Week 6-2
Perception and Vision

SFWRENG 4HC3/6HC3 Human Computer Interfaces

** Slides adapted from previous instructors of COMPSCI/SFWRENG 4HC3/6HC3*

McMaster University

Human-Centered Design

"an approach that puts **human needs, capabilities**, **and behavior** first, then designs to accommodate **those needs, capabilities, and ways of behaving**."

Understanding Users

Understanding the user is critical to the success of any interactive system

Two components:

1. **Needs** with respect to specific system being designed (e.g., expertise, tasks, procedures, context-of-use)
2. **Fundamental human characteristics** (e.g., vision, memory, cognition)

Week 6 Overview

- ~~**Monday**~~
  - ~~Task Analysis and HTA~~
- **Wednesday**
  - **Perception and Vision**
- **Friday**
  - UI/UX and HCI Research

The Human

A **simplified view** of “the human” involves:

- **Input/output** (vision, auditory, haptic; movement, voice)
- **Memory** (short term, long term, sensory)
- **Processing** (cognition, problem solving, learning, etc…)

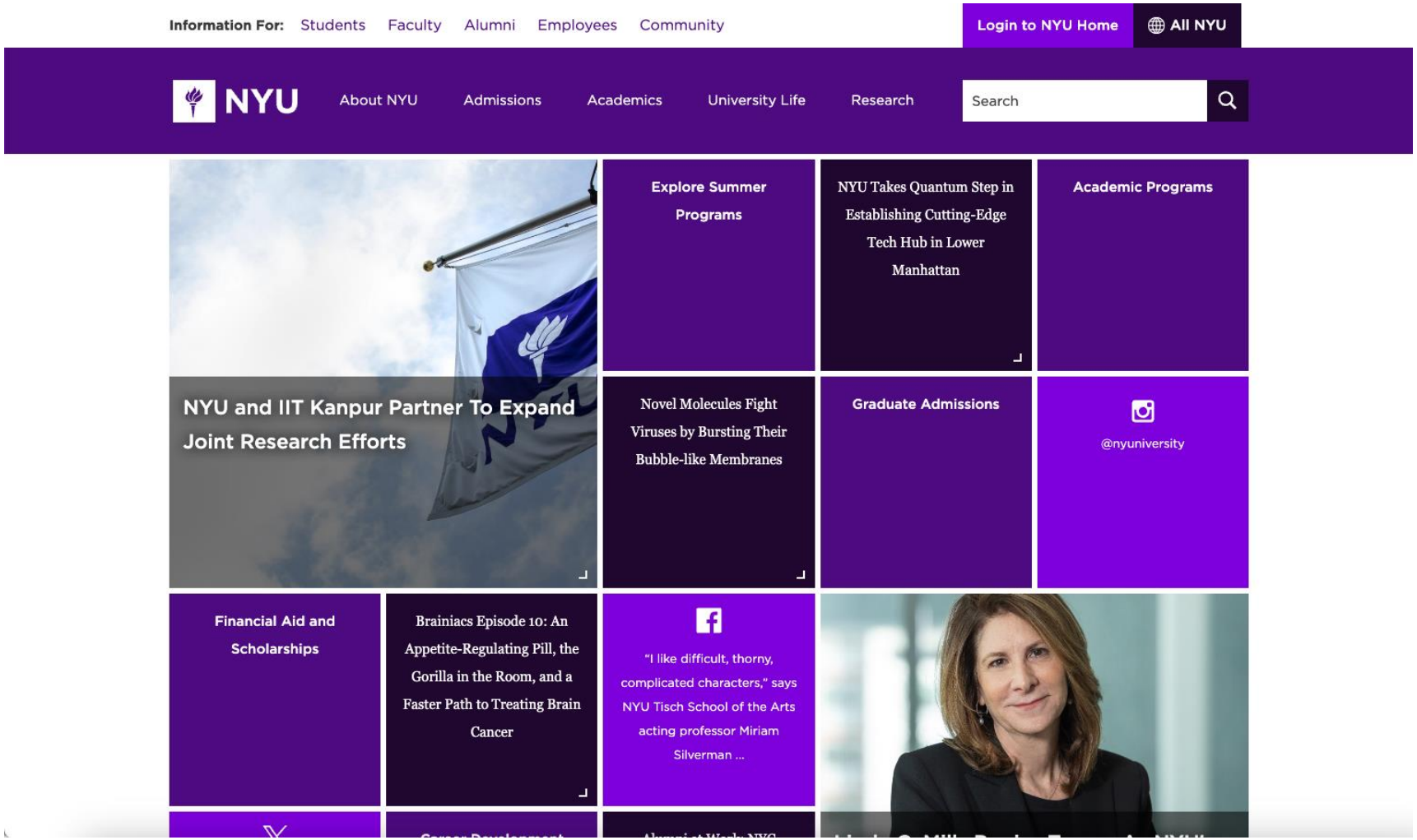
Each person is **different** in these aspects!

