



STRUCTURAL BIOLOGY OF TOOTH

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Course Purpose

The aim of this course is

- to understand tooth structure
- to investigate morphology of tooth under microscopic and submicroscopic level
- to explain importance of this structure for physiological and functional activities of tooth.

Weekly contents

- Embryology (cellular activities-proliferation)
- Embryology (histogenesis: amelogenesis)
- Embryology (histogenesis: dentinogenesis)
- Enamel (anatomy- histology)
- Enamel (biochemistry-physical properties)
- Dentin (anatomy- histology)
- Enamel-dentin physiology
- Cement
- Changes due to aging on enamel-dentin-cement
- Primary teeth (anatomy-histology)
- Primary teeth (biochemistry-physical properties)
- Pathology on tooth hard tissue (developmental disease)
- Pathology on tooth hard tissue (developmental disease)



Paul S. Casamassimo, Henry W. Fields, Dennis J. McTigue,
Arthur J. Nowak

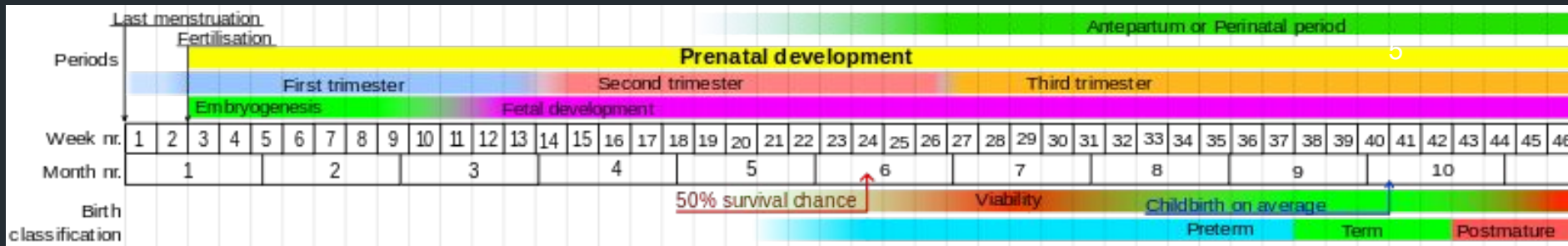
Pediatric Dentistry Infancy through Adolescence (5 ed)

Part 2

Chapter 12 The Dynamic of Change (Arthur J. Nowak)

A. R. Ten Cate

Oral Histology; Development, Structure and Function (3 ed)

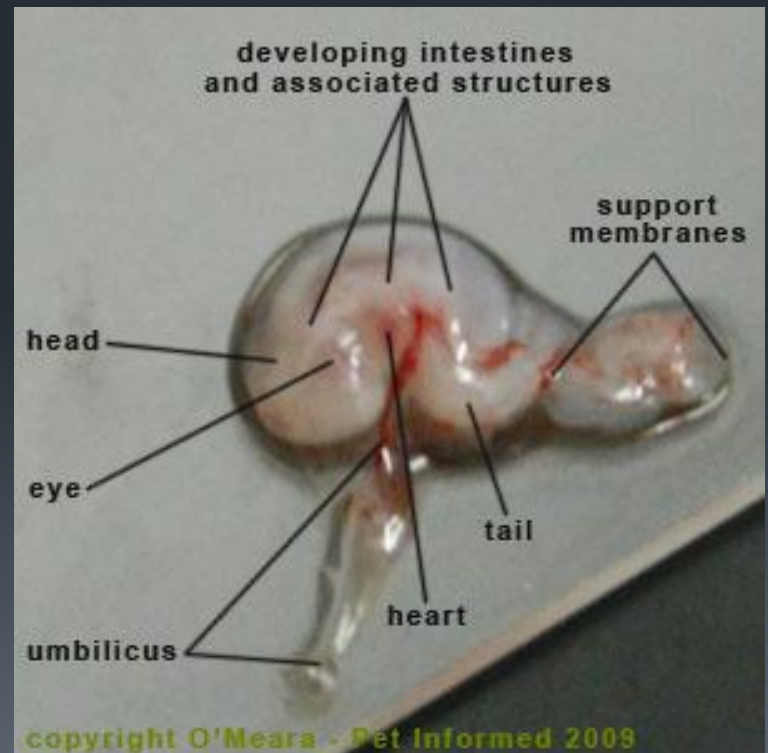


- Prenatal development is divided into three successive phases.
- The first two phases when combined constitute the embryonic stage of development, and third is the fetal stage of development; the forming individual is described as an **embryo** or **fetus**, depending on its developmental stage.



