Microscope Mystery
Practicing Proper Microscope Technique

The microscope is a valuable tool used by biologists. It magnifies materials such as cells that the human eye cannot distinguish. We cannot see objects much smaller than 0.1 mm in size. The most commonly used compound microscope is the monocular (one eyepiece) light microscope. The microscopes found in most high school laboratories magnify objects from 40× to 1000×. The resolving power is the limiting factor that determines how much a microscope can magnify. *Resolving power* is the measurement of how close two points can be and still be distinguished as separate. The resolving power of the human eye is approximately 0.1 mm. This value is somewhat variable as some humans are capable of making much finer distinctions than others and this ability can change with age.

A microscope is basically a tube with lenses at both ends. The lens that is closest to the eye is the *ocular lens*. Typically, the eyepiece lens magnifies an image 10 times or (10×). It is not unusual for this lens to magnify 10× by itself. The level of magnification is found on the side of the ocular. Some oculars will include built-in pointers or measuring devices.

The lenses that are found on the revolving nosepiece are the *objectives*. Most microscopes will have two or more objectives. The magnification of the objective lens is stamped on the side of the lens. The total magnification of an object can be found by multiplying the magnification of the objective lens with that of the ocular lens. For example, a microscope with a 10× ocular lens and a 10× low power objective lens has a low power total magnification of 100×. The objectives are attached to a revolving nosepiece so that turning the nosepiece can change the objectives. The advantage of using an objective with higher magnification is an increase in detail can be viewed. The disadvantage of viewing at a higher magnification is that less of the slide can be viewed. For example, if there are 20 evenly distributed yeast cells in the field of view at 50×, when the objective is changed to 100× only 10 cells will be visible. These yeast cells however, will appear twice as large. The other disadvantage of using higher magnification is that the depth of focus is much more difficult to control. For example, on 40× two crossed threads on a microscope slide can both be brought into focus. However, when the magnification is increased to 100×, only one of the threads can be brought into focus. The other thread will be out of focus.

Underneath the stage is the *condenser lens* which has a diaphragm. This diaphragm regulates the amount of light passing through the specimen. Specimens to be viewed are usually thin enough that the light passes right through them. Light reaches the eye after passing through the examined object. There are times when the amount of light passing through the specimen is too much and the amount of light needs to be reduced. The diaphragm of the microscope removes any stray light that might cause the image to be blurry.

PURPOSE
In this investigation you will learn how to use a microscope.

MATERIALS
- compound light microscopes
- prepared slide of the letter ‘e’
- 14 unknown prepared slides
- lens paper
- 14 clue cards

PROCEDURE

PART I: CARE OF THE MICROSCOPE

1. It is important to take proper care of the microscope; it is probably one of the most expensive pieces of equipment in the laboratory. When moving the microscope, always carry the microscope with both hands, placing one hand on the arm while holding the base with the other hand.

2. Always set the microscope down gently and away from the edge of the table. Keep the electrical cord away from any water. Remove all of your materials from the table except those items needed for the lab.

3. If you wear mascara hold your eyes at a distance from the ocular lens. When your eye blinks, your eyelashes can transfer some of the mascara to the ocular lens, making it difficult to see the specimen.

4. Before using the microscope, clean the lenses carefully with lens paper. The lenses of the microscope are the most expensive items on the microscope. Always clean lenses with the lens paper designed for this task. Using filter paper, paper towel or any other substitute may scratch the lenses.

5. To prevent damage to the high power objective, ALWAYS return the revolving nosepiece to the low power setting before putting away the microscope.

