Triple Defense for Healthy Eyes - Coppertone Polarized HEV/UV Sun Lenses

ABO Technical Level II

Coppertone Polarized Lenses - Product Spotlight

By Deborah Kotob, ABOM

Course objectives:

1. To learn how light becomes polarized and results in blinding glare
2. To learn how polarized lenses with a blue filter attenuate polarized glare and blue scatter glare.
3. To learn how to present polarized sunglasses as an essential pair of eyewear effectively

What do we have to offer patients for the best acuity, comfort, and eye protection when they're enjoying the great outdoors or driving? Answer: Polarized, Polarized, and Polarized!

We craft eyewear to help patients see their best and feel their best and look their best and when we add the benefit of protecting their eyes from harmful rays and impact injury, Eureka!, we strike optical gold!

In this course, we will review the patient benefits to be derived from wearing sunglasses with protection from polarized glare, light protection (UV and Blue) and impact protection.

Startling Stat

I'm baffled, the 2018 Vision Watch report from the Vision Council, says that only 7.5% of prescription eyeglass sold are polarized sunglasses! Yet, when I pose the following question to an audience of Opticians: "How many of you wear Polarized sunglasses?" 95% or more raise their hand. And, this happens every time I ask this question of opticians. We wear polarized, we love polarized, we understand the benefits of polarized sunglasses so, why aren't more of our customers opting for this glare-fighting eye comfort in a sunglass lens?

The goal of this course is to help us clear some hurdles that keep this percentage low. To do so, we will review all of the amazing benefits of these lenses. We will discuss simple ways to show and tell the customer how these lenses will make their lives better, when driving or when spending time outdoors. In this course, we will learn about polarized lens technology that goes beyond protecting our eyes from blinding and discomfort glare. We will learn about the increased solar blue light protection in Coppertone polarized lens. We will learn how Coppertone lenses provide triple defense for the eyes: 1. From polarized glare 2. From the harmful effect of light both UV and HEV (blue) light and 3. From impact injury. As a product spotlight CE, you will learn what's new in Coppertone polarized lens technology.

Understanding the New Consumer

Let's begin with the consumer. What do they want from you? Why do they purchase? What vision needs do they have of which they are unaware? And, how can you help? Understand that they may not know that a particular vision issue that they're having is something you can solve for them with eyewear. Take digital eyestrain (DES) as an example; a recent Vision Watch survey finds that patients don't bring up DES during an eye exam but if the Doctor inquires they admit to experiencing DES. Now, that a problem is uncovered the patient can be educated on ways to reduce DES. Likewise, they may not realize that the blinding glare they experience in the car is something you can solve for them with polarized sunglasses.

It is no longer enough to sell 'stuff' we have to shift our way of approaching our customers to reflect what they demand from their shopping experience.

They can have an ordinary retail transaction anywhere; in fact, they can have a convenient transaction online! So why would they come to you? Today's consumer wants more than a product. Consumers today want a great shopping experience that transcends a mere transaction, and they want products personalized to them that improve their life. To accomplish this, shopping and dispensing experiences, as well as products, have to be more. How are you engaging your customer, are they learning valuable information about their eyes and products that can enhance and protect their vision. Are you utilizing education to help the customer understand their various vision needs and how each product will address these needs and most important how addressing various vision needs will improve their life? When we educate the customer, we show them that we care about their wellbeing. And, when we educate we provide the information they need to make an informed decision.

Moving beyond the One Pair Mentality

For every customer that you assist in finding the perfect frame and lenses for their primary pair, there is a process. What is their style? What size frame is best for their facial features, size, color, and shape? What frame and lens/treatment combination will provide the best visual experience? We are very adept at the first pair sale. But, all of their vision needs cannot be ascertained by simply by looking at their prescription. Different activities, different light conditions, different focal distances and different accommodative demands all require different vision solutions. We have spent so many years selling only one pair of glasses for each customer that we have trained the customer to expect to leave with only one pair of eyewear.

