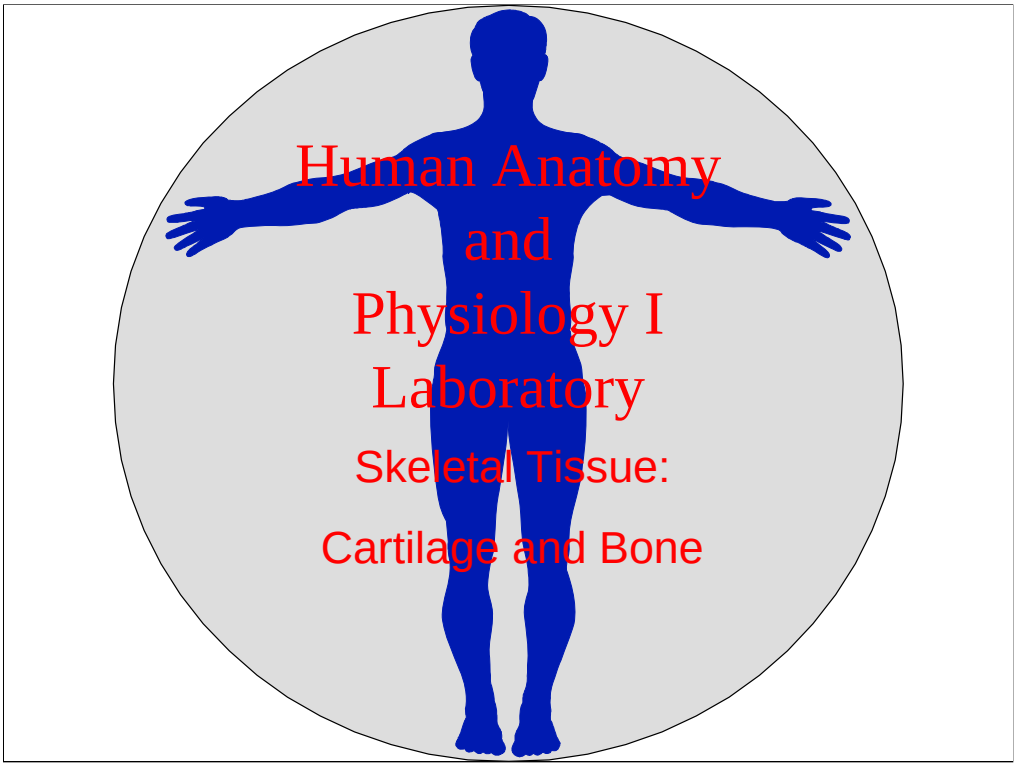
mp3

Mpeg 4 for iPod



This lab involves study of the laboratory exercise "*Overview of the Skeleton, Classification and Structure of Bones and Cartilages*", completing the Review Sheet for the exercise, and taking the relevant quiz. Alternately, your instructor may have you turn in drawings of cartilage and bone in lieu of the Review Sheets.
Use the Virtual Microscope or other histology sites for good images of cartilage and bone.

Click on the sound icon for the audio file (mp3 format) for each slide. There is also a link to a dowloadable mp4 video which can be played on an iPod.

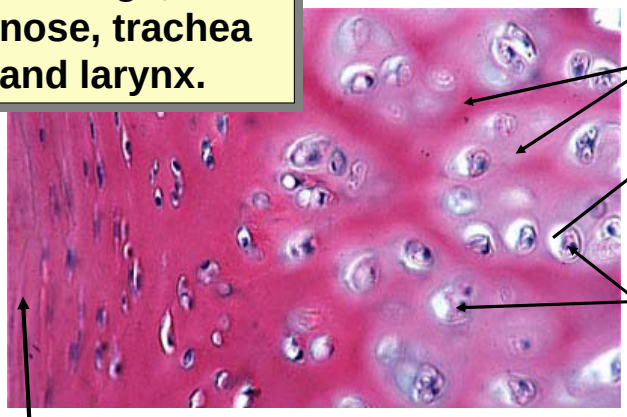
Cartilage Tissue

- cells called chondrocytes
- gel-like ground substance containing proteoglycans and glycosaminoglycans.
- elastic, inelastic, or reticular fibers.

