Bones, Joints, and Muscles

Spaceflight and fitness

Integrated Science I & Honors

Mrs. King

March 2004

Bones

- Made of living cells:
  - Blood vessels
  - Epithelial tissue lining blood vessels
  - Nervous tissue
  - Cartilage
- Cell secrete calcium phosphate
- Allow
  - movement
  - support
  - protect organs
  - mineral storage
  - blood-cell formation
- 206 bones in human body

Eukaryote link

•Part of multicellular organism

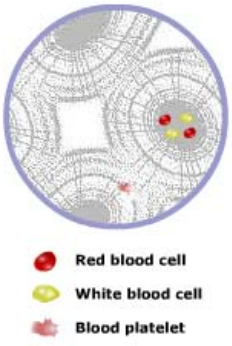
•Nucleus and membrane-bound organelles

•Lack cell walls, has cell membrane

•Heterotrophic

•Cells

Bones Contain Cells



- **Erythrocytes**-oxygen transporting cells.
- Surrounded by a plasma membrane but have no nuclei or organelles.
- Contain hemoglobin.
- **Leukocytes**- crucial in the body's defense against disease and function outside the bloodstream in loose connective tissue.
- Complete cell with organelles.

Platelets

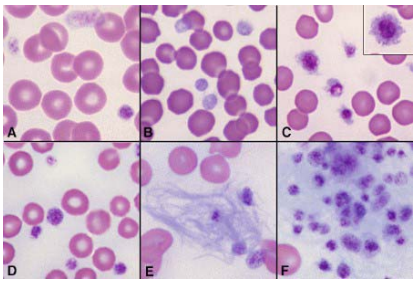
- Also called thrombocytes
- Clotting cells; they plug small tears in blood vessels to prevent bleeding.

Signs of a low platelet count:

- Easy Brusing
- Easy Bleeding (Gums, Blood draws, IV's)
- More Frequent Nosebleeds
- Severe Headache or Mood Changes

http://www.perfusion.com/perfusion/articles/general/9905-platelet-anatomy/

Animal Platelets

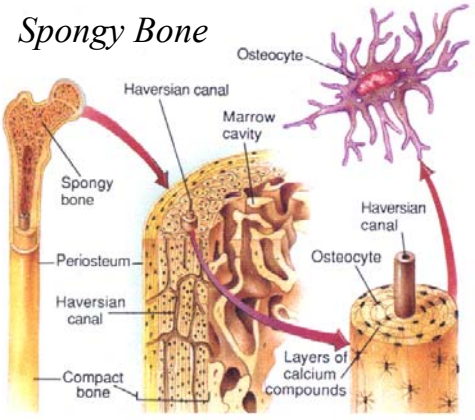


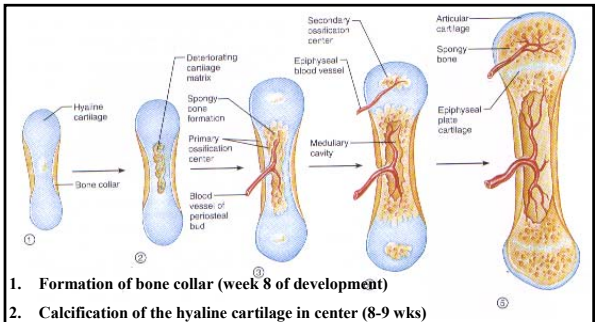
http://web.vet.cornell.edu/public/popmed/clinpath/CPmodules/heme1/plts.htm

Bone Marrow

- Bones contain red and yellow bone marrow
  - Only **red marrow** actively generates blood cells
  - **Yellow marrow** is the site for fat storage *(yellow color due to fat cells)*, with little or no role in blood-cell formation.
  - Yellow marrow is dormant and only makes blood cells in emergencies.