My challenge to you is this: Don't sell instead show and tell the customer how each pair you recommend will improve their comfort and vision when worn. Let them balance their finances, never assume. We all have stories of unkempt sometimes unbathed customers who turned out to be geniuses or millionaire/billionaires. Using interactive demonstrations engages your customers, and they are WOW'd by the difference with and without polarized lenses. This also provides them with a memorable experience that they will share with friends and family. Remember, they are looking for a shopping experience, not a transaction. Present the very best solutions, show them how it will improve their lives and I guarantee that you will see an increase in the number of customers choosing polarized sunglasses. By the way, don't forget contact lens wearers can benefit from the great fashion and sports styles available with plano polarized lens technology. For that matter, there are many of us emmetropes turned presbyopes who only wear prescription lenses for intermediate and near work. Plano polarized lenses are perfect for us, too.

Consider the benefit of polarized for the aging eye.

Johannes J Vos Ph.D. writes; "The age-adapted version of the Stiles-Holladay disability glare equation accepted by CIE as a standard, shows that disability glare rapidly increases beyond the age of 60 years: it doubles around 70 and triples at 83; of course, with large individual variations. Calculations indicate that the visual handicap due to disability glare in traffic and many other situations may be much more pronounced in the aged than in the young adult."
https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1444-0938.2003.tb03080.x

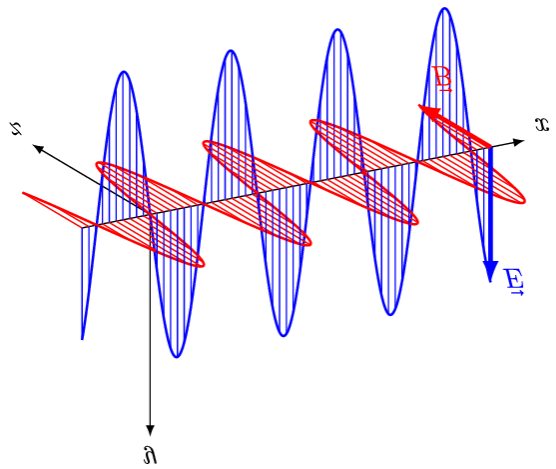
The inability to see clearly and comfortably to drive becomes a handicap that robs us of our independence.

How does light become polarized and result in disabling glare?

A high-intensity light source in our field of view outside causes haze as if a veil covers the scene before us. If we are close to the light source, it can dazzle and be blinding, but even at further distances, our vision is compromised. Drivers experience this regularly, we call it glare but more precisely its disabling glare.

Disabling glare is caused predominately by light waves reflecting off of horizontal surfaces, such as pavement, sand or water. This reflected light is partially polarized, but those waves that are reflected at Brewster's angle are 100% polarized and vibrate in a plane that is parallel to the reflecting surface. Brewster's angle for water, for example, is 53 degrees. Brewster's angle is measured from a line that is perpendicular to a surface. To find the angle measured directly from the surface, you must subtract Brewster's angle from 90 degrees. When light waves reflected from a horizontal surface like the road pavement, they become horizontally polarized and the magnitude of polarized light bombarding the eye increases resulting in an intensity that we experience as disabling glare. Blinding Glare is reflected light, that is intensified 10-100x. This reflected light is both uncomfortable and obscures our view causing a loss of contrast where detail is ill-defined, and edges of objects against their background are difficult to impossible to discern.

It is the un-polarized light waves that when reflected from water, pavement snow or other non-metallic surfaces becomes polarized. These polarized light waves produced from refection traveling on the same plane, parallel to the surface from which they've reflected. So light reflected from road surfaces and water is horizontally polarized and greatly intensified producing a visual experience of blinding glare. Polarized lenses absorb horizontally polarized rays while transmitting vertically polarized light waves.



Light is electromagnetic (EM) transverse waves with an electric field and a magnetic field. Light waves are polarized along the electric field in the direction of the wave oscillation. So when the electric field of a light wave oscillates up and down the EM wave is vertically polarized while light waves with an electric field oscillate side to side the EM wave is horizontally polarized. Ambient light is composed of waves oscillating in multiple directions, and therefore the light is said to be unpolarized.

- The direction of polarization is defined to be the direction parallel to the electric field of the EM wave.

- Un-polarized light is composed of many rays having random polarization directions.
- Light can be polarized by passing it through a polarizing filter or other polarizing material.
- Light can become polarized when reflected from horizontal surfaces.
- Scattered light is partially polarized
- The most efficiently scattered light is a blue light
- When light is reflected at Brewster's angle from a smooth surface, it is 100% polarized parallel to the surface from which it reflected.
- At a 45°angle between the direction of polarized light and the axis of a polarizing filter, the intensity is cut in half.

