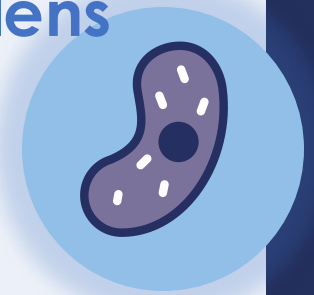
Microscopes

Answer the questions below.

1. State the function of a microscope.
   To magnify small objects that would otherwise not be visible to the naked eye.
2. Describe the key steps involved in the aseptic technique.
   The Petri dish is sterilised, the inoculating loop is sterilised, the agar lid is secured (but not completely sealed), the dish is incubated at 25 °C.
3. Explain why inoculated petri dishes are secured with tape but not the whole way round.
   Secured with tape to avoid contamination of the plate. Gaps are left to let oxygen in to keep the conditions aerobic.
4. Describe how to calculate the total magnification of a microscope.
   Total magnification = eyepiece lens magnification x objective lens magnification
5. Name the part of the microscope where the slide is placed.
   The stage

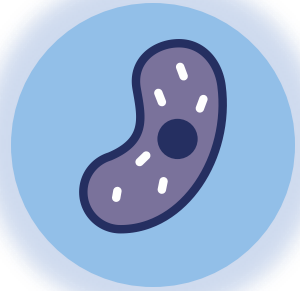
Do Now



Microscopes

B3.1.5

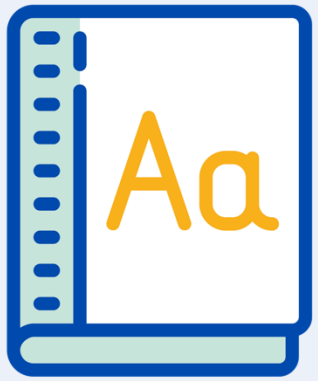
Science Mastery



Following this lesson, students will be able to:

- State the equation to calculate the magnification of an image
- Describe the differences between light and electron microscopes in terms of their magnification and resolution
- Explain how to identify the image size and the actual size of an object

Key Words:



electron **magnification** **resolution**

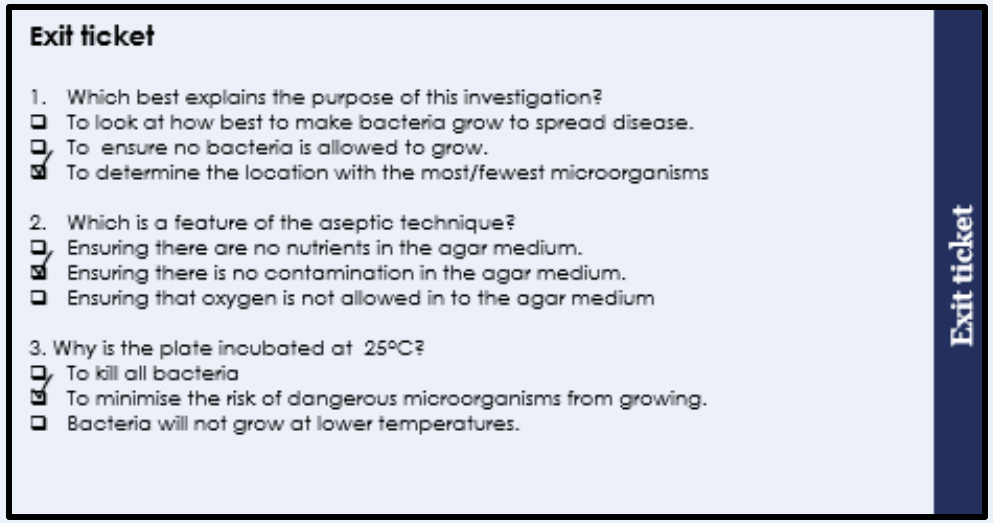
image **object** **scale** **sub-cellular**

Lesson Objectives

This is the fix-it portion of the lesson

The **fix-it** is an opportunity to respond to gaps in knowledge, especially those identified by the previous lesson's exit ticket.

- The teacher should customise this slide as needed, to facilitate
  - **reteach**, **explanation, demonstration** or **modelling** of ideas and concepts that students have not yet grasped or have misunderstood.
  - **practise** answering specific questions or of key skills.
  - **redrafting** or **improving** previous work.



