**Introduction: Microscope Types, Use, and Care**

**Light compound microscope** - the models found in most schools, use compound lenses to magnify objects. The lenses bend or refract light to make the object beneath them appear closer. Common magnifications: 40x, 100x, 400x

**Stereoscope (aka dissecting microscope)** - this microscope allows for binocular (two eyes) viewing of larger specimens.

**Scanning Electron Microscope** - allow scientists to view a universe too small to be seen with a light microscope. SEMs do not use light waves; they use electrons (negatively charged electrical particles) to magnify objects up to two million times.

**Transmission Electron Microscope -** also uses electrons, but instead of scanning the surface (as with SEM's) electrons are passed through very thin specimens.

**Part I. Microscope Parts:** make sure you write the correct functions from our discussion. Then use these terms to label the blank microscope diagram at the end of this packet.

1. eyepiece

2. body tube

3. revolving nosepiece (aka turret)

4. coarse focus adjustment

5. fine focus adjustment

6. arm

7. low-power objective lens

8. high-power objective lens

9. stage clip

10. diaphragm

11. stage

12. light source (aka illuminator)

13. base

**Microscope Use:**

14. When focusing a specimen, you should always start with the _____ objective.
15. When using the high power objective, **only the** _____ **knob should be used**.
16. The type of microscope used in most science classes is the _____ microscope.

17. You should carry the microscope by the _____ and the _____.

18. The objectives are attached to what part of the microscope (it can be rotated to click lenses into place?)

_____

19. A microscope has an ocular objective of 10x and a high power objective of 50x, what is the microscope's total magnification? _____

20. If a part of the microscope does not move, or is resisting your use, then _____!

21. Store the microscope with the _____ lens in position and the stage _____.

**Part II. Magnification:**

This is a **compound microscope**, meaning the power of magnification is the result of compounding (aka multiplying) the ocular lens magnification (eyepiece) by the objective lens' magnification (found on the lens itself). Fill in the table below using the numbers on the lenses of your microscope.

*Ex: Magnification of a 75x objective lens = (10x ocular lens) x (75x objective lens) = 750x total magnification*

| Lens name | Objective Lens Magnification | Ocular Lens Magnification | Total Magnification |
|---|---|---|---|
| Scanning power | | 10x | |
| Low power | | 10x | |
| High power | | 10x | |

**Part III: Calculation of the <u>Field of Vision or Field of View (abbreviated FOV)</u>**

You need to know the diameter of the field you are viewing so that you can estimate to the best of your ability what the size of a specimen or microscopic structure is. To do this, you need to be aware of the

1. Place a transparent metric ruler under **the low power (LP)** objective of a microscope so that one millimeter (mm) line is at one side of the equator of the field and you can see the ruler's scale easily.

2. Focus the microscope on the scale of the ruler using the coarse focus knob (larger) and then the fine focus knob (smaller), and measure the diameter of the field of vision in millimeters (mm). Record this number below.

3. Calculate the diameter in mm of the field of vision under high power (HP) using the following formula:

$$\text{Diameter in mm (unknown lens)} = \frac{(\text{diameter of known lens}) \times (\text{magnification of known objective})}{(\text{magnification of unknown objective})}$$

