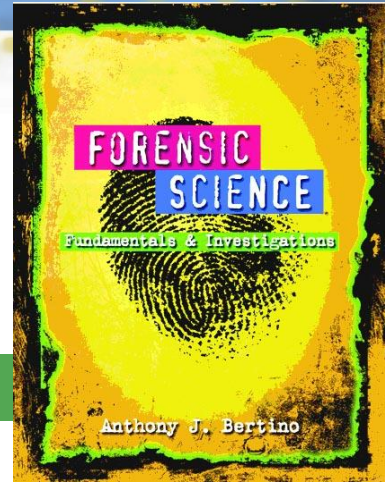


# Chapter 13 *Forensic Anthropology: What We Learn from Bones*

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

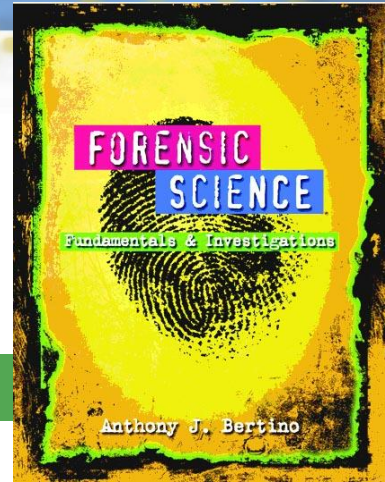


- Describe how bone is formed
- Distinguish between male and female skeletal remains
- Explain how bones contain a record of injuries and disease

All Rights Reserved South-Western / Cengage Learning © 2012, 2009

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

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



- Describe how a person's approximate age could be determined
- Explain the differences in facial structures among races
- Discuss the role of mitochondrial DNA in bone identification



# Osteology

- The study of bones.
- The branch of anatomy that deals with the structure and function of bones.



# Forensic Anthropology

- **Anthropology**— the science that deals with the origins, physical and cultural development, biological characteristics, and social customs and beliefs of humankind; the study of human remains.
- **Physical anthropology**—studies human differences
- **Forensic anthropology**— studies these identifying characteristics on the remains of an individual



# Historical Development



- **1800s**—scientists begin studying skulls
- **1897**—sausage maker's wife murdered; bone fragments found in his factory
- **1932**—the FBI opens the first crime lab
- Smithsonian Institution partners with FBI



# Alphonse Bertillon: “Father of Anthropometry”

- Developed an anthropometric system for human identification in the 1890s
- Anthropometry - The study of human body measurement for use in anthropological classification and comparison.
- The Bertillon system was eventually replaced by the fingerprint system



# Historical Development



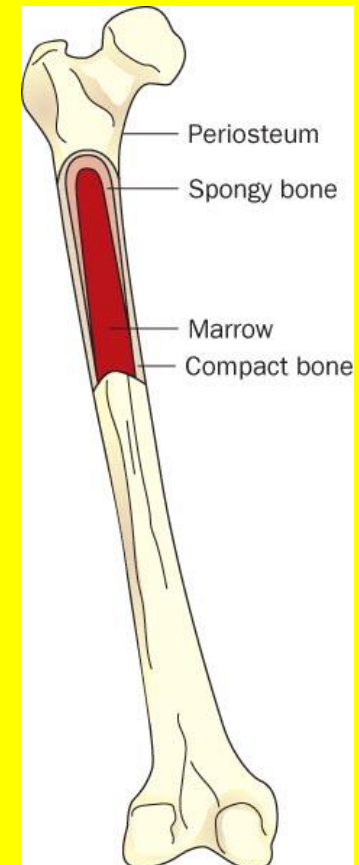
- **1939**—William Krogman publishes *Guide to the Identification of Human Skeletal Material*
- Soldiers killed in World War II are identified using anthropologic techniques
- DNA—new tool to analyze skeletons





# Characteristics of Bone

- Bones are alive; they respire and consume energy
- Marrow—creates blood cells
- Hormones affect the amount of calcium in the blood and bones; pre-puberty bones look the same.

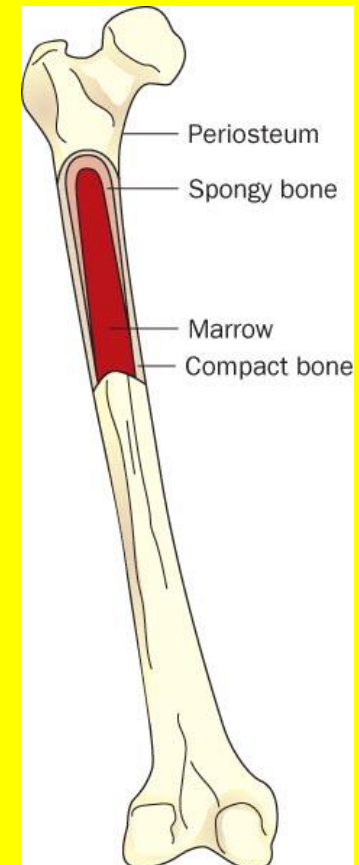






# Characteristics of Bone

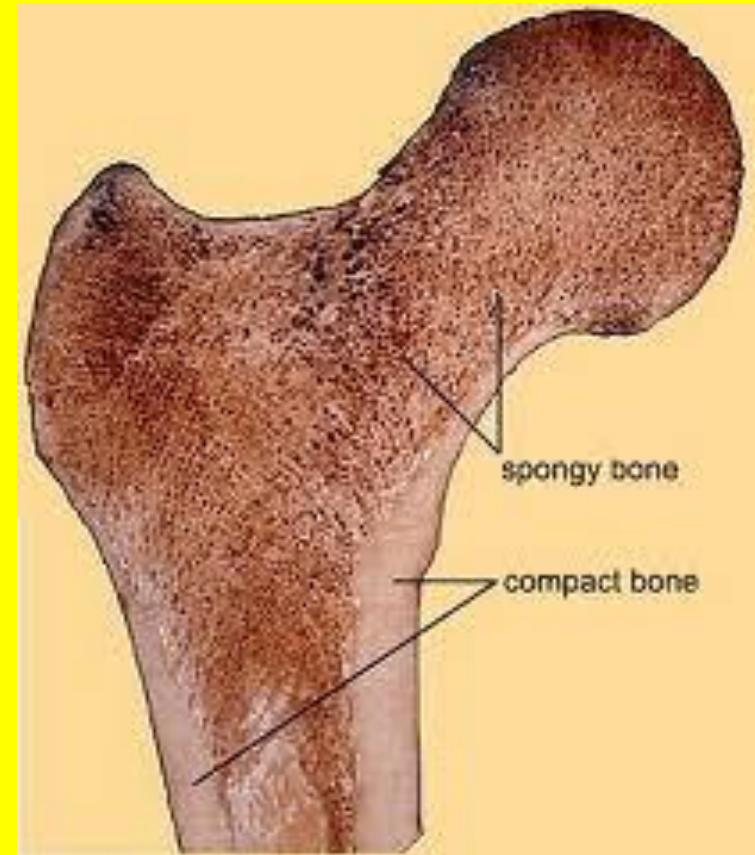
- Periosteum - is a membrane that lines the outer surface of all bones, except at the joints of long bones.
- Marrow - flexible tissue found in the interior of bones