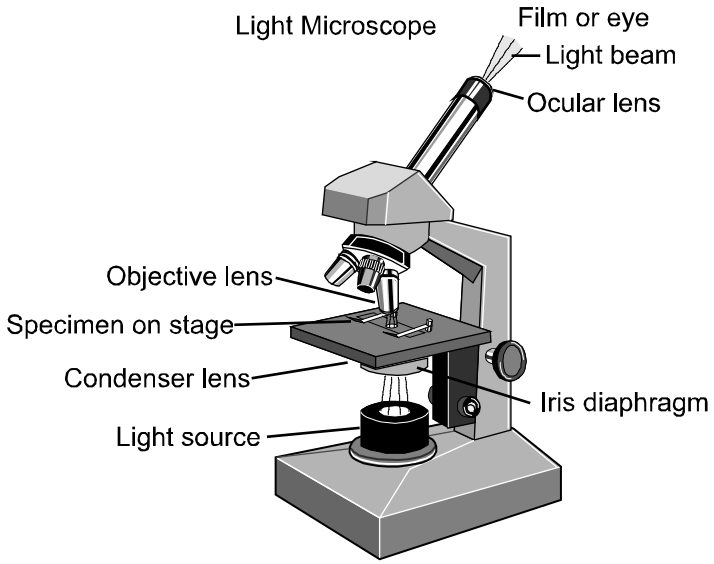

Figure 1

PART II: IDENTIFYING THE PARTS OF THE MICROSCOPE

1. Obtain a microscope and use Figure 1 above to guide you as you locate the various parts. Read about the function of each part of the microscope below. Use this information to complete the Pre-Lab labeling activity on your student answer page.
    a. **Ocular or eyepiece** − contains lenses to increase magnification, usually 10×
    b. **Arm** − connects body tube to the base where stage and adjustment knobs are located
    c. **Revolving nosepiece** − allows changing of various objectives
    d. **Objectives** − contains lenses of different magnifications, usually 4×, 10×, and 40/43×
    e. **Stage** − holds microscope slides and has an opening to allow light to pass
    f. **Stage clips** − hold the slide in place
    g. **Adjustment knobs** − can be found as one knob with two parts or as two separate knobs. The outer knob or the larger knob is the coarse adjustment and is used to bring the slide into focus. The fine adjustment is the inner knob or the smaller knob and is used to sharpen the focus.
    h. **Diaphragm** − regulates the amount of light passing through the stage
    i. **Light source** − directs light upward through the diaphragm
    j. **Base** − supports the microscope

PART III: USING THE MICROSCOPE

1. Plug in the microscope. Turn on the lamp to allow light to pass through the specimen. Most microscopes are equipped with a diaphragm for regulating light. Some materials are best viewed in dim light, others in bright light.

2. Rotate the nosepiece to bring the low-power objective into place. The low power objective will be the shortest and will have the smallest magnifying power as indicated by the number stamped on its side. When changing from one objective to another you will hear a click as the objective snaps into position.

3. Using only lens paper, wipe the lenses to make sure that they are dry and free of fingerprints and debris.

4. Obtain a prepared slide of the letter ‘e’ and look at it to locate the specimen. Place the slide on the stage so that the specimen is over the opening on the stage.

5. When focusing, start with the objective with the lowest magnification. Make sure that BOTH the coarse and fine adjustment knobs are lowered down as far as possible. Do not allow the objectives to touch the cover slip.

6. Adjust the light with the diaphragm so that an evenly distributed circle of light is visible.

7. Look through the ocular and slowly turn the coarse adjustment knob to raise the nosepiece until the specimen comes into rough focus. Use the fine adjustment knob to sharply focus the specimen.

8. Slowly move the slide to the right. Observe which direction the ‘e’ moves in the field of view. Slowly move the slide away from you. Again, observe which direction the ‘e’ moves in the field of view.

9. Sketch a drawing of the letter ‘e’ on low magnification. Indicate the magnification power below your sketch.

10. To increase the magnification, revolve the nosepiece to the higher objective until it snaps into place. You should only have to sharpen the focus with the fine-adjustment knob. You should NOT focus using the coarse-adjustment knob after changing to a higher magnification.

11. Sketch the letter ‘e’ as it appears under high power magnification in the space provided on your student answer page. Indicate the magnification power below your sketch.

12. Remove the slide and return to the low power objective.

PART IV: SOLVING A MYSTERY

1. Your teacher will provide you with a prepared microscope slides and a set of clue cards.

2. Using your newly acquired microscope skills, place the slide under the microscope on low power.

3. Adjust the magnification and focus so that the specimen can be best viewed.

4. Make a detailed drawing of the specimen that you are viewing under the microscope in the student DATA and OBSERATIONS portion of the lab. Also record the magnification that you are using.