Cartilage differs from the “connective tissues proper” which we studied in the last lab in that the matrix is a gel-like substance which gives the cartilage shape along with flexibility. Combining various matrix components including one or more type of fibers produces a variety of cartilage types.

Articular cartilage, costal cartilage, nose, trachea and larynx.

Hyaline Cartilage



The most common type of cartilage is hyaline. Hyaline cartilage has both elastic and inelastic fibers, but they are so finely divided that they cannot be seen under the light microscope. In cartilage the cells wall themselves off from the matrix inside **lacunae** or “lakes”. Cartilage will usually have a fibrous covering known as the **perichondrium**.

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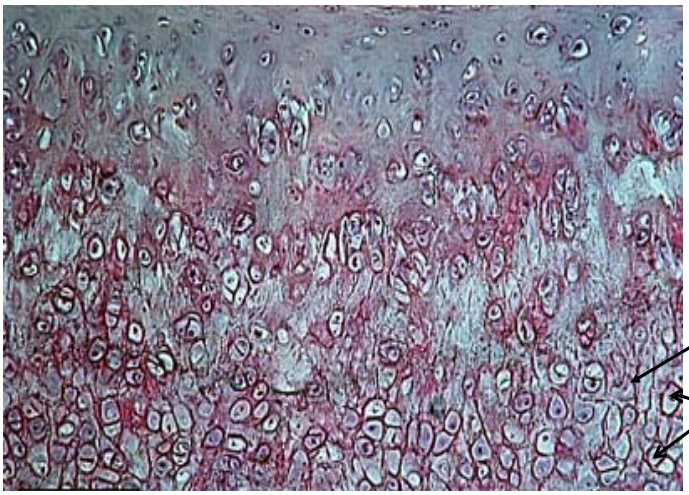
Elastic Cartilage

Epiglottis and the external ear



Elastic cartilage is very rare, found only in the epiglottis and aura of the ear. The elastic fibers are found in dense bundles.

Intervertebral Discs and Pubic Symphysis

Fibrocartilage

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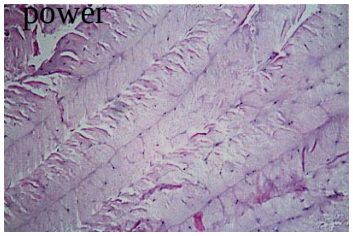
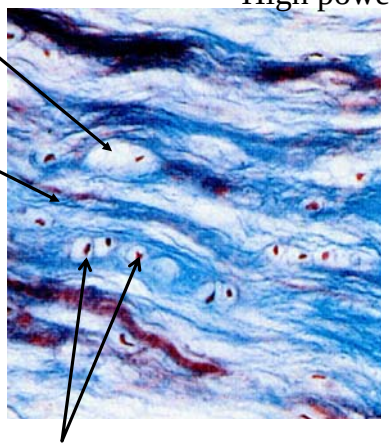
Low power



Note the classic herringbone pattern

High power



Fibrocartilage has inelastic collagen fibers, making it less flexible than the other types, but stronger.

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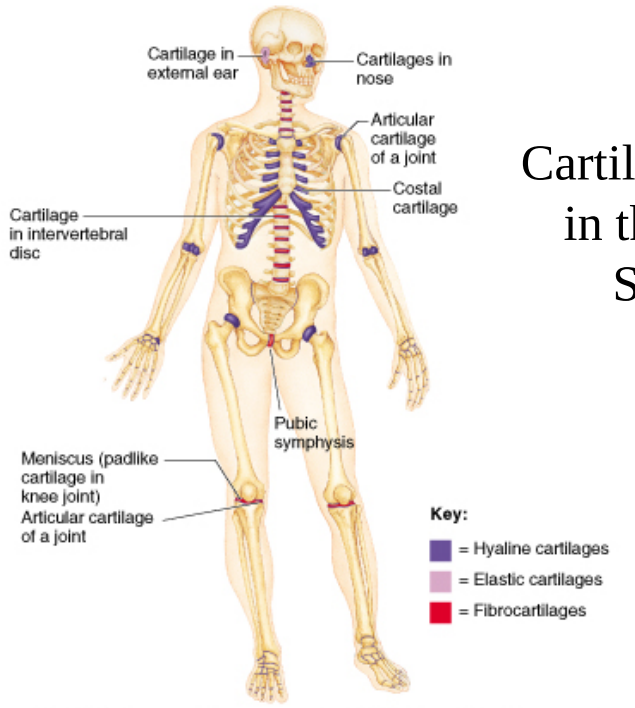
Cartilage Located in the Human Skeleton



Here are the major locations of cartilage in the human skeleton.