- The first phase begins at fertilization and spans the **first 4 weeks**. It involves largely **cellular proliferation** and **migration** with some differentiation of cell populations.
- **Few congenital defects** results from this period of development.

Third-week embryo- 3 mm



- The second phase spans the **next 4 weeks** of development and is largely characterized by the **differentiation of all major external and internal structures (morphogenesis)**.
- **Many congenital defects** results from this period of development.



A six-week embryonic age intact human embryo-4mm



- From the end of the second phase to term (at the beginning of the ninth week), further development is largely a matter of growth and maturation, **the embryo is now called a fetus.**



Approximately 12 weeks after fertilization

Carnegie Stages of Human Development

Dr Mark Hill, Cell Biology Lab, School of Medical Sciences (Anatomy), UNSW



Stage 1 Zygote
(1 day, not to scale)

1
(1 day)

2
(3 days)

3
(4 days)

7
(15-17 days)

8
(17-19 days)

9
(19-21 days)

10
(21-23 days)

11
(23-26 days)

12
(26-30 days)

13
(28-32 days)



14
(31-35 days)



15
(35-38 days)



16
(37-42 days)



17
(42-44 days)



18
(44-48 days)



19
(48-51 days)



20
(51-53 days)



21
(53-54 days)



22
(54-58 days)



23
(56-60 days)

