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Technology Transition Workshop| *Ashley Humphries, M.A.*

Determination of Biological Sex

Anthropological Protocol

- **Is the bone human? Context?**
- **How many individuals?**
- **Biological profile:**
  - ***Biological sex determination***
    - ***Morphology/anthroposcopic (visual)***
    - ***Metric/anthropometric (measurement)***
  - **Age-at-death**
  - **Ancestry**
  - **Stature**
- **Unique pathology or condition?**
- **Trauma?**

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Biological Sex vs. Gender

- **Biological Sex**
  - **The physical/anatomical difference between males and females**
  - **Often based on the type of gametes produced by the gonads (ova = female, spermatozoa = male)**
- **Gender**
  - **Social construct**
  - **Specifies the socially and culturally prescribed roles men and women are to follow**
    - **Can be influenced by an individual's biological sex**

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Biological Sex Determination

- **Sexual dimorphism**
  - **Size**
    - **Males larger, more muscled than females**
  - **Architecture**
    - **Female pelvis designed to bear children**

Image courtesy of Ashley L. Humphries

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Population Differences

European Female

Asian Male

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Sex Determination of Immature Skeletons

- **Difficult, not very accurate**
- **Sex differences do not become pronounced until puberty**

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Accuracy of Indicators
Anthroposcopic (Visual)

- **Skull and pelvis together**
  - **90-100% accuracy**
- **Pelvis alone**
  - **90-95% accuracy**
- **Skull alone**
  - **80-90% accuracy**
- **Long bones alone**
  - **~80% accuracy**

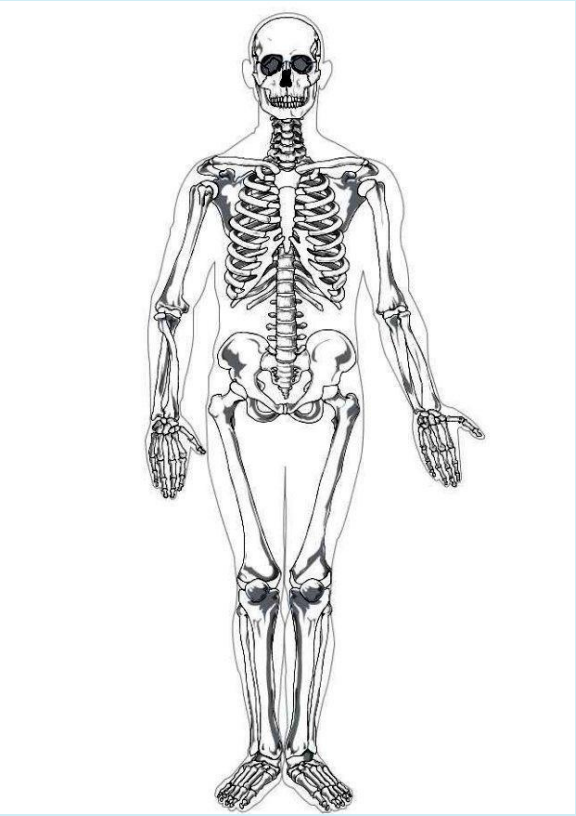

Image from www.edupics.com

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Sex Differences of the Pelvic Girdle

	ANTERIOR VIEW	SUPERIOR	INFERIOR
FEMALE	>90 degrees	Sacrum Tilted Back	Flared Ilia
MALE	<90 degrees	Sacrum Tilted Forward	Narrow Ilia

