

**Standard Operating
Procedure
on
Forensic
Identification
of
Skeletal Remains**

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Registration

All remains brought into the mortuary should be registered with a unique identification code.

The unique identification code could include

FM – 2074 - 0123

- Identification code for institute
E.g. – **FM – Forensic Medicine**
- Year of examination
E.g. – **2074 – 2074 B.S.** (or 2074/01 – Baisakh 2074 B.S.)
- Case number
E.g. – **0123 – Case # 123 for the year 2074**

The body should be tagged with label bearing the unique identification code. If the body is to be stored in a body bag, labels should be tagged to the body as well as the body bag.

The labels used should be written in permanent, indelible ink on a water proof tag.

The personal details should not be included on the tag. The personal details should be registered on a registration form as provided in Annex 01.

The necessary documents authorising the examination, from Nepal Police, as well as other documents including लासजाँच प्रकृति मुचुल्का and घटनास्थलमुचुल्का as well as medical record, if available, should be acquired.

The documents should all be included in a folder and confidentiality of the documents maintained.

Labelling and inventory

All remains brought in should be labelled and inventory maintained, as is relevant to the case. For this document, the labelling and inventory of skeletal remains will be dealt with.

As soon as the remains are received, the remains should be labelled with each element having a unique number. This is in addition to the registration number for the case.

For e.g. the bones of a case may be labelled – FM – 2074 – 0123 – BP 0001, FM – 2074 – 0123 – BP 0002 and so on. For convenience, the element itself may be labelled with only 0001, 0002 and so on for simplicity.

All elements as well as additional material evidence should be documented in the inventory provided in Annex B.

The inventory should include, but not limited to, the following:

- Condition of preservation of the remains
- Completeness or lack thereof of the remains
- Stains
- Taphonomic changes
- Pathological changes

These details should be recorded during the initial examination of the remains before the remains are processed.

Cleaning

All human remains and material evidences should be cleaned after inventory. The cleaning is best performed using soft material and plain water. If excessive amounts of grease or fatty deposits are present, the remains may be cleaned using warm water. However, it should be noted that unless the soft tissue have already been analysed or removed, remains should not be subjected to extremely hot water.

All extraneous material should be analysed before cleaning to ensure samples can be collected if required. The remains should then be thoroughly cleaned for skeletal examination. The cleaning should clear all dirt and extraneous material.

Chemicals, including detergents and soap should ideally not be used to clean the material as this may hamper the collection of samples for subsequent analysis. As described earlier, it is possible to completely clean the remains using water at different temperatures depending on the nature of remains.

The remains should be dried naturally, avoiding exposure to direct sunlight. The drying process should not be hastened as this would cause the bones to become brittle and susceptible to damage.

Layout

Once the remains have been cleaned and dried, the remains should be laid out to assist in the examination proper. The remains should be laid out in an anatomical position. This helps in finding duplicity of remains as well as to inventory any additional findings.

The anatomical position of the remains will primarily be dependent on realising the three dimensions, anterior-posterior, superior-inferior and medial-lateral. While this does not pose problems for larger bones, smaller metacarpals, metatarsals, phalanges, ribs etc. while difficult to differentiate between, they are quite distinct when it comes to determining the laterality or side.

The anthropologist should differentiate between the numbers of the elements to the very best of his/her ability. The remains after being laid out in anatomical position, should be photographed to ensure proper documentation.

Once the remains have been laid out, the inventory form should be re-evaluated to add additional information visible after the cleaning process.

Examination

The examination proper consists of three stages

- Establishing the biological profile
- Establishing identity
- Determining the cause of death

The examination should evaluate the remains as a whole for the determination. The analyst should refrain from developing opinions based on single elements or parts of the remains.

Establishing the biological profile

The establishment of biological profile consists of establishing the primary indicators, namely,

- Ancestry
- Sex
- Age
- Stature

The details regarding the procedures for establishing the biological profile should be referred to in the Guideline. This document will outline the basis steps in the process.

The ancestry is primarily established by examining the cranium, including the mandible and teeth.

As such, establishment of ancestry is primarily dependent on the analysis of non-metric traits in the cranium.

The main traits to be examined include prognathism, zygomatic process, nasal sill.

The establishment of Sex is primarily dependent on the traits seen in the pelvis as well as the cranium, including mandible and dentition.

The estimation of sex should be preceded by the establishment of ancestry as the traits used for sex estimation while generally highly distinct between the genders within the races. However these traits become less distinct when comparing between the races.

For example, the size of female Caucasoid skeletal remains cannot be differentiated from male mongoloid remains.