5 mm

Acknowledgements

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Primitive Mouth = STOMODEUM

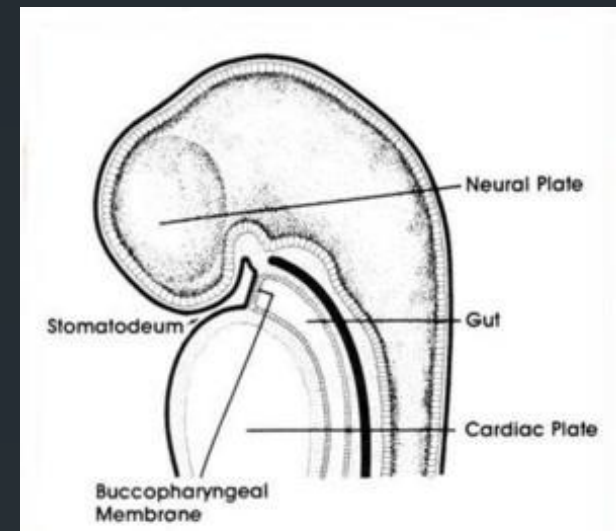
FORMS: during 3rd week

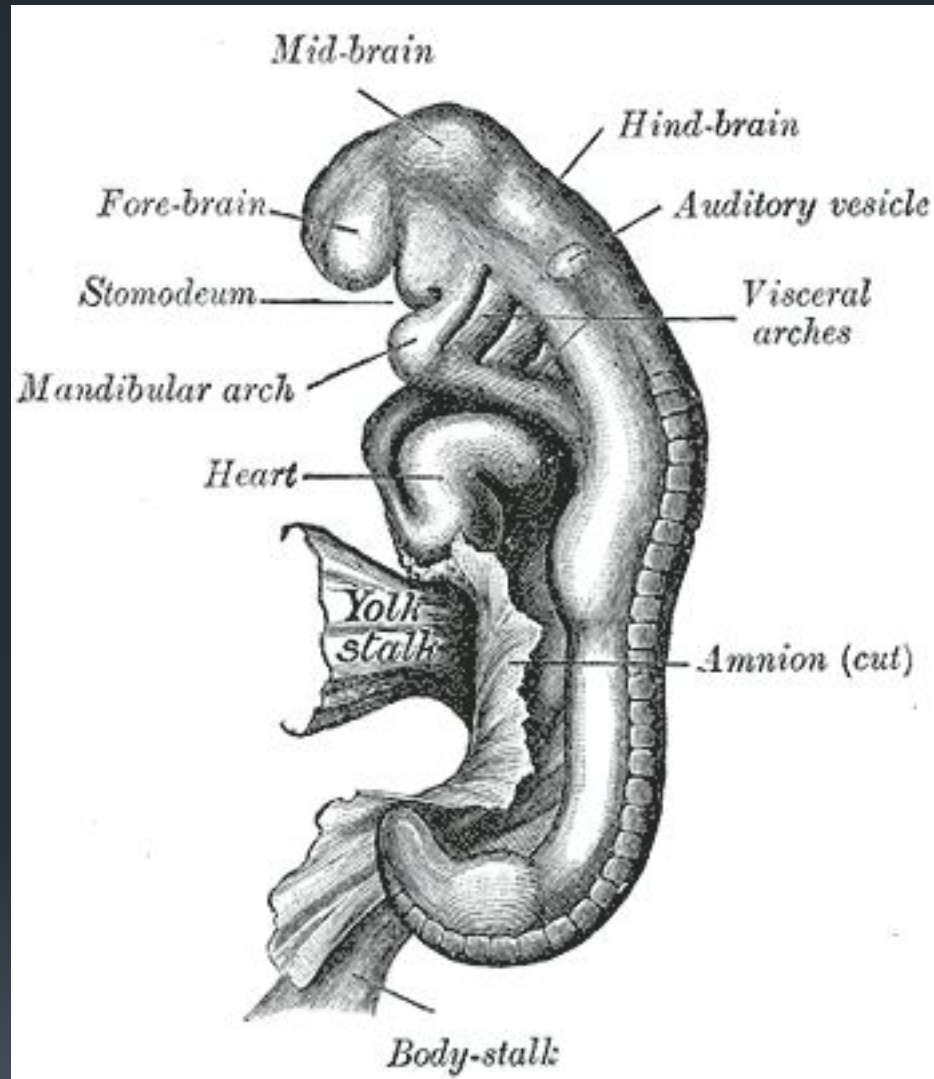
The **stomodeum** is a depression between the brain and the