# Characteristics of Bone

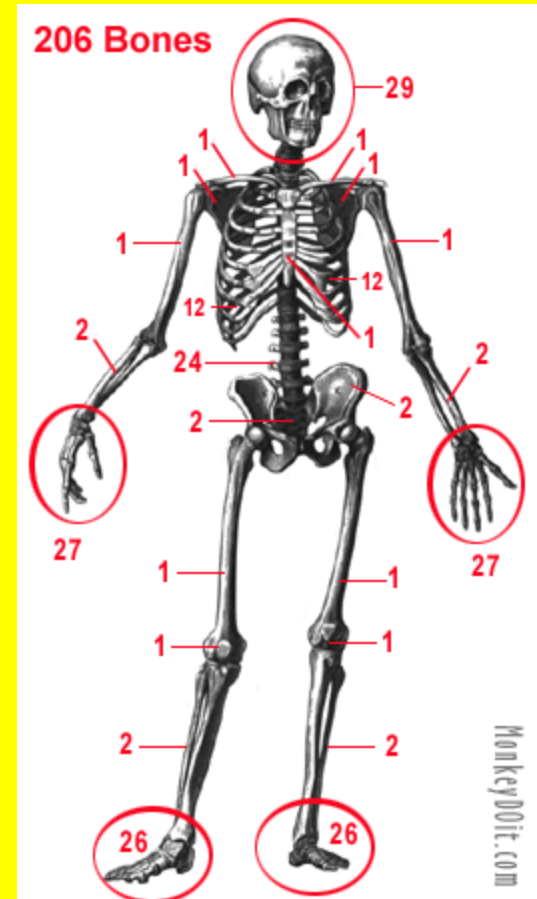
- Spongy Bone - found at the expanded heads of long bones and fills most irregular bones; makes bones lighter
- Compact Bone - forms the outer shell of all bone and also the shafts in long bones; makes bones stronger





# Number of Bones

- o Adults have approximately 206 bones
- o A newborn will have approximately 450





# Development of Bone

- **Osteoblast cells**— where bones originate; a type of cell capable of migrating and depositing new bone.
- **Ossification**—when osteoblast cells migrate to the center of cartilage production and deposit minerals; hardening of bones.
- **Life cycle**—bone is deposited, breaks down, and replaced
- **Osteoclasts**—a bone cell involved in the breaking down of bone and the removal of wastes.



# Development of Bone

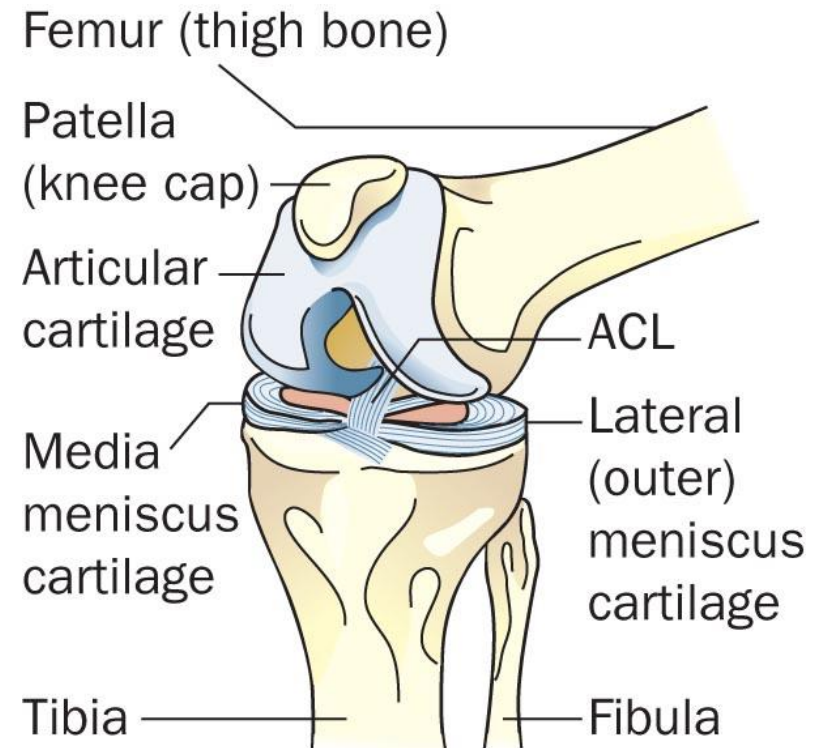
- **Osteoclasts**—the 2<sup>nd</sup> type of bone cell
  - Specialized to dissolve bone
  - Allows bones to reshape as they grow
  - Balances calcium levels in blood
  - Removes cellular wastes and debris from bones
- **Osteoporosis**— weakening of bone, which may happen if there is not enough calcium in the diet.



# How Bones Connect

**Joints** – locations where bones meet.

**Suture** - The process of joining two surfaces or edges together along a line by or as if by sewing. The lines between two bones.