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Greater Sciatic Notch

Males: Narrower ***Females: Wider***

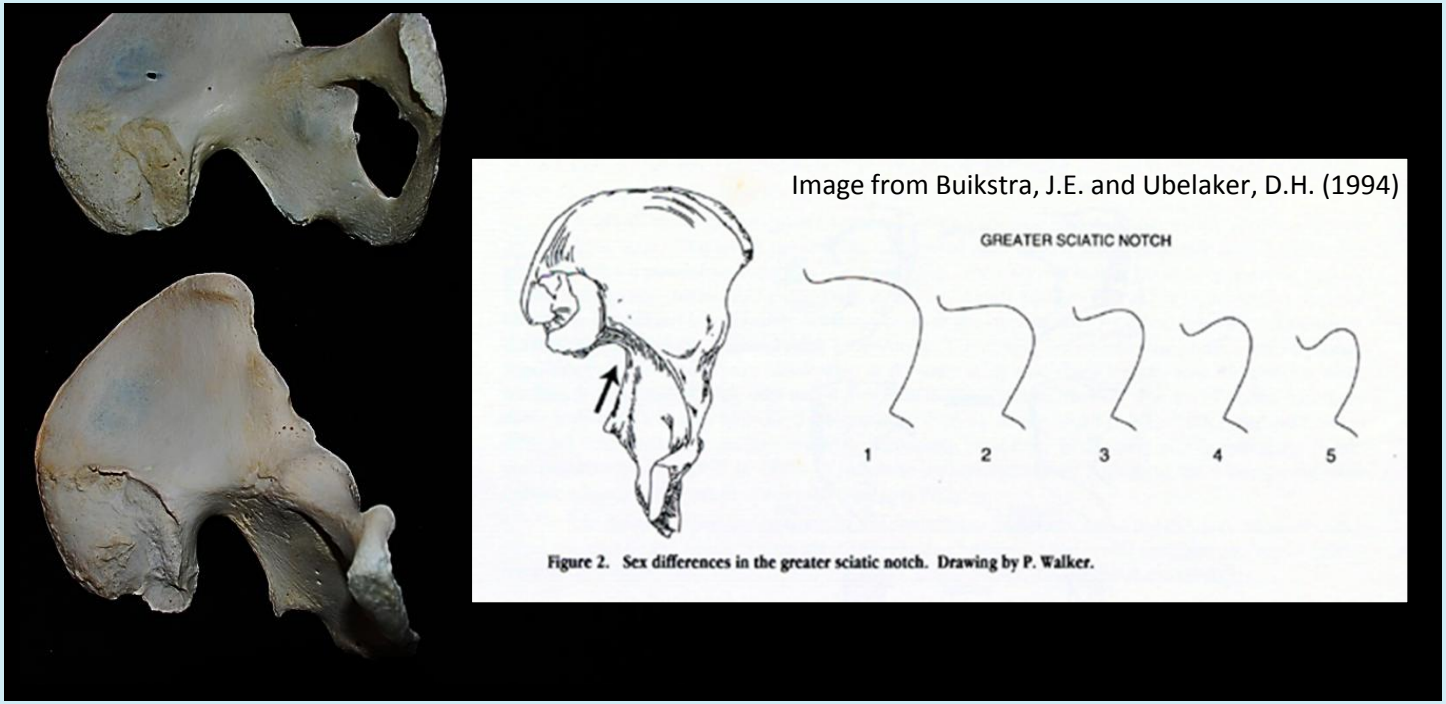

Image from Buikstra, J.E. and Ubelaker, D.H. (1994)

Figure 2. Sex differences in the greater sciatic notch. Drawing by P. Walker.