Fix-it

Microscopes

Microscope techniques have developed over time

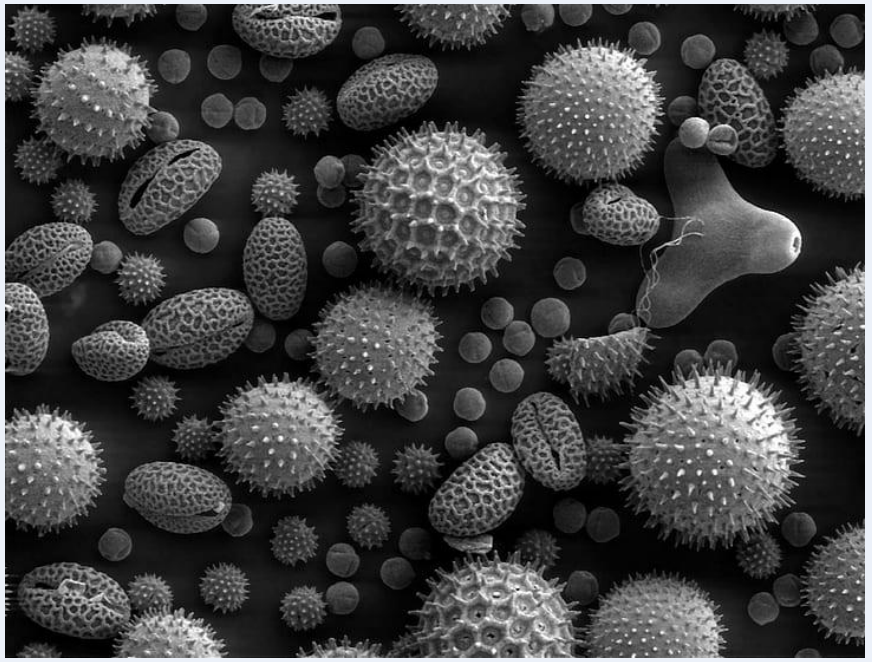
Microscopes originated from a simple magnifying glass

In the 1590s a Dutch father and son called Hans and Zacharias Jansen experimented with different lenses and made the first compound microscope

The first real microscope was made and used by Anton van Leeuwenhoek in the 17th century – he was able to use the microscope to see very small objects, including **microscopic animals** and **bacteria**. His work was crucial to the development of **cell theory**.

Microscopes

Light microscopes are limited in how much detail they can provide



Electron microscopes have **greater magnification** and **resolution** than light microscopes and have allowed scientists to study cells in greater detail, furthering understanding of sub-cellular structures.

Resolution is a measure of how detailed the image is.

Magnification can also be calculated by comparing the size of the image with the size of the real object

A stain is often used to make the organelles within a cell appear clearer

Timeline

1590s

First compound microscope

1670s

Van Leeuwenhoek made the first **light** microscope and viewed microscopic animals and bacteria

1838

Cell theory proposed

19th century

Scientists discover cell structures such as the nucleus and mitochondria

1931

German scientists Ruska and Knoll develop **electron** microscope

20th century

Electron microscopes allowed imaging of subcellular structures and viruses

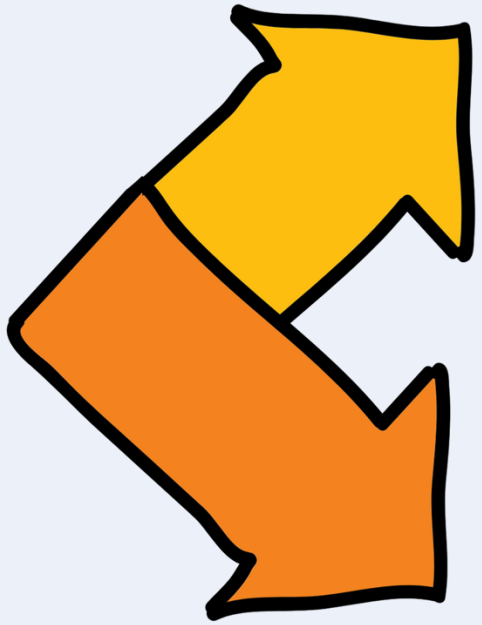
Quick Quiz

Determine whether each statement is true or false:

1. Electron microscopes can provide a higher magnification than light microscopes. **True**
2. The electron microscope was developed before the light microscope. **False**
3. Much of the understanding of sub-cellular structures has come from the use of electron microscopes.**True**
4. Total magnification of a light microscope can be calculated by adding together the eyepiece lens magnification and the objective lens magnification. **False**

Check for understanding

Can you explain the difference between these two microscopes?