pericardium in an embryo, and is the precursor of the mouth.

The stomodeum is lined by ectoderm.

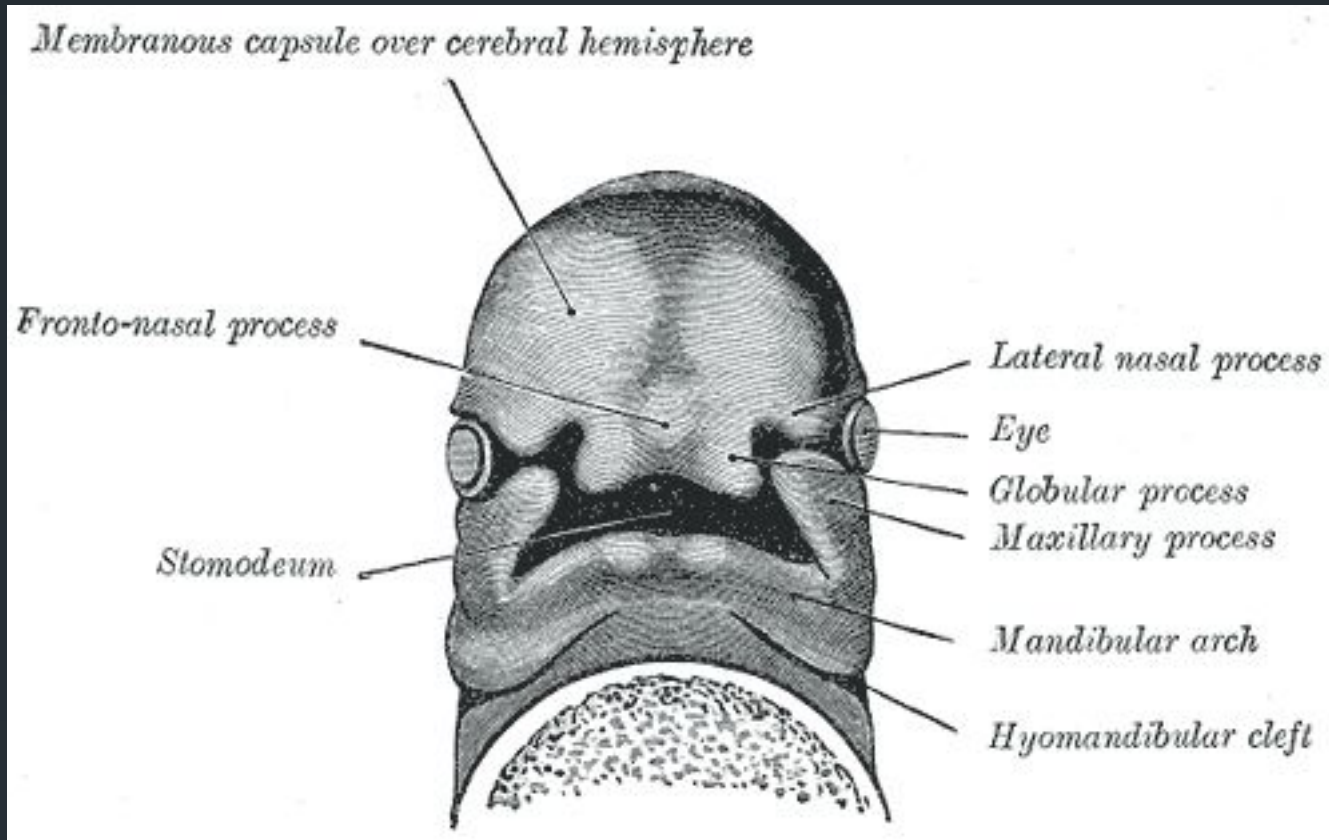
The oral cavity of the embryo is bounded by the frontonasal process and the maxillary and mandibular processes of the first branchial arch.

