

spongy

endosteum

osteons

lacunae

lamellae

bone marrow

compact

Haversian

periosteum

medullary cavity

epiphysis

Embedded content: [https://edu-dev.wp.uhi.ac.uk/wp-admin/admin-ajax.php?action=h5p\\_embed&id=149](https://edu-dev.wp.uhi.ac.uk/wp-admin/admin-ajax.php?action=h5p_embed&id=149)  
([https://edu-dev.wp.uhi.ac.uk/wp-admin/admin-ajax.php?action=h5p\\_embed&id=149](https://edu-dev.wp.uhi.ac.uk/wp-admin/admin-ajax.php?action=h5p_embed&id=149))

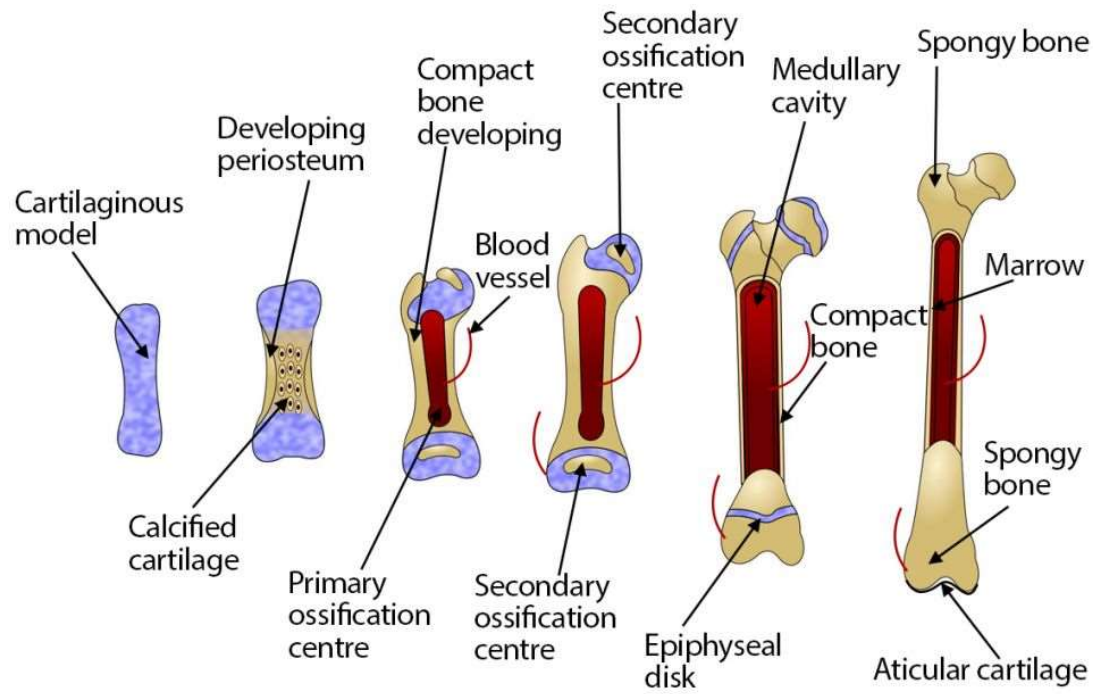
## Ossification

**Ossification** is the name given to bone formation. Depending upon where and when new bone tissue is formed, different names are used to describe the ossification.

The skeleton of a human embryo is composed of **fibrous connective tissue** and **hyaline cartilage** that is shaped like bones – these provide the skeletal structure for ossification to take place. Ossification begins approximately six or seven weeks into embryonic development and continues throughout life; the bones of an infant only become completely hardened by bone tissue during late adolescence. There are two forms of ossification.

**Intramembranous ossification** refers to bone formed directly onto loose connective tissue without going through a cartilaginous stage (skull, mandible & clavicles).

**Endochondral ossification** refers to bone formation in hyaline cartilage – this is how most bones, particularly long bones, are formed.



