

# CMSC 435

## Introductory Computer Graphics

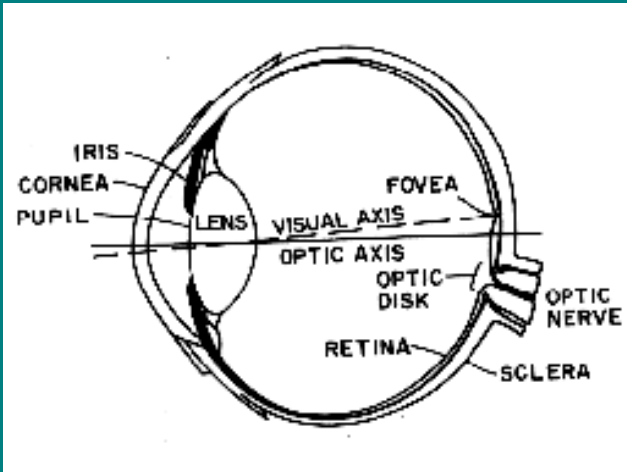
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UMBC

## Light

- Visible range: 390-700nm
- Luminance has a large dynamic range:
  - 0.00003 -- Moonless overcast night sky
  - 30 -- Sky on overcast day
  - 3000 -- Sky on clear day
  - 16,000 -- Snowy ground in full sunlight
- Actual colors result from spectral curves
  - dominant wavelength, hue
  - brightness, lightness
  - purity, saturation

## Physiology: Eye

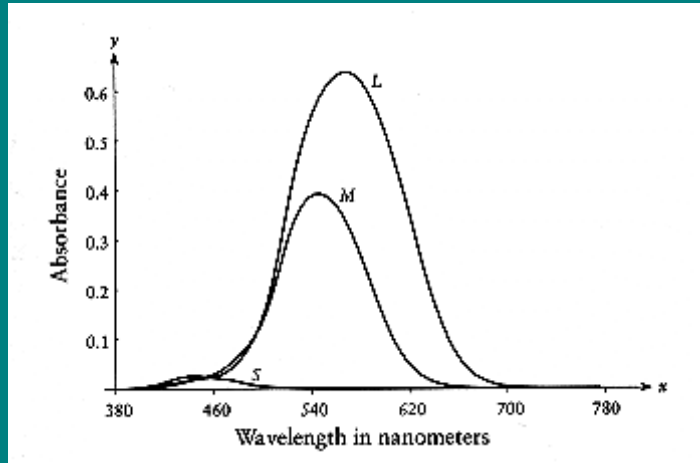
- Cornea
- Iris
- Lens
- Retina
- Optic nerve