How do polarized lenses filter blinding glare?

1. Polarized lenses increase sharp, clear vision in the presence of bright reflected light or hazy conditions by strongly filtering out the predominant light waves that produce disabling and discomfort glare.
2. Polarized lenses eliminate glare, haze and defocused blue light outdoors and when driving, thereby the discomfort from eyestrain and glare is alleviated.

Light may be polarized by passing it through a sheet of commercial material called Polaroid, **invented by E.H. Land in 1938**. A sheet of Polaroid transmits only the component of light polarized along a particular direction and absorbs the component perpendicular to that direction. Consider a light beam in the z direction incident on a Polaroid which has its transmission axis in the y direction. On the average, half of the incident light has its polarization axis in the y direction and half in the x direction. Thus half the intensity is transmitted, and the transmitted light is linearly polarized in the y direction. *https://www.physics.utoronto.ca/~phy224_324/experiments/polarization-of-light/polar.pdf*

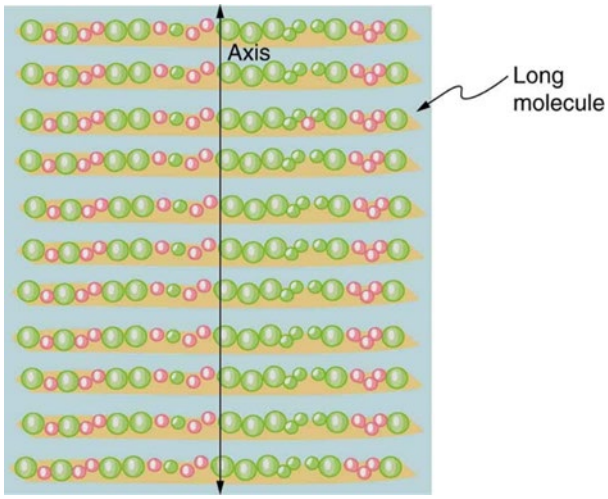
Polarized Primer

Polarizing filters are designed to allow light waves with a vertically oriented electric field to pass while blocking the transmission of light waves with a horizontally oriented electric field. Why is blocking horizontally aligned light waves important? Because what we experience as blinding disabling glare is primarily from polarized light with its electric field oscillating in the horizontal plane. Therefore polarizing filters contain long carbon molecules that absorb horizontal light waves and prevent their energy from passing through the lens while allowing vertically oscillating light waves to transmit. The long molecules that absorb horizontal light are arranged parallel to these waves in the filter and perpendicular to the vertical axis of transmission. The effect is illustrated in figure 1 that a light wave that oscillates up

and down (vertically) passes through these molecular openings in the lens while waves oscillating side to side (horizontally) are absorbed and therefore block from transmitting.

"Polarizing filters have a polarization axis that acts as a slit. This slit passes electromagnetic waves (often visible light) that have an electric field parallel to the axis. This is accomplished with long molecules aligned perpendicular to the axis as shown."

"Molecules in a polarizing filter are long in one direction (horizontal) and short in the perpendicular direction (vertical). Electrons can freely oscillate along the length of the molecule, absorbing or reflecting the light energy, while they are unable to oscillate very far along the short direction. The horizontally polarized wave emerges from its electron interaction with its amplitude reduced, while the vertically oscillating wave comes through with undiminished amplitude" Source: voer.edu.vn.



The blinding glare or disabling glare that we experience from horizontally reflected light waves is reduced to near extinction by polarized lenses. Vertically oriented light waves are not nearly as reflective as horizontally oriented light waves, so the goal of the polarizing filter in the lens is to block the greatest source of glare the horizontally polarized light waves. Polarized filters in sunglasses use the principle of absorption and interference to cancel or extinguish the transmission of these light waves while allowing the non-blinding vertically oriented light waves to transmit. To do this polarized filters in lenses align the long chain molecules with the absorbing horizontal axis oriented at 180°. The short molecules that allow vertical light waves to pass are aligned with transmitting axis 90 degrees away at 90°. Therefore it is critical that the polarizing axes are precisely oriented in the lens to absorb and diminish the blinding horizontally reflected light waves from water, snow, and pavement.

