

## Vision Glossary

### BIOL 131

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**Accommodation:** the focusing ability of an eye structure. Mediated by the lens of the camera-lens eye.

**Ambient light spectrum:** the spectrum of visible light produced when sunlight interacts with the environment. Example: ambient light in the ocean is blue, and gets bluer with depth.

**Area centralis/fovea:** high resolution portion in the center of some vertebrate eyes.

**ARTS diagram:** describes the steps of how visual signals travel from sender to receiver, accounting for ambient light, light reflected off of the sender, transmission distance, and receiver detection ability.

**Background spectrum:** the spectrum of visual noise “around” the sender that influences the detectability of the sender. The background spectrum arrives at the receiver eye at the same time as the visual signal described by the ARTS diagram.

**Binocular vision:** visual perception produced when the field of vision of both eyes overlaps — predators rely more on binocular vision, which creates high resolution images but also limits field of vision.

**Brightness contrast:** a strategy to increase conspicuousness wherein an animal increases the brightness of a visual signal that contrasts with its background.

**Camera-lens eye:** a type of eye with a refracting lens that can produce high-resolution images. In a camera-lens eye, the two-sided lens refracts light and maps images onto a retina over a short distance. Most vertebrates have a camera-lens eye.

**Cone:** a kind of photoreceptor that is used in bright-light scenarios and that produces detailed images that increase spatial resolution.

**Contrast threshold:** the amount of contrast at which a receiver can detect an object or signal. Accounts for just-detectable distance, which relies on the size and transmission distance of an object or signal.

**Cornea:** aids in accommodation in terrestrial vertebrates through light refraction.

**Dichromat:** an animal whose eyes have two cone pigments with slightly overlapping wavelength absorbance. The presence of two cone pigments allows for the comparison of the outputs of each cone pigment (dependent on the wavelength absorbed), which enables color detection. Dichromats can perceive colors best in the region where wavelength absorption between each cone overlaps, between 400-600 nm. Wavelengths outside of this range are perceived as grey or black — the range of wavelengths perceived as grey is called a neutral point.

**Feature detector:** a specialized cell that aids animals in detecting specific motions. Present in sit-and-wait predators and in flight detection.

**Field of view:** how much of their surroundings an animal can see at a given time. Dependent on eye placement. Lateral placement (eyes on each side of the head) is common in prey and allows for a 360 degree field of view using monocular vision. Front-facing placement is common in predators and, while reducing field of view, increases overlap through binocular vision.

**Focusing aberration:** most simply, aberration is blurring that occurs when light or wavelengths entering the eye at the edge of the lens causes variable focusing, or blurring.

**Ganglion cells:** a kind of photoreceptor cell responsible for distinguishing the brightness, hue, and saturation of visual signals. Ganglion cells respond to input from cones to specify color.

**Iris:** a part of the eye that uses muscle contractions to regulate how much light enters the eye.

**Just-detectable distance:** the distance at which a signal or object can be detected, depending on object size and the impact of distance on contrast (greater distance reduces perceived contrast between an object/signal and its environment).

**Lens:** a transparent tissue covering the eye that mediates light refraction in order to transmit an image to the retina. The lens is “doubly convex,” which allows it to refract light twice onto the retina, producing a more focused image.

**Monochromat:** an animal whose eyes have one visual pigment. Monochromats typically live in darker environments. They can differentiate between intensity/brightness, but not hue.

**Monocular vision:** visual perception produced when eyes independently (without overlap) detect the field of view. Prey species rely more on monocular vision, which allows for a wider but less specific field of vision.

**Motion contrast:** a strategy that animals use to either increase or decrease conspicuousness by adjusting their movements based on their background. Motion contrast is often paired with pattern contrast, as in zebras.

**Object recognition:** the process by which cells in the retina distinguish between objects in an image transmitted through the lens.

**Pattern contrast:** a strategy that animals use to either increase or decrease conspicuousness by either matching or differentiating their bodies with their background through color patches, textures, etc..

**Photoreceptor cell:** a grouping of nerve cells in the retina that receive and process images transmitted through the lens. These cells contain the pigment rhodopsin, which absorbs visible light energy. There are two types of photoreceptor cells: vertebrates use ciliary photoreceptor cells, including rods and cones.

**Pupil:** a hole in the iris that is either widened or shrunk to mediate how much light enters the eye. Round pupils prevent light hitting the edges of the lens from entering the eye, allowing for more focused color vision. Slit pupils are more flexible, allowing animals to have much higher light sensitivity at night and to protect their vision during the day.

**Reflected light spectrum:** describes the color and brightness of the light signal coming directly from the sender, not the background environment.

**Resolution/resolving power:** the ability of an animal eye to distinguish between visual signals or objects. Improving resolution often comes at the expense of sensitivity.

**Retina:** the photosensitive region at the back of the eye, made up of networks of photoreceptor cells and nerve cells, which transmit visual signals to the brain through the central nervous system.

**Rhodopsin:** a pigment present in the membranes of photoreceptors that absorbs visible light. Rhodopsin captures photons of light and converts light energy into a signal, which sets off a cascade of nerve signaling.

**Rod:** a kind of photoreceptor that is used in low-light scenarios and that are highly sensitive to light, but do not produce detailed spatial images.

**Scattering:** occurs when molecules or other scatterers absorb and rerefract light. Scattering can decrease visual resolution, so it is beneficial for eye tissue and the aqueous environment in the eye to be transparent.

**Sensitivity:** the number of photons caught per photoreceptor per second under normal conditions. Improving sensitivity often comes at the expense of resolution.

**Signal detectability:** the sum of contrast threshold, just-detectable distance, a receiver's resolving power, and the sensitivity of the receiver's eye.

**Tetrachromat:** an animal whose eyes have four or five cone pigments. The presence of many cone pigments allows for tetrachromats to perceive the entire visible light spectrum, along with some infrared and UV wavelengths. Tetrachromats can distinguish between very small differences in hue, saturation, and brightness.

**Transmission spectrum:** describes how a light beam attenuates (weakens) over the distance between sender and receiver. The presence of opaque objects, medium absorption, and scattering all impact signal transmission.

**Trichromat:** an animal whose eyes have three cone pigments. Trichromats, unlike dichromats, do not have a neutral point, and can distinguish between colors produced by the visible light spectrum.

**Visible light:** the range of wavelengths (~300-800 nm) in the electromagnetic spectrum that animals use for visual signaling and communication.