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ABSTRACT

This booklet, one of a series developed by the Frederick County Board of Education, Frederick, Maryland, provides an instruction module for an individualized or flexible approach to secondary science teaching. Subjects and activities in this series of booklets are designed to supplement a basic curriculum or to form a total curriculum, and relate to practical process oriented science instruction rather than theory or module building. Included in each booklet is a student section with an introduction, performance objectives, and science activities which can be performed individually or as a class, and a teacher section containing notes on the science activities, resource lists, and references. This booklet outlines the major bones of the human skeleton, describes the functions of the skeletal system, and relates this to paleobiology. The estimated time for completing the activities in this module is 2-3 weeks. (SL)

Bones

AIDS TO INDIVIDUALIZE THE TEACHING OF SCIENCE

MINI-COURSE UNITS

BOARD OF EDUCATION OF FREDERICK COUNTY

1974

Marvin G. Spencer

PALEO BIOLOGY

BONES: CLUES TO MANKIND'S PAST

Prepared by

Janet Owens

Estimated Time for Completion

2 - 3 weeks

CONTENTS

PALEO BIOLOGY

BONES: CLUES TO MANKIND'S PAST

The human skeletal system has many important functions for the living body. Bones also preserve important data about our ancestors and how we evolved through the centuries. The sex, approximate age, brain volume, diet, height and medical history of a person long deceased are data which can be obtained by studying bones. The techniques used in locating, excavating, and analyzing fossil bone remains are vital clues to the past of modern man and may even offer links to the continual evolution of Homo sapiens.

A. The Body's Framework

OBJECTIVE

The student will be able to:

1. identify the major bones of the skeleton, and relate the functions of the system to other parts of the body.

ACTIVITIES

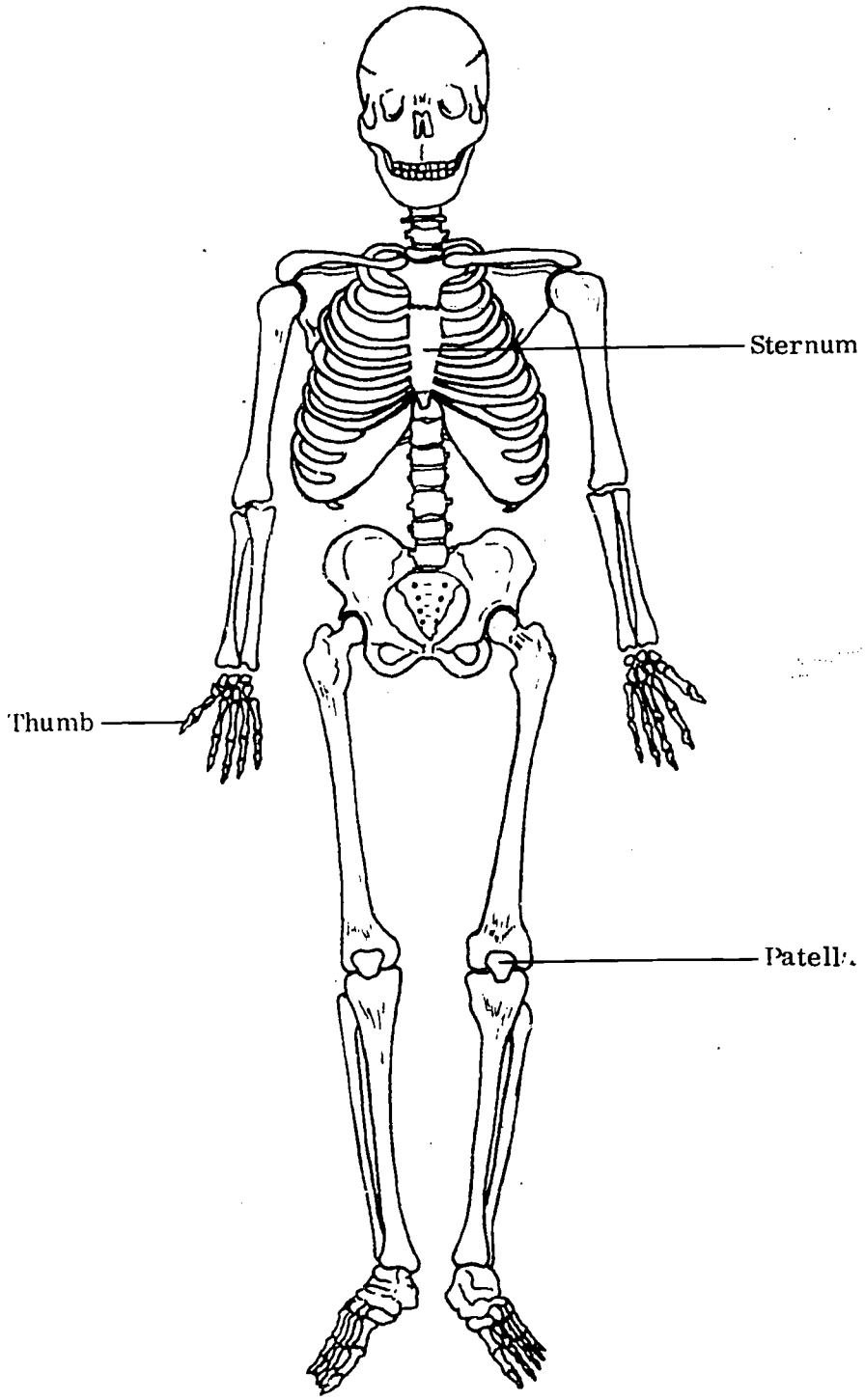
a. Label the major bones of the human skeleton, using Handout #1 "Human Skeleton - Anterior View" and Handout #2 "Human Skeleton - Posterior View". Reference - wall chart or Modern Biology, Chapter 40

b. Complete Worksheet #1 "Human Skeletal System". Reference - Chapter 41, Modern Biology & Reading #1

c. Discuss the relationships between the skeletal system and other systems of the body. Use the questions on Worksheet #2 as a guide and complete the answers during the discussion.

