The Skeletal System

PSK 4U
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The Axial Skeleton

- 26 vertebral column
- 1 hyoid (horseshoe shaped bone at base of chin)
- 22 skull
- 25 ribs and sternum

= 74 bones
The Appendicular Skeleton

- 64 upper extremity
- 62 lower extremity
- 6 auditory
Roles of the Skeleton

- Protection for internal organs
- Framework for body shape
- Attachments for muscles (with which movement is possible)
- Storehouse for essential nutrients
- Blood cell formation
Classification of Bones

- Short bones (ex: carpal bones in wrist)
- Long bones (ex: femur → thigh)
- Flat bones (ex: bones in skull)
- Irregular bones (ex: individual vertebra)
- Sesamoid bones: bones wrapped or imbedded in tendon (ex: patella, hyoid, 1st metacarpal, pisiform, etc)
Bone Characteristics

- 50% water and 50% organic and inorganic material
- Phosphorus, zinc, calcium, magnesium, iron, chlorine
- Resists compression and tension
- Bound by joints through ligaments
- Muscles attach to bones through tendons and produce movement
Components of Bone

- Hyaline cartilage covers the ends of bones, absorbs shock, prevents surfaces from rubbing
- Epiphysis is the end(s) of bones
- Diaphysis is the shaft of the bone
Components of Bone (cont’d)

- Epiphyseal plate is a line across the bone from which it grows in length
- Cancellous (spongy) bone stores red bone marrow where blood cells are manufactured
More Components of Bone

- Medullary Cavity is the space inside the diaphysis that contains the yellow bone marrow
- Periosteum covers the surface of the bone in the absence of hyaline cartilage
- Ligaments and tendons attach to periosteum
- Compact bone is the hard part surrounding the yellow marrow in the diaphysis and lends strength to the hollow part of the bone
Osteoblasts

- From the Greek: bone + germinate
- Generated by stem cells
- Work in groups to synthesize collagen and proteins which make the bone matrix

Photo credit: wikipedia (where else?)
Osteoclasts

- From the Greek: bone + broken

- Responsible for bone resorption (secretion of an acid and a collagenase to destroy bone at the molecular level)

- Help maintain bone integrity, control tissue levels, maintain Ca levels

Photo credit: MWSU Biology Department
Endochronal vs. Intramembranous

**Endochronal**

- Common mode of development
- Bone formation that begins within a cartilage
- Growth occurs at growth plate, continues until plate has ossified, when longitudinal growth is no longer possible

**Intramembranous**

- Cartilage not present during bone formation
- Essential for healing fractures and forming the bones of the head
Yellow and Red Marrow

- Red marrow consists of red blood cells, platelets, and white blood cells
- All marrow is red at birth
- Adults: 50% red marrow, 50% yellow marrow
- Site: epiphyses of long bones, and in flat bones (sternum, cranial bones, ribs)

- Yellow marrow consists primarily of fat cells (some white blood cells created in yellow marrow)
- Yellow marrow can be converted to red marrow in cases of trauma and severe blood loss
Epiphyseal Plates vs. Lines

- Plates: dark spaces on x-rays between the epiphysis and diaphysis of long bones
- Made of cartilage (x-rays pass through)

- Lines: white lines on x-rays
- Endochondral longitudinal growth no longer possible.

- What is the link between growth and resistance training?
Skeletal growth and resistance training

- Does resistance training impede skeletal growth?
  - Not really.
  - Too many maximal lifts at too young an age can have negative effects on epiphyseal sites

- This is why we never do 1RM tests in PAI
- Athletes younger than 12 are encouraged to limit resistance to BW
Skeletal response to exercise

- Bones respond to exercise and repeated stress
- Forearm bones (radius and ulna) in pro tennis players: ¼ inch longer in racquet arm
- Elbow joint: 1 cm wider
The skeleton as a bookcase

- One bookcase 4” wider than another = negligible weight difference
- Fill the bookcase with books, though, and weight difference is substantial
- Each kg (2.2lb) of bone has been found to support 5kg (11lb) of muscle
- Therefore, 5:1 ratio is the limit of skeleton to hold muscle (and interestingly about 4.2:1 in women)
- This is without steroids, which have been shown to allow athletes to surpass the 5:1 ratio (with side effects)
- How does / can this affect training?

Info: Holway, Cowgill (2010); Epstein (2013)
Mini Case Study

- Subject: 22 year old male
- Height: 6’2”
- Weight: 200lb
- Build: athletic
- Sports: football, basketball, track and field (throws)
- Body fat: 11%
- Muscle : Bone is approaching 5:1

Questions:
- Should the athlete try to gain more muscle?
- Is it ok to gain more fat?
- Should the athlete try to lower his body fat %? Why (not)?
Questions to consider:

- What are some of the common problems associated with bones and joints?
- What are the symptoms, results, and treatments for these problems?
- What are 4 recommended steps to help prevent osteoporosis?
- Why is this important to YOU??