The Skeletal System

- Growth and repair

Formation of the Human Skeleton

- In embryos, the skeleton is primarily hyaline cartilage
- During development, much of this cartilage is replaced by bone
- Cartilage remains in isolated areas
  - Bridge of the nose
  - Parts of ribs
  - Joints

Bone Growth (Ossification)

- Epiphyseal plates allow for lengthwise growth of long bones during childhood
  - New cartilage is continuously formed
  - Older cartilage becomes ossified
    - Cartilage is broken down
    - Enclosed cartilage is digested away, opening up a medullary cavity
    - Bone replaces cartilage through the action of osteoblasts

Bone Growth (Ossification)

- Bones are remodeled and lengthened until growth stops
  - Bones are remodeled in response to two factors
    - Blood calcium levels
    - Pull of gravity and muscles on the skeleton
    - An increase in muscle mass will increase bone mass
  - Bones grow in width (called appositional growth)
    - This will continue after bones stop growing in length in response to muscle pull, hormones, and other factors.

Long Bone Formation and Growth
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Long Bone Formation and Growth

- Growth: Bone grows in length because of cartilage growth.
- Remodeling: Growing shaft is remodeled by bone growth and absorption.

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Types of Bone Cells

- Osteocytes: Mature bone cells
- Osteoblasts: Bone-forming cells
- Osteoclasts: Bone-destroying cells
  - Break down bone matrix for remodelling and release of calcium in response to parathyroid hormone.
  - Bone remodeling is performed by both osteoblasts and osteoclasts.

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Bone Fractures

- Fracture: Break in a bone
- Types of bone fractures
  - Closed (simple) fracture: Break that does not penetrate the skin
  - Open (compound) fracture: Broken bone penetrates through the skin
- Bone fractures are treated by reduction and immobilization.

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Common Types of Fractures

- Chart showing various types of fractures such as compression, depressed, impacted, greenstick, etc.

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Repair of Bone Fractures

- Hematoma (blood-filled swelling) is formed
- Break is splinted by fibrocartilage to form a callus
- Fibrocartilage callus is replaced by a bony callus
- Bony callus is remodeled to form a permanent patch.
Stages in the Healing of a Bone Fracture

- Hematoma
- External callus
- Bony callus of spongy bone
- Healed fracture
- New blood vessels
- Internal callus (fibrous tissue and cartilage)
- Spongy bone trabecula

Developmental Aspects of the Skeletal System

- At birth, the skull bones are incomplete
- Bones are joined by fibrous membranes called fontanels
- Fontanels are completely replaced with bone within two years after birth

Skeletal Changes Throughout Life

- Fetus
  - Long bones are formed of hyaline cartilage
  - Flat bones begin as fibrous membranes
  - Flat and long bone models are converted to bone
- Birth
  - Long bones still have a large % of cartilage
  - Allows easier childbirth
  - Child is not mobile until some bones ossify
  - Fontanels normally remain until around age 2 but can exist much longer
- Adolescence
  - Epiphyseal plates become ossified and long bone growth ends
- Size of cranium in relationship to body
  - 2 years old—skull is larger in proportion to the body compared to that of an adult
  - 8 or 9 years old—skull is near adult size and proportion
  - Between ages 6 and 11, the face grows out from the skull

Skeletal Changes Throughout Life

(a) Human newborn  Human adult
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Skeletal Changes Throughout Life

- Curvatures of the spine
  - Primary curvatures are present at birth and are convex posteriorly
  - Secondary curvatures are associated with a child's later development and are convex anteriorly
  - Abnormal spinal curvatures (scoliosis and lordosis) are often congenital

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Primary curve at birth

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Normal adult curvatures

- Cervical (neck)
- Thoracic (ribs are attached)
- Lumbar (between ribcage and pelvis)
- Part of pelvis

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Disorders of curvature.
Scoliosis
• Lateral curve

Lordosis
• Exaggerated lumbar curve

Kyphosis
• Exaggerated thoracic curvature