>> October 17th, 2016. This is our next to last lecture in this second half of the nervous system. This week we're covering the so called special senses, and there are many of them. But certainly the most important in terms of your day to day activity – vision and hearing. And we'll devote our focus – we'll limit our focus to those. But before we actually consider the eye, let's consider receptors in general. A receptor is a cell or a group of cells which is designed to respond to a specific environmental stimulus. Now from grade school you memorized the big five. What are the big five senses? We have vision, we have hearing, we have taste, we have smell, and we have touch right. And so those are what are called extero-senses, because they are basically stimuli which are being applied to our body from the outside world. An exteroceptor then is a receptor which is sensitive to – responsive to external stimuli, and here's the list. We have mechanoreceptors which respond to physical contact, and certainly many of these are located in the skin. We call this response a response to touch or pressure. Then we have thermoreceptors, many of these also in your skin. They respond to what? Heat, not only heat but the absence of heat. So these are your hot and cold receptors. We have chemoreceptors that respond to chemicals. And these are actually chemicals in the food that we eat, or in the air that we breathe. And naturally detecting odors and detecting tastes are basically responsibilities of chemoreceptors. Then we have photoreceptors apparently sensitive to photos. No –photo reference to light, and as far as I know the only photo receptors are located in the retina of your eye. So these are the four subcategories for exteroceptors. But are we sensitive to things that are happening inside our body, internal changes? Those receptors are called interoreceptors and there are many here, but two you need to know by name. The first are called proprioceptors, we mentioned this sense previously. Proprioception is your awareness of where your muscles are, where your joints are. Do you know for instance at this moment where your big toe is without looking? Do you have a sense of where it is? That's called proprioception and these receptors are located in skeletal muscle, and in the diarthrotic joints that are acted upon by those muscles. Then we have a type of and interoceptor which is called a visceroceptor. This responds to aches and pains, changes in viscera, changes in blood vessels, and internal organs. Have you at times had a stomach ache? Have you at times had an ache in your – I don't know in your neck or something? These would be responses to vascular or pressure changes in deep organs. Deep organs known as simply viscera. So what have we said? Two classes of receptors: Those that respond to the outside world, they're called asked exteroceptors. Those that respond to internal changes, those are called interoceptors. So let's now turn to the eye which is a precious and fascinating organ, almost a sacred organ you could say. And as we're about to see it really is the window to the outside world. The eye is known as the eyeball, also called the globe, or simply the bulb. And it's situated naturally it's protected by the orbit, and so it's fairly well protected from trauma. We can dissect the eye and we will, and we'll discover that it's divisible into three distinct layers. But before we get to those layers let's sort of describe what also is in the orbit. Are there other structures aside from the eyeball which occupy the orbital space? The