The branchial apparatus is first seen at approximately the **third week of** intrauterine life.

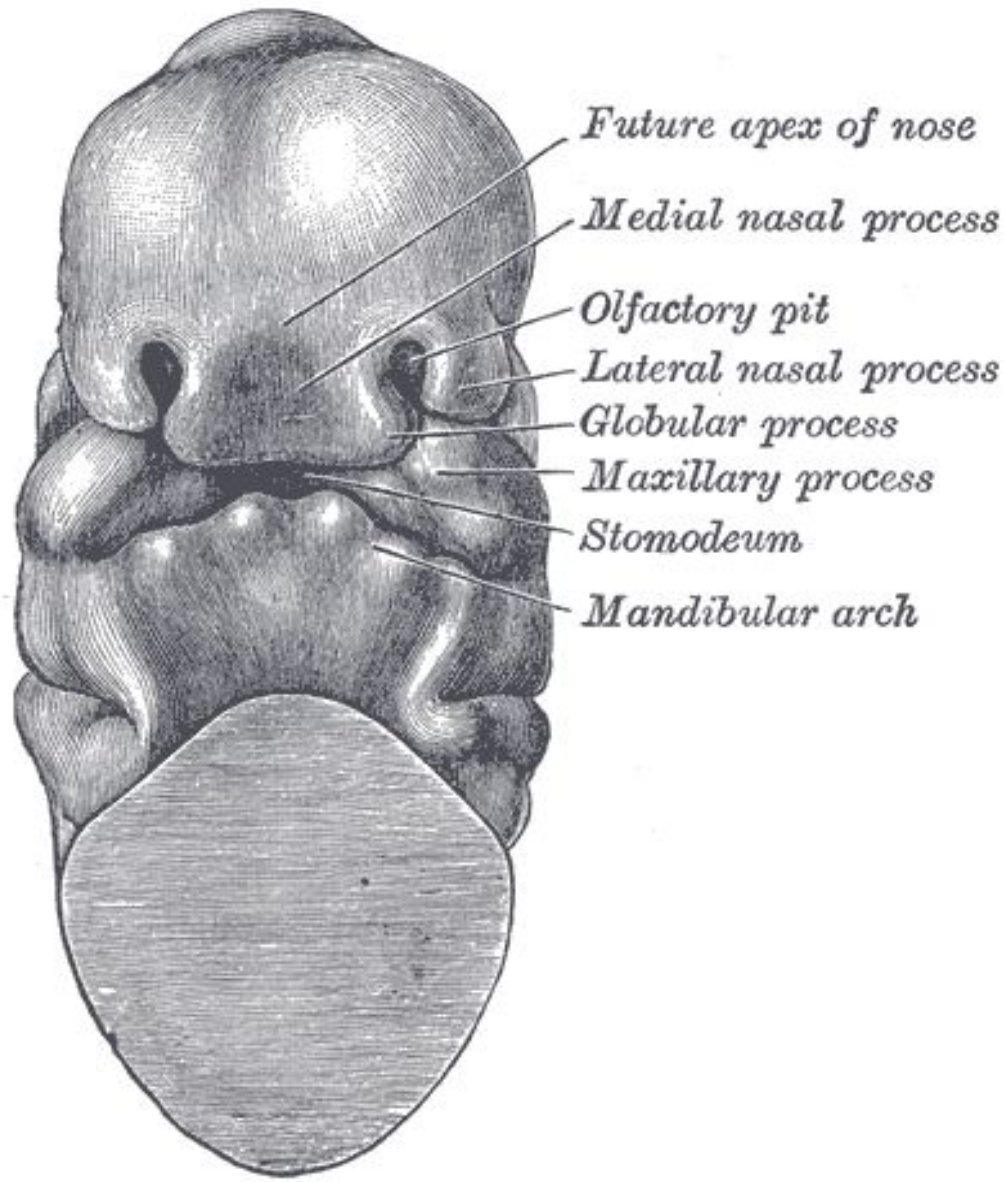




Embryo between eighteen and twenty-one days



Under surface of the head of a human embryo about twenty-nine days old



Development of Branchial
(Pharyngeal) arches and
the primitive mouth

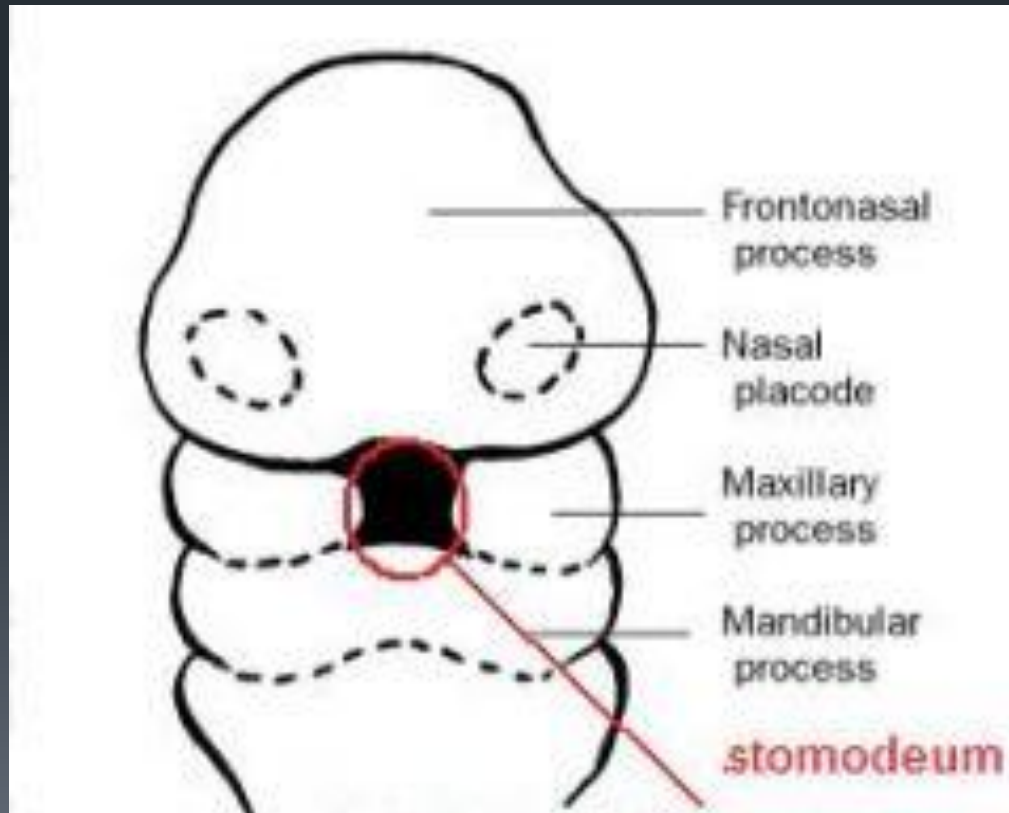
- The lips, teeth, and gums are formed from the walls of the **stomodeum**, but the tongue is developed in the floor of the **pharynx**.