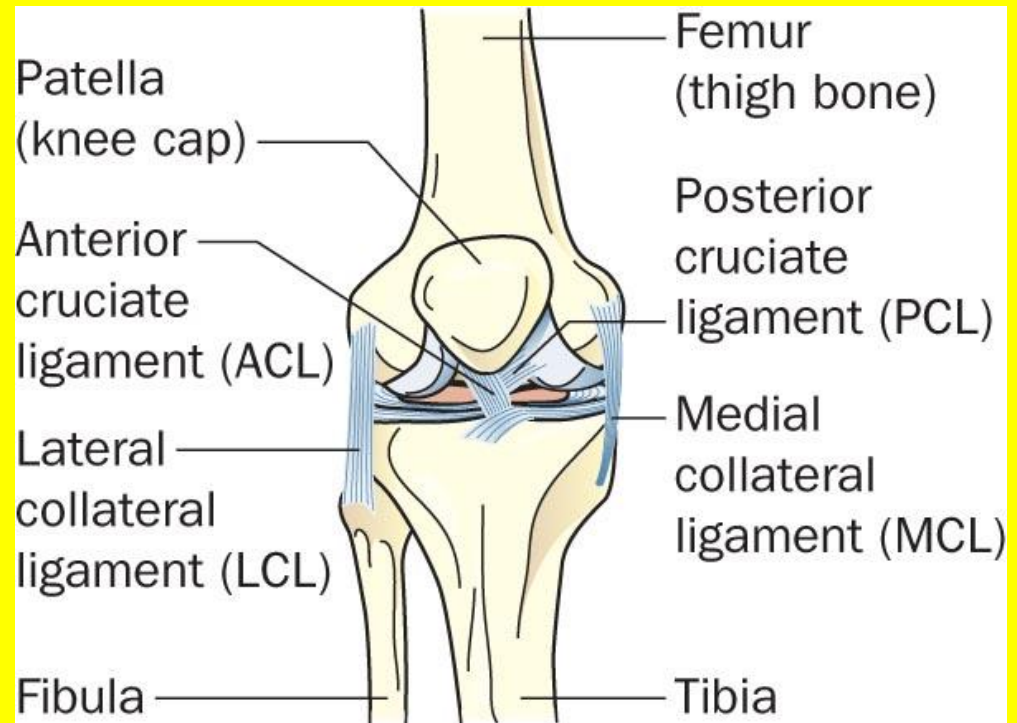




# How Bones Connect

**ligaments**—  
bands that  
connect two or  
more bones  
together

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

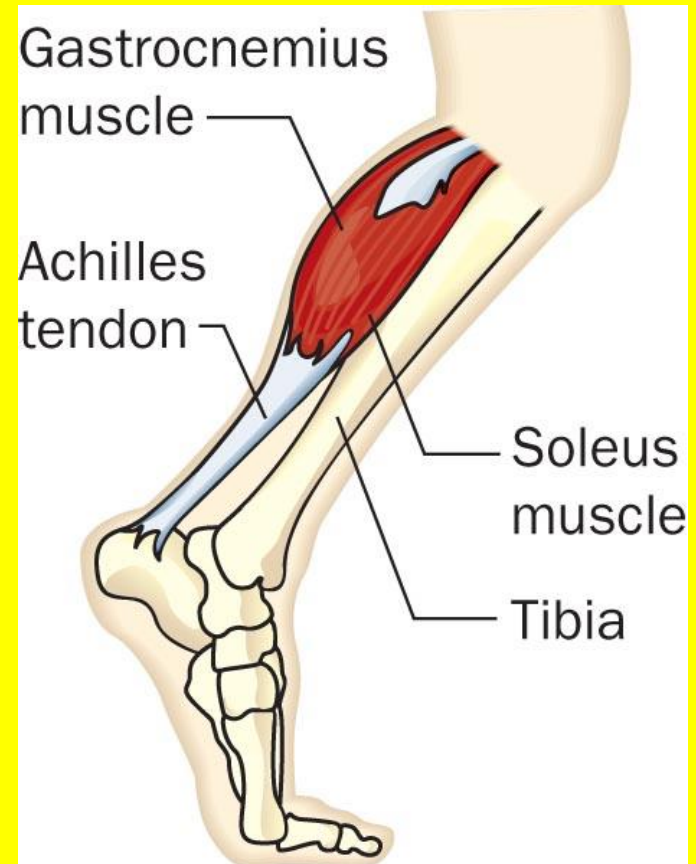






# How Bones Connect

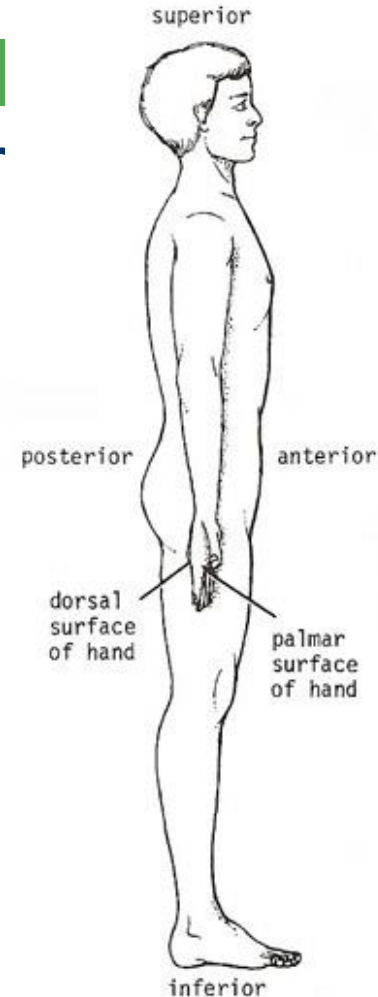
**tendons**—connect muscle to bone





# Describing Bone Location

- Anterior – in front of: The heart is anterior to the spine.
- Posterior – to the back of: The throat is posterior to the teeth.
- Superior – above, closer to the head-end  
The shoulders are superior to the hips.
- Inferior – below, closer to the foot-end:  
The tongue is inferior to the palate.





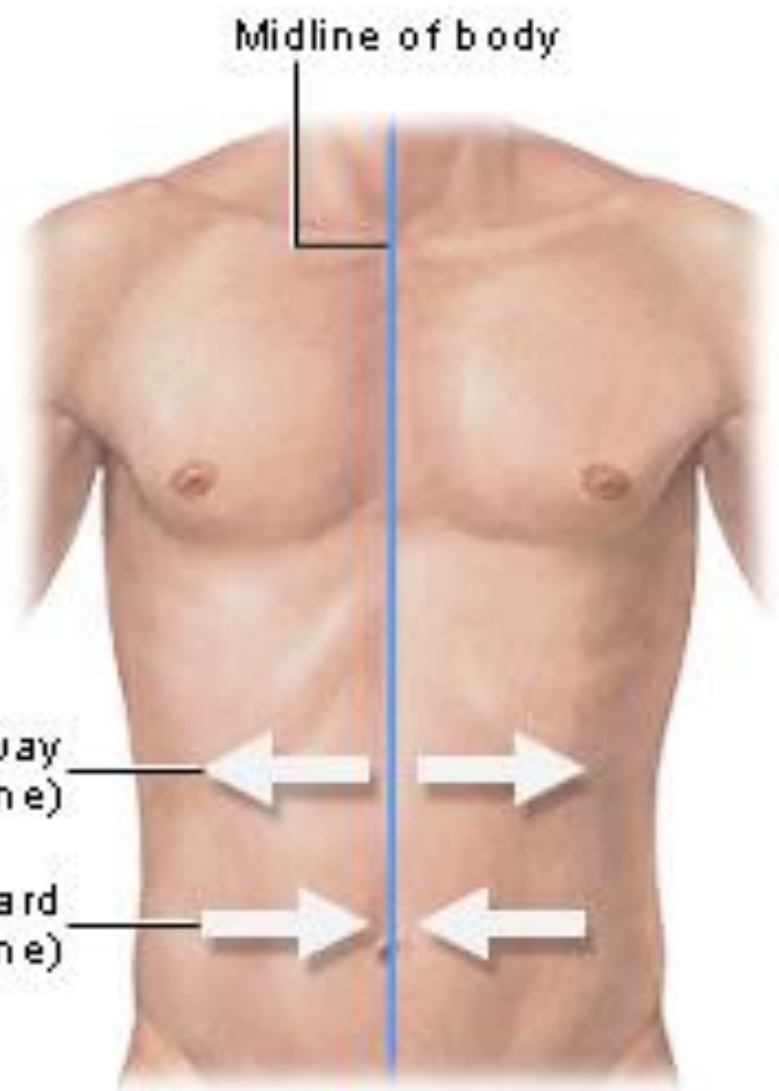
# Describing Bone Location

- Lateral – closer to the side of, farther away from the midline: The ribs are lateral to the sternum.
- Medial – farther from the side of, closer to the midline: The nose is medial to the eyes.
- Proximal – closer to the center of the body: The elbow is proximal to the wrist.
- Distal – farther from the center of the body: The ankle is distal to the knee.



