Perceptual Optics — 3. What Is Focus?

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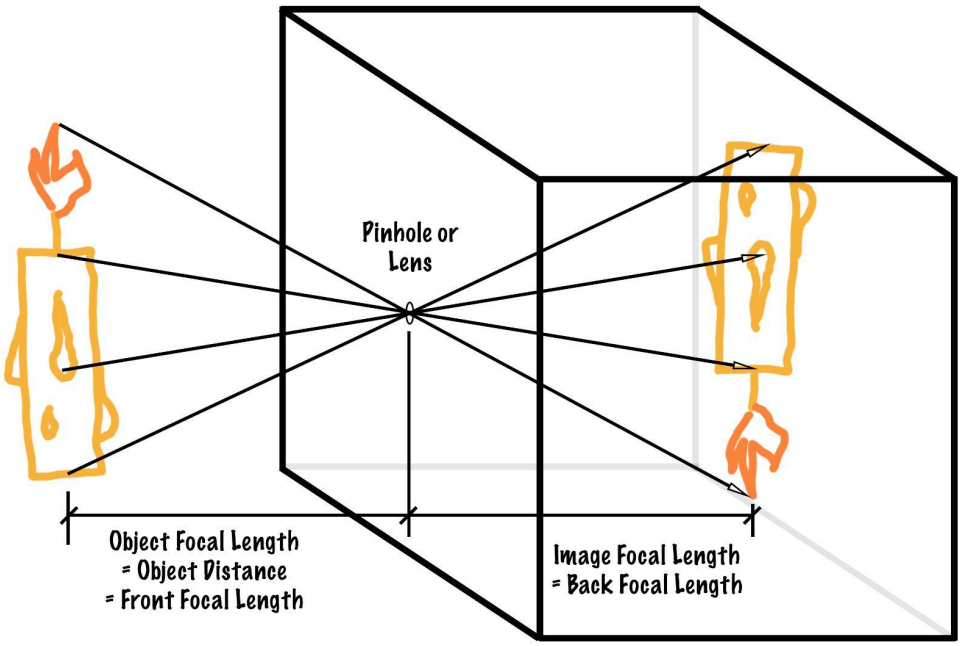
You already kind of learned what **focus** is in lesson two; nevertheless we cover it again here in more depth. Logically, the term **“focus”** should only ever refer to *the bending of a light cone from a pixel in the world back into a point upon reaching the sensor*. But as is often the case, this actual definition is hardly ever encountered, and everything else that *isn’t* focus gets mislabeled as being focus! So let’s familiarize ourselves with a couple other concepts so as to know what they are referring to.

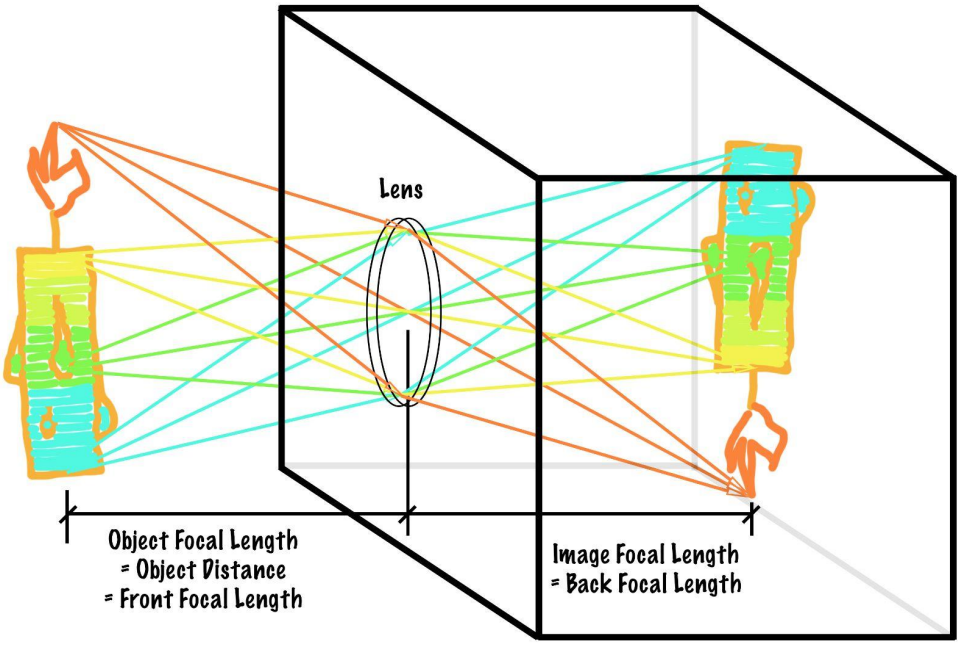
“Image focal length” or **“back focal length”** is the term *conventionally used to describe the distance from a lens to a sensor*. *The effect of varying this is to change the percentage of the sphere of perception (sphere of the world around you) included within the image on the sensor*. Increasing “focal length” means the image will be bigger upon landing on the sensor, and thus will crop the image, meaning that a smaller solid angle portion of the hemisphere is on the image. It’s a means of zoom. But if you don’t change the focal power of your lens along with it (“refocus”), it would result in the focal object being out of focus.

