

# BIO-1230: ANATOMY AND PHYSIOLOGY OF THE EYE

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## Cuyahoga Community College

**Viewing: BIO-1230 : Anatomy and Physiology of the Eye**

**Board of Trustees:**

March 2023

**Academic Term:**

Fall 2023

**Subject Code**

BIO - Biology

**Course Number:**

1230

**Title:**

Anatomy and Physiology of the Eye

**Catalog Description:**

Detailed examination of the anatomy and physiology of the eye. Emphasis on ocular terminology, structure, function, movement, disorders, diseases, lens physics, and visual testing/analysis. Study of eye model and preserved eye dissection.

**Credit Hour(s):**

4

**Lecture Hour(s):**

3

**Lab Hour(s):**

3

**Other Hour(s):**

0

## Requisites

**Prerequisite and Corequisite**

Departmental approval: admission to Optical Technology program.

## Outcomes

**Course Outcome(s):**

Apply fundamental knowledge of ocular anatomy and physiology to didactic and clinical experiences in the ophthalmic professions.

**Objective(s):**

- a. Explain how the skeletal, muscular, cardiovascular and nervous systems pertain to ocular physiology.
- b. Identify medical terminology that will be utilized in ophthalmic record keeping.
- c. Discuss the visual processing and identify factors that impact healthy vision.
- d. Describe ophthalmic treatments, including prescription lenses, ophthalmic surgeries and medications.
- e. Identify ocular structures and describe their function.
- f. Describe ocular conditions and their symptoms.
- g. Describe and list the different levels of structural organization of the body.
- h. Describe the structure of the cell and explain the function of cellular organelles.
- i. Discuss the function of the cell membrane as it relates to active transport, generation of an action potential and receptor binding.
- j. Identify directional terminology as it applies to the brain and eye.
- k. Discuss the physiology, conditions and evaluation techniques that are associated with each ocular structure.
- l. Apply fundamental knowledge of ocular anatomy and physiology to spectacle and contact lens fitting.

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**Course Outcome(s):**

Apply fundamental knowledge of ocular anatomy and physiology to attain professional credentials.

**Objective(s):**

- a. Identify medical terminology that will be utilized in ophthalmic record keeping.
- b. Discuss the visual processing and identify factors that impact healthy vision.
- c. Describe ophthalmic treatments, including prescription lenses, ophthalmic surgeries and medications.
- d. Identify ocular structures and describe their function.
- e. Describe ocular conditions and their symptoms.
- f. Identify directional terminology as it applies to the brain and eye.
- g. Discuss the physiology, conditions and evaluation techniques that are associated with each ocular structure.
- h. Apply fundamental knowledge of ocular anatomy and physiology to spectacle and contact lens fitting.

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**Course Outcome(s):**

Discuss key concepts of applied ocular anatomy and physiology with patients and ophthalmic professionals.

**Objective(s):**

- a. Discuss the visual processing and identify factors that impact healthy vision.
- b. Describe ophthalmic treatments, including prescription lenses, ophthalmic surgeries and medications.
- c. Identify ocular structures and describe their function.
- d. Describe ocular conditions and their symptoms.
- e. Identify directional terminology as it applies to the brain and eye.
- f. Discuss the physiology, conditions and evaluation techniques that are associated with each ocular structure.
- g. Apply fundamental knowledge of ocular anatomy and physiology to spectacle and contact lens fitting.

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**Methods of Evaluation:**

- a. Exams
- b. Lab exams
- c. Group projects
- d. Peer evaluation

**Course Content Outline:**

- a. Introduction
  - i. Definitions
    1. Anatomy
    2. Physiology
  - ii. Levels of organization
    1. Chemicals
    2. Cells
    3. Tissues
    4. Organs
    5. Systems
    6. Organisms
  - iii. Directional terms
  - iv. Planes
    1. Sagittal
    2. Coronal
    3. Transverse
  - v. Cell structure
    1. Cell membrane
      - a. Structure
        - i. Phospholipid bilayer
        - ii. Integral proteins