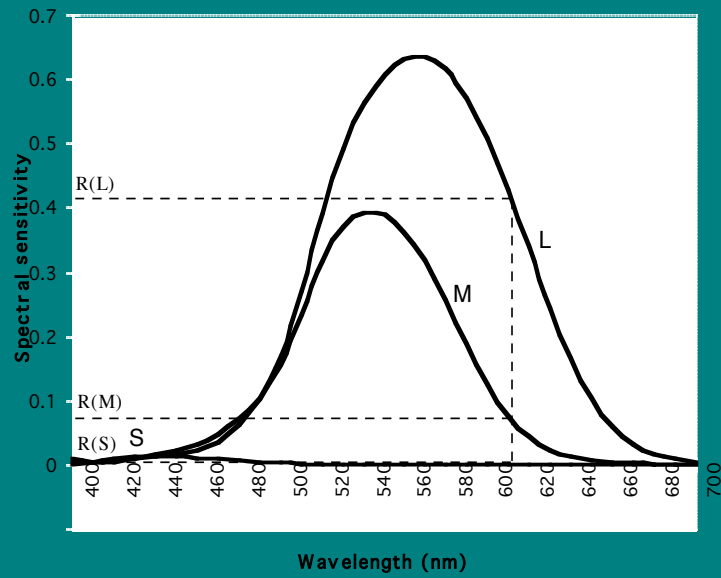
## Physiology: Receptors

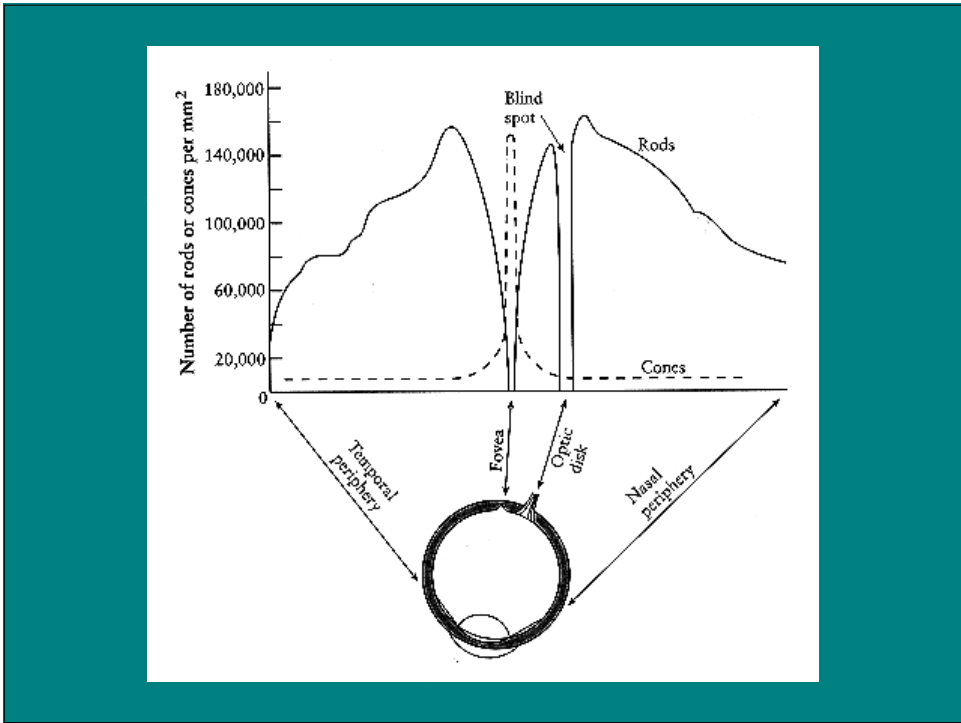
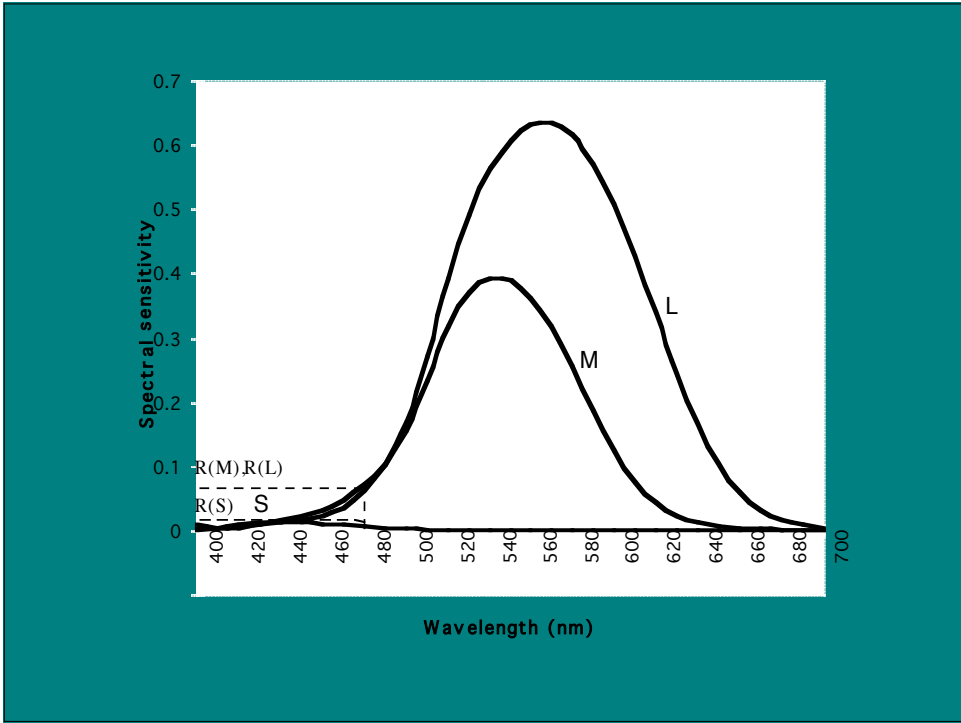
- Rods
  - active at low light levels (scotopic vision)
  - only one wavelength sensitivity function
- Cones
  - active at normal light levels
  - three types: sensitivity functions with different peaks