Human Skeleton – Anterior View

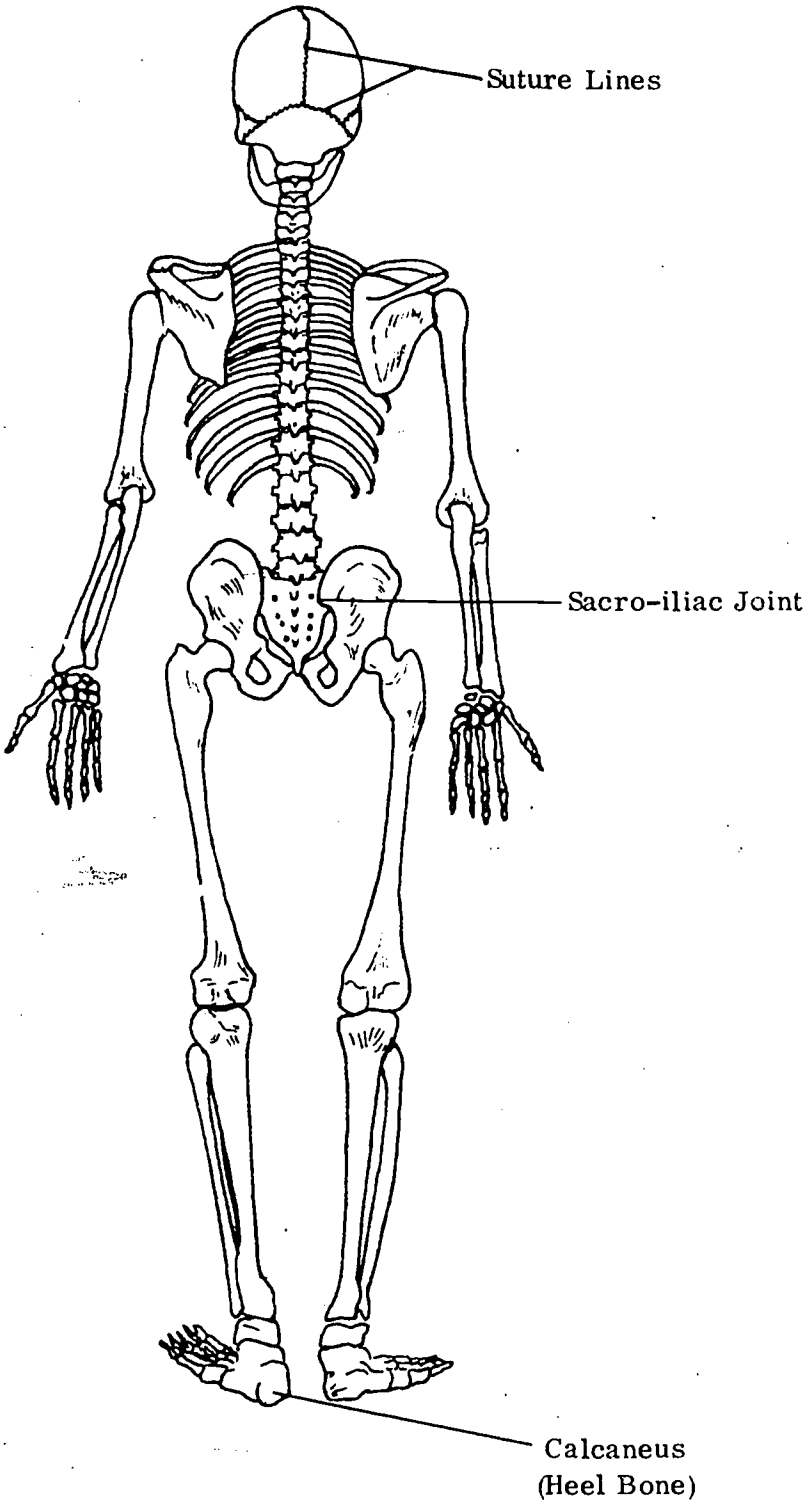
SKELETAL SYSTEM



Anterior View
(Front)

Human Skeleton – Posterior View

SKELETAL SYSTEM



Posterior View
(Back)

Worksheet #1

HUMAN SKELETAL SYSTEM

Name _____ Period _____ Date _____

1. Write the common names for the following bones:

   a. cranium _____
   b. sternum _____
   c. patella _____
   d. humerus _____
   e. pelvis _____
   f. clavicle _____
   g. femur _____

2. What are the five functions of the skeletal system?

3. Compare the front to the back view of the skeleton. What bones are more visible on each view?

4. Compare the position of the human skeleton to the position of the cat skeleton. (Use the human and cat skeletons for observations.)

5. Explain why the vertebrae closer to the head are smaller than the vertebrae near the legs.

6. How many pairs of ribs do you have?

   How many are not attached to the sternum?

   How many "floating" ribs do you have?

7. Why does the nose on the skull appear incomplete?

8. How is the kneecap or patella different from most of the other bones on the skeleton?

9. What is the longest bone in the body?

10. What is the main function of the spinal column?

11. Why are there 2 lower arm bones and 2 lower leg bones?

Reading #1

HUMAN SKELETON

The skeletal system of the human body is composed of 206 bones and has five major functions:

a. production of blood cells

b. helps in body movement by providing a place for the attachment of muscles

c. support for body tissues

d. protection of body organs

e. storage of body minerals

The front view of the skeleton can be identified from the back view because of the presence of the sternum, facial bones and patella. The drawing on Handout #1 shows the position of the body: erect, and head, palms of hands and feet facing forward. On Handout #2, the entire spinal column can be observed. The lower the vertebrae, the larger, heavier, and thicker they become because they must support more weight.

Worksheet #2

RELATING THE SKELETAL SYSTEM TO OTHER SYSTEMS

Name _____ Period _____ Date _____

1. Relate the skeletal system to the muscular system.

2. Relate the skeletal system to the nervous system.

3. Relate the skeletal system to the circulatory system.

4. Relate the skeletal system to the respiratory system.

5. Relate the skeletal system to the reproductive system.

6. Relate the skeletal system to the digestive system.

B. Location of Bone Remains

OBJECTIVES

The student will be able to:

2. identify the sites where bone remains are discovered.

3. explain why human remains are so scarce, and the reasons why they are found in a particular location.

ACTIVITIES

a. Read pages 28-31, Fossil Man. Also read page 15 in Early Man.

b. From your readings, complete Worksheet #3, "Locating Fossil Bone Remains".

c. Discuss the results of your research and relate the information to Slides 1 and 2.

Want to Know More?

Write a report or set up a display showing how man has used caves in the past and present.

Worksheet #3

LOCATING FOSSIL BONE REMAINS

Name _____ Period _____ Date _____

1. Explain why fossil bone remains are hard to find as compared to other fossils.

2. Where are fossil bones found?

3. Why are they found in particular sites?

4. What additional information, relating to the bones, can be obtained by examining the layer of earth where they were discovered?

C. Discovery and Excavation of Fossil Bone Remains

OBJECTIVES

The student will be able to:

4. explain how fossil bones are discovered and excavated.

5. relate the value of laboratory investigations to the field data, explaining the various steps involved in identification of the bones and the dating process that determines when the individual lived.

ACTIVITIES

a. Read pages 34-53, Fossil Man.

b. Complete Worksheet #4, "Discovery and Excavation of Fossil Bones".

c. Discussion: Relating the value of laboratory work to field work

Worksheet #4

DISCOVERY AND EXCAVATION OF FOSSIL BONES

Name _____ Period _____ Date _____

1. Describe the steps used in removing a bone from the site. Explain why the procedures are so time-consuming and tedious.

2. Why is careless digging harmful to the investigation of the site where human bones are located?

3. What are the major procedures in the laboratory?

4. Problems dealing with identification and comparison of the bones can be complicated for two main reasons. What are the reasons and how can we help in solving them?

5. Why are bones carefully measured?

6. Why do we need to use statistics as a mathematical tool in studying the bones excavated from each site?

7. Why is it important to correctly place the remains of fossil man in the time sequence of the Pleistocene period?

8. What are the different methods used in dating the fossil bones, according to the proper time sequence?

9. How did scientists determine that the Piltdown fossil man was a hoax?

The following sections are broken down into the various clues, preserved by bones, about our ancestors. You will notice that one particular part of the skeleton may offer several clues, thus being mentioned in different sections. In the summary, the data will be collectively analyzed.

D. Trends in Mortality - Clue #1

OBJECTIVES

The student will be able to:

6. discuss the various reasons for the changes in mortality from prehistoric man to modern man.

7. explain infanticide and the reasons for its practice.

ACTIVITIES

a. Complete Worksheet #5, "Trends in Mortality". Try to answer the questions on your own and then discuss them with other students.

b. Read and complete Worksheet #6, "Infanticide".