- The presomite stage of development (21 to 31 days), during which the **3 mm** embryo develops at its cranial end five mesenchymal elevations constitute the initial features of the face.

The five mesenchymal elevations;

- The frontonasal process
- Two maxillary processes
- Two mandibular arches

Contour the features of the face

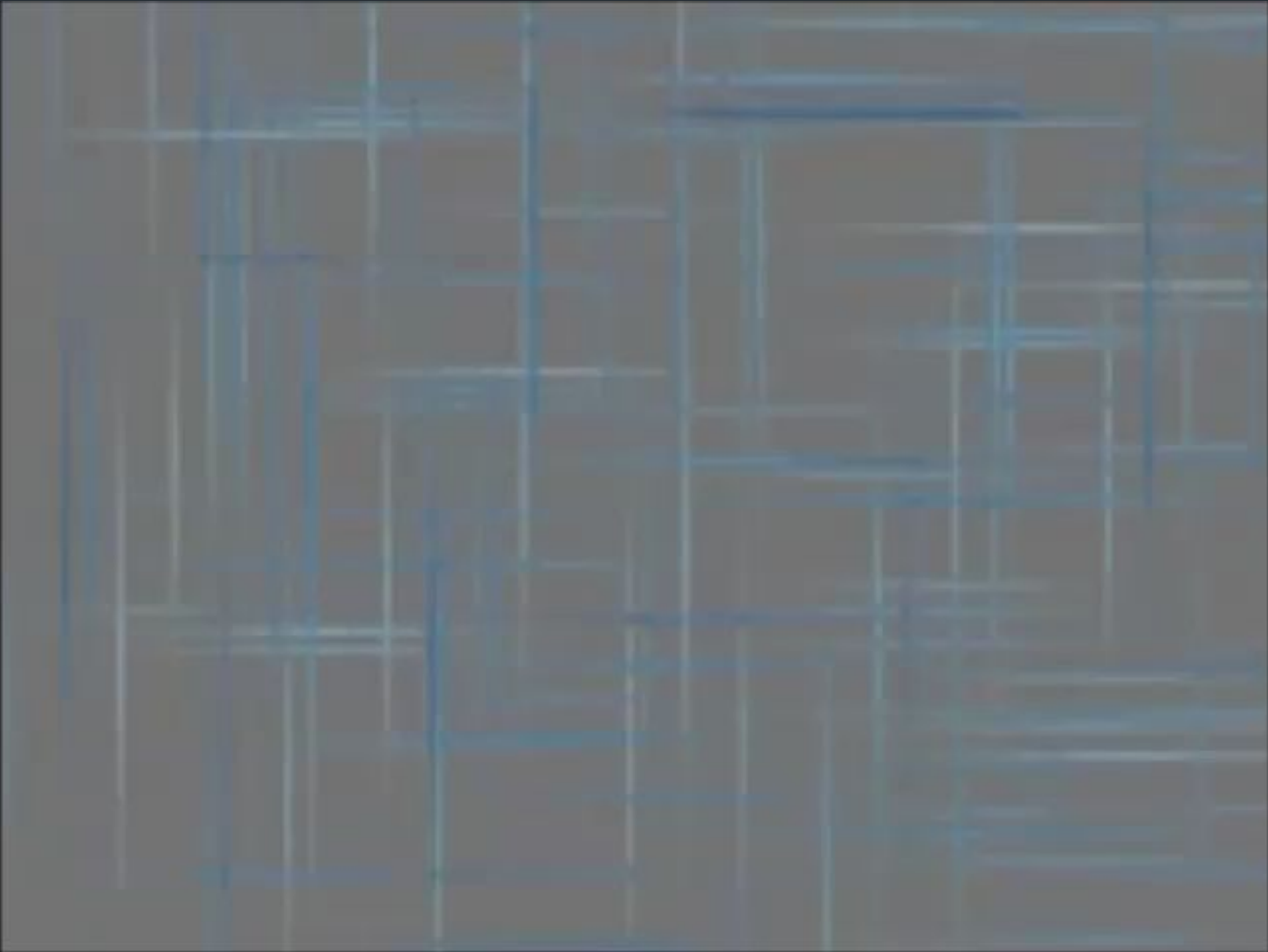




The face develops during the short span from the 4th - 7th prenatal weeks. Environmental factors can cause facial or pharyngeal arch defects, which would probably affect these tissues before the 4th week. This is the time to be careful of irradiation and chemical, hormonal, dietary or stress related factors.