# Cone Sensitivity Functions



- Glasner '95, p. 16.

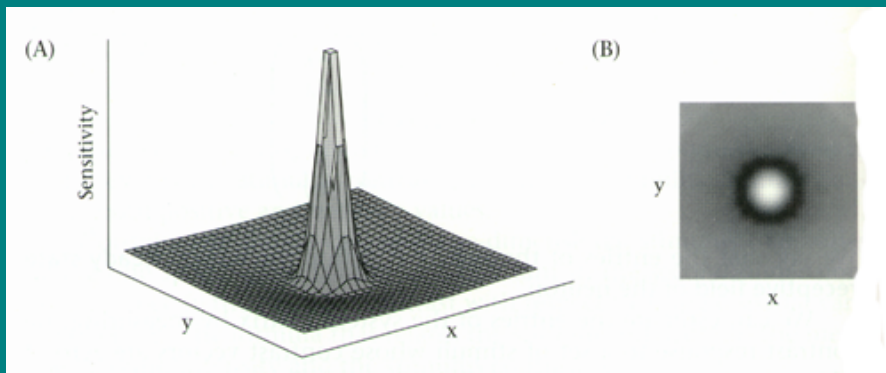


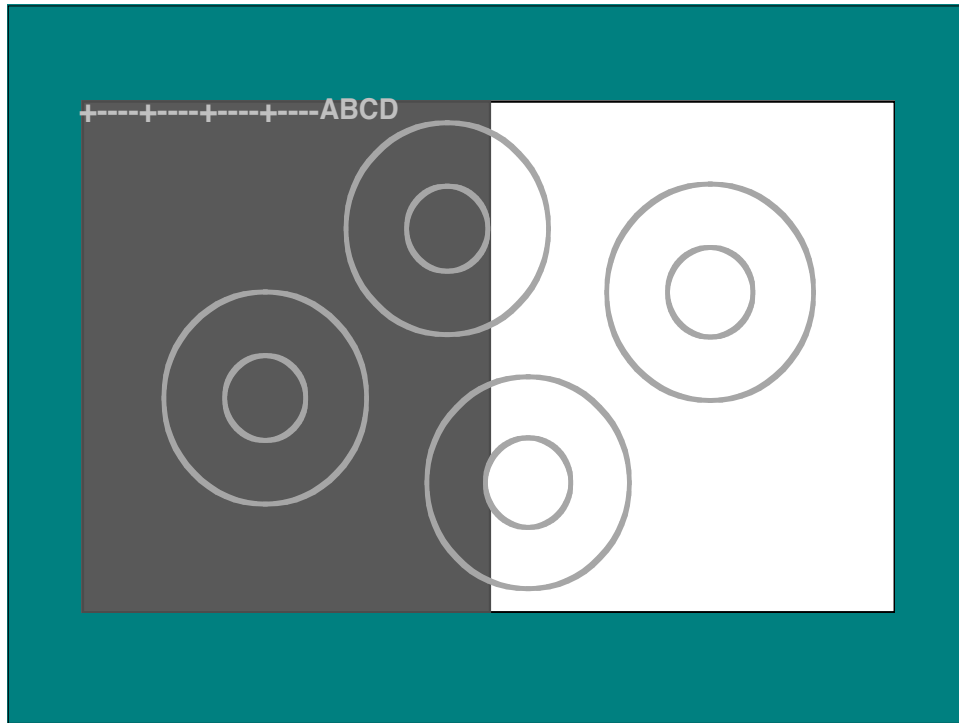


## Physiology: Ganglia

- Transform incoming SML into opponent color responses
  - G - R
  - Y - B ( $Y = R+G$ )
  - W ( $W \cong R+G$ )
- Characteristics
  - concentric receptive fields
  - logarithmic response of receptors
  - adaption