Most of the issues associated with discomfort when wearing polarized lenses are due to one or both of the lenses having the polarized film axis misaligned.

Polarized lenses produce a slightly darker image but with excellent contrast. They also reduce horizontally polarized light waves from scattered environmental light. (Rayleigh's Effect) They improve acuity, visual comfort, reduce haze and improve reaction time.

The 1rst defense for the eye from glare - how do Coppertone lenses manage polarized glare and protect the eye from harmful rays and impact injury?

Coppertone polarized lenses manage glare in two ways, 1. By managing horizontally polarized reflected light waves and two by reducing the blur effect from scattered light in the air. Coppertone polarized lenses are particularly good at reducing blue haze and blur from scattered light because they have a proprietary blue light filter built-in. Blue light is the most efficiently scattered of all the wavelengths of the visible spectrum. While blue scatter in the atmosphere is the reason we perceive the sky as being blue in color it scatters in the hydrogen and oxygen molecules of the air resulting in veil illuminance. Imagine a veil coming down in front of your vision. The image detail, color, and definition are compromised. Contrast is impaired. Blue wavelengths scatter 10x more than red. Wearing polarized sunglasses with blue filters allows you to dramatically reduce the effects of scattering and cut through the visual haze.

Blue Blur from Scatter

Short wavelength blue light molecules are attracted to the small molecules of hydrogen and oxygen present in our environment causing blue light to scatter in the air. The shorter the wavelength, the greater it scatters. This scattered light causes a loss of contrast sensitivity making it difficult for our eyes to see objects against their background. This loss of contrast leads to detail and edges becoming ill-defined. Think of looking through a veil of haze. Blue light scatters up to ten times more than red light.

To make matters worse blue light is never in focus on our retina. Due to its short wavelength and hi-index of refraction, it refracts more when it travels from air into a medium of a different index such as our refractive structures the cornea and crystalline lens. Inside our eye, blue light refracts (bends) more and therefore converges to a focal point sooner than green or red wavelengths of light. In fact, they converge to a point too soon, before reaching the retina and we all know the condition where light focuses before reaching the retina is called myopia, in this case,

blue myopia. Blue light is scattered more than red light by a factor of (700/400)4~=10.

Polarization by Scattering

Unpolarized light scattering from air molecules shakes their electrons perpendicular to the direction of the original ray. The scattered light, therefore, has a polarization perpendicular to the original direction and none parallel to the original direction.

Hold your Polarized sunglasses up towards a blue sky and rotate them, the sky brighten and dim as you turn the lens polarized filter. Light scattered by hydrogen and oxygen molecules in the air is partially polarized. Since light is a transverse EM wave, it vibrates the electrons off air molecules perpendicular to the direction it is traveling. The electrons then radiate like small antennae. Since they are oscillating perpendicular to the direction of the light ray, they produce EM radiation that is polarized perpendicular to the direction of the ray. When viewing the light along a line perpendicular to the original ray, there can be no polarization in the scattered light parallel to the original ray. Scattered light will only be partially polarized.

Only polarized sun lenses can eliminate disabling blinding glare. Nonpolarized tinted sunglass lenses only reduce light transmission to reduce discomfort glare, but they do not help with the much more serious disabling glare. Horizontally reflected light interferes with the clear, sharp vision demands of driving, and this can be a safety hazard. Polarized lenses strongly filter horizontally reflected wavelengths to reduce the blinding glare that these high energy wavelengths produce. And, they improve everyday comfort because polarized lens filters reduce haze or veiling glare caused by scattered light which disproportionately occurs from blue wavelengths. Blue light readily scatters in hydrogen and oxygen molecules air and intraocularly particularly in the presence of a cataract. Coppertone Polarized lenses manage this blue scatter haze best because they strongly filter a high level of blue light.

