NATURE’S LABORATORY

"*Listen to the colors of your dreams*."
-- The Beatles

Colorblindness is a condition that afflicts people throughout the world. Sometimes, they don't even know it. The term colorblind itself is misleading, however. The majority of colorblind people can see colors. Colorblindness includes a spectrum of visual capacities, ranging from anomalous trichromacy, characterized by a difficulty in discerning between shades of certain colors, to achromatopsia, the inability to see any colors at all.

Colorblindness is also known as Daltonism after John Dalton, the man who first noted the phenomenon in himself and his brother. In investigating his own colorblindness, Dalton thought (mistakenly) that his inability to see colors as others did was due to his eye color. In having blue eyes, he thought the vitreous humor (the jelly-like stuff that gives your eye shape) of his eyes’ lenses were also tinted blue, thus altering his color perception. Upon his death in 1844, an autopsy was performed at his request to determine the cause of his colorblindness. Contrary to his theory, his eyes were no different than any others'.

Color vision is determined by photoreceptor cells – namely cones – which, along with their night-vision counterparts – rods – carpet the surface of the retina at the back of the eye. Light traveling through the eye's lens is translated by photoreceptor and their accompanying cells into nerve impulses that are carried via the optic nerve and processed by the brain into a visual image, colors and all.

The components of color vision are orchestrated by three cone types: S-cones, M-cones, and L-cones – more commonly referred to as blue, green, and red cones, respectively. Not surprisingly, the genes that code for L-cones and M-cones (red and green) are beside each other on the X chromosome, are strikingly similar to each other, and are thought to have evolved from a common photoreceptor cell. And they are responsible for red-green colorblindness.

A quick genetics lesson: Colorblindness is a recessive trait, occurring for the most part only in males. That's because females have two X chromosomes and males have an X and Y chromosome. Recessive traits can be prevented or damped if a dominant trait is present on the second chromosome. When a trait coded for on a X chromosome has no complement on the Y, an otherwise hidden trait can appear. Such is the case with colorblindness.

Given the recessive nature of colorblindness, 8 percent of males are colorblind and less than 1 percent of females. Women can, however, be carriers of the recessive trait and have normal color vision. In this manner, colorblindness tends to skip generations. If a man is colorblind, his sons and daughters will have normal vision, but his daughters will be carriers of the recessive alleles. There is then a 50 percent chance that his daughters' sons will inherit colorblindness.

What is color? How do you describe blue? Well, it's blue, right? How we see, or more importantly, how we perceive, our understanding of color is an individual experience. Short of assigning an RGB (Red-Green-Blue) value to every color we encounter (as does a computer), people make an everyday assumption that most people experience a blue sky, green grass, and an orange orange in a similar fashion.

But how do you know that your neighbor experiences an apple as having the exact same shade of red you see? The Jalé tribes people of New Guinea describe greenery as being either black or white, depending on how dark or light the object is. How do you describe your "green" to them?

There are a number of formal tests to identify actual colorblindness. The Ishihara plate, HRR, and Dvorine are some of the most familiar tests which use psuedoisochromatic plates - pictures made from colored dots. Each in a series of cards is decorated with an array of dots in different colors which, to individuals with normal vision, appear as a number or a sailboat. Colorblind people see only dots. Other more devious plates reveal one number to people with normal vision, and a completely different number to those with colorblindness.

Colorblindness isn't always a handicap, though. Stories abound of how colorblind individuals were employed during WWII to help spot camouflaged German camps from spy planes. Instead of relying on colors, the colorblind soldiers identified camps based on textures.

Hands On*:* Imagine for a moment living in a world devoid of colors. Some of the colors you rely on every day - a green traffic light signaling you to go, a bead of red blood informing you you've cut yourself, a yellow banana indicating it's ripeness - would lose all meaning.

Find some color photographs you like and make some good, clean, black and white photocopies of them. Or, sit down with an old magazine and tear out some photographs, placing them into two piles: color, and black and white. Stare at each color picture for a minute or two, making a written list of everything that stands out to you: objects, feelings, expressions. Then, do the same with your stack of black and white photos. Compare your two lists, noting the differences and similarities. What can a black and white photo tell you that a color photograph can't? What can a color photo tell you that a black and white photograph can't?

It can take years to diagnose colorblindness sometimes, especially in children. Next time you visit your doctor, ask them to administer a psuedoisochromatic Ishihara plate test to see if you are colorblind!

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