Adventures in Optics: A Contact Lens is Born

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Course Description: (2 hours)

This course will look at the origins of contact lens development, manufacture, modalities, patient selection, instrumentation, and contact lens fitting. We will travel through time to discover the thought processes and technological advancements that produce today's contact lenses. In this story, we will focus on the history and development of contact lenses. In subsequent stories, we will progress to specialty soft contact lenses and eventually hard and specialty hard contact lenses. I hope you will enjoy this new approach to learning.

Instructional Objective

Upon the conclusion of this course the student will be able to:

Draw a timeline of contact lens development

List types of soft contact lens materials

Describe how soft lenses are manufactured

Describe contact lens shape and design

Describe available modalities

Discuss lens physiology in relationship to the eye

Describe the instrumentation needed for contact lens fitting

Discuss insertion and removal of soft contact lenses

Describe the care and handling of soft contact lenses

She is running, running fast, but he is right behind her. It's hot and there are people all around. You could smell the brine of the ocean and taste the salt in the air. I am stuck in my apartment and all I can do is watch. Maybe I can play on the boardwalk in a few days. On Tuesday, I will leave my self-imposed temple of solitude and sit for my ABO and NCLE. My brain is awash of information. I love fashion, I love color, and I love to talk. On career day, I met an Optician who said my passions and opticianry were a perfect match. He never told me about the math. Now, three years later, I sit, my brain filled with information. I find myself dreaming about anatomy and physiology, refraction, dispensing, contact lenses, and geometric optics.

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Why am I wearing this funny hat and shirt with puffy sleeves? I look around and nothing looks familiar. A man with a grey beard hands me a broom and tells me to sweep. Sweep what, I think, the floor is all dirt. To be honest the place smells. There are marble chips on the floor and there is a half-painted picture of a woman with a crooked smile on an easel in the corner. On what must be the worktable, there are letters, books, a feather pen, and a big bowl of water. The letters are addressed to Leo da Vinci and dated 1508. He must be the old man. Leo must be a serious writer because he has a series of books called Codex on the shelf. There is Codex Atlanticus, Codex Madrid, Codex Leicester, Codex Forster. Sitting on the adjacent table must be his latest work Codex D, Codex of the Eye. He sees me snooping and sits down next to me. He is wearing flowing clothes synched together with a leather belt. On the belt in the pouch are some paint brushes and what looks like a knife or chisel. Whatever it is, it has a sharp edge. Leo orders me to stick my face in the bowl. The water is not inviting but Leo does not look friendly and he has that sharp implement close at hand. I put my face in the bowl. He shouts, open your eyes and tell me what you see. Can you see better under the water? As I lift my head from the bowl, Leo tosses me a paint stained rag and explains his theory. The water surrounding my eye should have neutralized any corneal visual anomaly, creating better vision. I can hear him speak but the neurotic side of me is still thinking about the dirty water. Acanthamoeba keratitis that was the name that kept floating through my head. The infection caused by the microscopic, free-living amoeba that can live in contaminated water. Maybe Leo should be researching that. By the time I take a couple of deep breaths to calm down, Leo is next to the window painting a picture of a bunch of people sitting at a table.

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The smell is amazing. If I was right, or better yet if my stomach was correct, there must be a bakery nearby. Thoughts of croissants, baguettes, and eclairs are rolling through my head. Rene calls to me as if he is my best friend. Yes, Mr. Descartes, I'm coming. My head is pounding. Rene is a math genius. It's only 1621 and he just developed the techniques that make something called algebraic or analytic geometry possible. He and his friend Snell were working on what they named the "sine law of refraction" Anytime I think of his friend Snell (n1sin incident = n2 sin refraction) runs like a tickertape through my head.

Ben stop daydreaming he said. I have a job for you. Run into the house and get the hydrodiascope.

The what?

The glass tube on the work bench.

He filled the tube with water and told me to look through it. He must have read Leo's book because his theory was similar. The elimination of corneal power by a fluid, then by the coverage of this fluid negated the corneal surface and the end of the tube would be a new optical surface. Sounds good I said, but who is going to walk around holding two tubes of water in front of their eyes.

