

BrianQ This real image is really cool... everyone is quite used to looking at virtual images, but seemingly no one ever realizes the existence of real images

BrianQ But we see the real image used in lots of circumstances, which we'll discuss in a bit.

BrianQ So, the sort of lens that makes a real image is called a "converging lens"...

BrianQ So the loupe and a magnifying glass are examples of a converging lens.

BrianQ By the way... a magnifying glass is also called a "burning glass" because...

BrianQ little boys use it to burn up ants... when they are doing this...

BrianQ are they creating a "real image" or a "virtual image"?

doos real

DragonStek real

BrianQ yes, and what is the object that is being transformed into a real image?

doos the sun

BrianQ yes, and what is the screen?

doos the ant

BrianQ yes :)

DragonStek eyes

DragonStek oh

BrianQ no.. the poor burning ant.

doos poor antie

doos always gets burned by guys

BrianQ if the ant wasn't there, we'd see a small circle of bright light on the sidewalk (the screen)

BrianQ and the small bright circle is the image of the sun.

BrianQ and what about the distance between the magnifying lens and the sidewalk... what is that?

doos the focal length?

BrianQ yes, the focal length...

doos I'm having a good day, aint I?

DragonStek yup

BrianQ when an object is "infinite distance" from the lens, its real image is located at a distance equal to the "focal length" of the lens

BrianQ yes, you are Doos!

BrianQ now... we can call this converging lens a "magnifying lens", and most people do...

BrianQ but... is it really magnifying?

doos more redirecting

BrianQ Let's take a look... each of you has used a magnifying lens to find the real image of a window.

BrianQ yes?

doos yes

DragonStek yes but its rainy here

doos and dark here

BrianQ well, you don't have to do it today.. you just recall what you saw!

DragonStek nok

doos nok as well

DragonStek opps ok

BrianQ now compare the height of the actual window to the height of the window in the real image... which was larger?

doos the real one

BrianQ yes...

BrianQ and compare the diameter of the sun to the diameter of the real image that lights up an ant

BrianQ Which is bigger?

BrianQ heh

doos the object

BrianQ yes, the sun...

BrianQ So if the image in both these cases tend to be smaller than the objects, why do we call it a magnifying glass?

doos because we use the virtual image

BrianQ Yes, and for us... the virtual images always look magnified

doos geez, I'm about to pad myself on the back

BrianQ yes, really good today :)

doos brb

DragonStek yes gold star but computer really slow today

BrianQ Again, most people are used to using these lenses for the virtual images they produce... not for the real image they produce.

BrianQ Well Dragon... so what are the different qualities of these images that allow us to tell them apart?

BrianQ different characteristics...

DragonStek image is bigger ?

BrianQ nope... not a defining difference

BrianQ let's start with a tree... tree is the object, with roots at bottom and leaves at top

DragonStek right side up

BrianQ with a virtual image, where will roots and leaves be? with a real image where will roots and leaves be?

DragonStek not upside down

doos sorry, mom on the phone

doos back now

BrianQ Which one?

doos mine

DragonStek virtual right side up

BrianQ oops, no.. I was asking Dragon which of the two choices she was referring to

doos lol

BrianQ virtual is right side up... and

doos left-right as left-right

DragonStek the image is not flip flopped

doos heh

DragonStek opps

BrianQ yes Doos

DragonStek computer really slow

BrianQ yes, and what about the real image?

doos flip flopped

DragonStek upside down and flip flopped

doos like that

BrianQ yes...

BrianQ so that is one characteristic we can use to distinguish between the two images

BrianQ what is another characteristic?

doos we use "flip flop" for those sandals people wear in summer

BrianQ so do we...

BrianQ hate 'em myself, for wearing... just wear the sandals.

doos hurt

BrianQ can't run in 'em.

DragonStek hehe

doos another is that real is created at back of lens (closer to eye)

BrianQ yes, real is on opposite side of lens from object and virtual is on same side of lens as object.

BrianQ that is the other distinguishing characteristic.

