# **Skeletal System Formation**

M.G.Robertson Professor of Biology Delta College



## Components

#### Bones

- ✤ Axial (skull, vertebrae, ribcage)
- Appendicular (2 upper/2 lower extremities, pectoral/pelvic girdles)
- Cartilage (hyaline cartilage, elastic cartilage, fibrocartilage)
- Dense Fibrous Tissues
  - Tendons (muscle to bone)
  - ✤ Ligaments (bone to bone)
  - ✤ Aponeuroses (muscle to muscle)



## Bone Types

- Long (with hollow diaphysis and spongy epiphyses)
- femur, radius, tibia, all phalanges, humerus, ulna, etc.
- Short (spongy and cuboid in shape)
  tarsals and carpals only in adults
- Flat (2 compact sheets with diploe)
  - parietal, temporal, frontal, patella, manubrium of sternum, sternal body)
- Irregular (fused from smaller bones)
  - all vertebrae, sacrum, coccyx, scapula, coxals and sphenoid of cranium)





### Components of a Long Bone

- Epiphyses (proximal and distal) vs. Diaphysis (shaft)
- Periosteum vs. Endosteum
- Start with Hyaline Cartilage
  - collagen fibers resist torsion
    hydroxyapatite crystals (made of
  - calcium Ca<sup>2+</sup>) density and hardness
    proteoglycans (from matrix) flexibility
- Haversian System forms in the Compact Bone
- Red (blood production) vs. Yellow (energy storage) Bone



### Formation of a Long Bone

#### A CONTRACT STREET AND THE STREET AND

- Endochondral Ossification
- \* Form diaphyseal collar using osteoblasts at primary ossification site on diaphysis
- Cavitate (degrade) diaphysis using osteoclasts as the epiphyseal plates elongate
- Harden secondary ossification sites (epiphyses) along the way and then harden epiphyseal plates (to form epiphyseal lines) after GH drops off after puberty

### Cells and Hormones

- Calcitonin causes osteoblasts to harden bone (storing calcium in bones and removing it from blood)
- PTH causes osteoclasts to eat away bone (releasing calcium back to blood from the bone storage)
- GH keeps epiphyseal plates open (later in males than in females)



### Formation of Spine

#### Start with 5 Main Regions

- Cervical (7), Thoracic (12), Lumbar (5), Sacral (5), & Coccygeal (2-5)
- Fetal fuses laminae, pedicles and body to form individual vertebrae first
- Next fuses vertebrae together to form sacrum and coccyx
- Spinal Curvatures Change for Bipedal Posture
- Cervical (anterior), Thoracic (posterior), Lumbar (anterior), and sacral/ coccyx (posterior)

#### Spinal Deformities Often Develop Over Time

- Spina Bifida (open spine: genetic cause, incomplete laminal fusion)
- Steoporosis (develops with age, females before males)
- Scoliosis (lateral deviation of spine, birth or later with age)
- Kyphosis (hunchback: posterior thoracic curvature, with age)
- Lordosis (swayback: anterior lumbar curvature, pregnancy/weight, age)

### Bone Modifications Over Time

- Longitudinal (Endochondral) Growth
  Adds length to long bones; ends at puberty
- Appositional Growth
  Adds width to all bones; continues entire life
- Wolff's Law (late 1800's)
  - German surgeon Julius Wolff
  - Bone in a healthy person or animal will adapt to the loads it is placed under
- Sone Repair (After Fracture)
  - Torn blood vessels cause hematoma
  - Pulpy cartilage formed by osteoblasts
  - Protein fibers added to "knit" bones
  - Osteoblasts/osteoclasts form adult bone



C

Т

L

S



### **Bone Fractures**

#### AND TALLES AND A SET WAS IN THE OWNER OF ST

- Simple (periosteum intact)
- Compound (torn periosteum and skin)
- Comminuted (diaphysis is shattered)
- Greenstick (in juveniles)
- Transverse (complete)
- Spiral (diaphysis)
- Compression (crushed)
- Impact/Epiphyseal (epiphyses shattered)
- Depression (flat bones)





# Potential Journal Critique Topics?

- Osteoporosis/Osteopenia?
- Limb Prostheses?
- Fracture Repair?
- Skeletal Disorders of the Spine?
- Pituitary Dwarfism and Gigantism?
- Microcephalia and Zika Virus?



