

j o u r n e y t o t h e  
**microCOSMOS**  
**microscope manual**

## OVERVIEW

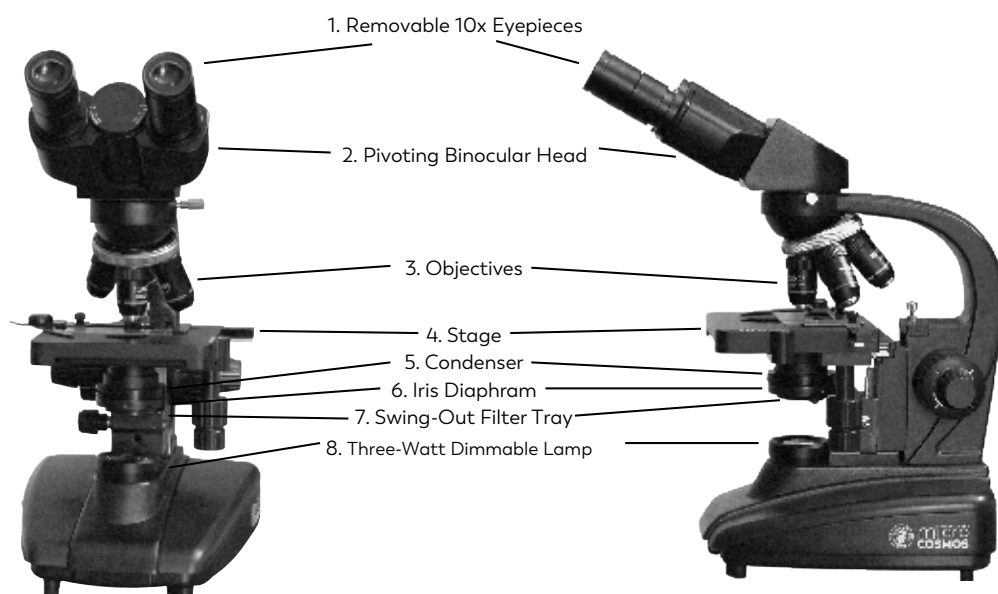
Hello! We're so excited that you're taking this next step on your journey into the microcosmos and, to get you started off on the right foot, we wanted to tell you a bit more about your new microscope.

We've also prepared a series of videos for you that discuss assembly, preparing slides, and more! You can find those videos at [microcosmos.store/videos](https://microcosmos.store/videos) or you can just scan this QR code.



This microscope was originally designed as a device for observing and testing biological samples in agricultural research, clinical testing, and demonstrations for classrooms. We've adapted this microscope for you so you can get a very flexible microscope, suitable for your own personal exploration.

### Here's what's in your package:



1. **Removable 10x Eyepieces:** These add another 10x magnification to your objectives, so 4x becomes 40x and 40x becomes 400x, etc. Remember, these are not secure in your microscope and they will fall out if you decide to invert your microscope. Also, it may go without saying, but best to not invert your microscope during operation.

2. **The Pivoting Binocular Head:** This allows you to move the eyepieces without moving the body, and the binocular vision means you don't have to always be closing one eye AND you get a three-dimensional view of the microcosmos, something we just can't give you on YouTube.
3. **The Objectives:** These are the four lenses that you can switch between. The base unit magnifications of the objectives are 4x, 10x, 40x, and 100x.
4. **The Stage:** This is the place where the slide goes, and there are knobs with which you can move the stage around to view your whole slide and track microbes.
5. **The Condenser:** This gathers light from the lamp and focuses it on the sample. It can be moved up and down to find the sweet spot.
6. **The Iris Diaphragm:** This lets you change the size of the beam of light travelling through your sample. More open is brighter, more closed will provide more detail.
7. **The Swing-Out Filter Tray:** Located at the very bottom of the stage assembly, you can swing out this filter holder to put in filters if you opted to purchase them.
8. **The 3-watt Dimmable Lamp:** This shines the light through your sample. Remember, brighter is not always better!

Also included are an extra fuse, a dust cover, a blue-light filter, and a vial of 100x objective-oil (we'll go through how to use that in a bit).