Spongy Bone





1. **Formation of bone collar (week 8 of development)**
2. **Calcification of the hyaline cartilage in center (8-9 wks)**
3. **Formation of spongy bone (week 9)**
4. **Secondary ossification (around time of birth)**
5. **Fully ossified epiphyses, growth at epiphyseal plates (from birth to adulthood). Closure of plate occurs around 18 in females and 21 in males.**

Joints

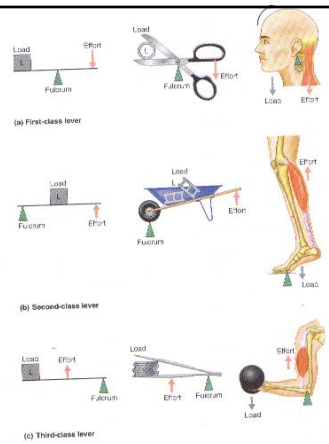
- Fixed: skull
- Semi-movable: backbone
- Movable: elbow, feet, etc.

Moveable Joints

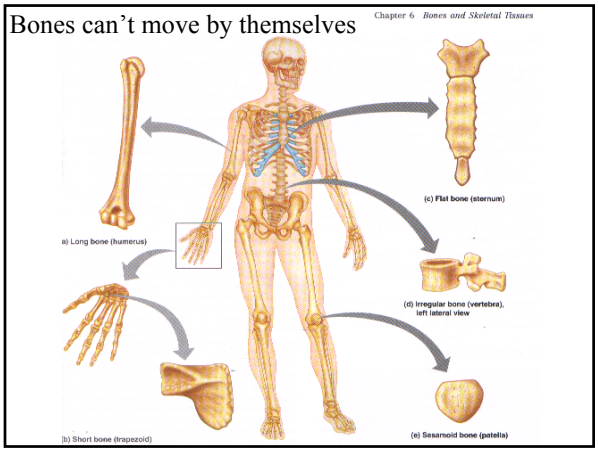
Places where two or more bones are connected

- Pivot: (forearm)
- Saddle: (base of thumb)
- Hinge: (knee and elbow)
- Ball-and-socket: (hip and shoulder)
- Gliding: (wrist and ankle)

The Human Lever



Bones can't move by themselves



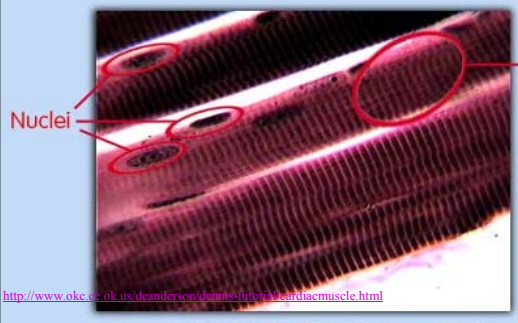
Tissues

Group of related cells working together to perform task

4 classes:

1. **Epithelial**- cover internal & external surfaces
   >Function: 1st line of defense from invaders. Secrets things (all glands are epithelial) allow for absorption.
2. **Connective**
3. **Nervous**
4. **Muscle**

Skeletal Muscle



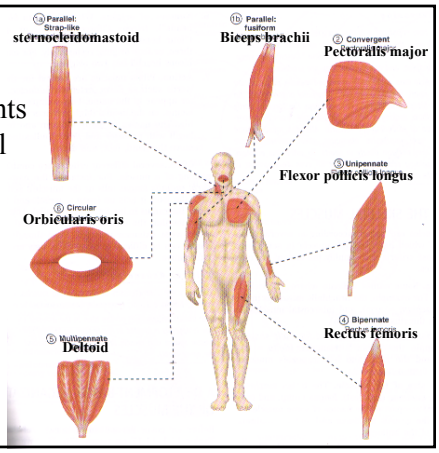
http://www.okcps.ok.us/deanderson/dennis-tutorial/cardiacmuscle.html

Long, cylindrical cells with many nuclei.
Striated with numerous fine bands.

Skeletal Muscle

- Involves chemical processes
- Converts ATP into mechanical work
- Makes up about 40% of body weight: women < men

Arrangements of Skeletal Muscle



Interactions of Muscles

- Muscles that have the major responsibility for producing specific movements are referred to as the prime mover or agonist (leader).
- Muscles that oppose or reverse a particular movement are called antagonist (against the leader).

