Use of the Binocular Microscope
Before you begin this learning module be sure that you have the following materials in front of you:

• A microscope
• A packet of lens paper and Kimwipes
• A glass slide of a biological specimen
• A bottle of immersion oil
• A worksheet to use while reviewing this module
• A labeled diagram of a binocular microscope
The objectives of this learning module are to:

1) identify and find the parts of a typical microscope and learn their functions,

2) properly use and maintain a microscope.
Part I

The parts of a typical binocular compound microscope and their functions.
The magnification of an object on the stage depends on the power of magnification of the objective lens and the eyepiece.
Turret head
Stage adjustment knobs
Base
Arm
Stage
The objective lenses are located directly above the stage.

The purpose of the next three slides is to show you the various objective lenses and the characteristics of each of the lenses.
The photo below shows a typical low power objective lens from two different microscopes.

The 10 printed on them indicates that they magnify an object 10 times.
The lens that has 40x magnification is color coded blue.

This lens is usually referred to as the “high dry” objective, since it is used with air, not oil, between the specimen and the objective lens.
This photo shows two 100x “oil Immersion” lenses.

These lenses are designed to be used with immersion oil on top of the specimen.

Each lens has OIL or oil printed on it. They are usually the highest power objective lenses available.

Never use oil with a lens that does not say OIL on it!
You should always double check by reading the power of magnification printed on a lens before using it.

Now examine the objective lenses on the microscope used for this module and determine their magnification.
The **total magnification** of a microscope is the magnification of the **objective** multiplied by the magnification of the **eyepiece**.

<table>
<thead>
<tr>
<th>Objective</th>
<th>X</th>
<th>Eyepiece</th>
<th>Total Magnification</th>
</tr>
</thead>
<tbody>
<tr>
<td>10x</td>
<td>X</td>
<td>10x</td>
<td>100x</td>
</tr>
<tr>
<td>40x</td>
<td>X</td>
<td>10x</td>
<td>400x</td>
</tr>
</tbody>
</table>

**Confirm that the eyepieces on your microscope are 10x.**
The microscope has two focusing knobs mounted together.

The **large knob** is for **coarse** focus adjustment.

The **smaller knob** is for **fine** focus adjustment.
A rotating, uncalibrated wheel is used to turn on the substage lamp and adjust its brightness.

**NOTE:** Do not turn to maximum power, since this might blow the fuse in the lamp circuit.
The next few slides identify the **condenser** and the **diaphragm** and illustrate their functions.

In Part II of this module, you will learn how to adjust them.
This photo shows the **substage condenser** of a microscope.

The **substage condenser** condenses light from the light source and focuses it on the plane of the specimen.

It is focused on the plane of the specimen using the **condenser adjustment knob**.
Schematic diagram of the optics of a compound microscope.
The diaphragm is adjusted with the **diaphragm ring** on this microscope.
The diaphragm is closed down.

The diaphragm is wide open and more light comes through the condenser.
The diaphragm should be opened just enough to allow the objective lens to collect all of the light that comes through the sample.

Opening the diaphragm too wide, allows some of the light to escape collection by the objective lens.

Closing the diaphragm too much, causes aberrations of the image.
This is the end of Part I
Part II

How to use, adjust and maintain a compound binocular microscope.
Step #1
Put the lowest power objective lens into place.

Notice that all the objective lenses turn on a turret and that they click into place.

As a general rule always use the lowest power objective lens to find your specimen.

On the microscope in front of you, this is the 4X lens and is the shortest.

Turn this lens into place.
Step #2
Now place the specimen on the stage.

Notice that the slide is held in a clip on the stage with the specimen side up.

The clip is adjustable and holds the slide firmly in place.

Pull back the clip and slip the glass slide into place on the stage as shown in the next slide.

Make sure that the clip is not on top of the slide, but holds it firmly in place.
The specimen on the prepared slide is probably not centered over the hole in the stage.
The **TOP** stage adjustment knob moves the slide forward and backward.

The **BOTTOM** stage adjustment knob moves the slide from side to side.
Note that there are **micrometer readings** to indicate the **position of the stage in both dimensions**.
Step # 3
Now that you have the lens in place and the specimen centered over the hole in the stage, gradually raise the stage using the coarse adjustment until you reach a stop.

Watch from the side of the microscope to make sure that the lens does not hit the bottom of the slide.
Step #4
Looking through only the **RIGHT** eyepiece, focus by lowering the stage **away from the lens** using the coarse adjustment knob.

