Combined Science - Biology - KS4
Cell Biology

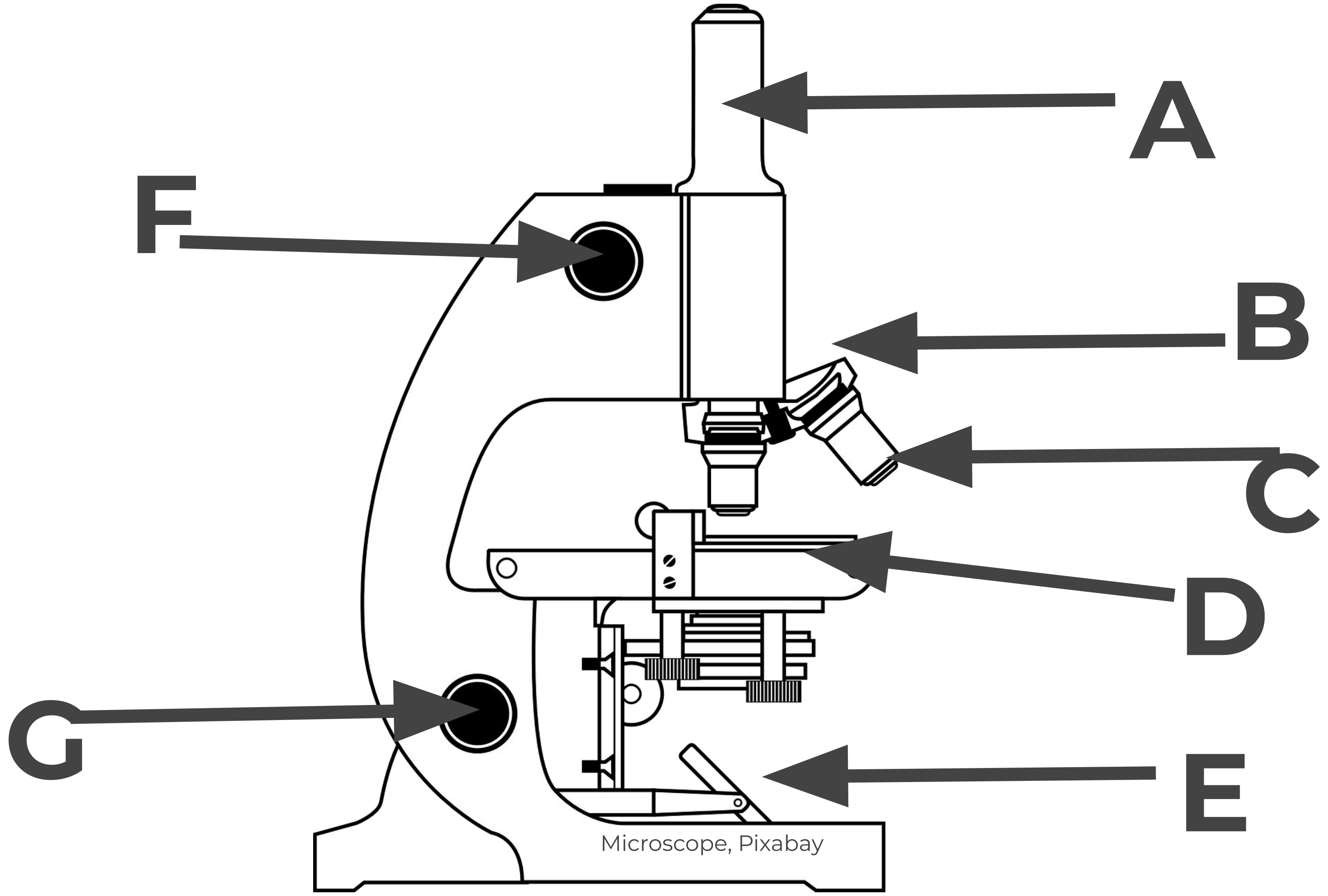
# Using the microscope and the magnification equation