answer is yes. And the first thing that you already know about is a gland, an exocrine gland here seen. This showers moisture over the front of your eyeball 24/7, and those secretions are called tears right. What's the name of the gland that produces and secretes tears? The lacrimal glands. Are lacrimal glands periodically active or constantly active? Constantly. The moisture, the tears that are produced are not to express emotion. But rather to wash the eye, and to clean the eye, and also flush out debris which naturally gets impacted into our eye. Lacrimal glands also help minimize infection because tears are antibiotic. But you know – you should know the name of the cranial nerve that innervates the lacrimal gland. Don't want to put anybody on the spot but how many cranial nerves are there? 12. And one of them, the F word – facial innervates the lacrimal gland. And without that nerve you're not going to be secreting tears, and that would cause a dry eye. Is a dry eye a serious condition? Yes. Next also in the orbit we have six muscles which move the eyeball in every conceivable direction. These are called extrinsic and they are skeletal muscles, meaning they're voluntarily controlled. How many of the cranial nerves are involved with these extrinsic muscles? Three. And you should know the three by name – they are the oculomotor, the abducens, and the trochlear. If these are not working harmoniously then your eyes are going to be seeing different things and you're going to have a real problem. Something called double vision, also called diplopia. The extrinsic muscles. Not seen in this image but covering the eye and sealing the orbit S E A L I N G. Sealing the orbit is a thin epithelial membrane called the conjunctiva. The word conjoin means to stick or adhere or join J O I N. The conjunctiva seals the orbit, that is it covers the upper eyelid, the lower eyelid, and covers the anterior visible surface of the eye. The conjunctiva normally – normally invisible because it's so thin and transparent. Its function is not stated here but implied. What's the function of this membrane? S E A L S it seals the what? Orbit, therefore prevents infection from moving behind the eye. Is the conjunctiva sometimes a victim of infection? Can the conjunctiva itself be infected? And what's the name of that? You all know it. Pinkeye okay, but it's actually called conjunctivitis wouldn't you know. And can that be seen at a distance, that is can you tell if somebody has an infected conjunctiva? Yeah pretty easy. Are kids sent home from school because of this? Is it contagious? Yeah. And it doesn't have to be an infection it can just be an irritation. If you have a lot of dust blowing into your eye will that cause redness of your eyes, your conjunctiva? Yes. So the conjunctiva is definitely a membrane which seals the orbit and prevents contamination of the orbital space. A side view of the eyeball, here's that gland again what was that? Lacrimal gland. These are the six muscles the extrinsic skeletal muscles. Here's a view from the front which shows again the lacrimal gland, and moisture – tears are constantly raining down. Which is interesting because it brings to question the eyelid. What's the eyelid for? You thought correctly that it obviously comes down to protect the eye, but aren't you blinking all the time? You are. And what is that blinking for? It disperses the lacrimal secretions. Ever put water on your windshield, then you take a squeegee. Why do you take the squeegee? To move it over. So the eyelid is basically squeegeeing, that is moving the lacrimal secretions

down into the nasal lacrimal duct. Where of course it goes into the nasal cavity. Here's a close-up of a youngster, she have a problem? What's the name of that condition? It starts with a C, it's conjunctivitis. It's an infection or an irritation to the conjunctiva. Here's an eye removed from a cadaver. This is the front part, and these are the muscles we spoke of which attach as shown. This is the back view of the eye and I'm sure you recognize or should this nerve. What's that nerve that comes out of the back of the eye? Optic nerve – which is number two on the cranial nerve chart, and is as you know exclusively sensory. Let's move on. The white part of the eye which a lot of people call the white part of the eye, is actually known as the sclera. The word sclera is latin it means hard H A R D. And it's made of what? Dense, irregular, connective tissue. What is the protein that gives the sclera it's hardness, its strength, its white color? Collagen, so the sclera is indeed hard, thick. And it's function is to maintain the shape of the eye, to support the spherical nature of the eye. So it's a white, supportive layer. And certainly seen here from behind and in the front as well. Now on the anterior portion of the eye, which we should go back to. We see the sclera as well, but also the sclera becomes transparent for this visible circle which creates about 1/6 of the visible anterior portion of the globe. This is fully transparent, not white, it's fully what? Fully and it's also convex. The word convex means to bulge out, so it has a greater curvature than the eyeball itself. You can see and should label the sclera and the cornea in these images that you have. The word cornea also means hard H A R D. But unlike the sclera the cornea is not white, it's transparent just like a window. So it's function of course is to allow light to pass. But it's not just a window because it's not flat, it's C word what? And anything that is convex will bend B E N D will bend light. The word for bending light is not reflection, it's this word refraction. To refract means to bring light together at a focal point. And that said the cornea has the function of preliminary focus, it helps bring images into focus on the back of the eye which is the retina. If you have visual problems you might have been described as being nearsighted or farsighted. Ever heard those terms? It's because you're cornea is either too convex or not convex enough. And how do we correct for a cornea which is misshapen? What's the cheapest easiest way to correct for a misshapen cornea? Glasses. Now if you don't like glasses, or you don't think they're really stylish for you. Then you can go the extreme method which is actually laser surgery. Which will resculpture, it's called Lasik L I S I X anybody have that done? It's pretty pricey. But alright, it's Lasik surgery which actually changes the shape of what? And therefore fixes permanently nearsighted or farsighted, even something called astigmatism which you can read about in your book. The cornea. Keyword about it is it's not white it's what? Transparent. Can the cornea become opaque? Can it be scarred? Yes. If I throw acid – excuse me I wouldn't do that. But if somebody were to throw acid in your eyes could that damage your sclera? Could it damage your cornea? Which would be worse? A cornea, it'd leave you permanently blind. So this is no-nonsense – the cornea a very vital structure. It's not just a window, it's a lens because it is C word and therefore R word helps to refract light. That's the outer layer, let's now go to the middle layer. The middle layer is seen here

