 μm
4. 1.2 mm (1,200 μm) by 1.9 mm (1,900 μm)
5. 0.5 mm or 500 μm
6. The diameter of the field of view is approximately 1.7 mm; total magnification is $100\times$ ($10\times$ ocular and $10\times$ objective).

   A. Descriptions will vary; dimensions are approximately 600 μm by 650 μm.

   B. Descriptions will vary; dimensions are approximately 50 μm by 50 μm.

   C. Descriptions will vary; dimensions are approximately 800 μm by 100 μm.