

MINISTRY OF HEALTH OF UKRAINE  
ODESA NATIONAL MEDICAL UNIVERSITY

Faculty of **Medicine**

Department of **Histology, Cytology, Embryology and Pathological Morphology**  
with a course in **Forensic Medicine**



APPROVED

Visor for scientific and pedagogical work

Eduard BURYACHKIVSKY

September 4, 2023

METHODOLOGICAL RECOMMENDATION  
FOR PRACTICAL CLASSES  
FROM EDUCATIONAL DISCIPLINE

Faculty of Medicine, course 2

Educational selective discipline - "THE BASICS OF GENERAL MEDICAL  
EMBRYOLOGY "

**Approved:**

At the meeting of the Department of Histology, Cytology, Embryology and  
Pathological Morphology with the course of Forensic Medicine of Odesa National  
Medical University

Protocol No. 1 of September 1, 2023

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## Seminar lesson No. 1

**Topic:** Progenesis. Features of the development of male germ cells.

**Purpose:** to give students the concept of embryology as a science, to understand the basic principles of embryogenesis, progenesis, to form an idea about the origin of male germ cells, general features and peculiarities of their development and differentiation in the gonads, which can be used for diagnosis, treatment and prevention of various disorders of spermatogenesis. Knowledge of embryogenesis will be of great help to the doctor when he is forced to analyze the causes and mechanism of spermatogenesis disorders, the causes of infertility.

### Basic concepts:

**Embryology** is a science that studies the patterns of embryo formation and the processes of its development.

**Ontogeny** is the individual development of an organism, which begins from the moment of formation of a single-celled embryo and continues until death.

**Prenatal period** - from conception to birth.

**Postnatal period** - from birth to death.

**Progenesis** (gametogenesis) is the process of formation of mature germ cells

**Spermatogenesis** is the process of formation of spermatozoa in the tortuous seminiferous tubules of the testis.

**Spermatozoa.** The head can be different in shape (depending on the type of animal) - from round to oval-spindle-shaped. The main component of the head is a cell nucleus with a haploid set of condensed chromosomes. The density of chromosome packing is so great that the volume of the nucleus is 30 times smaller than that of haploid cells formed immediately after meiosis. This is achieved due to the fact that the main nuclear proteins are not histones, but other main proteins rich in arginine and cysteine. In this condensed state, the genetic material is more protected from damage during the passage of the sperm through the ovum. Nucleosomal organization of chromatin is either completely absent or (according to other data) has very significant features. In front, a large part of the nucleus, like a double cap, is covered with an acrosome. An acrosome is a flattened vesicle that separates from the Golgi complex and is similar in many respects to a lysosome. It contains enzymes necessary for sperm penetration into the egg (collagenase, hyaluronidase, acrosin, acid phosphatase, etc.). The entire head of the sperm as a whole, as well as its tail, is surrounded by a plasma membrane. In the region of the head, this membrane contains special proteins. Some of them are negatively charged and contribute (at short distances) to the directed movement of the sperm towards the egg. Other proteins are involved in binding to the egg cell. Tail (flagellum). There are 4 parts in the tail: neck (I), intermediate part (II), main part (III) and terminal part (IV). The short neck contains 2 centrioles - empty cylinders of microtubules. The axoneme of the tail begins from one of the centrioles. The axoneme runs along the axis to the very end of the tail. It has the usual structure for all flagella and cilia, that is, it is formed by microtubules according to the scheme  $(9 \times 2) + 2$  (nine doublets of microtubules on the circumference and pairs of single microtubules in the center). Microtubules

interact with dynein knobs; due to this, neighboring doublets slide relative to each other, which leads to tail beating. Various structures may be located around the axoneme in different parts of the tail. Intermediate part of the tail. Around the axoneme - 9 t.n. external fibrils (which play the role of passive elastic structures) and mitochondrial "shell". The latter is formed by mitochondria arranged in a spiral, the turns of which are closely adjacent to each other. 54 The main part of the tail. Around the axoneme - 9 outer fibrils there is a fibrous sheath (thin fibrillar sheath). The final part. The axoneme is directly covered with a plasma membrane (which is also present in other parts of the tail). The plasma membrane of the tail plays a major role in its movement. First, it, like the membrane of nerve cells, is capable of excitation and conduct of excitation. Excitation is initiated by acetylcholine, which is produced in the flagellum itself. Acetylcholine acts on its receptors located in the membrane. This leads to a sharp increase in the permeability for Na<sup>+</sup> and Ca<sup>2+</sup> ions - membrane disruption. In addition, a special system (protein kinase) is connected to the membrane, with the help of which excitation of the membrane causes the sliding of the microtubules of the axoneme (and, ultimately, the beating of the tail). The normal beating frequency is 5 1 /c, and the speed of human sperm movement is 30-50 μm/s.

