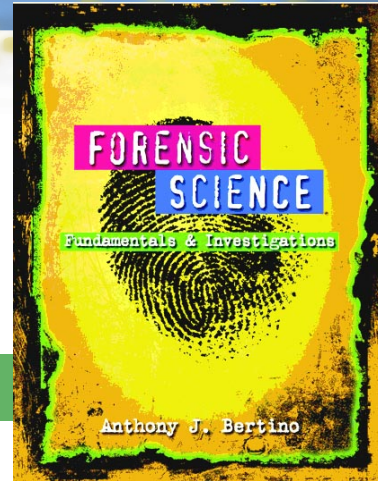


Chapter 13 *Forensic Anthropology: What We Learn from Bones*

By the end of this chapter you will be able to:



- describe how bone is formed
- distinguish between male and female skeletal remains
- explain how bones contain a record of injuries and disease
- describe how a person's approximate age could be determined
- discuss the role of mitochondrial DNA in bone identification

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Forensic Anthropology

- **Anthropology**—Scientific study of the origins and behavior as well as physical, social, and cultural development of humans.
 - tools, language, traditions societal relations, etc.
- **Forensic anthropology**—studies these identifying characteristics on the remains of an individual

Historical Development

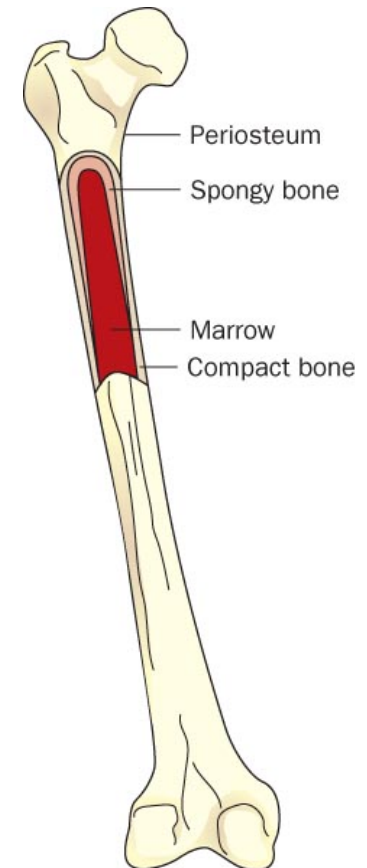


1. In Europe, in the 1800s, scientists began studying skulls. This laid the framework for today's knowledge.
2. In 1932 the FBI opened the first crime lab.
3. The Smithsonian Institution became its working partner in the identification of human remains.
4. 1939, text on how to ID skeletal material.
5. Soldiers killed in World War II were identified using anthropologic techniques.
6. Recently, mtDNA used to ID remains.



Characteristics of Bone

- Bones are alive. They carry on cellular respiration and use energy.
- Marrow—creates blood cells
- Hormones affect the amount of calcium phosphate in the blood and bones





Development of Bone- ossification

- Bones originate as soft cartilage and come from cells called osteoblasts.
- They migrate to the center of cartilage production and deposit minerals that harden – ossification.
- Begins during the first weeks of pregnancy, by 8th week, an outline of a skeleton can be seen on X-ray



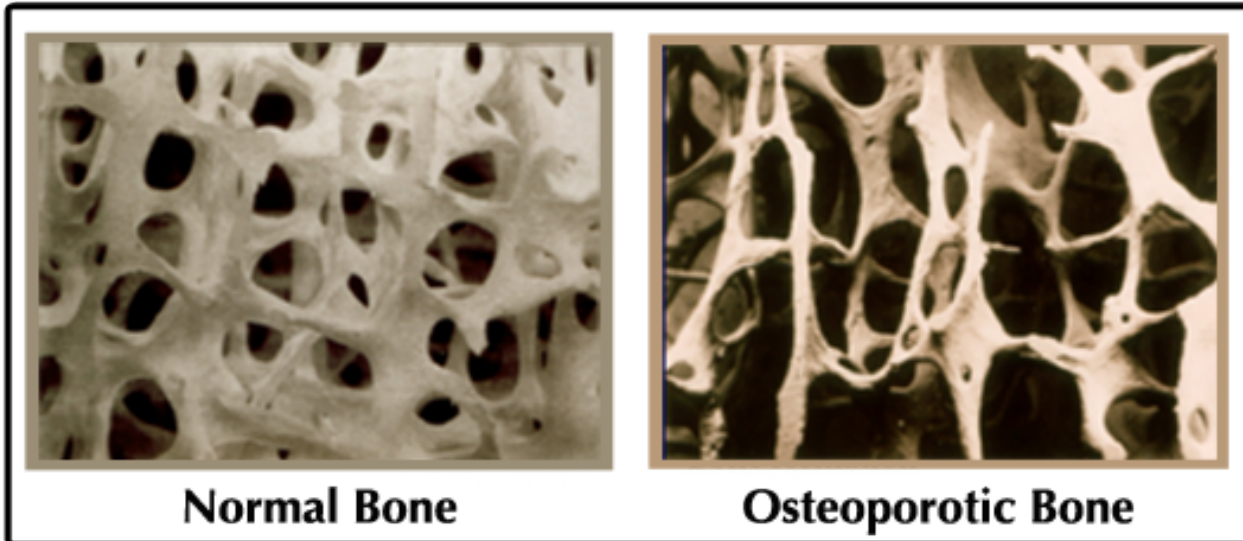
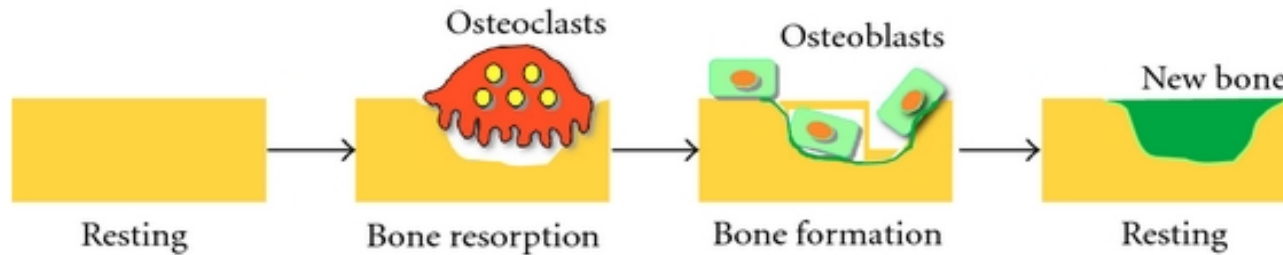
Development of Bone

