

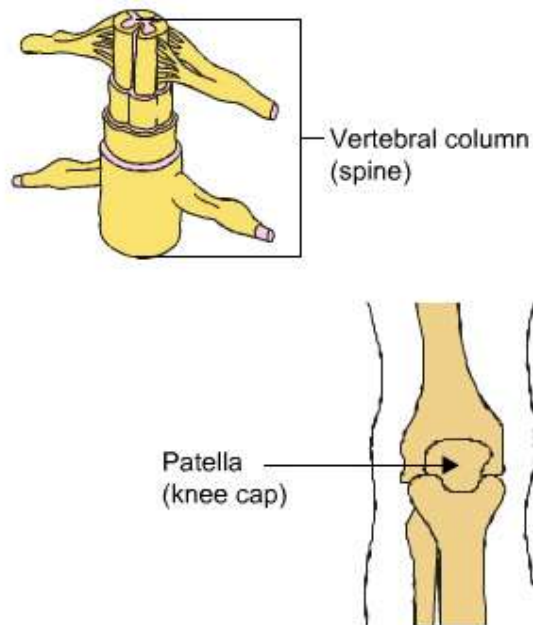
## Irregular Bones

Irregular bones are a variety of complex shapes and they may be used for leverage or have a protective or supportive function.

Examples of irregular bones include the vertebral column and the small bones of the face.

## Sesamoid bones

Sesamoid bones are bones which are embedded within tendons where pressure is great. The largest bone of this type is the patella (the knee cap).



(files/images/irregular-and-sesamoid.jpg?1611851376085)

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**Text**

Vertebral column (spine) and Patella (knee cap)

## Quiz

Have a go at identifying the classification of each type of bone.

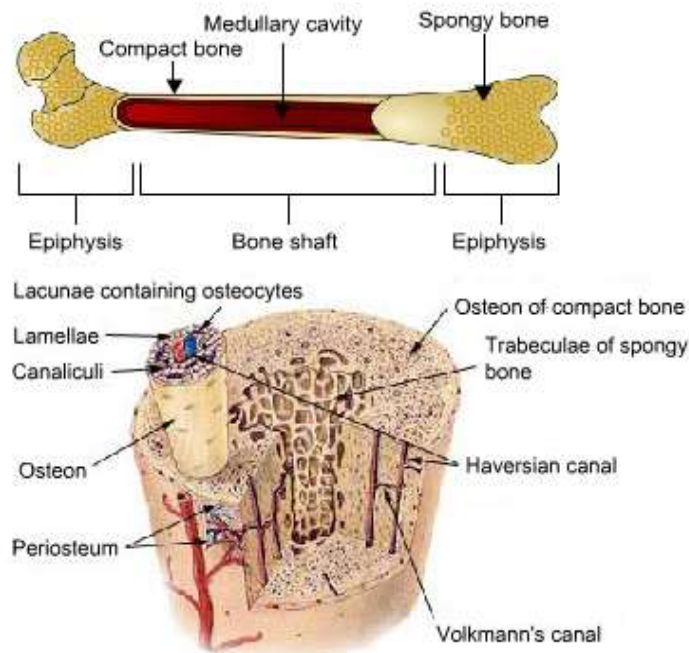
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## Microstructure of bone

Bone is a solid network of living **cells, mineral salts and protein fibres**. Bone tissue is made up of bone cells, collagen (connective tissue) and mineral salts.

Bone cells enable bone to function as a living tissue, taking in nutrients from the bloodstream and depositing waste products into the circulatory system to be removed. They also respond to hormones and regulate the amount of calcium that is deposited in, or removed from, the bone matrix.

Mineral salts such as **calcium phosphate** provide strength and protection. The proteinaceous **collagen** provides tensile strength and resilience for the skeleton.

