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Department: Science of the Earth and the Universe

2nd year LMD Applied geology

T.P PETROGRAPY OF IGNEOUS ROCKS

The aim of this practical work is to put the student in front of an instrumentthat will accompany him throughout his training, for this, it is therefore essential to familiarize him with this work tool.

For this, it is essential to give him a presentation of the different parts of which it is composed as well as the adjustments necessary to obtain a good setting.

Introduction

Geology is the study of Earth's structure, which includes the liquid and solid Earth, the rocks that the Earth is composed of, and the ways that those rocks change over time. As you can probably imagine, geologists spend a LOT of time looking at rocks, and microscopes help geologists see things in those rocks that are otherwise invisible to the naked eye. Some of the specific geological applications that involve the use of microscopes include lithology, petrology, and structural geology. Let's take a look at each discipline's definition and discover the unique role that microscopy plays in the world of geology.

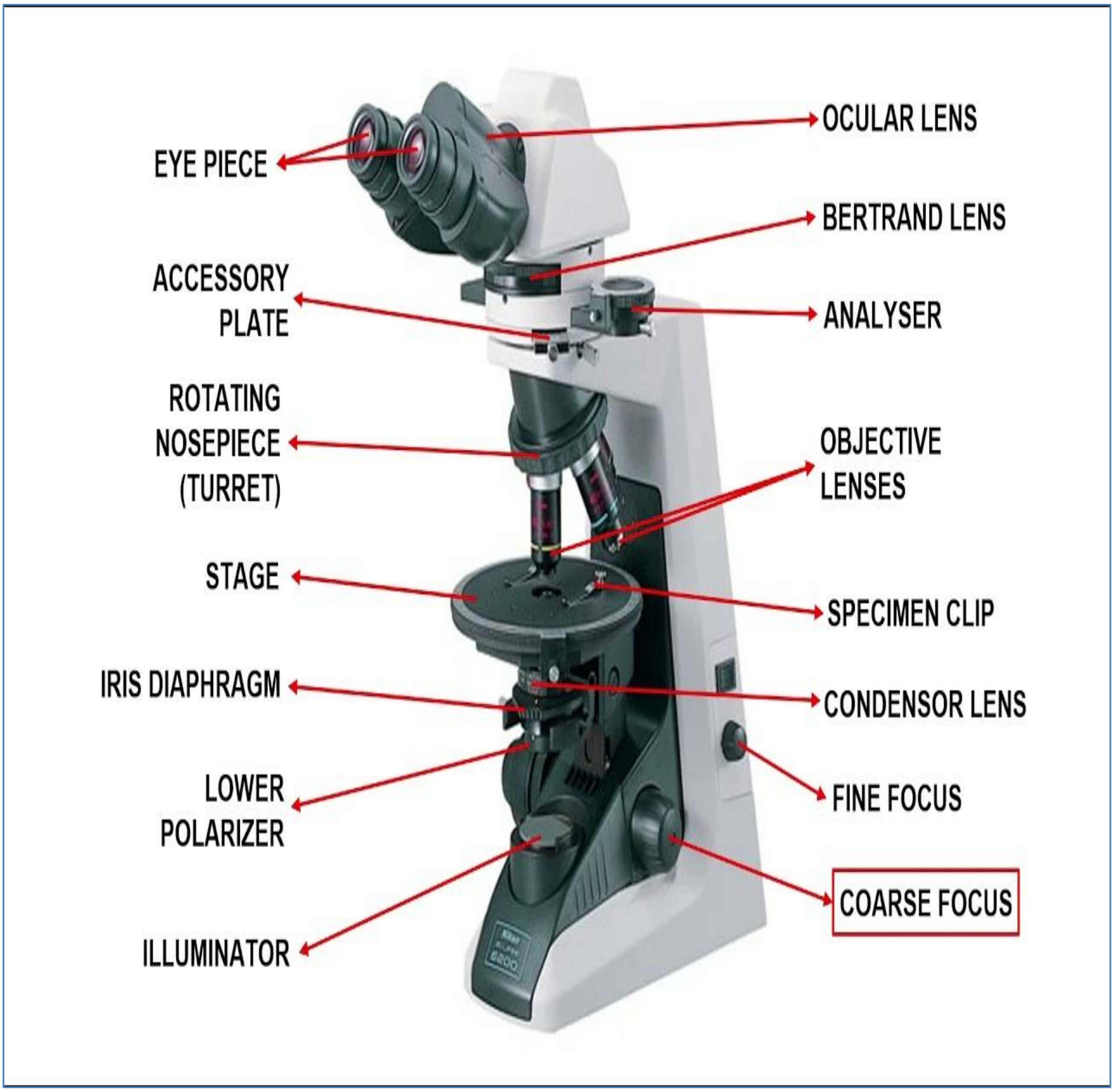
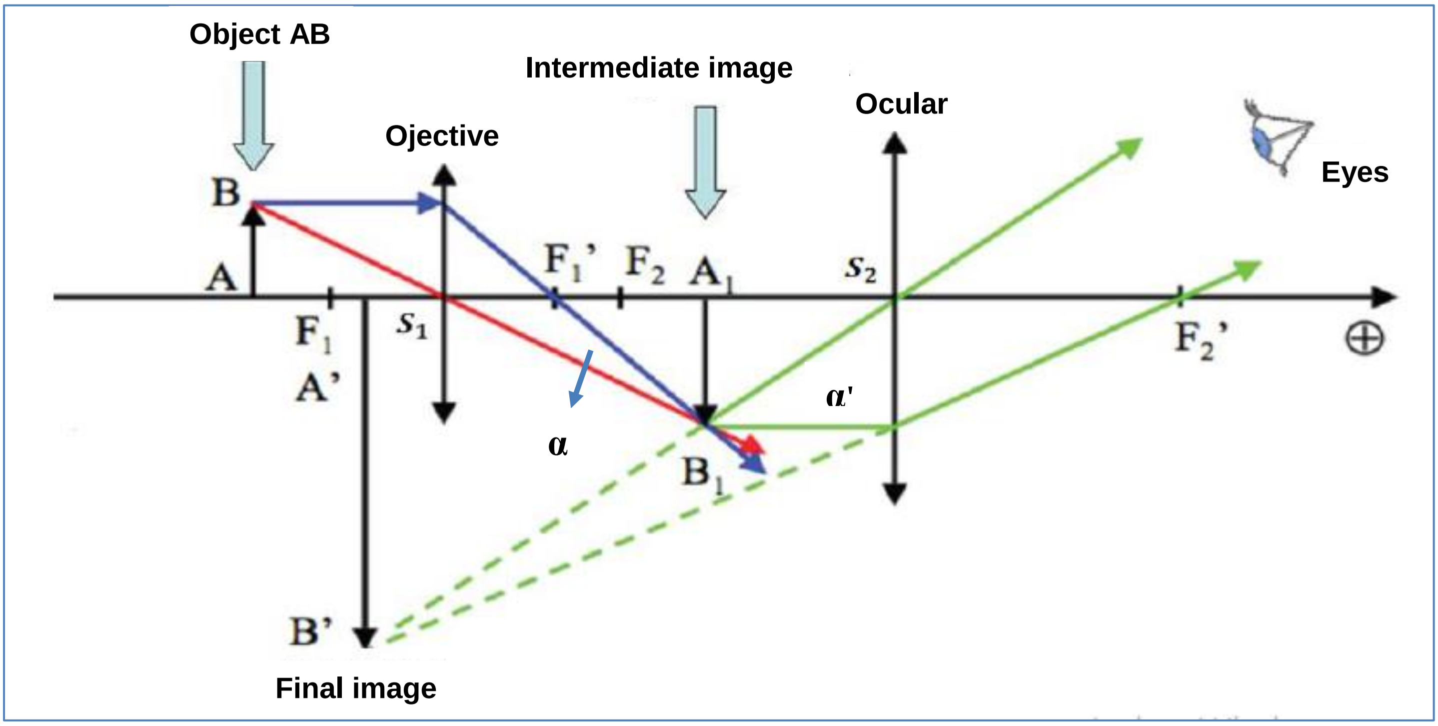
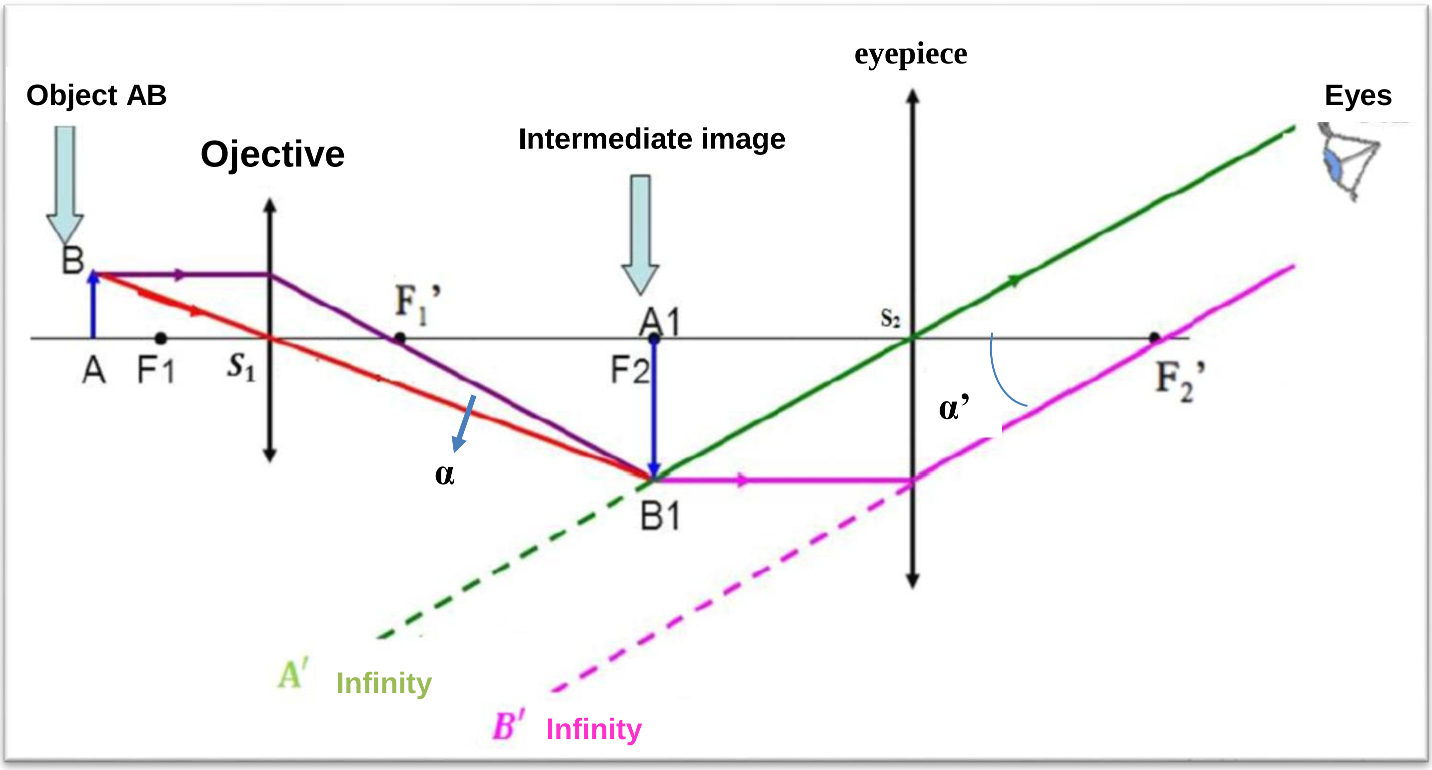


