SES-2100: SPORT AND EXERCISE PHYSIOLOGY

Cuyahoga Community College

Viewing: SES-2100 : Sport and Exercise Physiology

Board of Trustees:

May 2022

Academic Term:

Fall 2022

Subject Code

SES - Sport and Exercise Studies

Course Number:

2100

Title:

Sport and Exercise Physiology

Catalog Description:

Designed to increase student's knowledge and understanding about human physiology and the adaptations that occur during exercise. Topics include energy metabolism, cardiovascular, respiratory, endocrine, neuromuscular, nutrition, environmental factors, and applied exercise physiology. The laboratory is designed to complement the lecture area.

Credit Hour(s):

3

Lecture Hour(s):

2

Lab Hour(s):

2

Requisites

Prerequisite and Corequisite

SES-2310 Advanced Training Concepts and Techniques or departmental approval.

Outcomes

Course Outcome(s):

Examine the historical roots and research methods of sport and exercise physiology.

Objective(s):

1. Identify the historical events in exercise physiology.
2. Describe advances in sport and exercise physiology.
3. Discuss the importance of research in exercise physiology.
4. Explain the function of the nervous, myofascial, and musculoskeletal systems in exercise and sport.

Course Outcome(s):

Apply foundational knowledge of the principles of biology, nutrition, human anatomy, and physiology as they relate to responses and adaptations to physical activity and exercise.

Objective(s):

1. Define a variety of exercise physiology terms.
2. Describe the role of enzymes as catalysts during cellular chemical reactions.
3. Discuss the nutrients that are used as fuels during exercise.
4. Discuss the biochemical pathways involved in anaerobic and aerobic ATP production.
5. Discuss the relationship between exercise intensity and duration and the bioenergetic pathways that are responsible for the production of ATP during various types of exercise.

6. Describe oxygen deficit, lactate threshold, ventilatory threshold, steady-state, and exercise-post oxygen consumption.
7. Explain the function of the endocrine system in exercise and sport.
8. Identify various hormones, the site of release, and the stimulus for release for these various hormones.
9. Describe the following: structure of the skeletal muscle fiber, mechanical and biomechanical properties of skeletal muscle fiber types, the basic mechanism of contraction, sliding filament model/theory, twitch, summation, and tetanus with respect to muscle contraction, types of muscle contraction, muscle spindle, and Golgi tendon organ.
10. Explain the function of the circulatory system in exercise and sport.
11. Describe normal cardiorespiratory responses to static and dynamic exercise in terms of heart rate, blood pressure, and oxygen consumption and how they change with adaptation to chronic exercise training.
12. Discuss how gases are transported across the blood-gas interface in the lung and the major transportation of oxygen and carbon dioxide in the blood.
13. Explain the following cardiovascular and respiratory terms and changes that occur during exercise: heart rate, stroke volume, cardiac output, arteriovenous oxygen difference, ejection fraction, minute ventilation, total lung capacity, vital capacity, residual volume, tidal volume, respiratory frequency, and forced vital capacity
14. Discuss the relationship between body composition and nutrition for health.
15. Describe the mechanism, benefits, and risks of ergogenic aids on exercise performance.
16. Discuss the physiological effects of various environmental conditions including temperature, humidity, and altitude during exercise.

Course Outcome(s):

Apply foundational knowledge of exercise physiology to understand the physiology of training and its effects on maximal oxygen consumption (VO2 max), performance, homeostasis, and strength.

Objective(s):

1. Identify the common theories of muscle fatigue and delayed onset muscle soreness.
2. Identify the various factors affecting fatigue and the factors limiting performance in a variety of activities.
3. Recognize the physiological changes that occur during warm-up and cool-down.
4. Discuss the relationship between physical activity and cardiovascular disease, obesity, diabetes, and other health/medical issues.
5. Explain the basic principles of training for health, exercise, and sport.
6. Describe basic exercise prescriptions for health and fitness and for special populations.
7. Explain the acute changes that occur in exercise and chronic adaptation that occur from training in the following systems: metabolic, cardiovascular, respiratory, endocrine, nervous, and musculoskeletal.

Course Outcome(s):

Perform basic skills pertaining to assessments, laboratory methods, sound experimental and analytical practices, data acquisition, and reporting in exercise physiology settings.

Objective(s):

1. Perform tests to assess body composition and correctly analyze the data.
2. Perform and monitor sub-maximal and maximal tests to determine cardiorespiratory fitness and correctly analyze the data.
3. Explain the use of ECG in exercise testing.
4. Locate the appropriate sites for the limb and chest leads for resting and exercise ECGs.
5. Perform and monitor tests for anaerobic power, muscular strength, and muscular endurance and correctly analyze the data.
6. Evaluate metabolic equations, basic conversions from English to metric (i.e, SI units), and various calculations used in exercise physiology.
7. Perform tests to assess lactate levels, and analyze the data to determine lactate threshold as a performance marker.