Want to Know More?

Do a little research about the practices of infanticide in modern times, writing a report about it or giving an oral presentation to the class.

Read the article, "Checks on Population Growth: 1750-1850", from Scientific American. The article discusses the roles of infantcide and marriage customs in controlling population growth. After reading it, complete the optional Worksheet #1, "Controls from 1750-1850". A copy of this article can be obtained from the mini-course kit or from your teacher.

Worksheet #5

TRENDS IN MORTALITY

Name _____ Period _____ Date _____

1. During the early existence of man, the world population increased by only one person every five years. Today, seventy-two million human beings are added to the world population each year. What factors are responsible for this change?

2. In the past, adult females died usually during the 20-30 age category while adult males died later (during the 30-40 age category). Today in the United States, the life expectancy for women is longer than for men. Can you explain this turnabout?

3. The average life span of prehistoric man was naturally much lower than modern man, but averages can be misleading. For example, there is a story of a man who drowned in a river that had an average depth of one foot. What might be a factor in pulling down the average life expectancy of early man?

4. Disease and starvation are factors that tend to limit a population. Do you think these two factors were responsible for the very small increase in early man's population (one person every five years)? Explain your answer.

Worksheet #6

INFANTICIDE

Name _____ Period_____ Date _____

The high rates of infant mortality appears deliberate in primitive groups and throughout man's history. Infanticide is the practice of killing unwanted children. Early cultures believed that in infanticide, the soul of the child is not lost when sacrificed, but goes back into a reserve pool. In various cultures, it has been described as necessary for disposing of infants who were diseased or deformed and also as a method of controlling population size. During the early years of man's existence, fifty percent died in the first year of life.

Evidence from fossil bone remains shows that the bulk of infant skeletons were basically females. Even in modern times, primitive hunters and food-gatherers practice female infanticide.

1. Why were more female infants killed than males? Give your opinion.

Sedentism (agricultural revolution occurred and man settled down, no longer nomadic) happened about 10,000 B.C. When this took place, the practice of infanticide was no longer as necessary as before.

2. Why did nomadic man have to practice infanticide?

Optional Worksheet #1

CONTROLS FROM 1750-1850

Name _____ Period _____ Date _____

1. Why was famine more a local problem than a widespread problem?

2. What diseases controlled population size during that time?

3. What marriage customs helped in controlling the growth rate in Europe?

4. What were the opinions of Plato and Aristotle about infanticide?

5. If infanticide was not accepted by the governments, why was it a widespread problem?

6. List the five common methods of committing infanticide.

7. During the medieval age, the "regulator of population" was:
   A. the Black Death
   B. starvation
   C. black rat
   D. war
   E. city

8. Briefly explain the following institutions:
   A. Foundling Hospitals:

   B. Parish workhouses:

   C. Baby farms:

   D. Revolving Boxes:

9. There was a higher percentage of children dying in the first year of life during the period 1750-1850 than 3 million years ago. What was the percentage of children dying in the first year of life back 3 million years?
   A. 40%
   B. 50%
   C. 70%
   D. 80%

10. Which of the following methods of disposing of children was considered the most common?
   A. overlaying
   B. strangulation
   C. exposure
   D. starvation

11. Which method was considered "accidental" most of the time?
   A. overlaying
   B. strangulation
   C. exposure
   D. overdose of drugs

12. What reasons were given for the increase in population growth after 1850?

E. Age Identification - Clue #2

OBJECTIVE

The student will be able to:

8. identify and explain the various parts of the skeleton used to determine the approximate age of the individual.

ACTIVITIES

a. Age Identification Determination by Teeth

1. Complete Handout #3, "Teeth"
Instructions: Upper dental arch drawing - Label the teeth using the following terms:

Central incisors
Lateral incisors
Canines
First premolars
Second premolars
First molars
Second molars
Third molars "Wisdom teeth"

Reference: Modern Biology, pages 649-650

Lower dental arch drawing - Use two different colors for your key showing ages of eruption and loss of teeth (may be pen and pencil).

One color: to indicate the ages of eruption and loss of baby teeth

One color: to indicate the ages of eruption of permanent teeth

Reference: Chart #1, "Eruption and Shedding of Teeth"

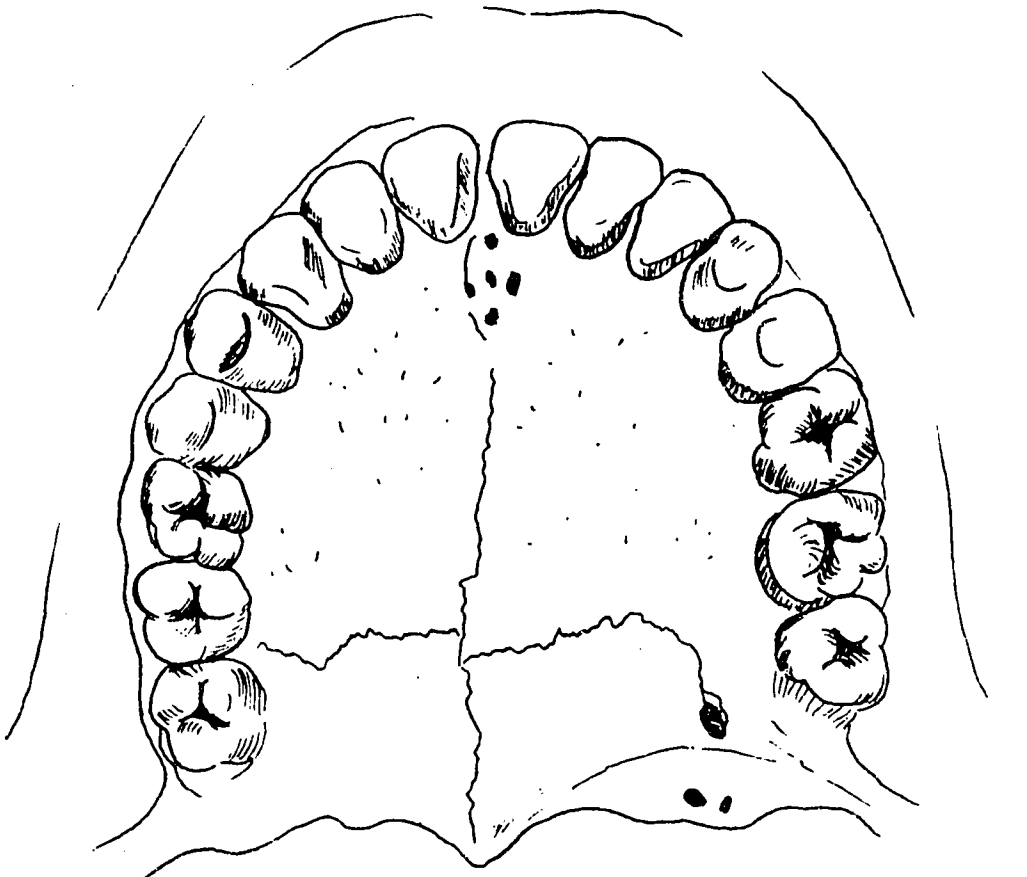
2. Complete Worksheet #7, "Determining Age by Examining Teeth"