- iii. Ion channels
      - 1. Non-gated ion channels
      - 2. Ligand gated
      - 3. Voltage gated
    - 2. Functions
    - 3. Membrane transport
      - a. Active processes
      - b. Passive processes
  - vi. Cytoplasm
  - vii. Organelles
    - 1. Nucleus
    - 2. Ribosomes
    - 3. Endoplasmic reticulum
    - 4. Golgi apparatus
    - 5. Mitochondria
    - 6. Lysosomes
- b. Skeletal system
  - i. Regions
    - 1. Axial
    - 2. Appendicular
  - ii. Skull (axial skeleton)
    - 1. Structure
    - 2. Function
  - iii. Orbit
    - 1. Structure
    - 2. Function
- c. Muscular system
  - i. Types
    - 1. Skeletal
    - 2. Smooth
    - 3. Cardiac
  - ii. Extraocular muscles
    - 1. Function
    - 2. Innervation
    - 3. Position of gaze
  - iii. Palpebral muscles
  - iv. Ciliary muscle
  - v. Muscles of the iris
  - vi. Yoked muscles
- d. Cardiovascular system
  - i. Heart
  - ii. Vessels
    - 1. Arteries
    - 2. Capillaries
    - 3. Veins
  - iii. Circulatory routes
    - 1. Systemic circulation
    - 2. Pulmonary circulation
  - iv. Vascular tunic of the eye
    - 1. Iris
    - 2. Ciliary body
    - 3. Choroid
- e. Nervous system
  - i. Organization
    - 1. Central nervous system
    - 2. Peripheral nervous system
  - ii. Histology
    - 1. Neuroglia
      - a. Function
      - b. Types

2. Neurons
  - a. Structure
    - i. Axon
    - ii. Dendrite
    - iii. Cell body
  - b. Classification
    - i. Structure
    - ii. Function
- iii. Physiology
  1. Nerve impulse
    - a. Resting potential
    - b. Action potential
    - c. Repolarization
    - d. Refractory period
    - e. Saltatory conduction
    - f. Speed of transmission
  2. Conduction across a synapse
- iv. Neural layer of the eye
  1. Retinal pigment epithelium
  2. Layers of the retina
    - a. Photoreceptor layer
    - b. External limiting membrane
    - c. Outer nuclear layer
    - d. Outer plexiform layer
    - e. Inner nuclear layer
    - f. Inner plexiform layer
    - g. Ganglionic layer
    - h. Fibers to optic nerve
- v. Brain
  1. Brain stem
    - a. Medulla oblongata
    - b. Pons varolii
    - c. Midbrain
  2. Diencephalon
    - a. Thalamus
    - b. Hypothalamus
  3. Cerebrum
    - a. Cortex
    - b. Hemispheres
  4. Cerebellum
  5. Cranial nerves
- vi. Motor, sensory and integrative functions
  1. Sensory functions
    - a. Receptors
    - b. Cranial nerves with ocular sensory function
  - c. Visual pathway
    - i. Retina
      1. Photoreceptors
        - a. Rods
        - b. Cones
      2. Bipolar cells
      3. Ganglion cells
      4. Horizontal cells
      5. Amacrine cells
    - ii. Optic nerve
    - iii. Optic chiasm
    - iv. Optic tract
    - v. Lateral geniculate nucleus

- vi. Optic radiations
- vii. Visual cortex
- 2. Motor function
  - a. Extraocular muscles
  - b. Cranial nerve innervation of ocular structures
- 3. Integrative functions
- vii. Anatomy and physiology of the eye
  - 1. Bones of the orbit
  - 2. Ocular anatomy
    - a. Tear film
      - i. Lipid layer
      - ii. Aqueous layer
      - iii. Mucin layer
    - b. Cornea
      - i. Epithelium
      - ii. Bowman's layer
      - iii. Stroma
      - iv. Descemet's membrane
      - v. Endothelium
    - c. Limbus
    - d. Sclera
    - e. Conjunctiva
      - i. Bulbar conjunctiva
      - ii. Conjunctival fornix
      - iii. Palpebral conjunctiva
    - f. Anterior chamber
    - g. Posterior chamber
    - h. Vitreous body
      - i. Pupil
      - j. Ciliary muscle
    - k. Zonules
    - l. Crystalline lens
    - m. Uvea
      - i. Iris
      - ii. Ciliary body
      - iii. Choroid
    - n. Adnexa
      - i. Eyebrow
      - ii. Conjunctiva
      - iii. Palpebrae
      - iv. Lacrimal system
    - o. Extraocular muscles
      - i. Superior rectus
      - ii. Inferior rectus
      - iii. Medial rectus
      - iv. Lateral rectus
      - v. Superior oblique
      - vi. Inferior oblique
    - p. Optic Nerve
    - q. Ocular physiology
      - i. Corneal physiology
      - ii. Lacrimal dynamics
        - 1. Production
          - a. Goblet cells
          - b. Lacrimal gland
          - c. Meibomian gland
        - 2. Drainage
      - iii. Aqueous dynamics