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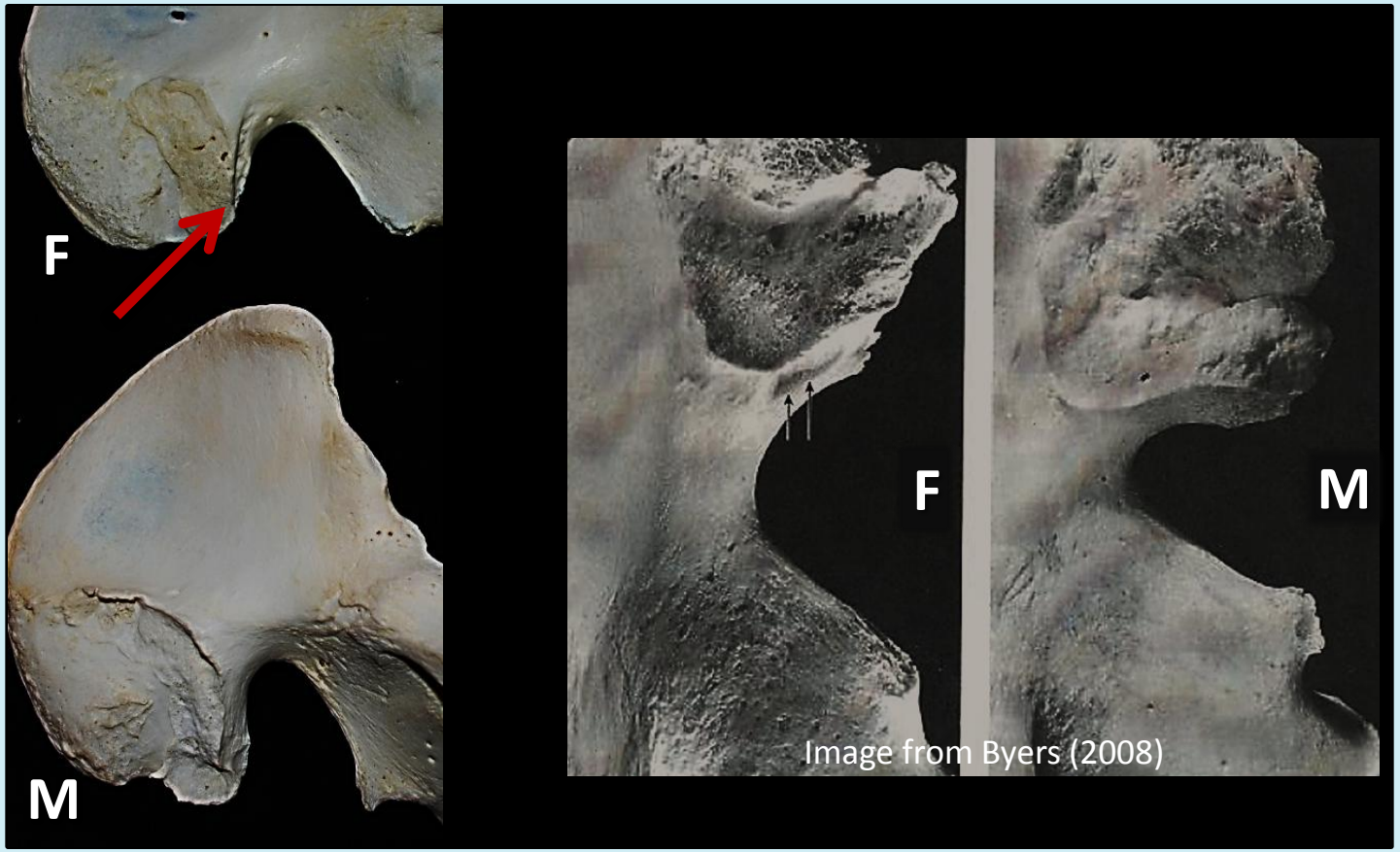
Preauricular Sulcus

Males: Absent, Rare ***Females: Usually Present***



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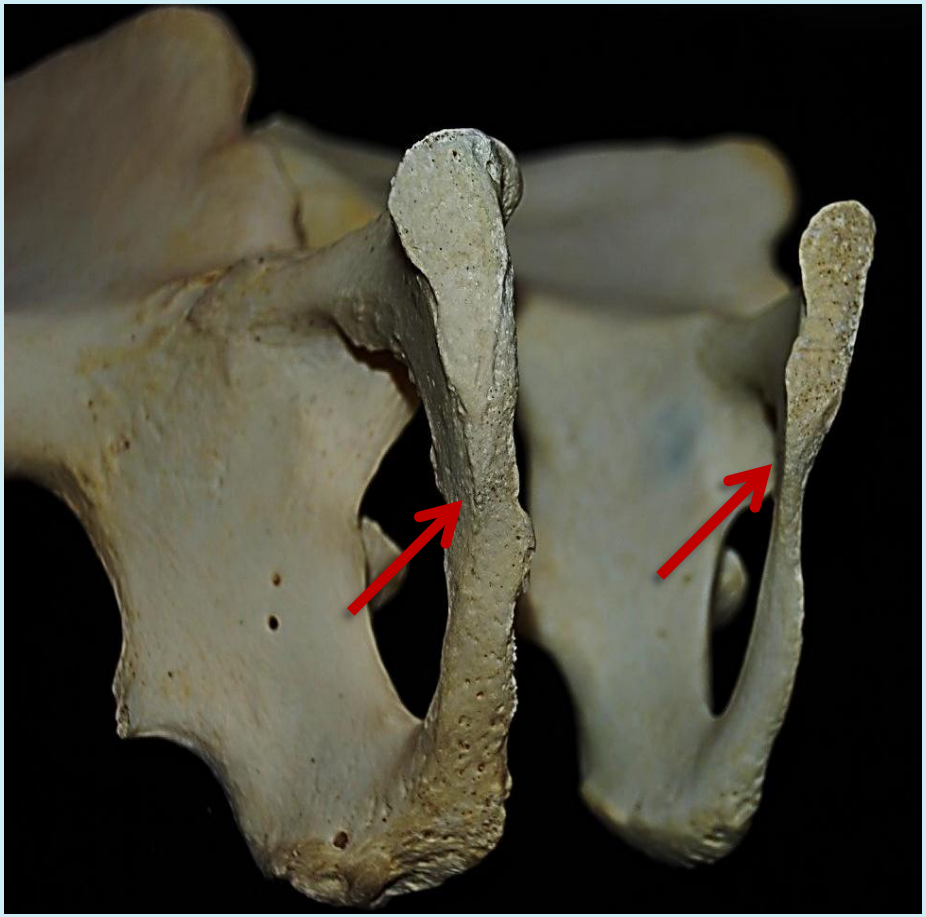
Ischiopubic Ramus