BrianQ Memorize those two for all time, and you can get any question referring to which image is being created.

doos will do

BrianQ Now... recall that a converging lens, we call it a magnifying glass, because the virtual image is "magnified"... larger than the object

BrianQ As it happens, a converging lens only creates a virtual image IF the object is located a distance shorter than the focal length of the lens

BrianQ and... the closer to the lens, the larger the magnification.

BrianQ So... converging lens... virtual image checklist....

BrianQ object must be within focal length of lens

BrianQ image is magnified

BrianQ image lies outside the focal length (further from lens than the object)

BrianQ image is on same side of lens as object

BrianQ image is upright and not reversed left-right

BrianQ This image is useful for depth perception... objects that are slightly separated front-back, their images look stretched even further apart.

BrianQ Now... you hold a loupe close to your eye, and you hold a gem close to the loupe...

doos ok

BrianQ Why does the gem have to be located close to the loupe?

doos small focal length

doos $e = a$ somewhere

doos uh ..

BrianQ yes, the loupe have a very small focal length

DragonStek focal length

BrianQ so... to create a virtual image, the gem (the object) has to be located within that focal length

BrianQ so... our virtual image checklist makes sense here.

doos yes it does

BrianQ and, smaller the focal length... apparently the larger the magnification... but then

also the closer to the lens the object has to be located.

BrianQ Next up, let's consider the real image made with a converging lens.

BrianQ We

BrianQ We've seen one example... with our magnifiers and our own eyes

BrianQ what about another... lens in a camera creates an image on film... what type image, and how do we know?

doos real .. look at the negative

BrianQ yes, and also because the film is acting as a "screen".... remember that real images show up on screens?

doos yes

BrianQ and also... what you take a picture of is on one side the lens (outside the camera) and the "picture" (the image) is on the other side of the lens (inside the camera)

BrianQ Defining characteristics :)

doos so a virtual image does not have a screen?

doos or can not be shown on a screen that is

BrianQ No, you can't put a screen at the position of the virtual image and "see" it appear on the screen

doos thanks

doos DragonStek and I had a heated discussion on that the other day, guess I was right

doos jk

DragonStek lol

BrianQ Now, how about the size of the "image" produced by the camera, compared to the size of the object?

doos I'll let DragonStek play now

BrianQ heh

DragonStek small in the camera

BrianQ so... image is small, object is big...

DragonStek ops yes

BrianQ Now let's consider another situation... have either of you been to that new-fangled cinema thingy, where they show "movies"?

DragonStek no

doos pron you mean?

doos no

BrianQ heh...

BrianQ I mean like "

BrianQ gone with the wind" Doos!

doos dont like clarke gable .. steals all the pretty ladies

DragonStek lol

BrianQ maybe soon no one will ever go there, since we will all have home-cinemas.

BrianQ But I just went myself a few weeks ago to see the new "Batman" movie...

doos nice ..

doos I liked the book better though

BrianQ a sucker for summer-action flix... only shows up best on the big screen

DragonStek ihate watching movies with ppl who talk during the movie

DragonStek yes i like books better too

BrianQ heh

doos :)

BrianQ so... the actual "movie" one sees is really an image... what kind of image?

doos must be a real one

BrianQ a "moving image" ;)

BrianQ but yes, a real image too... how come?

doos because it can be projected on a screen

BrianQ and it IS projected on a screen

BrianQ what was the object?

doos the little people inside the projector

doos or the film

BrianQ heh, no little people in there... they die of dehydration because of the heat

BrianQ yes, the film

DragonStek the movie, film

BrianQ Now usually the buildings in the movie appear upright, although many times

Batman himself doesn't....

BrianQ What does that imply about the film running in the movie?

doos flip flopped

DragonStek upside down and flipped

BrianQ yes... the film has to run through the projector upside down... isn't that interesting!

doos heh

doos nerd

doos sorry

BrianQ Back in the 50s, 60s, and 70s, people used to show projector slides of their vacation trips....