Muscles

- The biceps and triceps are called an **antagonistic pair** of muscles
- Many other pairs in the human body
- Ligaments hold bones together at moveable joints

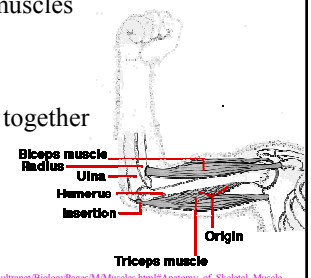
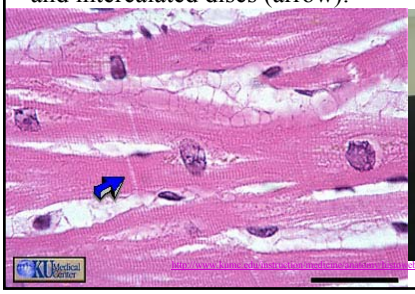


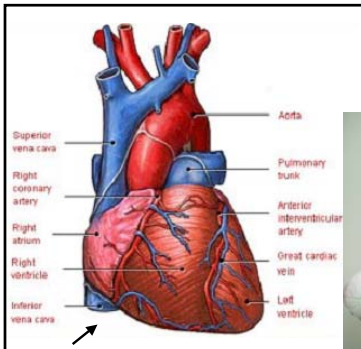
Photo: http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/M/Muscles.html#Anatomy_of_Skeletal_Muscle

Cardiac Muscle

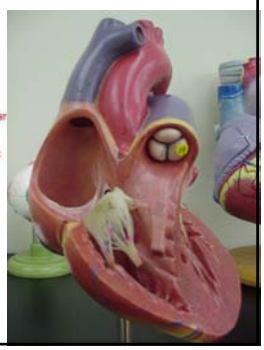
- Longitudinal cardiac muscle identified by centrally placed round to oblong nuclei, striations, branching, and intercalated discs (arrow).



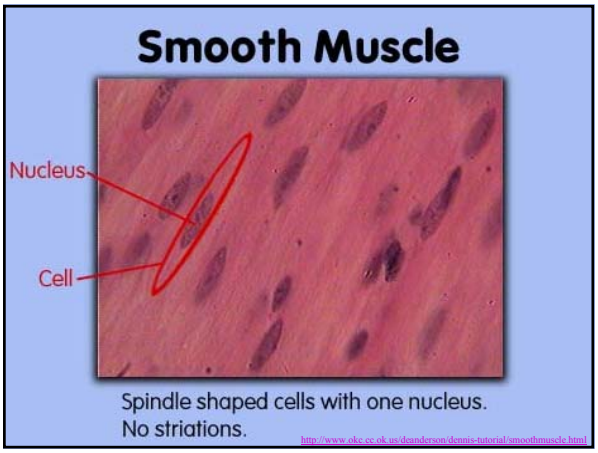
http://www.kumc.edu/instruction/medicine/anatomy/histoweb/muscular/muscle14.htm



Adam Software

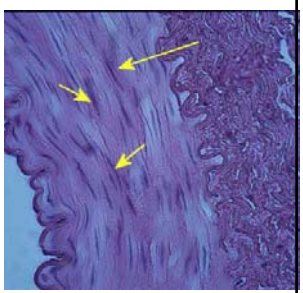


Lab Photo



Smooth Muscle

- Arrows are pointing to the **nuclei of the Smooth Muscle Cells** found in the wall of arteries like the aeorta.
- The nuclei are **long and spindle shaped**, one of the defining characteristics of Smooth Muscle.
- Yellow arrow - Smooth Muscle Cell Nuclei



Disorders

- Osteoporosis
  - porous bone
  - Calcium deficiency
- Muscular Dystrophy (MS)
- Arthritis
  - disease of the joints
- Sprains and strains
  - Injuries to ligaments, tendons, and muscles

Effects of Spaceflight on Humans

- Bones become weaker during spaceflight
- Muscles atrophy
- Anemia
  - During space flight the concentration of red blood cells stay the same but loose about 10% in volume.
  - Causes lightheadedness when back on Earth
  - Takes several weeks to return to normal
- http://www.nsbri.org/HumanPhysSpace/

Interesting Links

- Cardiac Muscle.
  http://www3.umdnj.edu/histsweb/lab6/cardiacmuscle/cmarrangement.html
- Cardiac and Smooth Muscle (slides)
  http://www.life.uiuc.edu/csb/213/PDF/16b.pdf
- Hematology
  http://www.okccc.edu/deanderson/hemotology/hemotologydef.html

Works Cited

- Muscles. Retrieved 3/2/04 from website http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/M/Muscles.html