Bone Tissue

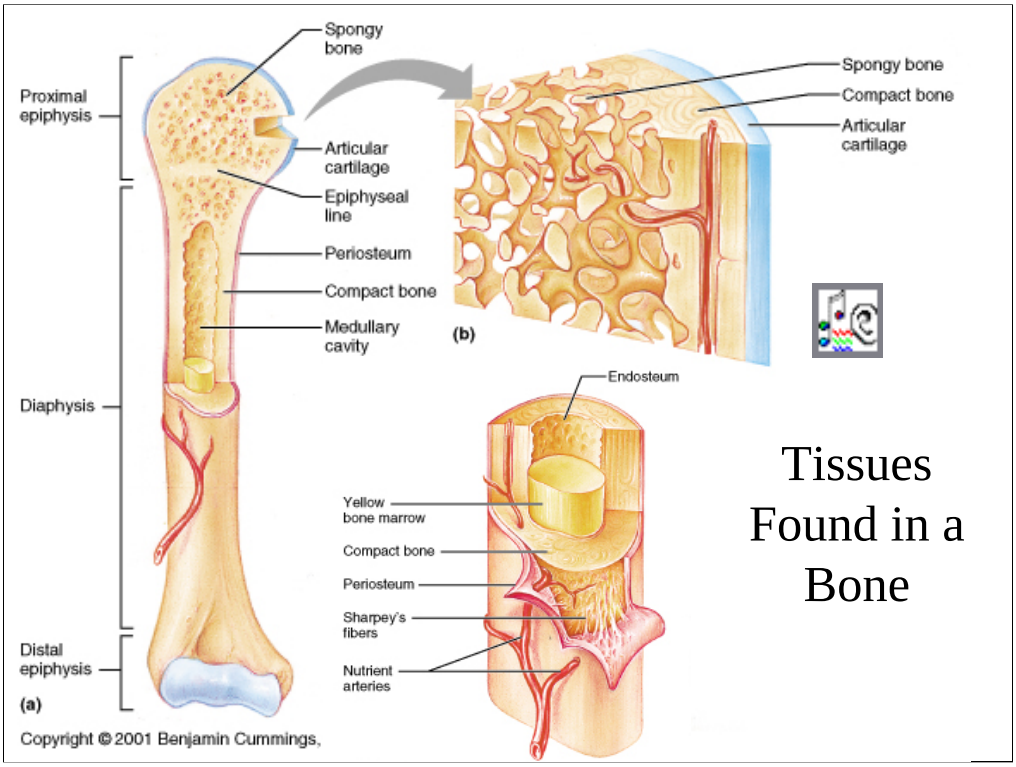
- Matrix:
  - collagen fibers
  - proteoglycans (glycoproteins)
  - Hydroxyapatite: inorganic salt of calcium and phosphorus

Bone tissue (**osseous tissue**) differs from cartilage in having a solid matrix due to the presence of inorganic salts of calcium and phosphorus. These enable bone to have a rigid shape. The organic fibers give it resilience and resistance to stress.