**Miss Wong**

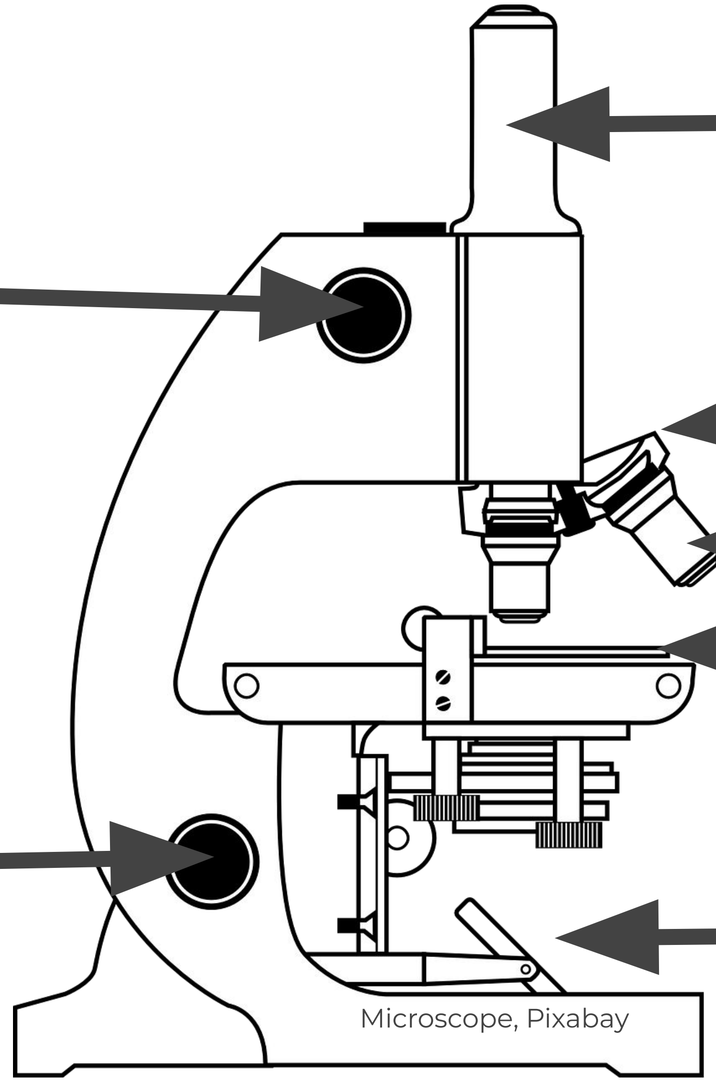
OAK NATIONAL ACADEMY

# Using a microscope

# Quick recap: What are the names of these parts of the light microscope?



# Answers to Quick recap:




Microscope, Pixabay

# Equipment needed for the practical

Viewing plant cells under a microscope

| An onion | A glass slide | A microscope |
| --- | --- | --- |
| You only need the epidermis of the onion. Peel off the top layer of a piece of onion. | A glass slide is where you place your specimen onto.<br>To make the cell structure more obvious, add a drop of iodine solution.<br>Use a coverslip to cover it when finished. | View the onion cell under the microscope and draw what you observe. |

**Arrange the following sentences in the right order.**

Manually focus using the fine focus knob.

Switch to a higher magnification.

Observe through the eyepiece and manually focus using the coarse focus knob.

Make sure the objective lens with the lowest power is in use.

Adjust the mirror to focus light onto specimen.

Secure the specimen on the stage using the clips.

## Answers

Make sure the objective lens with the lowest power is in use.

Secure the specimen on the stage using the clips.

Adjust the mirror to focus light onto specimen.

