How we see

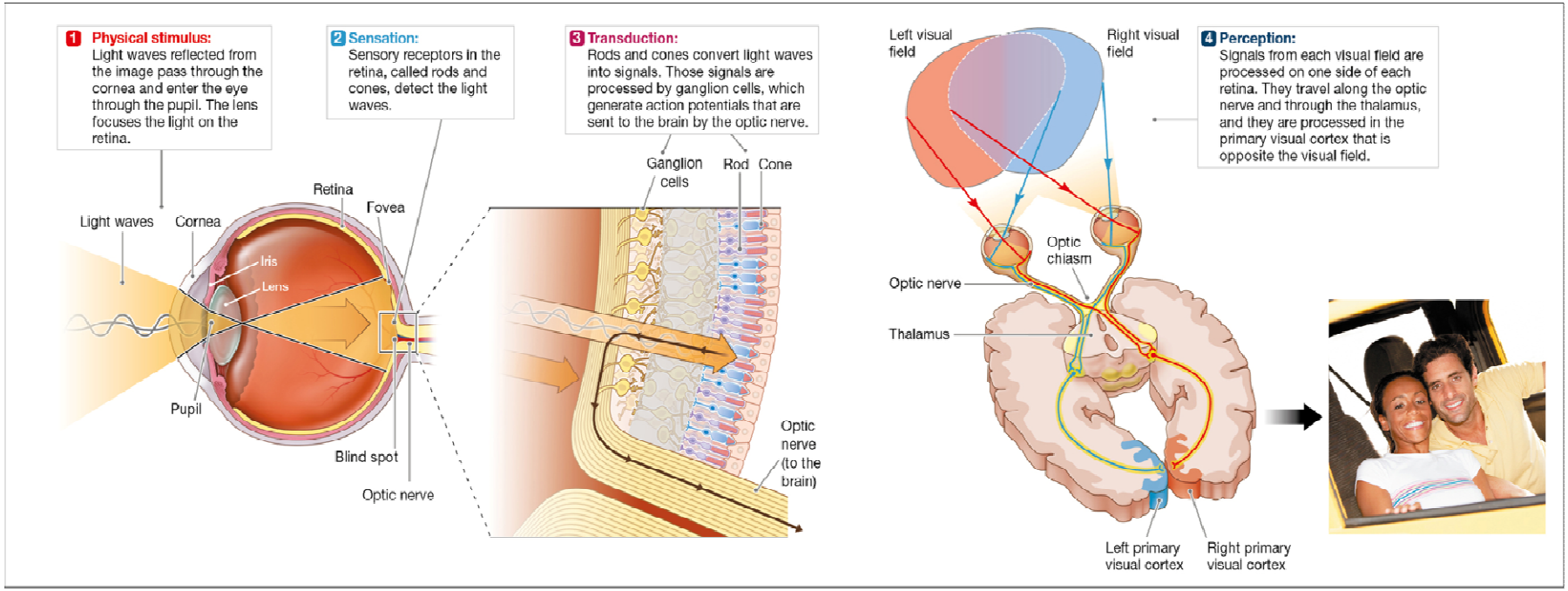

FIGURE 5.5

GlowImages/Alamy Stock Photo

Rods and Cones

To help you remember information, you should organize the information, relate the information to images, your experiences and connect the information in a story (see homework assignment).

Rods	Cones
• Long and thin with blunt ends	• short and fatter with ends that taper to a point
• estimated at 120 million	• estimated at 6 million
• primarily for night vision / seeing in dim light conditions.	• primarily for color vision • perceiving fine details
• there are no rods in fovea, but more prevalent in the peripheral areas of the retina	• cones are concentrated in the fovea, and less common in the periphery