He retorted; you must be hungry because you are being silly. The same effect might be obtained by placing a solid tube filled with a single lens or lenses or "other transparent bodies" just in front of the eye.

This was getting deep, too deep, but in France do as the French do. Rene where is your wine cellar?

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There is nothing more relaxing than looking at the stars on a clear night. John Herschel is lucky. His father has an observatory. Inside is a 40-foot telescope. John is regaling me with stories of the heavens and telling me that one day man would visit the planets. I am thinking he is a day late and a dollar short, but I guess in 1827 he iss on the right track. He loves optics and the telescope. He is

enamored by the lenses and mirrors that make it work. He is an avid reader about science. His favorite researchers were Thomas Young and G. B. Airy. Young had written about his research regarding accommodation and the cornea and Airy had written about the correction of corneal astigmatism with spectacle lenses. This theory helped him develop his theory of contact lenses. Contact lenses was another passion of Johns.

Ben do you want to see something cool. Come with me.

There is an old creepy building at the end of the walkway. As he opened the door, I had to wonder whether it was Halloween. Inside there is a big table. The table is overflowing with jars labeled with the names of animals. All the jars are filled with some type of gooey substance.

Ben pick up a jar and shake it.

I don't think so.
He picked one up and shook it, then held it up to the big candle that lit the room.

My goal is to find a clear animal jelly and slather it between a person's eye and a lens that fits on the eye to make them see clearer. Better yet, if I take a mold of a person's eye, I could design a lens to fit.

Good luck finding a volunteer I thought. I am sure the goo smells as good as it looks. Take Jell-O off my shopping list.

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Guten Abend. Mochtest du ein Bier.

I didn't know what he was saying but I recognized the golden-brown liquid with the foam on the top. Thanks. My name is Ben and yours?

I am August Muller, but my friends call me F.E. I am on the way to my shop if you tag along, I'll freshen up your drink.

Sounds like a plan. I walked into the shop and a hundred eyes were on me. It was an eerie feeling to be stared at by so many unblinking eyes.

I am sorry, I should have told you I am a glass blower. I make prosthetic eyes. If you come to the lab, I will show you my latest work. It is called it the Wiesbaden Lens. There is a poor man that has lost one eye and his eyelids to cancer. I was asked by Dr. Saemish to develop a lens to protect his other eye. I made this thin shell by blowing some clear glass. The lens does not have any power, but it should help keep the eye from drying out. I have some colleagues that are working on these types of lenses that are curved to provide power to the eye. People are going to find that 1888 is the year of the contact lens. If you want to take a road trip, we can visit A. Eugen Fick in Switzerland and Edouard Kalt in Paris. Kalt is developing a glass shell for keratoconus patients using a device called an Ophthalmometer. The Ophthalmometer was invented by Hermann von Helmholtz. This device can measure the curves of the eye. Fick is using it too, but he is designing 2 types of lenses. The first is a glass lenses that is small and rests on the cornea and the second is a large one that rests on the sclera. Ernst Abbe from Carl Zeiss grinds some of the lenses for them. I am sure whatever he is paying he is getting a good value. He is calling the lenses Haptic or Scleral. I don't think marketing is his forte. So, road trip it is? Grab your coat, my new Benz Motorwagen goes 10 mph and it gets breezy. We should be back in a few months.

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"Sucker" …. Excuse Me! ….. Sucker, what do you think of the name? The Carl Zeiss company and the Muller company are manufacturing contact lenses that fit over the eye. The Zeiss Company is making lathe cut lenses from molds. The Muller company is making their shells from blown glass. These guys are really going at it. I hear the Muller companies' lens is more comfortable, but the Zeiss companies lens has better optics. Either way they need something to remove the lens from the eye. I made this thing out of rubber that fits on the outside of the contact lens. I was thinking of calling it the "Sucker".

Mr. Sigrist, I said, even in 1912 that is not a very nice word. Why don't you call it a plunger?