Always remember when focusing to adjust the stage **AWAY** from the objective lens.

Never raise the stage while looking through the microscope. You could smash the slide into the lens and ruin them both.

Now focus on your specimen with your right eye.
Step # 5
After finding the object with the coarse adjustment knob, adjust the focus slightly with the fine adjustment knob until the specimen is sharp and clear.
Step # 6
Now you will adjust the binocularity, so that you can use both eyes to view the specimen. First move the eyepieces so that you can look through both eyes at the same time.
Step # 7
Now you will adjust the focus of the eyepieces.

Note that the right eyepiece is fixed, but that the left one has telescoping capability.
First cover your left eye.
Looking through your right eye, once again bring the object into focus by turning the fine adjustment knob.

Now cover your right eye.
Focus the specimen with your left eye by adjusting the telescoping knurled knob on the left eyepiece.

The microscope should now be in focus for you as an individual.
Step # 8
In preparing to adjust the light on the specimen, use the stage adjustment knobs to move the stage forward, backward or sideways to get a better view of the specimen.

Now you will be instructed on how to adjust the condenser and then the diaphragm to get reasonably good, consistent lighting.
Step # 9
Close the diaphragm as far as possible by rotating the diaphragm ring.

Notice that the light decreases but does not disappear.
Step # 10
While looking through the microscope, move the condenser up and down until you see a “pebbly” or “pearly” appearance.

At this point the light from the lamp is focused on the plane of the specimen.

Once you have found this pebbly appearance, adjust the condenser knob toward you slightly until this disappears and the light appears constant.
Step # 11
Once the condenser is adjusted, open the diaphragm slightly, until the light reaches a constant illumination across the entire field.

Now that the light is adjusted, you might need to adjust the fine focus again to see the sharpest image possible.
Most modern microscopes are parfocal. This means that once the specimen is in focus with one objective lens, only a slight turn of the fine focus knob is required when changing to a higher power objective.

It also means that when you change to a higher power lens, the lens should not hit the slide. However, just to be sure, always look at the slide from the side while you change from one objective lens to another to make sure that the lens does not hit the slide or the stage.
**Step # 12**

Change to the 10X lens by rotating the turret 90 degrees and feeling the click as the objective comes into place.

Do not move anything else when doing this.

Do not adjust the coarse focus knob, because the slide is now so close to the lens that movement of the coarse focus knob could raise the stage enough to smash the objective lens.

Now focus using the fine adjustment knob.
You might now have to recenter the specimen using the two stage adjustment knobs as you did in Step #8.

You might also need to open the diaphragm a little more.

These are the only other adjustments that you need to make when changing objective lenses.
Remember that when you change objective lenses:
   do not adjust the lamp
   do not adjust the condenser.

Do adjust if necessary:
   the fine focus
   the diaphragm
   the mechanical stage.

Now repeat Step #12 with the “high dry” 40X objective.
Using the 100X Oil Immersion lens

The last lens is the 100X oil immersion lens. This lens requires special care. It requires oil between the slide and the lens, allowing more light to be gathered by the objective lens.

To apply oil, rotate the oil immersion lens about halfway into place so that no lens is directly over the specimen.
Place a drop of immersion oil on the slide at about the point centered over the stage and then carefully rotate the 100X oil objective into place with a click.

From the side, you should notice a flash as the lens enters the oil.
The photo below shows the oil immersion lens in place.

You can see the actual connection between the lens and the oil on the slide.

For highest resolution, place oil on the condenser lens too.
Now adjust the fine focus, diaphragm and the stage as described in Step #12.

With the 100X magnification lens and the 10X eyepiece, the total magnification is 1000-fold.

You will not want to look at every specimen with the oil immersion lens. Some specimens are too big to be seen clearly at this magnification.
When you are ready to clean up, follow the steps described below.

1. Put the low power objective lens in place.

2. Lower the stage all the way down with the coarse adjustment knob.
3. Using **lens paper**, carefully clean all the oil off of the oil immersion lens using a rotating motion as shown in the photo below. Be sure that ALL of the oil is removed!
4. Remove the slide and clean the oil off of the slide and the stage, using lens paper or a Kimwipe. *Never use Kimwipes on the objective lenses!*

5. Turn the light off.
When carrying a microscope always use two hands: one on the Arm and one on the Base.

Set it down carefully.

These simple rules will allow you to keep a microscope in peak operating condition.

You have now completed the Use of the Binocular Microscope Module.

Obtain a post test from the assistant at the desk. You will need to refer to the lab microscope for part of the test.