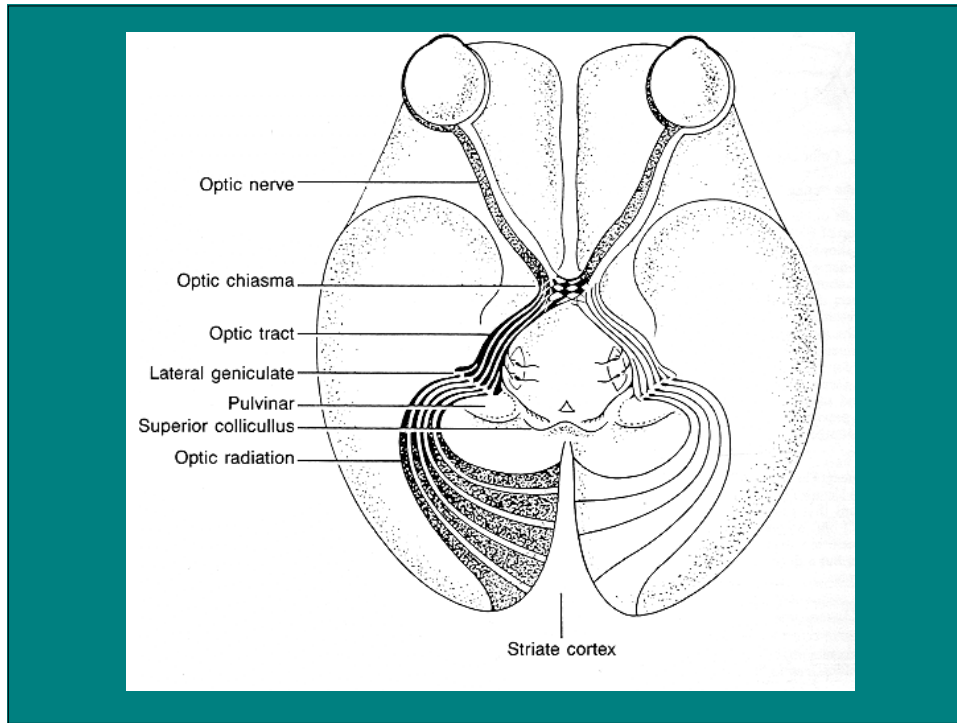
## Center-surround Receptive Fields





## Physiology: Brain

- Lateral geniculate nuclei
  - assemble data for single side of visual field
  - 2 monochromatic layers => magnocellular path
  - 4 chromatic layers => parvocellular path
- Visual cortex
  - orientation
  - end-stopped
  - ocular dominance
  - spatial frequency
- Feedback from cognitive levels to earlier stages



## Magnocellular Division

- Role in vision
  - identify objects and boundaries
  - depth perception
  - motion perception
- Characteristics
  - color: achromatic
  - acuity: large RF centers
  - speed: fast, transient response

## Parvocellular Division

- Role in vision
  - discrimination of fine detail
  - color
- Characteristics
  - color: sensitive to wavelength variations
  - acuity: small RF centers
  - speed: relatively slow response