1. Production
  2. Drainage
  - iv. Physiology of the Iris
  - v. Ocular motility
  - vi. Accommodation
  - vii. Photopic vision
  - viii. Scotopic vision
  - ix. Binocular vision
  - x. Visual fields
- viii. Ocular Disorders
1. Refractive Errors
  2. Astigmatism
  3. Presbyopia
  4. Strabismus
  5. Amblyopia
  6. Cataract
  7. Disorders of the skin and lids
    - a. Blepharitis
    - b. Chalazion
    - c. Dermatochalasis
    - d. Ectropion
    - e. Entropion
    - f. Ptosis
  8. Disorders of the conjunctiva
    - a. Conjunctivitis
      - i. Allergic conjunctivitis
      - ii. Bacterial conjunctivitis
      - iii. Giant papillary conjunctivitis
      - iv. Viral conjunctivitis
    - b. Pinguecula
    - c. Pterygium
  9. Disorders of the cornea
    - a. Arcus senilis
    - b. Corneal dystrophy
    - c. Keratitis
    - d. Keratoconus
    - e. Neovascularization
    - f. Corneal ulcer
  10. Disorders of the anterior chamber
    - a. Glaucoma
    - b. Hyphema
    - c. Hypopyon
    - d. Narrow angles
  11. Disorders of the iris and pupil
    - a. Anisocoria
    - b. Argyll Robertson's Syndrome
    - c. Iris synechia
    - d. Marcus Gunn pupil
    - e. Uveitis
  12. Disorders of the retina
    - a. Retinopathy
    - b. Age-related macular degeneration
    - c. Retinal detachment
  13. Disorders of the optic nerve
    - a. Cupping
    - b. Optic neuritis
    - c. Papilledema
- ix. Basic examination techniques

1. Applanation tonometry
2. Color vision test
3. Corneal topography
4. Cross cover test
5. History
6. Hirschberg test
7. Keratometry
8. Lensometry
9. Ocular motility
10. Pachymetry
11. Pupil evaluation
12. Refractometry
13. Retinoscopy
14. Schirmer's test
15. Slit-lamp examination
16. Visual acuity
  - a. Snellen chart
  - b. Jaeger chart
17. Visual fields
  - a. Amsler grid
  - b. Confrontation fields
  - c. Perimetry
- x. Basic overview of ophthalmic surgery
- xi. Basic overview of ophthalmic pharmacology
- xii. Basic overview of ophthalmic medical terminology
- xiii. Corrective lenses
  1. Spectacle lenses
  2. Contact lenses
  3. Prescription for lenses
  4. Scope of practice

## Resources

Contact Lens Society of America. *Contact Lens Manual Volume 1*. 1st. St. Paul: Contact Lens Society of America, 2016.

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Dingman, Marc. *Your Brain, Explained: What Neuroscience Reveals About Your Brain and its Quirks*. Boston, MA: Nicholas Brealey Publishing, 2019.

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Efron, Nathan. *Contact Lens Practice*. 3rd. China: Elsevier, 2017.

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Ledford, Janice and Roberto Pineda II. *The Little Eye Book*. 2nd. Thorofare, NJ: Slack, 2008.

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Stein, Harold et al. *The Ophthalmic Assistant*. 11th. Elsevier, 2022.

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Remington, Lee Ann. *Clinical Anatomy of the Visual System*. 3rd. Butterworth-Heinemann, 2012.

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Root, Timothy. *Ophthobook Questions Volume 1*. 1st. CreateSpace Independent Publishing Platform, 2016.

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Root, Tim. *Ophthobook Questions: Volume 1*. United States of America: CreateSpace Independent Publishing Platform, 2016.

### Resources Other

<https://www.aoa.org/patients-and-public/caring-for-your-vision/contact-lenses?sso=y> (<https://www.aoa.org/patients-and-public/caring-for-your-vision/contact-lenses/?sso=y>)

<https://www.brainfacts.org/>

<https://www.cdc.gov/contactlenses/index.html> (<https://www.cdc.gov/contactlenses/>)

<https://www.clspectrum.com/>

<https://www.clspectrum.com/CLASS> (<https://www.clspectrum.com/CLASS/>)

<https://thecrashcourse.com/courses/anatomy?page=2> (<https://thecrashcourse.com/courses/anatomy/?page=2>)

<http://www.gpli.info/online-curriculum/>

<https://www.neuroscientificallychallenged.com/>

<http://www.optiboard.com/forums/>

<http://www.optiboard.com>

<http://www.quantumoptical.com/>

<https://www.reviewofoptometry.com/>

<https://timroot.com/videos/>

<https://www.youtube.com/doctoreyehealth> (<https://www.youtube.com/doctoreyehealth/>)

Top of page

Key: 913