I am also thinking you should put a hole from the shaft to the base to release the suction in case the user misses the contact lens.

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As usual I am starving. Best rule of thumb; eat when you can, you never know when the opportunity will present itself again. There is a long line in front of a restaurant call Chasen's. It must be good. I see a couple getting up from a table and grab it before anybody notices. An open table and a free newspaper. Must be my lucky day. Wow, this guy must be fast. The newspaper reports he won four gold medals, one in the 100-meter race, one in the long jump, one in the 200-meter race, and one in the 4x100 meter race.

Excuse me, can I share your table. It is mobbed in here today. Name is Dr. Fienbloom. Please call me Bill. I saw the headline earlier. It is amazing what that Owens accomplished over there in Germany. With that crazy guy in charge it looks like trouble is brewing.

What kind of Doctor are you?

I am an Optometrist. I am currently working on a special material to be used for contact lenses. It is called poly methyl methacrylate. PMMA for short. They developed the material a while ago, but it is now thought the material might have uses in the medical community. It seems that the U.S. Army Air Corps have been using it for the canopies on their planes. Airplane pilots whose eye were damaged by flying debris of PMMA coped much better than those injured by regular glass. I am trying to prove that there is increased compatibility between human tissue and PMMA as compared to glass. If I can develop a contact lens that is glass in the middle and PMMA on the outside I think I can achieve both good comfort and vision. I am also working on a contact lens that you can see both distance and reading. It is just like bifocal glasses.

I keep finding these guys that only want to talk science. Must be a very intense life. I need to lighten the air. So, how about those Yankees?

You must be from New York. When are you going back? I have a friend Teddy in New York who is working on contact lenses also. When you get back, visit him, his address is 209 East 56th Street.

Pizza, bagels, and that new building that opened a few years ago. I hear that the Empire State building is the tallest in the world and if you go to the top you might be able to hitch a ride on those flying things called dirigibles. Maybe it is time for me to go home.

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Hey buddy get out of my way. Move. Watch where you're going. People were shouting at me. Some can't think of more than four letters to string together. I think to myself, with a smile on my face, I'm home.

The new building called the Empire State Building is at 34th Street and 5th Avenue. Taking a tour would be a good way to spend some time.
That building is amazing. Hard to believe they finished it in little over a year. It is still sunny, and Penn Station is not too far. I can hop on the subway and spend the rest of the afternoon at Central Park. Why would anybody live anyplace else? Playgrounds for the kids, buggy rides, food. I love New York. I will take the East 58th Street exit from the park towards the East River. I think I will be walking close to Bill's friend Theodore Obrig's place. I have time for a quick visit.

When I walked in, the place was dark. I saw a weird blue light shining in the back room. Entering the back room, I saw a man I assumed was Teddy. He was holding up a magnifying glass that projected blue light in front of a woman's face. Her eyes were glowing a greenish color. Was she a superhero? Maybe a mix between the Green Hornet and Superman. Either way, a good time to go.

Who's there?

Teddy turns around.

Too late to make my escape. Greetings. My name is Ben. Your friend from California, Bill said I should pass by if I was in the neighborhood.

You have great timing. Bill would be excited to see this. After this young lady put her contact lenses in, I instilled a few drops of a chemical called Fluorescein. When I shine this Ultraviolet Light into her eyes the chemical glows a green color. The green is her tears. I can evaluate the fit of the contact using this method. The contact lens I use is made from a material called PMMA. Bill uses glass and PMMA, but he can still evaluate using this method. I have been working with Ernest Mullen from Worcester on the project. We use the method of taking eye impressions developed by Joseph Dallos. We cast the individual's eyes then we use a heated, softened plastic to mold over the cast. This is the best way to obtain a lens to fit the eye. There is still a large gap between the cornea and the back of the contact lens. I am postulating the use of some type of liquid between the eye

and the lens to solve this problem. We must make sure that the eye gets oxygen. The studies show that no oxygen can get through the PMMA. I wanted to discuss this with Ernest, but he is still angry over the "Babe". How he blames me for the Curse of the Bambino is beyond me.
I recently hired a new guy, Kevin Touhy, he might be able to help solve the issue.

