

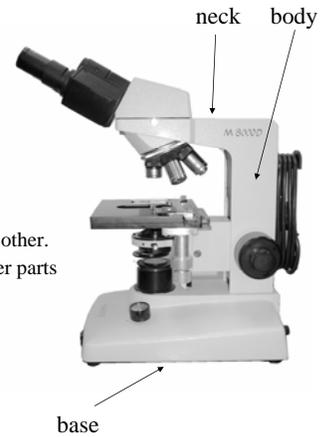
## Introduction to the Microscope

### Basic Skills

This presentation is best viewed in a laboratory, with a microscope available for use!

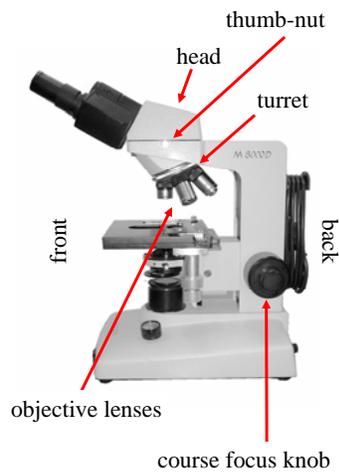
## Carry the microscope carefully to your work area.

- Carry the microscope with two hands!
  - Support the base with one hand...
  - and hold the body or neck with the other.
  - Never lift a microscope by any other parts – they'll bend or break!

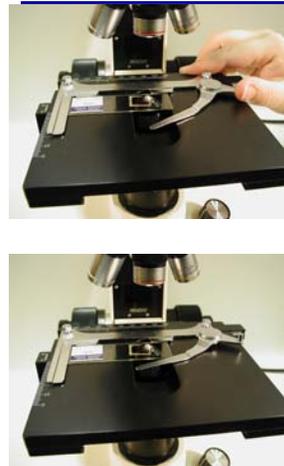


## Position the head and “objective lenses.”

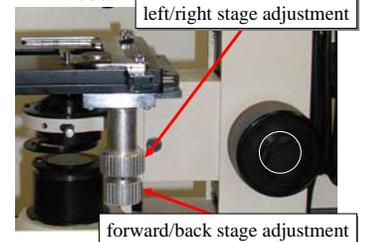
- On many microscopes, the head rotates for storage. (It will be held in position by a thumb-nut of some sort.) Gently adjust the head to the forward position (facing the front of the microscope).
- If the microscope is not already on the lowest power (the shortest, smallest objective lens), rotate the turret so that it is.
- Maximize the distance between the lenses and the stage by using the course focus knob.



## Position the stage and slide.

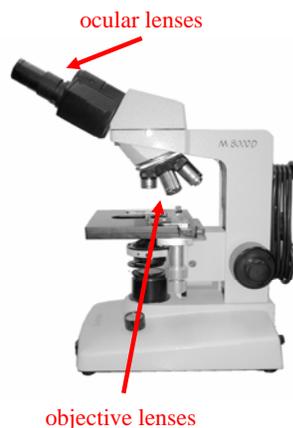


- Gently place a slide in the slide holder.
  - Warning!** Letting the slide retainer arm snap shut will break the corner of the slide.
- Adjust the position of the stage (move it left, right, forward, or backward) using the adjustment knobs.



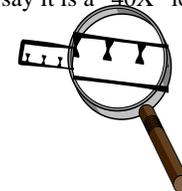
## Vocabulary Break: Lenses

- There are two major sets of lenses
  - (1) The set near your eyes (*ocular lenses*)
    - Binocular microscopes have two ocular lenses.
    - Monocular microscopes have one ocular lens.
  - (2) The set near the object you want to see (*objective lenses*)
    - Most microscopes have three or four objective lenses of different powers.



## Vocabulary Break: “X”

- In magnifying glasses and microscopes, the image is larger than the object.
- We describe the lens by the size of the image.
- Examples:
  - If the lens gives an image that is ten times larger than life (10 X lifesize), we say it is a “10X” lens (pronounced “ten ex”).
  - If the lens gives an image that is forty times larger than life (40 X lifesize), we say it is a “40X” lens.



A “2X” lens. Note that the image is upside-down!

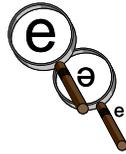
## Vocabulary Break: Total X

- You can use two lenses together to magnify an image more than either lens alone can do.
- Multiply the “X” factors together to find the total magnification.
- Example:
  - Looking at a 10X image with a 2X lens gives a “20X total magnification!”
  - Another way to say it: “Total X is 20X.”

An object viewed through one “2X” lens:



An object viewed through two “2X” lenses:



$$\text{“Total X”} = (2X)(2X) = 4X$$

## Calculate “total X” for the lenses on the microscope.

- Most microscopes are “compound microscopes.”
  - Compound microscopes use at least two lenses.
- To calculate “total X” for the image you are seeing with the microscope:
  - multiply the “X” that is written on the objective lens by the “X” that is written on the ocular lens.

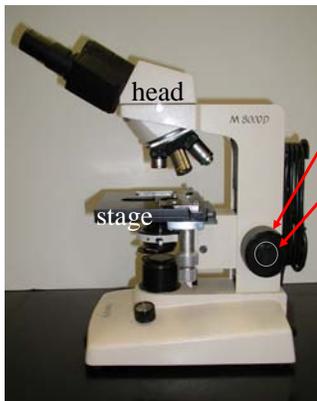


The magnification of an objective lens follows the letters DIN, and precedes a “/”.

