Name……. Period……

Student Laboratory Packet
Measuring Using a Microscope
A Laboratory Activity for the Living Environment

Background

It is interesting and informative to observe specimens under the microscope, but it is often difficult to know the actual size of the object being observed. Magnification causes us to lose the idea of actual size. You cannot hold a ruler up to a paramecium or a plant cell while it is under a microscope. Therefore, size must be measured indirectly—that is, it must be compared with the size of something you already know. The diameter of the microscope field seen through the ocular is a convenient standard to use.

Two metric units are useful when measuring small objects:

1 meter (m) = 1000 *millimeters* (mm) 1 mm = 1000 *micrometers* (μm)

Objectives

In this activity you will:

1. Measure the diameter of the low-power field.
2. Calculate the diameter of the high-power field.
3. Learn how to estimate the sizes of objects under the microscope.

Materials

microscope
transparent metric ruler
prepared slide of paramecium

prepared slide of tilia root (corn stem)

Procedures and Observations

1. Examine the markings on a transparent metric ruler. Determine which marks indicate millimeter lengths. Then place the ruler on the stage so that it covers half of the stage opening as shown in Figure 1.

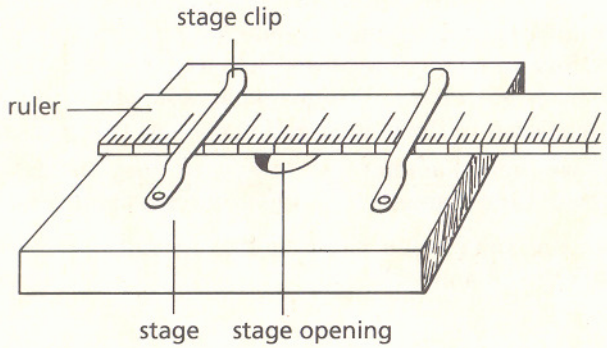

Figure 1

2. Prepare your microscope for low-power observation of the ruler.
3. Look through the ocular. Focus on the edge of the ruler, using the coarse adjustment. Adjust the position of the ruler so that the view in the low-power field is similar to Figure 2.

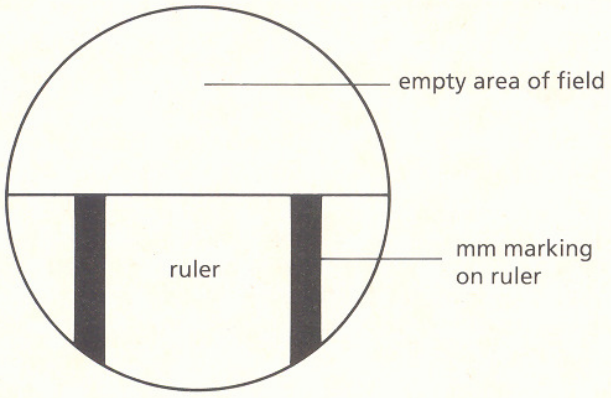

Figure 2

4. Place the center of one mark at the left side of the field of view. Make sure that the edge of the ruler is exactly across the center of the field. If the ruler sticks to your fingers, use the eraser end of a pencil to arrange it.
5. Note that 1 millimeter is the distance from the middle of one mark to the middle of the next mark. The diameter of the low-power field measures 1 millimeter plus a fraction of another.
   a. *Record the measurement of the low-power field diameter in millimeters, expressing the length to the nearest tenth of a millimeter.*

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6. Convert the measurement in millimeters to micrometers by multiplying by 1000.
   b. *Record the measurement of the low-power field diameter in micrometers.*

You cannot measure the diameter of the high-power field using the process you have just completed. Viewing a ruler under high power presents light and focusing problems. Also, the high-power field diameter is less than 1 millimeter. But you can indirectly obtain the high-power field diameter. You know the low-power field diameter and the magnifying power of both objectives. The magnification of the objectives is inversely proportional to the field size. You can use this formula:

$$\frac{\text{high-power field diameter}}{\text{low-power field diameter}} = \frac{\text{low-power magnification}}{\text{high-power magnification}}$$

7. Substitute the values you know in this formula to calculate the high-power field diameter.

c. *Record the high-power field diameter in micrometers. Show your calculations.*

The measurements of the low-power and high-power field diameters can be used to measure other things indirectly.

8. Under low power, focus on a prepared cross section of corn stem.

The center of a corn stem is filled with large, thin-walled cells. These are *pith cells.*

9. Observe the pith cells.

d. *How many pith cells fit across the diameter of the low-power field?*

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10. To calculate the diameter of a pith cell, divide the diameter of the low-power field by the number of cells given for Question d.

e. *Record the diameter of a pith cell in micrometers.*

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11. Switch to high power and focus with the fine adjustment.

f. *How many pith cells would fit across the diameter of the high-power field?*

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12. To calculate the diameter of a pith cell as seen under high power, divide the diameter of the high-power field by the number of cells given for Question f.

g. *Record the diameter of a pith cell in micrometers, as measured under high power.*

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h. *Compare the measurement of the diameter of a cell under low and high power.*

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13. Observe a paramecium on a prepared slide under low power. Estimate its length by comparing it to the diameter of the low-power field.

i. *Record the length of the paramecium in micrometers.*

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14. Switch to high power. Estimate the length of the paramecium by comparing it to the diameter of the high-power field.

    j. *Record the length of the paramecium in micrometers as measured under high power.*

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Analysis and Interpretations

1. Compare the measurements that you calculated for the pith cells and for the paramecium under low with their measurements under high power. If measurements of the same object are different, what could be the reason?

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2. Find the diameter of the high-power field of a microscope with an ocular marked 10X, a low-power objective marked 10X, a high-power objective marked 40X, and a low-power field diameter of 1600 micrometers.

3. What approximate fraction of the low-power field *area* would you see if you were to change to the high-power objective, using the microscope in Question 2?

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