Lesson 2 – Lenses – Transcripts

* Lenses are most commonly made of glass and they are essentially pieces of shaped glass that bend light in useful ways.
* Lenses help us focus light and form images.
* Lenses are absolutely everywhere and in every piece of equipment that deals with optics. This includes our eyes and cameras.
* There are really two basic kinds of lenses.
* Convex lenses or vexed out or positive lenses;
* Convex lenses tend to converge light and can form an image from the light reflected off of an object.
* Concave Lenses – are a little special. They don’t really form a real image and cannot converge any light coming through them.
* Instead concave lenses diverge light and instead make it look like the subject or object was far closer to the center of the lens and that is where the light is coming from. This is an unreal or imaginary image.
* To understand convergence and images let’s look at this image I took.
* Here I simply took a mason jar and filled it with a clear liquid, in this case water.
* The curved nature of the glass and the clear liquid created a nice makeshift convex lens.
* You can clearly see the cone of light flowing through the glass and the really bright point at the top if the cone where the image converges.
* Since I did this on my porch during the day, the source of light was obviously the sun, which compared to the tiny lens is phenomenally far away. A concept we call infinity in optics.
* The image of an object so distant is basically a point image which is clearly observed in this image.
* Cameras, binoculars, and telescopes do much of the same and all of them converge light from a source on to a screen and they all use lenses.
* Exercise> To try out convergence and divergence.
* I would recommend replicating the same experiment with glasses of varying sizes and diameters.
* This should illustrate tot you how a thicker lens behaves as opposed to the thinner lens.
* Hint the point of convergence will be closer to the center of the lens you create.
* Concave lenses are a little different.
* Concave lenses do not converge light at one point.
* A common way to see this effect is to use a glass with a thick bottom. Due to the curvature and shape there will still be some convergence but there will also be a section of that glass that acts as a divergent lens.
* Concave lenses make It look like the light is bending away from a point.
* This ability to diverge light is actually very useful to us.
* Let’s talk a little about the application of these lenses in a far more useful manner.
* While it is common to fid convex and concave lenses around the house, we don’t often use them alone.
* We almost always use them in combinations of lenses. This setup is called a complex lens.
* The combination of lenses gives us the ability to work with focal lengths, focus points, sharpness, size, and the distance and location of image formation.
* A major advantage of a complex lens is the ability to move the system of lenses along a central axis to converge, diverge, magnify and sharpen an image.
* They help us get sharp accurate results. Results that a simple lens just simply cannot get us.
* Focal lengths, let us briefly talk about focal lengths.
* The focal length of a lens is the distance from the center of the lens to the point where the lens will focus or make it look like the light diverges from.
* Remember the bright spot formed from our glass experiment with the makeshift lens. The distance from the center of your glass to that bright spot is the focal length of the makeshift lens.
* The focal length is a lens property. That is, it will not change with the object, source of light.
* A positive lens will focus light rays at a point along the direction of the path of the light.
* A negative lens on the other hand will make it look like that light diverges from a point, and, will have a negative focal length.
* For an observer the image formed by a convex lens is real and one by a concave lens is imaginary. The concave lens makes it look like the subject is at the focal point and the light is diverging from there.
* Focal length is crucial for camera lenses which are incredibly complex systems. So much so that anywhere between 4 – 40 lenses are coupled together using complicated software to design the system.

Appendix:

* Light – Wikipedia - <https://en.wikipedia.org/wiki/Light>
* Optics for kids – Concave vs Convex Lenses - <https://www.synopsys.com/optical-solutions/learn/optics-for-kids/lenses.html>
* Lenses – Wikipedia - <https://en.wikipedia.org/wiki/Lens_(optics)>
* Nikon - <http://imaging.nikon.com/lineup/dslr/basics/19/01.htm>