The main features used for sex estimation include dimorphic features in the pelvis as well as skull.

These traits include examining the pelvis for phenice's triad, sub-pubic angle, greater sciatic notch, pre auricular sulcus and ischial tuberosity.

Traits that show reliable dimorphism in the skull include external occipital protuberance, mastoid process, supra-orbital margin, supra-orbital ridge or glabella and mental eminence.

The estimation of age from human remains should be determined based on the age group of the examinee.

For example, the estimation of age in foetal and infant remains should be determined by the examination of appearance of centers of ossification.

In children, adolescents and young adults, the most reliable method is the conglomeration of examination of centers of ossification, eruption and development of dentition as well as completion of fusion of epiphyseal plates.

In adults, the examination of dentition requires destruction of the tooth as well as specialised expertise. This may not be available or feasible in most of the cases. As a result, the closure of sutures is the primary method to be used for estimation of age in adults and in the elderly.

Stature is the primary indicator that is most dependent on the ancestry, geographical as well as dietary variations etc.

Therefore, while it is preferable to use data from specific population to analyse and estimate sex as well as age, it is an absolute necessity that population-specific data is used for the estimation of stature.

Just as in the estimation of sex and age, the stature should also be analysed by ensuring a holistic approach, utilising as many elements as possible.

Establishing identity

Development of identity depends on the examination for individual and group markers that could assist in establishing the identity.

These traits could include deformity, development anomaly, pathology, occupational markers, etc.

The role of visual identification should be minimised, based on the degree of post-mortem alteration. The process of visual identification process can be made more scientific by collecting ante-mortem information of the missing person(s), without showing the remains, and then scientifically establishing match, after completion of the entire process of examination of remains. Ideally, the process of collection of ante-mortem and post-mortem data should be performed by independent teams to ensure pre-conceived notions and bias do not affect judgement.

Forensic anthropological examination of remains is important not just in cases of skeletal remains but only in cases of mutilated and commingled remains. As a result, forensic anthropological analysis of remains is an integral part of disaster victim identification operations.

Depending on the nature of case, it may also be possible to establish identity based on exclusion. For example, in a closed disaster, like an aircraft crash, it may be possible to establish the identity by exclusion after all other identities have been confirmed.

During disaster victim identification operations, it is also important to pre-establish the nature of work to be undertaken. This means that it is important to pre-establish whether the operation would aim towards identification of all persons involved or for identification of all human remains. The extremely high resource requirement for the latter preclude that all disaster operations in Nepal aim towards identification of all individuals present and not on identification of all bodies or body parts. This means that the identification process would be suspended after identification of all individuals reported missing. The unexamined or unidentified remains remaining should be disposed of, after consultation with legal authorities.

Determining the cause of death

The thorough investigation of all injuries present on the remains will assist in establishing the cause of death. For detailed information on injuries as well as cause of death, guidelines on Injury and Autopsy Examination respectively, should be referred.

Documentation

Forensic investigation by its very nature is a destructive process. It is therefore imperative to maintain standard documentation to be presented as evidence, if required.

The documentation process includes various forms like:

Formal forms of documentation:

- Reports
- Medical Records
- Inquest papers
- Maps
- Chain of Custody forms etc.

Informal forms of documentation:

- Analyst notes
- Logs
- Inventories
- Sketches
- Drawings etc.

Reporting

Report is a tool for formal dissemination of information. The reports should be developed in prescribed formats to ensure uniformity and ease of accessibility.

As prescribed, the report should consist of

1. Introduction
2. Objectives
3. Methodology
4. Results
 - Description of remains (including inventory)
 - Odontology (with odontograms)
 - Minimum/Probable number of individuals
 - Ancestry
 - Sex
 - Age
 - Stature
 - Variations
 - Pathology
 - Trauma
 - Taphonomy
 - Associated evidences
 - Sample collected
5. Summary (with homunculus)

Storage

All human remains and associated evidences should be stored in a responsible and dignified manner. Human remains that can undergo decomposition should be stored at a temperature between 0°C and 4°C for storage for upto one week.

If decomposable human remains need to be stored for periods greater than one week, the remains should be refrigerated at -18°C. This is rarely available in Nepal and a cheaper and more feasible alternative is to be stored in temporary burials.

The principles of temporary burial relies on the difference in temperature between the surface and under the soil, to delay the process of decomposition till a later date, when the remains will need to be repatriated.