Anterior (toward the front)

Posterior (toward the back)



Midline of body

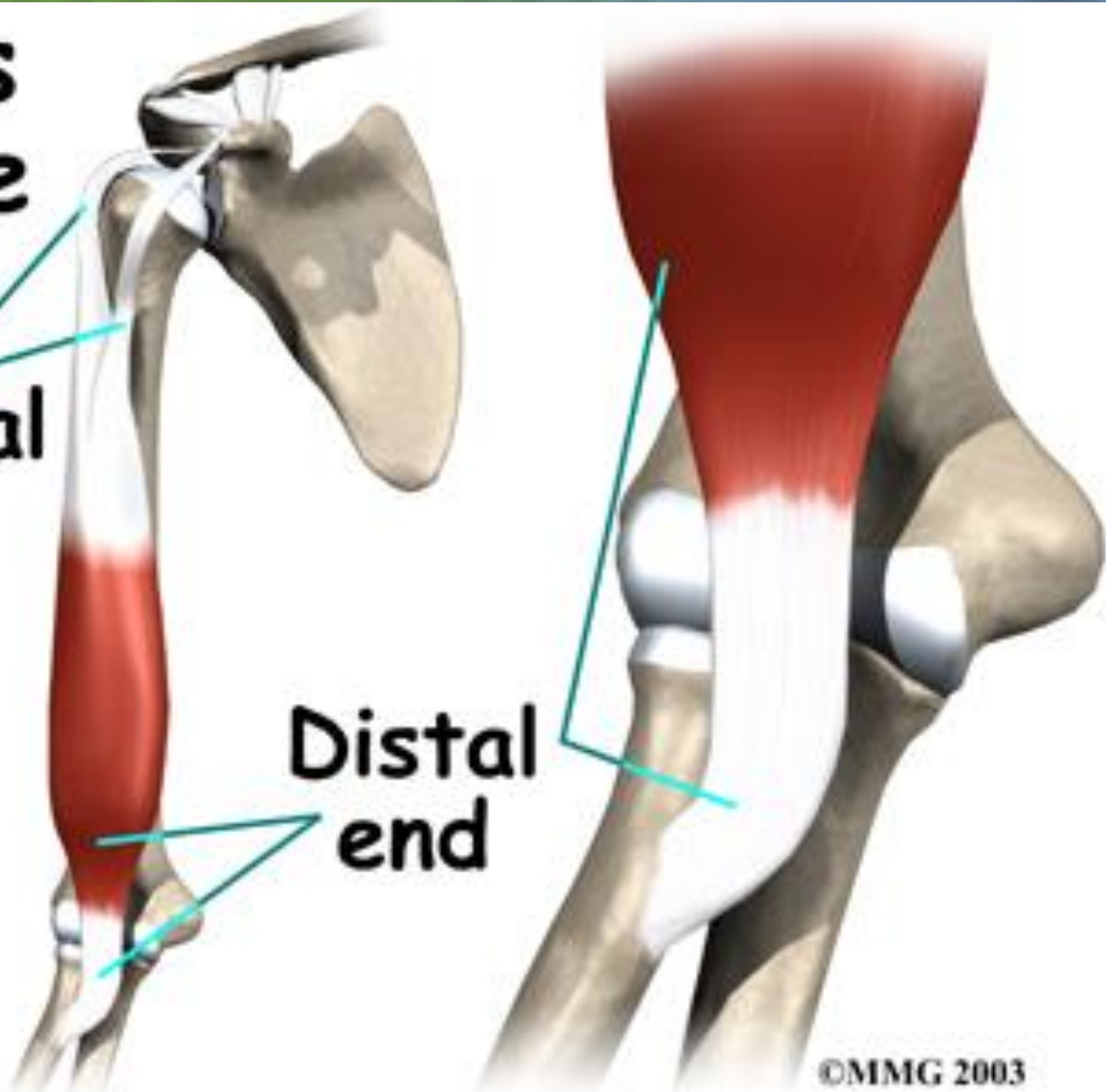
Lateral (away from the midline)

Medial (toward the midline)

# Biceps Muscle

Proximal end

Distal end





# Aging of Bone

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





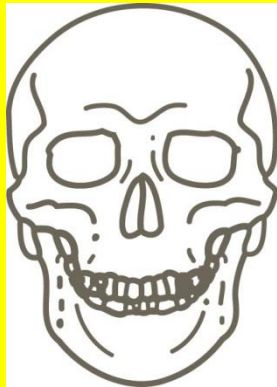
# What Bones Can Tell Us

- **Osteobiography**— the physical record of a person's life as told by his or her bones.
- Analyzing bones reveals clues to gender, age, height, and health
- Examples:
  - In a right-handed person, right arm bones might be slightly larger than the bones of the left arm
  - X-rays may identify prior fractures, pins, artificial joints





# Gender—Skull

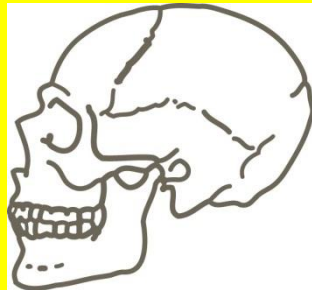


Male Characteristics	Trait	Female Characteristics
More square	Shape of eye	More rounded
More square	Mandible shape from underside	More V-shaped
Thick and larger	Upper brow ridge	Thin and smaller

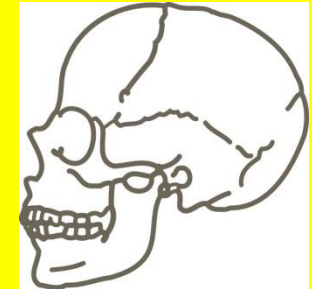




# Gender—Skull

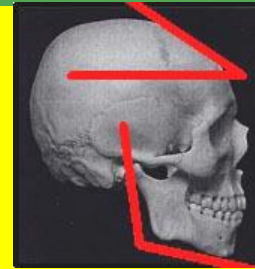
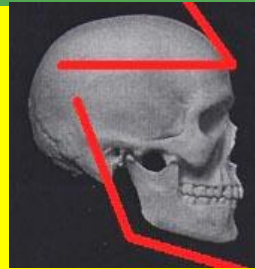


Male Characteristics	Trait	Female Characteristics
Present	Occipital protuberance	Absent
Low and sloping	Frontal bone	Higher and more rounded
Rough and bumpy	Surface of skull	Smooth
Straight	Ramus of mandible	Slanting
Rough and bumpy	Nuchal crest	Smooth





# Gender—Skull



- Is the female skull smoother than the male's?
- Which frontal bone is lower and sloping?
- Are the male's eye orbits more circular?
- Which jaw is more square, with an angle that is closer to 90°?