If all of that sounded a little intimidating, don't worry! We'll walk you through what you need to operate this microscope and set you on your journey to the microcosmos!

## SPECIFICATIONS

1. Mechanical tube-length: 160mm
2. Objectives Included in the base-unit:

Magnification	Numerical Aperture	Working Distance
4X	0.1	37.5
10X	0.25	7.63
40X	0.65	0.63
100X	1.25	0.2

3. Eyepieces

Magnification	Focal Distance	Diameter of View-field (mm)
10X	25	$\phi$ 1X

#### 4. Total Magnification

		Objectives			
		4X	10X	40X	100X
Eyepieces	10X	40X	100X	400X	1000X

5. Coarse focal range: 8mm
6. Stage size: 126mm x 115mm
7. Condenser: NA 1.25 ABBE condenser with iris diaphragm and filter tray
8. Illumination: 3W LED lamp
9. Net weight: Approximately 4kg
10. Measurements including binocular head: 220mm x 175mm x 375mm

### ASSEMBLY

The microscope comes disassembled into five pieces: the microscope base, the head, the two eyepieces, and the power plug.

Place the microscope base on a large flat table. A table that wobbles can disturb the samples you'll be viewing, so the sturdier the better. Locate the power connector on the back of the microscope, and position the microscope base so that the power plug is facing away from where you will be sitting.

Plug the cord into the microscope and into the wall. We recommend using a surge protector, if you can, to help protect your LED light.

The microscope's head will have one large opening at the bottom and two smaller openings at the top. The large opening at the bottom should be just large enough to fit snugly into the microscope's base. Tighten the thumbscrew on the neck of the microscope to firmly attach the head.

Finally, the two eyepieces will slide into the two tubes at the top of the microscope head. They will just fall into place. They aren't designed to lock or snap, so don't go turning your microscope upside down while they're in there.

That's it! Your microscope is ready to go!

### BASIC OPERATION

First, we'll need a quick tour of your new microscope.

1. **The foot**, upon which it stands. This holds the LED lamp and the dimmer dial.
2. **The condenser**, which also houses the diaphragm and filter holder.
3. **The stage**, upon which our subjects will be placed for observation.
4. **Objective lenses**; four lenses arranged in a rotating assembly.

- 5. The head**, which can rotate 360 degrees and moves the light from your sample to your eyepieces.

To operate, your microscope needs only three things: a subject to look at, light to illuminate that subject, and you. We have it on good authority that you have a you, so let's focus first on light.

### Getting Ready

**Step 1:** On the back of the microscope is an on/off switch. Switching it into the on position will activate the lamp at the bottom of your microscope. If you don't see a light, or the light is dim, locate the dial on the left side of the foot of the microscope. Turning it will make the lamp brighter. Let's start with the lamp as bright as it can go.

**Step 2:** On the left side of the condenser is a knob that will raise and lower the condenser beneath the stage. Turn the knob so that it goes as high as it can go. You can adjust later to find the sweet spot for your sample.

**Step 3:** Slightly above that, on the left, will be a slide-lever that opens and closes the diaphragm. It acts exactly like the iris in your eye or in a camera. Opened wide, the iris lets lots of light in. Closed tightly, it lets very little light in. Your LED lamp puts out a lot of light so, for now, let's close the iris as tight as it will go. You should only see a pinprick of light coming out from the top of the condenser.

**Step 4:** Gently but firmly rotate the objective lens assembly so that the shortest lens is pointing straight down. This will be the 4x lens. You'll feel it click into place.

### Preparing your sample

Much of what we look at on Journey to the Microcosmos comes from samples taken from local bodies of water. Sometimes they're ponds, sometimes streams, sometimes even puddles. At the start of your journey, look for water that's relatively calm, perhaps with some green algae or decaying plant matter floating in it. Honestly, mucky-looking plants are the best when it comes to finding exciting things to look at under the microscope.

Using a clean jar or bottle, collect a cup or two. If you can, also try to collect some silt, soil, or other material and put it in with your water sample.