DragonStek lol yes i remember them

BrianQ and everyone back then knew that you had to load the slides upside down...

doos yes the 64 asa dia slides

BrianQ but that bit of knowledge is pretty much being lost nowadays.

doos still hear the teacher cursing when the carousel jammed

BrianQ now.... which is bigger, movie (image) on the screen or film (object) in the projector?

doos the image

DragonStek image

BrianQ yes... but... how does this compare with our camera example?

doos just the reverse happening?

BrianQ yes... so real image can be magnified or it can be reduced in size.

DragonStek wow yeah why

BrianQ time for a converging lens... real image checklist...

BrianQ first... image is upside down, reversed left-right from object and

BrianQ second... it is on opposite side of lens from object and...

BrianQ object can be located anywhere (inside or outside focal length of lens)

BrianQ if object is located inside focal length, the real image is outside the focal length and magnified

BrianQ if the object is located outside focal length, the real image is inside the focal length and reduced.

BrianQ As the object moves outside the focal length, further and further from the focal length...

BrianQ how does the image move (recall it is located between the focal length and lens).. does it move closer to the focal length or closer to the lens?

doos closer to the lens

DragonStek closer to the lens

BrianQ oo, first error Doos :(

doos darned

BrianQ I have said, and you can go back and read it.... if the object is really far away, where is the real image located?

doos at the focal point

BrianQ so.. the further the object is from the focal point, the closer the image moves to the focal point

doos yes

BrianQ and vice versa.... the closer the object is to the focal point, the further the image is from the focal point.

DragonStek oh ok

BrianQ Now... what if you put an object (a candle or whatever) at the focal point of the lens.... where will you have to put the screen to see the image?

doos at infinity?

BrianQ yes... an infinite distance away... so putting objects at the focal point of a lens doesn't do much to create a useful real image

BrianQ So... if you want a real image, not good to put an object at focal length....

BrianQ Oh... one last thing to add to the checklist.... if the object is inside the focal length...

BrianQ the image is magnified... (we've already said this)

doos yes

BrianQ Which way do we need to move the object to increase the magnification... toward the focal length or toward the lens?

doos towards the lens

BrianQ nope... toward the focal length....

DragonStek towards the focal length

DragonStek opps

BrianQ as object moves toward the focal length the image moves further away and gets bigger

BrianQ So... a lot of different behaviors to explore...

doos indeed

DragonStek yeah

BrianQ you guys should draw some pictures that show what is happening.

doos I'm trying to draw them in my head

BrianQ Now did you guys spend any time looking at your loupes at the virtual and real images of the same thing?

DragonStek not much crazy week

BrianQ um... like a gemstone or inclusion in a gemstone?

DragonStek ok yeah

doos brian

BrianQ You should try to see if there is a difference between the two images when you look at the same thing.

doos I did a drawing on the board

doos focal point closer to lens (blue lines, increase magnification?)

doos <http://yey.be/chat/drawboard/blackboard.html>

BrianQ not very useful drawing... I can show you how there are two light rays you can always use, but it takes some skill.

doos oh ok, maybe for next week then

BrianQ Maybe I'll post a set of diagrams on the Sunday thread to show how to locate object, image, and magnification.

doos yes that would be nice

DragonStek yeah

BrianQ But even without the drawings, you should try to picture where, for a given focal length, you place an object... where are the images?

doos at infinity

BrianQ hah, not always...

doos oh you mean real vs. virtual

BrianQ looking through a loupe at some inclusion and seeing the virtual image of the inclusion, where is that image located?

doos between object and lens

BrianQ Nope, further from the lens than the object.

BrianQ but... on the same side of the lens as the object

doos yes

BrianQ Now, looking through a loupe at some inclusion and seeing the real image of the inclusion, where is that image located?

doos between lens and eye

doos or on the back of the eye?

BrianQ Yes... really...

BrianQ It is between the lens and the eye, on the side opposite the object... but because of the eye's own lens...

BrianQ it ends up looking like it is pasted right on top of the lens itself.... weird is that

doos yes

BrianQ That is you could put a screen between the lens and the eye and see the image on the screen...