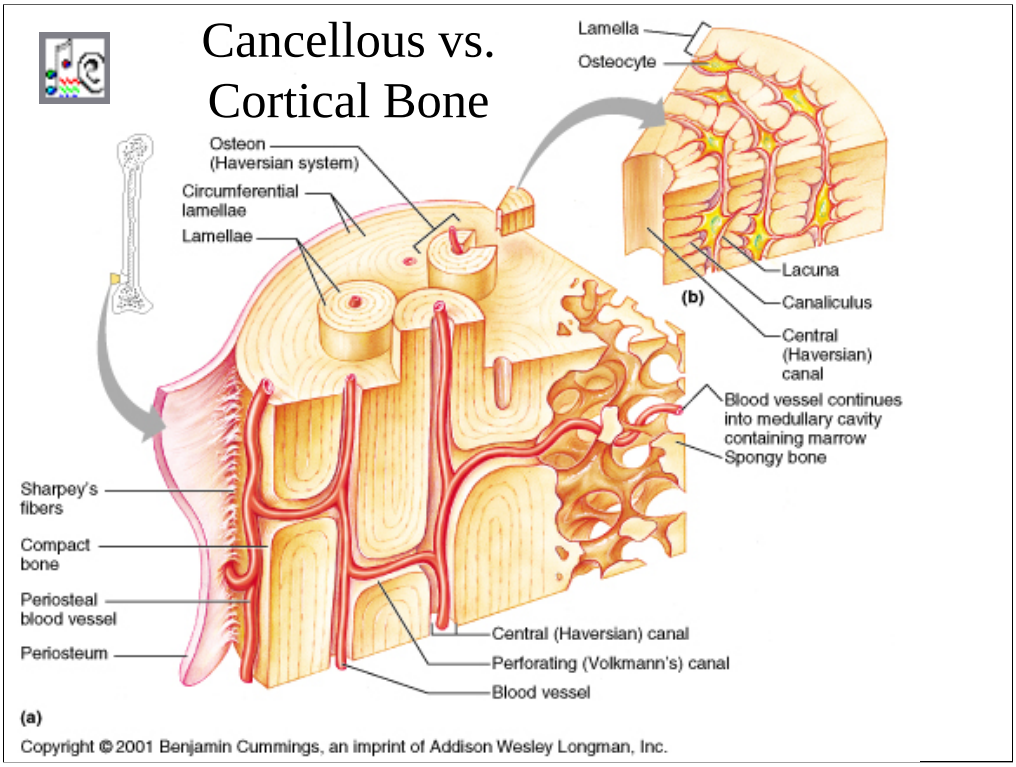
❖ Cells Associated with Bone Tissue

- osteoprogenitor cells: derived from mesenchyme these differentiate into osteoblasts.
- osteoblasts: bone forming cells which secrete the osteoid and then calcify it.
- osteoclasts: bone resorbing cells derived from monocytes.

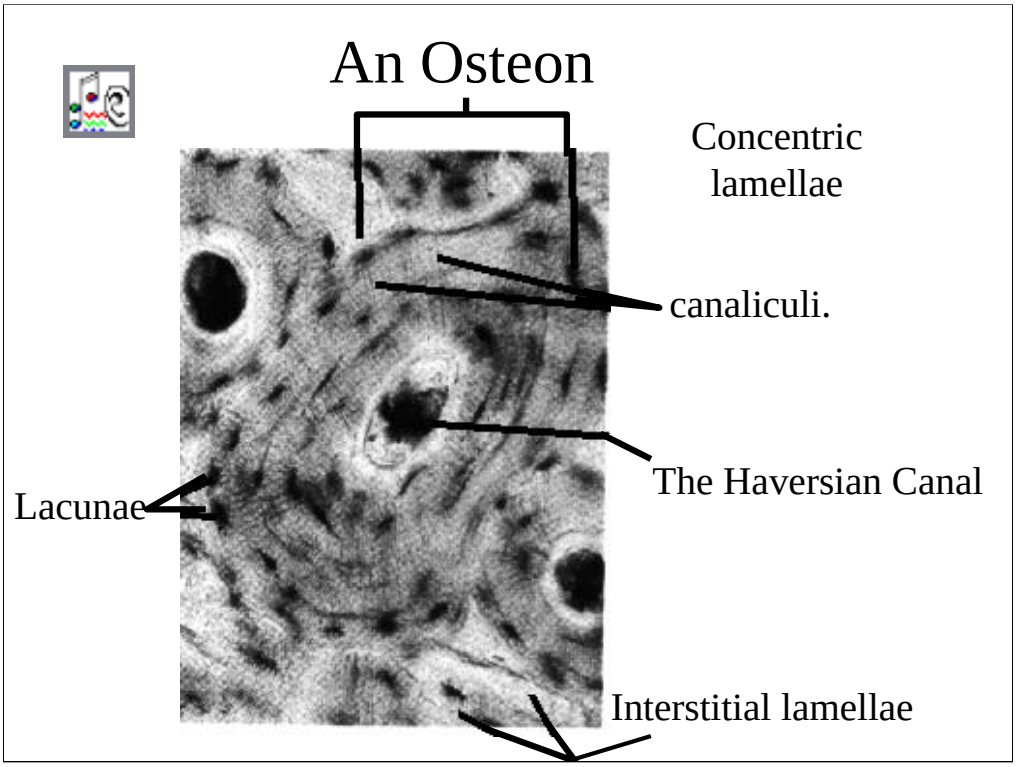
The cells found in bone tissue reflect the processes of remodeling and maintenance which go on constantly. In remodeling, first **osteoclasts** remove bone tissue, an **osteon** at a time. Next **osteoblasts** build up new bone to replace the old. Then the osteoblasts become **osteocytes**, mature bone cells which maintain the matrix. In this way the structural and functional integrity of the bone is maintained.