**Note: Sometimes wild animals or poisonous plants can live in or near the water where you will be collecting your sample. Please take care of yourself when you're collecting your sample! Also, make sure you have permission to be on the land where you're collecting!**

Once you've collected your sample, let it sit still in a nice, cool area. A little sun isn't a bad idea, but not too much - we don't want to cook our critters. Just enough light to let some photosynthesis occur, should there be anything with green chlorophyll living in there. You may not see it yet, but it's probably there!

Give your sample time to settle. Let the silt, sand, and plant matter fall to the bottom. An hour or two will be fine.

You can find more details on gathering different kinds of samples in different conditions (and keeping those miniature ecosystems happy) in our field guide, which was included as a PDF with your microscope order.

## Preparing Your Slide



**You'll need just a few small common household items to prepare your slide:**

Small tweezers or a toothpick

An eyedropper

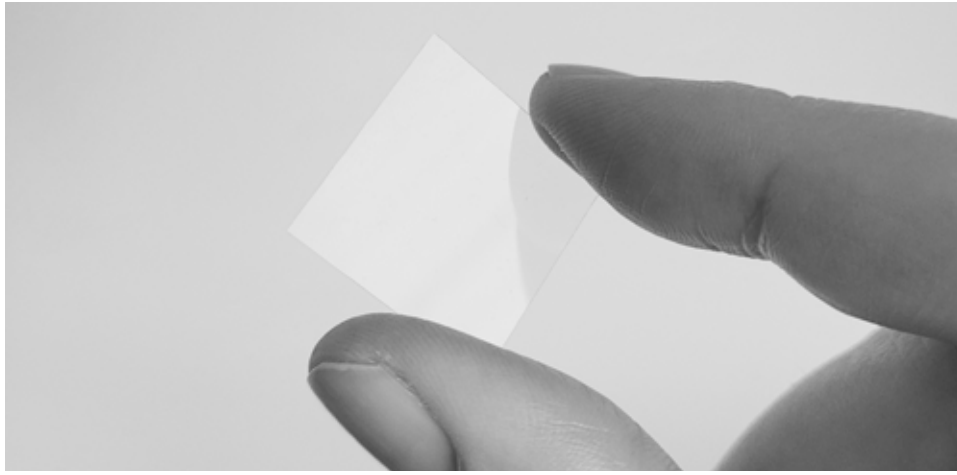
A pin or a needle

In truth, you really only need either the eyedropper, the needle, **or** the tweezers, but all three can come in handy.

**Step 1:** Take a slide out of your box of slides and set it at the front of the stage (the side closest to you).

**Step 2:** If you're using an eyedropper, draw a small amount of water closest to something interesting in your water sample. Look for a floating bit of slime, a bit of fuzz clinging to a twig, or even a clump of silt. Most of the organisms will be living near the interesting parts of your sample. If you're using tweezers or a toothpick, carefully scrape around near those same areas and pull out a bit of material. It will probably have a bead of water clinging to it, which is great!

**Step 3:** Slowly and carefully transfer your speck or a single drop of water to the center of your slide.



**Step 4:** Remember, slide covers are very thin and sharp pieces of glass. VERY gently pick up a single slide cover and hold it between a finger and thumb.

**Step 5:** Gently drop the slide cover onto the drop of water. This will spread the water to the edges of the slide, giving your organisms a somewhat flatter field in which to crawl and swim.

**Step 6:** Pull back the clip on the left side of your stage and place the slide onto the stage. Move the slide up against the frame of the stage and slowly release the clip. The clip will now hold the slide against the frame and prevent it from moving.

### **Moving the Stage**

Two knobs on the right side of the stage will move the stage, and the critters on your slide, forward, backward, left, and right. With some practice, you'll learn quickly which knob moves left and right, and which knob forward and backward.

### **Finding Focus**

At the back of the microscope, behind the stage, are the focusing knobs. There is one set on each side, but it's better if you try to use your left hand for focus so your right hand can control the movement of the stage.