**Male**  
**Robust**

Supraorbital  
Ridges

Extreme

slight

**Female**  
**Gracile**

Sharp Orbital  
Border

Pronounced  
Muscle  
Attachments

Large  
Canines

Square Chin

Round Chin





# Gender—Pelvis



- An easy method to determine gender
- The surface of a woman's pelvis can be scared
- The sub pubic angle of the female pelvis is greater than  $90^{\circ}$ ; the male's, less



Page 6, step 1

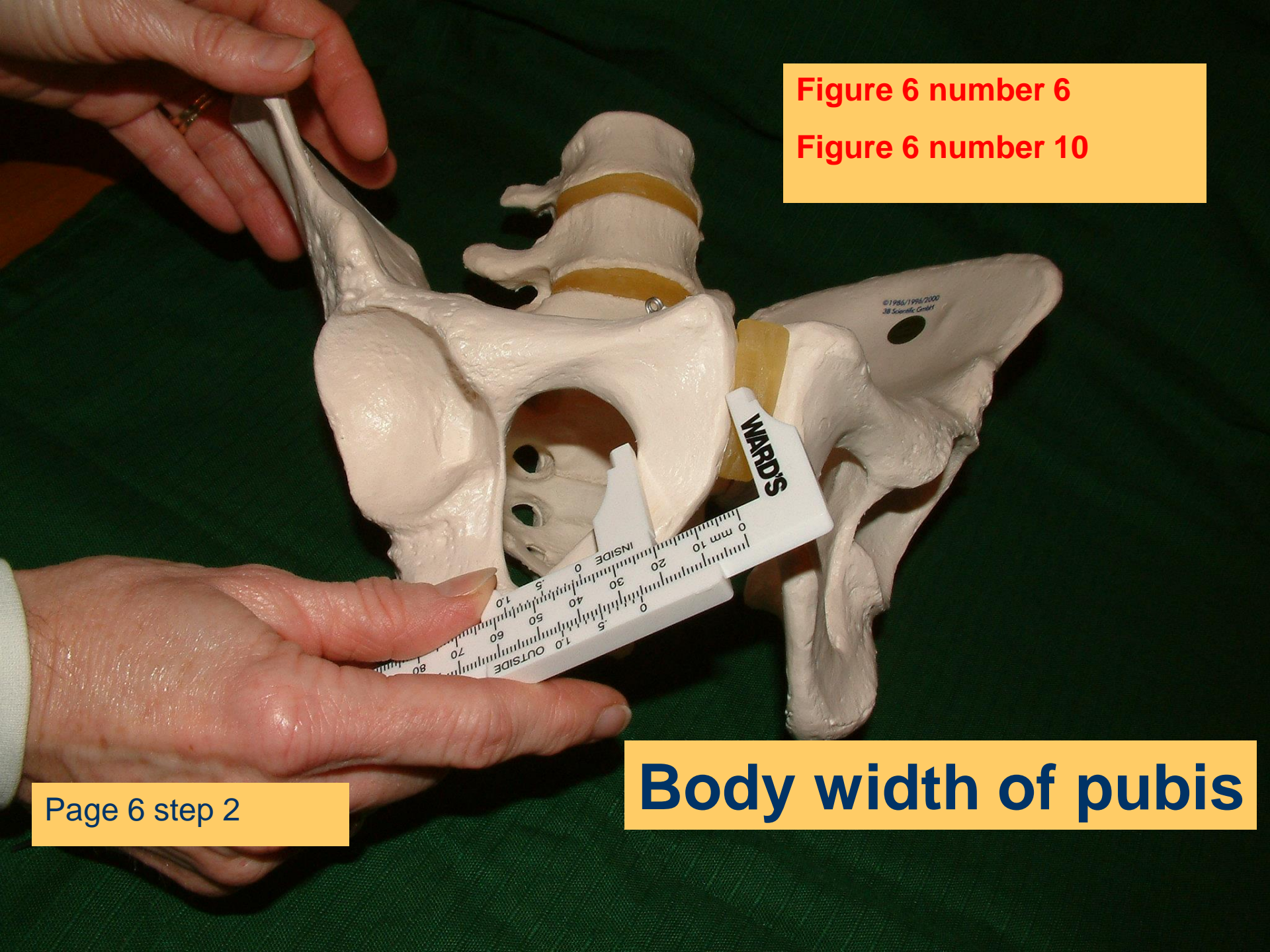
# Subpubic angle





Figure 6 number 6

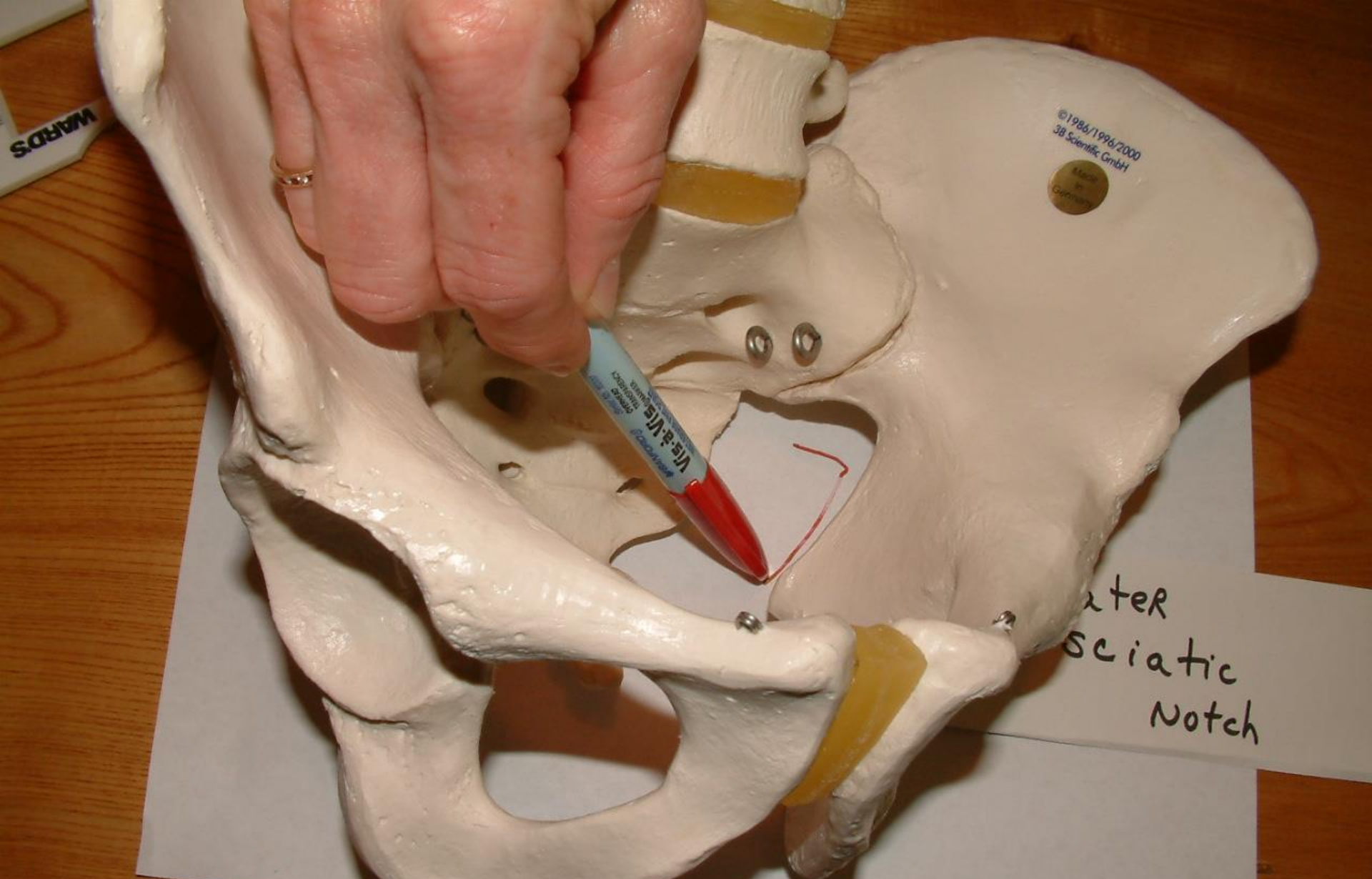
Figure 6 number 10



Page 6 step 2

**Body width of pubis**



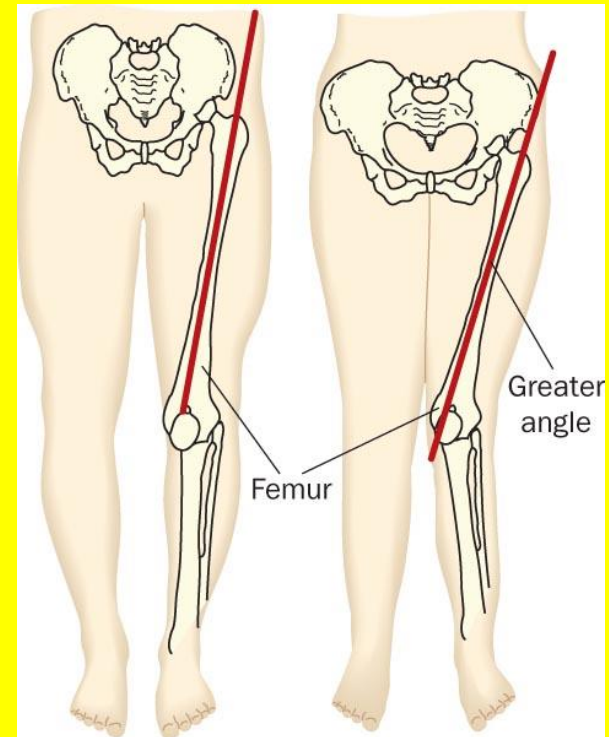


**Greater Sciatic Notch**



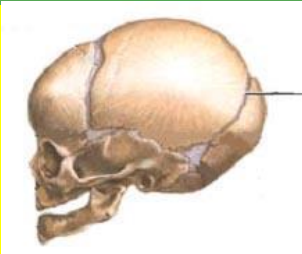