Male: Wide, blunt ***Female: Narrow, sharp***

Image from
www.edupics.com



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Pubic Body

Males: Triangular ***Females: Rectangular, Square***

Image from
www.edupics.com

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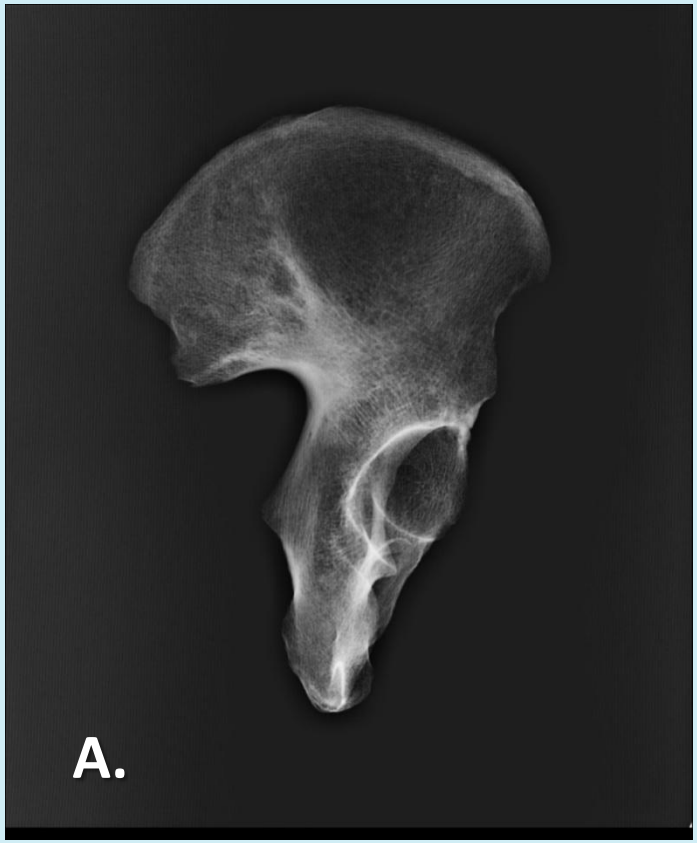
Male or Female?



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Male or Female?

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Male or Female?

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Sex Differences of the Skull (Anthroposcopic)