Perception (input/output)

Perception is the processing of **sensory information** to see, hear, taste, smell, or feel objects in the world

- **Vision** is a dominant form of perception
- Need to **understand perceptual phenomenon** for proper visual designs
    - Impacts a number of design issues including:
        - What **elements** are easily distinguishable
        - What draws **attention**

Design Example



Good or bad design?

Vision

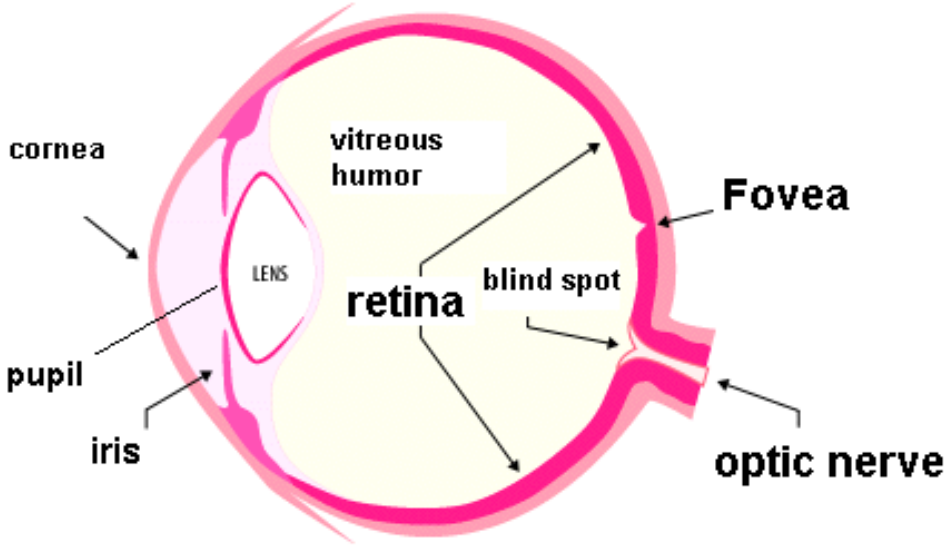
Two stages in vision

1. Physical reception of stimulus **(EYE)**
2. Processing and interpretation of stimulus **(BRAIN)**
    - Size and depth
    - Color
    - Patterns

The Eye: Physical Reception

Sensing begins at the retina, which has two type of sensors

- **Cones:** detect color
- **Rods:** intensity, gray
  - Primarily for night vision & perceiving movement



The Eye: Physical Reception

Center of retina (fovea) has the highest concent

IMPLICATION:

Allows for high acuity of objects focused at center

The Eye: Physical Reception

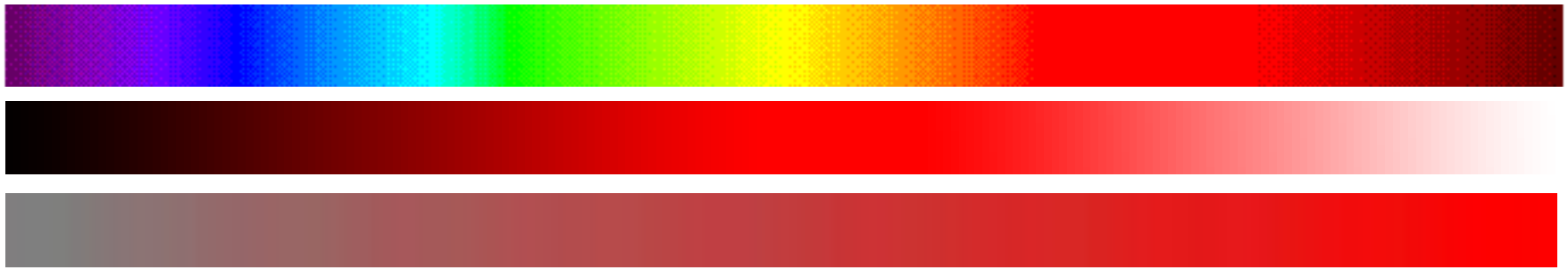
Rods are mostly located in the periphery

