

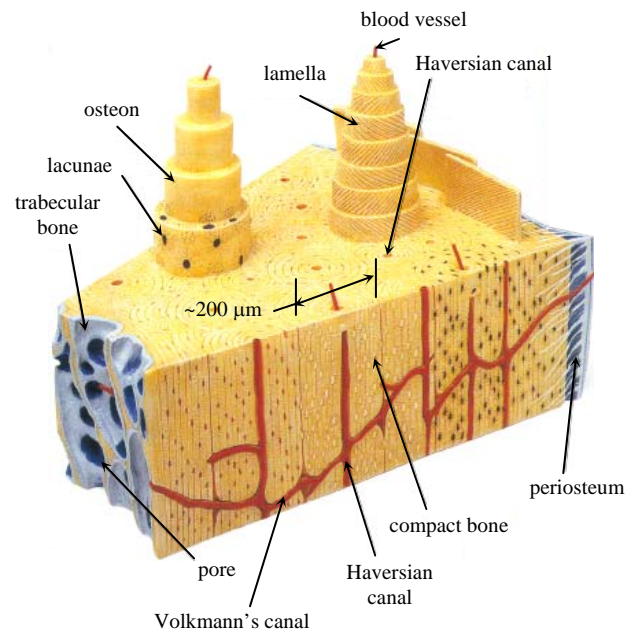
## ESc 22 MECHANICS 2: MATERIAL SCIENCE

### LAB 10: OBSERVING THE MICROSTRUCTURE OF CORTICAL BONE

#### INTRODUCTION

Cortical or compact bone is the dense tissue comprising the midshafts of the long bones of mammalian skeletons. It is distinguished by its low porosity from the trabecular bone of the interiors of long bone ends and vertebral bodies of the spine. In humans and most other larger mammals, cortical bone undergoes internal remodeling, in part, to repair microfractures. The remnant of this remodeling activity, the osteon, is the basic structural unit of secondary cortical bone and is approximately 200  $\mu\text{m}$  in diameter (Figure 1), secondary in that it has supplanted previously existing bone. Each osteon is surrounded by a weak interfacial layer (the cement line) which acts to arrest and deflect cracks.

Through the center of each osteon is a Haversian canal, which are interconnected via transverse Volkmann's canals. These canals and resorption spaces (osteons that have yet to fill with bone tissue) comprise the porosity of osteonal bone. Independent of porosity is the degree of mineralization, as a region of bone can be occupied by mass other than mineral and still not be porous there. Generally, older tissue is more mineralized. However, subtle changes in porosity and/or mineralization have a profound effect on the mechanical properties of bone: a 10% increase in mineralization or a 10% decrease in porosity can increase stiffness more than 50%.



**Figure 1.** Microstructure of osteonal bone, the mature bone of most mammalian long bone midshafts. Image adapted from: Parker S. Human body. New York: Dorling Kindersley 2000.

#### PROCEDURE

A slide will be mounted on the microscope stage. This slide contains a transverse section through the third metacarpus of a horse. This bone is found in the palm of your own hand in line with your middle finger. Simply observe the bone section at various magnifications and in a few locations. Make a few sketches in your lab notebook. Determine which side of the section is the periosteal surface (i.e., the outside of the bone) and how you determined this (see Figure 1). Note any variations in osteon size or packing density. Note any irregularity in the packing or if other types (non-osteonal) of cortical bone are present.