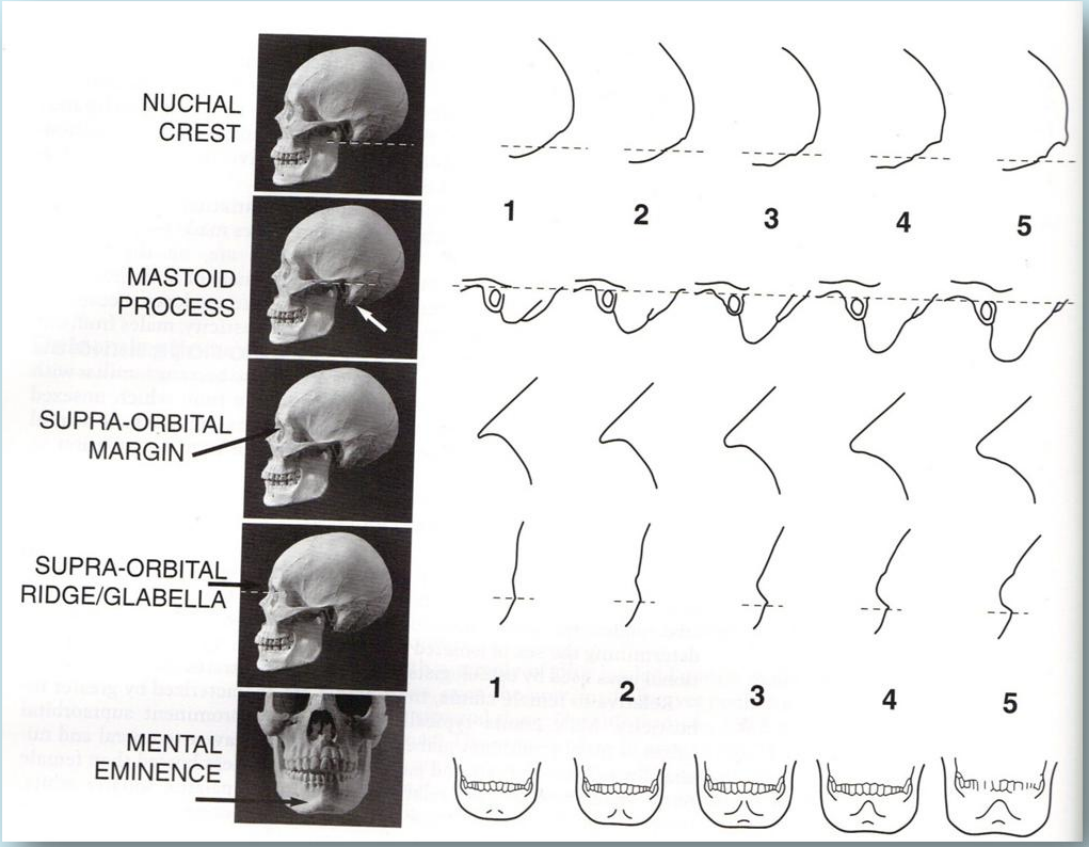

Image from Buikstra, J.E. and Ubelaker, D.H. (1994)

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Nuchal Area

Males: *rugged, sometimes w/ hook*

Females: *smooth, hook uncommon*

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Mastoid Process

Males: Larger, more projecting

Females: Smaller, non-projecting

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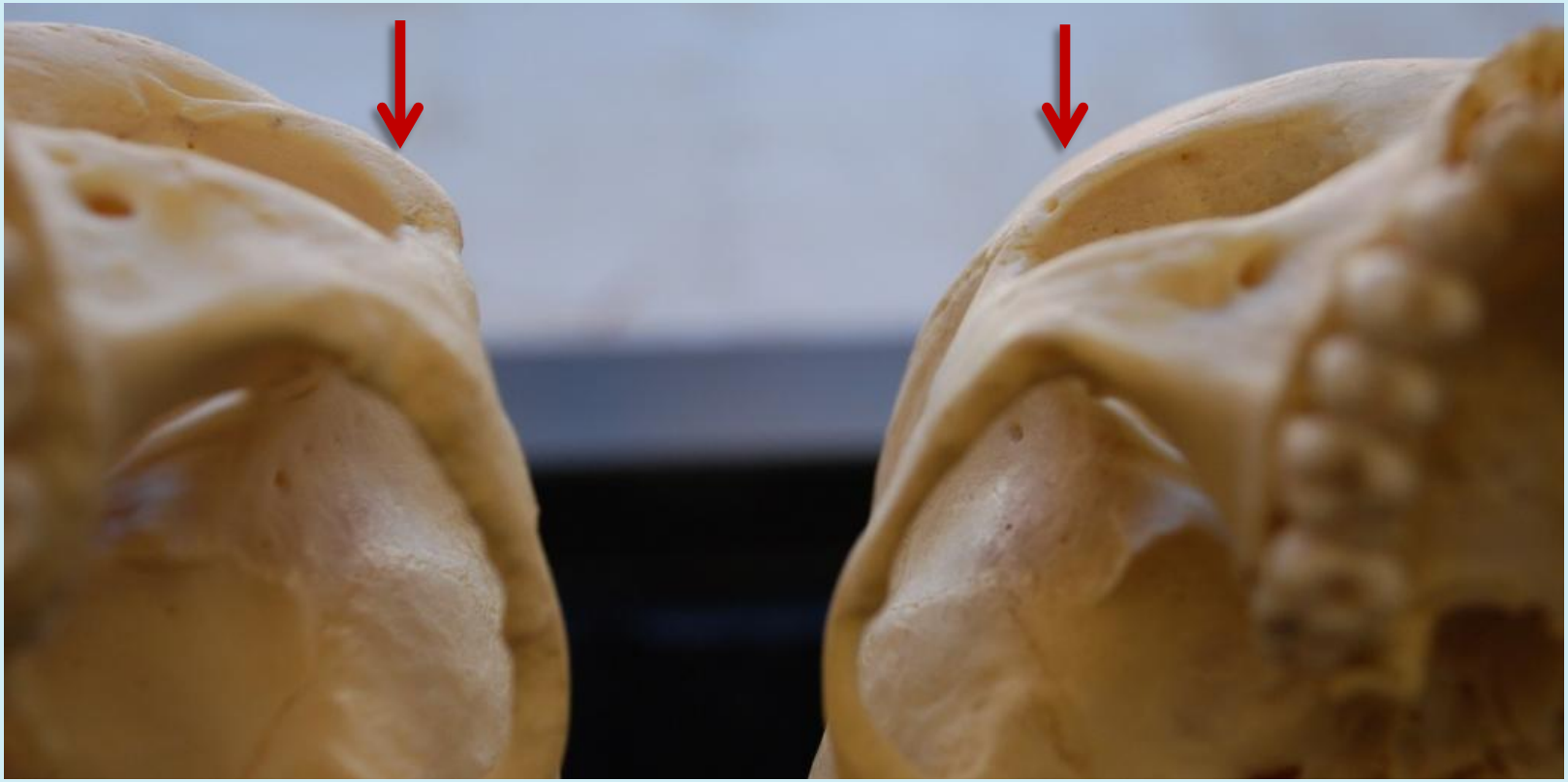
Supra-Orbital Margin