- Throughout life, bones are being broken down, deposited, and replaced.
- Osteoclasts, the 2nd type of bone cell, among other tasks, remove cellular wastes and dissolves bone if needed.
- Adults have 206 bones. Babies have about 300 bones because they are not fused completely yet.



Bone development

TedEd – How bones grow





Skull Cleaner (optional)

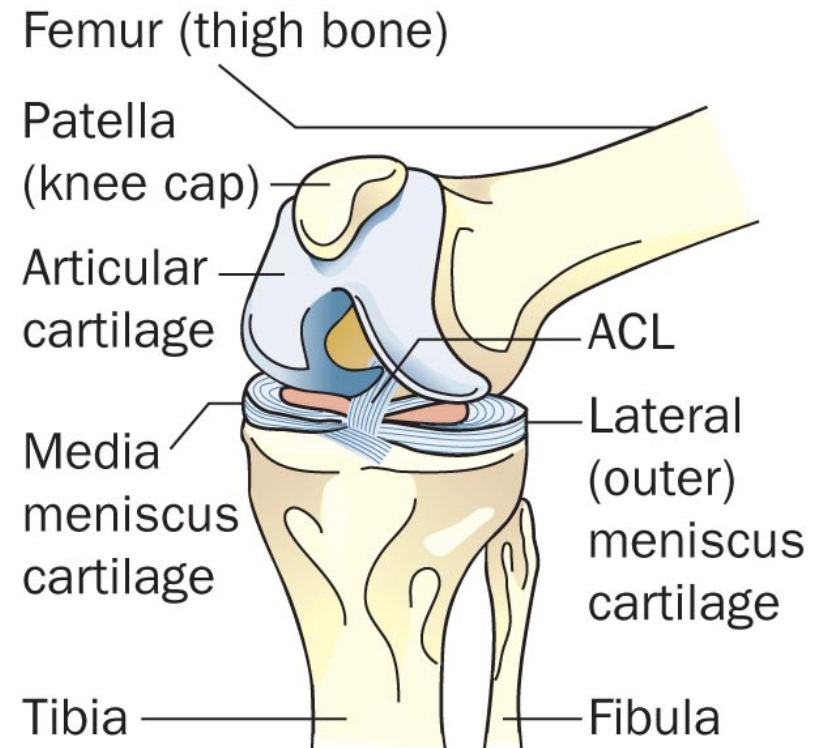
- Sometimes bones are exposed, other times they need to be cleaned
- Dirty Jobs – Skull Cleaners

<http://www.discovery.com/tv-shows/dirty-jobs/videos/skull-cleaner/>



How Bones Connect

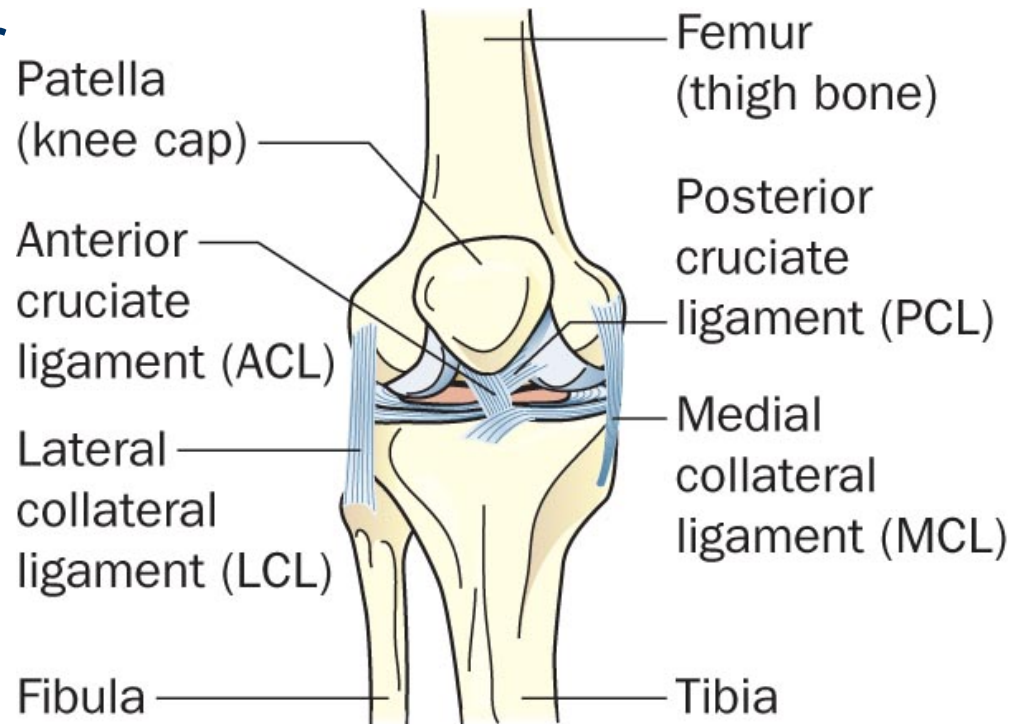
cartilage—wraps the ends of bones for protection and prevents scraping