The temporary burial of human remains requires that

- Burial should be 1.5m deep
- Leave 0.4m between bodies
- Lay bodies in one layer only (not on top of each other)
- Label each body and mark their positions on the ground
- Bottom of graves should be at least 1.5 m from water table
- The distance of the burial site from source of drinking water is dependent on the number of bodies to be buried or on the area of the burial site, as follows

Number of Bodies	Distance from source of drinking water
4 or less	200 m
5 to 60	250 m
60 or more	350 m
120 bodies or more (per 100 m2)	350 m

As already described in the section on Registration, all bodies should be stored in body bag and all body bags and bodies should be individually tagged with waterproof labels.

In case of skeletal remains, the remains should be stored in a dark, well ventilated room to prevent infestation with fungi. The remains should be naturally dried before they are stored. The period of storage of the remains should be fixed after consultation with legal authorities.

Sample collection

Collection of samples may be required for histology, toxicology, DNA analysis, etc.

For DNA analysis, the ideal samples include

Condition of body	Recommended sample
Complete, non-decomposed corpse	<ul style="list-style-type: none">• Blood (on FTA paper or swab), and saliva (buccal, oral) smears
Mutilated, non-decomposed corpse	<ul style="list-style-type: none">• If available: blood and deep-seated red muscle tissue (~1.0g)
Complete, decomposed corpse or mutilated remains	<ul style="list-style-type: none">• Sample from long, compact bones (4-6 cm sections, window section, without shaft separation), or• Healthy teeth (preferably molars), or• Any other available bone (~10g, if possible; preferably cortical bones with dense tissue)
Severely burned corpses	<ul style="list-style-type: none">• All samples listed above and impacted teeth or tooth roots if present, or• Smears from the bladder

Taken from the INTERPOL DVI Guide 2014

Each samples collected should have unique identification code to assist in maintaining chain of custody.

For Toxicology, the samples to be collected vary depending on the condition of the remains. In skeletonised remains, the samples should include bone, hair and/or nail.

Repatriation

Human remains should be repatriated to family members only after obtaining the required document, namely लाश सदगत पुर्जा.

The family member prescribed on the letter should document receipt of the remains by signing the registration book with his address and contact details.

The unique identification code should be verified with the details of the letter to prevent accidental swapping of remains.

Annex A – Registration Form

1. **Case registration number:**
2. **Police Office sending for examination:**
 - a. **Date**
 - b. **Reference Number**
3. **Name of accompanying Police Personnel:**
4. **Date and time of recovery of remains:**
5. **Date and hour of receipt of**
 - a. **Remains**
 - b. **Inquest papers**
6. **Date and hour of starting examination:**
7. **Date and hour of concluding examination:**
8. **Name of the Experts conducting examination:**
 - a. **Faculty**
 - b. **Residents:**
9. **Name of the Hospital:**

RELEVANT DETAILS

In case of remains being identified,

Information of alleged missing person

- a. **Name:**
- b. **Address:**
- c. **Gender:**
- d. **Age/Date of Birth:**

Dead body identified by:

Annex B – Inventory Form

Skeletal Inventory (List All Skeletal and Dental Elements Present):

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Anthropologist _____

Date_____

Signature/Initials_____

Page_____of_____

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Date_____

Page_____of_____

Describe any re-association, in case of commingled or multiple remains, and the basis for the determination:

Date_____

Page_____of_____

PROVENIENCE TABLE

Element	Portion	Provenience	Other Observations
<i>Cranium</i>			
Vault			
Base			
Face			
Mandible			
Teeth			
<i>Axial skeleton</i>			
C1			
C2			
C3-7			
T1-7			
T8-11			
T12			
L1-4			
L5			
Sacrum			
Coccyx			
Sternum			
L Ribs			
R Ribs			
<i>Left Arm</i>			
Clavicle			
Scapula			
Humerus			
Radius			
Ulna			
Carpals			
Metacarpals			
Phalanges	Proximal		
	Middle		
	Distal		
<i>Left Leg</i>			
Innominate			
Femur			
Tibia			
Fibula			
Tarsals			
Metatarsals			
Phalanges	Proximal		
	Middle		
	Distal		

Anthropologist _____

Date _____

Signature/Initials _____

Page _____ of _____

Element	Portion	Provenience	Other Observations
<i>Right Arm</i>			
Clavicle			
Scapula			
Humerus			
Radius			
Ulna			
Carpals			
Metacarpals			
Phalanges	Proximal		
	Middle		
	Distal		
<i>Right Leg</i>			
Innominate			
Femur			
Patella			
Tibia			
Fibula			
Tarsals			
Metatarsals			
Phalanges	Proximal		
	Middle		
	Distal		
<i>Other:</i>			
Fragments			
Sesamoid			
Ribs			