**Equipment:** slides , histological micropreparations, microscope, electronograms.

Plan.

Technological class map for face-to-face training

	Stages	Time	Teaching aids	Equipment	Venue
1	Greeting. Attendance check	5		Journal of success	Study room
2	Basic level check	15	Test questions, situational problems		
3	Correction of assimilation of theoretical material	20		Tables, slides, micropreparations	
4	Checking the initial level of training	15	Written assignments, surveys		
5	Independent work. Preparation of the protocol of the practical session.	20	Atlas with micropreparations and EG	Microscope, micropreparations, album	
6	Analysis of results.	15	Checking the practical part of		

	Summing up		the lesson		
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### Technological lesson map for online learning

	Stages	Time	Teaching aids	Equipment	Venue
1	Greeting. Attendance check	3		Journal of success	Study room
2	Basic level check	15	Test questions, situational problems		
3	Correction of assimilation of theoretical material	10		Tables, slides, micropreparations	
4	Checking the initial level of training	15	Written assignments, surveys		
5	Independent work. Preparation of the protocol of the practical session.	15	Atlas with micropreparations and EG	Microscope, micropreparations, album	
6	Analysis of results. Summing up	2	Checking the practical part of the lesson		

Control of the reference level of knowledge.

Tests

1. The sperm acrosome is:

- A. \_ core
- B. \_ mitochondria
- C. \_ Golgi complex
- D. \_ cell center
- E. modified lysosome

2. In the reproductive phase of spermatogenesis:

- A. \_ reduction division of spermatocytes
- B. \_ reduction division of spermatogonia
- C. \_ mitotic division of spermatogonia
- D. \_ DNA reduplication in spermatozoa

E. \_ equational division of spermatocytes

3. During the maturation phase of spermatogenesis:

A. \_ reduction division of spermatocytes

B. \_ reduction division of spermatogonia

C. \_ mitotic division of spermatogonia

D. \_ DNA reduplication in spermatocytes

E. \_ meiotic division of spermatocytes

4. On one of the phases During spermatogenesis, there are changes in the nucleus and cytoplasm of spermatids, which lead to the formation of mature germ cells. Name the phase of gametogenesis.

A. \_ formation

B. \_ maturation

C. \_ growth

D. \_ reproduction

E. \_ proliferation

5. A man with the genetic Kartegener syndrome, which is based on the lack of movement of eyelashes and flagella, came to the hospital. What are the molecular mechanisms of this pathology?

A. \_ Absence of dynein

B. \_ Excess dynein

C. \_ Absence of tubulin

D. \_ Deficiency of spectrins

E. \_ Lack of hyaluronidase

6. The formation of sperm occurs in:

A. \_ straight tubules of the testis

B. \_ convoluted tubules

C. \_ distal tubules

D. \_ ducts of the appendix

E. \_ tubules of the network

7. Gonoblasts are first formed in:

A. \_ sexual shaft

B. \_ the wall of the yolk sac

C. \_ in the primary intestine

D. \_ somit nizhka

E. \_ all of the above

8. An insufficient number of germ cells was found in a 25-year-old patient during the examination of seminal fluid. Which of the cells of the male gonads, dividing, usually provide a sufficient amount of material for fertilization?

A. \_ spermatogonia

B. \_ spermatids

C. \_ sustentocytes

**D.** \_ Leydig cells

**E.** \_ Sertoli cells

Questions to check basic knowledge on the topic of the seminar:

1. Embryology as a general biological science.
2. Characteristics of mitosis
3. Characteristics of meiosis.
4. Haeckel-Müller's biogenetic law.
5. Morphology of chromosomes
6. Morphofunctional characteristics of the male genital organs systems.