# Gender—Thigh bones

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





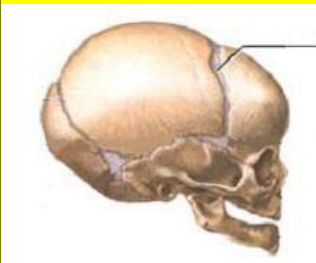
# Age—Skull



- By about age 30, the suture at the back of the skull closes



- By about age 32, the suture running across the top of the skull, back to front, closes

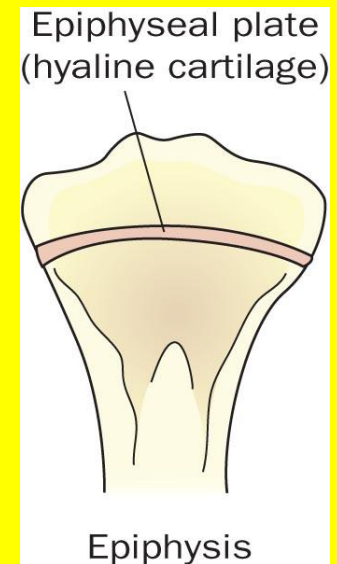


- By about age 50, the suture running side to side over the top of the skull, near the front, closes



# Age

- At birth—450+ 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





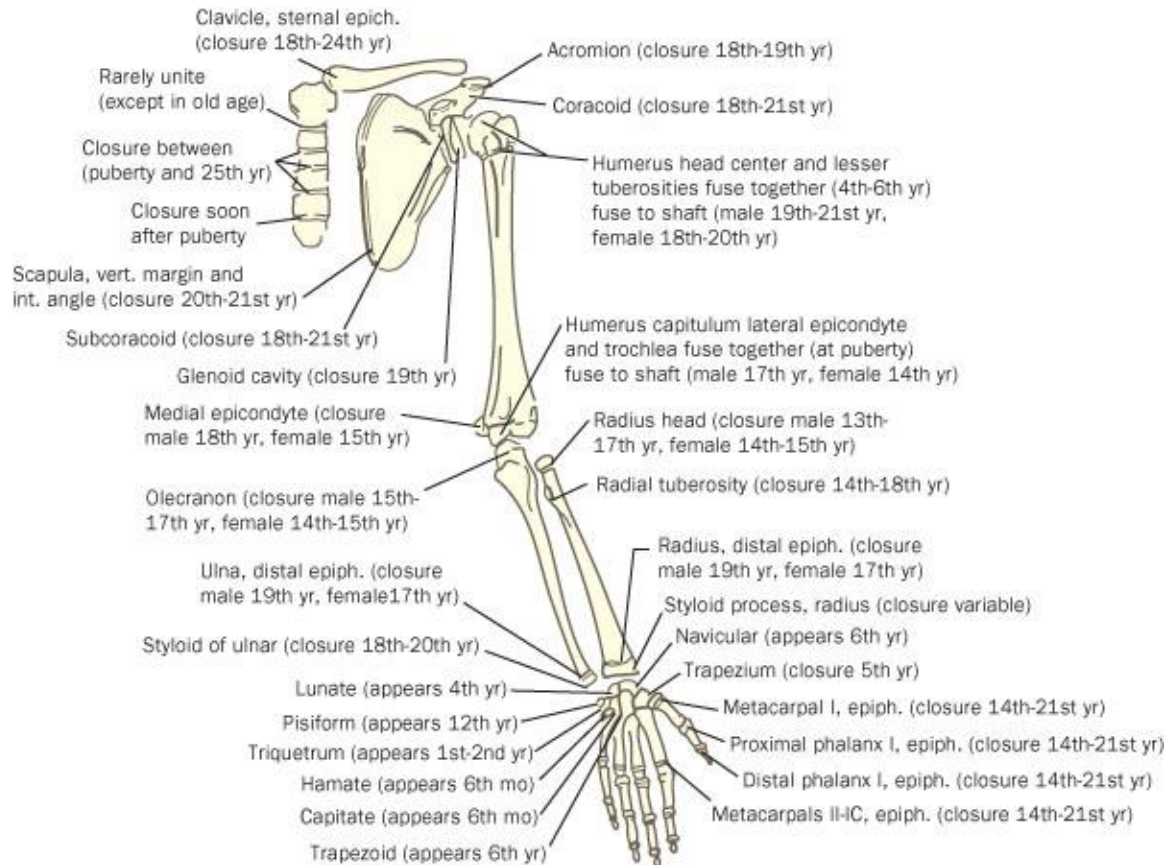
# Describing Bones

- Diaphysis - the main or mid section (shaft) of a long bone.
- Epiphysis - the end part of a long bone which is at first separated from the main part by cartilage, but later fuses with it by ossification