in black because it is. And the layer that is immediately deep to the sclera is called the choroid. The word choroid refers to something that's skin-like, indeed you heard and used that word before. What's the name of those vessels inside the ventricles of your brain? And so this is not called the choroid plexus it's simply the – It's a very vascular network of blood vessels which provides oxygen and nutrients to the sclera. The sclera's relatively avascular. And also provides blood supply – that is oxygen and nutrients to the retina which is superficial to the choroid. In other words the choroid is in between the sclera and the retina which we're about to describe. It contains ciliary vessels which provides oxygen and nutrients to the sclera. But it also contains a very large quantity of a black pigment. What's the only black pigment that we've ever mentioned in this class that is normally thought of in the skin? Not myelin, it is melanin. And the choroid is black because it's richly impregnated with melanin, and so it is jet black in color. Which raises the question why? Here's the answer. You've all been inside a movie theater right? Are the walls painted white or black? They're black. Why not white? If they were white then the light that hits the screen and bounces off would bounce off all this white surface, it would create very distracting reflections. And so the function of the choroid is to absorb light so that it doesn't back out, that is bounce around and reflect around in the back part of the eye. That said this is true for humans, but in animals that work at night i.e. dogs, cats, cows, alligators, etc. Now those that are nocturnal – you've been outside with a flashlight right? And there's that critter out there – oh it's your friendly dog. But what happens to that light? It goes in their eyes and comes right back, the eyes seem to glow right? Now why is that? Because their choroid – their choroid is different, it's not black it's shiny and so hence the reflection of that light. Apparently it allows them to see better at night but it's hard to get an interview with a dog and have any real information come out of it. Now as you follow the choroid forward and we need to go to a picture to help show that. This is an image a cross-section through the eye. So to repeat the outer layer is? The middle layer is choroid. The choroid as we go forward turns into two structures one of which is called the ciliary body. The ciliary body is a complete encirclement of this structure which we'll get to in a moment called the lens. The ciliary body is basically the anterior portion of the choroid which completely wraps around 360 degrees of the lens as you'll see. It contains muscles and has a serrated or ruffled edge to the back. This will make much more sense when? When you get into the lab and actually see it. This is very hard to convey in words. So if it's not clear it will be I hope in lab. Now we said that the ciliary body surrounds this structure which dominates the central light path of the globe. And the name of it is quite logical it is L E N S, it's the lens. The lens is not made of glass, it's not made of plastic, it's actually made of layer upon layer of epithelium and a lot of re-enforcing protein fibers. Is this opaque or transparent you think? It's transparent. What's opaque mean? Opaque means to be cloudy, and if it was cloudy you wouldn't be seeing right? So it's fully transparent, it's also a what? Avascular – no blood vessels to speak of. So obviously light passes through the lens and we can go further and say this is biconvex. Because it's convex on its anterior surface, convex on its posterior