How Bones Connect

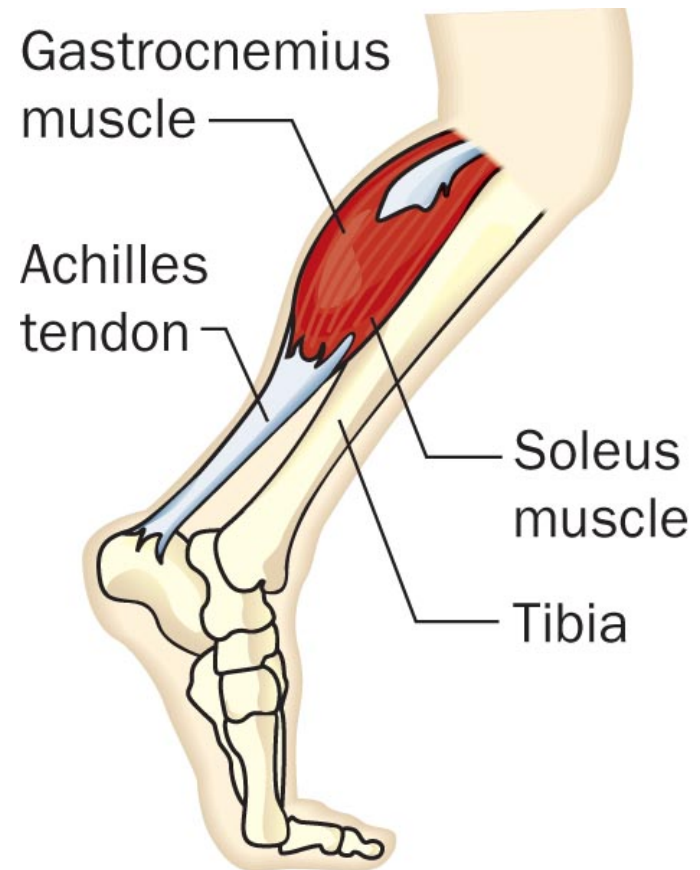
ligaments—bands that connect two or more bones together