## Human Visual Characteristics

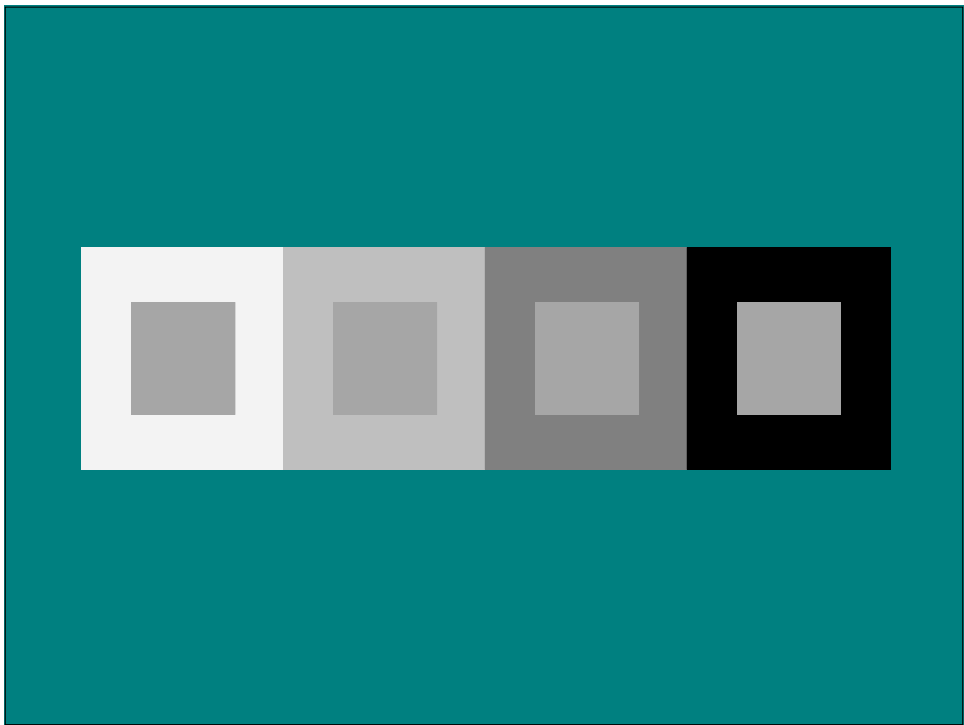
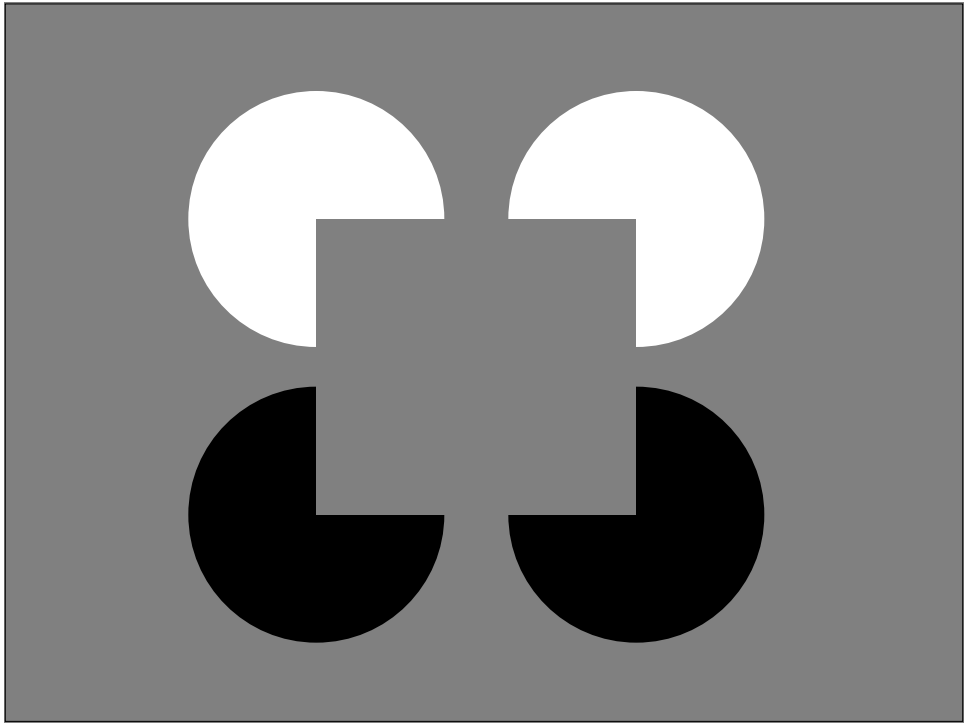
- Contrast sensitivity influenced by spatial frequency
- Adaption
- Communication between neighboring receptors
- Illusions