surface. So will light be bent as it passes through the lens? What's the word for bent? Refraction. So the lens is also primarily to refract, to bring to a focus point the light which is coming through it and to it. But here's the kicker. It's not stiff, it's not plastic, it's P word what? So if you had a human lens in your hand it would feel very soft like a pillow. And that's of course a reference to this word pliability. It has the capacity to change shape, it can become tall and skinny or it can become sort of fact and bulgy. And with that affect the R word? Yes it would help refract, that is bring to focus either near or far objects. So here are the two things about the lens. Number one it's fully T word transparent. But it's also P word what? Pliable. Now what happens to those two properties in life? Does it get more pliable or less pliable? Does it get more transparent or less transparent? There you are. Nothing improves when you get old. So what if the lens becomes less transparent? That's the number one problem for people as they age. And you know the name for this syndrome, you know the name for the condition. Starts with a C – cataracts. You must know somebody with cataracts, or maybe a dog you know has cataracts. Easy to spot, very cloudy lenses. Can we fix cataracts? Yes you can't do it at home, well I guess you could try but it would probably be a mess. But you can take cataracts out. You must know somebody who's had cataract surgery. It is the most popular, the most popular and performed surgery in the world. Cataract surgery – we'll get to that later. That's because the lens has lost it's T word? Transparency. Far more insidious is the fact that it will lose its P word what's that? And therefore the lens can't change shape. The ability of the lens to change shape allows you to do something called accommodate. The word accommodation, to be able to focus near or far. We all do that right? You've got a menu in your hand and you're at a restaurant. Some people are like this, some people are like this. Now why is that? Older people are like this. Younger people are like this. My grandson's always shoving stuff in my face read this grandpa. I say whoa – put it out there I can read it right. Now when I was young I could see that but I can't anymore. Why is that? My lens has lost its? And don't laugh because it will happen to you too. My wife used to tease me. The name for this condition – which is really an insult. It's called presbyopia, which is latin for old eyes. I'm not kidding old eyes presbyopia. And so how do people compensate for presbyopia? You can go to any drugstore and you'll see glasses there, what are they called? Well no I think they're called reading glasses aren't they? Yeah you can get him for $.99 yeah it's great. And all they are is magnifiers, but they're great because they're compensating for a lens that's no longer what? Pliable. So hang on you'll get there. Surrounding the lens but anterior to it is arguably the most attractive portion of the eye. When somebody said: Oh he has dreamy eyes, they're not talking about his sclera. They're not saying: Oh that's a really nice-looking cornea there. No they're talking about what? They're talking about the iris. The word iris latin it means a rainbow, because it's very pretty in color. And of course here's your standard view. This is the what? Iris. Now lets keep in mind we're looking through and cannot even see what's in front of the iris. What's this transparent window? C word cornea. So you can't see the cornea, if you can see the cornea it's because somebody

threw acid in your face. But this is the what? Iris. Now the iris of course is colored so it's pretty enough, but that's hardly its function. The iris is attached to and acted upon by the ciliary body and the ciliary muscles. It contains two kinds of muscle. And so let's first of all realize that the iris surrounds and creates this opening. This opening which appears to be like a black spot is not a black spot, it's actually an opening. Why does it appear to be black? Well because everything behind it is dark right. If we turned all the lights off here and opened that door and you were standing outside. That space would look black only because the room is black. I'm getting off target here but this everybody knows what that's called. So let's say it together it's what? The pupil. It's not a black dot, it's actually an opening through which light passes. And the creation of the pupil is by the action of the iris. The iris is the muscle that surrounds and creates the pupil. So if this is the pupil I'm drawing a black circle. I can show muscles which extend laterally away from that center, those are called radial muscles. And then I can show a spiraled group of muscles that are the sphincter muscles that surround it like that. These two muscles change the size of the pupil, and therefore bring about the obvious changes that we know by name. When the pupil gets larger it's called? Dilation. When it gets smaller it's? Constriction. Which of these muscles would pull the pupil wider, or make the pupil wider? The radial fibers. Which would narrow it down? Those would be the sphincter or the circular ones. Are these innervated by the autonomic nervous system? Sympathetic and parasympathetic the answer is yes. And therefore what division of the autonomic nervous system controls the radial fibers? The radial fibers do what to the pupil? And what is that associated with sympathetic or parasympathetic action? Sympathetic, the fight or flight. So I'm trying to connect a lot of different information here for you. But let's get down to something very familiar. Which of these changes occurs quickly in your own experience? Do these muscles open the pupil or close the pupil quicker? Which occurs quicker? Actually it's closing. When you step outside BAM your pupils go to a pinpoint right. When you go into a theater do they dilate immediately? No they dilate gradually so at first you're sort of what? Stumbling around, because your pupil hasn't what? D word dilated. Anyway obviously these are changes that we've all seen and know about. So the iris is designed to determine and change the shape of the opening which is called the pupil. Bringing us to of course the color of the iris, which some would describe as being blue and sometimes brown. But the color is due to a pigment which you can see here in this close-up. Again that brown pigment which may or may not be there. What's the name of that brown pigment? Melanin. If you have melanin in your iris, what color is your iris? Brown. If you don't what color is your iris? Blue. There is no blue pigment, it's just the absence of what pigment? Is there blue pigment in the sky? No. Why does it appear blue? It's just an optical illusion. Is there fluid out front of the eye here? Yes we're about to describe it. So blue is actually an optical illusion, there is no blue eyes, there's just the absence of what? Absence of melanin. Now that's an interesting question because what was the function of melanin in the skin or anywhere else? Function of melanin was to absorb ultraviolet light. Would

