OBJECTIVES:
1. Define postural control, and distinguish between orientation and stability.
2. Describe motor, sensory, and cognitive system contributions to postural control.
3. Describe the three types of postural control (steady state, reactive, proactive) and how motor, sensory, and cognitive systems contribute to each type.
4. Define 3 movement strategies used during reactive postural control.
5. Discuss how aspects of the environment regulate both sensory and motor aspects of postural control.

I. Introduction
   
   A. Postural control: the ability to control the body’s position in space for the dual purposes of orientation and stability
      1. Orientation: the ability to maintain appropriate task-specific relationships between the body segments and between the body and the environment
      2. Stability: the ability to control the center of mass relative to the base of support
   
   B. Postural control emerges from the interaction of individual capabilities, task requirements, and environmental constraints or affordances
   
   C. Definitions
     1. Center of Mass (COM): the point that is at the center of the total body mass
     2. Center of Gravity (COG): vertical projection of COM
     3. Base of Support (BOS): defined by the parts of the body in contact with the support surface
     4. Center of Pressure (COP): center of distribution of total force applied to support surface
   
   D. Systems involved in postural control
     1. Motor: musculoskeletal (strength, ROM, muscle tone, alignment) and neuromuscular (postural tone; selection, amplitude, timing, and coordination of muscle activity)
     2. Sensory: integration and organization of visual, vestibular, somatosensory inputs
     3. Cognitive (cortical): attention, adaptation, anticipation, confidence/fear
E. Types of postural control
   1. Steady state (static): control of the COM relative to the BOS under unperturbed conditions
   2. Reactive: ability to recover postural control after an unexpected perturbation
   3. Proactive (anticipatory): ability to modify postural control prior to a potentially destabilizing movement in order to avoid instability

F. Model of disablement perspective
   1. Pathology: variety of disease processes contribute to balance impairments
   2. Impairment: impaired steady state, reactive, and/or proactive balance
   3. Functional limitation: sitting, standing, walking, transfers, reaching, etc.
   4. Disability: ADL’s, vocation, avocation, social roles, falls

II. Steady state postural control
   A. Motor system
      1. Musculoskeletal: alignment, strength, ROM, muscle tone
      2. Neuromuscular: postural tone (activity in antigravity postural muscles), generation of coordinated forces to maintain postural control
   B. Sensory system
      1. Sensory integration: CNS organizes and integrates information from somatosensory, visual, and vestibular senses
      2. Relative weighting of the these senses can be modified to some extent
   C. Cognitive system
      1. Attention: postural control is not automatic, but requires some amount of attention or information processing
      2. Dual tasking: when performing more than 1 task at the same time, different tasks may compete for the same information processing resources or pathways; if the multiple task demands exceed processing capabilities, performance on one or more tasks will decline
      3. Functional tasks often require the performance of multiple tasks

III. Reactive postural control
   A. Motor Systems
      1. Synergy: a functional coupling of groups of muscles that act together as a unit in order to simplify the job of the CNS
2. Fixed base of support (in-place) strategies
   a. Ankle
      i. Forward movement of COM (e.g. forward perturbation, backward surface translation):
      ii. Backward movement of COM (e.g. backward perturbation, forward surface translation)
   b. Hip
      i. Forward movement of COM:
      ii. Backward movement of COM:

3. Changing base of support strategies
   i. Stepping
   ii. Reaching

4. Anterior-posterior stability: controlled primarily at ankle and hip joints

5. Medial-lateral stability: controlled primarily at hip joints

6. Multidirectional stability: complex patterns of muscle activity that can be modified in response to perturbations in any direction
B. Sensory systems
   1. Sensory information used depends on individual capabilities and the availability of information based on task demands and the environment
   2. reactive postural control relies primarily on somatosensory information
   3. increased reliance on vision when learning and after neurological injury

C. Cognitive systems
   1. requires some amount of attention attention
   2. adaptation: decreased sway and amplitude (increased efficiency) of responses if a perturbation is given repeatedly
   3. anticipation: responses are modified based on central set, or our anticipation of the size and direction of the perturbation

IV. Proactive (anticipatory) postural control
   A. Motor system
      1. Patterns of muscle activity are similar to those for reactive postural control
      2. Anticipatory muscle activity occurs in advance of primary agonist activity
      3. Patterns depend on direction, speed, and force of planned movement

   B. Sensory system
      1. Visual information used to predict trajectory and estimate forces required for anticipated movement

   C. Cognitive system
      1. anticipatory postural adjustments occur earlier with practice