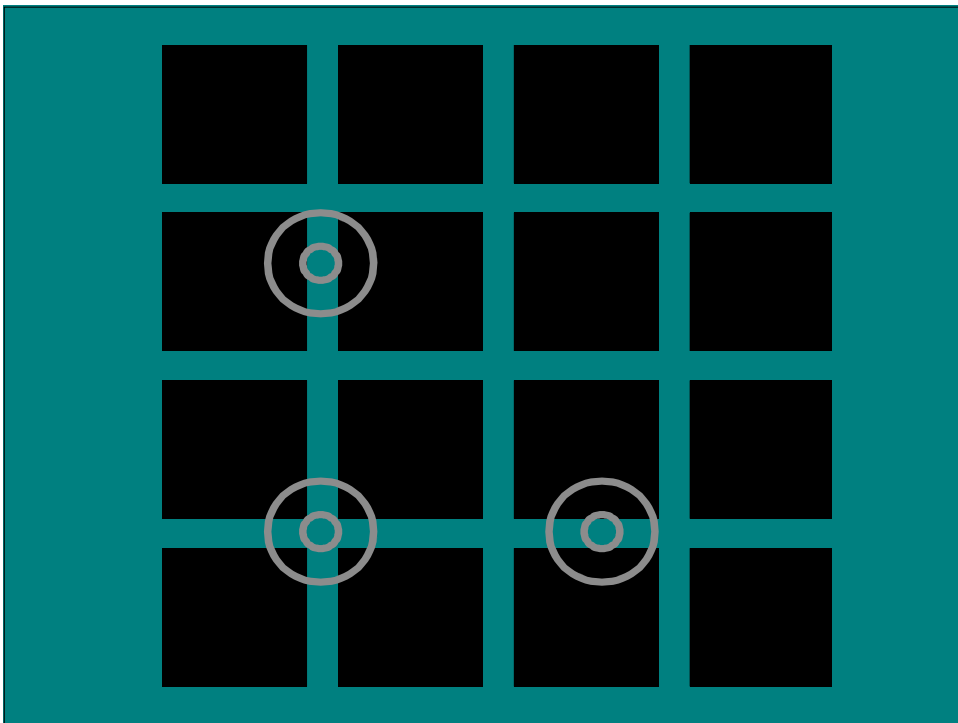
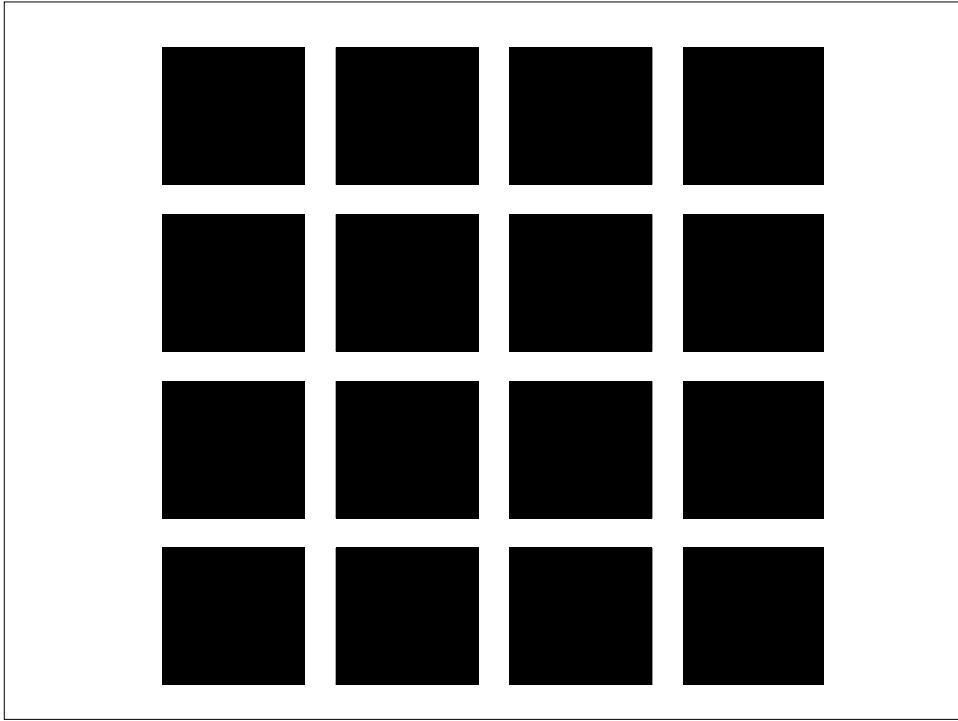