it do that here as well? Yes. And what's behind the iris which is deserving of shielding from ultraviolet light? What is this yellow thing? It's not really yellow, the lens. Can the lens be damaged by ultraviolet light? Absolutely. And what is the damage called? [whispers] We gave that earlier. C word. Cataracts. So with all that information who would get cataracts sooner blue-eyed people or brown eyed people? Because they lack what the M word? And therefore don't have as much shielding from ultraviolet light. Today do we have ways to screen ultraviolet light? Sure we have shades called what? Ray-Ban whatever okay. Iris. Actually and interestingly the pattern of muscle in the iris is so unique from person to person that it's now used to screen people. Maybe you've seen this. They're vetting Syrian refugees not by their fingerprints but by what their? Iris. We can take pictures of their iris and therefore distinguish people. Because your iris very different from anybody else on the planet. Are there devices which screen that for security reasons? Yeah. So it's a state-of-the-art it's a pretty cool thing. I'm sorry?

>> What about twins?

>> What about twins, the answer is they have different irises. Just as they have different fingerprints. So you think oh twins are the same, well almost the same. Good question though. The iris may be may be pigmented with what? And if it is what color are your iris? If not? You say well what about hazel? Well what about hazel? Hazel is just a little bit of brown, not so much brown right. In other words you can have degrees of brownness. Alright the inner layer. The inner layer is where the action is. And the inner layer is right on top of the choroid, and this is the most delicate of the layers. Dominated by mainly represented by what's called the retina. Everybody's heard the term retina, if not retina. Alright it's the photo receptive layer. Where else will you have photoreceptors I guess. What's a photoreceptor? Do photoreceptors react to sound? No. Do they react to light? Yeah. And you have two basic kinds of photoreceptors. Maybe even read about this – the rods which are rod shaped, the cones which are cone shaped. The cones react to colors different wavelengths, that is the red the blues and the greens RGB. The rods don't react to color, they react to light or the absence of light. Therefore they give you night vision. With that said which of these receptors is most sensitive to light – rods or cones? The rods, because what vision do you lose at night? Color vision which is cones. So read more about these they are embedded in the retina. The retina is actually red in color coincidentally. And that's because of its rich blood supply it turns out. You've all seen the retina, yes you have. Because you've all taken flash photos of people right. And then you look at them and say: Well they've got pinkeye here, what's going on? The red or actually that flash went in their pupil and lit up the back of their eye, and what you're seeing is the retina which is what color? Red alright. So that red spot that you're disturbed by with those photos – actually just photographing the retina. So the retina is important because of the photoreceptors, and the most important part of the retina is a position called the macula lutea. Now you should study this picture in your book, if you don't have a book borrow one. But this is

