Before I could drive, we would walk. Or if we had bikes for everyone, we would bike. It was such a long walk, or at least it seemed that way. Passing one huge estate at a time, we would make our way to the beach. The summer air, the sand that was so hot is now too cold, the ever-present sound of waves crashing. Light from a sun passed onto the moon falls onto the crests of the choppy ocean: daylight and night. Waves of light hit waves of liquid. Light that can only be seen with your eyes; light that no lens can capture. Let's keep walking, further down, over there. Further away from the dunes. Right here. I'll go get wood. You guys dig the hole and set up the blankets. The wood crackles as it burns; a trail of smoke gets lost in the night sky. Stars float just above our heads. Our backs are cold but our faces are warm and red. We can't help but to stare into the depths of the flames and the embers that seem to naturally burn from the inside. What is it about light that is so captivating? We try to emulate its beauty as it is reflected off of objects but we seldom look at the inherent beauty of light itself.

Light seems very simple, yet when we try to describe it in depth we find ourselves at a loss for words. In the later half of the 1600's, Sir Isaac Newton proposed that light was made up of a stream of tiny particles. Then, in 1678, the Dutch physicist Christian Huygens said that light was made of waves that travel through space (The Dynamic Unity of Reality). Well, lo and behold, they where both right. Light is an electrical disturbance in space that is made up of particles called photons that oscillate up and down forming waves. Photons are particles that are emitted from an atom that we see as light. This is because photons emit electromagnetic radiation (Rossotti). An atom's nucleus has a positive charge, and surrounding this nucleus is a cloud of electrons that carry a negative charge. These electrons are sorted by energy level sounding the nuclei. Picture a target: electrons in the outer rings have more energy and gradually decrease in energy when you move toward the nucleus. When an atom gains energy, some electrons move away from the atom because they have more energy. When the electrons fall back down to their original energy level, heat and light is emitted (Rossotti).

The light that we see has both additive and subtractive properties. White light, or visible light, is made up of all the colors of the rainbow. Light can be refracted into its parts by a glass prism or a drop of water. When mixing colored light, the sum of the parts is always lighter than its components. Yellow and red, for instance, make orange light, which is lighter (more white) then yellow or red alone. Yet when we mix lots of different colors of paints the result is a dark brown. What is different about mixing paints? Your shirt is blue because it absorbs all colors except blue wavelength of light, which it reflects. When you mix blue and yellow paint the result is green—now the paint is reflecting blue and yellow light. The more colors you add, the more light is reflected, until the color becomes very dark. The sum of the components of a paint color will always be darker than the each individual component of the paint (Caulfield).

As we now know, everything has a color because of the light waves it absorbs and the ones it reflects—but *why* does my yellow shirt reflect yellow light and absorb all other colors? Well this relates to the energy levels we were talking about before. There is a specific amount of energy that it takes to move an electron up one energy level, depending on the atom and the arrangements of the atoms in relation to each other: "So the characteristic colour of an object, in daylight, depends on the wavelength needed to produce a readjustment of electrons, because it is these energies which determine the composition of that remaining mixture of light, which enters our eye and causes the sensation of colour" (Rossotti, 42). So why do things seem to change color under different light? The color of an object can seem to change because of the light it is held under. If one is wearing a blue shirt in daylight it will absorb all wavelengths except blue light, and the absorbed wavelengths are converted to heat. Yet if one goes into a room with only yellow light, the same blue shirt will look black because it is absorbing red and green light (what yellow light is composted of). The yellow lamp is only giving off red and green wavelengths, and there is no blue light to be reflected, so the blue shirt will appear very much black (Caulfield) (Rossotti).