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You're a thief and a scoundrel. After all I have done for you, this is how you treat me. Contract, contract. When I trust a man, I don't need a contract. Go to California. Get out of my office before I do something, I am not proud of.

I grabbed Kevin's arm and pulled him out of the office before things got any worse.

Wow that was intense muttered Kevin. World War II just ended, and I feel like World War III was about to start.

What did you expect? He taught you everything you know. You started in manufacturing and were promoted to fitting. He counted on you. Now you are leaving him to become partners with Braff and Villagran at Solex Laboratories. How would you feel?

Yes, but I did not feel he was going in the right direction. I think a contact lens should be much smaller. It should have a smaller diameter than the cornea.

As he is talking, his voice fades into the background. Pictures, diagrams, and initials are flashing in my head. OAD, OZ, OZD, BC, PCW, PCR, SPCW, SPCR. The initials are written on what looks like an archery target. Overall diameter, optic zone diameter, optic zone diameter width, base curve, peripheral curve width and radius and secondary peripheral curve width and diameter.

……And besides a smaller diameter the inside curve which I will call the base curve should be flatter than the flattest curve of the central cornea. I also think the lens should be thin .3mm should do it. We must think fit and oxygen. The body needs oxygen.

I sure needed oxygen. It was getting stuffy in here. Kevin, I am going down to the ocean to get some fresh air. I might visit the port to watch the ships. Do you want to tag along?

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The staterooms were plush and the furnishing elegant. Dr. Bier was amazed at the transformation. Not too long ago the RMS Queen Elizabeth was shuttling troops and out running U-boats. Now he was taking a leisurely trip to New York.

I was sitting on the boat deck with a 1947 Hermitage in a snifter.

This Aladino Elegante will pair perfectly with your brandy. May I offer you one? This is my first trip to the United States. The ship docks in New York and I am looking forward to the adventure. Have you ever been to New York?

Literally, it seems like just a few hours ago, I replied. I am sorry, what were you saying.

I am going to meet with colleagues to discuss my favorite topic. I even started writing a book titled Contact Lens Routine & Practice. I am overly concerned about corneal edema. Swelling of the cornea is a big issue. This can happen when there is not enough oxygen passing through to the eye. My first idea was to drill small holes in the periphery of the contact lens. It is called fenestration. More oxygen got through, but it stopped the lens from rotating. Not the optimal solution I was looking for. The idea I want to bounce off my colleagues is what I call a tear pump. If I designed a corneal lens that had very little tear fluid between the lens and the eye, and if the lens had the correct center thickness, it would flex slightly each time a patient blinked. After each blink, the old tears would exchange for new tears. The new tears would bring fresh oxygen to the cornea eliminating the edema. What do you think of that idea?

Sounds good. I know a guy in New York, Theodore Obrig. You should talk to him.

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Why is everybody whispering?

The Ninth-of-May Constitution just passed. We are officially a communist nation. If President Gottwald's people hear us, we can be put in prison. We are now the People's Republic of Czechoslovakia. I hope they let me continue my work.

Otto, calm down, I said. I am sure that they would not stop the famous Dr. Wichterle from doing his work. Whether you get to keep it is another story. If they find out, I would think it will become the property of the state. What are you working on?

I am sure you have heard of PMMA. I am developing a plastic material that will simulate living tissue that might be used for orbital implants. My partner Drahoslav Lim thinks the material can be used for contact lenses. I can see his point. The material hydroxyethyl methacryate, HEMA for short, is a hydrogel. Hydrogels absorb relatively large quantities of water. This material can absorb 30% to 85% by weight and become soft and flexible. The trick will be to transform the material to be a viable contact lens. The issues would be to correct power and comfort.