the pathway of light that's going through the eye. And what structures does it encounter from front to back? We've already mentioned the first membrane not even shown here – well I guess it is, the conjunctiva. Then it's going to go through the C word cornea. Then it's going to go through nothing which is the pupil. Then it's going to go through the L word what? Lens. And finally it's going to work its way back here and impact on the retina. Specifically the macula lutea, macula – macula means spot S P O T lutea means yellow. So it translates to yellow spot. Which is the most cone sensitive, cone concentrated area of the eye. Especially in the center of the macula which is called the central fovea, fovea you know means pit. Now this may make no sense to you right now but I know if you watch enough TV and who doesn't? There's a condition called macular degeneration which you've heard about on TV. Macular degeneration is just that, degeneration of the macula. And that will leave you blind, that is you'll have black spots in your visual field. And it's ultimately going to lead to permanent blindness, macular degeneration. So here's a bit about cataract surgery which we mentioned. Actually can animals get cataracts? Yeah. That was a picture of an elephant being operated on so I don't have time. Obviously this is what? I word iris. This is the P word? This is a hole H O L E. There are two types of smooth muscle in here what are they? They are the radial and circular, they determine the size of the pupil. Does this got any melanin in it? Yeah well it does. Right here. But from a distance it would look like what color eyes? Green yeah so it's not exactly Brad Pitt but okay. Now here's from the inside out. This is neat how did they get that photo? Very tiny cameras. But obviously this is what? Maybe not obvious pupil, and this is the iris. This is how the retina sees the outside world. Of course the pupil can change sizes, we talked about that. This is bright light, this is dim light, and this is a function of the autonomic nervous system right. To repeat sympathetic does what? D word dilate. Parasympathetic C word constrict. Now why is this important? To allow more or less light into the eye. You're always admonished not to look at the sun directly right? But there's stupid people that do anyway. Oh look at the sun. And even though the pupil gets very small you can do permanent damage to the R word, permanent damage to what? The retina. So again don't do that. Now when you go get an eye exam they'll say: Hey do you want a picture of your retina for an extra charge? I said sure how much is it? $20 bucks okay sure I want that picture. So I walked out with this thing. This is a picture of my retina back in 06. Pretty nice retina if I do say so myself. Well what makes it – first of all why is it red? Blood vessels okay. Now there's two spots on the retina that are muy importante. This spot which is not so much, and this spot which is very much. This is called the macular lutea, this is where most of the light naturally and normally is directed. Notice there aren't any blood vessels crossing over that spot. This spot incidentally is called the optic disc. Which is in fact totally useless. Because there is no photo receptors here at all. If we looked on the backside of this we would find that's where the optic nerve exits. And so all of the nerve fibers are coming out of the eye through and at this spot, which is called the optic disc. If light however is directed here what would you see? If the light were ever directed there are there are any

photoreceptors there? No. What would you see? Nothing. And so what's the name for that? What's the functional name for that? Blind spot, literally it is a blind spot. And you can find that through various tests and one of them is in your lab manual. But normally light is directed here. So the optic disc is the area functionally known as the blind spot. It is devoid, whats that mean devoid? Has no rods and has no cones. Therefore no photoreceptors hence the blind spot. They optic nerve comes right out of the blind spot, and is of course the second cranial nerve. Is it sensory, motor, or mixed? Sensory 100% sensory 5 million sensory axons coming out. And remember the whiter the eye – what was the white of the eyeball called that outer S word it was the? Notice that the sclera if you look at this illustration actually comes off the eye and becomes the outer covering of what is then the optic nerve. And as it turns out of this sclera in this location is continuous with the dura. The dura – the dura what? The dura mater. So if you start piecing all this together the sclera is really part of the dura. And so with that said the eye is really I next engine an extension of your brain. The sclera is really the dura mater which is coming out this far. Made of dense, irregular, connective issue. And if there is dura here would there be arachnoid right up to the back of the eye? Yes. Would there be pia? Yes there is. Would there be CSF right up to the back of the eye? Yes there would be. And what is that condition where too much CFS – I said it wrong. Too much cerebral spinal fluid is in your cranium or central nervous system? That condition's called hydrocephalus. Would that press right up against the back of the eye? Yes. Now here's a picture of somebody's retina which is not as nice as mine. And is this bulging out here? Yes it is. And that bulge is the retina which is being pushed from behind by fluid, what fluid? Which is in high pressure because of hydrocephalus. So hydrocephalus is easy to diagnose by looking at somebody's retina. If you see that wooooo you've got obviously hydrocephalus. Now occasionally you'll hear about diabetic retinopathy. Ever heard of that? Diabetic retinopathy you just did. And that's because diabetics have trouble with blood vessels, see that right there? Blood loss, and that can lead to blindness. So retinopathy meaning disease of the retina is very common in diabetics. Moving along. The fluids of the eye. We've got just enough time to get it in here. Essentially and importantly there are two isolated spaces in the eye. Everything in front of the lens and obviously everything what? Behind the lens. These are filled with very different fluids. Everything in front of the lens fills the space called the anterior segment, also known as the anterior cavity – anterior cavity. We are going to call it the anterior segment. It's defined as everything in front of the lens. Which includes everything behind the iris and everything in front of the iris. This is confusing I know but this is what? Lens, what's this thing here? Iris. Is there a space behind the iris but in front of the lens? Yes it's called the posterior chamber. Is there something out front of the iris but behind the cornea? Yes that's called the anterior what? The anterior chamber plus the posterior chamber make up the anterior cavity a.k.a. the anterior segment. Okay I know this is confusing but you'll get it. Anyway what fills this space is called the aqueous humor. Humor is not anything to do with comedy, humor refers to a substance. Aqueous refers to something that's