This illustration shows the various tissues associated with a bone, using the long bone as an example. Two of these are osseous tissues, **cancellous** and **cortical** bone, the others are various types of connective tissue. These include **articular cartilage** (hyaline as discussed earlier), the a fibrous covering called the **periosteum**, a similar tissue which lines the **medullary canal** called the **endosteum**, and the two types of marrow: adipose **yellow marrow** in the medullary canal, and **red marrow** which produces blood found in the space of the cancellous bone.



In this view you see the differences between **cancellous (spongy) bone** and **cortical (compact) bone**. The spongy bone has numerous spaces which contain red marrow in a living bone. Red marrow is called **myeloid tissue**, which means it produces the various types of blood cells, a process known as **hematopoiesis**. Cortical bone has a regular arrangement of circular systems called **Haversian systems** or **osteons**. Note also the detail of the periosteum and how its collagen fibers, called **Sharpey's fibers**, actually invade and fuse with the fibers of the cortical bone. The periosteum also fuses with tendons and ligaments to produce an extremely strong connection.



An osteon, or Haversian system, consists of an **Haversian canal** surrounded by layers (**lamellae**) of **osteocytes** in **lacunae**. The tiny canals which produce the “hairy” appearance are **canaliculi**, tiny canals through which osteocytes connect to one another and obtain nutrients. Lamellae which surround an Haversian canal are **concentric (circular) lamellae**, those which fill in between osteons are **interstitial lamellae**.

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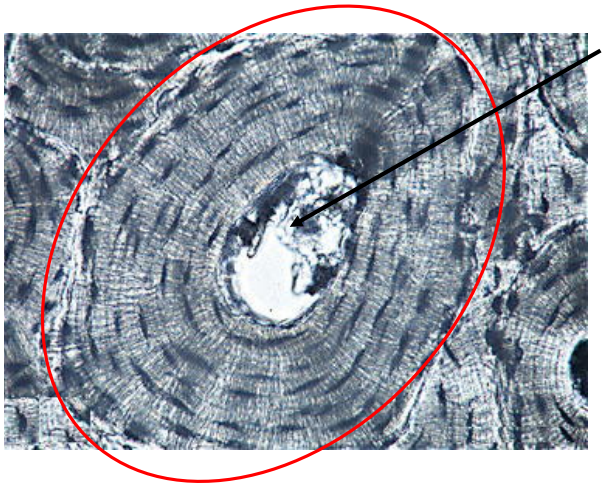
Osteon = Haversian System



In a living bone the Haversian canal contains blood vessels. Their remnants seen here.

The components of **osteons** appear dark in dry ground bone due to refraction of light. Actual cells and other organic structures have been destroyed by the drying process.