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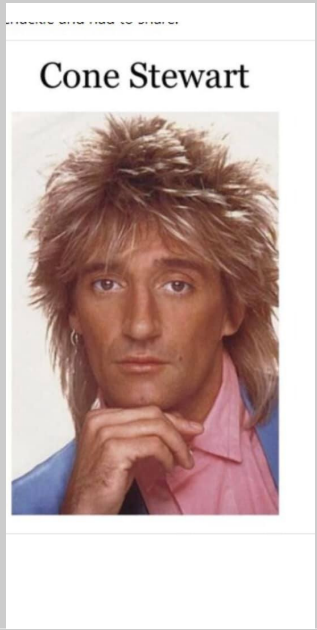

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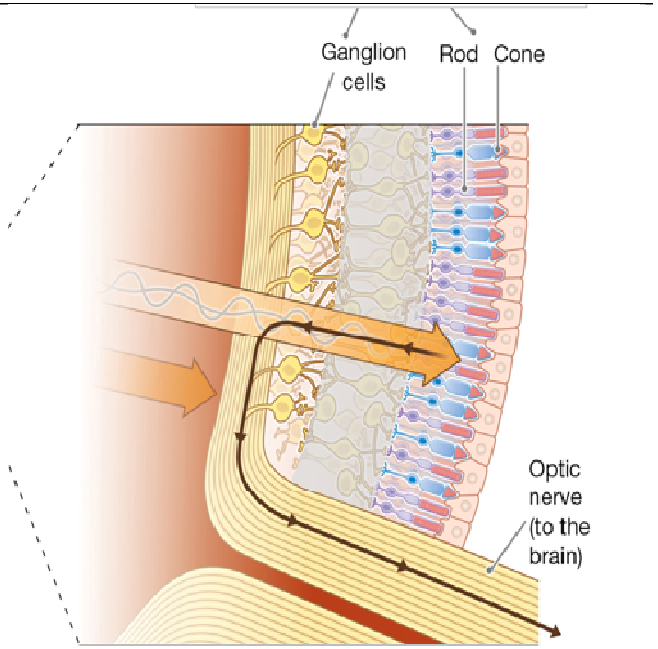
• Long and thin with blunt ends	• short and fatter with ends that taper to a point	
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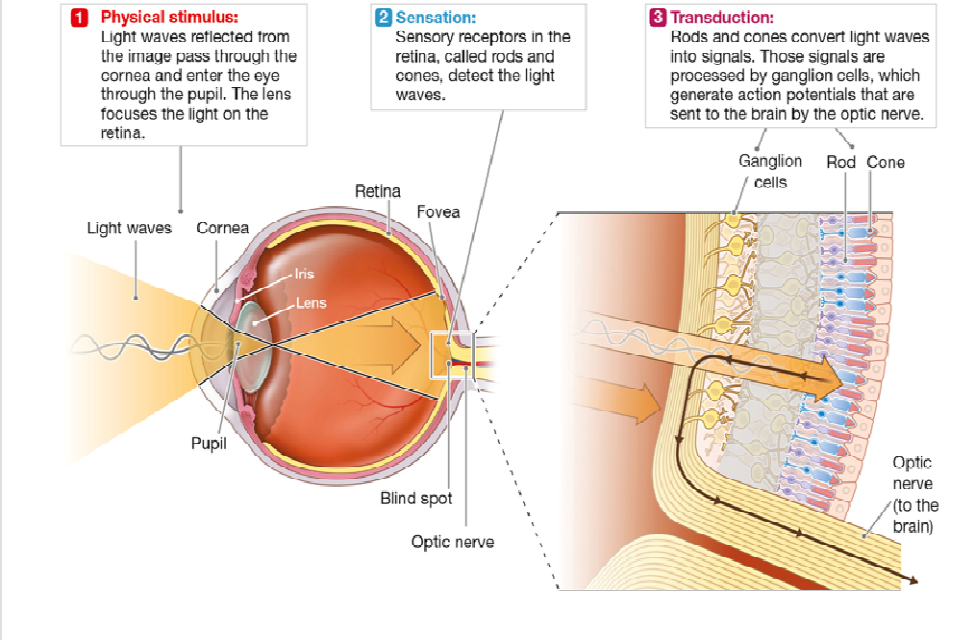
The blind spot