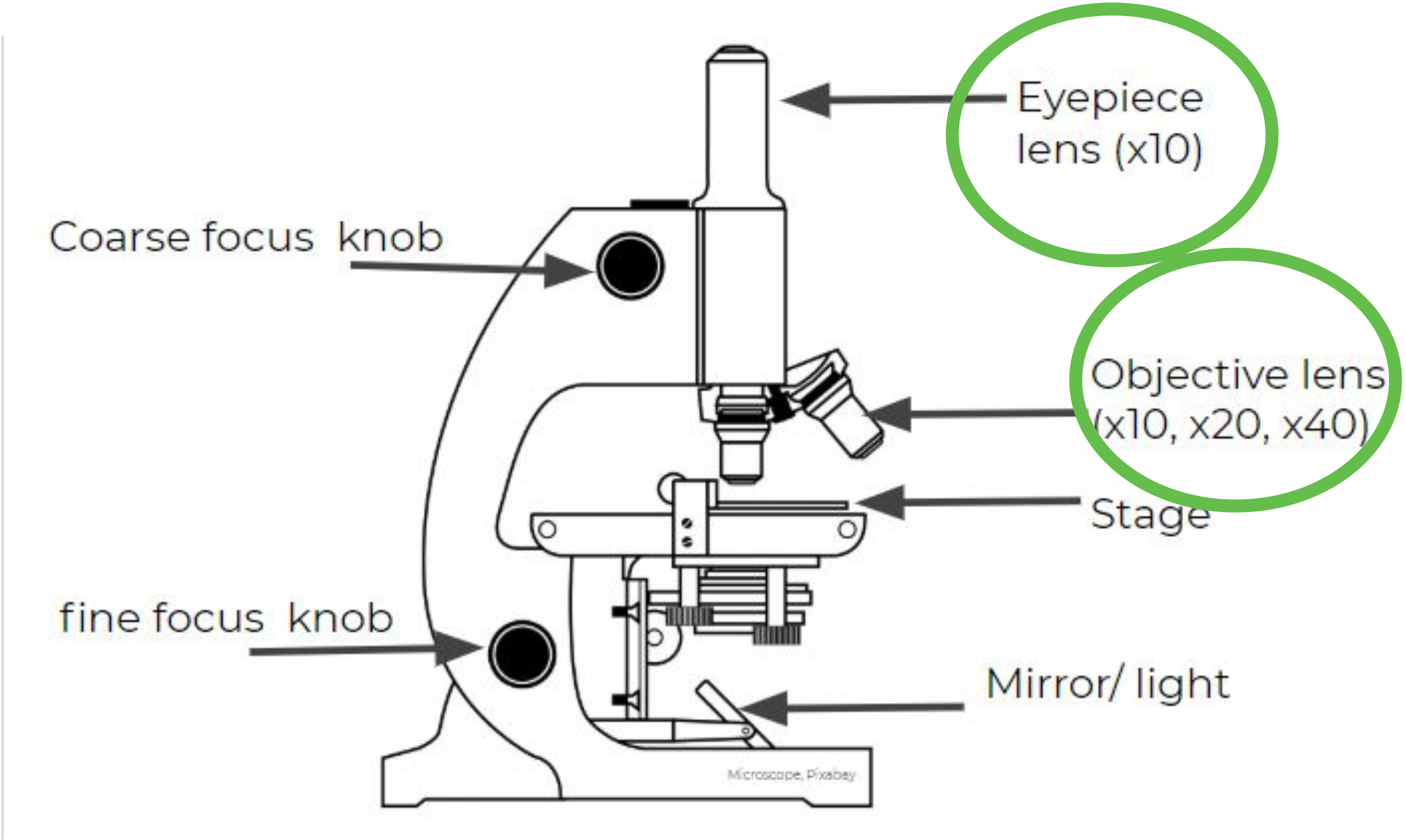
Observe through the eyepiece and manually focus using the coarse focus knob.

Switch to a higher magnification.