Reference: Handout #3, completed in above activity

Upper and Lower Dental Arch

DIGESTIVE SYSTEM

UPPER DENTAL ARCH



LOWER DENTAL ARCH

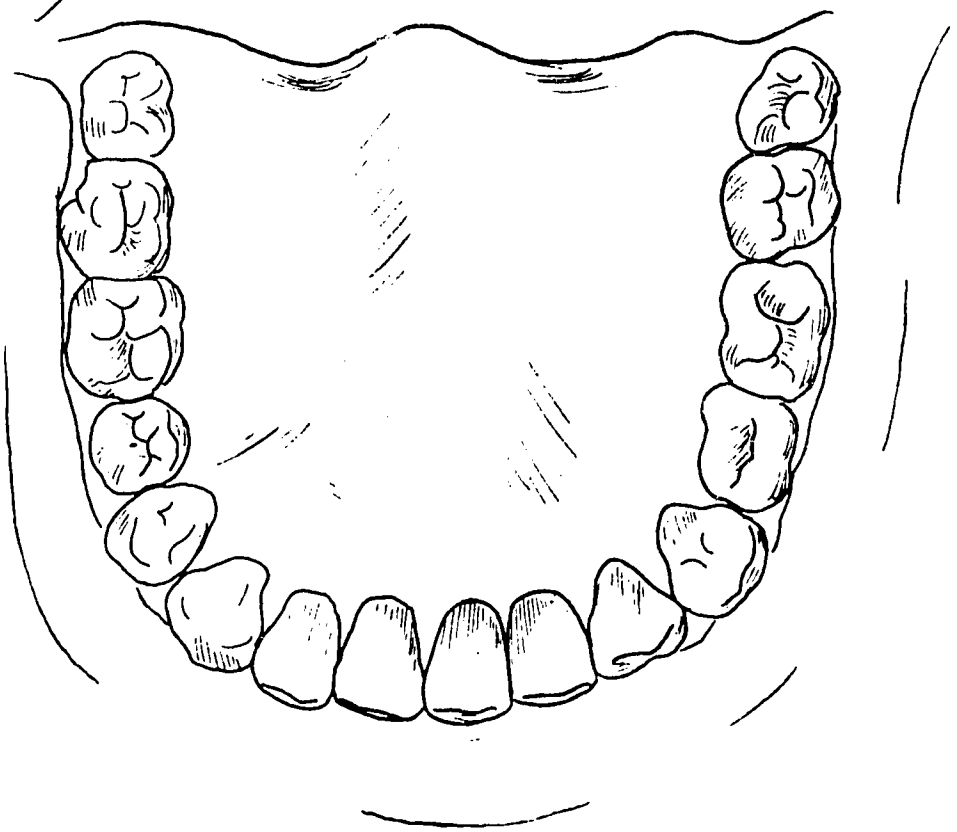


Chart #1

ERUPTION AND SHEDDING OF TEETH

TEETH	BABY TEETH		PERMANENT
	ERUPT	LOST	ERUPT
Central incisors	7 1/2 months	7 years	6-8 years
Lateral incisors	7-9 months	8 years	7-9 years
Canines	16-18 months	10 years	9-11 years
First premolars			9-10 years
Second premolars			10-12 years
First molars	12-14 months	10 years	6-7 years
Second molars	20-24 months	12 years	11-13 years
Third molars			17-21 years

Worksheet #7

DETERMINING AGE BY EXAMINING TEETH

Name _____ Period _____ Date _____

Slide 3 - A. robustus mandible

1. In general, how could we determine the approximate age of this individual?

Slide 4 - A. africans, Child 6

2. How do we know that this individual was six years old at the time of death?

Slides 5 & 6 - H. erectus mandible

3. Why are the molars almost worn down to the gums?

4. On Slide 6, the wisdom tooth or third molar is not worn down like the other molars. How old was the individual at the time of death?

General Questions:

5. By examining the teeth, how could we identify an elderly individual?

6. During what part of life span are teeth good indicators of approximate age?

b. Age Identification Determined by Examination of Skull

1. Complete Worksheet #8, "Age Determined by Examination of the Skull".

2. Complete Handout #4, "Skull".

Instructions: Label the numbered sutures on the drawing as the following:

1. sagittal suture (top of skull)
2. coronal suture
3. interfrontal suture

Locate these sutures on the human skull or model.

Write your answer on the handout to the following question:

How can we determine age by examining the individual sutures?

Reference: Chart #2, "Fusion of Skull Sutures"

3. Complete Worksheet #9, "Fontanels".

c. Age Determined by Studying the Spinal Column

Using Handout #5, "Spinal Column", explain on the back of the paper, how you could tell the age of an individual. What happens to the spinal column from infancy to adulthood?

Reference: Page 67, Fossil Man

d. Age Determined by Observing Long Bone Development

1. On Handout #6, "Bone Diagram", label and identify the following structures: spongy bone, epiphysis, bone marrow

2. Examine the real bones that have been sawed in half longitudinally and locate the various parts of the bone.

3. Complete Worksheet #10, "Bone Development".

Reference: Modern Biology, pages 634-635

e. Age Identification - Pelvis

By studying Slide 10, how could we determine age by examining the pelvic bones (answer on own paper).

f. Age Determination - Elderly Skeleton: On your own paper, list the features of a skeleton which would indicate old age.

Worksheet #8

AGE DETERMINED BY EXAMINATION OF THE SKULL

Name _____ Period _____ Date _____

Slide 7 - Australopithecus (Early Ancestor)

1. At what period of time did these individuals live?

2. By comparing the child's skull to the crushed adult skull (and possibly model cast), how can we generally determine approximate age?

Slide 8

3. We can determine age throughout the life span with more exact skill than the general observations illustrated in Slide 7. This method involves the sutures of the skull. What happens to these sutures during the life span?