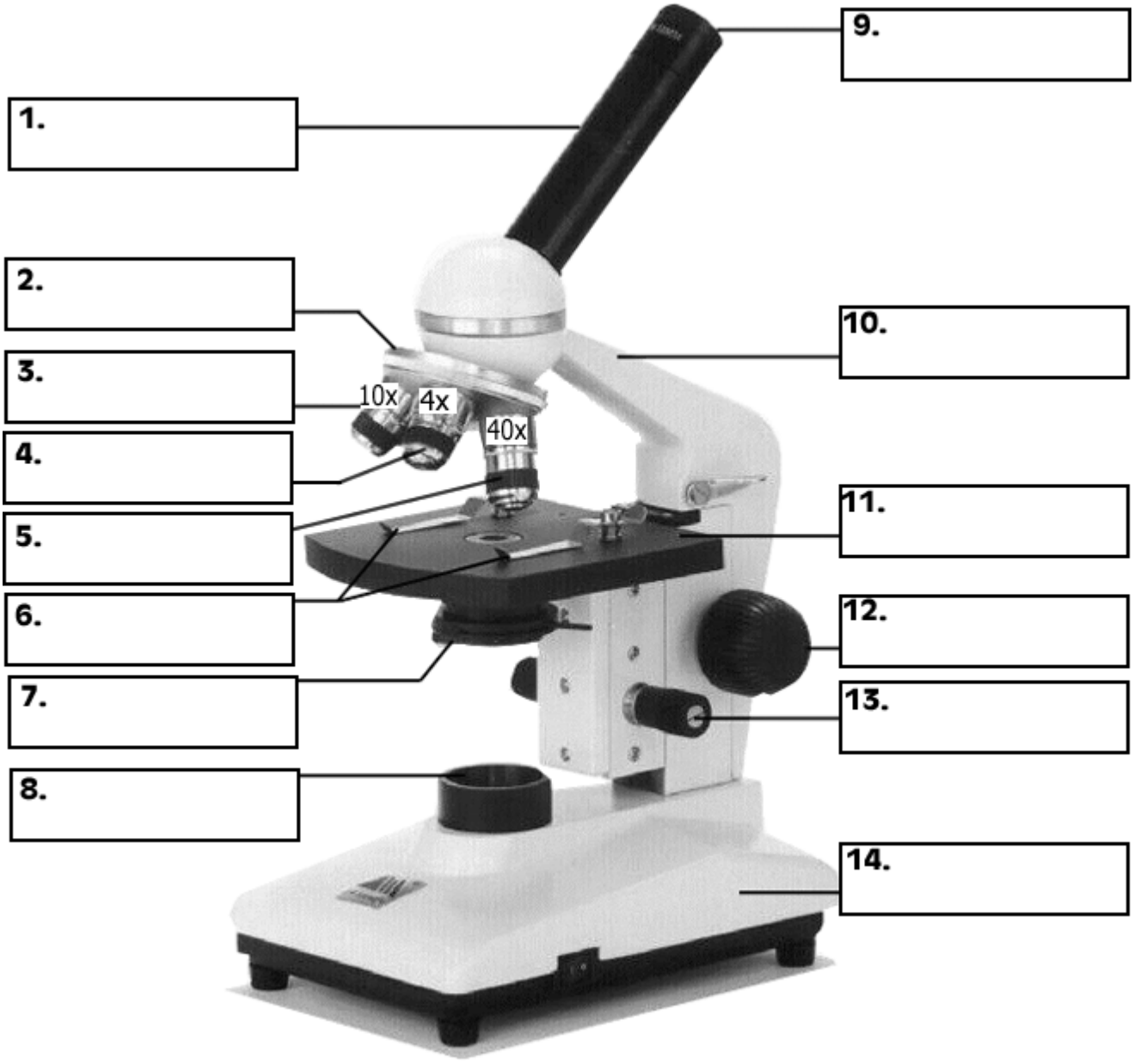
*Ex. What is the diameter of the low power lens (10x) if the diameter of the scanning lens in use is 4mm and its magnification is 40x? Diameter of LP lens = (4mm) x (40x) = 160 / 100 = 1.6 mm*

*(100x)*

Results: Diameter of the scanning field of vision (mm) = _____ (measured by eye)

Diameter of the LP field of vision (mm) = _____ (calculate from formula)

Diameter of the HP field of vision (mm) = _____ (calculate from formula)




Quiz yourself on the parts of the microscope and if you are incorrect on any part, cross it out above and write the correct one next to it (*no penalty section!!):* https://www.biologycorner.com/microquiz/index.html

**Part IV. Microscope Function: how to focus on specimens**

1. **Always start with the scanning objective (4x lens, 40x total magnification)**. Odds are, you will be able to see something on this setting. We use this objective first to find the sample on the slide. Use the coarse knob to focus, the image may be small at this magnification, but you won't be able to find it on the higher powers without this first step. Do not use stage clips, try moving the slide around until you find something. Look for what may appear like dirt and that is a place to start.

