Physiology of Physical Activity

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Figure 11.1
What Does a Physiologist of Physical Activity Do?

- University professors
- Researchers for the military or NASA
- Employees of corporate fitness or hospital-based wellness programs
- Clinical exercise physiologists employed by hospitals in cardiac rehabilitation programs
- Exercise instructors
- Personal trainers
- Strength and conditioning professionals
- Can specialize with a particular population (older adults, children, pulmonary patients)
Goals of Physiology

1. To understand how to enhance physical performance
2. To understand how to improve physical function in particular environments such as a high temperature or high altitude
3. To understand how physical activity and exercise improve health and fitness
4. To understand how exercise can be used in treating and preventing disease and alleviating symptoms of disease
5. To understand adaptations in human anatomy and physiology in response to physical activity
Sport and Exercise Physiologists

• Sport physiologists apply physiological concepts to the training of athletes.
• Clinical exercise physiologists study the role of physical activity in disease management and rehabilitation.
History of Physiology of Physical Activity

• Early beginnings evolved from physiology
  – Antoine Lavoisier
  – August Krogh
  – A.V. Hill

• Early laboratories
  – Harvard Fatigue Lab: D.B. Dill
  – Springfield College: Peter V. Karpovich
Significant Events Since 1950

• 1950s: Morris Coronary Heart Disease study in England; ACSM founded
• 1960s: Biopsy needle; Mexico City Olympics; Medicine and Science in Sports
• 1970s: ACSM certification program; publications
• 1980s: Amenorrhea related to low bone density
• 1990s: NIH and surgeon general’s reports
Research Methods in Physiology of Physical Activity

- **Laboratory**
  - Ergometers: treadmills, leg and arm cycles, and swimming flume
  - Oxygen uptake: gas analyzers
  - Body composition: underwater weighing, calipers, and DEXA
  - Biochemical methods: blood samples and muscle biopsies
  - Animal models: mammals that match humans as closely as possible; can control the subject and environment more easily and specifically

- **Fieldwork:** outside the laboratory; technological advances have made fieldwork more practical
Figure 11.2
Figure 11.3
Overview of Knowledge in Physiology of Physical Activity

- How physiological systems respond and adapt to physical activity (single and repeated bouts)
- Factors that influence physiological responses (e.g., temperature, diet, and altitude)
- The relationship among fitness, activity, and health
Skeletal Muscles

• Muscle fiber types
• Energy sources
  – ATP-phosphocreatine system (initial 10-15 seconds of exercise)
  – Anaerobic glycolytic system (initial 1-2 minutes of high-intensity exercise)
  – Aerobic system (prolonged, continuous, light- and moderate-intensity activities, lasting more than 2 minutes)
• Adaptations
  – To anaerobic and aerobic training
  – To resistance training
• Training principles
  Progressive overload and specificity
Cardiovascular System

- Cardiac output: heart rate and stroke volume
- Blood flow distribution
- Cardiorespiratory adaptations to training
Respiratory System

Ventilation increases rapidly at the onset of physical activity and also as a function of exercise intensity.
Temperature Effects

• Muscle contractions produce heat, which helps maintain the body’s internal temperature. During physical activity, increased heat production by skeletal muscles stimulates vasodilation of skin blood vessels and sweating.
Nutritional Effects

• Carbohydrate
• Fluid intake
• Iron intake
• The amount of glycogen stored is directly related to the carbohydrate content of the diet.
• Inadequate fluid intake will result in elevated body temperature, risk of developing a heat illness, and possible decrements in performance.
Physical Activity, Fitness, and Health

• The minimal recommended amount of physical activity for improvement in cardiorespiratory endurance is 20 to 60 minutes of activity at 70% to 94% of maximal heart rate, three to five days per week (ACSM 2006).
• Increased amounts and intensity can result in greater benefits, if injury and burnout are avoided.
Physical Activity, Fitness, and Health (continued)

- Effects of age on fitness
- Physical activity, fitness, and coronary heart disease
- Physical activity and weight control
Wrap-UP

• Acute and chronic changes to the physiology of the body in response to physical activity.
• Studies cellular and total body physiology
• Exercise scientists have studied these changes in an effort to help people be more physically active, healthy and physically fit.
• Provides many career opportunities