Image construction

a) With accommodation



b) Without accommodation



Characteristics of an optical microscope

Power of a microscope

The power of a microscope is the ratio of the apparent diameter of the image (α') to the length of the object (AB):

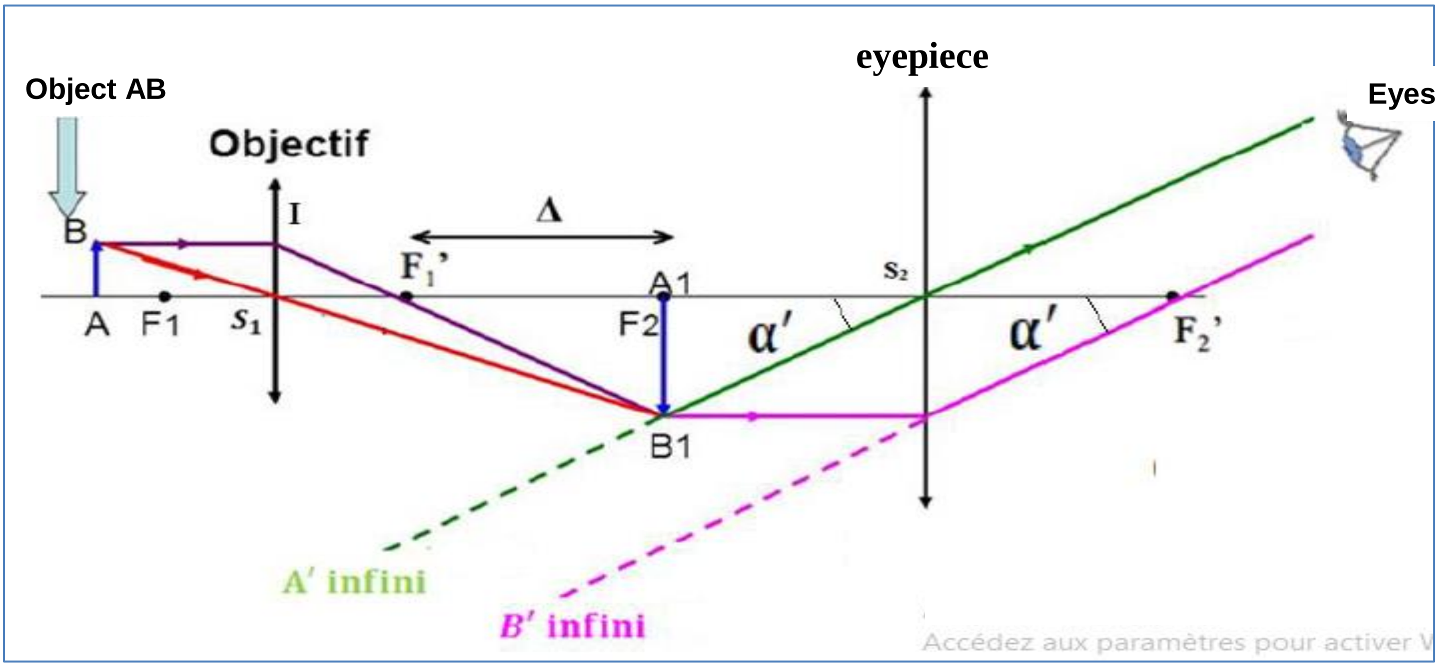
$$P(\delta) = \frac{\propto'(rad)}{AB(m)}$$

$$P = \frac{\propto'}{AB} = \frac{\propto'}{A_1B_1}\frac{A_1B_1}{AB} = P_{Ocu}\gamma_{Obj}$$

The power P is expressed as the product of the absolute value of the magnification γ_O of the objective by the power P_{Ocu} of the eyepiece

Intrinsic power

The intrinsic power P_i of a microscope is the power in the case of vision at infinity (the final image A'B' is located at infinity).



$$\gamma_{obj} = \frac{\overline{A_1B_1}}{\overline{AB}} = \frac{\overline{A_1B_1}}{\overline{S_1I}} = \frac{\overline{F'_1F_2}}{\overline{F'_1S_1}} = \frac{\Delta}{f'_1}$$

$$P_{ocu} = \frac{\alpha'}{\overline{A_1B_1}} = \frac{\tan\alpha'}{\overline{A_1B_1}} = \frac{1}{f'_2}$$