I want to contact John de Carle in London. He is developing a bifocal contact lens with something called concentric rings. He must have the power questions solved. I also hear that Walter Becker from Pittsburgh is working on a silicone elastomer material for his soft contact. That silicone material might allow more oxygen through it, be durable and be more stable, but it is hydrophobic. If you are inserting a device in you eye, one would think that you would want it to absorb liquid not repel it. Hydrophilic is the way to go. His silicone hydrogel material will be a bust. I understand Joe Breger is thinking about buying the patent. They both will lose their shirts.

Sounds like your material is better, but you have some issues. How long do you think it will take you to solve the problems?

My team will be working hard. Christmas is just a few months away. Why don't you join us for Christmas dinner? You can see how far we have gotten.

Merry Christmas Otto. Thank you for inviting me. The house looks festive and the children must be excited. I have never seen so many presents under a tree.

My wife Linda and I love this holiday. She has been in the kitchen all day long. I hope you have not eaten. I want you to see the golden piglet.

Otto, that is certainly a strange pet. Back home we have a dog or cat.

Don't be silly the golden piglet is not a pet. According to Czech tradition if you fast throughout Christmas Eve day, only eating soup, you will see the golden piglet. It is said if you see the piglet you will have good luck. If you think that is unusual, come with me to the bathroom.

How much weirder could things get. I shook my head as I followed Otto into the bathroom. There it was. A big fish swimming in the bathtub. I remembered when I was in the Ukraine a few years ago during Christmas. They decorate their homes with spider webs. Fake webs and fake spiders. No arachnophobia there. If you had a case of Ichthyophobia you would have an issue in this house.

We are going to fry this carp for dinner. I will give you one of the scales. If you dry it and put it in your wallet you will have good luck and good fortune next year. Linda says dinner is ready. Let's sit down to eat. Afterwards we can watch the kids open their presents.

That was a wonderful dinner. I want to thank you both. Otto, we have not had a chance to talk about your soft material contact lens. Have you made any progress?

Join me in the kitchen for a plum brandy and we can talk. I am sorry my son left his Merkur on the table. In America you might call it an erector set. To answer your question, we have not yet designed a method to convert the material into a contact lens. I was thinking we would need to spin the material to make it work. Let me show you what I mean. I can use the Merkur and the bicycle dynamo I bought the kids for Christmas. Grab me that mold of the eye and the glass tubing please.

Linda come here and try this on. I think I did it. Thank goodness for the golden piglet. My lens is comfortable. It seems your is also. It looks like I solved the comfort issue. Now I must solve the prescription or power issue.

This is amazing Otto. You have invented a soft contact lens. Don't forget to patent the idea. In a few months, you will be making thousands of lenses.

I agree. I will have to increase the number of spindles to increase output. Unfortunately, this motor is not strong enough. If Linda doesn't catch me, I am going to use the motor from her gramophone.

Pollack, Feldman, and Morrison from the NPDC are looking at buying the patent. If I design the unit to produce more lenses, I should get a good price. I hear Morrison is not happy with the company. He is the only Doctor in the group. The others are lawyers. Not a good mix. Pollack is also thinking of leaving and joining International Hyron Corporation. I hope it doesn't affect the sale.

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What a rube. That guy in Czechoslovakia didn't know what he had. The National Patent Development Corporation is on its way. Money and success are our next stop. Now, all we must do is find a company to sublicense the technology. They develop it, they market it, they accept liability for it, and we get the money for it. 1966 is a good year. Ben have you ever heard of a company called Bausch and Lomb?

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I hate the cold. I love the seasons. As you know, I love New York. The real New York. When you leave the city and the land is no longer flat, it really isn't New York. As I stare at the intersection of Interstate 490 and Interstate 590, I know I am in Rochester New York. Some people call it North Canada. Some people call it the lens capital of the world. Otto suggested I stop by and meet William McQuilken. William is the new president of Bausch and Lomb and he is developing the soft contact lens material.

Good to see you Ben. Otto mentioned you would be stopping by. We are having a devil of a time developing the soft contact lens. We invested over 3 million dollars. The researchers think we are almost there. Unfortunately, we are getting some push back from the FDA. They want to classify the contact lens as a drug. If they do, and you know 1968 is the year of big brother watching, we will be bogged down in red tape before we can release the lens. If you want to hang around for a bit, you can try the final product.