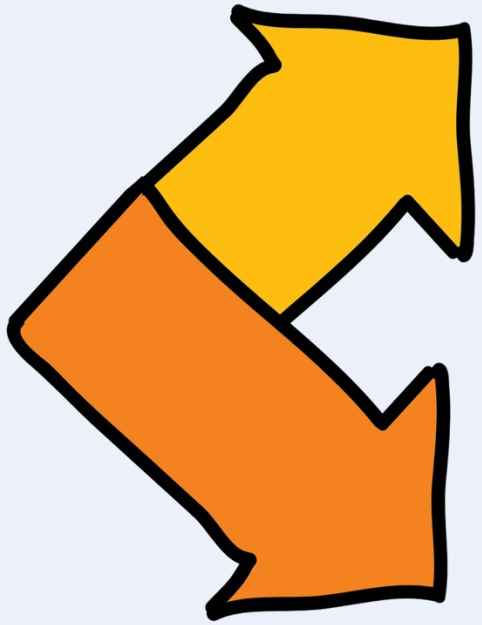


Light microscope

Electron microscope

Talk Task

Can you explain the difference between these two terms?



Magnification

Resolution

Talk Task

Drill

1. State the equation used to calculate magnification
2. How are cells made to appear clearer when using a microscope?
3. Name the type of microscope which has a high resolution and high magnification (light or electron microscope).
4. State and explain which type of microscope is more convenient to use in a school laboratory.
5. State one disadvantage of using electron microscopes.
6. Convert 1mm to µm

Check for understanding

Drill answers

1. Magnification = $\frac{\text{Size of Image}}{\text{Size of object}}$
2. Applying a stain
3. Electron microscope
4. Light microscope, as it is smaller and less expensive.
5. The sample cannot be live/must be dead, the microscope is large and expensive, more difficult to use, they typically produce black and white images
6. 1000µm

Check for understanding

Calculating magnification

The image on the right shows an electron micrograph image of a bacteriophage.

The length of the scale bar is 1 cm (10 mm).

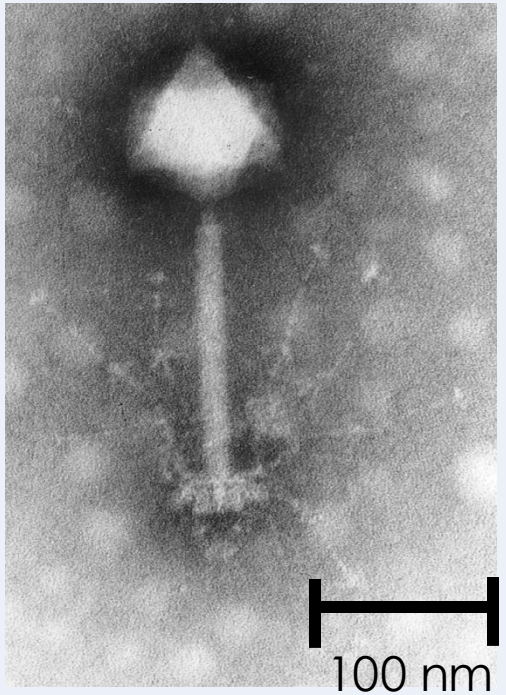
We can calculate the magnification used for this image using the formula:

$$\textbf{Magnification} = \frac{Size\ of\ image}{actual\ size\ of\ object}$$

$$= \frac{10\ mm}{0.0001\ mm\ (nm\ converted\ to\ mm)}$$

$$= 100000$$

(This object has been magnified 100000 times)



Calculating magnification

The image on the right shows an electron micrograph image of a mitochondria.

$$\text{Magnification} = \frac{\text{Size of image}}{\text{Actual size of object}}$$

The measured length of bar AB in the image is 21 mm.