2. **Once you've focused using the scanning lens, switch to low power (10x lens, 100x magnification)**. Use the coarse knob to refocus if necessary, then use the fine focus knob to get a crystal clear image before moving on. Again, if you haven't focused on this level, you will not be able to move to the next level as easily.

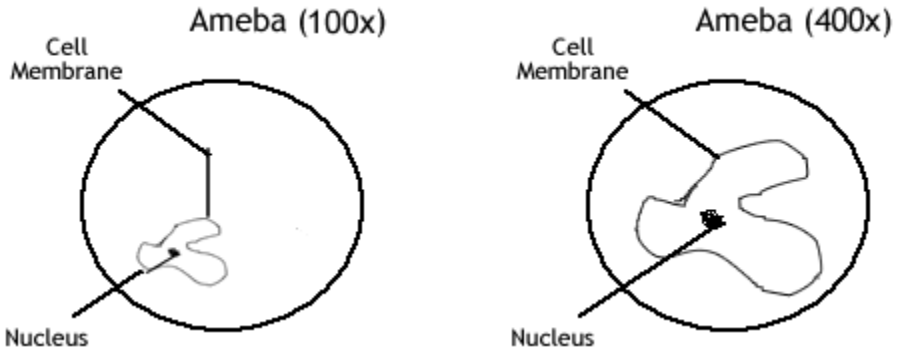
3. **Now switch to high power (40x lens, 400x total magnification**. (If you have a thick slide, or a slide without a cover, do NOT use the high power objective). At this point, **ONLY USE THE FINE ADJUSTMENT KNOB** to focus specimens. If you use the coarse focus here, there is a good chance you will break the slide with the high-power lens and scratch or break the expensive lens glass in the process.

4. If the specimen is too light or too dark, try adjusting the diaphragm to let more light into the view.
5. If you see a line in your viewing field, try twisting the eyepiece, the line should move. That's because it's a **pointer** and is useful for pointing out things to your lab partner or teacher. It also can work like a placeholder so you can more easily find your specimen at the next power.

**Drawing Specimens**

1. Use pencil - you can erase and shade areas
2. All drawings should include clear and proper labels (and be large enough to view details). Drawings should be labeled with the specimen name and magnification.
3. Labels should be written on the outside of the circle. The circle indicates the viewing field as seen through the eyepiece, specimens should be drawn to scale. If your specimen takes up the whole viewing field, make sure your drawing reflects that.

Example:



**Troubleshooting**

Occasionally you may have trouble with working your microscope. Here are some common problems and solutions.

1. Image is too dark! *Adjust the diaphragm, make sure your light is on.*

2. There's a spot in my viewing field, even when I move the slide the spot stays in the same place! *Your lens is dirty. Use lens paper, and only lens paper to carefully clean the objective and ocular lens. The ocular lens can be removed to clean the inside.*

3. I can't see anything under high power! *Remember the steps, if you can't focus under scanning and then low power, you won't be able to focus anything under high power.*

4. Only half of my viewing field is lit, it looks like there's a half-moon in there! *You probably don't have your objective fully clicked into place.*

**Part V: The letter "e" and the inverted image.**

Obtain a slide with the letter "e". View the letter under the microscope and answer the following questions:

1. Draw the letter "e" as it appears under the microscope.

2. Describe how the letter physically looks on the slide and how it looks when you look through the eyepiece.

3. What happens to the "e" as you move the slide to the right?

4. What happens if you push the slide away from you?

5. What is the total magnification of the low-power lens? And what size would you estimate the letter "e" to be?

6. What happens to the letter "e" when you change to the high-power lens?

7. What is the total magnification of the high-power lens? And what is new about the letter under high power?

8. About how many times was the magnification increased when you changed from low-power to high-power?

9. How does this change the area of the slide included in the high-power field?

**Part VI. Threads and Depth of Field (DOF)**

Obtain a slide of threads and view the slide under the microscope. This will get you used to a concept called **depth of field**. This refers to the fact that there is a depth of the layer the specimen is held within. You can focus on any part of the specimen at different depths as you move the fine focus knob. Follow the steps below and answer the following questions:

1. Draw what you see under low power after getting the specimen in very clear focus.

2. Describe any changes in the appearance of the position of the fibers when you turn the fine adjustment knob back and forth.

3. Explain why these apparent changes occur.

4. How can you determine which fiber is on top when you look through the microscope?

5. What happens to the resolution (clearness) when you change from low power to high-power?

6. What happens to the field of vision (diameter) when you change from low power to high-power?

7. What happens to the brightness when you change from low power to high-power? Why do you think this happened?

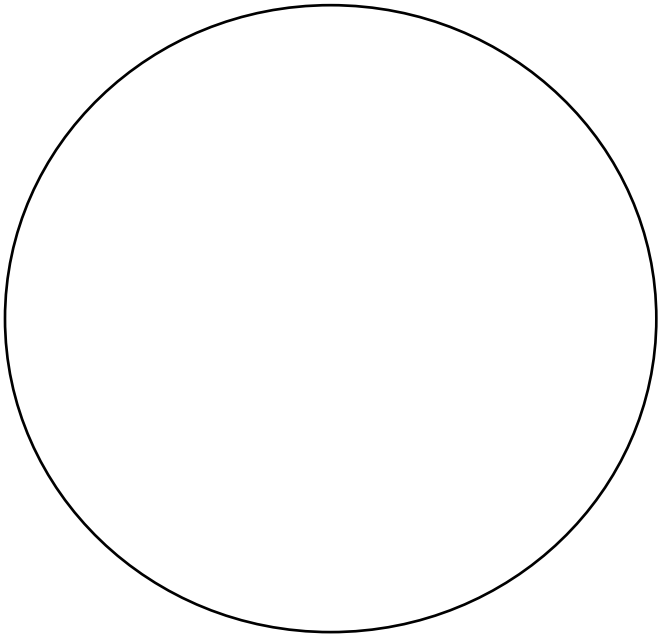
**Part VII. Observing specimens and drawing them to scale.**

Obtain a prepared slide of a **generalized animal cell** and an ***Elodea*** (an aquatic plant). Observe both under **low and high power** and, USING PENCIL, draw what you see under the microscope in the fields below. Remember to include the details about the image you're viewing! Label cell membranes and nuclei using the "drawing specimens" directions from Part IV of this packet.