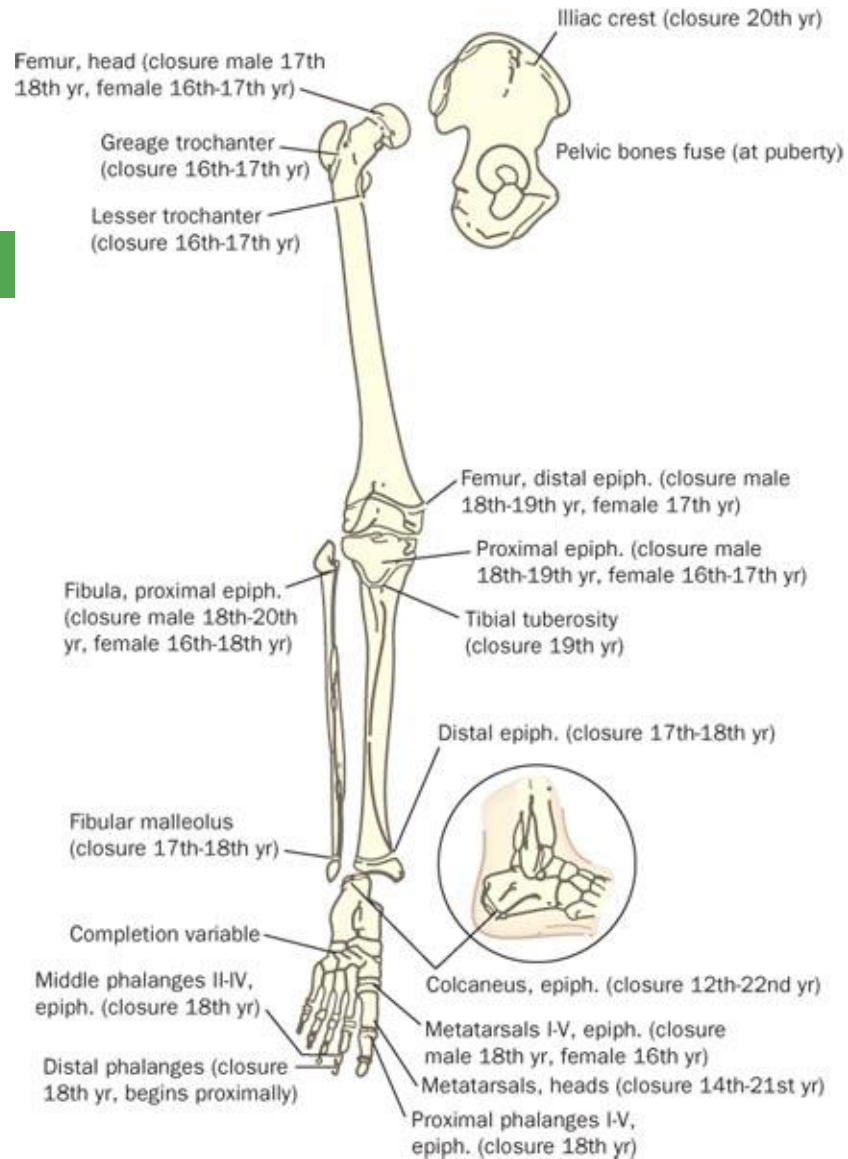




# Age—Epiphysis



# Age— Epiphysis







# Height

- An estimate of height can be made by measuring one of the long bones
- Gender and race is taken into consideration



# How to Distinguish Race

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

# Three races



**Caucasoid**



**Negroid**



**Mongoloid**



# Facial Reconstruction

- Facial muscles follow the contour of the skull
- A face can be rebuilt from just skeletal remains
  - Facial markers are positioned at critical locations
  - Clay is contoured to follow the height of the markers
- Computer programs perform a similar function
- Computer programs also can “age” missing persons and criminals

# Steps in Facial Reconstruction

## Obtain a copy of a skull

- Establish age, sex and race
- Plot landmarks for tissue thickness
- Plot origin and insertion points for muscles
- Plot landmarks for facial features
- Select a dataset and mount markers for tissue thickness
- Mount the eyes
- Model muscles on skull
- Add fatty tissue around eyes and lacrimal glands
- Add eyelids
- Add the nose
- Add the parotid gland
- Add the ears
- Cover all with layers of skin
- Detail the face



# DNA Evidence

- Bone contains little nuclear DNA but it does contain mitochondrial DNA
- Nuclear DNA degenerates before mitochondrial DNA
- **Mitochondrial DNA** is found in the mitochondria and inherited only from the mother
- Compare results with living relatives on the mother's side of the family