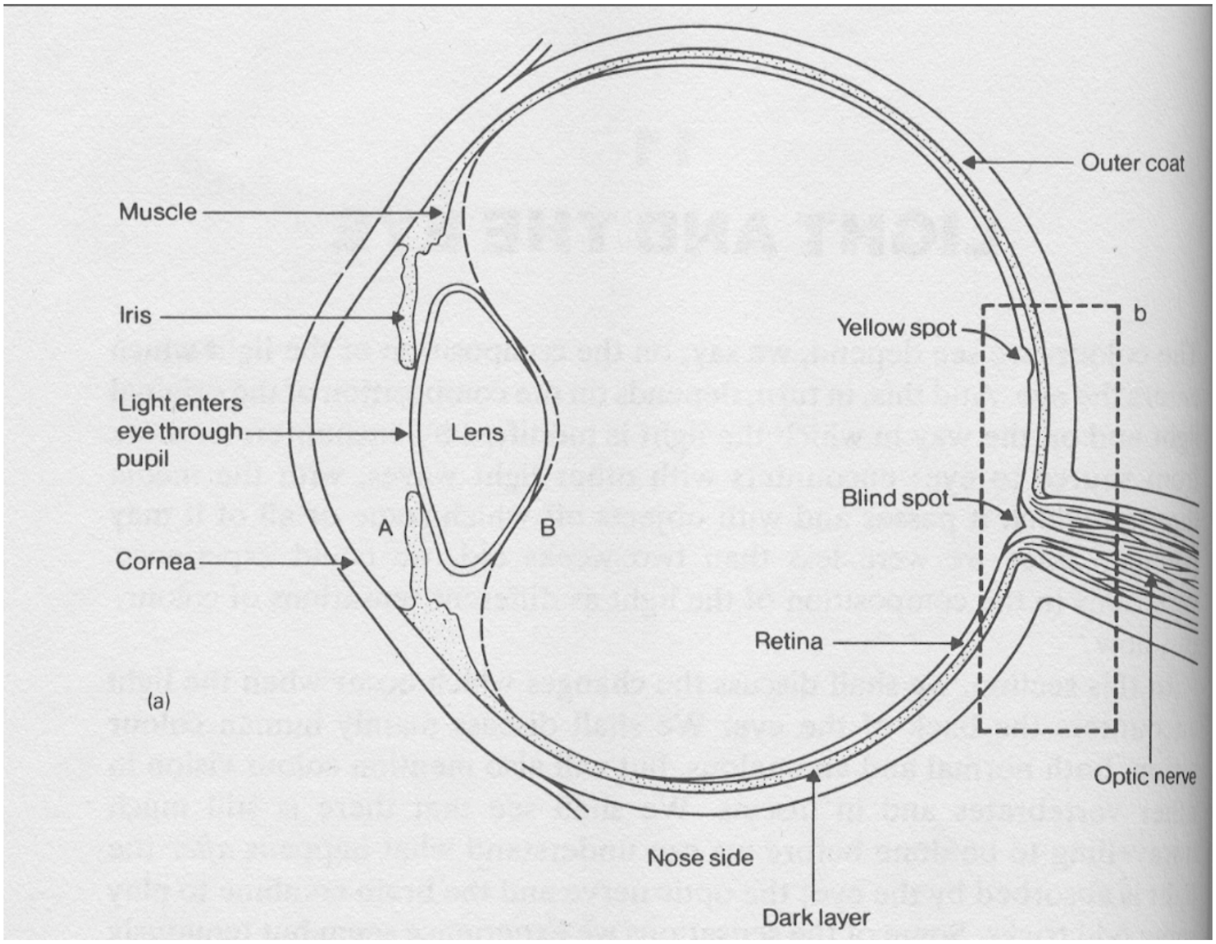
To perceive light, we depend on specialized cells and nerves in our eyes to create the sensation of vision. When light reaches our eye, it passes through the cornea, then the pupil, and falls onto the retina in the back of the eye (See *fig. 1*). The retina is lined with layers of transparent nerve fibers and under those there are photosensitive cells. "The photosensitive cells are colored; they contain pigments which absorb visible light; and it is this absorption which forms the basis of our sense of sight. In the human retina, there are two classes of photosensitive cells called rods and cones on account of their (very approximate) shape" (See *fig.2 & 3*) (Rossetti, 112). The rods are only active in low light settings, differentiating between light and dark only. Cones are used in conditions of normal light intensity allowing us to understand color. In a normal, healthy eye, there are three types of cones, each of which corresponds to a color of light. The cone corresponding to blue light most effectively understands light at about 460 nanometers (nanometers are a measurement used in determining a specific wavelength). Then there are green cones which peak at about 560 nm, followed by the longest wavelength-receptive cones, red, at 660nm (Rossotti, 119). Have you ever noticed how right around dusk everything appears to be blue? It's not because there is more blue light in the atmosphere; it is because of your rods and cones. See, normally, rods and cones work at separate times. But at dusk, the atmosphere is both bright enough for cones to still be active *and* simultaneously dark enough for rods to be active. Cones pick up on yellow light most easily, while rods are most sensitive to blue light. This is why at dusk everything seams to turn from a yellowish color into a blue haze, followed by darkness (Rossotti).