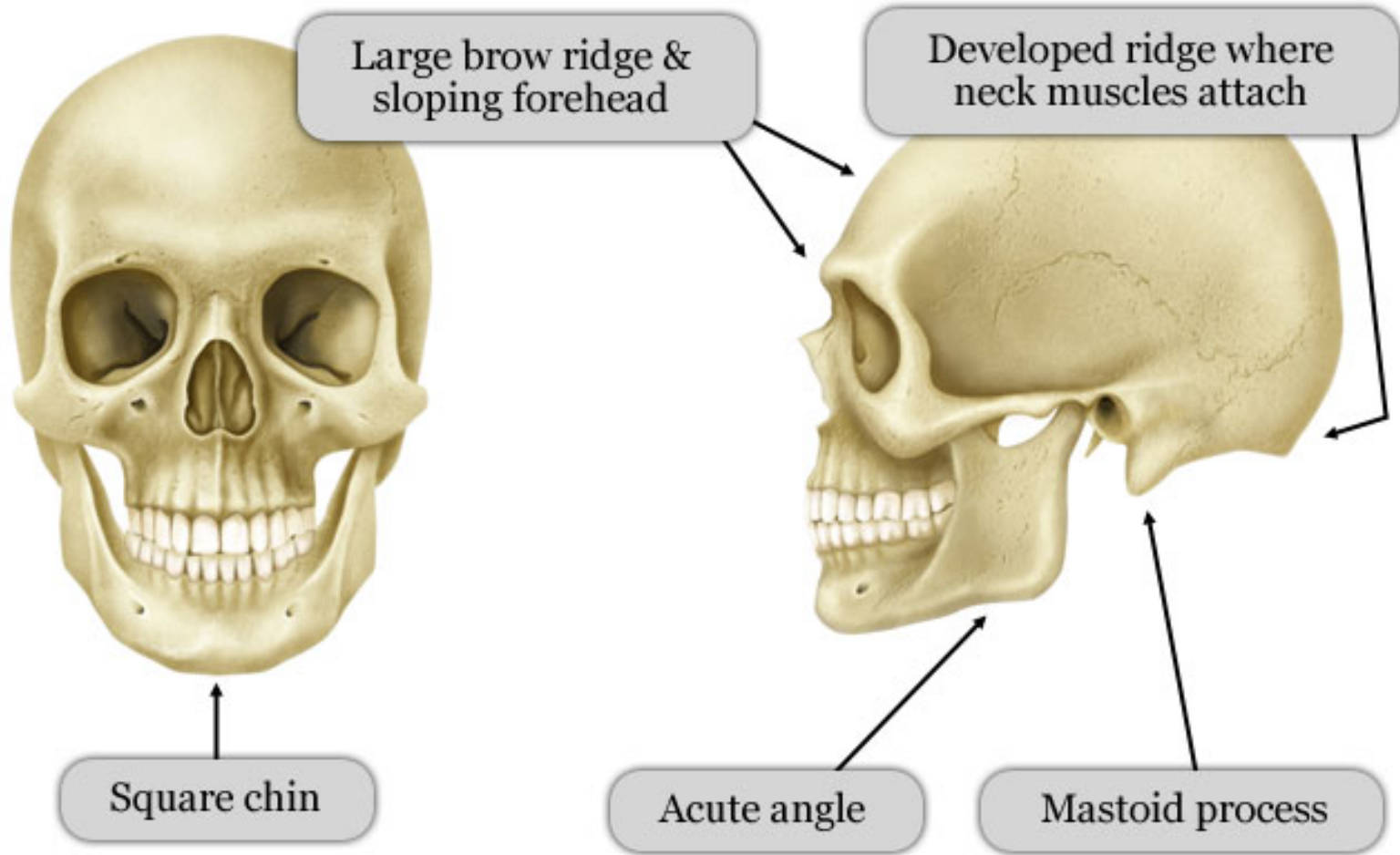


How Bones Connect

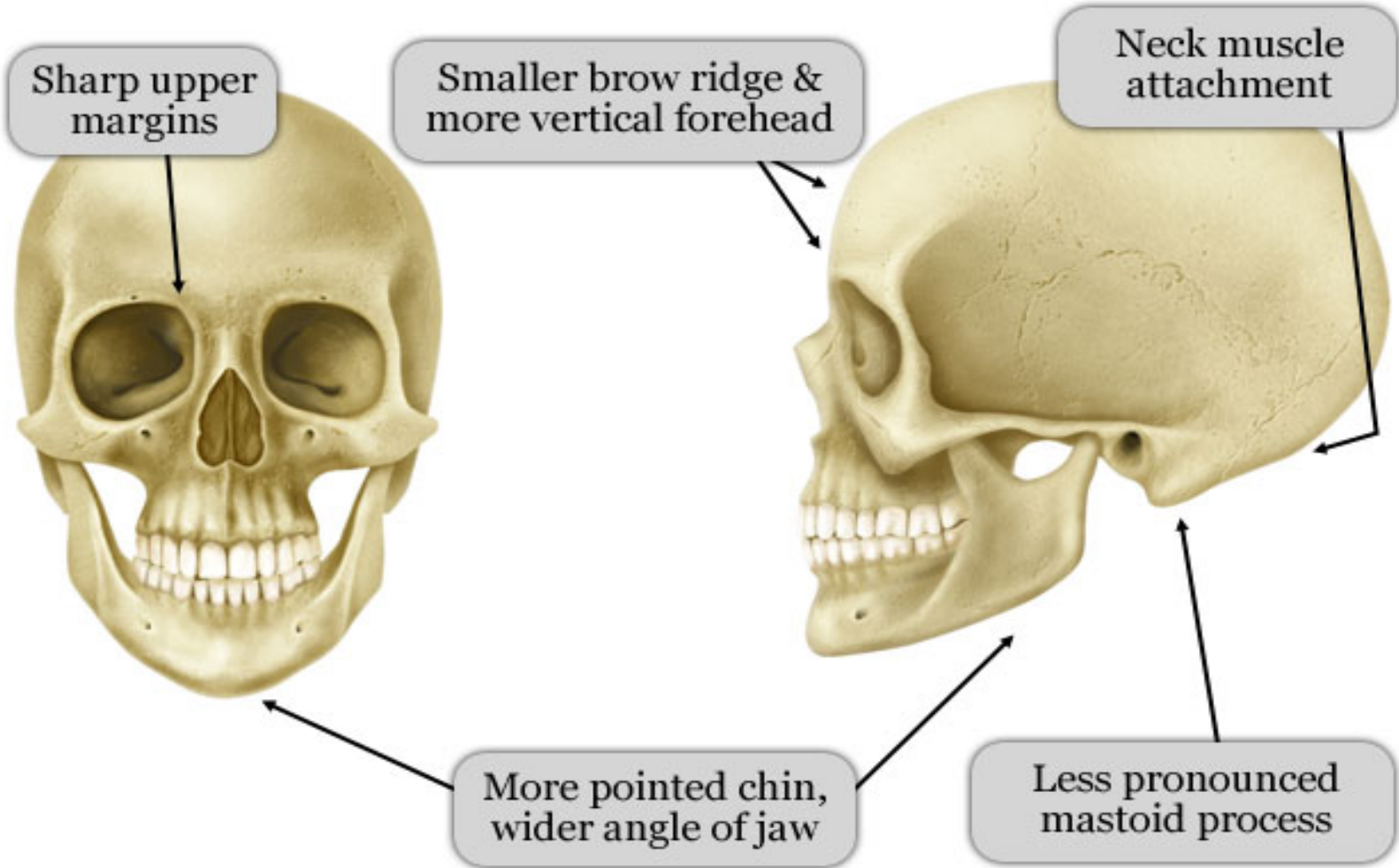
tendons—connect muscle to bone



Gender Male (Activity 13-2)