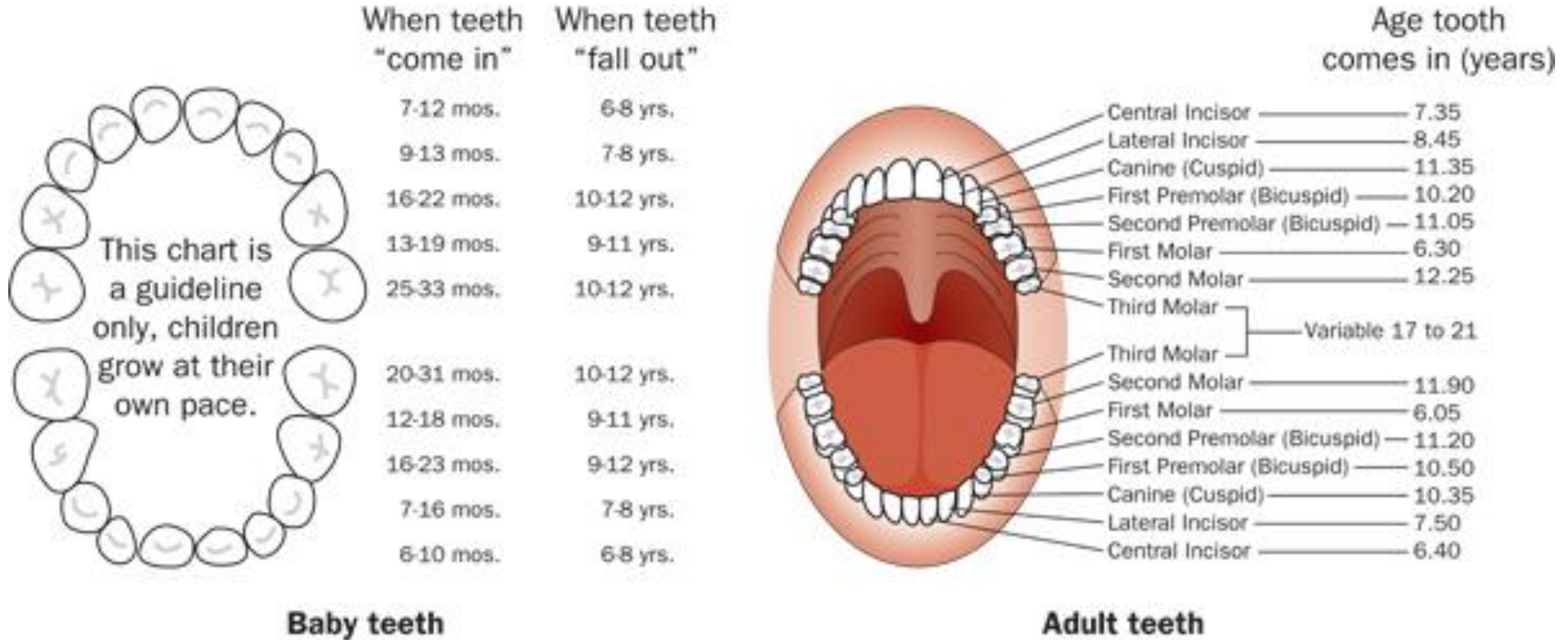


# Skeletal Trauma Analysis

- the investigation of bones and the marks on them to uncover a potential cause of death.
- Forensic anthropologists determine if damage to bones occurred before or after death
- Distinct patterns exist for damage by
  - Environment
  - Sharp-force trauma
  - Blunt-force trauma
  - Gunshot wounds
  - Knife wounds



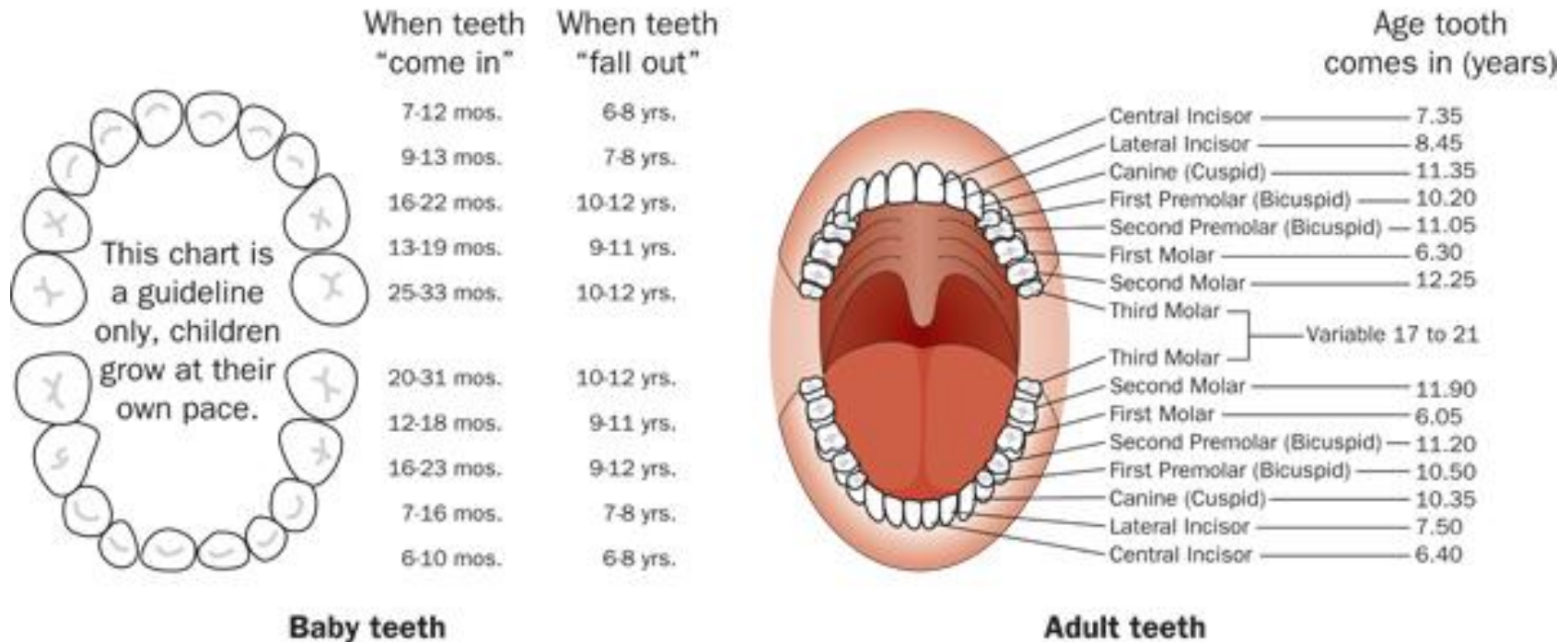
# Development of Teeth





# Odontology

- o the study of teeth, the science that deals with teeth, their structure.





# Decomposition – how we are left with Bones

Stage	Description
Initial Decay	Carcass appears fresh externally but is decomposing internally
Putrefaction	Carcass swollen by gas produced internally; odor of decaying flesh
Black Putrefaction	Flesh of creamy consistency with exposed parts black. Body collapses as gases escape; odor of decay very strong.
Butyric Fermentation	Carcass drying out. Some flesh remains; cheesy odor develops. Ventral surface moldy from fermentation
Dry Decay	Carcass almost dry



# Decomposition Terms

- **Putrefaction** - the anaerobic decomposition of organic matter by bacteria and fungi that results in obnoxiously odorous products.
- **Decomposition** - of a corpse is a continual process that can take from weeks to years, depending on the environment. In this website we have divided the process into stages; rotting.



# Decomposition Terms

- **Adipocere** - a waxy substance formed during decomposition of dead animal bodies, consisting mainly of insoluble salts of fatty acids.
- **Entomology** – The scientific study of insects.
- **Metamorphosis** – the process of moving through the stages in the life cycle





# Excavation

- most commonly used within the science of archaeology. In this sense it is the exposure, processing and recording of archaeological remains.
- The term is also used for an example of the application of the technique to the study of a given site. A site in which bones are dug



# Excavation





# Clandestine

- Kept or done in secret, often in order to conceal an illicit or improper purpose.







# Exhume

- to dig (something buried, esp. a dead body) out of the earth.
- Usually you already know where to dig





## ..... Summary .....

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