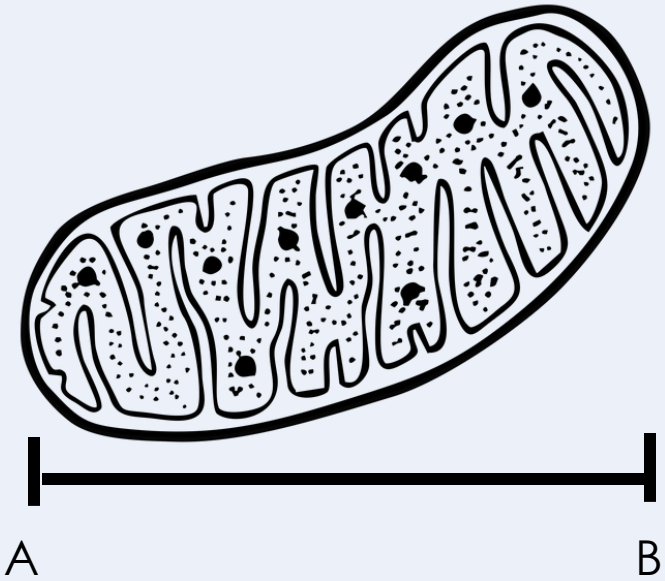
The actual length is 1.5 µm.

Calculate the magnification for this image

Magnification = $\frac{\text{Size of Image}}{\text{Size of object}}$

= $\frac{21 \text{ mm}}{0.0015 \text{ mm (µm converted to mm)}}$

= 14000



Check for understanding

I: Worked example

VESCU

Apply

One red blood cell was 50 µm wide.

When viewed using a microscope the image of the red blood cell was 2 mm wide.

Calculate the magnification used to view the cell.

Magnification = ? Size of image = 2mm Size of object = 50 µm
= 0.05mm

$$\text{Magnification} = \frac{\text{Size of Image}}{\text{Size of object}}$$

$$\text{Magnification} = \frac{2}{0.05}$$

Magnification = X40

We: Worked example

VESCU

The real length of one muscle cell is 0.8 mm.

Calculate the image length in μm if the muscle cell is viewed at a magnification of ×20

Magnification = X 20 Size of image = ? Size of object = 0.8 mm

$$20 = \frac{\text{Size of Image}}{0.8}$$

Size of image in mm = 16

Size of image in μm = 16,000

Apply

You: Worked example

VESCU

Apply

A student viewed a section of a leaf using a microscope.

The student measured the length of one of the palisade cells.

The cell image measured 25 mm in length when viewed at a magnification of ×500
Calculate the size of the palisade cell in millimetres (mm).

Magnification = x500 Size of image = 25mm Size of object = ?

$$\text{Magnification} = \frac{\text{Size of Image}}{\text{Size of object}}$$

$$500 = \frac{25}{\text{Size of object}}$$

$$\text{size of object} = \frac{25}{500}$$

$$\text{size of object in mm} = 0.05$$

$$\text{size of object in } \mu\text{m} = 50$$

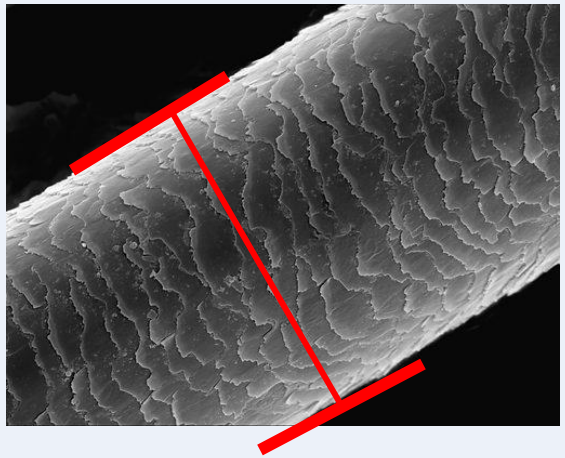
Answer the questions below.

1. Which statement is correct?

- ❑ A. Both light microscopes and electron microscopes allow us to look at large objects that are far away on a much smaller scale.
- ❑ B. Light microscopes have the greatest magnification and allow us to look at sub-cellular structures
- ☑ C. Electron microscopes have greater magnification than light microscopes and have enhanced understanding of sub-cellular structures.

Exit ticket

Answer the questions below.



2. The image on the right shows a strand of human hair. The red line measures 20 mm and the width of the hair is 0.001 mm. Which statement is correct?

- ☑ A. Image size is 20 mm, actual size of object is 0.001 mm.
- ☐ B. Image size is 0.001 mm, actual size of object is 20 mm.
- ☐ C. You need to know the magnification to calculate the image size and actual size

3. What is the magnification of this image using the given information in question 2?

- ☐ A. 0.02
- ☑ B. 20000
- ☐ C. 0.00005

Exit ticket

Feedback

Lesson B3.1.5	
What was good about this lesson?	What can we do to improve this lesson?

Send us your feedback by clicking this link
or by emailing sciencemastery@arkonline.org
Thank you!