Reference: Modern Biology, page 633, figure 40.1

SKELETAL SYSTEM

LATERAL VIEW OF RIGHT SIDE

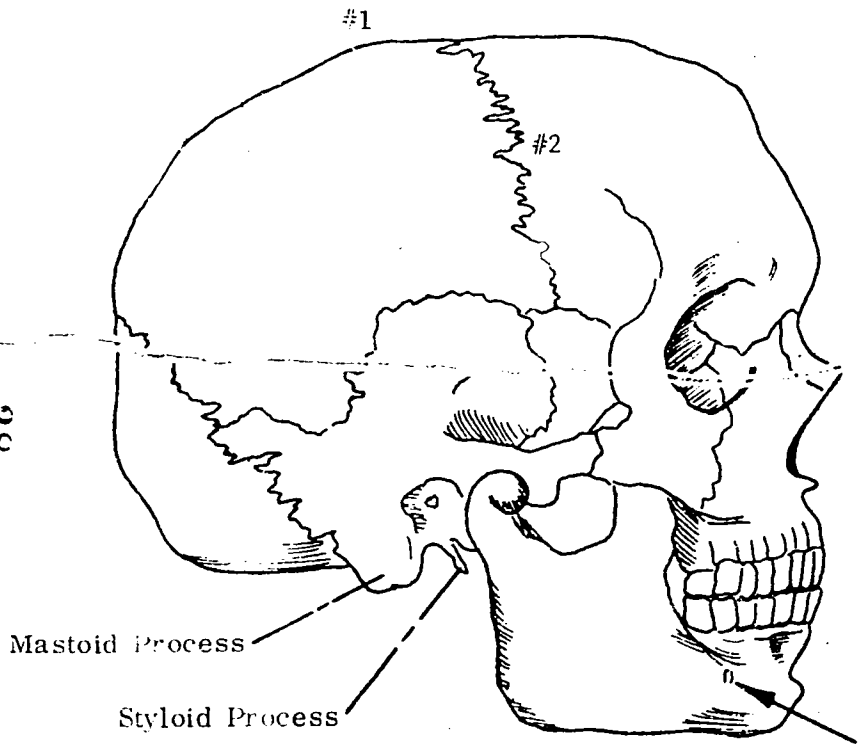


Diagram A

FRONTAL VIEW

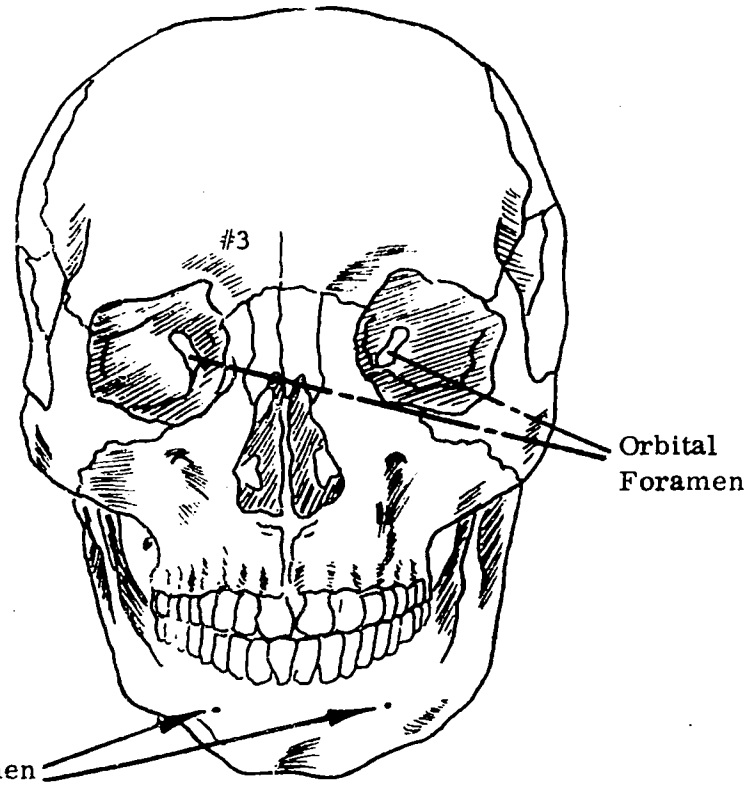


Diagram B

Chart #2

FUSION OF SKULL SUTURES

SUTURE	BEGINNING OF FUSION	COMPLETE FUSION
Sagittal	22 years - slow to age 26	35 years
Coronal	24 years - rapid to about age 30	38 years
Masto-occipital	30 years - slow at first	81 years
Squamous	37 years - almost no activity until age 62	81 years
Interfrontal	second half of first year	end of second year

NOTE: The interfrontal suture and its fusion, as with the others, is dependent upon the individual and in rare cases may not happen at all. For example, th interfrontal suture may remain unclosed in 8.5% of adults. In fact, it has occasionally been mistaken for a fracture.

Worksheet #9

FONTANELS

Name _____ Period _____ Date _____

Fontanels are membrane-covered spaces at the areas of the cranial bones which are the last to undergo ossification. The membranes in these areas are not ossified until the child is born.

1. Examine the fetal skull, identifying the fontanels or "soft spots".

2. Locate the most noticeable soft spot located near the front of the skull on top.

Use Chart #3, "Times of Closure for Fontanels", to answer the following questions:

3. Which soft spot is usually the first to close?

4. Which one is usually the last to close?

5. If you were examining a fetal skull, how would you determine the age as being about one year old?

6. How would you conclude that an individual was 2 years old?

Chart #3

TIMES OF CLOSURE FOR FONTANELS

FONTANEL	APPROXIMATE TIME OF CLOSURE AFTER BIRTH
Posterior	2 months
Anterolateral	3 months
Posterolateral	end of first year
Anterior (most noticeable)	during second year
Sagittal	often at birth, but usually before fourth month

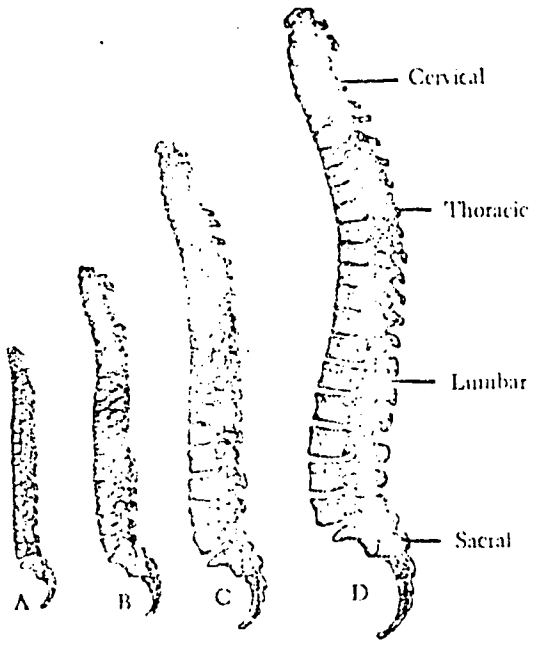
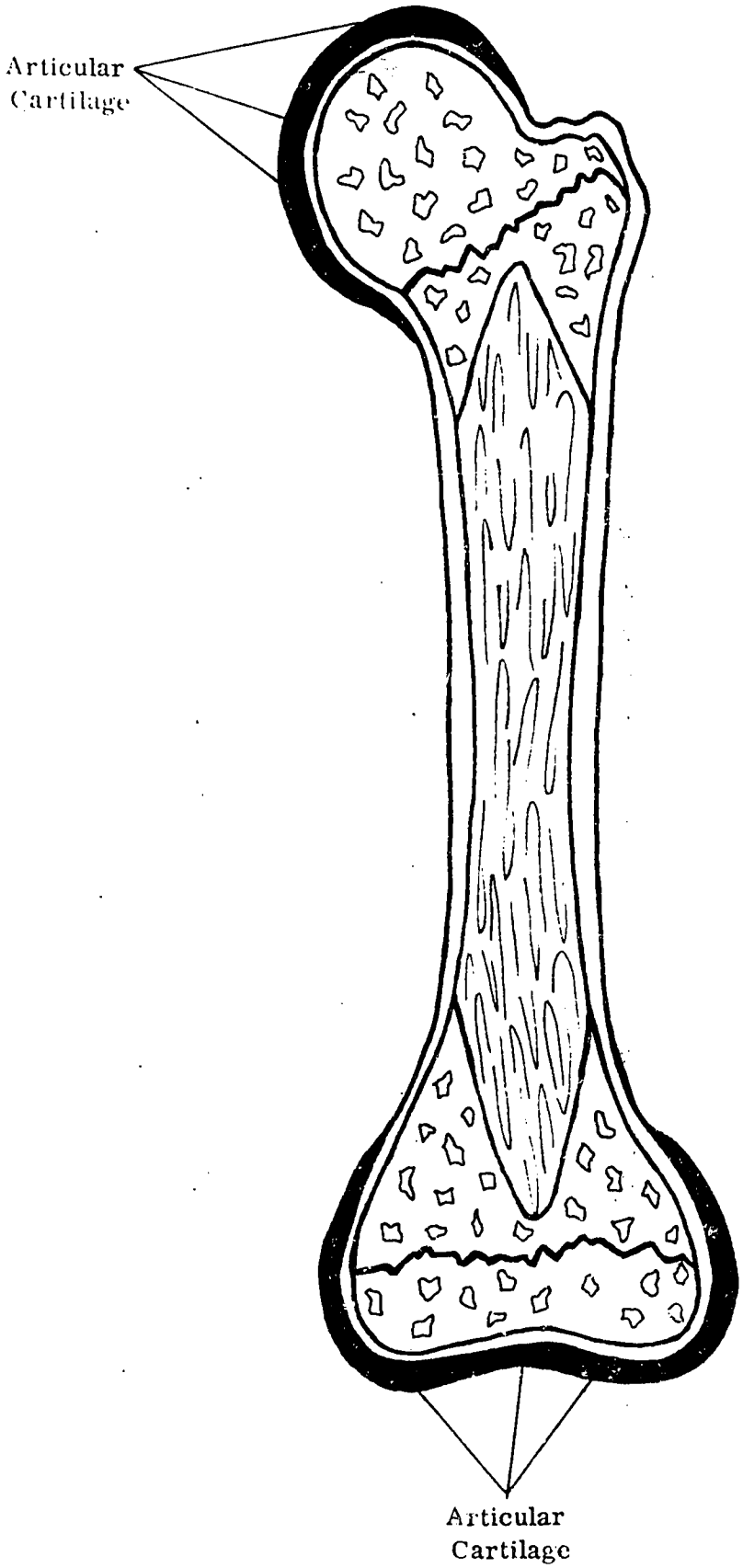