- The mandibular processes fuse at the midline before the maxillary and nasal process.
- In the mandible, the cartilaginous skeleton of the first branchial arch, known as Meckel cartilage, provides a form for the development of the mandible.

- At approximately 60 days of gestation, the embryo has acquired all its **basic morphologic characteristics** and enters the **fetal period**, which is marked by **osseous development**.



- The maxilla also develop from a center of ossification in the mesenchyme of the first arch, in contrast to the mandible, however, the center is in the maxillary process.
- **No arch cartilage** or **primary cartilage** exists in the maxillary process.

- Each maxillary process moves toward the midline and joins with the lateral nasal fold of the frontonasal process.
- The palatal fusion is completed by the eighth intrauterine week.

Development of the Maxilla

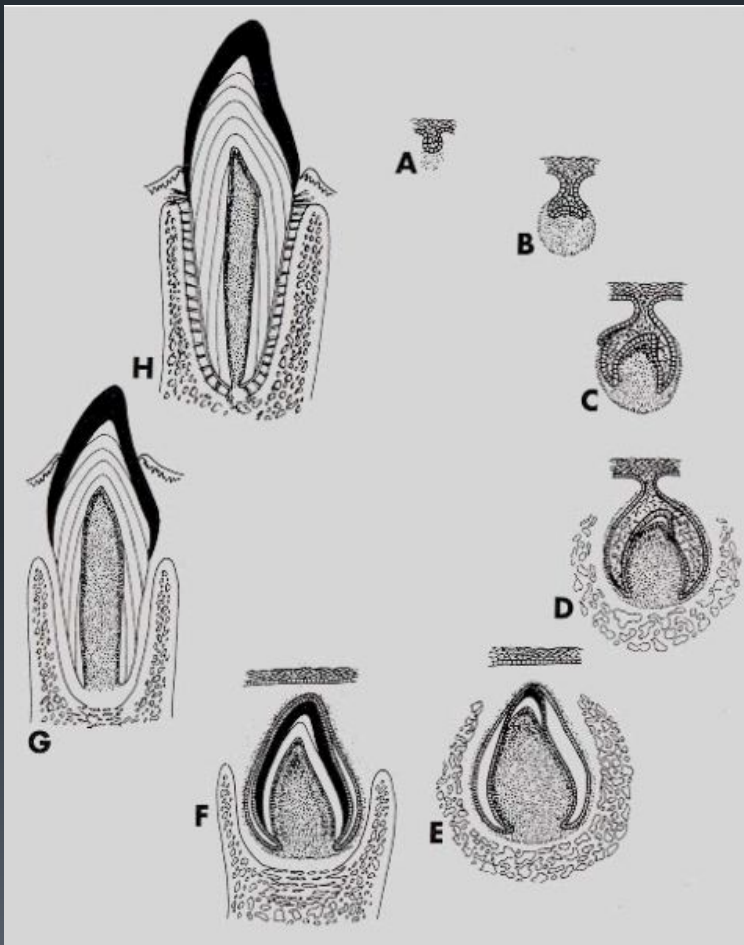
- The mandible grows at a **greater** pace and equals the size of the maxilla by 11 weeks in utero.
- Between the thirteenth and twentieth weeks in utero, mandibular growth again lags relative to the maxilla.
- At birth, the mandible tends to be **retrognathic** to the maxilla.

- Unlike the embryonic period, during the **fetal period** the size of the **maxilla** relative to the mandible varies **widely**.
- Throughout the **embryonic stage**, the **mandible** is considerably **larger** than the maxilla.



NEXT WEEK Tooth Development

▪ Embryology (cellular activities-proliferation)



A. Bud Stage
B. Cap Stage
C. Bell Stage