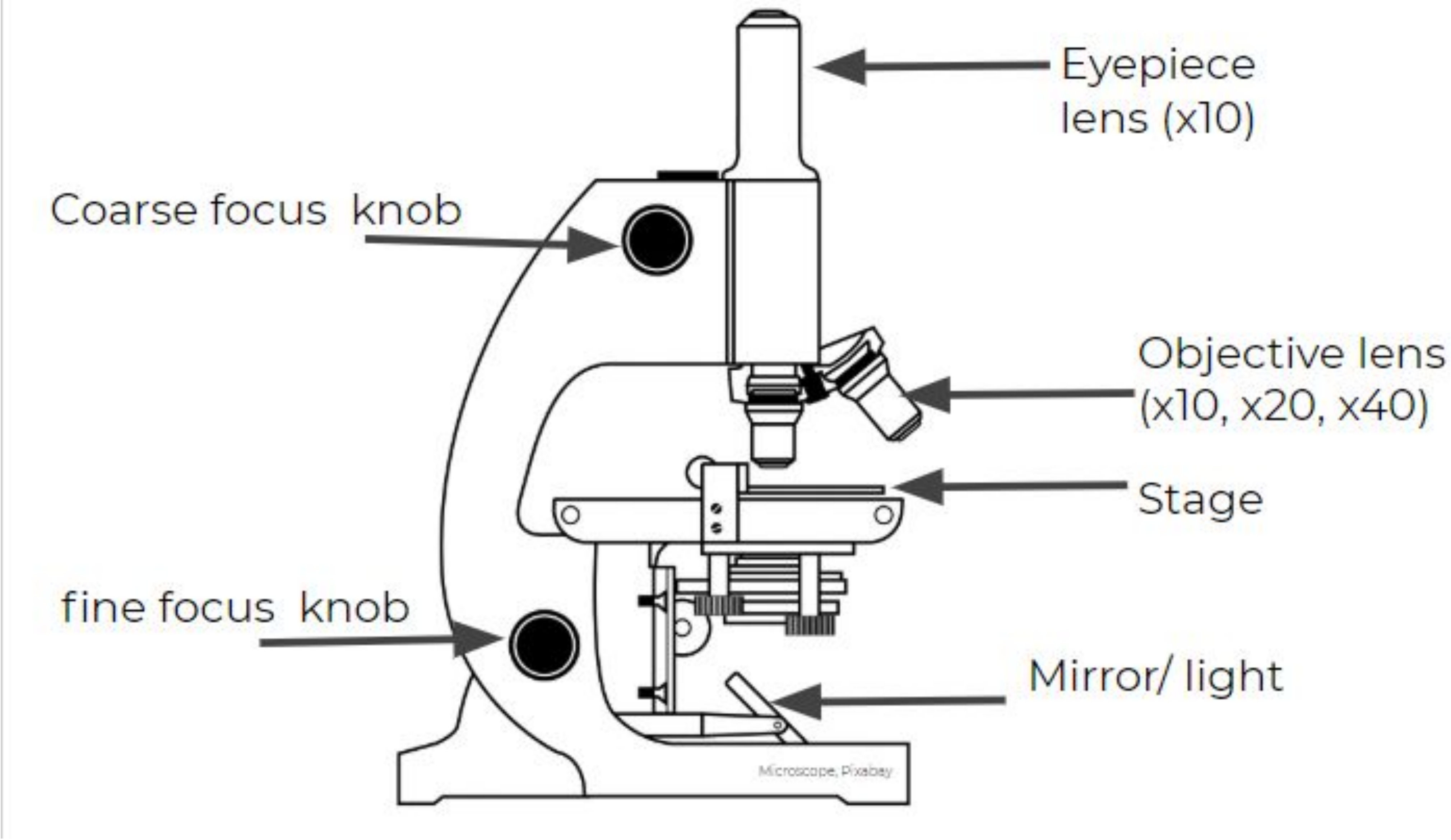
Manually focus using the fine focus knob.