Gender Female

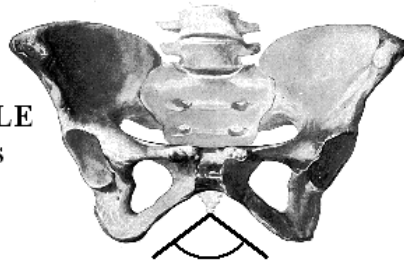


Gender



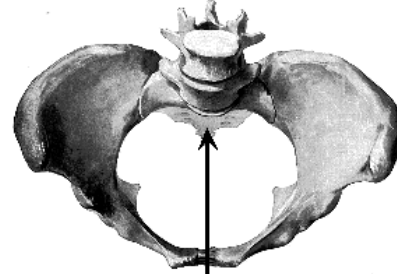
FEMALE
pelvis

Anterior view



$> 90^\circ$

Superior view



Sacrum tilted back

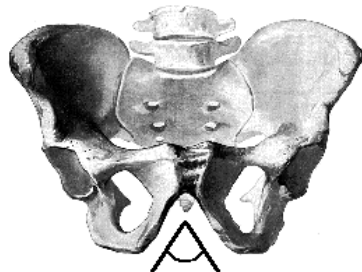
Inferior view



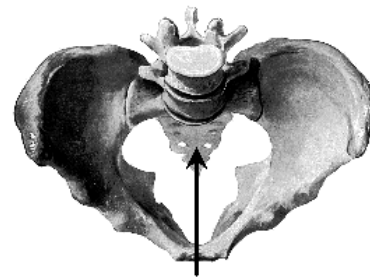
Ilia spread wider



MALE
pelvis



$< 90^\circ$



Sacrum tilted forward



Ilia closer together

- One of the easiest methods of determining the gender of a skeleton is by examining the pelvis.
- The surface of a woman's pelvis can be scarred.
- The sub pubic angle of the female pelvis is greater than 90° ; the male's, less.



Aging of Bone

- Under 30 years of age—bones increase in size
- Over 30—process reverses
- Exercise slows deterioration



Examining the bone

- Is it bone? Examine under magnification.
- Is it human? Compare to template.
- Are remains modern or ancient? Examine context of deposition. (modern dental work, clothing, cell phone, etc)



What Bones Can Tell Us

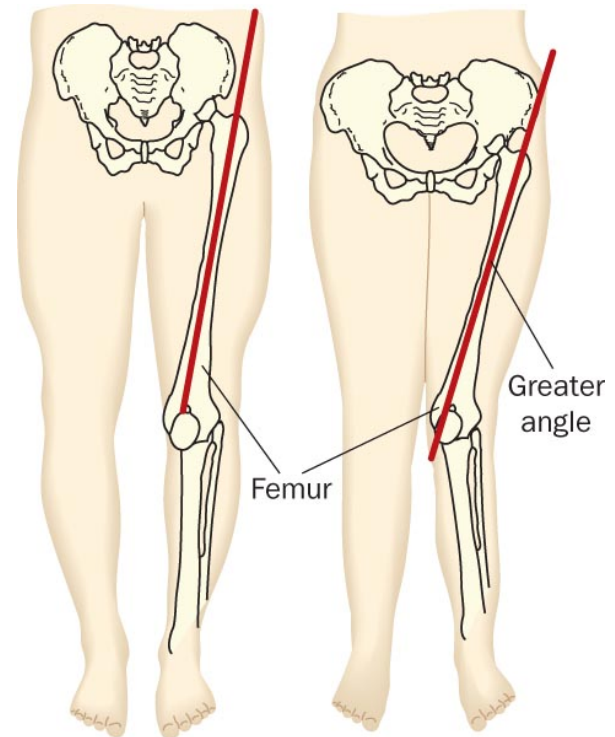
- **Osteobiography** tells much about a person through the study of the skeleton.
- The bones of a right-handed person, for example, would be slightly larger than the bones of the left arm.
- Forensic scientists realize that bones contain a record of the physical life.
- Analyzing bones can reveal clues to such things as gender, age, height, and health.

Femur → Height Calculation (Activity 13-4)



Gender—Thigh bones

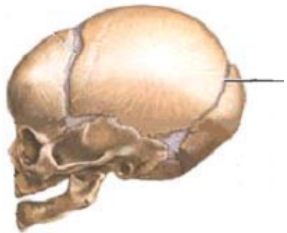
The male femur is thicker and joins the pelvis at a straighter angle than the female femur



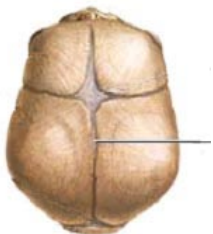


Age

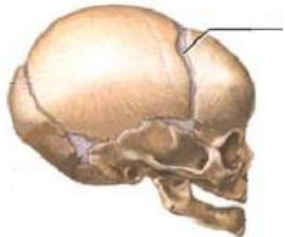
Copy Figure 13- 7 then complete Activity 13-1