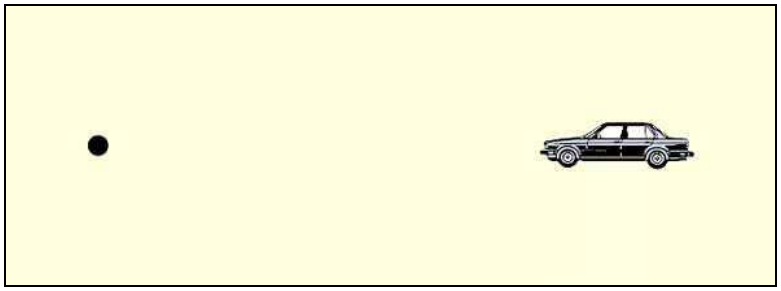


Image source: Psychology ( ), Myers

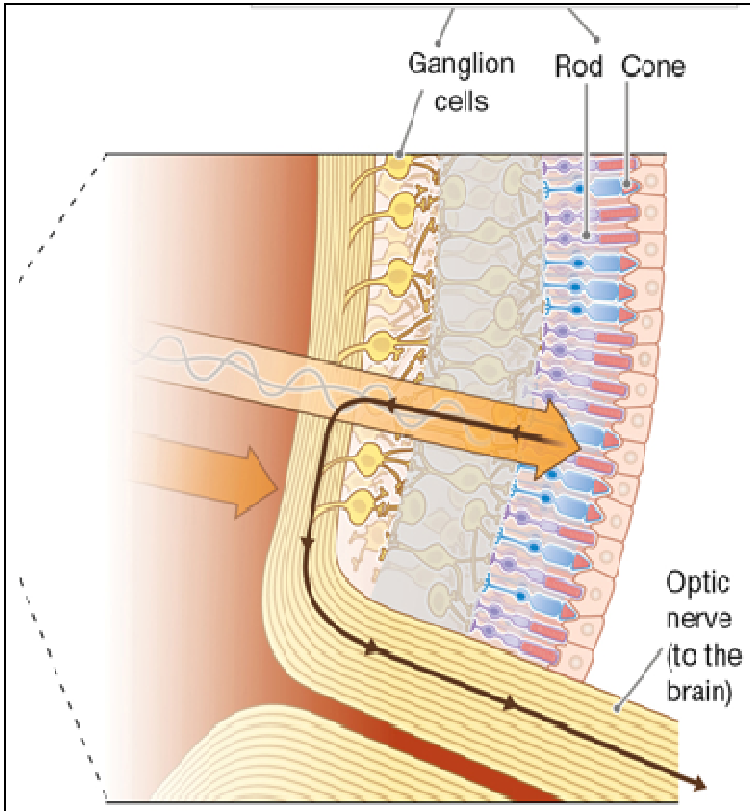
Put the black dot about 12” in front of your right eye. Using only your right eye (close the left eye), stare at the black dot and move the image forward and back until the car disappears

- Why is there a blind spot?
- Why don’t we perceive a blind spot?
- What does the blind spot tell us about perception?
- What does this suggest to a driver about seeing pedestrians, people riding bicycles, motorcycles?

How many of you read this wrong?

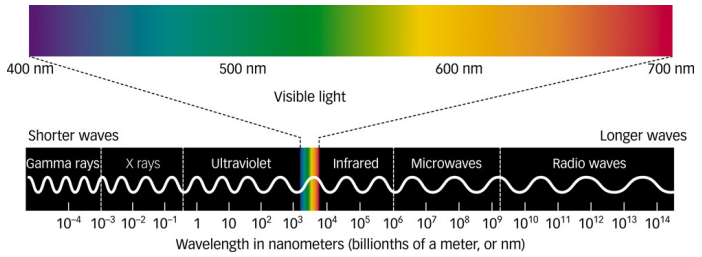
Our brains fill in missing information or correct information unconsciously and automatically to conform with what we expect to perceive.

The Trichromatic Theory



Cones are responsible for color perception. According to the theory, there are three types of cones in the fovea that are very sensitive to certain wavelengths of light and not very sensitive to the other wavelengths of light.