BrianQ But when you try to put your eye in as screen there is the additional complication of the eye's lens...

BrianQ Which makes it look like the image is right on the surface of the lens.... even though in reality it is another real image located on back of your eye.

BrianQ so both answers correct.

doos heh

DragonStek sorry just got a call school is closed due to tropical storm

doos hope it is not too bad

DragonStek dont know might become hurricane

BrianQ Here is a thing to try, to compare both images as you see them with the loupe...

BrianQ Find the virtual image in the loupe, and move your head left-right to use "parallax" to find if the image is located behind, on, or in front of the lens.

BrianQ Moving left... if the image is behind, it will be obscured by the left edge of the loupe.

doos yes

doos it also tilts to the left

BrianQ Moving left..if the image is on or in front, I think it will be obscured by the right edge of the loupe

BrianQ yes, Doos, behind moves left....

BrianQ which suggests that in front moves right

BrianQ and on top of doesn't move

BrianQ this is the principle of parallax to determine relative distance.

BrianQ that is... if the real image IS pasted onto the lens (by our eye's second lens) then you can't move its position one side or the other on the lens by shifting your eye.

doos I'll give that a try tomorrow in better light

doos and better brain

BrianQ Ok, that will make for an interesting result... is the real image seen by our eye really appearing ON the lens or IN FRONT of it.

BrianQ Ok, now there is another type lens, called a diverging lens...

BrianQ It doesn't create a real image, and its virtual images are smaller than the object.

BrianQ We won't spend much time on them, because they aren't used in normal microscope circumstances...

BrianQ Which brings us to the microscope... we are about ready to discuss it... what makes a microscope different from a loupe, simply speaking?

DragonStek higher magnification

doos and longer distance between eye and object

DragonStek oh ok yeah

BrianQ mm... that is something, but I mean when you look at a microscope, how is it different from looking at a loupe?

doos much larger

BrianQ Doos is sort of in the direction I'm thinking, but not quite

DragonStek deeper in depth of the object

doos the real image gets transformed to a virtual one?

BrianQ the loupe is a short tube, and the microscope is a long tube.... Yes?

doos yes

BrianQ What is the bottom thing on the microscope tube called, and what is the top thing called?

doos lens and ocular

BrianQ mm... objective lens and ocular (or eyepiece) lens

BrianQ Anything in that tube between the objective lens and the eyepiece lens?

doos a few mirrors?

BrianQ yep, but we'll ignore the mirrors

doos extra adjustable lenses

doos for focusing

BrianQ No, nothing adjustable under normal circumstance... only the eyepiece position is adjustable

doos space then?

DragonStek i dont know much on the microscope , can you tell?

BrianQ Yes, mostly empty air. Sometimes, for some microscopes there is an additional lens called a "tube lens". We'll discuss when it appears

BrianQ But the basic difference between the microscope and loupe is that a loupe is a single "compound" lens....

BrianQ many pieces of glass make it compound, but they are all stacked one right after the other, so you can think of the loupe as being a single lens

BrianQ Whereas a microscope is two (and on special circumstances, three) lenses separated by space

doos a triplet single compound lens :)

BrianQ A triplet lens is a single compound lens, yes

doos I'll remember .. fun to confuse people with

BrianQ a microscope is two sets of compound lenses, separated by a large gap.

doos yes

BrianQ So how do two lenses work.... we know one lens is used to produce an image....

BrianQ The second lens treats that image as a new object and produces a new image.

BrianQ And so next time, we'll talk about what is going on... which image is used for each, and make sure all our checklist items apply correctly

BrianQ How about that!

doos great!

doos heh, thanks

DragonStek yeah and ill read up on microscopes

DragonStek yes thanks

BrianQ So, Doos will forward this on :)

doos I will Brian, just checked and it is saved

BrianQ we'll see you guys next week, Dragon... don't let the water rise.

DragonStek good need to reread again to correct notes

BrianQ ciao ciao

doos thanks again Brian, till next week

DragonStek thanks brian have a good week