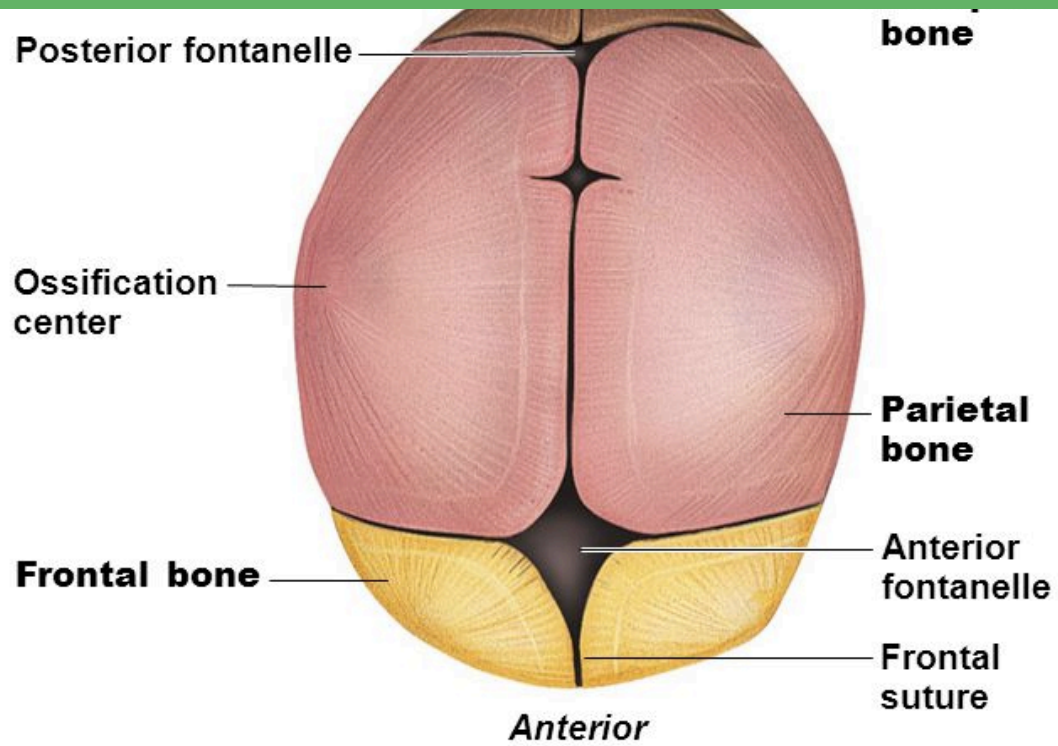
- The suture at the back of the skull (lamboidal suture) begins closing at age 21, and by age 30 will have closed.



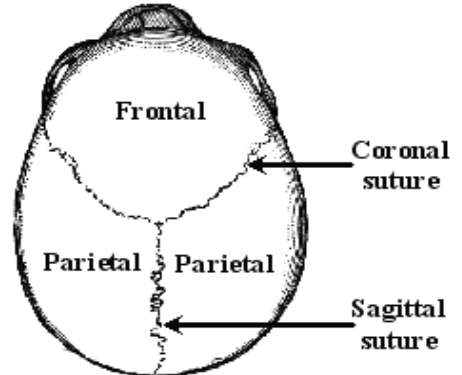
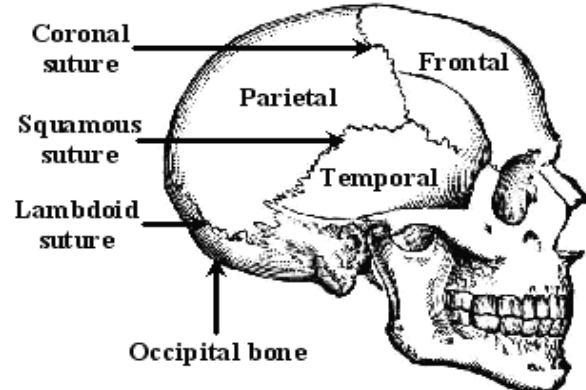
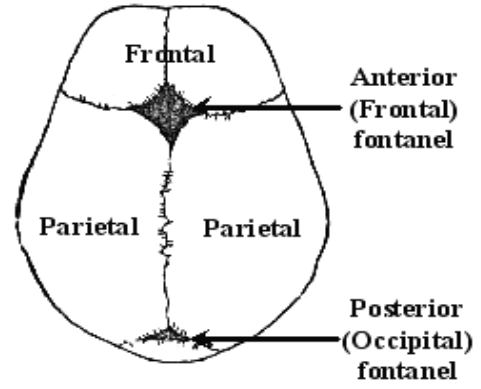
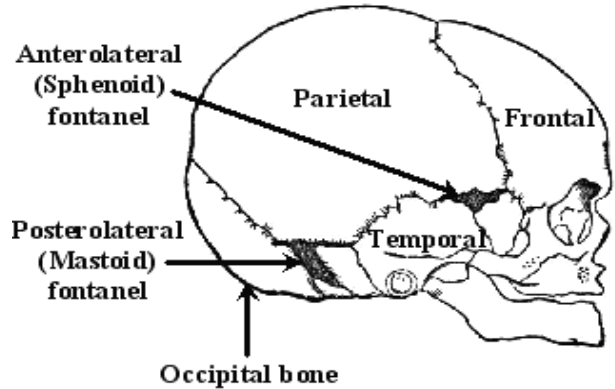
- By about age 32, the suture running across the top of the skull (sagittal suture), back to front, will have closed.



- By about age 50, the suture running side to side over the top of the skull, near the front (coronal suture), will have closed.



(a) Superior view

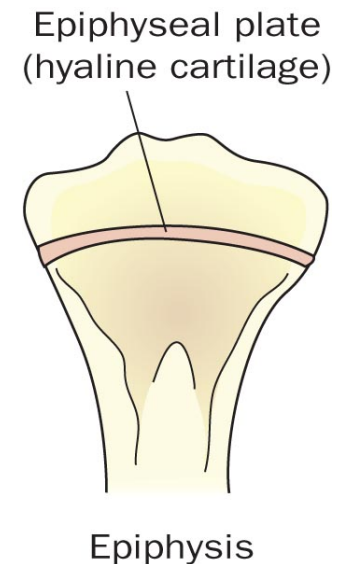


NOTE: Skulls are not to scale



Age

- At birth—300+ bones in the skeleton
- Adults— 206 bones
- **Epiphysis line**—appears where cartilage is replaced by bone
- When the cartilage is fully replaced, the line is no longer visible
- This information can be used to approximate a skeleton's age.
- Fusion of end to shaft (middle).





