Work Physiology

► Started in 1913 by Max Rubner in Berlin.
► Discipline grew in an effort to understand where humans could operate.
► War (especially cold war) was the primary motivator.
► At one time both were studied together...differences in physiological demand caused the two to disciplines to separate.
► Workers rarely exceed 30 to 40% of their maximum aerobic capacity. Athletes regularly exceed these rates.
► Today, more exercise physiology research.
► Simple, infrequent lifting produces mechanical forces -- Carrying, repetitive lifting, & walking create physiological demands.
► Carrying, repetitive lifting, and walking can exceed the anaerobic energy stores.

Aerobic Process

► Continuous muscle contractions are supported by the aerobic process where carbohydrates and/or fat are oxidized in the presence of O\textsubscript{2}.
► For each liter of O\textsubscript{2}, about 5 kcal of energy are generated (note: 1 gallon of gasoline = 31M calories or 31,000 Calories)
► NIOSH limits aerobic work to 9.5 kcal/min
► A limit of 70% of maximum aerobic capacity for arm work.
► Limits of 50%, 40%, and 33% of maximum aerobic capacity for 1 hour, 1 to 2 hour, and 2 to 8 hour work.
► We can estimate maximum aerobic capacity based on the relationship between heart rate and oxygen consumption.
► Assuming: linearity of heart rate – oxygen consumption relationship

Maximum Aerobic Capacity

► Can be assessed by:
  - Running on a treadmill
  - Exercising on a cycle ergometer
  - Step test
► Expired air is collected and measured for volume and O\textsubscript{2} content.

Factors Affecting Aerobic Output

► Training – adaptation
► Sex & Age
► Anthropometry
► Nutrition
► Psychological factors
► Type of work
► Work duration
► Technique
► Environment

Biomechanics

► The study of internal and external forces acting on the body segments, and the effects produced by these forces.
► The principles of engineering, specifically mechanics, applied to human movement.

[Diagram of Biomechanics: Mechanics (Static: constant state of motion, Dynamic: acceleration present), Kinematics, Kinetics]
Definitions

► Kinematics: study of the variables that describe or quantify motion
  - Displacement
  - Velocity
  - Acceleration

► Kinetics – study of the variables that cause or influence motion
  - Forces
  - Torques
  - Mass

► Biomechanists use the principles of mechanics in the analysis of human movement to answer:
  1. How can human performance be enhanced?
  2. How can injuries be prevented?
  3. How can rehabilitation from injury be expedited?

Areas of Biomechanics

► Sports Biomechanics
  - Study the most optimal way to move the body in order to achieve maximal performance, whilst minimizing risk of injury

► Occupational Biomechanics
  - To design machines and the workplace to reduce repetitive stress on workers’ joints

► Clinical Biomechanics
  - Analyzes the mechanics of injured patients and provide feedback (biofeedback) to restore normal function

► Military Biomechanics
  - To design equipment to reduce risk of hazard associated with biomechanical injuries