**RESOLUTION PART 4: THE 100X OBJECTIVE**

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**INTRODUCTION:**

I have been analyzing in this series the resolution of the 4 common objectives supplied with the compound microscopes that we as enthusiasts for most of the time acquire.

I mean achromatic objectives so, up to this point we have established the level of resolution of the 4x, 10x, and it has been shown that they can *detect* objects smaller that the established resolution limit for them.

Also explored was the 40x the most common dry high power objective used by the amateur microscopist, which under certain conditions can also surpass the limit of resolution but always not going farther than the limit established by nature of the wavelength of light which is about 0.2-0.4 micrometers.

This time the 100x objective is going to be analyzed and its features regarding the resolution limit. See below.

**DEVELOPMENT AND RESULTS:**

The 100x objective is the highest power one of almost any microscope, it has the purpose of giving the greatest level of magnification and resolution to a sample.

According to the formula that has been used in the previous articles of this series, the resolution limit of an achromatic 100x objective is:

**Resolution** = the wavelength of the light used = 0.22 micrometers

2 x the numerical aperture

It is necessary to say that the 100x objective is “special” because it is an immersion one, which means that it needs a drop of a liquid beneath the lens to produce a clear image and to optimise the resolution. *[Editor's note: The condenser if well corrected should also be immersed to fulfil the achromatic objective's NA of typically 1.2 – 1.3. If not immersed, its operating NA is a maximum of 1.0 in air and thus its resolution is reduced.)*

The most common liquid used in microscopy is the modern synthetic equivalent of the formerly used cedar oil. The refractive index is similar to the glass of the slide and the cover slip upon the sample that according to most authors is 1.5.

Oil is necessary with this objective because it is designed to be used immersed. The space between the cover slip and the lens of the objective is so small that the full cone of light has difficulties in reaching the sample and when the oil is applied it is optimised

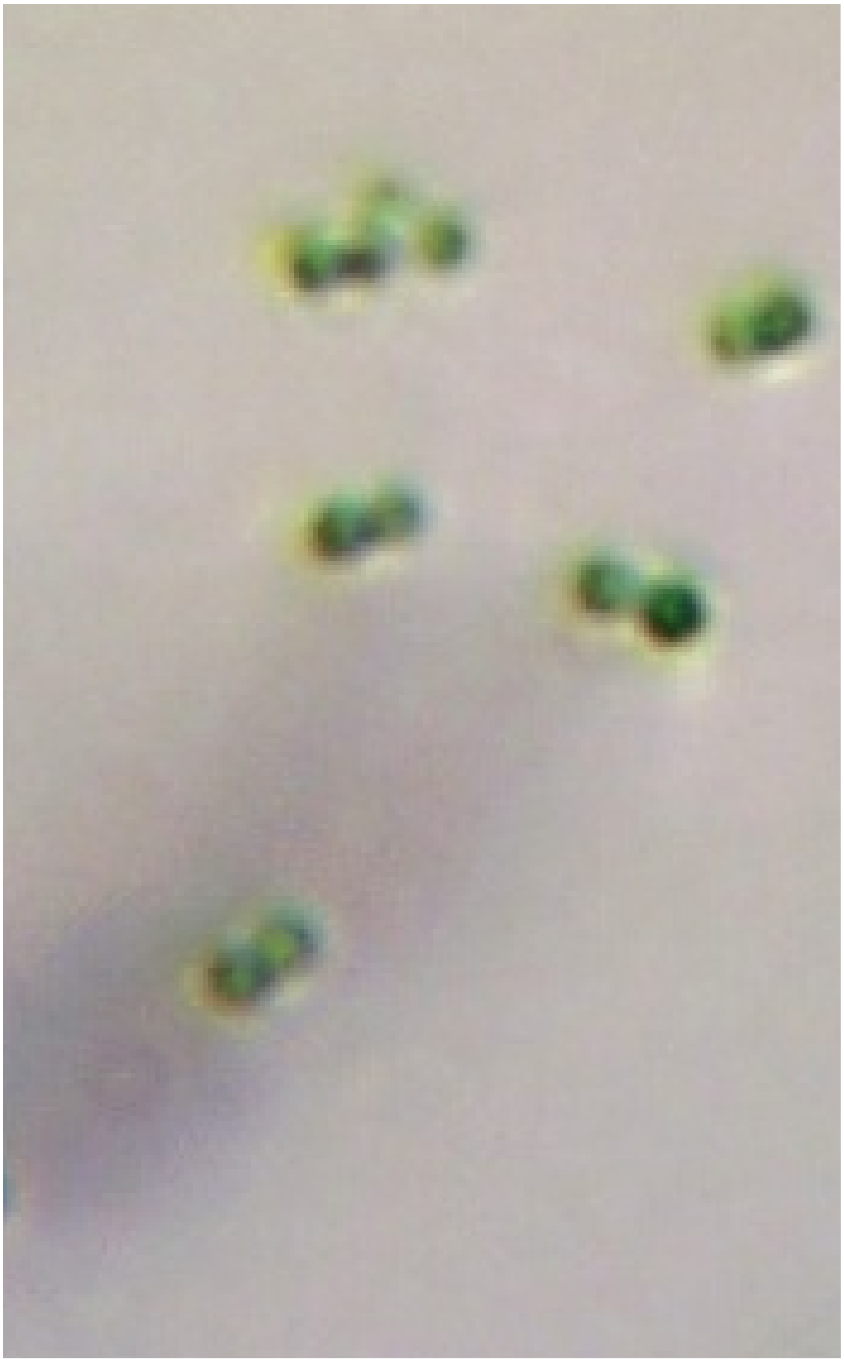
When to used immersion oil with a 100x objective? Always, if it is designed for it (there are examples used dry.)

Is 0.22 micrometers mentioned above the resolution limit of a 100x objective?

I think the answer is yes it is, because as mentioned for the 40x objective, the wavelength of light limits this.

Using again a sample of streptococcus of yogurt but now an unstained sample and just fixed with heat alone.

It is shown that it does give more magnification but not more resolution, because no more parts of the cells are seen than the ones already shown with the 40x.



A pair of crops of photographs of *Streptoccocus* of yogurt 100x in bright field.

**CONCLUSION:**

That is the farthest we can go with an optical microscope of a type which most of us has at home, as enthusiast microscopists. Since we have agreed in this series that the width of a chain of streptoccocus is 0.83 micrometers that is not so bad, most of the samples we have access to are bigger that this.

So I state that a coccus of any species of bacteria and of any conformation is the simplest form of life we can see with our optical microscope, and I dare to say that because I have found no other one as an enthusiast microscopist.

Dear reader. Do you agree or disagree?

Email author: doctor2408 AT yahoo DOT com DOT mx (Above in anti-spam format. Copy string to email software, remove spaces and manually insert the capitalised characters.)

Published in the December 2017 issue of *Micscape* magazine.

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