watery – the aqueous humor. Which incidentally is produced 24/7 by the ciliary body which is this segment right here. And specifically the medial extensions of it called the ciliary processes. The function of aqueous humor is right here. The function of the aqueous humor is maintains the shape, the proper curvature of what? What is this big window out front here that so important C word? Maintains the shape of the cornea. The what? The aqueous humor. We're going to talk about this because it's produced 24/7. If it's produced it has to be absorbed and it is absorbed at this gutter which runs circumferentially at the perimeter where the iris joins the cornea. This gutter G U T T E R is called the canal of Schlemm, I don't make this up. Guess who discovered it? I'm going to go with Schlemm okay. And the function of this canal is to drain aqueous humor. Without this the fluid would build and therefore the cornea would literally what? Bulge. And would that change its shape? Would that change its affect on light? You bet. You've all had eye exams, or maybe one or two that never did. So you go to the eye guy, the eye woman, whoever the eye person is. What are they called? Op – they could be called optometrists, they could be ophthalmologists. One you pay more for, one you pay less for. Anyway they're going to give you the eye exam blah blah blah. They're going to see if you need glasses, that's all cornea related. But another test that you had is a pressure check right? You sat in front of this thing, you put your chin on this thing, and there's a little puff of air that goes Puuuuh and you react to it right. It doesn't actually do that, but how many of you have had that done? Alright so you know what I'm talking about. And that little puff of air is going up against your cornea and then it's going back into the machine. And the quicker it returns means what about the cornea? Think about it. If the cornea is tight then that's going to go. If the cornea is loose it's going to go. And so the speed at which it returns can be calculated and that's an indication of the pressure. Pressure of what? Pressure of this fluid which is called the aqueous humor. And why do we care? If that pressure is too high then that pressure is going to be telegraphed back into the posterior part of the eye, and it's going to crush your retina. And that's a condition that you know, you also heard this I think. What's the name of that condition that's a result of too much pressure in the eye? Starts with a G – Glaucoma good. And glaucoma can cause blindness and you've all been tested for glaucoma apparently. Because many of you rose your hand when I said have you ever have that puff of air in your cornea. Now everything behind the lens is filled with something totally different. It's transparent of course and speaking of that why would both these fluids need to be transparent? Is light going to go through there? We hope so. Alright so the aqueous is liquid that is water-like. The vitreous – the word vitreous means jelly or glassy. Because as you'll see in lab when you cut into the posterior segment this is going to come out like a big glob of hair gel. You all know what hair gel is. Because it is G E L it's gel-like, it's not aqueous. And the vitreous humor which fills the posterior segment, is a glassy compound produced only once. And is designed there to support the sclera, the eye in general. But also to support the retina. This is pretty important because the retina could be compared I suppose to this pink sheet of paper right? And

what's the white sheet of paper which is the outer part of the eye? That's the sclera. But we need to have a choroid in there so okay I'll put a choroid in there. Now the retina is held up against here by the pressure of the V word what the? Vitreous. If the vitreous would be lost then what would happen to the retina? It would basically do that. And what do you call that when the retina does that? It's called a detached retina. Have you ever heard of that? Detached retina you just heard of it. Used that joke too many times. But are there people who actually get paid to be punched in the face? Yes, they get paid well we hope. And what are the occupational hazards of being punched in the face a lot? Never mind concussion that too, but detached retina. And what does that look like to the person who has a detached retina?

>> Nothing.

>> Exactly it looks like absolutely nothing. It's described as: I was watching a movie and suddenly it went black right there, because the retina just went phtew like that. Can this be fixed? Yes. Does it cost a lot of money? Yes, but again you got paid to do that so okay. A lot said today. This is an introduction but hopefully gets you oriented to at least some of the terms and relationships of your eyes.