5. As you observe and sketch the specimen, read though the clue cards. Determine the clue card that best corresponds with the unknown specimen and write your selection under “Clue.”

6. Remove the slide from the stage and to the low power objective.

7. As directed by your teacher, rotate to each of the microscopes and repeat steps 3-6 until all 14 slides have been viewed, sketched, and identified.

8. After sketching and recording each of the slides and clues, your teacher will place on the board a list of the names of the organisms or structures on the slides. With your partner, determine the “identification” of each of the unknowns and record it under your sketch.

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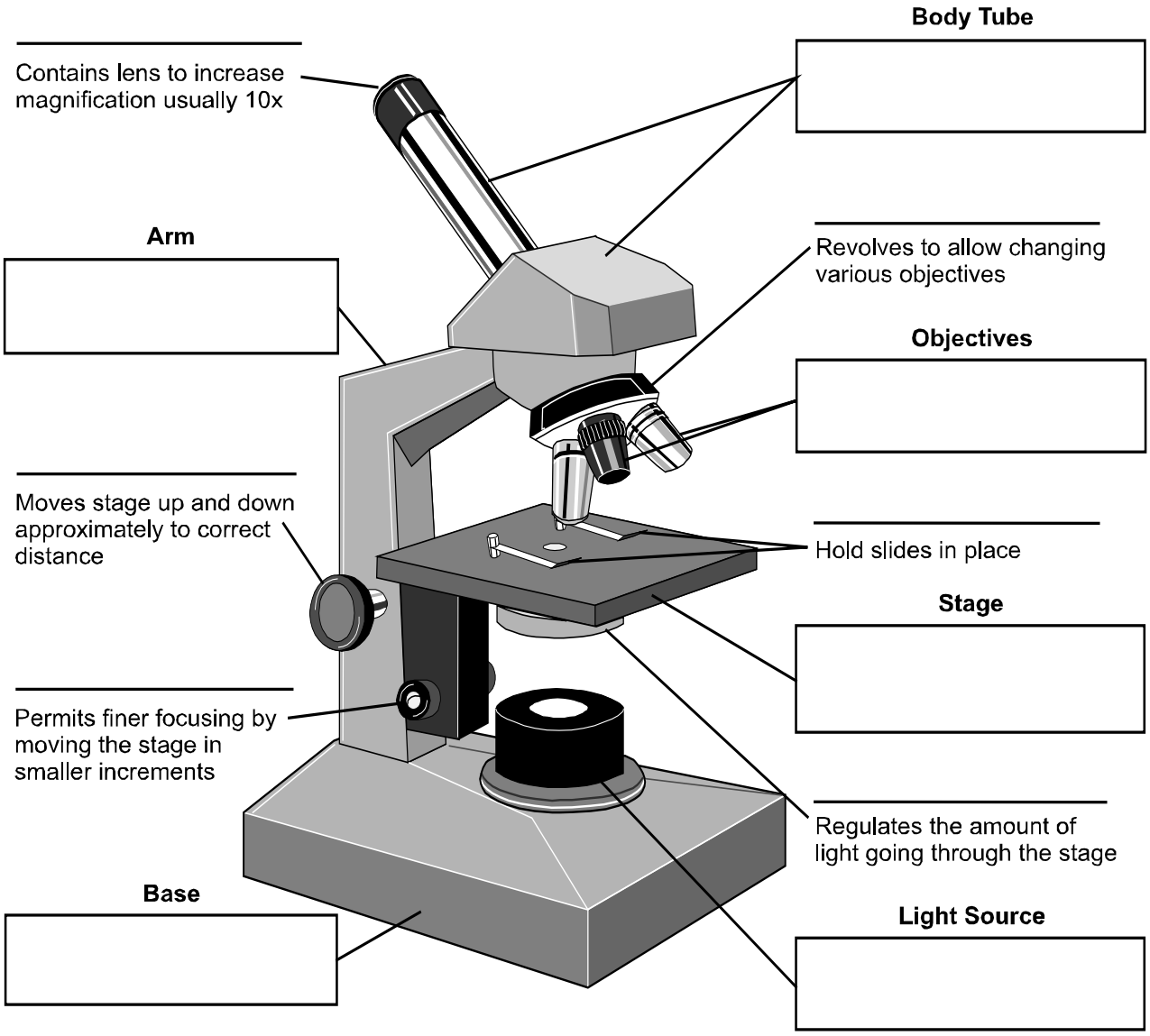
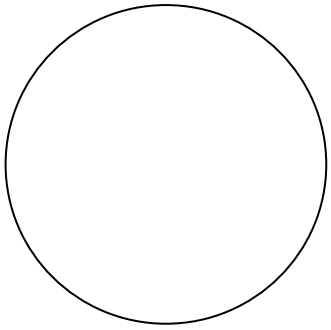
PRE-LAB