Additional Notes:

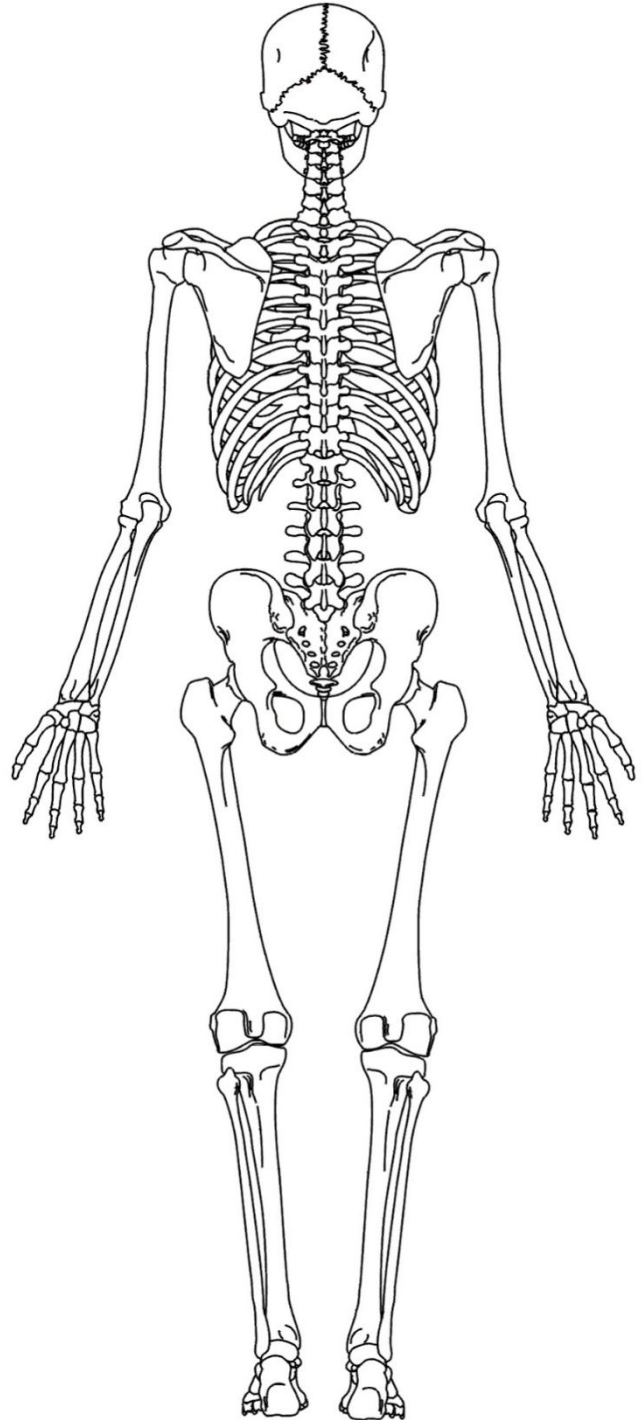
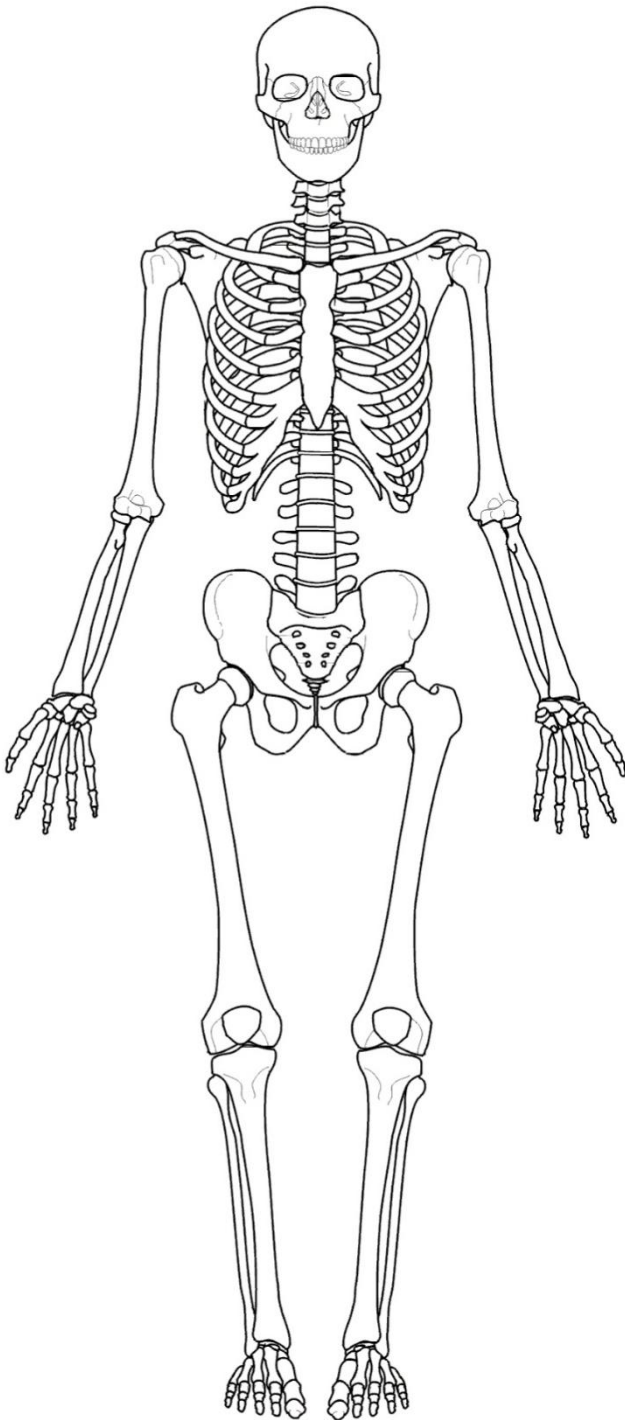
Anthropologist _____