Sounds like a plan. I would not mind seeing the new lens in action. Buffalo is only an hour away. Do you want to join me at the Anchor Bar? I understand they have a new thing called a spicy chicken wing. People have been raving about it.

Those wings were great. But, standing in line for 3 years was a bit much. I am glad the FDA has finally approved the lens and we can begin marketing. We project we will sell 100,000 lenses this year. We are calling it Soflens. The HEMA material is 38% water. We are hoping this will allow for enough oxygen exchange and reduce edema. The researchers are predicting that it has a DK of 8.4. The DK is a measure of the oxygen permeability of contact lenses it indicates how much oxygen is passing through the material under certain conditions. The futurists in the company envision a soft lens that one day will have a DK of 160. If the DK of the lens can be increased, you might be able to sleep in the contact lens. We are toying with decreasing the thickness of our lens to achieve more oxygen transmissibility. If we make it work, we will call the lens O for oxygen and market it as an extended wear lens. But I digress, as I was saying:
The lens is so thin and pliable that it drapes and conforms to the cornea. If the cornea is not spherical, we have noticed that vision while wearing the contact lens will not be totally corrected. It will be important for the practitioner to select their patients carefully.
Let's pop one of these vials open and you can try it on. It is a little tricky getting the lens out. The rubber stopper is sealed to the vial and then we clamp a metal cap to the vial for further protection. Don't cut your finger on the top and make sure to pour the lens out into your hand.

William, this lens is so thin and bigger than I thought it would be. How can a person get it into the eye?

We have developed 2 lenses we named B3 and B4 the B3 has a diameter of 13.5mm and the B4 has a diameter of 14.5mm. Because the curve is the same the 2 lenses fit slightly different. The bigger lens will be looser. We can talk about fit later. Let's get that puppy in your eye.
The first step is to make sure the lens is open on your fingertip. It should have the shape of a bowl. Like you are looking into an empty bowl of soup. If the lens looks like a saucer it is incorrect, you must turn it inside out. Take a good look at the edges. Make sure there are no tears or cracks. Take the mirror and move it in front of you. To insert the right lens, put the lens on the pointer finger of your right hand with the bowl open towards you, hold the upper lid of your right eye with your left hand, use the ring finger on your right hand to hold the lower lid of the right eye and slowly put the lens in your eye. Make sure not to blink. To put the left lens in, reverse your hands and follow the same procedure.

That seems like a whole bunch of work. Why can't I just hold my eye open and shove the lens in before I blink.

Ben, you can't beat your blink. The human blink lasts only 100 milliseconds. That is the same as a tenth of a second. You would not even get the contact lens halfway to your eye before you blink.

Ok, before I put this thing in how do I get it out?

Easy as pie.
It sounds funny but the most important thing to do before taking the lens out is to make sure it is in. Sometimes these lenses pop out. Some of our study participants never realized their lens was out when they attempted the removal process. This caused corneal abrasions and discomfort. In your case it is easy to tell if the lens is in your eye. If your lens is in and you cover the other eye you should be able to see. You could also look in the mirror. You should see the edge of the contact lens around the colored portion of your eye. We call that part of the eye the iris. This lens is clear so it might be difficult to see. In the future we will put a slight color in the contact lens to make it more visible. Once you are sure the lens is in. Use your hand to open your eyes the same way you did when you put the lens in. Put your pointer finger directly on the contact lens. Drag the lens toward your ear and slightly down. The lens should slightly crinkle. Take your thumb and pointer finger and pinch the lens out.

As we said before, the contact lens is 38% water. When you take the lens out be sure to put it in the case with saline solution. If you leave the lens on the counter or put it in the case without solution, it will dry up. It will look like a clear cornflake. Be fastidious, these things cost too much to replace. The lenses should last at least a year.

We should make some good money from these lenses American Optical is developing a lens, but we don't think it will be ready and approved before 1973. The accountants believe by that time 350,000 people around the world will have bought our lenses.