Light is clearly present in almost all forms of art, but the relationship of physics and art is not one that is equally clear. When you think of art, the next thing that pops into your mind is most likely *not* physics. Yet our understandings of fundamental constructs of space, time, and light—all present in art—are dependent on physics; the two often parallel one another in history. For example, objects in Cubism were broken down so the painting would show every side of something at once (See *fig. 4*) (Shlain). Cubist painters would flatten space and time to capture all sides of an object at the same moment, using an effect called the "red shift." When things are moving away from the viewer they appear to be red, and when they are coming toward us they appear to be bluer. Moving at the speed of light, you would see the front and back of an object at the same time. All colors would merge together making everything neutral tones of black, white, brown, and grey: the colors used by cubist painters (see *fig. 5*) (Shlain).

In Einstein's theory of relativity, he presents a thought experiment in which a train is traveling at the speed of light. When a viewer looks out the window of that train, the surroundings will be stretched taller than would appear when the viewer is traveling at lower speeds. This elongation is something that the art community was dealing with as well. Using distortion and elongation in art began as early as the 1880's with Cezanne and Seurat, and later with Modigliani (see *fig. 6*) (Shlain). If Einstein had created a model of what the human figure would look like when the viewer is traveling at the speed of light, it would have resembled the Swiss sculptor Giacometti's work (see *fig. 7*). The relationship between Cubism and Einstein's theory of relativity is the most evident parallel between these two communities of art and physics.