Fig. 5-17. Vertebral column of (A) newborn child; (B) three-year-old child; (C) seven-year-old child; (D) adult. (From *Atlas of Human Anatomy*, Barnes & Noble, Inc., 1956.)

one Diagram in Cross Section

SKELETAL SYSTEM



Worksheet #10

BONE DEVELOPMENT: DETERMINING AGE

Name _____ Period _____ Date _____

1. Looking at Slide 9, what happens during bone development?

Study the following list showing the different ages of appearance and fusion of epiphyses to the ends of the long bones:

Appear	Fusion
18 years	22-25 years
20 years	20 years
6 months - 4 years	3-7 years
4-11 years	14-21 years
7-14 years	13-21 years
6-16 years	17-24 years
3 months - 3 years	15-25 years

2. Using Handout #7 and the above chart, how do we determine age by studying long bones?

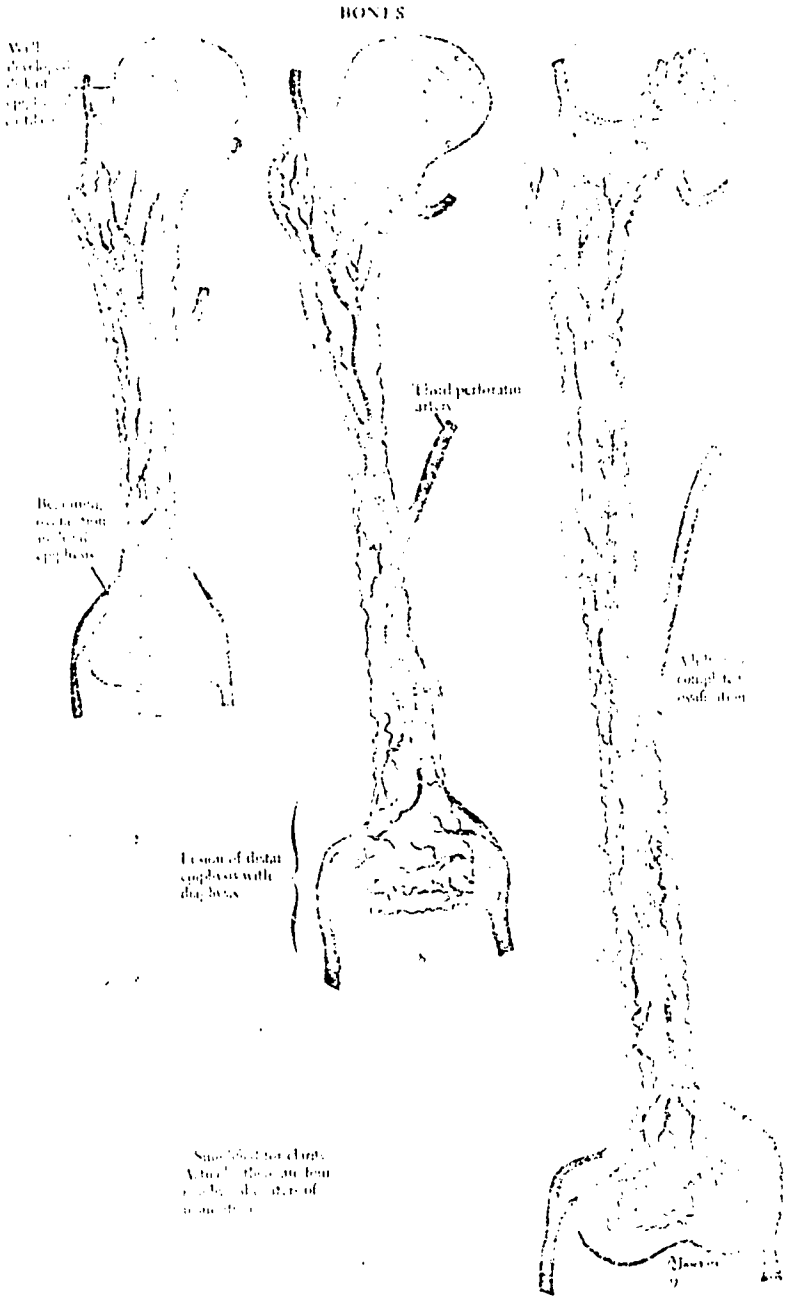


Fig. 5.3 Later stages in growth of a long bone.

F. Sex Identification - Clue #3

OBJECTIVE

The student will be able to:

9. identify and explain the various parts of the skeleton used to determine the sex of the individual.

ACTIVITIES

a. Teeth - A clue?

In gorillas, the male has a larger canine tooth than the female, thus we can determine sex by examining the teeth. Are the size of teeth in man a good indicator of sex? (answer on own paper)

Reference: page 63, Fossil Man

b. Facial Bones - a fair clue

Observing Slide 11, can you tell the difference between the male and female skulls of Homo sapiens? You will notice that the female skull has more delicate facial features than the male.

c. Examination of Pelvis - the best clue

1. Handout #8: Read over the description of the basic differences between the male and female pelvic bones and study the two drawings. Notice the "u" shaped public arch of the female in comparison to the "v" shape of the male. Also note the flared-out "hip bones" of the female.

   Can you answer these questions:

   Why has the pelvis changed more than any other part of the skeleton?

   Why is there such a distinct difference between the male and female pelvic bones?

2. Study the pelvic bones of the male and female models or try to determine the sex of the real skeleton in the front of the room.