Date _____

Signature/Initials _____

Page _____ of _____

Skeletal Inventory Homonculus Form



Anthropologist _____

Date _____

Signature/Initials _____

Page _____ of _____

Annex C - Examination Forms

Ancestry assessment form

Macro-morphological race assessment

State Methods used and References:

Notes

Anthropologist _____

Date _____

Signature/Initials _____

Page _____ of _____

Sex assessment form

Macro-morphological sex assessment

Pelvis*	Left	Right
Ventral Arc (1-3)		
Subpubic Concavity (1-3)		
Ischio-pubic Ramus Ridge (1-3)		
Greater Sciatic Notch (1-5)		
Pre-auricular Sulcus (0-4)		

Skull*	Left		Right
Nuchal Crest (1-5)			
Mastoid Process (1-5)			
Supraorbital Margin (1-5)			
Glabella (1-5)			
Mental Eminence (1-5)			

* *Standards for Data collection from Human Skeletal Remains*, Buikstra, J. E. and Ubelaker D. H. 1994:16-21.

Other Sex Assessment Methodologies (State References):

[illegible]

Sex assessment using other methodologies_____

Notes

Anthropologist_____

Date_____

Signature/Initials_____

Page_____of_____

Age assessment form– 1 (Sub-Adult)

Total Length Method: (Scheuer and Black, 2000)

Diaphyseal Length:

Bone length	Right (mm)	Left (mm)	Age range
Humerus			
Ulna			
Radius			
Femur			
Tibia			
Fibula			

Total Length including Epiphyses:

Bone length	Right (mm)	Left (mm)	Age range
Humerus			
Ulna			
Radius			
Femur			
Tibia			
Fibula			

	Range	Minimum	Maximum
Final age estimation	±		

Tooth	Eruption completed		Calcification of root completed	
Central incisor				
Lower		6–8 months		1.5–2 years
Upper		7–9 months		1.5–2 years
Lateral incisor				
Upper		7–9 months		1.5–2 years
Lower		10–12 months		1.5–2 years
1st molar		12–14 months		2–2.5 years
Canine		17–18 months		2.5–3 years
2nd molar		20–30 months		3 years

Anthropologist _____

Date _____

Signature/Initials _____

Page _____ of _____

Age assessment form – 2 (Adult)

Sternal rib end (Iscan et al 1984b, 1985)

Rib Number:

Left Phase:

Right Phase:

Age by sternal rib end:

Pubic symphysis – Brooks and Suchey (1990)

Left Phase:

Right Phase:

Age:

Other Age Estimate Methodologies (State References):

Estimated Age Using Other Methodologies: _____

Estimated Age Using Trace Evidence and Other Methodologies: _____

Notes:

Anthropologist _____

Date _____

Signature/Initials _____

Page _____ of _____

Age assessment form – 3 (Epiphyseal union)