Osteons Produce the Dense Arrangement in Ground Bone Tissue

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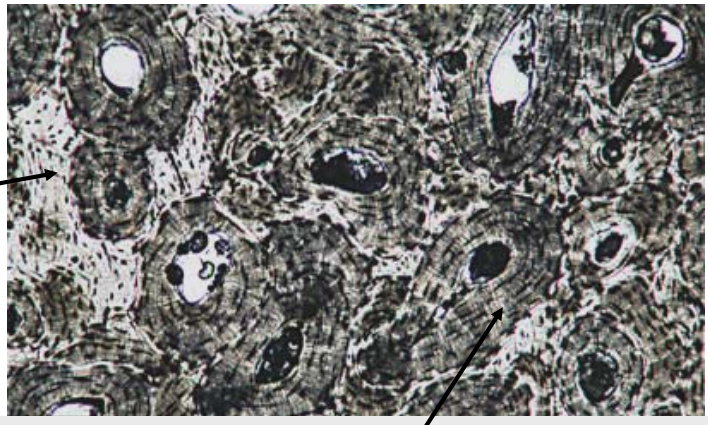
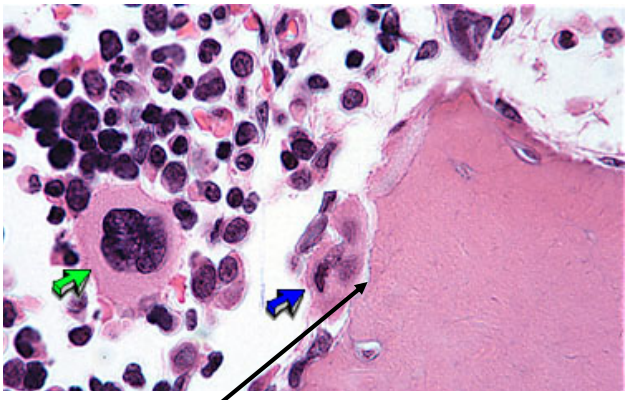


Compact bone consists of a dense arrangement arrangement of osteons.

Decalcified Bone Matrix



Osteoclasts (blue) are responsible for degradation of old bone. The megakaryocyte (green) has a single multi-lobed nucleus.

Resorption bay produced by the dissolution of the matrix.

The decalcification reveals cells which are not visible in dry ground bone, such as **osteoclasts**, and blood cells. The **megakaryocyte** is a stem cell for blood **platelets**.

Types of Bones

1) Long bones – bones of the upper and lower arms and legs as well as the metacarpals and metatarsals.
2) flat bones – sternum, ribs, scapulae
3) short bones – carpals and tarsals
4) irregular bones – vertebrae
5) sesamoid bones – patellae

Bones can be categorized into different types. Flat bones are produced by **intramembraneous ossification**, the other types by **endochondral ossification**.

Skeletal Divisions

1) Axial skeleton – skull, sternum, ribs, and vertebrae (including sacrum)
2) Appendicular skeleton – bones of the pectoral and pelvic girdles and of the arms, legs, wrists, hands, ankles, and feet.

TABLE 6.1 Bone Markings

Projections that are sites of muscle and ligament attachment. A.k.a. processes, all these markings "stick out" (project) from the bone.

Tuberosity - Large rounded projection; may be roughened

Crest - Narrow ridge of bone; usually prominent

Trochanter - Very large, blunt, irregularly shaped process (The only examples are on the femur.)

Bone markings are the contours such as processes, canals, holes, etc. Many of these are sites of attachment for muscles, tendons, and ligaments, or passageways for nerves or blood vessels. Learning these general names first makes it much easier to learn the names of the specific markings on the individual bones.

Projections (contd.)

Line - Narrow ridge of bone; less prominent than a crest

Tubercle – small rounded projection or process

Epicondyle – raised area on or above a condyle

Spine – sharp, slender, often pointed projection

Process – any bony prominence

More general terms for bone projections (processes).

Projections that help to form joints

Head – bony expansion carried on a narrow neck

Facet – smooth, nearly flat articular surface

Condyle – rounded articular projection

Ramus – armlike bar of bone

Depressions and openings allowing blood vessels and nerves to pass

Meatus – canal-like passageway

Fossa – shallow depression in a bone

Groove – furrow

Fissure – narrow, slit-like opening

Depressions and openings usually are there to allow blood vessels and nerves to pass

Depressions and openings (contd.)

Foramen – opening through a bone

Sinus – cavity within a bone

More depressions and openings in bones.

Lab Protocol

1) After studying the lab exercise and this PDF, complete the Review Sheet which accompanies the lab exercise.
2) Look at histology web sites for images of cartilage and bone
3) Take the quiz on bone and cartilage.