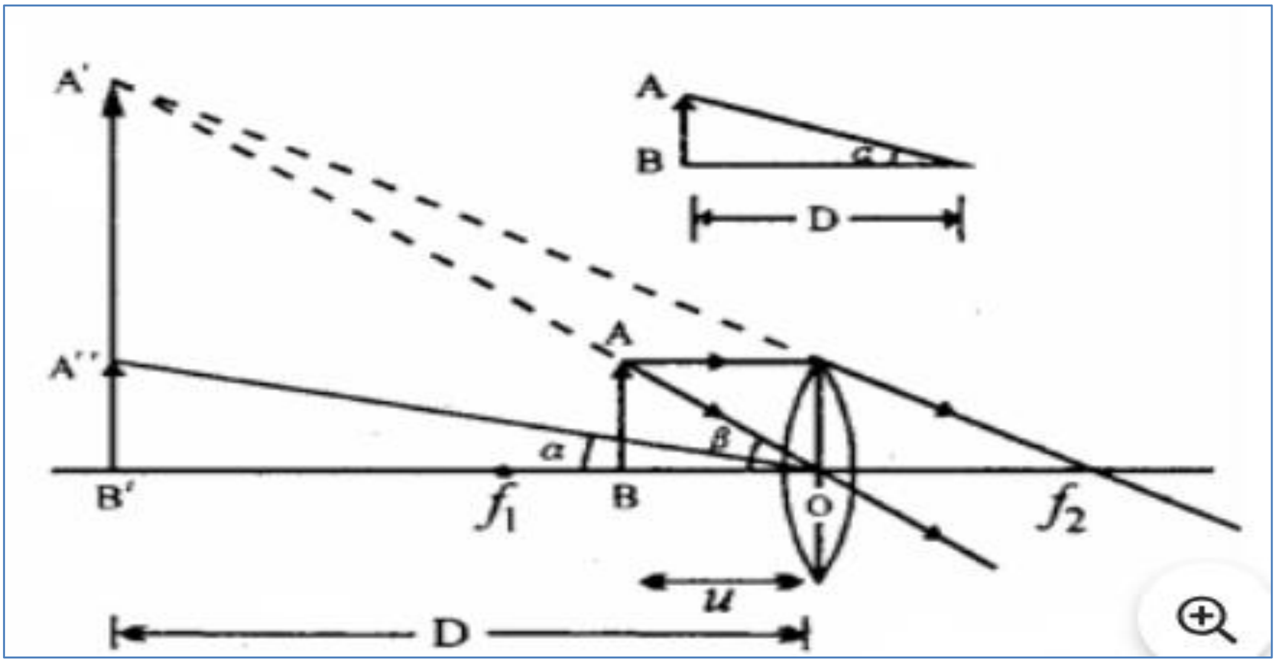
$$P = P_{i\,Ocu}\gamma_{Obj}$$

$$P_i = \frac{\Delta}{f'_1 f'_2}$$

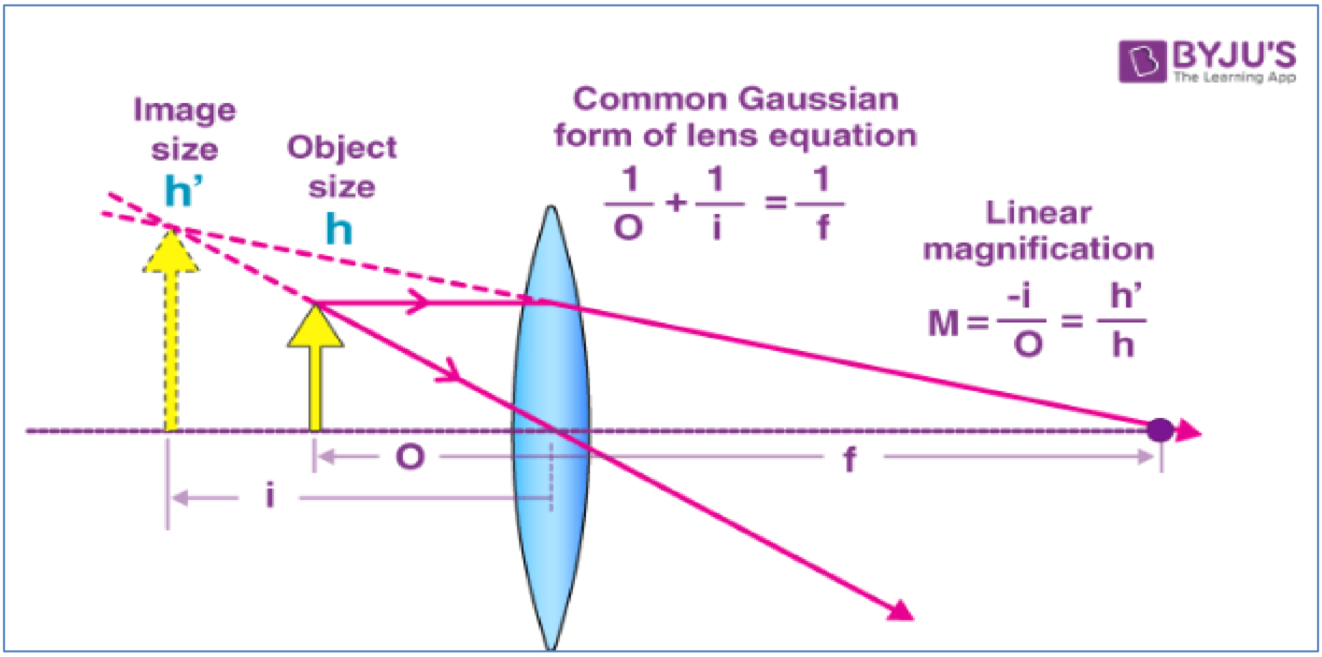
- **Magnification**

Magnification, M = image length / object length

Magnifying power (*m*) a microscope is defined as the ratio of the visual angle subtended by the image at the eye (β) to the visual angle subtended by the object at the eye when placed a minimum of the distance of distinct vision (α).
We can refer to following the figure for further understanding.



$$m = D \times \left(\frac{D+f}{Df}\right) = \left(1 + \frac{D}{f}\right)$$



Method 02

$$M = \frac{\alpha'}{\alpha_m} = \frac{P \times AB}{AB / D_m}$$

$$P = \frac{\propto'}{AB}$$

$$\propto_m = \frac{AB}{D_m}$$

$$M = D_m P$$

The magnification of a microscope is equal to the product of its power by the minimum distance (Dm) of distinct vision of the eye using it.

