

ZOOLOGY 331  
Lecture Outline

A. General metabolic functions

I. Nutrition

Foods, food factors, and their sources

General foods

Essential foodstuffs

Feeding mechanisms

Mechanisms for small particles

Mechanisms for large particles

Mechanisms for soft tissues and fluids

Digestion

Intracellular

Extracellular

✓ Digestive enzymes

*Trager - Physiol. Rev. 1941*

*Young - Biol. Rev. 1928*

*Young - Biol. Rev. 1937*

*Vauk - " " "*

II. Respiration

Aerobic and anaerobic respiration

Factors influencing respiration

Respiration in water

Without specific organs

With specific organs

Transitional types between aquatic and aerial respiration

Respiration in air

Gills *skin*

Lungs

Tracheal systems

Respiratory functions of the blood

Transport of carbon dioxide

✓ Transport of oxygen

Adaptation of circulation to respiratory needs

*Krogh - 1941*

*Carter - Biol. Rev. 1931*

III. Body fluids: their composition, properties and circulation

○ Composition and properties

Chemical constitution

x Phagocytosis

Coagulation

x Immunological reactions

○ Circulation

Without a true vascular system

With a vascular system

Physiology of hearts

External control of heart rhythm

x Physiology of blood vessels

*Pantiri, Biol. Rev. 1931*

*Huff. Physiol. Rev. 1940*

*Clark. 1927 Cyt. Physiol. of the*

IV. Body fluids: their regulation

Osmotic and ionic regulation

Aquatic organisms

Marine invertebrates

Fresh-water invertebrates

Vertebrates

Terrestrial organisms

Invertebrates

Vertebrates

Elimination of nitrogen

Aquatic organisms

Terrestrial organisms

Acid-base regulation

Regulation of sugar, etc.

*Krogh 1939 Conn. Regul. in Aquatic*

*Delaney 1931 Biol. Rev.*

*Marshall 1934 Physiol. Rev.*

*Baldwin*

B. Integration and reaction

V. Receptor physiology and response to stimuli

- Photoreceptors
- Mechanoreceptors
- Chemoreceptors
- Stimulation organs

VI. Effector physiology

- Contractile elements
- Glands
- Cilia and flagella
- Amoeboid activity
- Chromatophores
- Electric organs
- Photogenic organs
- Trichocysts and nematocysts

VII. Nervous mechanisms of integration

- Neuroid transmission
- Nerve conduction
- Physiology of the synapse
- Specific systems and their physiology
  - The protozoan system
  - The parazoan system
  - The coelenterate system
  - The annelid system
  - The arthropod system
  - The vertebrate system
- Analysis of locomotory mechanisms
  - Intracellular
  - Dermomuscular
  - Ambulacral
  - Skeleto-muscular

VIII. Endocrine mechanisms of integration

- Circulating hormones
- Reproduction and development
- General metabolic regulation
- Responses of effector organs
- Diffusion hormones
  - Acetylcholine
  - Adrenaline

IX. Integration

1. Coelenterate neuromuscular physiology
2. Arthropod neuromuscular physiology
3. Fish neuromuscular physiology
4. Central nervous physiology of animals
5. Mechanisms for orientation
6. Hormonal control of salt, pigmentation, and metamorphosis
7. Hormonal control of chromatophores and retinal pigments
8. Hormonal control of respiratory, water, and carbohydrate metabolism
9. Segmental rhythmicity and arrhythmicity

ZOOLOGY 331  
Laboratory Outline

In view of the limited facilities available for conducting laboratory work in comparative physiology and also because of the very nature of the subject, we have decided to divide the class into groups of 2, 3 or 4, each group of which will conduct one project approximately 13 hours in length, selected after consultation with the instructor, in each of the following areas of comparative physiology:

- I. Nutrition and respiration
- II. Body fluids: their composition, properties, circulation and regulation
- III. Receptor and effector physiology, and behavior
- IV. Integration (nervous and humoral)

After each group has completed its project it will be given 15 minutes during the 2:30 hour on Monday or Tuesday to report its methods (demonstrations whenever possible), results and conclusions to the remainder of the class.

*Mer. Cor. & Sp.*

Suggested Laboratory Experiments

I. NUTRITION AND RESPIRATION

1. Feeding mechanisms in animals
2. Comparative study of digestion in animals
3. Comparative study of digestive enzymes
4. Comparative study of basal metabolic rates
5. O<sub>2</sub> and CO<sub>2</sub> partial pressures upon respiratory rhythms and O<sub>2</sub> consumption
6. The effect of temperature upon respiratory rates
7. Comparative O<sub>2</sub> dissociation curves for bloods
8. Physiology of fish swimbladders

II. BODY FLUIDS: THEIR COMPOSITION, PROPERTIES, CIRCULATION AND REGULATION

1. Comparative study of osmotic pressures of bloods
2. Comparative study of phagocytosis and blood clotting
3. Comparative physiology of hearts
4. Osmotic regulation in protozoa
5. Osmotic regulation in higher invertebrates and lower vertebrates
6. Conservation of water in terrestrial forms
7. Buffer capacities of body fluids
8. Comparative study of nitrogen excretory products

III. RECEPTOR AND EFFECTOR PHYSIOLOGY, AND BEHAVIOR

1. Properties of photoreceptive mechanisms of Daphnia, Drosophila, Limax, etc.
2. Comparative physiology of muscle contraction
3. Physiology of ciliary movement
4. Physiology of amoeboid movement
5. Chemoreception, statoreception, and thermoreception
6. Background selection in animals
7. Experimental modification of animal responses
8. Kineses, taxes, and transverse orientations

IV. INTEGRATION

1. Coelenterate neuromuscular physiology
2. Arthropod neuromuscular physiology
3. Frog neuromuscular physiology
4. Central nervous physiology of animals
5. Mechanisms for locomotion
6. Hormonal control of molt, pupation, and metamorphosis
7. Hormonal control of chromatophores and retinal pigments
8. Hormonal control of respiratory, water, and carbohydrate metabolism
9. Organismic rhythmicity and arrhythmicity

One Hour Exam.  
Zoology 331.  
Tuesday, July 15th.

Answer any four:

1. Give an account of proteases and their distribution through the animal kingdom.
2. Outline, briefly, types of mechanisms for feeding upon fine particles. Give in some detail the operation of a molluscan ciliary and a crustacean setose mechanism.
3. Discuss factors influential in modifying the rate of oxygen consumption of animals.
4. Compare the properties of hemoglobins of a number of animals taken from environments widely different from one another in the availability of oxygen.
5. What are some of the physiological adaptations of birds and mammals to diving. Explain the significance of each.