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Hurry up and wait. I never thought I would wait this long just to fill the tank. The salesman should have told me how much gas this car drinks. To be honest how many miles per gallon did I think I would get from a GTO, affectionately named a Goat, with a 400CID V8. Curse OPEC. Rochester to Massachusetts in 340 miles at 11 mpg I will have to fill up 3 times just to get to American Optical. They are using the same material for their contact lens as Bausch and Lomb, but they are manufacturing it differently.

Gentleman thank you for allowing me to take the tour. When I was in Rochester B&L manufactured their lens using a spin cast process. They would inject the liquid polymer into spinning molds, the centripetal force would form the base curve. They would bath the lens in UV light so it would cure, buff the edge and then immerse it in sterile water. The power was determined by the spin speed and the thickness would be determined by the volume of the polymer injected into the mold. How does your process differ?

Our process allows for a more stable lens. We start from a button size and shaped piece of HEMA material, around 12mm to 15mm and 4.5mm thick. We mount the lens on a mini lathe and cut the base curve, peripheral curves, and reduce the thickness to 2.5mm. We polish the back side, then mount the lens so we can cut the front surface. We polish the front surface and bathe the lens in sterile solution until soft. I think you can see why our lens is better than the B&L lens. The power of our lens is more precise. Granted our lens is slightly thicker. The thicker lens is a benefit in some situations. It will not drape as completely on the cornea therefore it will correct small amounts of astigmatism. Our lens also costs more to manufacture. I hear that B&L is cutting their prices by 25 percent to compete. They don't know that our contact lens division is being bought be CIBA Vision so we will be able to give them a run for their money

Seems like this soft contact lens is becoming a real money maker.

Ben you can't image what is happening. Besides B&L and us there are many other companies in the game. Companies named Barnes Hind, International Hydron Corporation, Cooper Vision, Frontier and Johnson and Johnson are all getting into the fray. The International Hydron company is developing a lens called Hydrocurve Soft Toric. This lens will correct astigmatism. They literally cut the bottom of the lens flat to stop rotation. They call it truncation. It stops the lens from rotating and keeps the lens on axis. I am most worried about Bausch and Lomb's acquisition of the Dow Corning lens. They have successfully developed

the silicone hydrogel material. A little more work and it will make HEMA a thing of the past.

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White sand, blue water, and heat. Florida here I am. Finally, a place I can call home. It is not Miami, but Jacksonville will do. Frontier Contact Lens Company was just bought out by the big guy Johnson and Johnson. My friend Seymour is now a wealthy guy. He started the company in 1950 and now 31 years later he is on easy street. They renamed the company Vistakon and are continuing with his development of the Acuvue disposable lens. They think it will be more popular then the new extended wear lenses the FDA just approved. The key to the lens is the unique manufacturing process. The disposable lens is manufactured using a cast molding process. One half of the mold forms the base curve of the lens the other part of the mold forms the front curve of the lens. We snap the 2 sides together and inject the liquid monomer. There is no need to polish the lens and the power, edges, and thickness are constant. Quick turnaround, reproducibility, and low cost is the name of the game. I know Vistakon will take the company to a new level. They have some wild marketing ideas.

186,000 miles per second. 186,000 miles per second. The speed of light in air is 186,000 miles per second.

Tape my windows. Why would one tape their windows? Does the weatherman think masking tape will stop a hurricane? I know they say it might just be a tropical depression. It has dropped at least 10 inches of rain so far. Maybe I should trade the Goat for a boat. The meteorologist says that 1987 will be worse than 1986 but not as bad as 1985. I understand the next name on the list is Floyd. Mr. Frinzi over at Vistakon says his new contact lens is ready for market and he wants to bounce some ideas off me. He must realize how many centuries of knowledge I have.

Ben our lens in ready to go. We are calling it Acuvue and it is a disposable contact lens. The lens is intended to be worn for seven days of extended wear use than disposed of. We have been getting some push back from the Doctors, so we have a genius idea. We are going to market directly to the end user, the consumer. Get them excited about the lens. They will only be able to purchase them from selected eyecare professionals. We will sell our fitting kits to the Doctors. They

will be the only ones licensed to sell the product. Who wouldn't come on board when they realize how many people will ask about our lens?