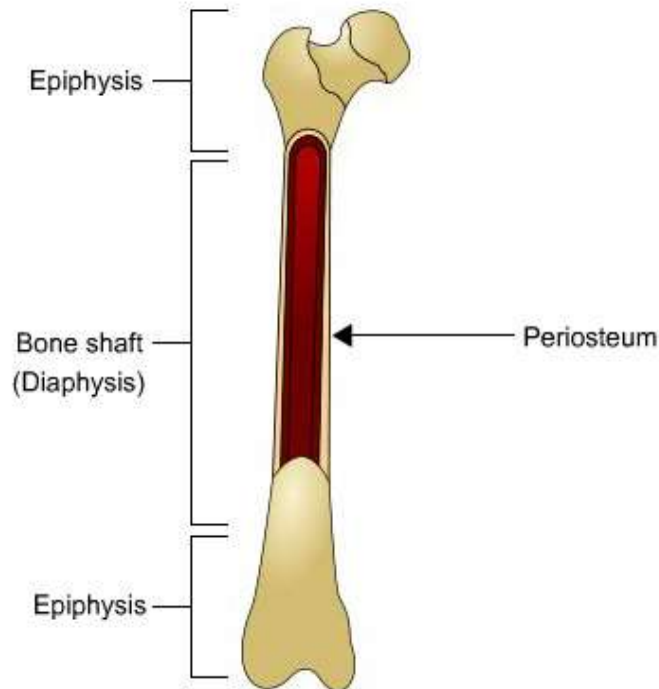


(files/images/Microstructure-of-bone.jpg?1611851614294)SEER

([https://commons.wikimedia.org/wiki/File:Illu\\_compact\\_spongy\\_bone.jpg](https://commons.wikimedia.org/wiki/File:Illu_compact_spongy_bone.jpg)) / Public domain

## Bone structure

Each bone is surrounded by **fibrous connective tissue** called the **periosteum**. This is a tough coating consisting of two dense layers of **connective tissue** containing a network of blood vessels which supply oxygen and nutrients to the bone, enabling nourishment, growth and repair. The periosteum also provides some protection and enables tendons and ligaments to attach to the bone



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### Text

Epiphysis  
 Bone shaft (Diaphysis)  
 Periosteum

## Types of bone tissue

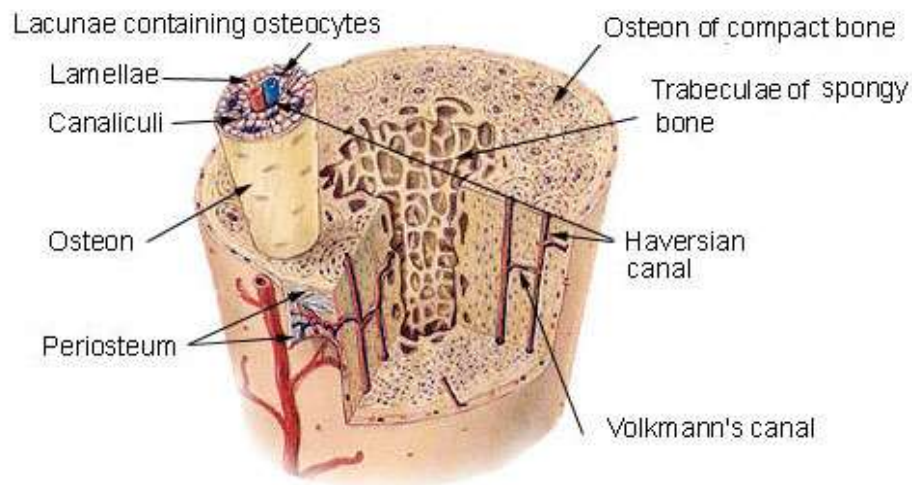
### Compact bone

Immediately inside the periosteum is a layer of **compact bone** which forms a hard shell around the outside of the bone, being thickest halfway down the shaft, gradually thinning towards the end of the bone. This provides strength and enables the bone to withstand pressure.

Compact bone tissue forms the outer layer of all bones and is also found in the **diaphyses** (shaft) of long bones. Compact bone is arranged in rings as shown in this

diagram, and blood vessels, lymphatic vessels and nerves feed bone tissue through penetrating **canaliculi**.

