how to match
camera resolution

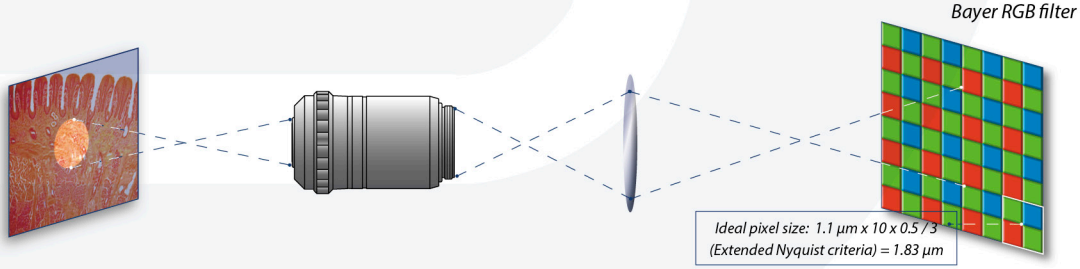
In microscopy, the image of the sample under observation is projected by the optical components of the microscope (objective lenses, eyepiece lenses, intermediate lens or camera relay lenses) onto the surface of a camera sensor or the retina of a human eye

Not the total amount of pixels – which basically determines the field of view of the camera image - is primordial but a more important specification is the pixel size of the camera sensor. What might be astonishing to know about digital resolution of camera's is the fact, that the higher the magnification, the fewer pixels the chip of a camera needs!

To optimize the transfer of the details of the sample (resolving power) to the camer]] a, the pixel size of the photodiodes of the camera sensor is a key element

EXAMPLE OF A 10X/0.25 OBJECTIVE WITH 1/2 INCH CAMERA SYSTEM

Sample *10x/0.25 objective* *0.5x Relay lens* *1/2 inch camera sensor with Bayer RGB filter*



Maximum resolving power limit of a10x/0.25 objective is a 1.1 µm detail

Projected image is 1.1 µm x 10x x 0.5 = 5.5 µm

MAXIMUM AND OPTIMUM PIXEL SIZE REQUIREMENTS:

Obj. Magn.	NA	Resolving power[1] (µm)	Projected size (µm)	Projected size with 0.5x lens (µm)	Maximum [2] camera pixel size (µm)	Optimum [2] [3] camera pixel size (µm)
1x	(0.04)	6.90	6.90	3.45	1.72	1.15
2x	(0.06)	4.60	9.20	4.60	2.30	1.53
4x	(0.10)	2.80	11.2	5.60	2.80	1.86
10x	(0.25)	1.10	11.0	5.50	2.75	1.83
20x	(0.40)	0.69	13.8	6.90	3.45	2.30
40x	(0.65)	0.42	16.8	8.40	4.20	2.80
60x	(0.80)	0.34	20.4	10.2	5.10	2.40
100x	(1.25)	0.22	22.0	11.0	5.50	3.67

(1) Resolving power of the objectives: r = 1.22 • λ / (NA Objective + NA Condenser). With NA = numerical aperture , λ = wavelength and r = optical resolving power. The resolving power limits are based on various theoretical calculations. Low specimen contrast, improper or low illumination conditions, etc, may serve to lower resolving power limits, more often than not, the real-maximum values are not realized in practice

(2) The Nyquist criterion states that the maximum camera pixel size can't exceed half of the resolving limit of the objective. For high resolution images, the Nyquist criterion is even extended to 2.5 to 3 pixels per detail and thus the optimum camera pixel size (3) is calculated as maximum 1/3 of the resolving limit of the objective

(3) Although smaller pixel size of photodiodes of the camera sensor improve the resolution, smaller pixel sizes lower signal to noise ratios, lower the dynamic range and collect less light! Binning techniques can compensate for lower signal to noise ratios