IMPLICATION:

We are sensitive to motion in the periphery

Color Components: HSI/L Model

- **Hue** is the property of the wavelength of light (i.e. color) such as red or yellow
- **Lightness** is the amount of white or black in a color (brightness). Some hues are inherently lighter or darker
- **Saturation** is the strength or purity of the hue in a color. The higher the saturation, the purer the color, i.e. red is more saturated than pink. Lower saturation -> more grey



Interpreting the Signal: Color

Process:

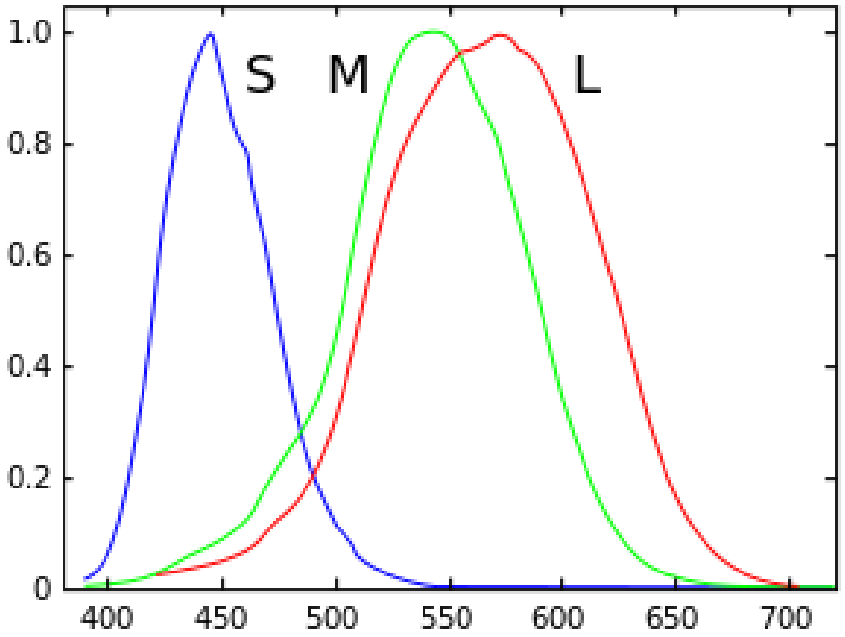
- Light source (emitting a distribution of colored wavelengths of light) **strikes** a colored object
- Object **reflects** light in another particular distribution of colored wavelengths → **received** by the photoreceptors of the human eye
- **Sent** as a stimulus to the brain, causing us to **perceive** color

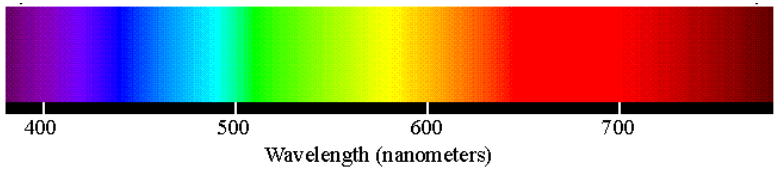
How Light Becomes Color

Cones (not rods) are sensitive to **particular wavelengths** of light

Three basic groups of cones:

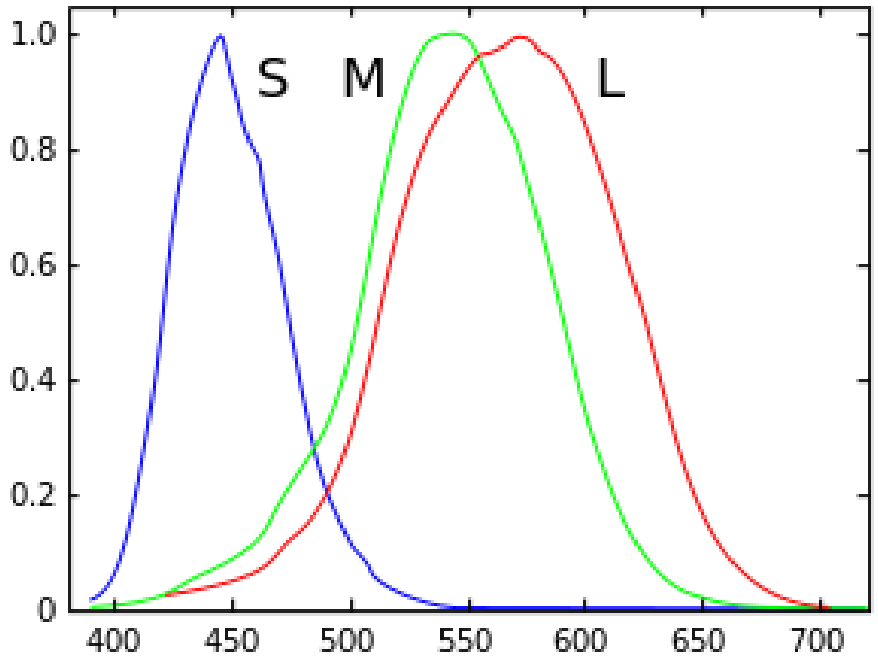
- 430nm light, 530nm light, 560nm light
- **Our brains** interpret these differently because they are **separate cones**. They become blue, green, and red.
- But we can see more than just those three colors!

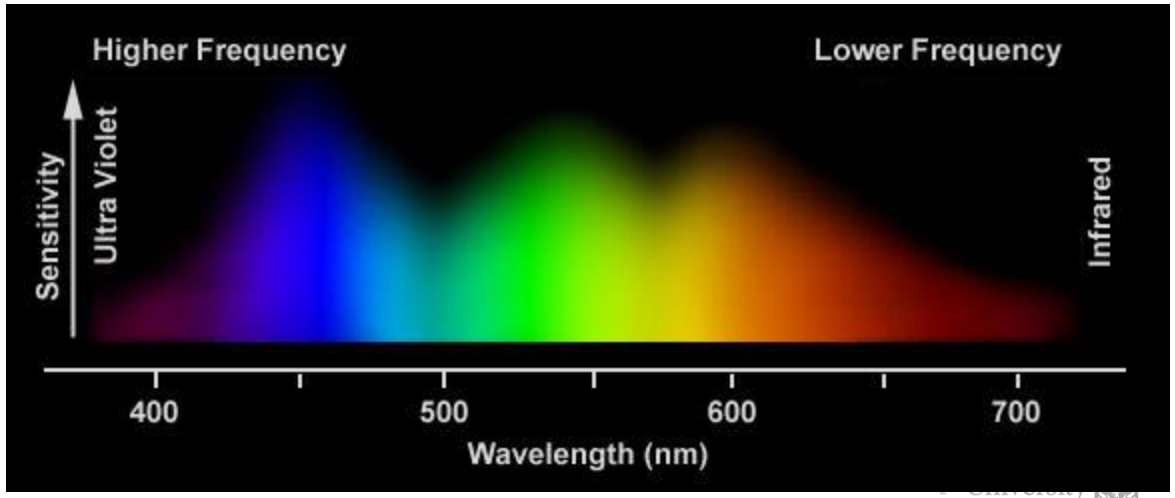




Color “Chording”

- Our brain **“guesses” (extrapolates?)** the wavelength based on the three sensor values
- Our eyes are not actually sensitive to light at, e.g., the **aqua wavelength**
- **Implication:** not all colors are equal. We have varying sensitivity to different colors





Color Sensitivity

Cones are **unequally** distributed (~ 60% red, 30% green, 10% blue)

Center of retina (high acuity) has **no** blue cones

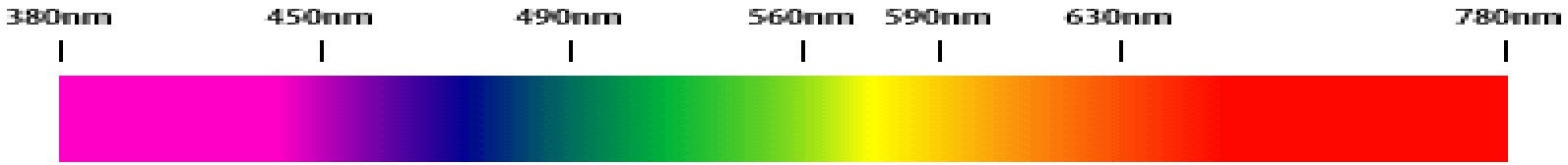
- **IMPLICATION:** disappearance of small blue objects you fixate on