## Compact Bone & Spongy (Cancellous Bone)



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([https://commons.wikimedia.org/wiki/File:Illu\\_compact\\_spongy\\_bone.jpg](https://commons.wikimedia.org/wiki/File:Illu_compact_spongy_bone.jpg)) / Public domain

### Text

#### Compact and spongy (cancellous bone)

- Lacunae containing osteocytes
- Lamellae
- Canaliculi
- Osteon
- Periosteum
- Osteon of compact bone
- Trabeculae of spongy bone
- Haversian canal
- Volkmann's canal

#### Haversian systems

Compact bone is composed of structural units called **Haversian systems** or **osteons**. Each osteon unit is made up of cylinders of hard, calcified matrix (hydroxyapatite) called **lamellae**. In the middle of each cylinder is a narrow channel called a **Haversian canal** that contains blood vessels and nerves. This allows blood to be supplied to the bone tissue, providing nutrients and minerals to enable bone cell function and bone mineralization. Blood vessels run through interconnected Haversian canals creating a network that nourishes the bone. **Lacunae** are small spaces between the calcified rings containing **osteocytes**

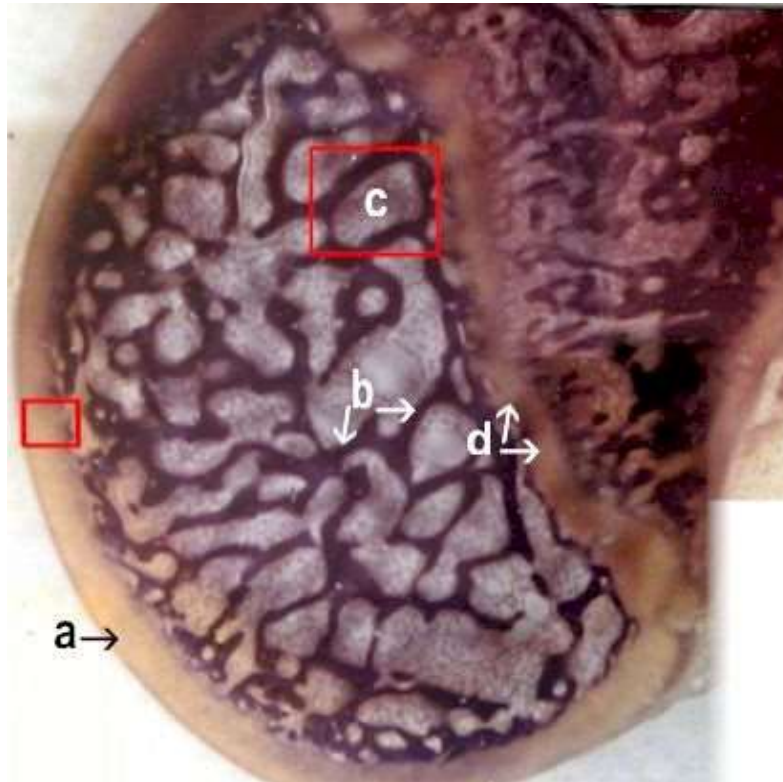
#### Cancellous (spongy) bone

Inside the layer of compact bone is **cancellous** or **spongy bone** tissue, which has the same structure as compact bone but has more spaces between bone tissue filled with blood vessels, fat, fluid and connective tissue. Spongy bone is found mostly in the centre of bones or at the **epiphyses** (ends of long bones)

underneath a thin layer of compact bone and is well suited to cope with the compression forces produced by skeletal weight-bearing.

### Key

- a. Compact bone
- b. Cancellous bone
- c. Red marrow cavity
- d. Epiphiseal plate



(files/images/trabeculae of spongy bone.jpg?1611852180159)aplabs  
(<http://aplabs.org/epiphyss/epiphyss.html>)\*

\*Image used under copyright exception [teaching] (<https://www.gov.uk/guidance/exceptions-to-copyright#teachingcopyright%20exception:%20teaching>).

### Quiz

Before you go on, have a go at labelling this diagram which illustrates bone structure by dragging the terms to the correct areas highlighted.