This example is a 10X lens.



## Vocabulary Break: Terms Used While Focusing



*Coarse Focus Knob*

*Fine Focus Knob*

Note that on most microscopes, the head is fixed, and the stage moves up and down when you adjust focus.

- Modern microscopes are *parfocal* – if an object is “in focus” at one magnification, it is in focus at the others also!
  - It’s a mistake to change focus when you change the objective lens!
    - (On some microscopes, you may have to “tweak” the fine-focus knob very slightly.)

## Focus the Microscope

Before looking through the microscope:

- Clean lenses and slides (if necessary). Use only optical lens paper or you’ll scratch the surfaces.
- Rotate the turret to select the lowest power objective lens.
- Center the slide.
- Use the course focus knob to minimize the distance between the objective lens and the stage. Watch carefully.
  - Reason: when you’re looking at a thick object, instead of a slide, this habit will allow you to avoid having the object hit the lens!
  - Tip: get in the habit of moving the stage and objective lenses *apart* instead of *together* to focus so that you’ll never damage a sample by pushing a lens through it!
- Adjust the light to a moderate level.
  - Tip: using too much light is a common mistake. Many microscopic objects are a bit transparent, and disappear in bright light!

## Focus the Microscope (2)

Now, look through the microscope.

- Tip: if your eyes are too close to the ocular lenses, too far from them, or slightly to one side, you will see your own eyelashes (black bars) or the inside of the microscope (solid black!) instead of the object.
- To focus, use the course focus knob to increase the distance between the stage and the objective lenses. Stop when something comes into focus!
    - Tip: if you try this more than once without success, focus on the edge of the slide’s cover slip first.
  - Refine the focus to “crystal clear” by using the fine focus knob.
    - Tip: if you focused on the edge of the cover slip in step 1, move to the center of the slide for this step to focus on the object you actually want to view.
    - Tip: to be sure you’ve really focused on the slide and not on dirt on the lens or other distractions, move the stage left and right very slightly. The object you’re viewing should move as you do this.

## Focus the Microscope (3)

Once you’ve focused at low power:

- Without* touching the course or fine focus knobs, gently rotate the turret to the next highest objective (if desired).
  - Tip: it is almost impossible, even for an experienced microscopist, to focus on a high power without first focusing on low power. This is why parfocal microscopes were invented! Always start at low power!
- Look through the microscope.
  - Center the object by moving the stage. (Most microscopes have a pointer: you can move the stage so that the object is at the pointer’s tip.)
  - Turn the fine focus knob *slightly* (if necessary) to obtain the clearest image possible.
  - Adjust the light intensity (if necessary).
- Repeat steps (1) and (2) to reach the next highest power.
  - Tip: it’s a rare microscope that will provide a clear image at 1000X without using “oil immersion” – that is, without replacing the air between the slide and objective with oil. Your instructor will tell you if you will use this technique in this course.

## Using Both Eyes

- Vary the distance between the ocular lenses, and the distance between your eyes and the microscope, until you can see clearly with both eyes.
  - Tip: the distance between the ocular lenses of a binocular microscope is always adjustable.
  - Tip: this takes practice, but is worthwhile.
- You can rotate one of the ocular lenses on most binocular microscopes to change the focus for one eye at a time.
  - If you are using a microscope and one eye is blurry, rotate the ocular with the tic-marks to "match" the focus for both eyes.



## When you're done ...

- Remove your slide and put it away, and turn off the microscope.
- Clean the lenses thoroughly with optical lens paper, if you used oil immersion at high power.
- Return the objective to the lowest power.
  - Reason: If someone accidentally raises or lowers the stage and the objective is *not* at the lowest power, the lenses will be damaged.
- Return the stage to the lowest position.
  - Reasons: (1) If the stage is *not* lowered and someone accidentally spins the turret, the lenses collide with the stage. (2) With the stage lowered, the next person using the microscope will be able to quickly put the slide onto the stage without changing its position.
- Return the head to a "facing the back" position if your microscope permits.
  - Reasons: (1) This puts the ocular lenses over the body, where they are less likely to be bumped or damaged. (2) This maximizes the number of microscopes that will fit in the storage cabinet.
- Wrap the cord carefully, return the microscope to the appropriate cabinet or shelf, and cover it with a dust cover (if available).

## A Final Note

- This presentation covers only the *basics*. You may, later in the course or in future courses, be introduced to many more techniques, as well as to other types of microscopy.
- Examples of topics you may soon explore:
  - Using the condenser and condenser aperture diaphragm to improve image resolution and contrast.
  - Using a stage scale to record position.
  - Calculating field of view and the size of objects viewed.
  - Care and maintenance of the microscope.

## Resources

You can learn more at the following sites, if this topic interests you:

<http://www.olympusmicro.com/primer/anatomy/anatomy.html>

<http://www.olympusmicro.com/primer/index.html>

## Acknowledgments

Parts of this presentation were excerpted from a much more in-depth presentation prepared by Dr. David O'Neill under a Summer Grant from the Community college of Baltimore County to facilitate learning at CCBC. Laurie Montgomery of the Health and Natural Science Dept assisted in the preparation of those parts, and students Jamie Johnson and Yana Vays served as "hand models." (Many thanks!)

Copyright the Community College of Baltimore County, Maryland, David J. O'Neill, and R. Michael Anson