Most sensitive to the **center** of the color spectrum

- **IMPLICATION:** blues & reds must be brighter than greens & yellows

Shapes are detected by **finding and contrasting edges**

- **IMPLICATION:** lower contrast with blue, so harder to find edges. hard to deal with blue edges and shapes



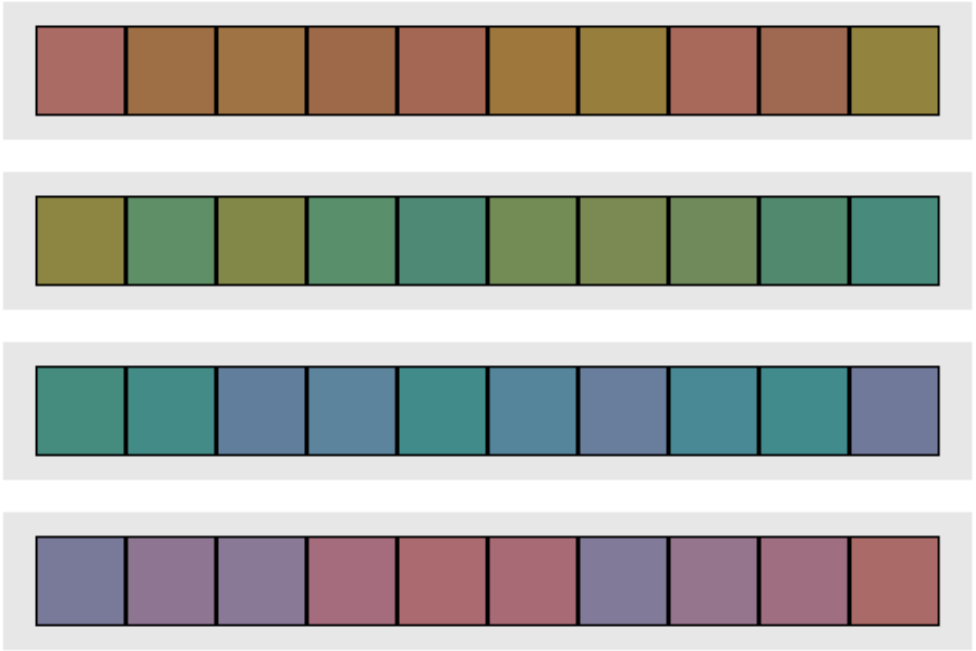
Quick Break

Test your color IQ

https://www.xrite.com/hue-test

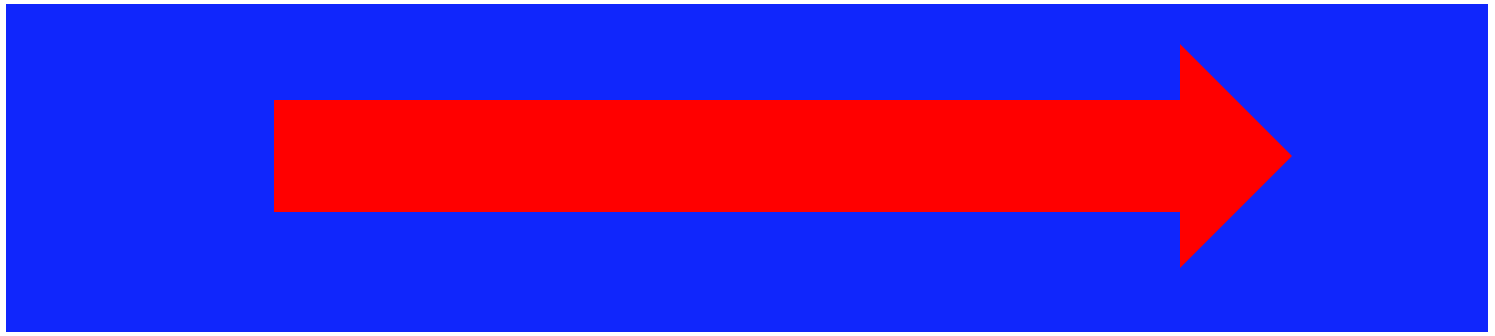
Different on Everyone

- Everyone perceives color **differently**
- **Device capabilities** also affect how people see color



Interpreting Color

- Different wavelengths of light **focus at different distances** behind eye's lens
  - i.e., red appears closer than blue (chromostereopsis)
- **Difficult to focus** because one color is fuzzy when the other is in focus
  - Need for constant **refocusing**
  - **IMPLICATION**: Careful about color combinations