There are two knobs in each set: The outer gross-focusing knob, and the inner fine-focusing knob. Turning the outer knob adjusts the focus in larger increments. Turning the inner knob adjusts the focus in much smaller increments.

While looking through the eyepiece at your subject-slide under 40x magnification, slowly turn the gross-focusing knob. You may see a quick flash of something moving in and out of focus. If you do, stop turning, and start turning the fine-focusing knob. It shouldn't take too long, but don't worry if it does. First, make sure that your objective lens is pointing directly at the sample on your slide. If it's not, move the stage until your subject is directly beneath your objective. If you still can't see anything come into focus, try turning the outer focus knob in the other direction. It's possible you shot past your focus point and missed it.

Go slowly. Take your time. Your patience will be rewarded. Soon, you may see something swimming quickly in your sample.

Congratulations! You're a microscopist!

## CELL PHONE CAMERA USE

Connecting your cell phone camera to your new microscope can be tricky, but once you've done it a few times, it'll go much faster. We've found this process works well with both iPhone and Android phones, but cameras with more than one lens can sometimes be pretty tricky to work with. On some smartphones, when you zoom in with your camera to get a better view of your subjects, the default camera app may switch to a different lens abruptly, and you'll suddenly be faced with a black screen. By choosing the right cell phone camera lens, using the right camera app, and with some practice, you'll get amazing results.

**iPhone** users will have the best results using an app called "ProCam", which lets you specify exactly which lens to use. It's a paid app, but offers features the default camera app does not.

**Android** phone owners may have to hunt around a bit for camera apps which work best for them. In our testing, "Open Camera" works very well. You may even find that the default camera app which comes with your phone works perfectly.

If you have more than one camera lens, the technique is generally the same: locate which of your lenses gives you 2x or better magnification, and line up that lens with your microscope's eyepiece.

### Attaching Your Phone To Your Microscope

Your included smartphone adapter has three adjustable knobs to help you attach your phone to your microscope.

**Step 1:** Place the C-shaped part of the adapter onto the end of the right eyepiece and adjust the knob to ensure a tight fit. You may need to adjust this again later to make sure your phone aligns properly with the eyepiece.

**Step 2:** Place your phone inside the front-facing clamp, using the knob on the right side to secure it tightly in place. You may need to loosen the clamp first in order to fit your phone inside of it.

**Step 3:** Loosen the knob on the back of the adapter to adjust the placement of your phone. Once you've lined up your phone's camera lens with your eyepiece, you can tighten this knob.

**Step 4:** Open your preferred camera app. You should see a bright round area in the center of your screen. If not, use the knob on the back of the adapter to readjust the position of your phone carefully so that the bright round area is centered on your camera's screen. Everything will be backward, moving up will move the circle down, moving left will move the camera right. So go slow and concentrate! Once it's centered, make sure all of the knobs are tight so your phone will stay in place.

You may need a few tries to get the image centered and free from distortion. Don't give up! You're almost there!



## Zooming in

You might find that your cell phone camera gives you a view like the one below, where you see plenty of microorganisms, but they're in a circle, surrounded by black. You may want to fill your view entirely, and you can do that by zooming in with your cell phone camera.



Most cell phone cameras use a “pinch-and-zoom” feature to zoom in. But some apps have magnification buttons instead.

If you zoom in, and suddenly your camera goes black, don't worry. Smartphones that have more than one camera lens will sometimes jump between one lens and another in order to get the best picture. If that happens, figure out which lens your camera has jumped to, and readjust your phone adapter until the eyepiece is against the correct camera lens. Or, find an app that will let you select and stick with one lens like ProCam or Open Camera.

It may take a few tries to get it right, but you'll be rewarded with a breathtaking view of the world you can now photograph, record, and share with your friends. And we also like seeing your findings! So, please share your pictures and videos with us on Twitter and Instagram [@journeytomicro](#)!