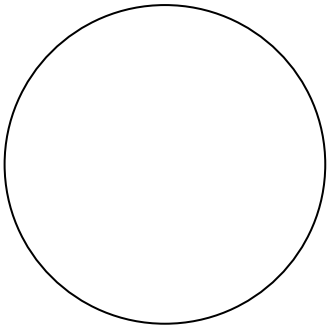
Fill in the diagram of the microscope with the term or description that matches the microscope part.



DATA AND OBSERVATIONS

PART III: USING THE MICROSCOPE





Magnification: _____ Magnification: _____

Compare the appearance of the ‘e’ when viewed with the naked eye to its appearance when viewed under the microscope. List three ways in which it appears different.

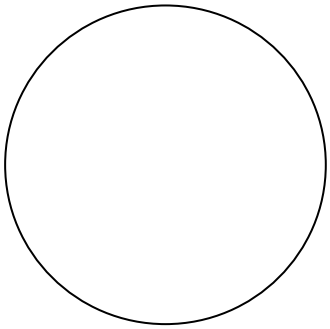
1.

2.

3.

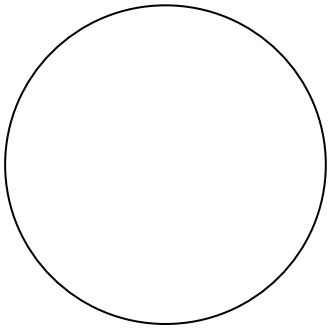
PART IV: SOLVING A MYSTERY

Unknown A:



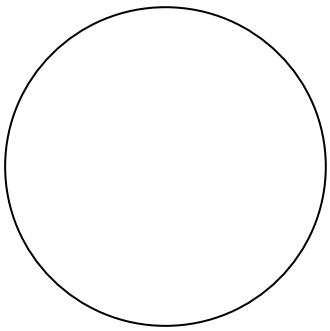
Magnification: _____
Clue: _____
Identification: _____

Unknown B:



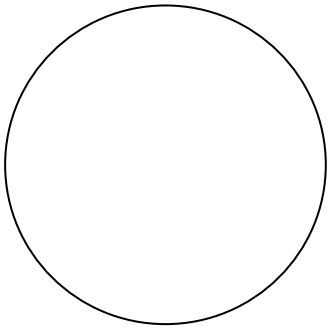
Magnification: _____
Clue: _____
Identification: _____

Unknown C:



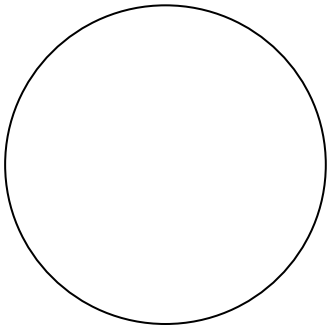
Magnification: _____
Clue: _____
Identification: _____

Unknown D:



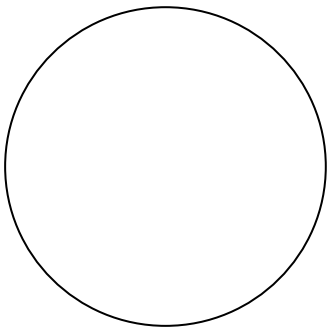
Magnification: _____
Clue: _____
Identification: _____

Unknown E:



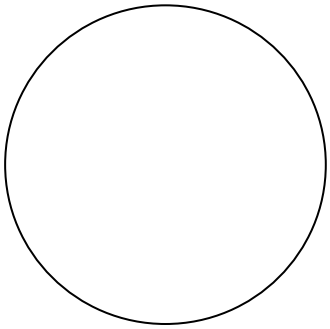
Magnification: _____
Clue: _____
Identification: _____