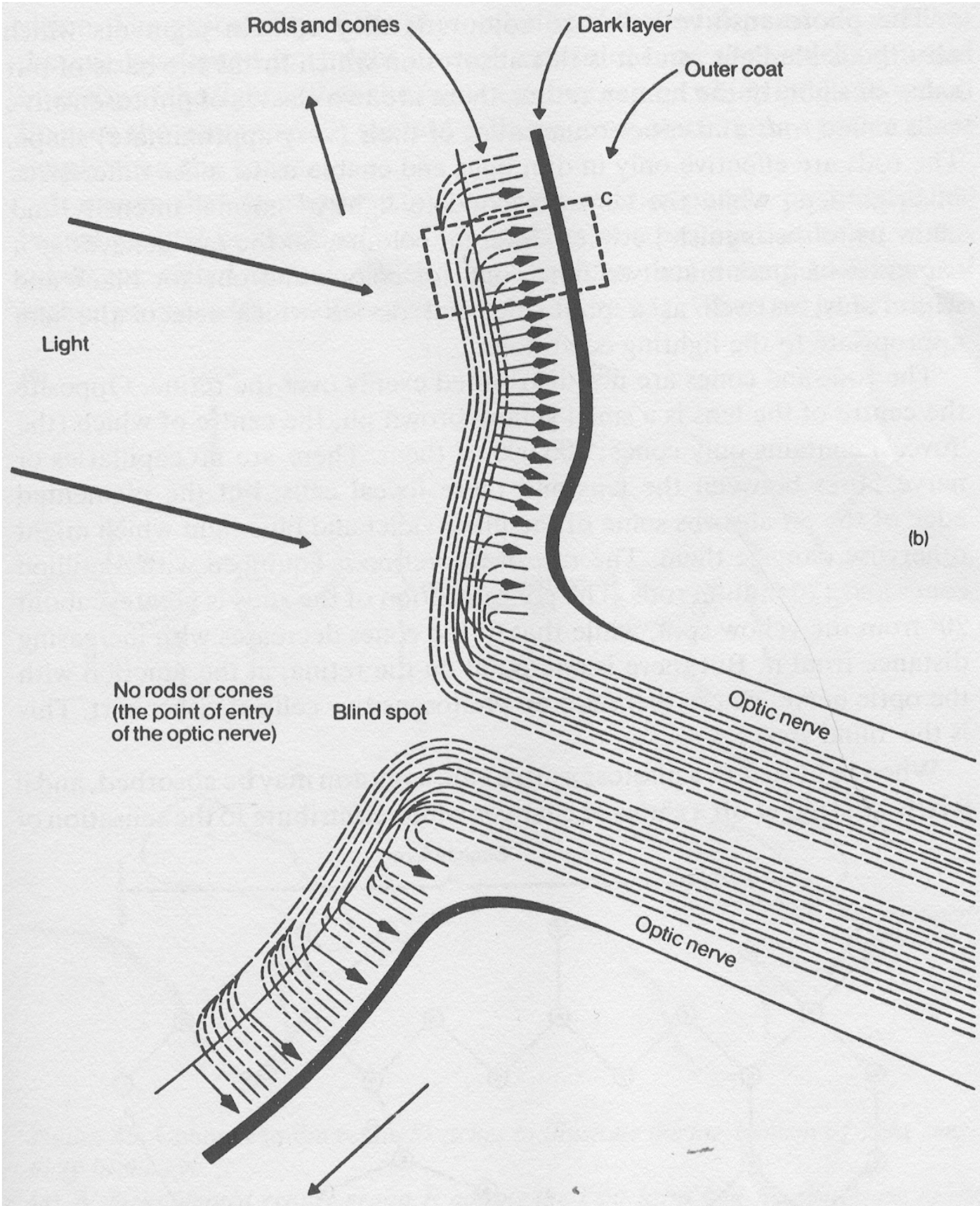
I don't know if I'm an artist, or if I want to be one, but I do know that I'm not a Math and Science kid or an English and History kid. I'm an Art and Science kid. I like things that have a process and a method, something that can be repeated to get the same results. I think that's the science nerd in me talking. I started with a digital camera but it felt too easy: anyone can point and shoot without thinking about aperture. So I worked backward and entered a black and white analog photography class; I think that class was when I really started to study and observe light. Then, here at Oxbow, I took my exploration into light and my love for science deeper. After being given a few names of artists to look at, the most influential being James Turrell, the first product of this exploration was a short twelve-second video showing the sun's paths through the sky as distinguished by its shadows. My most recent and most in-depth exploration of my fascination with light has been working within the limitations of a room to create a full spectral experience. I set out to create something that the viewer feels compelled to look at. Well, not exactly, because you look at a painting, but you *gravitate* toward light.

Oh, and in case you were wondering: the sky is blue because the moisture in the atmosphere most effectively scatters blue light. (Rossotti)



Outer coat
Muscle
Iris
Yellow spot
b
Light enters
eye through
pupil
Lens
Blind spot
A
B
Cornea
Retina
(a)
Optic nerve
Nose side
Dark layer

Figure 1.



Rods and cones
Dark layer
Outer coat
c
Light
(b)
No rods or cones
(the point of entry
of the optic nerve)
Blind spot
Optic nerve
Optic nerve

Figure 2.