3. Slides 12 and 13: Can you identify the male and female pelvic bones?

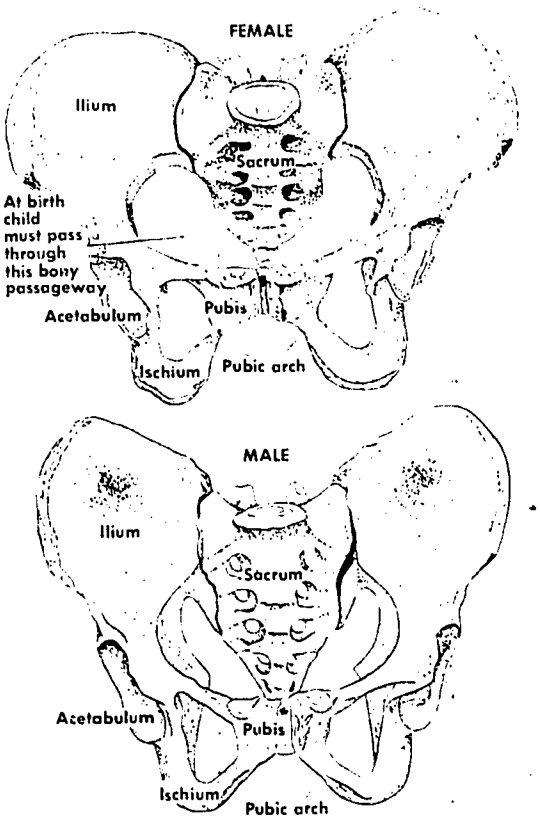


Fig. 529

Chief difference between male and female skeletons is structure of pelvis. Female pelvis has less depth with broader, less sloping ilia, more circular bony ring (pelvic canal), wider and more rounded pubic arch, and shorter and wider sacrum. Most structures of female pelvis are correlated with child-bearing functions. In evolution of human skeleton, pelvis has changed more than any other part because it has to support weight of erect body. (Anterior view.)

G. Relationship between Diet and Brain Volume. Evidence: Changes in Human Skull - Clue #4

OBJECTIVE

The student will be able to:

10. explain the theory relating the changes in man's diet to the increase in brain volume throughout his evolution.

ACTIVITIES

a. Study and complete Worksheet #11, "Diet and Brain Volume".

b. Read page 77, last paragraph, Fossil Man.

c. Study Figure 39-9, page 626, Modern Biology and answer the two questions about the drawings, on your own paper.

Worksheet #11

DIET AND BRAIN VOLUME EVIDENCE: SKULL CHANGES

Name _____ Period _____ Date _____

1. Look at Slide 14, showing a side profile of early man's skull, and describe the structure of the skull and teeth.

2. Examine a modern man's skull (from side profile) and describe the structure of the skull and teeth.

3. Early man was a herbivore. What evidence illustrates this eating habit?

4. As man evolved, his diet also changed and he became a carnivore, and started cooking his food which is perhaps a form of pre-digestion. What has happened to his teeth and jawbone over the centuries?

5. The ridge of the side of the skull and the thickness of the skull are related to the support of the jawbone and teeth. When the teeth and jawbone decreased in size and weight, what happened to the size of that ridge and the thickness of the skull?

6. Referring back to #5, due to the changes in the thickness of the skull, it allowed more room for the brain. According to this theory, what happened to the brain volume?

H. Determining Height and Erect Posture - Clue #5

OBJECTIVE

The student will be able to:

11. identify and explain the parts of the skeleton used in determining erect posture and approximate height of early man.

ACTIVITIES

a. Pelvis

1. Read the second paragraph, page 620, Modern Biology, and study Figure 39-1.

2. Read page 682, Biology.

3. Study Figure 30-3, page 682, Biology.

4. Answer the following questions on your own paper:

What was the proof that Australopithecus was humanlike and not apelike?

How do we determine if an ancestor stood erect?

b. Skull

1. Read page 681, Biology, and study Figure 30-2 on the same page.

2. Compare the cat and human skulls (use models), showing how the location of the foramen magnum varies according to the certain angle where the skull joins the spinal column.

c. Leg Bones: Read pages 128-129, Fossil Man, comparing early leg bones to modern man.

d. Results of Standing Erect: Another Form of Evidence - Hand and Foot Structure

Instructions: Read pages 72-74, Fossil Man

e. Determining Height - Arm and Leg Bones

Read and study the drawing and chart on page 60, The Body.

I. Medical History - Clue #6

OBJECTIVE

The student will be able to:

12. determine the medical clues preserved by bone.

ACTIVITIES

a. Study the photographs and read the small description on pages 18-19, The Body.

b. Read page 59, The Body, "Skeletons and Time Clocks".

c. Read page 145, "The Lively Skeleton", Part 6, Story of Life.

d. Make a list of the above clues and some of your own clues about medical history preserved by bones.

J. Summary of Clues

OBJECTIVES

The student will be able to:

13. collectively analyze the separate data about the clues preserved by bone.

14. apply his information to different exercises on identification of bone remains.

ACTIVITIES

Complete Worksheet #12, "Summary of Clues Preserved by Bones".

Evaluations

You will obtain from the teacher several different evaluations, including written, audio-visual and practical lab exercises.

Conclusion

Review over the fourteen objectives. Did you accomplish each one?

Worksheet #12

SUMMARY OF CLUES PRESERVED BY BONES

Name _____ Period _____ Date _____

Conclusions

1. List all the various clues preserved by an old skull:

2. List all the various clues preserved by teeth:

3. List all the various clues provided by studying the leg or arm bones:

4. List all the clues preserved by the pelvis:

5. What parts of the skeleton can we use to determine age throughout the life span of an individual?

   What parts would offer their best clues under age 25?

6. Relate our diet to brain volume.

Applications

Slide 15

1. How do we know that this skull is an adult female?

Slide 16

2. How would you determine that this fragmented skull is an approximately 19-year old female who was a herbivore?

3. How would you identify an ancestor as being about 5 feet tall, male, and having a brain volume of about 507.9 cubic centimeters?

4. How would you identify a female, about 10-12 years old?

5. How would you identify an approximately 70-year old male who lived 3 million years ago?

6. How would you identify a three-year old child?

UNIT OBJECTIVES

The student will be able to:

1. identify the major bones of the skeleton, and relate the functions of the system to other parts of the body.

2. identify the sites where bone remains are discovered.

3. explain why human remains are so scarce, and the reasons why they are found in a particular location.

4. explain how fossil bones are discovered and excavated.

5. relate the value of laboratory investigations to the field data, explaining the various steps involved in identification of the bones and the dating process that determines when the individual lived.

6. discuss the various reasons for the changes in mortality from prehistoric man to modern man.

7. explain infanticide and the reasons for its practice.

8. identify and explain the various parts of the skeleton used to determine the approximate age of the individual.

9. identify and explain the various parts of the skeleton used to determine the sex of the individual.

10. explain the theory relating the changes in man's diet to the increase in brain volume throughout his evolution.

11. identify and explain the parts of the skeleton used in determining erect posture and approximate height of early man.

12. determine the medical clues preserved by bones.

13. collectively analyze the separate data about the clues preserved by bone.

14. apply his information to different exercises on identification of bone remains.

GENERAL INFORMATION

1. This unit may be included at the conclusion of one dealing with evolution, or implemented in human physiology and anatomy, within the regular topic of the skeletal system.

2. It may be teacher-directed or used in the same format, only individualized. With either method, there should be discussions involving the teacher and students included at the end of the different sections.

3. The unit is devised as a "mystery" activity in which the students have a problem: identifying the characteristics of early man; learn the various "clues" preserved by bones; and finally apply those clues.

4. Resources: The paperback, Fossil Man, should be used as the text for the unit. It costs $1.45 and you could obtain perhaps 15 copies having one book per two students.