Interpreting Color

As we age, lens becomes yellow

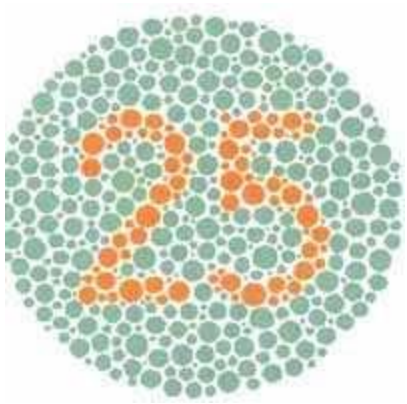
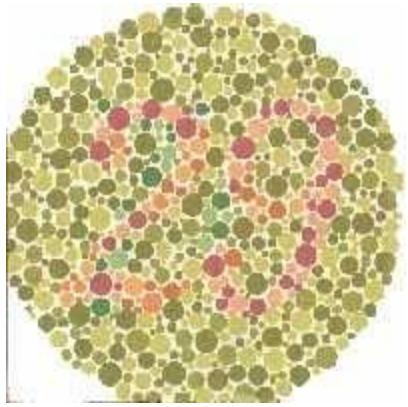
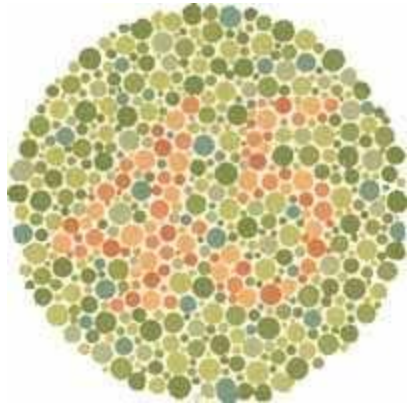
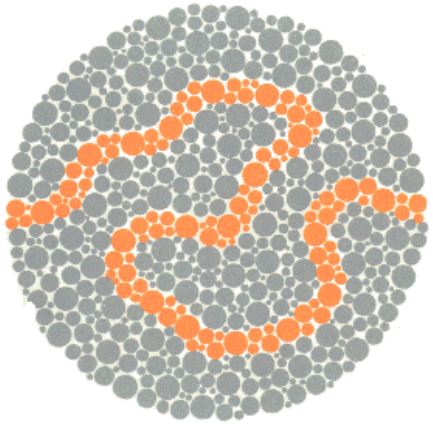
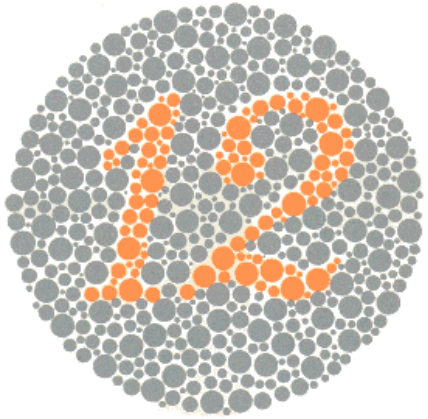
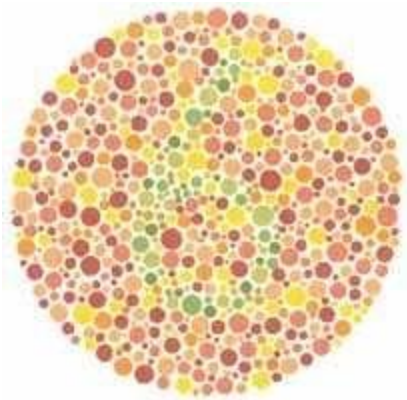
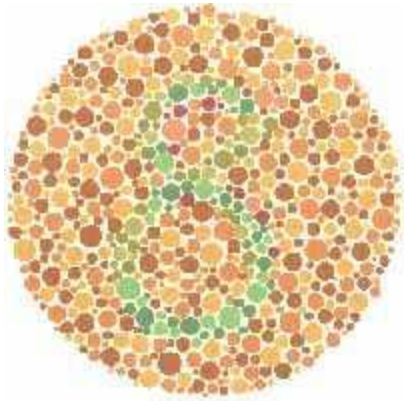
- **Absorbs the shorter wavelengths**
- Sensitivity to blue is reduced