Age

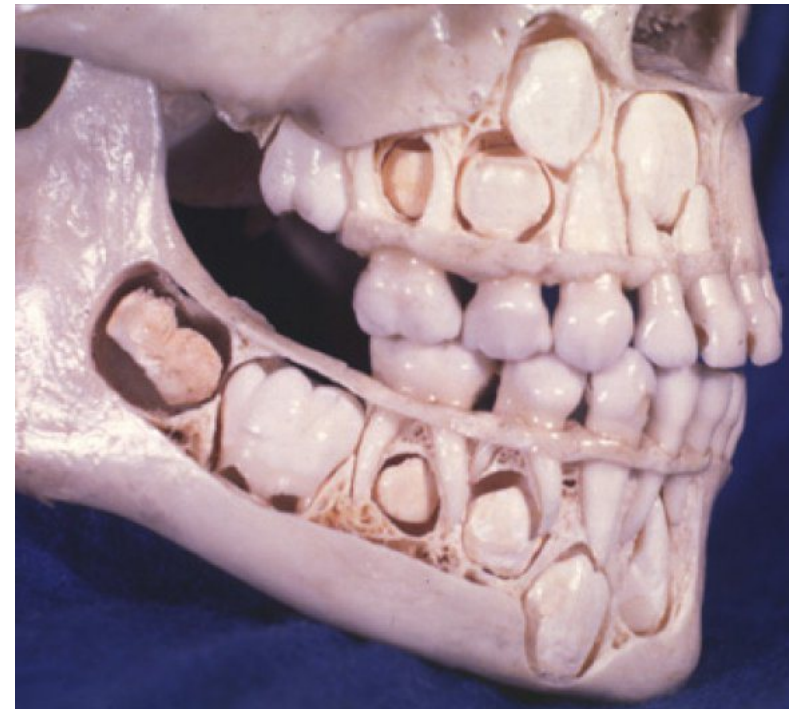
Region	Bone	Age (for fusion of end to shaft)
Arm	Humerous	18-20
Leg	Femur	16-18
Shoulder	Clavicle/sternum	18-24
Pelvis	All sacral bones	25-30
Skull	Sutures closed	50



Age

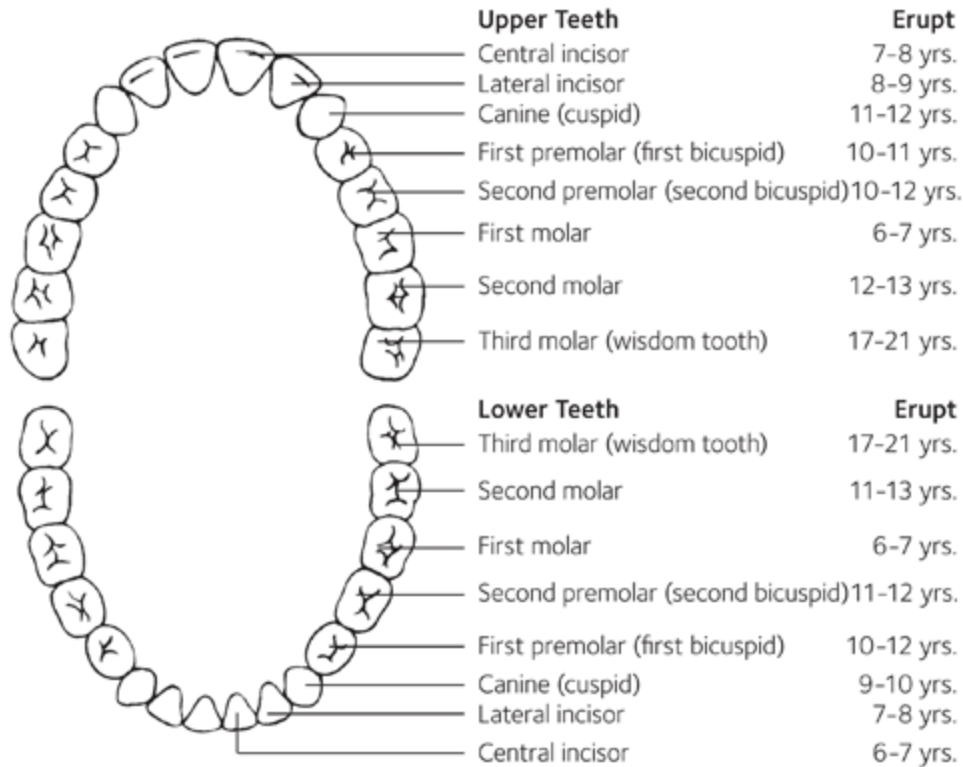
- Teeth are the best way to determine age in a child

	Upper Teeth	Erupt	Shed
	Central incisor	8-12 mos.	6-7 yrs.
	Lateral incisor	9-13 mos.	7-8 yrs.
	Canine (cuspid)	16-22 mos.	10-12 yrs.
	First molar	13-19 mos.	9-11 yrs.
	Second molar	25-33 mos.	10-12 yrs.
	Lower Teeth	Erupt	Shed
	Second molar	23-31 mos.	10-12 yrs.
	First molar	14-18 mos.	9-11 yrs.
	Canine (cuspid)	17-23 mos.	9-12 yrs.
	Lateral incisor	10-16 mos.	7-8 yrs.
	Central incisor	6-10 mos.	6-7 yrs.





Age for permanent teeth





Age



male 6 months



male 6 years



male 8 years



Height

- Just as age can be estimated by looking at the bones of the arm and leg, so also can an estimate of height be made.
- Often, the approximate height of a person can be calculated from one of the long bones even if just one of those is found.
- Gender and race will need to be taken into consideration in making the estimate.