Males: Rounded ***Females: Sharp***



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Browridges

Males: Large or pronounced ***Females: Small or none***

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Frontal Bone

Males: Slanted ***Females: High, rounded***

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Shape of the Mandible

Males: Broad, square

Female: Narrow, pointed, rounded

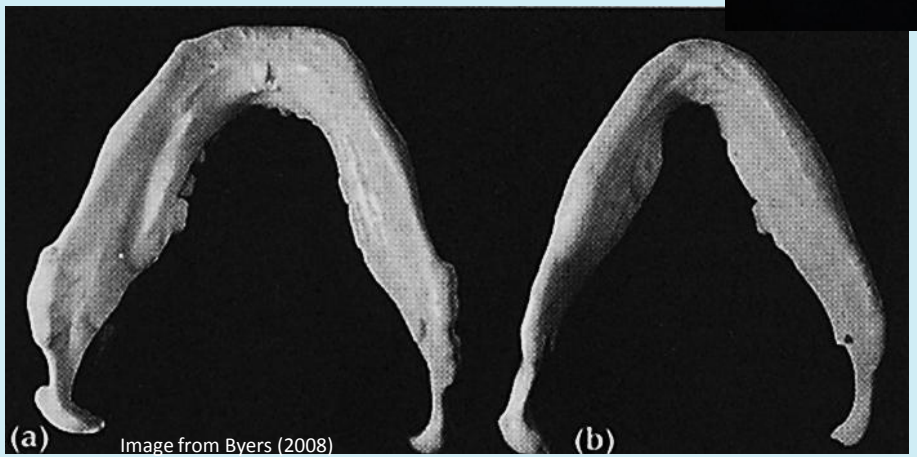

Image from Byers (2008)

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Male or Female?

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Male or Female?