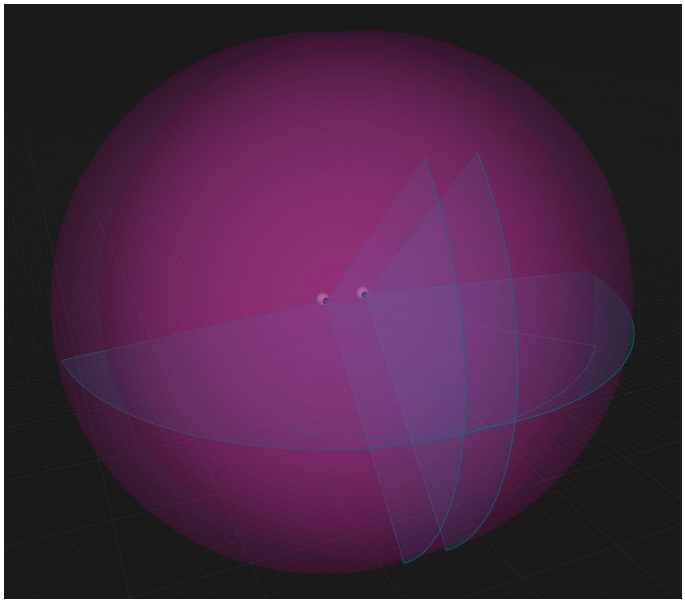
“Object focal length,” “object distance,” or **“front focal length”** *describes the distance from a lens to the object you want to be in focus*. Focusing on far objects requires less focusing power; focusing on near objects requires a lot of focusing power. *If you need to focus on something close, you can push the lens away from the sensor so that there is more distance to work with in bending the cone back to a point.*

DSLR lens-makers use lots of lens elements, but tend to define optics very confusingly.



The below visual gives a good idea of both what **focus** is and what a **lens** does. The graphic is in 2D, but if you use your imagination, you can envision cones in 3D. As you can see, every point in the world sends off light in every direction. This makes an expanding sphere. But at the point of crossing the lens, you're only sampling a very small area of the sphere shell, so the shape appears as a cone. The goal of the lens is to bend that cone back into a single clear point right as it reaches the sensor.





The human can see roughly 180º horizontal by roughly 100º vertical, but the fovea can discriminate 1/60th of a single degree. That which is in foveal view also has clues as to depth because it knows what focus the lens is currently using, the degree of vergence, and the degree of pupillary constriction dictated to help see close up focal objects. Images lose depth and this depth component must be rebuilt by the brain prior to visual perception. The brain may keep tabs on **the eye's current focal power** alongside incoming vision to *help specify depth in converting foveal pixels back to voxels*.