## ADVANCED OPERATION

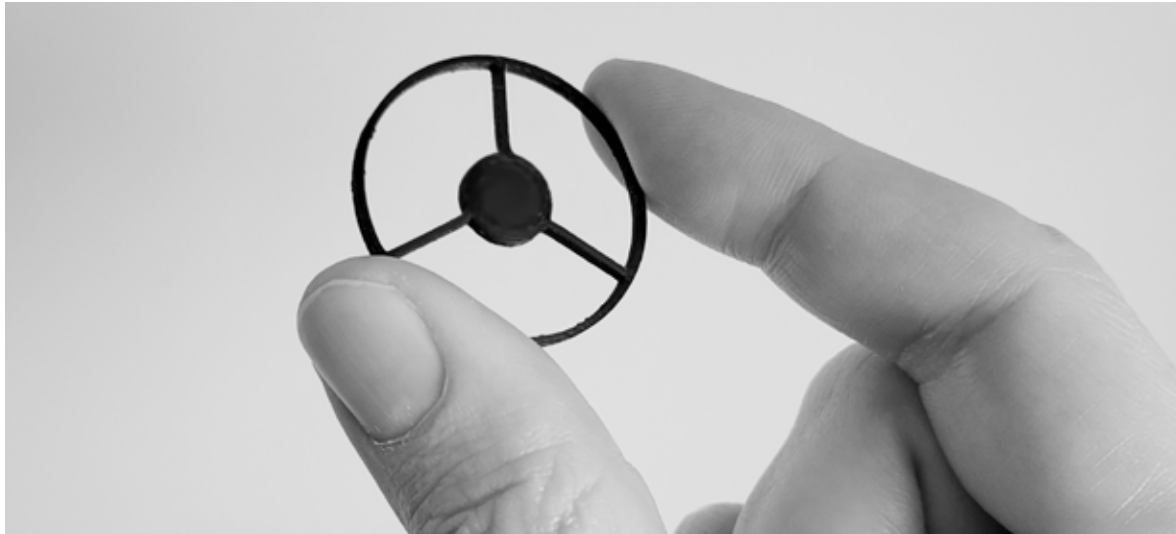
### Oblique Illumination

Our microscopic critters are so small that they are practically transparent, and even though we can shine a light through them, that may not always be the most interesting way to look at them.

For those who purchased our Oblique Illumination filters, you'll find that the set includes 36 small black discs of varying shapes and sizes. Each one is designed to block light coming from one direction and allow it in another. Each shape, when coupled with a corresponding objective lens, can provide really interesting lighting options for your subjects.

To start experimenting with oblique illumination, we'll start with **Darkfield Illumination**. Darkfield is called that because the area behind our subjects will be dark, letting our subjects that are brightly lit from the sides shine in contrast. By the way, when the background is bright, that's called **Brightfield Illumination**.

To get started with **Darkfield Illumination**, first, set your objective lens to the lowest magnification - 4x. Put your subject on a slide and get it in focus. Then, grab the oblique illumination filter that looks like this one:



Place it in the filter tray underneath your condenser and swing it into place. Turn your lamp on, and make sure your condenser is in position as high as it will go. Now look through your subject into the light coming out of the condenser. Do you see any light at all, or is it completely dark?

If it's bright, close the condenser's iris until only a little bit of light peeks through. If it's completely dark, open it up just a little until you see a small amount of light. The trick is to find the right balance between too much light and not enough.

Look through your eyepiece and see how it looks. If you've set it up right, you should see your subjects brightly illuminated with white light while the background is very dark, like they're flying in space!

If it's not quite right, don't worry! Try opening and closing the condenser's iris to let in or close off more light. If there's a big dark spot in the middle of your view, try moving the condenser down a little bit. Also, try swinging out the filter tray slightly -- sometimes only a tiny bit of movement can change the lighting drastically! Look for the edges of shadows cast by your darkfield filter for the most interesting effects.

Because of the way the darkfield filter works, higher-magnification objectives won't give you very good results. Darkfield works best with objectives between 4x and 10x.

If you've got the hang of Darkfield, experiment with the other filter shapes. What will your amoeba look like if they're only illuminated on one side? Or just a tiny crescent of light? Try different things and document your results!