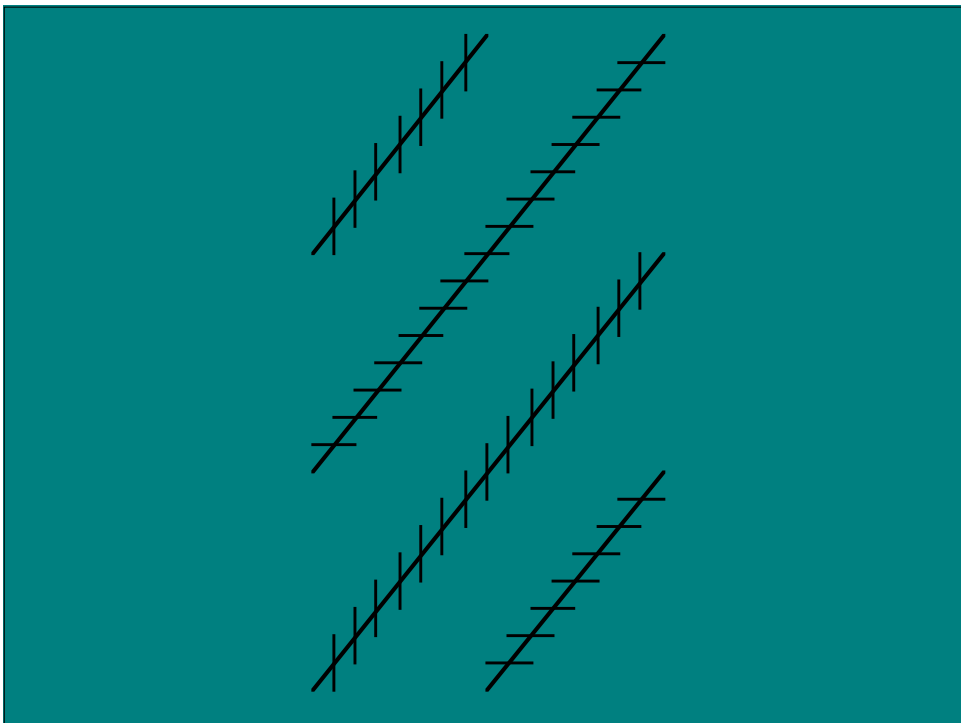
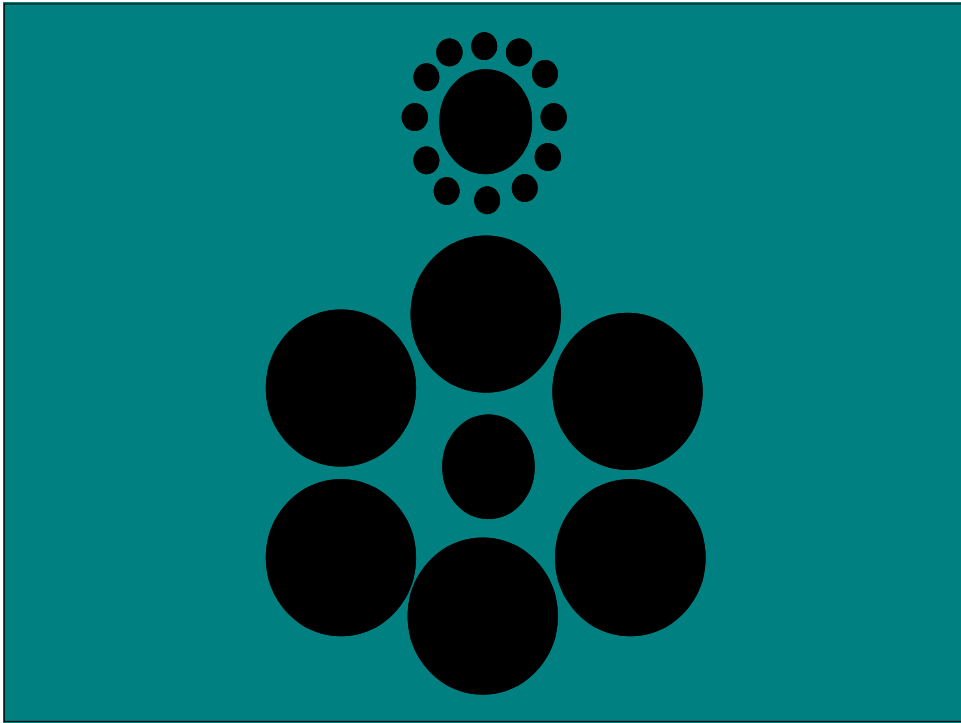
## Communication between Receptors