Unknown F:



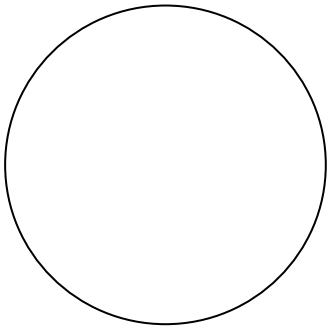
Magnification: _____
Clue: _____
Identification: _____

Unknown G:



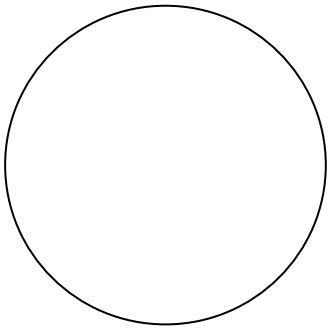
Magnification: _____
Clue: _____
Identification: _____

Unknown H:



Magnification: _____
Clue: _____
Identification: _____

Unknown I:



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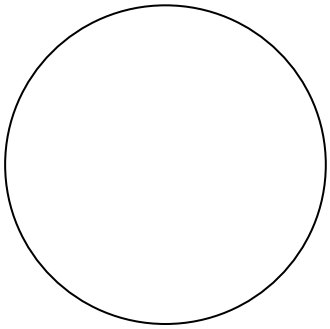
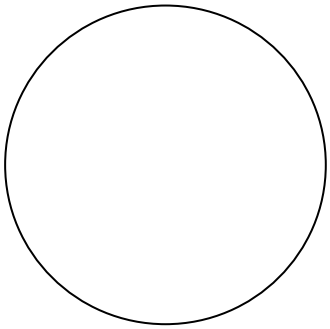
Clue: _____
Identification: _____

Unknown J:



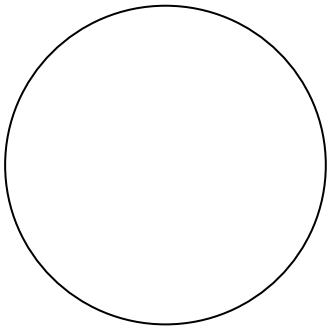
Magnification: _____
Clue: _____
Identification: _____

Unknown K:



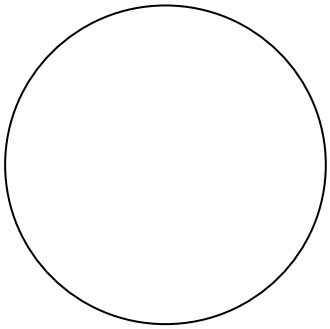
Magnification: _____
Clue: _____
Identification: _____

Unknown L:



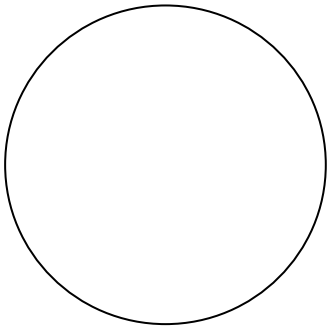
Magnification: _____
Clue: _____
Identification: _____

Unknown M:



Magnification: _____
Clue: _____
Identification: _____

Unknown N:



Magnification: _____
Clue: _____
Identification: _____

CONCLUSION QUESTIONS

1. What is the advantage of using high power?

2. What is the advantage of using low power?

3. List three structures that you were able to see better using the high power objective.

4. When you moved the slide to the right, which direction did it appear to move under the eyepiece?

5. What evidence suggests that Unknown K is more advanced than Unknown A?

6. Which of the unknown specimens most likely were photosynthetic? Explain.

7. An unknown specimen is placed on the stage to be viewed on high power. Place the steps in order that one should undergo in order to view the specimen.

_____ Focus the specimen using the course adjustment knob.
_____ Focus the specimen using the fine adjustment knob.
_____ Place the slide on the stage.
_____ Remove the slide from the stage.
_____ Return the objective to low power.
_____ Turn the objective on high power.
_____ Turn the objective to its lowest magnification.