### **Rheinberg Filters**

Those of you who purchased our Rheinberg Filters will find a set of thin film discs designed to fit in the filter tray of your microscope. They come in many colors, and are either fully colored, are donut rings (annulus filters), or donut holes (stop filters). They're stackable so you can fit two (or more) of them together for interesting effects.

They work by sending different colors of light through different parts of our condenser so that your sample will be lit by a different color than the background.

To get started with Rheinberg Filters, it's best to try something with a strong contrast that's fairly large. Turn your lamp on to full brightness and place your subject slide on the stage. Set the objective at 4x, and get it into focus.

This works best if the subject is lit brightly and the background is dark. The donut hole will be your background color and the donut (if you use one, you don't have to) will be the color your sample is lit by. So choose a light-colored donut (or none at all) and a darker donut hole (or stack several, to make it even darker.)

Open the aperture 100% and move the condenser as high as it will go. Normal brightfield operation usually has the aperture as closed as it can get, but you'll need to open it in order to get the light shining through the colored part of the Rheinberg Filter.

Now, move the condenser up and down a bit while watching to see if your subject is being lit by the different color of the donut ring. If you aren't seeing it, leave the condenser all the way up, and then move the filter tray back and forth until you see your sample lit by a different color than your background.

These filters are a ton of fun to experiment with. Adding different colors, stacking filters, and moving the filter tray around will give you some super gorgeous images, and they can also give you views into internal structures that are harder to make out without the filters.

### **Oil-Immersion Objectives**

The 100x objective will get you up to 1000x magnification, but to get this high magnification, a special kind of lens is necessary. Your 100x objective will not work unless it is submerged in oil.

The refractive index of oil-immersion fluid is almost the same as the glass of the coverslips. The advantage there is, if you carefully place a drop of oil-immersion fluid between the coverslip and the objective lens, and then lower the lens into the oil, there's optically no barriers between your subject and the optics of your microscope.

Be warned, however, oil can be a bit messy. It will get on your objective lens, and you may forget it's there and get it on one of your other lenses that will be damaged by the oil. Only the 100x lens benefits from it, so be careful!

Make sure to clean off your objective and your stage when you use oil-immersion. A clean dry cloth will wipe it clear easily. Don't use detergents or soaps on your microscope or objectives. Take care when using paper-towels as they can sometimes be abrasive. Tissues can also leave behind lint, and lint and dust are the enemies of optics.

Your best bet is to wipe away the oil with a very soft cloth or tissue, then wipe again with a microfiber cloth to remove any excess dust.

## **MICROSCOPE MAINTENANCE**

### **Keeping Your Microscope Dust Free**

Dust is the enemy. Whenever you're not using your microscope, use the included plastic dust-cover to prevent excess dust buildup on your optics. Always put the plastic cover back on after you're done.

### **Cleaning Dust From Your Microscope**

If you notice a great deal of dust in your optics, don't worry - the most common places dust can interfere with your viewing experience is right in the eyepiece. Use compressed air from a rubber squeeze bulb, available from any photo supply store, to blow dust from your optics. If you still see dust in your microscopy, try cleaning the condenser lens just below the stage. **Never use water, glass cleaner, or any other solvent to clean your optics.**

### **Cleaning After Oil-Immersion**

As a reminder, you need to make sure to clean your objective and your stage when you use oil-immersion. Don't use detergents or soaps on your microscope or objectives. Your best bet is to wipe away the oil with a very soft cloth or tissue, then wipe again with a microfiber cloth to remove any excess dust. (See the previous page for more thorough cleaning instructions)

**There is an entire world to explore. You'll find that things that look absolutely disgusting in a pond turn into beautiful, bizarre scenes under your microscope. If you're anything like us, you'll start to see every puddle as an enticing opportunity. Maybe your friends and family will roll their eyes as you dunk a soda bottle into every nearby stream, but this is the curiosity that has made us who we are and we should cultivate it and indulge in it.**

**We're so excited for you to start your own journey, as you explore the unseen world that surrounds you.**

**If you have any problems with your microscope, please reach out to us at [hello@dftba.com](mailto:hello@dftba.com), and please share your microscopic findings with us on Twitter and Instagram @journeytomicro!**