Secondary centers of ossification – Upper limb

0= Not appeared 1 – Appeared but open 2 – Partly fused 3 – Completely fused

Bone	Epiphyses	Right	Left	Appeared	Not Appeared	Fused	Not Fused
Clavicle	Medial End			> 15 years	< 16 years	> 20 years	< 22 years
Scapula	Acromion			> 14 years	< 15 years	> 17 years	< 18 years
Humerus (Proximal)	Head			> 1 year	< 1 year	> 5 years (Composite Epiphysis)	< 6 years (Composite Epiphysis)
	Greater Tubercle			> 3 years	< 3 years		
	Lesser Tubercle			> 5 years	< 5 years		
	Composite Epiphysis			> 5 years	< 6 years		
Humerus (Distal)	Medial Epicondyle			> 5 years	< 6 years	> 14 years (Composite Epiphysis)	< 16 years (Composite Epiphysis)
	Capitulum			> 1 year	< 1 year		
	Trochlea			> 9 years	< 11 years		
	Lateral Epicondyle			> 11 years	< 11 years		
	Composite Epiphysis			> 14 years	< 16 years		
Radius	Proximal			> 5 years	< 5 years	> 16 years	< 17 years
	Distal			> 2 years	< 2 years	> 18 years	< 19 years
Ulna	Proximal			> 9 years	< 9 years	> 16 years	< 17 years
	Distal			> 5 years	< 6 years	> 17 years	< 18 years
Carpals	Capitate			> 2 months IUL	< 2 months IUL		
	Hamate			> 3 months IUL	< 3 months IUL		
	Triquetral			> 2 years	< 3 years		
	Lunate			> 3 years	< 4 years		
	Trapezium			> 5 years	< 6 years		
	Trapezoid			> 5 years	< 6 years		
	Scaphoid			> 5 years	< 6 years		
	Pisciform			> 10 years	< 12 years		
Metacarpals	Base of 1 st			> 2 years	< 3 years	> 15 years	< 17 years
	Heads of 2 nd – 5 th			> 1.5 years	< 2.5 years	> 16 years	< 18 years

Secondary centers of ossification – Lower limb

0= Not appeared 1 – Appeared but open 2 – Partly fused 3 – Completely fused

Bone	Epiphyses	Right	Left	Appeared	Not Appeared	Fused	Not Fused
Hip Bone	Ishio-pubic symphysis					> 6 years	
	Tri-radiate Cartilage					> 1` years	< 14 years
	Pubic Ramus			> 14 year	< 14 year	> 20 years	< 20 years
	Iliac Crest			> 3 years	< 3 years	> 18 years	<20 years
	Ischial Tuberosity			> 5 years	< 5 years	> 19 years	< 21 years
Femur	Head			> ½ year	< 1 year	> 14 years (Composite Epiphysis)	< 17 years (Composite Epiphysis)
	Greater Trochanter			> 5 years	< 6 years		
	Lesser Trochanter			> 12 years	< 14 eyars		
	Composite Epiphysis			> 14 years	< 17 years		
	Distal			> 9 months IUL	< 9 months IUL	> 18 years	< 20 years
Tibia	Proximal			Full term	< Full term	> 18 years	< 19 years
	Distal			> 1 year	< 1 year	> 16 years	< 17 years
Fibula	Proximal			> 4 years	< 4 years	> 18 years	< 19 years
	Distal			> 1 year	< 1 year	> 16 years	< 17 years
Calcaneum	Heel			> 5 months IUL	< 5 months IUL	> 14 years	< 16 years
	Head			> 6 years	< 8 years		
Talus				> 7 months IUL	< 7 months IUL		
Cuboid				Full term	< Full term		
Cuneiforms	Lateral			> 1 year	< 1 year		
	Medial			> 2 years	< 2 years		
	Intermediate			> 3 years	< 3 years		
Navicular				> 3 years	< 3 years		
Metacarpals	Base of 1 st			> 2 years	< 3 years	> 18 years	< 20 years
	Heads of 2 nd – 5 th			> 2 years	< 3 years	> 18 years	< 20 years

Anthropologist_____

Date_____

Signature/Initials_____

Page_____of_____

Age assessment form – 4 (Dentition)

Dental development (eruption)

_____ = (Total teeth)

Tooth	Eruption completed		Root calcification completed	
1st molar		6–7 years		9–10 years
Central incisor		6–8 years		10 years
Lateral incisor		7–9 years		11 years
1st bicuspid		9–11 years		12–13 years
2nd bicuspid		10–12 years		12–14 years
Canine		11–12 years		12–13 years
2nd molar		12–14 years		14–16 years
3rd molar		17–25 years		22–25 years

Age by dental development:

Notes

Stature assessment form - 1

Arithmetical method: (Trotter and Gleser, 1952)

