SKELETAL SYSTEM LAB EXERCISE: GROWING BONES

Purpose
In this exercise, you will examine some upper and lower limb bones of a child’s skeleton. On the basis of its dentition and its bone development, the child was probably around five to six years old.

Overview
The long bones of the appendicular skeleton begin as pre-bone models of hyaline cartilage. During growth of the bone, multiple areas of bone formation—ossification centers—develop in the hyaline cartilage. The first or primary center of ossification is located in the shaft (body, diaphysis). Later or secondary centers form in the proximal and distal ends (epiphyses) of the bone. The times at which the centers appear in the bone are well documented. However, there can be considerable individual variation.

Bone formation spreads from the ossification centers, replacing the hyaline cartilage, until only thin plates of cartilage—epiphyseal plates or growth cartilages—remain between the diaphysis and the epiphyses. The bone continues to grow as long as the epiphyseal plate cells produce cartilage faster than the bone cells can replace it with bone. When the rate of cartilage formation drops below critical levels, then bone replaces the epiphyseal plate, the epiphysis fuses with the shaft, and growth terminates. The times at which these fusions usually occur are known. However, there is individual variation.

Instructions
Read the description of each bone and find its diaphysis (body, shaft), epiphyses, and epiphyseal plates. Remember that this child was only five or six years old, so some epiphyses and plates may not yet have developed.

The femur develops from five ossification centers: shaft, distal end, head, greater trochanter, and lesser trochanter. The center for the shaft appears during the 7th week of fetal life; for the distal end, around the 9th month of fetal life; for the head, around the 1st year; for the greater trochanter, around the 4th year; and for the lesser trochanter, around the 13th or 14th years. Between the 18th and 20th years, the epiphyses fuse with the shaft in the following sequence: lesser trochanter, greater trochanter, head, distal end. (Notice that the order of fusion is the reverse of the order of appearance of the epiphyseal ossification centers.)

Why don't you see the lesser trochanter?
The *tibia* develops from three ossification centers: shaft, proximal end, and distal end. The center for the shaft appears during the 7th week of fetal life; for the proximal end, around birth; and for the distal end, sometime between the 1st and 2nd years. The distal epiphysis fuses with the diaphysis around the 18th year and the proximal fuses with the diaphysis around the 20th year. *The tibial tuberosity and the medial malleolus may develop from separate ossification centers.*

Like the tibia, the *fibula* develops from three ossification centers: shaft, distal end, and proximal end. The center for the shaft appears during the 8th week of fetal life; for the distal end, around the 2nd year; and for the proximal end, around the 3rd to 4th years. The distal epiphysis fuses with the shaft around the 20th year and the proximal fuses with the shaft around the 25th year.

*Why don't you see the tibial tuberosity?*

The *humerus* develops from eight ossification centers: shaft, head, greater tubercle, lesser tubercle, capitulum, medial part of the trochlea, medial epicondyle, and lateral epicondyle. Ossification begins in the body during the 8th week of fetal life; in the head, at year 1; in the capitulum, at year 2; in the greater tubercle, at year 3; in the lesser tubercle, at year 5; in the medial epicondyle, at year 5; in the medial part of the future trochlea, at year 10; and in the lateral epicondyle, at year 12 or 13. (The lateral part of the trochlea is derived from the ossification center for the capitulum.) At the proximal end of the bone, the head and the greater and lesser tubercles form a single proximal epiphysis at about 6 years. It generally fuses with the shaft around the age of 20 years. At the distal end of the bone, the epiphyses for the lateral epicondyle, capitulum, and trochlea form a single epiphysis that fuses with the shaft between the 16th and 17th years. The epiphysis for the medial epicondyle joins the shaft around the 18th year.

*Why don't you see the medial part of the trochlea or the lateral epicondyle?*
The **radius** develops from three ossification centers: shaft, distal end, and proximal end. The center for the shaft appears during the 8th week of fetal life; for the distal end, around the 2nd year; and for the proximal end, around the 5th year. The proximal epiphysis fuses with the diaphysis between the 15th and 18th year and the distal epiphysis fuses with the diaphysis between the 17th and 20th years.

The **ulna** develops from three ossification centers: shaft, distal end, and proximal end. The center for the shaft appears during the 8th week of fetal life; for the distal end, between the 5th and 6th years; and for the proximal end, around the 10th year. The proximal epiphysis fuses with the shaft around the 25th year. The distal epiphysis fuses with the shaft around the 20th year.

Each **carpal** bone ossifies from a single center. The centers appear in the following sequence: capitate (1 yr); hamate (2 yrs); triquetral (3 yrs); lunate (4-5 yrs); scaphoid, trapezoid, trapezium (5-7 yrs); pisiform (9 – 11 yrs). *It is difficult to distinguish the scaphoid and lunate in this preparation and the pisiform appears to have started to develop very early in this individual.*

A primary ossification center appears in the body of each of the **metacarpals** during the 8th to 9th weeks of fetal life. Secondary centers appear in the distal ends (heads) of metacarpals 2-5 and in the proximal end (base) of metacarpal 1 at about 3 years. Fusion of the bones occurs around the age of 20.