Methods of Evaluation:

1. Competency skills test
2. Written assignments
3. Practical/skills tests
4. Laboratory assignments
5. Written examinations
6. Case studies
7. Oral presentations

Course Content Outline:

1. Introduction to exercise and sport physiology
   a. History of exercise physiology
   b. Research in exercise physiology
2. Bioenergetics and energy metabolism
   a. Cell structure and biological energy transformation
   b. Fuels for exercise
   c. Metabolic pathways: phosphagen, anaerobic glycolysis, oxidative phosphorylation
   d. Energy requirements at rest, rest-to-exercise, and recovery
   e. Factors governing fuel selection
3. Structure of Muscle Tissue and Muscle Contraction
   a. Structure of skeletal muscle
   b. Muscular contraction
   c. Fiber types
   d. Alterations to skeletal muscle due to exercise, inactivity, and aging
   e. Speed, force regulation, force-velocity, and power-velocity regulation and relationships in muscle
4. Nervous system and exercise
   a. Function
   b. Sensory information and reflexes
   c. Somatic motor function
   d. Autonomic nervous system
   e. Motor control
5. Circulatory system and exercise
   a. Organization of the circulatory system
   b. Heart myocardium and cardiac cycle
   c. Cardiac output and hemodynamics
   d. Changes in oxygen delivery to muscle during exercise
   e. Response to exercise
6. Respiratory system and exercise
   a. Structure and function of the lung
   b. Mechanics of breathing
   c. Pulmonary ventilation, volumes, capacities, and diffusion of gases
   d. Oxygen and carbon dioxide transport in blood
   e. Ventilatory and blood gas response to exercise
   f. Control of ventilation
7. Endocrine system
   a. Hormonal responses to exercise
8. The physiology of training: Effect of VO2 max, performance, homeostasis, and strength
   a. Principles of training
   b. VO2 max, cardiac output, and arteriovenous oxygen difference
   c. Detraining and VO2 max
   d. Endurance training: effects on performance and homeostasis
   e. Physiological effects of strength training
9. Physiology of health and fitness
   a. Patterns in health and disease
   b. Work tests to evaluate cardiorespiratory fitness
   c. Exercise prescription for health and fitness
   d. Exercise for special populations
   e. Body composition and nutrition for health
10. Physiology of performance
    a. Factors affecting performance
    b. Laboratory assessment of human performance
       i. Direct testing of maximal aerobic power
       ii. Laboratory tests to predict endurance performance
       iii. Tests to determine exercise economy
       iv. Estimating success in distance running using the lactate threshold and running economy
       v. Determination of aerobic power
       vi. Evaluation of muscular strength

11. Training for performance training principles
    a. Components of a training session
    b. Training to improve aerobic power
    c. Training for improved anaerobic power
    d. Training to improve muscular strength
    e. Training for improved flexibility
    f. Training for athletes
    g. Training for the female athlete, children, and special populations
12. Nutrition, body composition, and performance
13. Exercise and the environment
    a. Altitude
    b. Heat
    c. Cold
    d. Air pollution
14. Ergogenic aids

Resources

Powers, S., Howley, E., & Quindry, J. (2020) *Exercise Physiology: Theory and Application to Fitness and Performance*, New York, NY: McGraw Hill.

American College of Sports Medicine. (2021) *ACSM's Guidelines for Exercise Testing and Prescription*, Philadelphia, PA: Lippincott, Williams, and Wilkins.

Haff, G. & Dumke, C. . (2019) *Laboratory Manual for Exercise Physiology*, Champaign, IL: Human Kinetics.

Kenney, W.L., Wilmore, J.H., & Costill, D.L. (2020) *Physiology of Sport and Exercise*, Champaign, IL: Human Kinetics.

Murray, R. & Kenney, L.W. . (2021) *Practical Guide to Exercise Physiology*, Champaign, IL: Human Kinetics.

Taylor, M.J. & Johnson, A. W. (2022) *Physiology of Exercise and Healthy Aging*, Champaign, IL: Human Kinetics.

Beam, W. & Adams, G. (2019) *Exercise Physiology Laboratory Manual*, NYC: Mcgraw Hill.

American College of Sports Medicine. (2021) *ACSM's Resources for the Exercise Physiologist*, Philadelphia: PA: Lippincott Williams & Wilkins.

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