(files/images/stages of ossification in bone.jpg?1612175733768)UHI / CC0

### Text

Stage 1 = Cartilaginous model

Stage 2 = Developing periosteum and calcified cartilage

Stage 3 = Compact bone developing, blood vessel and primary ossification centre

Stage 4 = Secondary ossification centre develops

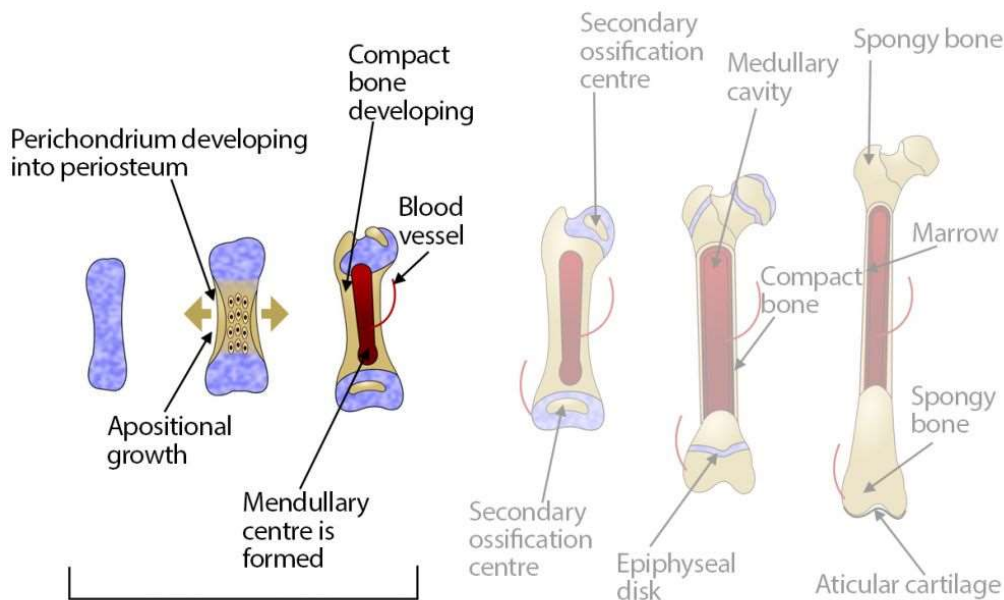
Stage 5 = Epiphyseal disc, medullary cavity and compact bone develop

Stage 6 = Spongy bone, marrow and articular cartilage

Although these are different methods of bone formation the end result is the same, with either method replacing connective tissue with bone. Most bone formation is endochondral ossification. This type of ossification is split into two phases – **Primary and Secondary ossification**.

### Primary ossification

Primary ossification occurs before the epiphyses of bone and the **epiphyseal growth plates** are formed. A cartilage matrix is initially formed in the shape of bone and surrounded by a membrane called the **perichondrium**. The cartilage matrix grows and more cells are formed. Most of the growth is an increase in length, known as **interstitial growth**, but an increase in thickness is called **appositional growth**. As the cartilage cells grow, the matrix pH changes and **calcification** begins.



(files/images/Primary Ossification.jpg?1612175887833)UHI / CC0

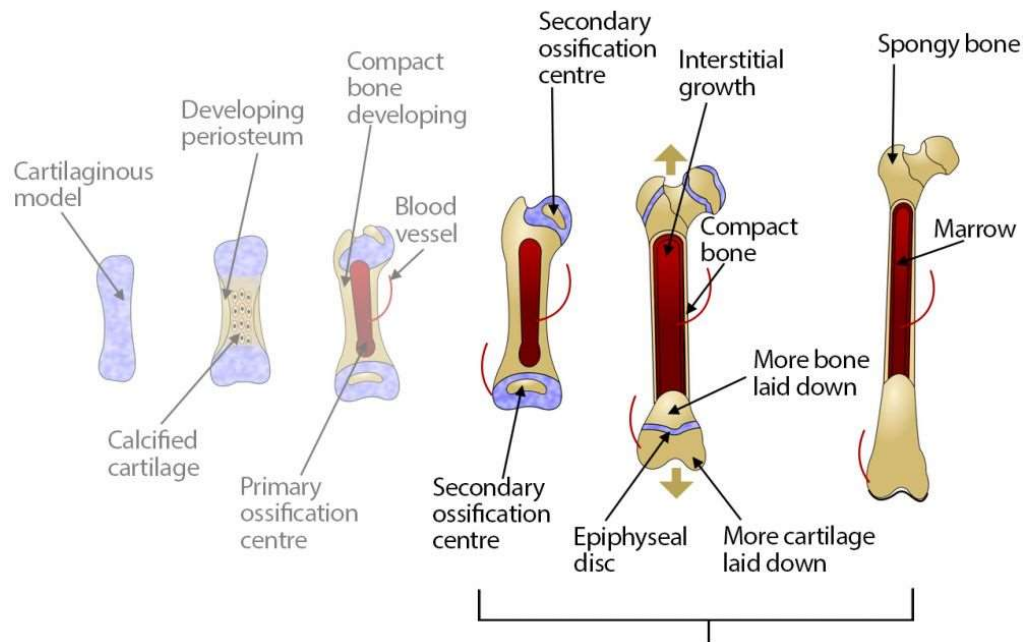
At the same time, blood supply penetrating through the perichondrium stimulates **osteoblast** formation, and **cartilage cells** are gradually replaced by **osteocytes**.