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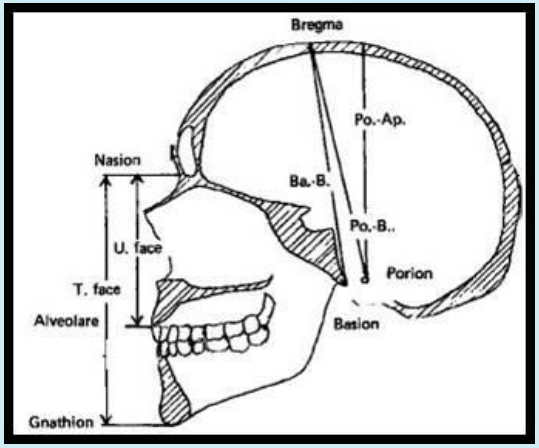
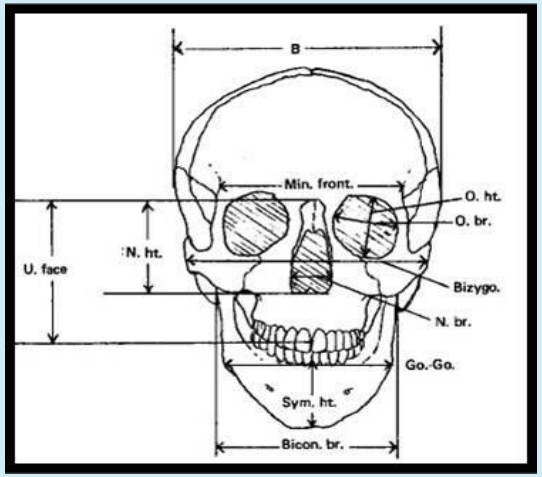
Determining Sex

Metric Approaches

Image from http://www.anthro4n6.net/forensics/



Images from Bass (2005)



- **AKA: Anthropometry**
- **Quantified approaches**
- **Early comparisons based on single measurements or indices**
- **Recent analyses have taken advantage of multivariate statistics**
- **Accurate measurements require knowledge of the skeleton and its various features and landmarks**

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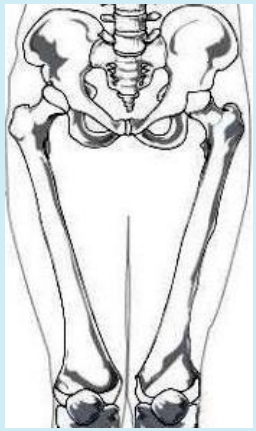
Metric Analysis - Postcrania

Image from www.edupics.com



- **Femoral Head Diameter**
  - **European American**
    - **Female** **<42.5**
    - **Female?** **42.5-43.5**
    - **Indeterminate** **43.5-46.5**
    - **Male?** **46.5-47.5**
    - **Male** **>47.5**
  - **From: Stewart (1979)**

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Metric Analysis - Postcrania

- **Humeral Head Vertical Diameter**
  - **Females** **<43mm**
  - **Indeterminate** **44-46mm**
  - **Males** **>47mm**
- **From: Stewart (1979)**

Image from www.edupics.com

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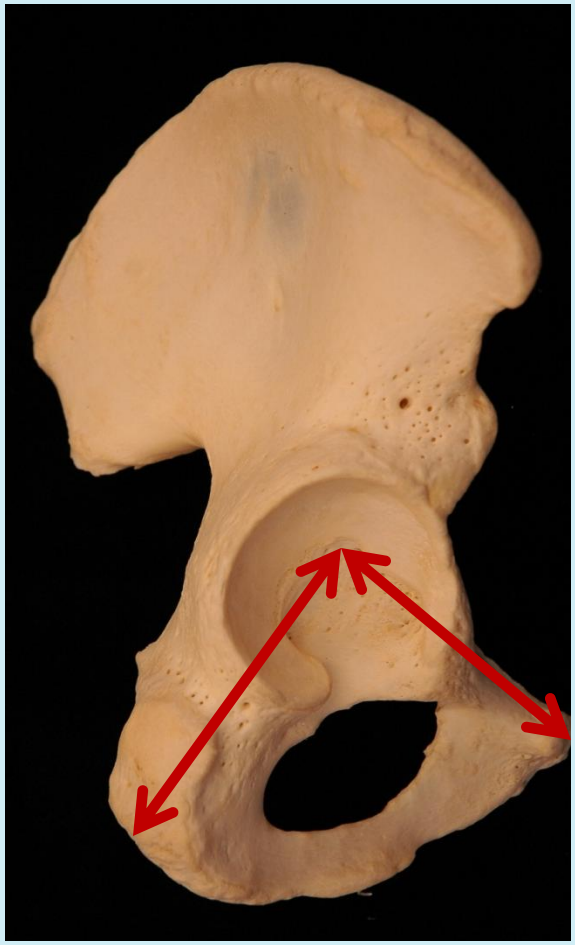
Ischio-Pubic Index



- (pubic length) / (ischium length) X 100
  - Male <84
  - Female >94
- If ancestry is known:
  - African American
    - Male <84
    - Female >91
  - European American
    - Male <91
    - Female >94
- From: Bass (2005)