- **Blue light** (short wavelength), S cones
- **Green light** (medium wavelength), M cones
- **Red light** (long wavelength,), L cones



The perception of other colors (such as **yellow**) is the stimulation of a combination of cones (**green** and **red**).

The Trichromatic Theory

What does the trichromatic theory of color perception explain?

People with red/green color blindness cannot distinguish between the two colors because their red and green cones are sensitive to the same color. Technically, this should be called color deficiency, but is commonly called being color blind (about 8% for men, and ½% for women).

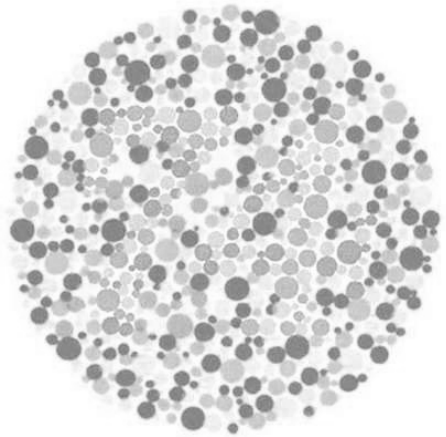
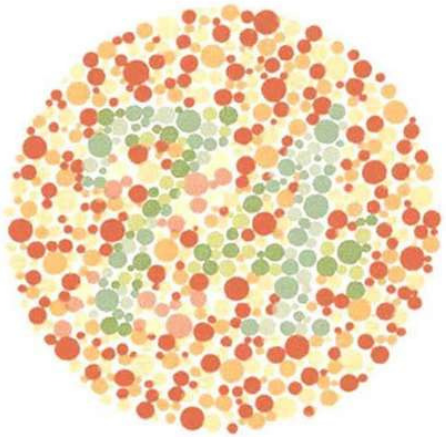
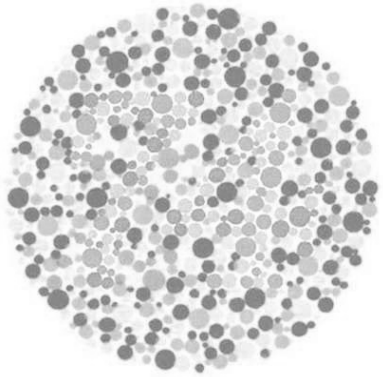
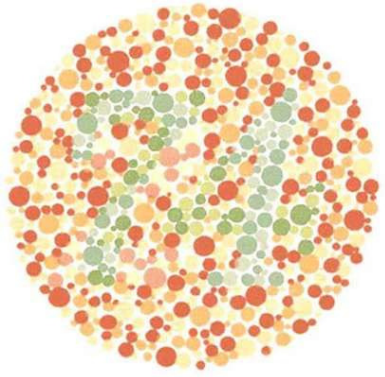
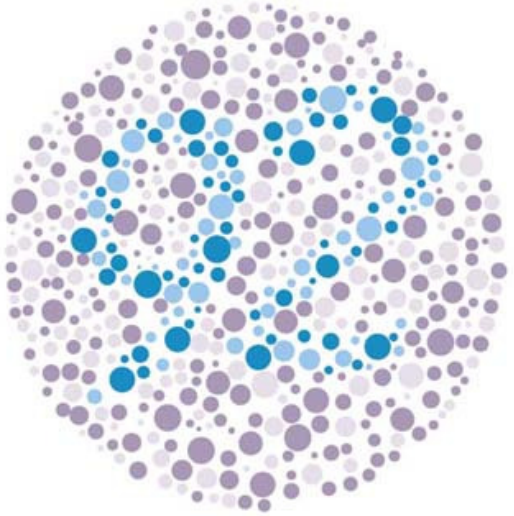
	
• **Blue sensitive cones** • **Green or Red sensitive cones** • **Green or Red sensitive cones**	• **Blue sensitive cones** • **Green sensitive cones** • **Red sensitive cones**