Facial Reconstruction

- A face is formed by the skull with the muscles and tissues on top of the skull.
- Theoretically, nonetheless, a face can be rebuilt from just skeletal remains.
- Facial markers are positioned at critical locations on a skull, and clay is contoured to follow the height of the markers.
- Today, computer programs perform a similar function.
- These computer programs also can age missing persons and criminals.

<https://facial reconstruction video>



DNA Evidence

- Bone contains little nuclear DNA.
- But it does contain mitochondrial DNA.
- This has DNA that is inherited only from the mother.
- Long after nuclear DNA has been lost through tissue degeneration, mitochondrial DNA can be obtained from bone.
- Results can be compared with living relatives on the mother's side of the family to identify skeletal remains.

[bones of Richard III](#)



How to Distinguish Race

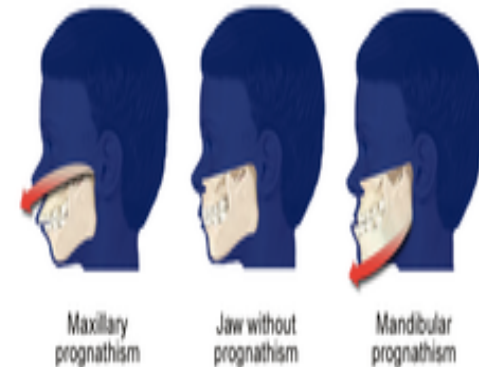
(copy down table fig. 13-21)

- Losing its significance due to blending of physical traits.

- Best indicated by skull and femur

- Skull-

- Shape of the eye sockets
- Absence or presence of a nasal spine
- Measurements of the nasal index (nose height)
- Prognathism
- Width of the face
- Angulation of the jaw and face





Other characteristics

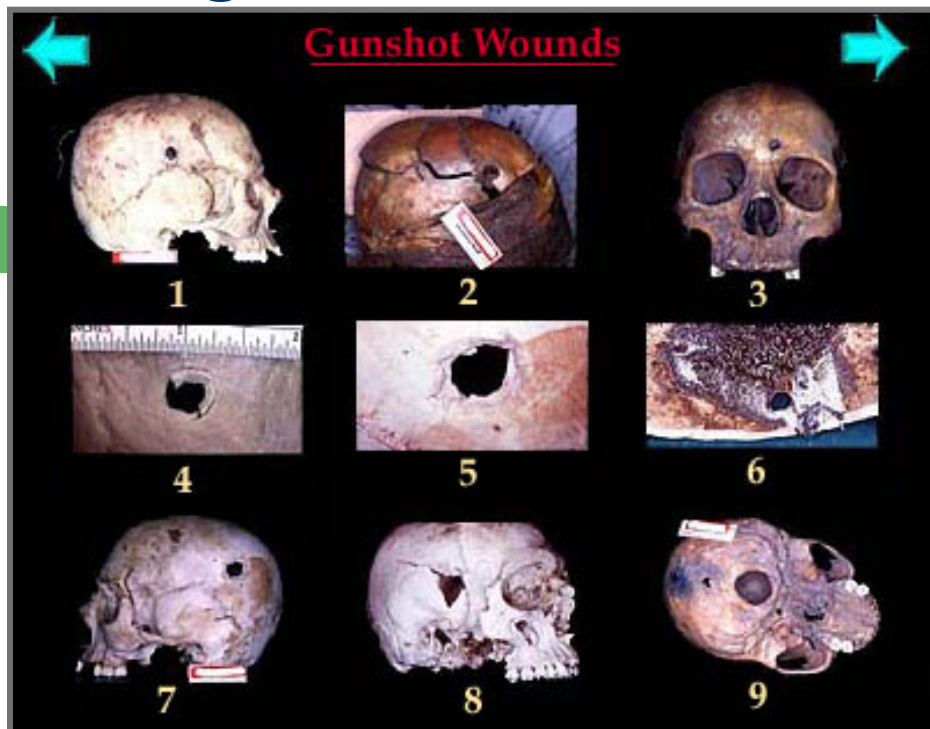
- Bones can also show
 - Diet/Nutrition, especially lack of Vitamin D and calcium
 - Diseases and genetic disorder, arthritis, scoliosis
 - Previous fracture
 - Types of work/sports
 - Surgical implants
 - Childbirth (pubic bones separate to move the baby out – ligaments connecting the bone stretch which tears then when they reattach, bones leave little linear or circular grooves.)



Skeletal Trauma Analysis

- Forensic anthropologists often determine if damage to bones occurred before or after death.
- Definite distinctions exist between patterns on bones made by weapons and the patterns created by the environment after death. (i.e. living bones will shatter in spiral pattern where as old bones break perpendicular to the length)
- Sharp-force trauma, blunt-force trauma, gunshot wounds, and knife wounds all have distinctive patterns.

Determining Cause of Death



- Sharp force trauma (bone cut)
- Blunt force trauma (broken bone)
- Antemortem vs. postmortem breaks



Antemortem vs. Postmortem

- Antemortem – before death, should show signs of healing
- Postmortem – after death, does not show signs of healing
- Perimortem – occurred very close to time of death



..... Summary

- Bones are live and carry on all life functions.
- The condition of bones can tell investigators about a person's health and nutrition during life.
- Male and female skeletons differ in many ways.
- The age of a person at death can be estimated by analysis of a number of bones.



..... Summary

- A person's height can be estimated by the length of long bones.
- Facial reconstruction is possible to some extent.
- Mitochondrial DNA can be extracted to help identify skeletal remains.
- Skeletal trauma analysis examines bones for evidence of damage.