WHITE MALES			RIGHT				LEFT			
Element	Equation	SD	Length (cm)	Mean (cm)	Min (cm)	Max (cm)	Length (cm)	Mean (cm)	Min (cm)	Max (cm)
Femur	$2.38 \times \text{Femur} + 61.41$	3.27								
Tibia	$2.52 \times \text{Tibia} + 78.62$	3.37								
Femur + tibia	$1.30 \times (\text{Femur} + \text{Tibia}) + 63.29$	2.99								
Humerus	$3.08 \times \text{Humerus} + 70.45$	4.05								
Radius	$3.78 \times \text{Radius} + 79.01$	4.32								
Ulna	$3.70 \times \text{Ulna} + 74.05$	4.32								
Fibula	$2.68 \times \text{Fibula} + 71.78$	3.29								

WHITE FEMALES			RIGHT				LEFT			
Element	Equation	SD	Length (cm)	Mean (cm)	Min (cm)	Max (cm)	Length (cm)	Mean (cm)	Min (cm)	Max (cm)
Femur	$2.47 \times \text{Femur} + 54.10$	3.27								
Tibia	$2.90 \times \text{Tibia} + 61.53$	3.37								
Femur + tibia	$1.39 \times (\text{Femur} + \text{Tibia}) + 53.20$	2.99								
Humerus	$3.36 \times \text{Humerus} + 57.97$	4.05								
Radius	$4.74 \times \text{Radius} + 54.93$	4.32								
Ulna	$4.27 \times \text{Ulna} + 57.76$	4.32								
Fibula	$2.93 \times \text{Fibula} + 59.61$	3.29								

Stature:

Anthropologist_____	Date_____
Signature/Initials_____	Page_____of_____

Trauma analysis form

Trauma Analysis Notes:

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Anthropologist _____

Date_____

Signature/Initials_____

Page_____of_____

Additional information form

Additional information:

[illegible]