IMPLICATION: don’t rely on blue for text or small objects

Color Deficiency

- Also referred as color blindness
- Approximately 8% of human males, along with a rare sprinkling of females, have some form of color blindness
- Most common is known as **red/green** color blindness
- Usually, a lack of red cones, **OR**, cones attuned to a non-standard wavelength (too much overlap)

Ishihara Test

Use of Color

Color is an **extremely valuable** tool in design

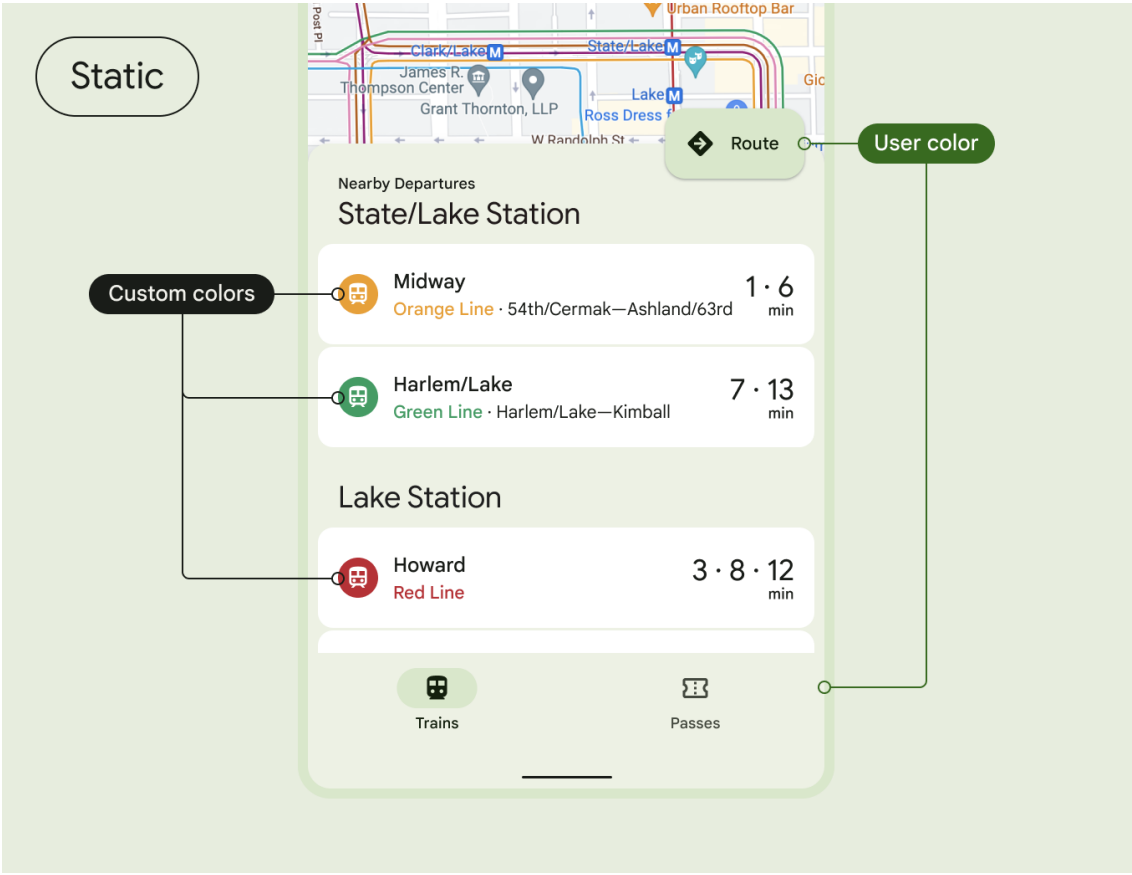
But when using color, we also need to exercise caution

- Cannot **detect color differences** in the periphery
- **Certain colors** more easily detectable (e.g., blue has low sensitivity)
- Need to design for **color blindness**

Use of Color

If you use color in the interface, should also use clear, secondary cues to convey the information for those with deficiencies

- Grey scale differentiation
- **Different** graphics/labels associated with **each color**



Use of Color: Color Symbolism

People have emotional responses to color:

- Red is associated with danger and aggression
- Blue is associated with serenity and wisdom
- Green is associated with money (US)

There are also **cultural differences**

- Mourning is symbolized by white in East Asia, black in the North America

Color for Contrast

Contrasting is useful for drawing attention, viewing detailed information, but be careful with color choices