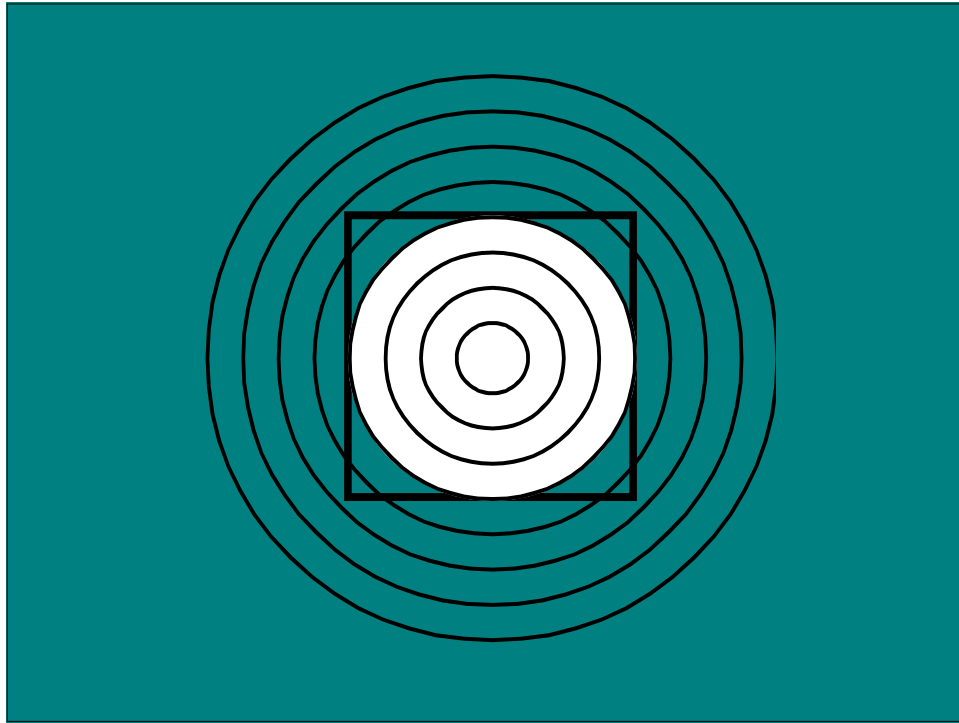
- Edge completion: subjective contours
- Relative judgements
  - intensity
  - size
  - slope
- Constancy
  - lightness
  - simultaneous contrast
- Tolerance of noise











## Illusions

- Feedback from higher visual processes
- 3D interpretation of 2D drawings
- Expectations from experience