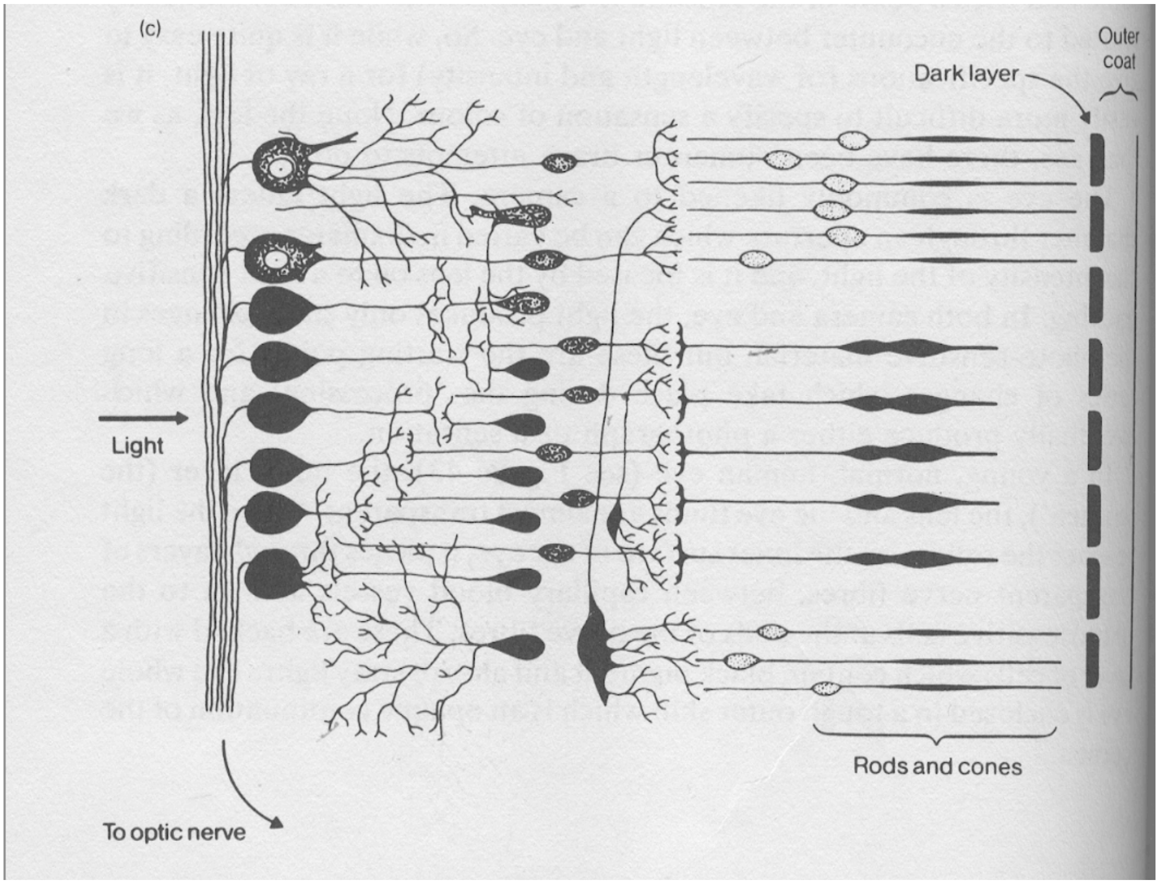


Figure 3.

Figure 4. *Portrait of Marie-Thérèse Walter,* Picasso, 1937)

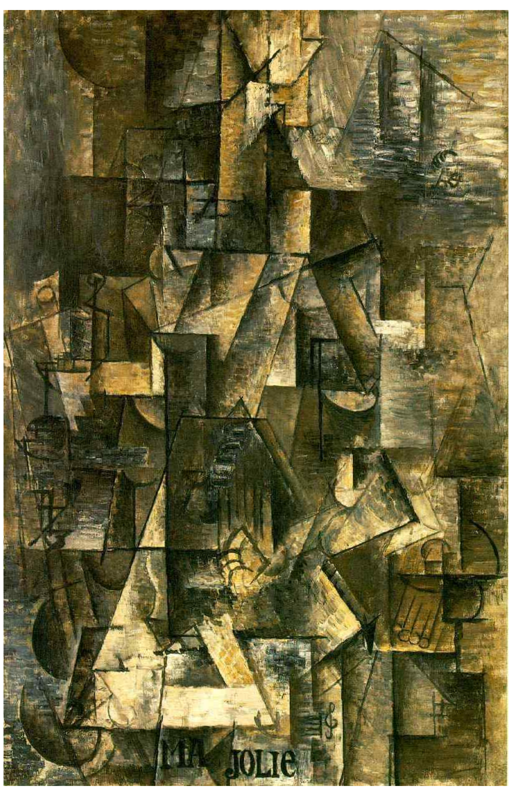


Figure 5. *Ma Jolie*, Picasso, 1911

Figure 6. *Portrait of Lunia Czechowska*, Modigliani, 1919

Figure 7. Grande Femme IV, Giacometti, 1960

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