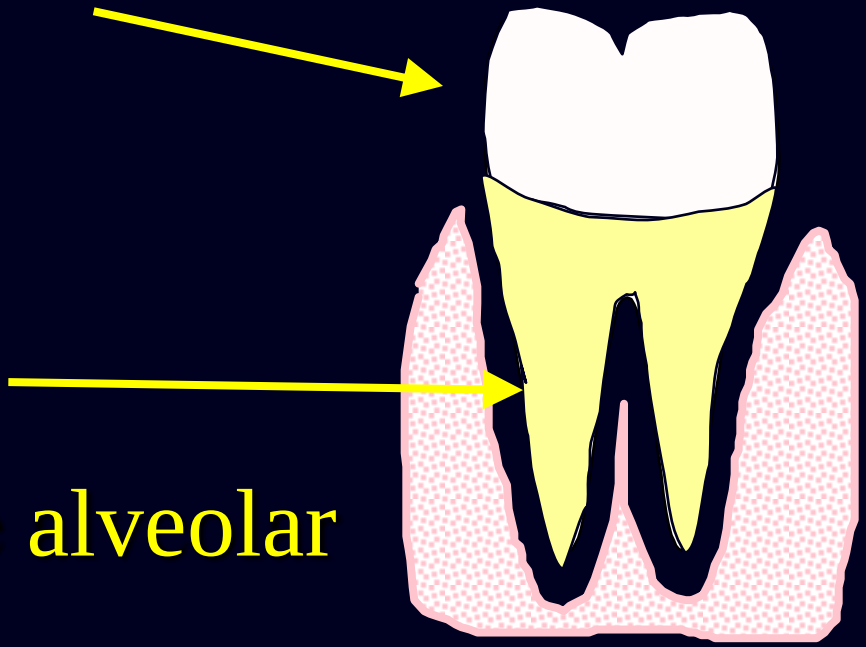
DENTAL BIOCHEMISTRY

Dental Anatomy

a. Anatomical crown- portion of tooth covered with enamel

b- Root

Part of tooth embedded in the alveolar process and covered by cementum.



Tooth Structure

Two main regions-crown and the root.

a- **Crown-** exposed part of the tooth above the gingiva (gum)

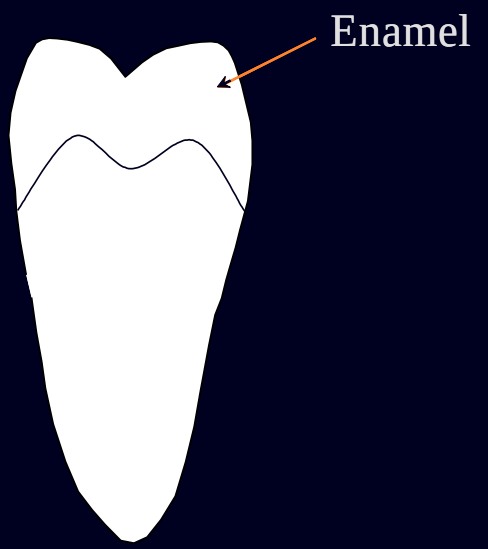
Enamel- acellular, brittle material composed of calcium salts and hydroxyapatite crystals is the hardest substance in the body

Enamel encapsules the crown of the tooth.

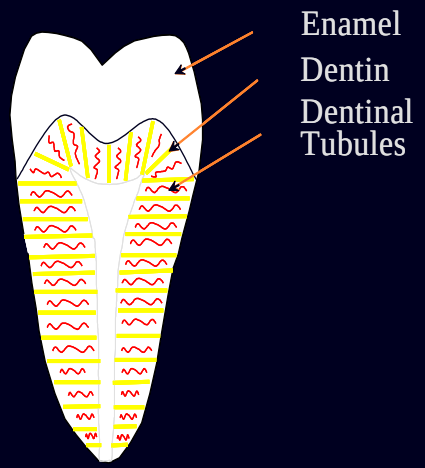
b- **Root-**portion of the tooth embedded in the jawbone

Tooth Structure

a. Enamel
   (1) Makes up anatomic crown.
   (2) Hardest material in the human body.
   (3) Incapable of remodeling and repair.



Tooth Structure



b. Dentin

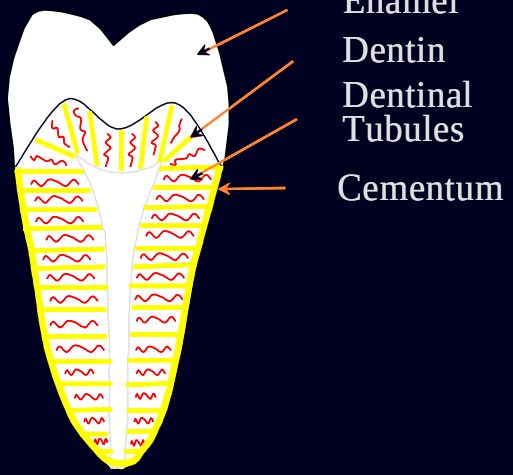
(1) Makes up bulk of tooth.