The osteoblasts create a calcified bone matrix known as **hydroxyapatite**, and the spongy bone originally formed in the centre of the bone is broken down by osteoclasts to form the **medullary cavity**, which fills with **red bone marrow**. Primary ossification proceeds inwards from the periosteum.

## Secondary ossification

The **epiphyseal growth plate or disc** (ossification centre) develops shortly after birth where the shaft (diaphysis) and the epiphyses meet in long bones, and this is where interstitial bone growth occurs.

Long bones develop and grow throughout childhood at these growth plates at each end of the bone. Bone grows in length as more cartilage (matrix & chondrocytes) is produced on the epiphyseal side and bone is laid down on the diaphyseal side of the growth plate.



(files/images/Secondary Ossification.jpg?1612176033224)UHI / CC0

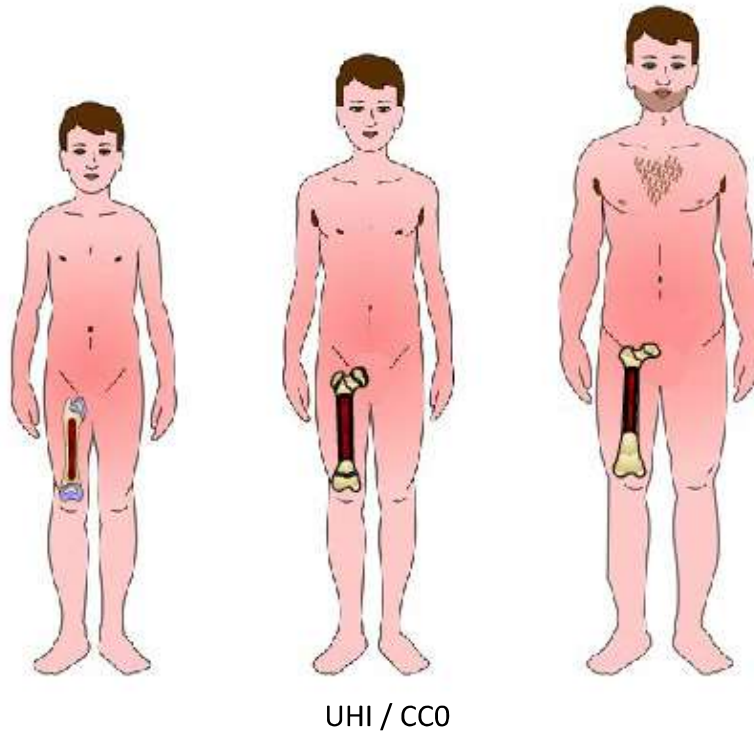
The growth plates consist of cartilage in children and young adults, but as we mature this is replaced by bone. If the epiphyseal plate is damaged during childhood by fracture or as a result of repetitive or demanding exercise, the bone may be shorter, as any damage to the cartilaginous growth plate results in the growth plate closing earlier.

Ossification continues until the early twenties when all **epiphyseal disc cartilage** is replaced by bone (**closure of the epiphyseal disc**) and the bone lengthening process stops.

### Completion of ossification

Bones begin to fuse prior to teenage years but ossification is not complete until an adult enters their twenties. Growth usually stops at approximately age 18 in females and age 21 in males. Although ossification ends, bone is a living tissue, and as such, it is constantly being broken down and rebuilt.

In adults, **cartilage** is still found in the tip of the nose, the external ear, the voice box (larynx), and in joints (knee). Cartilage is also found where the ribs are attached to the breastbone (sternum), thus allowing the rib cage to move during breathing.



## Quiz

Before you go on, have a go at this quiz to test your knowledge on ossification by putting the words to the correct areas. If you need a hint, click Reveal to see the missing word options.

### Reveal

epiphyseal growth plate

appositional growth

medullary cavity

epiphyseal

skull

Primary ossification

cartilage

bone

endochondral ossification

perichondrium

diaphyseal

interstitial growth

Intramembranous ossification