Image source: Psychology (2009), Hockenbury and Hockenbury

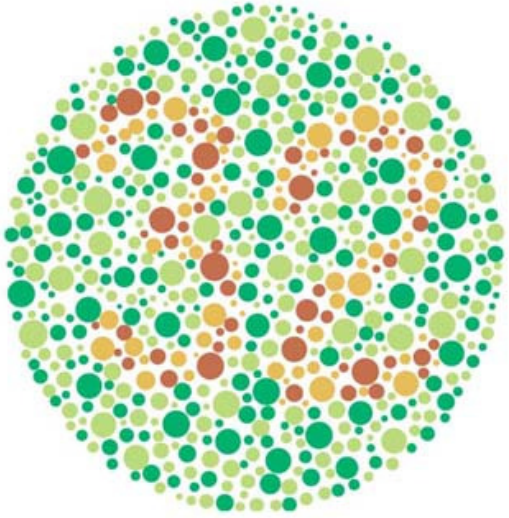
The Trichromatic Theory

	
• **Blue sensitive cones** • **Green or Red sensitive cones** • **Green or Red sensitive cones**	• **Blue sensitive cones** • **Green sensitive cones** • **Red sensitive cones**

Color Perception

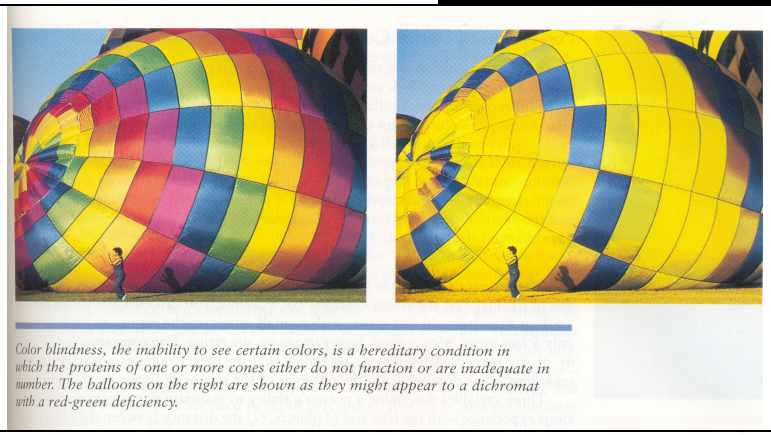


The top image tests for blue-yellow color blindness



The bottom image tests for red-green color blindness

Color Perception



Color blindness, the inability to see certain colors, is a hereditary condition in which the proteins of one or more cones either do not function or are inadequate in number. The balloons on the right are shown as they might appear to a dichromat with a red-green deficiency.

Image source: Psychology, Lefton

• **FIGURE 5.13** Color blindness and color weakness. *(a)* Photograph illustrates normal color vision. *(b)* Photograph is printed in blue and yellow and gives an impression of what a red-green color-blind person sees. *(c)* Photograph simulates total color blindness. If you are totally color-blind, all three photos will look nearly identical.

Image source: Psychology, Coon

Image source: Psychology, Schacter et. al.

The Opponent-Process Theory

The trichromatic theory cannot explain an afterimage such as seeing a faint red, white and blue flag after staring at a yellow/green flag.

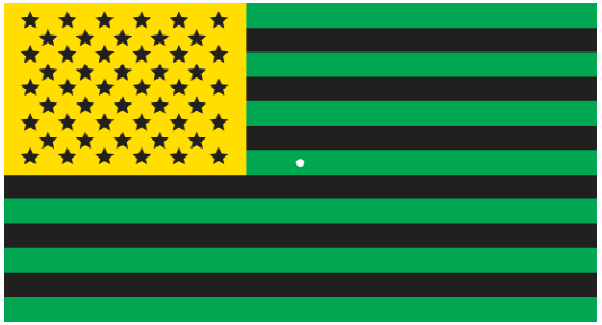


Figure 3.6
Hockenbury/Nolan, *Psychology*, 8e, © 2016 Worth Publishers

According to the opponent process theory, there are three types of color sensitive neurons that are sensitive to a certain pair of colors:

1. **red** / **green**	**red** / **green**	**red** / **green**	**red** / **green**
2. **blue** / **yellow**	**blue** / **yellow**	**blue** / **yellow**	**blue** / **yellow**
3. white / **black**	white / **black**	white / **black**	white / **black**

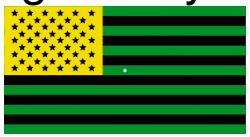
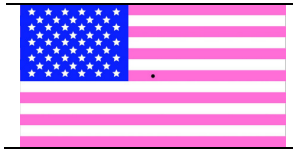
One single receptor can only be activated to a single color, while the other color is inhibited (blue can be activated, while the yellow is inhibited). With multiple receptors, some receptors can be sensitive to blue, while others can be sensitive to yellow.

All color perceptions are a combination of these receptors. For example,

- **orange** = **red**/green + blue/**yellow**
- **purple** = **red**/green + **blue**/yellow

How does the opponent-process explain an afterimage?

Afterimages are explained when it is combined with the general principle of sensory adaptation—the weakening of the sensitivity of your senses when they become adapted to a stimulus.

Before staring at the "green / yellow" flag	Normal	Sensitivity
	red	/ **green**
	blue	/ **yellow**
	white	/ **black**
Staring at the "green / yellow" flag 	Normal sensitivity	Reduced sensitivity
	red	/ **green**
	blue	/ **yellow**
	white	/ **black**
Looking at a white background that reflects all colors of light	**RedOrangeYellowGreenBlueIndigoViolet**	
	**RedOrangeYellowGreenBlueIndigoViolet**	

Since the red and blue receptors are more sensitive, they will activate and accentuate those colors when you look at a white background, producing a weak afterimage of a red, white and blue flag.

What theory of color vision is "right", they both can't be right?

What theory of color perception explains how we perceive color?

This is the wrong question to ask about color perception. Both theories explain color perception, but at a different level of color perception.

- The trichromatic theory primarily explains perception within the structure of the eye (the cones and retina) before being transmitted to the brain via the optic nerve.
- The opponent-process theory explains perception within the ganglion cells, thalamus and visual cortex.

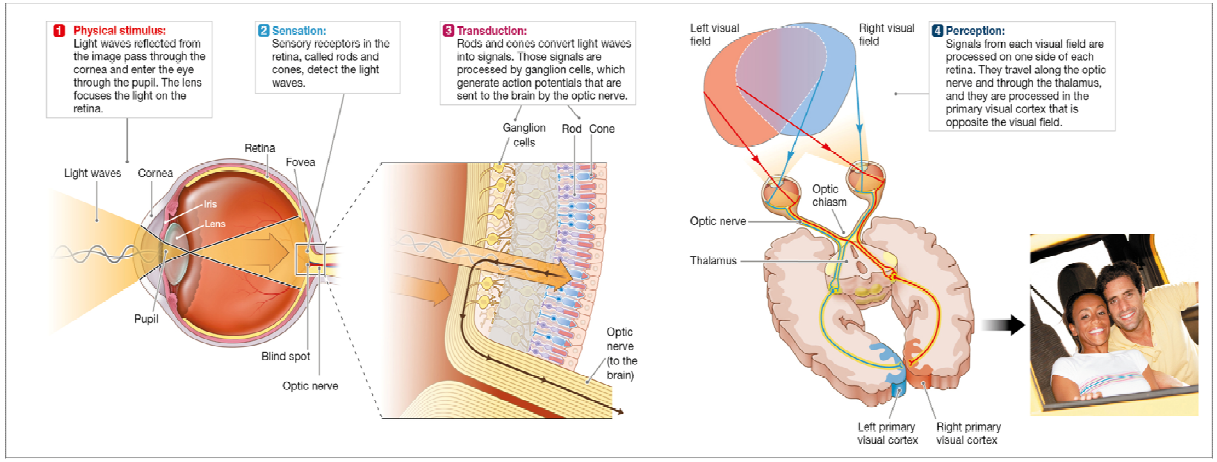


FIGURE 5.5