The larger the items, the less contrast needed

Examples of high contrast:

black on white

dark green on white

white on purple

Examples of low contrast:

yellow on white

blue on black

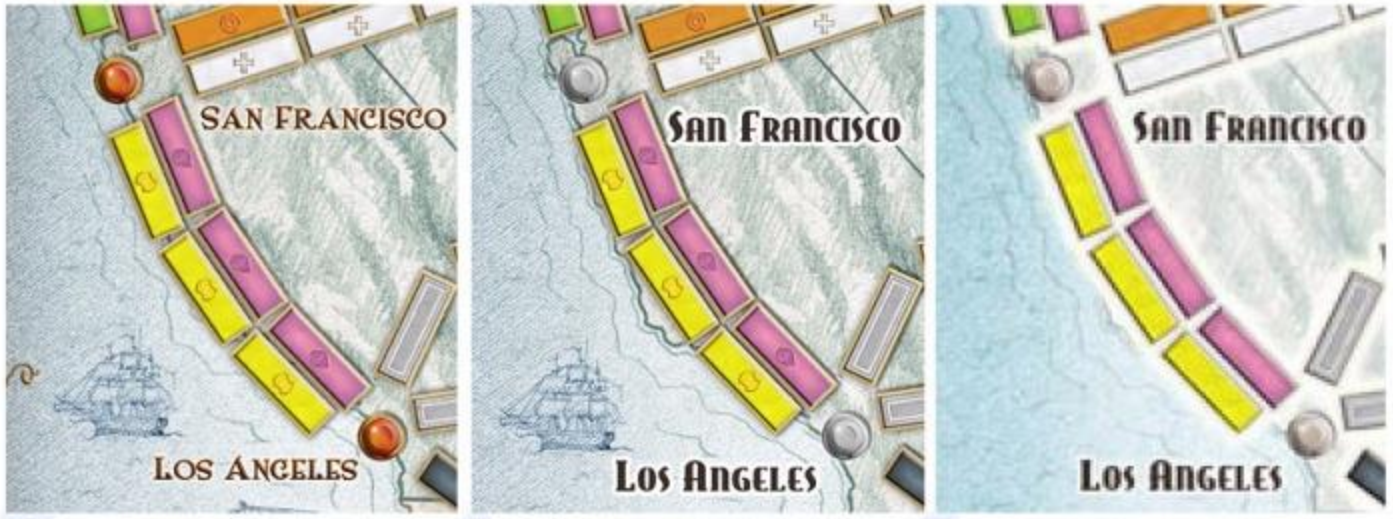
Contrast

There are a number of tools available to test whether color combinations provide sufficient contrast:

- https://accessibleweb.com/color-contrast-checker/
  - (also available as plugin)
- http://webaim.org/resources/contrastchecker/

Summary of Color

- Cannot easily detect **color differences in the periphery**
- Certain colors more **easily detectable** (e.g., blue has low sensitivity)
- Need to design for **color blindness/aging users**
- Color is awesome, but **DON'T RELY ON IT**



Beyond Color : Patterns and Shapes

Higher-level visual system is capable of perceiving **forms and patterns**

Contrast helps define object borders

Gestalt Principles

- Set of principles describing how our mind perceives wholes out of incomplete elements
- Extremely useful in **creating structure** in an interface

Practice
Examine Website Color Usage

Examine Website Color Usage

You can either do this solo or work with others – We are going to examine the how good the color usage is on a website by examining their color contrast. Pick one website and perform the check:

- If you don't know which website to start, you can pick McMaster's website: https://www.mcmaster.ca/.
- There are several ways to look at the color contrast:
  - You can do that manually using tool https://webaim.org/resources/contrastchecker/
  - For some components you can also look up the contrast ratio in the Developer Tool in Chrome
  - There might also be browser plugins for you to use for examining the contrast ratio: https://accessibleweb.com/color-contrast-checker/
  - You can also quickly run a greyscale check, by modifying the css directly (greyscale is a little different from the contrast ratio but you can easily get an idea of where might go wrong)
- Generally speaking, WCAG 2.0 level AA requires a contrast ratio of at least 4.5:1 for normal text and 3:1 for large text. WCAG 2.1 requires a contrast ratio of at least 3:1 for graphics and user interface components (such as form input borders).
- **Any color usage you found might be problematic?**

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