   Actual models (human skeleton, cat skeleton, male and female pelvic display, fetal skull, plastic casts of early man's skulls, or bone kit) develop high interest and motivation during the unit. However, if you are not able to obtain these models, drawings, pictures, or slides can easily supplement the unit.

   The sixteen slides, included within the teacher's package, are essential to the unit. The students work with the slides, and from their observations, answer the questions on worksheets. This is an excellent way for the student to observe, think, and draw his own conclusions.

5. Worksheets: These are basically designed so the student can work with them by himself or be used as a guide for class discussions. Many of them are thought-oriented, and the student will not simply "find" the answer in a book and write it on the paper.

6. Want to Know More? These sections are optional activities for the students who are interested in learning more information.

SPECIFIC INFORMATION FOR EACH SECTION:

A. The Body Framework

   1. [illegible], decide what bones the student should label on the drawings

   2. Worksheet 1: For question 4, student should observe the models of the human skeleton and cat skeleton

   3. Worksheet 2: Student should have a sufficient background in man anatomy and physiology for this discussion.

B. Location of Bone Remains

1. Slide 1, "Mammoth Cave": Illustrates the location of bone remains

2. Slide 2, "Lost John": 42 year old Indian mummy found at Mammoth Cave approximately 2,000 years old

C. Discovery and Excavation of Fossil Bone Remains

1. The amount of information the student will be responsible for should be decided by the individual teacher.

2. Students should clearly understand that this dating process related to <u>when</u> the ancestor lived, not how old he was at the time of death.

D. Trends in Mortality - Clue #1

1. Students are usually very interested in the topic of infanticide and the practice of it.

2. Activity a - Worksheet #5: Selected Answers

1. harsh survival in past, high infant mortality through the years, developed better health care, sanitation, changes in life styles, agricultural and industrial revolutions

2. In past, females died in childbirth. Today, males die earlier than females - stress of civilization; heart diseases, etc.

3. High infant mortality rates (50% died in first year of life)

4. Yes or No Two theories:

a. evidence from bones of diseases

b. since nomadic, little contact between groups; thus small chance of spreading diseases

Starvation: food-gathers and hunters (Refer to modern groups and their relationship with starvation)

3. Activity b - Worksheet #6: Selected Answers

1. males needed for hunting and gathering from females and children; thus fertility age

2. Since nomadic, woman could only carry one child at a time

Keep population in check with food supply

E. Age Identification - Clue #2

1. The student needs to study and relate the detailed data in this section only for the purpose of understanding how we can identify the approximate age of early man. Remembering exact data is not important as his understanding of how to use it.

2. Worksheet #7: Selected Answers

    2. number of teeth; possible eruption of central incisors of permanent teeth

    3. eating raw, dirty food - vegetable matter

    4. approximately 19 years old; notice wisdom not worn down so had to erupt shortly before death

    5. wear and tear on teeth; possible loss of teeth

    6. first two decades of life

3. Handout #6: May want to have students label more parts of the bone

F. Sex Identification - Clue #3

1. Slide 11 - female skull is on the far right, male skull in the center and Neanderthal skull on the left

2. Slide 13 - Note that the male pelvis has the "flared-out" hips. Use this to discuss the variable of individualization in interpreting data.

G. Diet and Brain Volume - Clue #4

1. Will need human skull or drawing

2. Worksheet 11: Selected Answers

    3. large teeth

    4. decreased in size

    5. decreased

    6. increased

H. Intermediate Height and Erect Posture - Clue #5

1. Will need ape and human skulls or drawings

I. Medical History

1. The length and detail of this section will be decided by the individual teacher.

J. Summary of Clues

1. This is perhaps the most important section because here the student must collectively analyze the information he has received and then apply it. Encourage the students to answer the questions as thoroughly as possible.

Evaluations

Audio-visual or practical lab exercises would determine the individual student's understanding of this unit.

STUDENT REFERENCES

Biological Science; An Ecological Approach, BSCS Green Version, 1973

Biology, Silver Burdett Company, New Jersey, 1971

Fossil Man, Day, Michael; Bantam Books "Knowledge Through Color" series, paperback, 1971

Life Science Library Series, Time-Life Books, New York, 1971
The Body

Early Man

"The Lively Skeleton", Story of Life Series (Weekly magazine), Part 6

(Can substitute any references for the above)

Modern Biology, Holt, Rinehart and Winston, Inc., 1973

TEACHER REFERENCES

Anatomy and Physiology, Volume 1, College Outline Series, Barnes and Noble, New York, 1965

Biology and Human Progress, Prentice-Hall, New Jersey, 1972

Fundamental Concepts, Amsco School Publications, Inc., New York, 1972

Life Nature Library, Time-Life Books, New York, 1964
Physiology

Processes of Organic Evolution, Prentice-Hall, New Jersey, 1966

The Human Revolution, Bantam Books, New York, 1965
(paperback, available at bookstores)

SUGGESTED FIELD TRIPS

Calvert Cliffs, Maryland - to learn techniques of excavating fossils and relating this experience to excavating bone remains

Smithsonian Institute - Excellent displays of bone remains

An actual "dig" if available

AUDIO-VISUAL AIDS

16 slides in teacher's package

MODELS

Human Skeleton

Male and Female Pelvic Display

Fetal Skull of Human

Cat Skeleton

Bone Kit

Plastic Casts of Early Man's Skulls

Evaluation Form for Teachers

Name of mini-course ____

Evaluation Questions	Yes	No	Comments
1. Did this unit accomplish its objectives with your students?			
2. Did you add any of your own activities? If so, please include with the return of this form.			
3. Did you add any films that other teachers would find useful? Please mention source.			
4. Were the student instructions clear?			
5. Was there enough information in the teacher's section?			
6. Do you plan to use this unit again?			

7. Which level of student used this unit? ______________________________

8. How did you use this unit - class, small group, individual? __________

____

[illegible] TO [illegible] SUPERVISOR'S OFFICE AS SOON AS YOU COMPLETE [illegible] COURSE.

SCIENCE MINI-COURSES

	Prepared by
PHYSICAL SCIENCE	
ELECTRICITY: Part 1 (Types of Generation of Electricity)	Marvin Blickenstaff
ELECTRICITY: Part 2 (The Control and Measurement of Electricity	Marvin Blickenstaff
ELECTRICITY: Part 3 (Applications for Electricity)	Marvin Blickenstaff
CAN YOU HEAR MY VIBES? (A Mini-course on Sound)	Charles Buffington
LENSES AND THEIR USES	Beverly Stonestreet
WHAT IS IT? Identification of an Unknown Chemical Substance	Jane Tritt
BIOLOGY	
A VERY COMPLEX MOLECULE: D.N.A. The Substance that Carries Heredity	Paul Cook
Controlling the CO[illegible]E OF LIFE	Paul Cook
Paleo Biology – BONES: Clues to Mankind's Past	Janet Owens
A Field Study in HUMAN ECOLOGY	Janet Owens
Basic Principles of GENETICS	Sharon Sheffield
HUMAN GENETICS – Mendel's Laws Applied to You	Sharon Sheffield
SCIENCE SURVEY	
WEATHER Instruments	John Fradiska
TOPOGRAPHIC Maps	John Geist and John Fradiska
CHEMISTRY	
WATER	Ross Foltz
PHYSICS	
PHYSICAL OPTICS	Walt Brilhart