Commercial magnification (M_1)

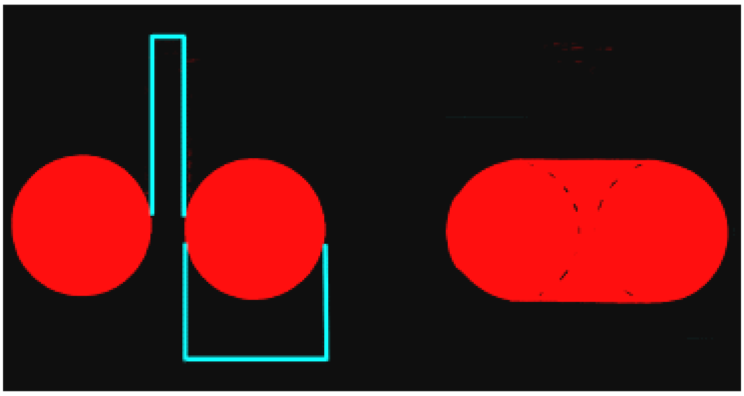
-Focus at infinity the final image A'B' located at infinity): P=Pi

-Minimum distinct viewing distance: Dm= 0.25 m

$$M = M_1 = D_m P_i = 0{,}25 P_i \qquad M_1 = \frac{P_i}{4}$$

Resolving power

The resolving power of a microscope characterizes the smallest distance between two points that can be seen as separated. If the resolving power of the eye is ε, that of the microscope ε' is given by:



$$\varepsilon' = \frac{\varepsilon}{P}$$

The resolving power of an objective lens is measured by its ability to differentiate two lines or points in an object. The greater the resolving power, the smaller the minimum distance between two lines or points that can still be distinguished. The larger the N.A., the higher the resolving power.

Resolving Power Formula

The following formula is generally used for determining resolution.

$$\varepsilon = 0.61 \times \frac{\lambda}{N.A.} \quad \text{(Reyleigh formula)}$$

λ : Wavelength

λ =0.55µm is used for visible light

N.A.: Objective lens N.A.

Example MPLFLN100×(N.A. 0.90)、λ =0.55µm

$$\varepsilon = 0.61 \times \frac{\lambda}{N.A.} = \frac{0.3355}{N.A.} = \frac{0.3355}{0.90} = 0.37\mu m$$

What is Resolution In A Microscope?

In microscopy, resolution is a numeric quantification of how clearly an objective lens can image a specimen. More specifically, it is the shortest distance between two objects within a specimen at which the two objects can be distinguished from each other. Resolution is a calculated number, inversely related to the Numeric Aperture (NA) of the lens. Therefore, the higher the objective lens NA, the smaller the resolution. But don't let that mislead you; a smaller resolution number is a good thing! It means that specific lens can more clearly show smaller and smaller samples.

Microscope Resolution Equation

There are a few different equations that allow us to state what an objective lens' resolution is, and show the relationship between resolution and NA. Here is one equation we use: (r) = 0.61λ / NA, where r is resolution, λ is the imaging wavelength (550nm on average), and NA is the numeric aperture of the objective lens in question. So, if a 10x objective lens has a NA of 0.25, the resolution of that lens is (0.61 x 550nm) / 0.25, or 1.34µm. For a 100x objective lens with a NA of 1.25, the resolution of that lens is (0.61 x 550nm) / 1.25, or 0.268µm.

Exercise

A microscope is modeled by 2 converging lenses (objective and eyepiece). The object AB measures 2.5 mm; it is placed to the left of the objective, at 14.9 cm; the focal length of the objective is 12.5 cm and that of the eyepiece 25 cm. The interfocal distance or optical interval Δ is worth 62.5 cm. The eye is placed on the image focus of the eyepiece.

1- Determine the nature, dimension and position of the image A 1 B 1 given by the objective of AB Deduce γ obj

2- The position of the final image A'B' of A 1 B 1 given by the eyepiece

3- Calculate the power and magnification of this microscope

2- 4- Calculate the intrinsic power and commercial magnification