Discussion of theoretical issues:

1. Medical embryology, its role and significance in training a doctor.
2. Periodization of ontogenesis
3. Characteristics of the stages of the prenatal period
4. Gametogenesis is the initial stage of ontogenesis.
5. Spermatogenesis. Characteristics of the reproduction phase. Types of spermatogonia.
6. Characteristics of the growth phase.
7. Characteristics of the ripening phase
8. Characteristics of the formation phase
9. Concept of cycle of spermatogenesis
10. The structure of mature sperm.

Tests.

1. In a conditional experiment, at the early stage of embryogenesis, the mesenchyme in the wall of the yolk sac of a mammalian embryo was destroyed. What will be the consequences of such manipulation?

**A.** \_ The formation of blood vessels and the formation of gonoblasts will be disturbed

**B.** \_ The embryo's trophism will be disrupted

**C.** \_ The release of metabolic products will be disturbed

**D.** \_ The formation of the allantois will be disturbed

**E.** \_ The formation of the amnion will be disturbed

2. During the mechanical injury of the testicle in a man, a violation of the integrity of the walls of many convoluted tubules was noted. What will this lead to?

**A.** \_ aspermatogenesis

**B.** \_ polyspermy

**C.** increasing the amount of testosterone

**D.** \_ monospermia

**E.** \_ decrease in testosterone synthesis

3. It is necessary to identify spermatogenic cells at different stages of spermatogenesis on the histological specimen. Which spermatogenic cells correspond to the growth phase?

**A.** \_ spermatogonia

- B. \_ spermatids
- C. \_ spermatozoa
- D. \_ spermatocytes of the 1st order
- E. \_ II order spermatocytes

4. On the histological preparation of the testicle in the lumen of the convoluted tubule, cells can be distinguished, which have a pear-shaped nucleus with dense chromatin and a tail wrapped in the lumen of the tubule. What cells are found on the drug?

- A. \_ spermatogonia
- B. \_ spermatids
- C. \_ spermatozoa
- D. \_ spermatocytes of the 1st order
- E. \_ II order spermatocytes

5. It is necessary to identify spermatogenic cells at different stages of spermatogenesis on EG. At what stage of the growth phase in the nucleus of the spermatocyte of the first order are homologous chromosomes located in pairs, conjugating along the length and forming bivalents (dyads)?

- A. zygotene
- B. \_ pachytene
- C. \_ leptotenes
- D. \_ diplotenes
- E. \_ diakinesis

6. It is necessary to identify spermatogenic cells at different stages of spermatogenesis on the histological specimen. Which spermatogenic cells correspond to the stage of the first division of meiosis, the maturation phase?

- A. \_ spermatocytes of the 1st order
- B. \_ spermatids
- C. \_ spermatozoa
- D. \_ spermatogonia
- E. \_ II order spermatocytes

7. Cells of various irregular shapes with dense oval nuclei can be distinguished on the histological specimen of the testicle in the lumen of the convoluted tubule. The cells are located closer to the lumen of the tubule. What cells are found on the drug?

- A. \_ spermatids
- B. \_ spermatogonia
- C. \_ spermatozoa
- D. \_ spermatocytes of the 1st order
- E. \_ II order spermatocytes

8. It is necessary to identify spermatogenic cells at different stages of spermatogenesis on EG. At what stage of the growth phase in the nucleus of a spermatocyte of the first order do the chromosomes thicken, become shorter, and synaptothemic complexes are detected electron microscopically?

- A. \_ diplotenes
- B. \_ pachytene
- C. \_ leptotenes
- D. \_ zygotene
- E. \_ diakinesis

9. During the examination of the seminal fluid of a man complaining of a sterile marriage, an insufficient number of spermatozoa was found.

- A. \_ spermatogonia
- B. \_ spermatids
- C. \_ spermatozoa
- D. \_ spermatocytes of the 1st order
- E. \_ II order spermatocytes

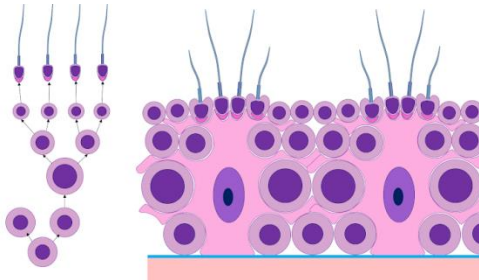
10. It is necessary to identify spermatogenic cells at different stages of spermatogenesis on the histological preparation. Which spermatogenic cells correspond to the stage of the first second division of meiosis, the maturation phase?