***Glare** can be defined as the contrast lowering effect of stray light in a visual scene. Glare forms a veil of luminance which reduces the contrast, and thus the visibility of a target is decreased. ... And the sensitivity to glare is amplified as scattering in cornea or lens increases.*

sdhawan.com/ophthalmology/glare.html

Color shades and effects:

Know the color choices and their visual effects when recommending Polarized sun lenses. Coppertone grey reduces glare and maintains a neutral color experience. The sky is blue; the

grass is green because grey does not alter color perception. All colors improve contrast because they block polarized glare, but browns and greens improve contrast further reducing blue scatter. Increased Contrast improves the definition of edges and details of objects against the background. Details pop due to the added clarity experienced when wearing polarized lenses. And because blue light is attenuated in Coppertone polarized lenses, the eye can more easily focus on objects in the environment. Polarization efficiency measures how well the lens eliminates reflected polarized light. The lighter the lens, typically the less efficient so darker polarized sunglasses are better in their effectiveness at eliminating those intense reflections called blinding glare. Coppertone Gray and Green color lenses have 97% or higher polarized efficiency. And they all provide the highest reduction in visible light transmission for bright light conditions for their color category 97% and 96% reduction in transmission, respectively.

Great for water activities and bright sunny conditions.

Great for snow and hiking activities where detecting contour is important.

Great for tennis, biking and in bright light conditions where sharp detail is needed.

HEV GRAY	HEV BROWN	HEV GREEN
• Blocks 93% of blue light • Blocks 90% of visible light • Darkest gray polarized • Great for light sensitive eyes • Improved contrast	• Blocks 97% of blue light • Blocks 83% of visible light • High contrast and acuity • Great even on overcast day • Great for elderly who need added light transmission	• Blocks 96% of blue light • Blocks 91% of visible light • Darkest green polarized • Great for light sensitive eyes • Color neutral

The 2nd defense for the eye – protection from harmful light:

It is well accepted in scientific and medical communities that actinic light both UV and high energy blue light contain sufficient energy to produce a photochemical reaction that leads to the creation of reactive oxygen species (ROS) that damages and destroys cells. Protecting the eye from this light and from the greatest source of this light, the sun is a sensible precaution that we should advise all customers to take. Are your customers aware that exposure to harmful UV rays is the number one contributor to the most common form of cataract? Are they aware that exposing their eyes in their youth to 5 hours daily of summer sunlight results in a ten year earlier incidence of age-related macular degeneration? Are they aware that a simple precaution like wearing protective sun lenses and hats when outside protects their eyes from this threat? And finally, are they aware that the actinic light damage that leads to ocular disorder and disease is cumulative and irreversible making it imperative that we start protecting our eyes in our youth?

Coppertone lenses provide UV400 protection from UV and the highest level of blue light protection in a polarized sun lens.

The 3rd defense for the eye – protection from impact injury:

Impact resistance: Coppertone lenses are available in polycarbonate and Trivex is providing the highest level of impact resistance when you need it most: driving and when enjoying outdoor activities and sports.

Coppertone lenses are endorsed by the Skin Cancer Foundation. Did you know that 10% of cancers occur in the delicate skin surrounding the eye? And these malignancies spread rapidly due to the thin tissue properties.

Important note: Commercial airline pilots cannot wear polarized lenses for several reasons 1. Annoying stress patterns on the tempered polycarbonate windshield become visible with polarized lenses 2. Screens on their instrument panel displays are partially polarized dimming the screen view. Some instrument panel LCD displays are polarized causing the numbers to disappear when stacking another polarizing filter on top of the view.3. Light from aircraft reflect horizontal light and these reflections are important for spotting these planes and their location in the shared airspace.

Manage your customers' expectations: they are less likely to be concerned about LCDs and tempered glass stress patterns if they are made aware that these are minor tradeoffs to have the glare-fighting, harmful light fighting and impact protection inherent in these lenses.

Next Steps:

Communicate the comfort and clarity that you experience in your polarized sunglasses. Your recommendation still ranks highest as the purchasing influencer for eyewear consumers. It is easy to confidently convey the benefits of a product that you experience the benefits of every day. What's good for you is good for your customer. Only polarized lenses reduce the sun's environmental scatter and resulting veil illuminance from affecting visual clarity. And, only polarized lenses attenuate the bright blinding disabling glare of horizontally reflected light waves.