# Finding magnification

# The two lenses that magnifies the cell



# Finding the total magnification




For example,

When the objective lens of x10 magnification is in use, the total magnification will be:

10 x 10

=100x

## Quick concept check

When viewing a cell using a light microscope, the eyepiece lens of power 5x and the objective lens of power 20x were used. What is the total magnification?

## Quick concept check

When viewing a cell using a light microscope, the eyepiece lens of power 5x and the objective lens of power 20x were used. What is the total magnification?

**5 x 20 = 100x**

# Finding the magnification using the magnification equation

$$\text{Magnification} = \frac{\textbf{Image size}}{\textbf{Actual size}}$$

E.g. Calculate the magnification of an object that is **0.001mm** long but has an image **100mm** long.

$$\frac{\mathbf{100}}{\mathbf{0.001}} = 10{,}0000\text{x}$$

# Finding the magnification using the magnification equation

E.g. Calculate the magnification of an object that is **0.05mm** long but has an image **250mm** long.

$$\frac{250}{0.05} = 500\text{x}$$

$$\text{Magnification} = \frac{\textbf{Image size}}{\textbf{Actual size}}$$

# Finding the magnification using the magnification equation

E.g. Calculate the magnification of an object that is **0.06mm** long but has an image **180mm** long.

$$\frac{180}{0.06} = 3000\text{x}$$

$$\text{Magnification} = \frac{\textbf{Image size}}{\textbf{Actual size}}$$

# Finding the magnification using the magnification equation

E.g. Calculate the magnification of an object that is **0.025mm** long but has an image **5mm** long.

$$\frac{\mathbf{5}}{\mathbf{0.025}} = 200\text{x}$$

$$\text{Magnification} = \frac{\textbf{Image size}}{\textbf{Actual size}}$$

# Finding the magnification using the magnification equation

E.g. Calculate the magnification of an object that is **0.05mm** long but has an image **2mm** long.

$$\frac{2}{0.05} = 40\text{x}$$

$$\text{Magnification} = \frac{\textbf{Image size}}{\textbf{Actual size}}$$

# Finding the magnification using the magnification equation and unit conversion

E.g. Calculate the magnification of an object that is **50µm** long but has an image **2mm** long.

Step 1: Complete unit conversion **2mm = 2000 µm**

Step 2: Find the magnification

$$\frac{\mathbf{2000}}{\mathbf{50}} = 40\text{x}$$

$$\text{Magnification} = \frac{\textbf{Image size}}{\textbf{Actual size}}$$

# Finding the magnification using the magnification equation and unit conversion

E.g. Calculate the magnification of an object that is **50µm** long but has an image **3mm** long.

Step 1: Complete unit conversion **3mm = 3000 µm**

Step 2: Find the magnification

$$\frac{\mathbf{3000}}{\mathbf{50}} = 60\text{x}$$

$$\text{Magnification} = \frac{\textbf{Image size}}{\textbf{Actual size}}$$

# Finding the magnification using the magnification equation and unit conversion

E.g. Calculate the magnification of an object that is **0.5µm** long but has an image **1.5mm** long.

Step 1: Complete unit conversion **1.5mm = 1500 µm**

Step 2: Find the magnification

$$\frac{1500}{0.5} = 3000\text{x}$$

$$\text{Magnification} = \frac{\textbf{Image size}}{\textbf{Actual size}}$$

# Finding the magnification using the magnification equation and unit conversion

E.g. Calculate the magnification of an object that is **0.05μm** long but has an image **0.8 mm** long.