(2) Covered by enamel on crown and cementum on the root.

(3) Not as hard as enamel.

(4) Exposed dentin is often sensitive to cold, hot, air, and touch (via dentinal tubules).

Tooth Structure



c. Cementum

(1) Covers root of tooth.

(2) Overlies the dentin and joins the enamel at the cemento-enamel junction (CEJ).

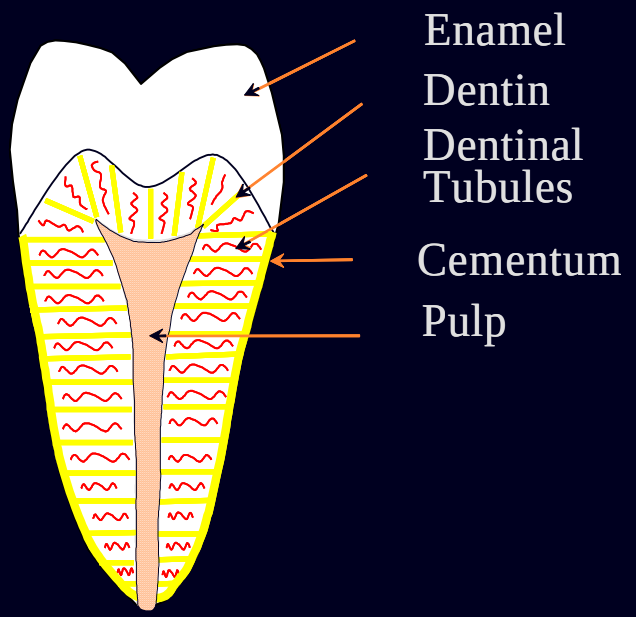
(3) Primary function is to anchor the tooth to the bony socket with attachment fibers.

Tooth Structure

d. Pulp

(1) Made up of blood vessels and nerves entering through the apical foramen.

(2) Contains connective tissue, which aids interchange between pulp and dentin.



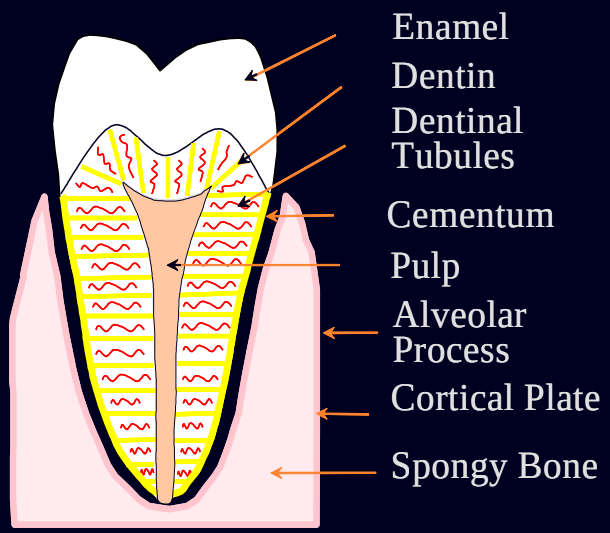
Dental Anatomy

4. Periodontium

a. Alveolar process.

(1) Bone extensions of the maxillae and mandible that supports the teeth.

(2) Cortical plate is the dense outer layer of bone covering the spongy (cancellous) bone



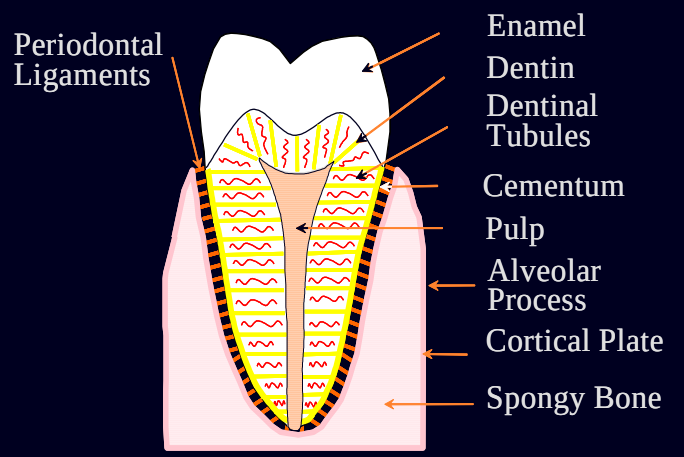
Dental Anatomy

b. Periodontal ligaments.

(1) Dense connective fibrous tissues that connect teeth to the alveolar bone.