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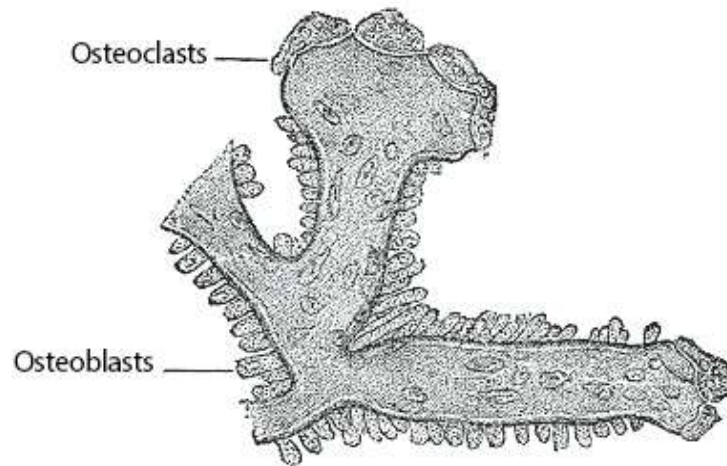
### Types of bone cell

**Osteocytes** are mature bone cells which maintain bone tissue through the exchange of nutrients and waste. They are derived from osteoblasts and are embedded in compact and spongy bone.

**Osteoblasts** are bone cells that lay down bone minerals. They make collagen and hydroxyapatite (mineral matrix).

**Osteoclasts** are bone cells that resorb bone minerals, reducing the amount of calcium and other minerals and salts in bone tissue. They also make **collagenase** and secrete acids which dissolve hydroxyapatite structure.

Osteoblasts and osteoclasts balance bone tissue being built up or broken down, controlled by calcitonin, parathyroid hormone and calcitriol.



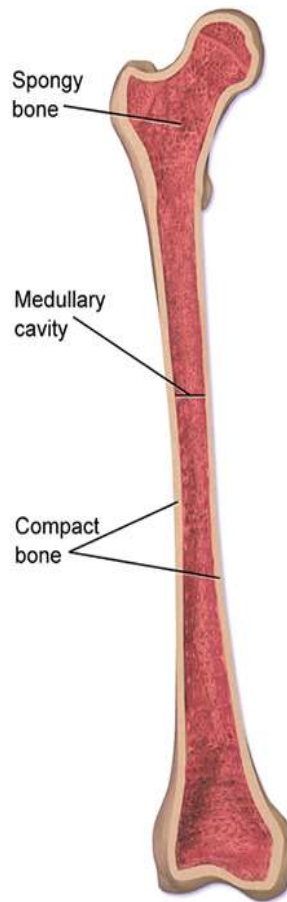
(files/images/osteoclasts and blasts.jpg?1612172254331)Henry Vandyke Carter  
(<https://commons.wikimedia.org/wiki/File:Gray81.png>) / Public domain

## The medullary cavity and bone marrow

Inside spongy bone and in the middle of long bone shafts (diaphyses) is the **medullary cavity** which contains **bone marrow**. It is also called the marrow cavity. There are 2 types of bone marrow in most bones.

**Yellow bone marrow** is found in most bones in the medullary cavity, usually filling the shafts of long bones. It is made up of blood vessels, nerve cells and fat cells (adipose tissue) and can be converted to red bone marrow and produce blood cells if severe blood loss occurs.

**Red bone marrow** is found mostly in spongy bones and the end of long bones. It produces red blood cells (erythrocytes), white blood cells (lymphocytes) and platelets.



(files/images/medullary cavity.png?1612172432900)Gallery of Blausen Medical 2014  
([https://commons.wikimedia.org/wiki/File:Structure\\_of\\_a\\_Long\\_Bone.png](https://commons.wikimedia.org/wiki/File:Structure_of_a_Long_Bone.png))/ CC BY 3.0  
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### Text

Spongy bone  
Medullary cavity  
Compact bone

## Quiz

Before you go on, have a go at completing this paragraph to test your knowledge of bone structure. If you need a hint, click Reveal to see the missing word options.

### Reveal

compact

Compact

spongy

oestron

Haversian Systems