186,000 miles per second. 186,000 miles per second. The speed of light in air is 186,000 miles per second.

I hate those dreams. You know the one that you are walking around high school and you forget to go to class for your final. Or you are walking into school in your pajamas. The experts interpret those dreams as being unprepared. How can you prepare for a test that incorporates the need to remember so much information? Contact lenses design and manufacture is a never-ending field of improvement. There are clear lenses, colored lenses, daily wear lenses, extended wear lenses, monthly wear lenses, bifocal lenses, therapeutic lenses, toric lenses, hard lenses, soft lenses, hybrid lenses, scleral lenses, RGP lenses, etc. Not to mention the specialized testing and fitting techniques needed for each one.
Fluorescein pattern; does the bright green in the middle mean too flat or too steep?

186,000 miles per second. 186,000 miles per second. The speed of light in air is 186,000 miles per second.

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Adventures in Optics: A Contact Lens is Born

1. Who wrote the Codex of the Eye?

a. George Washington
b. Michael Angelo
c. Rene Descartes
d. Leonardo Di Vinci

2. A hydrodiascope is a:

a. A water cannon.
b. A round microscope.
c. Glass tube filled with water..
d. An instrument to measure water.

3. August Muller was a:

a. Maker of beer
b. Designer of the modern calendar
c. Developed soft contact lenses
d. Glass Blower

4. The benefits of PMMA were first noticed by:

a. USAAF
b. USO
c. NATO
d. FDA

5. A Sucker is used to:

a. Attach a contact lens to a lathe
b. Remove swarth
c. Adhere a lens to a block
d. Remove a contact lens

6. What ship did Dr. Bier travel on?
a. Queen Elizabeth
b. Queen Mary
c. Queen Anne
d. King Charles

7. Dr. Wichterle developed:
a. PMMA
b. SYLHY
c. HEMA
d. NACL

Adventures in Optics: A Contact Lens is Born

8. The FDA declared a contact lens a drug in:
a. 1939
b. 1942
c. 1973
d. 1968

9. A daily wear HEMA lens is:
a. 59% water
b. 38% water
c. 12% water
d. 100% water

10. A B4 lens had a diameter of:
a. 16.5
b. 13.5
c. 15.5
d. 14.5

11. What is the colored portion of the eye called:
a. iris
b. limbus
c. sclera
d. pupil

12. The average blink lasts:
a. 1 tenth of a second
b. 1 twentieth of a second
c. 1 second
d. 1 minute

13. Using the spin cast method of manufacture. The lens material is:
a. Lathed
b. Chopped
c. Injected
d. Painted

14. To compete in the market B&L cut their price by:
a. 10%
b. 25%
c. 20%
d. 30%

Adventures in Optics: A Contact Lens is Born

15. The first toric lens was developed by:
a. Cooper Vision
b. Johnson and Johnson
c. International Hydron Corp.
d. Ciba Vision

16. J&J Vistakon home office is located in:
a. England
b. Rochester
c. Miami
d. Jacksonville

17. The first disposable lens was named:
a. O3
b. Silsoft
c. Permalens
d. Acuvue

18. In world of contact lenses, a button is used:
a. On a lathe to make a contact lens
b. To start a centrifuge
c. To close a shirt
d. To open a contact lens vial

19. Frontier Contact lens Company was bought by:
a. B&L
b. Cooper Vision
c. Ciba Vision
d. Johnson and Johnson

20. The speed of light in air is:
a. 100,000 miles an hour
b. 186,000 miles per second
c. 186,000 miles per hour
d. 100,000 miles per second

Answer sheet: Adventures in Optics: A Contact Lens is Born—2hrs

Send this answer sheet only, don't enclose the entire printed material or the questions pages! Send as a pdf format as a scan (business scanner is best) by email to:

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Or: Postal Mail it: CEDO INC PO BOX 46486 TAMPA, FL 33646 (do not certify!)

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