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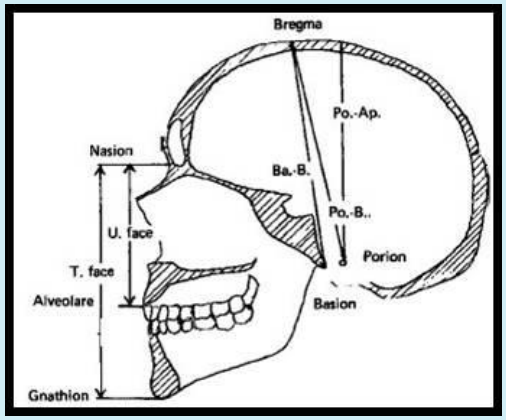
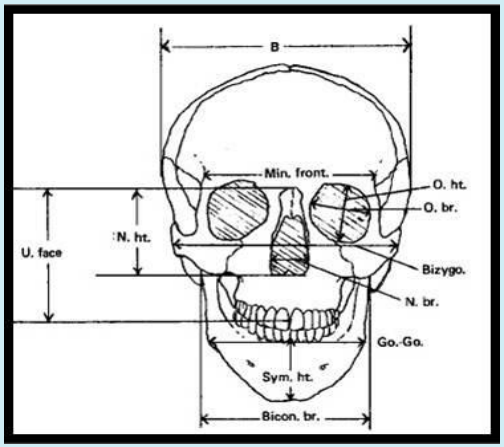
Cranial Measurements

Allow researchers to summarize the dimensional elements of Sexual Dimorphism



Images from Bass (2005)



- **Size and shape analysis based on linear distances between landmarks**
- **Linear measurements plugged into discriminant function equations to produce sectioning points**
- **Female <sectioning point> Male**
- **Ancestry dependent standards**
- **Beware of standards based on inappropriate data**

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Example Discriminant Functions:

Sex Estimation using Cranial Metrics

African American: (measurement) x (coefficient) = value

- **Max breadth (XCB): (142) x (9.22) = 1309.24**
- **Max length (GOL): (190) x (7.00) = 1330**
- **Basion-Bregma (BaBr): (132) x (1.00) = 132**
- **Basion-Prosthion (BaPr): (105) x (5.89) = 618.45**
- **Bizygomatic breadth (BB): (134) x (31.11) = 4168.74**
- **Palatal breadth (PB): (57) x (-30.56) = -1741.92**
- **Nasion-alveolare (NaAlv): (75) x (20.22) = 1516.5**
- **Mastoid length (LM): (37) x (47.11) = 1743.07**
- **Sum of all values: 9076.08**

Greater than 8171.53? = *yes*

Male or female? = *Male*

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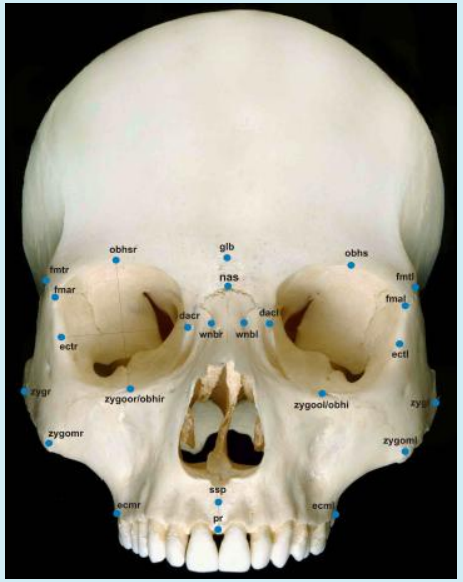
3D-ID

Slice, D. E.; Ross, A. 3D-ID: Geometric Morphometric Classification of Crania for Forensic Scientists. Version 03DEC2009. http://www.3d-id.org (accessed Jun 24, 2011).

- **Linear measurements taken between endpoints (landmarks) provide incomplete information about their relative positions**
- **Geometric Morphometrics**
  - **Size and shape analyses that uses Cartesian coordinates of anatomical landmarks from which traditional linear measurements are taken**
- **3D-ID**
  - **X, Y, Z coordinates from an unknown are compared to a known reference population**

Image from Slice and Ross http://www.3d-id.org (2011)



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Questions?

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Note: All images are courtesy of Dr. Ann H. Ross, unless otherwise indicated.

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