Furthermore, you can enhance the comfort and acuity benefits by offering polarized lenses with the safest lens materials polycarbonate and Trivex. Finally the icing on the cake you can increase actinic light protection for your customer's eyes with both UV and HEV (blue) light protection built into the lens. Increasing the light protection factor with polarized lenses reduces cumulative and irreversible harm to the retina as well as the anterior structures of the

eye and eyelids. Give your customer the opportunity to invest in the preservation of their eye health and their visual comfort in high glare conditions.

Self-Assessment

Triple Defense for Healthy Eyes

1. **Polarized lenses filter blinding glare produced by _____ reflected and polarized light waves.**
    a. **Vertically**
    b. **Horizontally ***
    c. **Oblique**
    d. **Ambient**
2. **Coppertone polarized lenses reduce blur resulting from the scatter of these light waves:**
    a. **Red**
    b. **Green**
    c. **Yellow**
    d. **Blue ***
3. **Blue light does not focus on the retina it focuses:**
    a. **Before reaching the retina ***
    b. **Behind the retina**
    c. **At two focal lengths one in front of and the other behind the retina**
    d. **At two focal lengths both behind the retina**
4. **Blue light scatters ___ times more than red light.**
    a. **10 ***
    b. **9**
    c. **7**
    d. **6**
5. **Brewster's Law states that light reflected from a surface at Brewster's Angle is ____% polarized**
    a. **100 ***
    b. **90**
    c. **80**
    d. **75**
6. **Blinding glare interferes with all of the following when driving except:**
    a. **Reaction time**
    b. **Visual Comfort**
    c. **Contrast and discerning detail**

d. **Seeing the dashboard *****

7. **Blue light scatters in air molecules and contributes to _____ luminance.**
    a. **Veiled *****
    b. **Accurate**
    c. **Crystal**
    d. **Clear**

8. **Polarizing sunglass lens filters allow _____ oriented light waves to transmit through the lens.**
    a. **Horizontally**
    b. **Vertically *****
    c. **Obliquely**
    d. **Both horizontally and vertically**
9. **What was the name given to the first commercial polarized film filter developed in 1938?**
    a. **Polaroid *****
    b. **Polarizer**
    c. **Polar**
    d. **Polar-block**
10. **What other sun lenses block blinding disabling glare other than polarized?**
    a. **None *****
    b. **Photochromic**
    c. **Tinted G-15**
    d. **Tinted neutral grey**
11. **Coppertone Polarized lenses defend the eyes in three ways which of the following is not one:**
    a. **Block blinding horizontally polarized light-induced glare**
    b. **Blocks blue scatter induced blur**
    c. **Protects the eye from Actinic UV and Blue light rays**
    d. **Filters out infrared *****
12. **What percentage of eyeglass sales in 2018 were for prescription polarized sunglasses per the Vision Watch report?**
    a. **7.2%**
    b. **7.5% *****
    c. **7.8%**
    d. **7.9%**
13. **Who benefits from attenuating road surface reflections?**
    a. **Skiers**
    b. **Drivers *****
    c. **Hang-gliders**
    d. **Pilots**

14. Short wavelength blue light molecules are attracted to the small molecules of _____ in the air causing them to scatter.

a. **Hydrogen and helium**
b. **Hydrogen and lithium**
c. **Hydrogen and oxygen *****
d. **Hydrogen and calcium**

15. Coppertone polarized lenses provide triple defense for the eye from polarized glare, harmful UV/blue light and:

a. **Impact injury*****
b. **Aging**
c. **Dry eyes**
d. **Myopia**

16. Actinic light consists of ultraviolet radiation and:

a. **Red light**
b. **Green light**
c. **Yellow light**
d. **High energy blue light *****

17. Actinic light can result in the production of these damaging molecules that harm cells:

a. **Reactive Oxygen Species *****
b. **Antioxidants**
c. **Melanopsins**
d. **Opsins**

18. Polarized light from reflection consists of waves that vibrate in a plane that is _____ to the reflecting surface.

a. **Perpendicular**
b. **Parallel *****
c. **Oblique**
d. **Random**

19. The direction of polarization is defined to be the direction parallel to the _____ ____of the EM wave.

a. **Electric field *****
b. **EM field**
c. **Magnetic field**
d. **Eccentric field**

20. Who invented the first commercial polarizing filter in 1938?

a. **Edwin Hand**
b. **Edwin Land *****
c. **Edgar Land**
d. **Edgar Hand**