

What Is Bone Made Of?

Bone is made mostly of [collagen](#), a [protein](#) that is woven into a flexible framework. Bone also contains calcium [phosphate](#) and [calcium carbonate](#), minerals that add strength and harden the framework. The combination of calcium and collagen gives the bone its strength and flexibility. The flexibility (or ability to withstand [stress](#)) of the bone protects it from breaking. Bone is strong because of calcium, but bone also acts like a storehouse for calcium. In fact, more than 99% of the body's calcium is contained in the bones and teeth. The remaining 1% is in the blood.

Even though it is mostly made of protein and minerals, bone is living, growing tissue. Throughout a person's lifetime, old bone is broken down (a process called resorption) and new bone is added to the [skeleton](#) (formation). When more bone is broken down than is added to the skeleton, bone loss occurs.

Basic Structure of an adult long bone:

A typical long bone of adult human beings consists of the following important parts.

Shaft (Diaphysis):

It is the long middle part of an adult human long bone. It is composed of periosteum, cortex and a medullary cavity from outside to inside.

Periosteum is thick fibrous membrane covering the surface of the bone. The periosteum is composed of two layers; an outer fibrous layer and an inner osteogenic (bone producing) cellular layer. This attachment of bone and the periosteum is specifically strong over the attachments of tendons and ligaments.

The cortex is actually the compact part of the long bone. The strength of the bone which makes it capable to withstand all the stresses is mainly due to this cortex. In the cortex the ratio of bone substance to bone spaces is a large quantity.

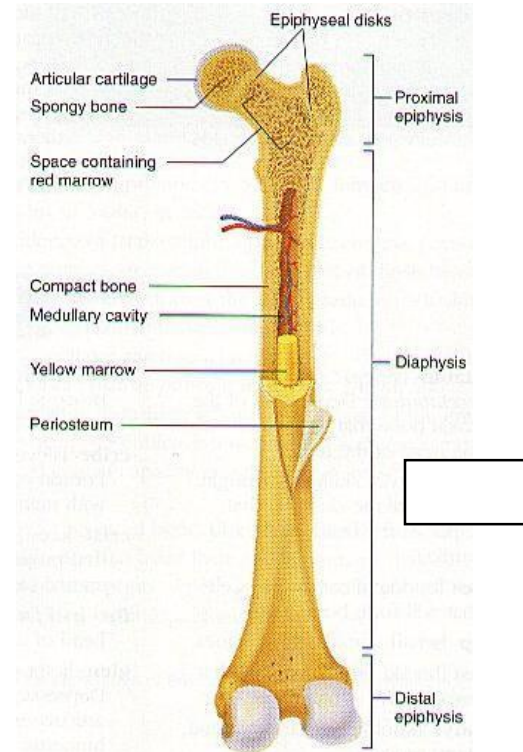
The medullary cavity is the central portion of a long bone that is filled with red or yellow bone marrow. At the time of birth the bone marrow is red everywhere and hemopoiesis is very active in this marrow but as a person gets older, the red marrow is replaced by yellow marrow that is fatty in nature and has no power of hemopoiesis (Blood cell production). At this level of age the red marrow persists only at the cancellous (spongy) ends of a long bone. In cases of severe blood loss, the body can convert yellow marrow back to red marrow to increase blood cell production. Although the primary function of yellow bone marrow is to store fat which the body consumes as a last resort in cases of extreme starvation.

Ends (Epiphysis):

Spongy (cancellous) bone makes up short, flat, and irregularly shaped bones. It also forms the ends (epiphysis) of long bones. Its structural units are called trabeculae "little beams" and within the spaces of these irregular frameworks of columns are found red bone marrow – the sites of blood cell production.

The spongy appearance is due to these trabeculae. It serves to lighten the weight of the bone.

The ends of long bone are actually not compact as the shaft. They are made up of spongy (cancellous) bone. In cancellous bone the bone substance to bone spaces ratio is a smaller quantity. This means that there is little bony tissue and more empty spaces in this portion of the bone.

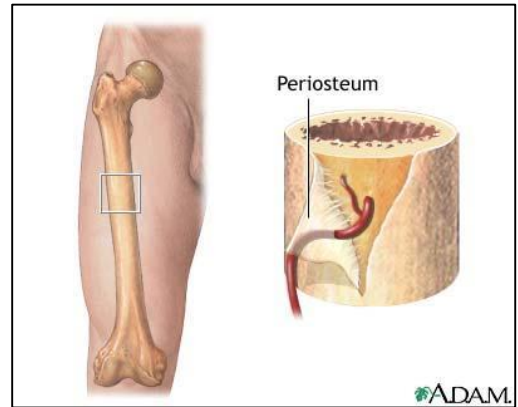


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Although bone is not an actively growing tissue in adults, it does need a constant blood supply to stay alive. In fact, the supply of blood to long bones is profuse and derived from a number of sources that are explained with detail in the lines below.

Blood supply of bones

Bone has a rich vascular supply, receiving 10-20% of the cardiac output. The blood supply varies with different types of bones, but blood vessels are especially rich in areas that contain red bone marrow. The Nutrient artery is the principal artery and major supplier of oxygen and nutrients to the shaft of the bone.



Nerve Supply of Bone

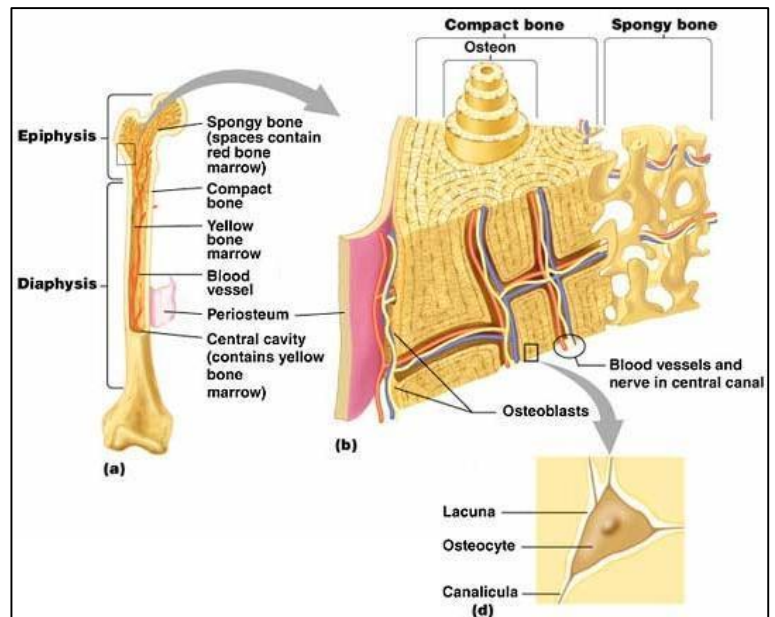
As with all other living tissues, the bone is innervated by peripheral nerves so that it can coordinate with the central nervous system. The important part of this coordination is formed by the sensory signals coming from the bones. The brain reads these signals and make necessary changes to avoid any damage to bones and other body tissues.

Nerves are most rich in the articular extremities of the long bones, vertebrae, and larger flat bones. Many nerve fibers accompany the blood vessels to the interior of the bones.

The periosteal nerves (nerves of the periosteum) are sensory nerves, some of which are [pain](#) fibers.

Therefore, the periosteum is especially sensitive to [tearing](#) or tension.

Accompanying the arteries inside the bones are vasomotor nerves, which control vascular constriction and dilation.



Questions

1. Describe the composition of bone. What makes it strong and flexible?