Slide Title: _____

_____

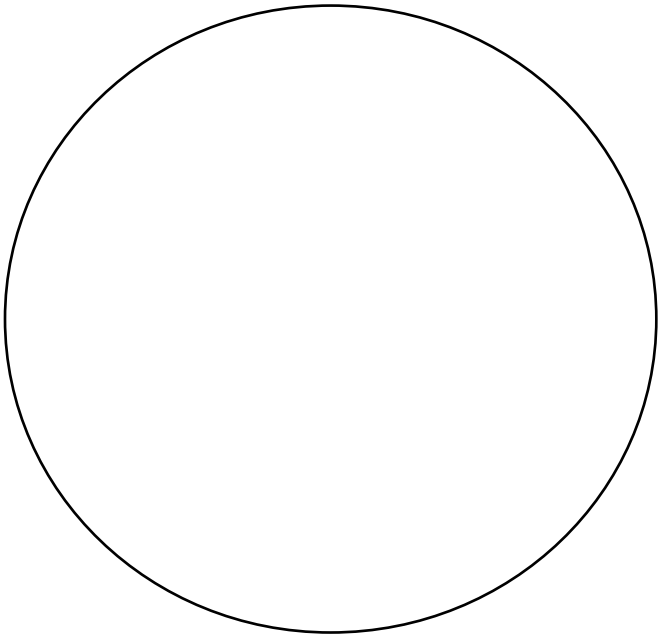
Total Magnification: _____



Slide Title: _____

_____

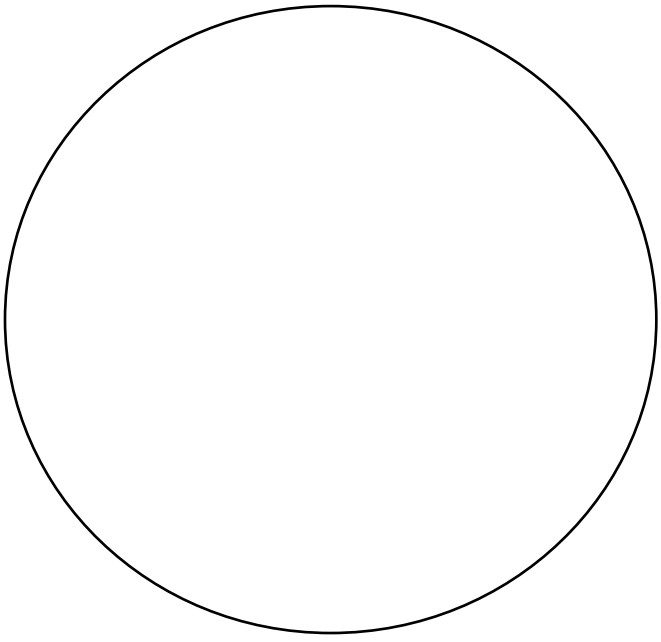
Total Magnification: _____



Slide Title: _____

_____

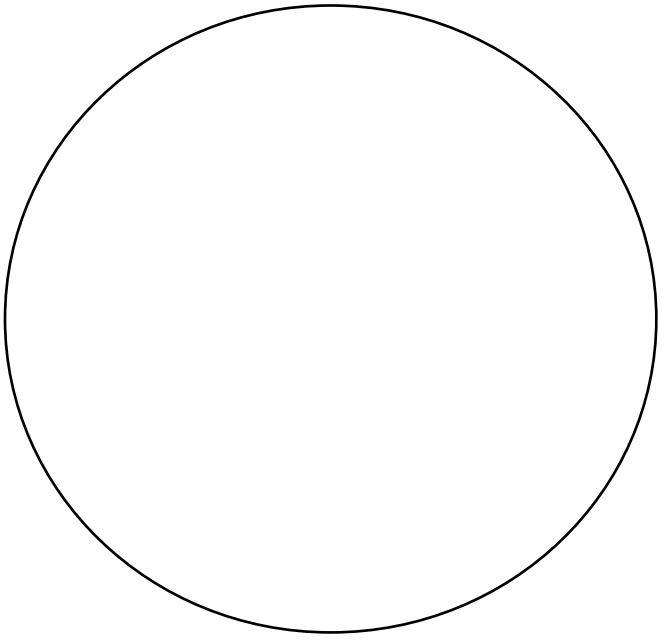
Total Magnification: _____



Slide Title: _____

_____

Total Magnification: _____



Answer true or false to each of the statements

_____ On high power, you should use the coarse adjustment knob.
_____ The diaphragm determines how much light shines on the specimen.
_____ The low power objective has a greater magnification than the scanning objective.
_____ The fine focus knob visibly moves the stage up and down.
_____ Images viewed in the microscope will appear upside down.
_____ If a slide is thick, only parts of the specimen may come into focus.
_____ The type of microscope you are using is a scanning microscope.
_____ For viewing, microscope slides should be placed on the objective.
_____ In order to switch from low to high power, you must rotate the revolving nosepiece.
_____ The total magnification of a microscope is determined by adding the ocular lens power to the objective lens power.