Step 1: Complete unit conversion **0.8 mm = 800 μm**

Step 2: Find the magnification

$$\frac{800}{0.05} = 16000\text{x}$$

$$\text{Magnification} = \frac{\textbf{Image size}}{\textbf{Actual size}}$$

# Finding actual size

# Finding the actual size of cells

What is the actual size of an object that looks **32 mm** under a **10x** magnification?

$$\text{Magnification} = \frac{\textbf{Image size}}{\textbf{Actual size}}$$

$$10 = \frac{\mathbf{32}}{\textbf{Actual size}}$$

$$\textbf{Actual size} = \frac{\mathbf{32}}{10} = \mathbf{3.2mm}$$

# Finding the actual size of cells

What is the actual size of an object that looks **8mm** under a **200x** magnification?

$$\text{Magnification} = \frac{\textbf{Image size}}{\textbf{Actual size}}$$

$$200 = \frac{\mathbf{8}}{\textbf{Actual size}}$$

$$\textbf{Actual size} = \frac{\mathbf{8}}{200} = \mathbf{0.04mm}$$

# Finding the actual size of cells

What is the actual size of an object that looks **0.5mm** under a **2000x** magnification?

$$\text{Magnification} = \frac{\textbf{Image size}}{\textbf{Actual size}}$$

$$1500 = \frac{\mathbf{0.5}}{\textbf{Actual size}}$$

$$\textbf{Actual size} = \frac{\mathbf{0.5}}{1500} = \mathbf{0.00025mm}$$

$$= \mathbf{2.5 \times 10^{-4} mm}$$

# Finding image size

# Finding the image size

E.g. A cell that is **2μm** long is viewed under an 150x microscope.

How long is the image?

$$\text{Magnification} = \frac{\textbf{Image size}}{\textbf{Actual size}}$$

$$150 = \frac{\textbf{Image size}}{\textbf{2}}$$

$$\textbf{Image size} = 150 \times \textbf{2} = \textbf{300μm}$$

# Finding the image size

E.g. A cell that is **0.8μm** long is viewed under an 400x microscope. How long is the image?

$$\text{Magnification} = \frac{\textbf{Image size}}{\textbf{Actual size}}$$

$$400 = \frac{\textbf{Image size}}{\textbf{0.8}}$$

$$\textbf{Image size} = 400 \times \textbf{0.8} = \textbf{320μm}$$

# Finding the image size

E.g. A cell that is **1.2µm** long is viewed under an 800x microscope. How long is the image?

$$\text{Magnification} = \frac{\textbf{Image size}}{\textbf{Actual size}}$$

$$800 = \frac{\textbf{Image size}}{\textbf{1.2}}$$

$$\textbf{Image size} = 800 \times \textbf{1.2} = \textbf{960µm}$$

# Post Lesson Independent practice

# The magnification equation

Use the following equation to finish the questions on the next slide.

Rearrange the equation if necessary.

$$\text{Magnification} = \frac{\textbf{Image size}}{\textbf{Actual size}}$$

# Independent practise

1. An object 4.5mm wide is viewed under a 600x magnification. How wide is the image?
2. Calculate the magnification of an insect that has an image of 3.5 cm but is actually 0.5 mm long.
3. An object that is 200μm long is viewed under an 2000x microscope. How long is the image?
4. A student is looking at a diagram of a red blood cell. The diagram tells him that the cell has a magnification of 5000x. The student then measures the size of the image and finds that it is 7 mm long.
   a. What equation would the student need to use in order to calculate actual size?
   b. Calculate actual size in μm.
5. What is the actual size of an object that looks 32 mm under a 10x magnification?
6. Calculate the magnification of a cell that has an image 0.7 mm long but has an object 0.4 μm long.

# Answers

1. 4.5 x 600 = 2700mm
2. 3.5cm =350mm. 350÷0.5 = 700x
3. 200 x 2000 = 400,000μm = 400mm
4. 
    a. Magnification =Image size ÷ actual size
    b. 7÷5000 = 0.0014mm = 1.4μm
5. What is the actual size of an object that looks 32 mm under a 10x magnification? 32 ÷ 10 = 3.2mm.
6. 0.7mm = 700μm. 700 ÷ 0.4 =1750x