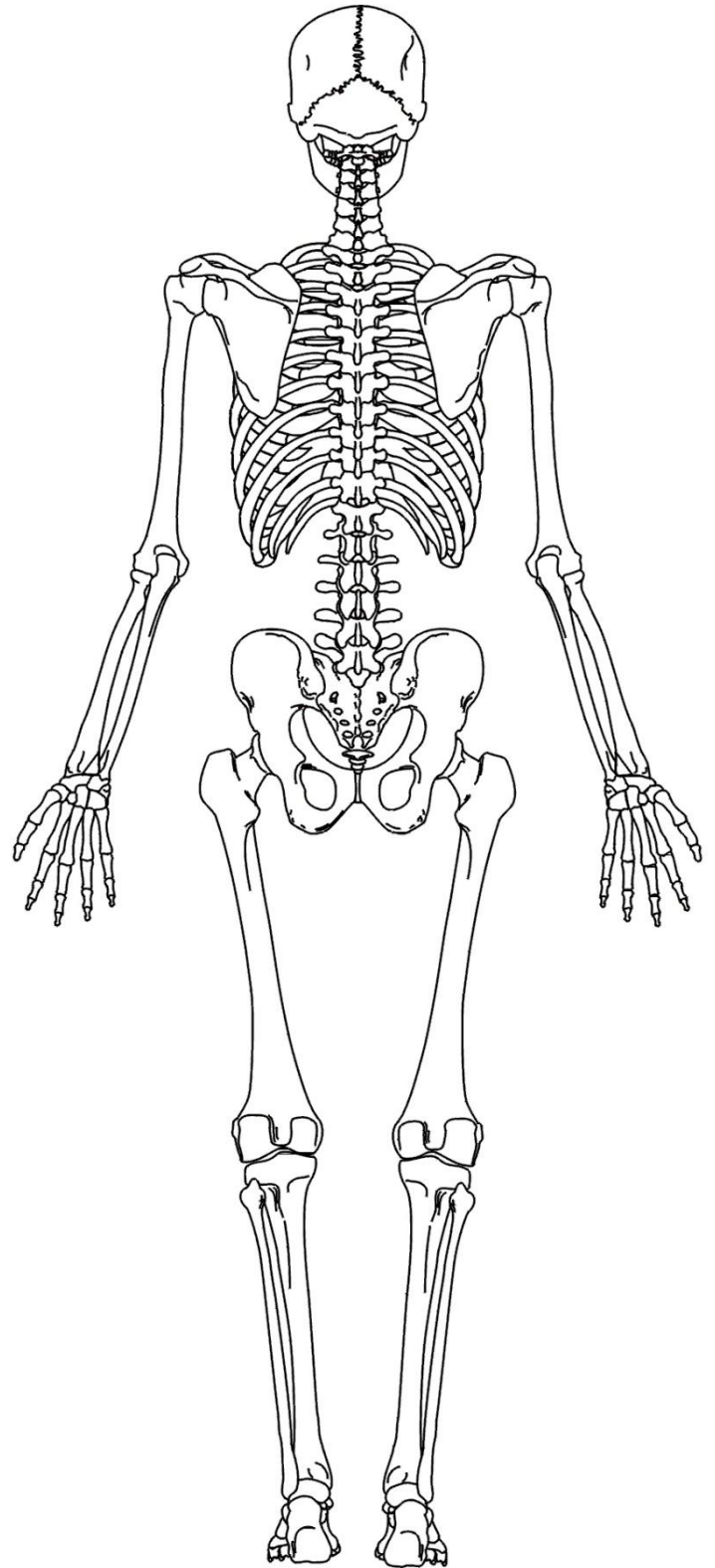
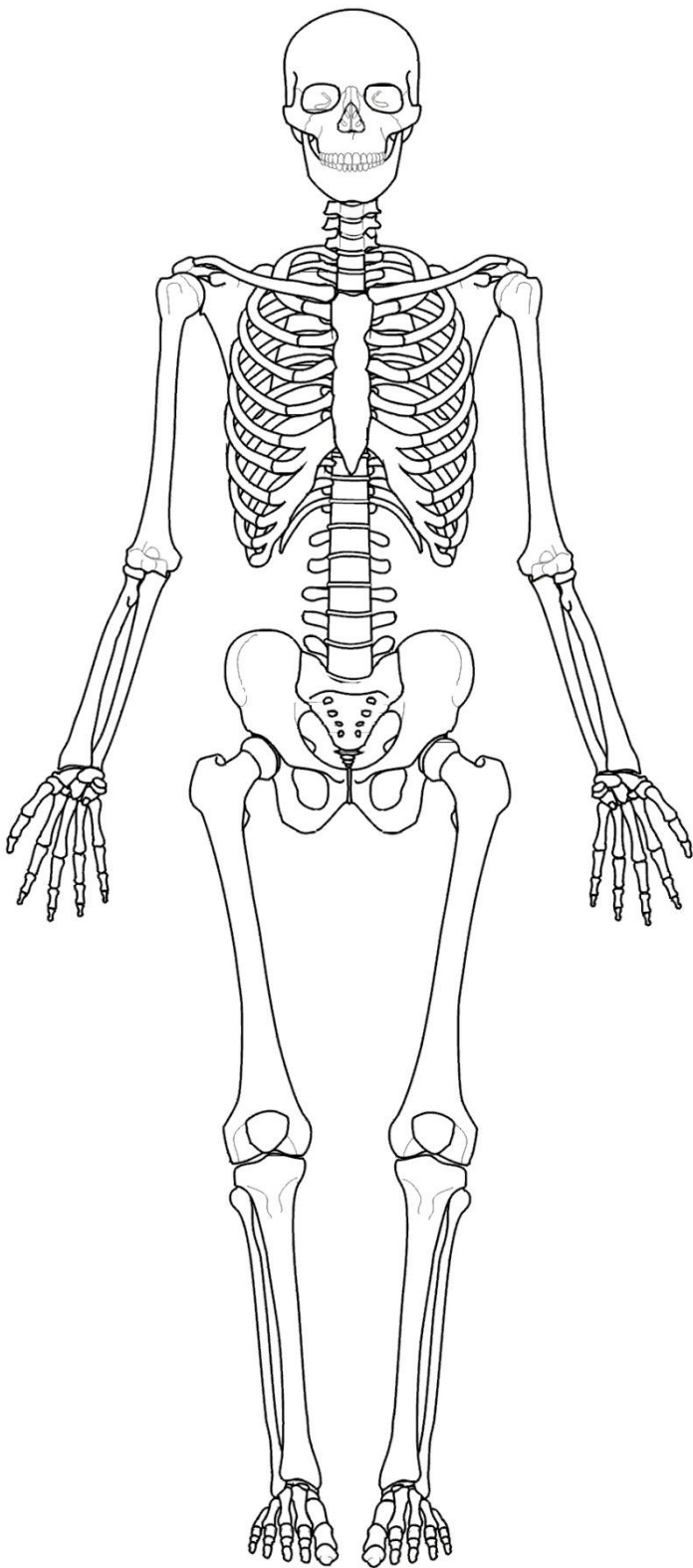
Anthropologist _____

Date_____

Signature/Initials_____

Page_____of_____

Trauma and Additional Information Homunculus Form



Anthropologist _____

Date _____

Signature/Initials _____

Page _____ of _____