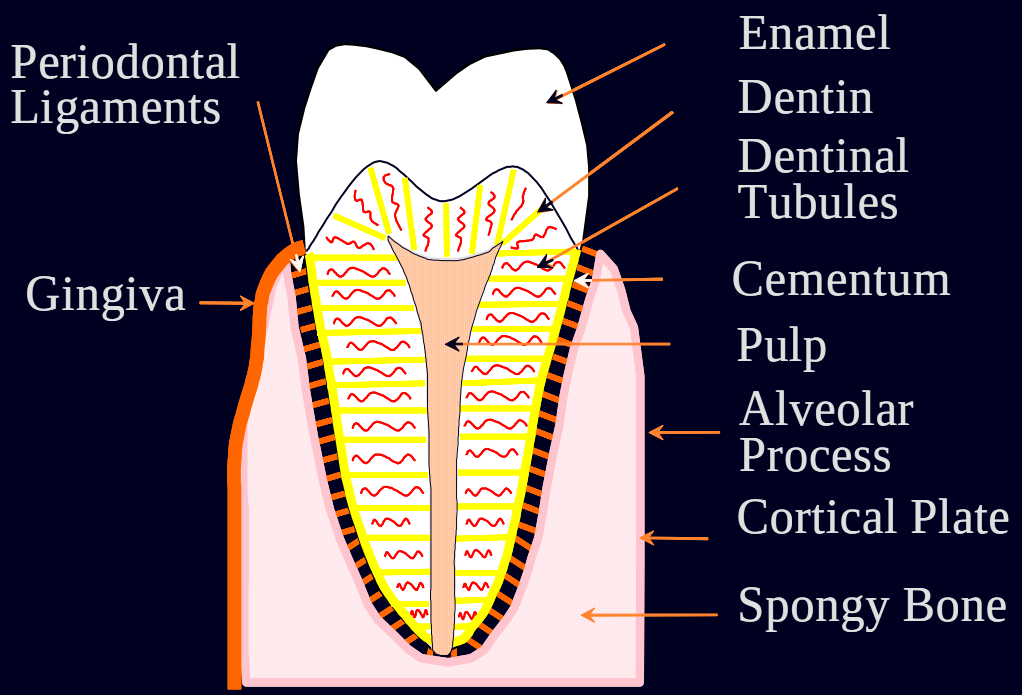
(2) One end is embedded in cementum and other end in bone.

(3) Supports and protects the tooth from normal shock.



Dental Anatomy

c. Gingiva - surrounds the teeth and covers the alveolar process.



Tooth and Gum Disease

- **Dental caries- gradual demineralization of enamel and dentin by bacterial action**
  - Dental plaque, a film of sugar, bacteria, and mouth debris, adheres to teeth.
  - Acid produced by the bacteria in the plaque dissolves calcium salts.
  - Without these salts, organic matter is digested by proteolytic enzymes.
  - Daily flossing and brushing help prevent caries by removing forming plaque.

Tooth and Gum Disease: Periodontitis

- **Gingivitis** – as plaque accumulates, it calcifies and forms calculus, or tartar
- **Accumulation of calculus**:
  - Disrupts the seal between the gingivae and the teeth
  - Puts the gums at risk for infection
- **Periodontitis** – serious gum disease resulting from an immune response
- **Immune system** attacks intruders as well as body tissues, carving pockets around the teeth and dissolving bone

Proposed Mechanism of Action of Fluoride

- Increases enamel resistance to acid demineralization
- Increases rate of enamel maturation after eruption.
- Remineralization of incipient lesions
  - At the enamel surface.
  - >1 ppm fluoride needed to slow demineralization process
- Interference with microorganisms
- Improved tooth morphology

Tooth Decay Process

- Bacteria in mouth convert sugars to polysaccharides
- Plaque = coating of bacteria + polysaccharides
- Other bacteria convert the carbohydrates in the plaque to carboxylic acids such as lactic acid
- Tartar = plaque that combines with Ca_2^+ and PO_4^{2-} ions in saliva to form a hard yellow solid

How Does Dental Caries Begin?

- Formation of acid by microorganisms in plaque overlay the enamel
- Requires the simultaneous presence of three factors
- 1- microorganisms,
- 2- a diet for the microorganisms
- 3- a susceptible host or tooth surface
- It 1, 2 and 3 are absent no caries develop

Demineralization and Remineralization

- **Caries dissolution of enamel**
  - Cyclic phenomenon with phases of demineralization and reprecipitation.
  - Determines by changes in pH and ionic concentrations within the plaque and the lesion.

Remineralization

- Remineralization: deposition of calcium, phosphate, and other ions into areas of previously demineralized by caries or other causes.
- Porous or slightly demineralized enamel has a greater capacity to acquire flouride than adjacent sound enamel (3-5x more)
- Greater capacity of demineralized enamel to absorb fluoride. = ↓ enamel dissolution.

Biochemical Basis

- Enamel exposed to pH of $\leq$ 5.5 = enamel dissolution:

- **$Ca_{10}(PO_4)_6(OH)_2 + 8H^+ \longrightarrow 10\ Ca^{++} + 6HPO^{2-}_4 + 2H_2O$**
- **Hydroxyapataite** **Dissolved ions**
- **(Solid)**

Protection of enamel by fluoride

- Fluoride exposure reduces enamel solubility when fluoroapatite is formed

- $Ca_{10}(PO_4)_6(OH)_2 + 2F^- \longrightarrow Ca_{10}(PO_4)_6F_2 + 2OH$

  Hydroxyapatatite (Solid) → **Fluoroapatatite (Solid)**

- $Ca_{10}(PO_4)_6F_2 + 2H^+$ — **No reaction**