- A. \_ spermatocytes of the 1st order
- B. \_ spermatids
- C. \_ spermatozoa
- D. \_ spermatogonia
- E. \_ spermatocytes of the first order

11. In the electron microscopic photograph of a mature spermatozoon, it can be seen that in the front part of the head, the nucleus is covered with elements of a modified Golgi complex, which is called acrosome and consists of bubbles filled with enzymes. They are necessary for the dissolution of the egg cell membranes and the successful implementation of the fertilization process. What enzymes does the acrosome contain?

- A. Trypsin, pepsin
- B. Amylase, catalase
- C. Lipase, pepsin
- D. Trypsin, hyaluronidase
- E. Trypsin, catalase.

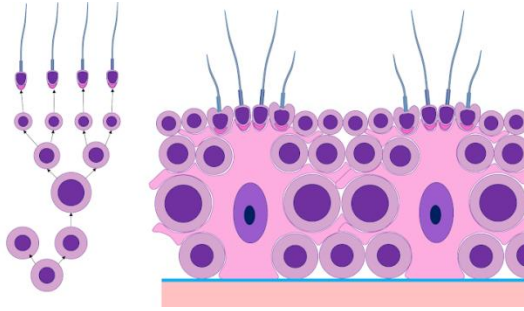
12 . What cells are formed as a result of the growth period?



- A. \_ Spermatozoa
- In \_ Secondary spermatocytes
- S. \_ Spermatogonia
- D. \_ Spermatids
- E. \_ Primary spermatocytes

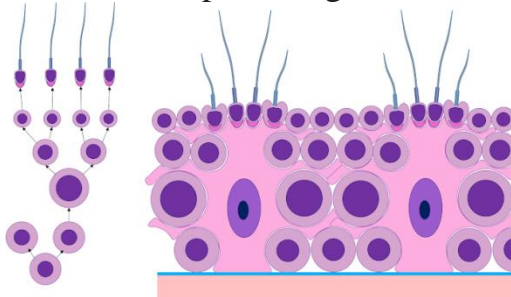


13. What cells are formed after the first division of meiosis?



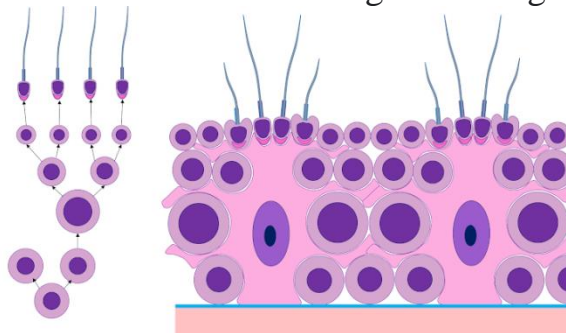
- A. Sperm
- V. Spermatids
- S. Spermatogonia
- D. Secondary spermatocytes
- E. Primary spermatocytes

14. Phases of spermatogenesis:



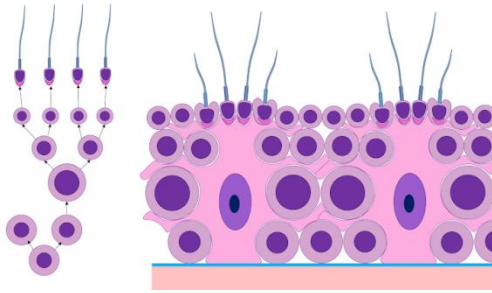
- A. Reproduction, ripening, growth, formation
- B. Reproduction, formation, ripening, growth
- S. Reproduction, growth, ripening, formation

15. List the cells according to the stages of spermatogenesis.



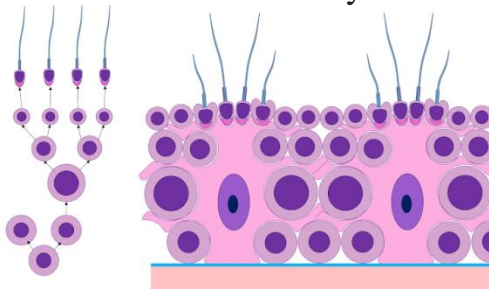
- A. Spermatogonia, spermatids, primary spermatocytes, secondary spermatocytes, spermatozoa
- B. Spermatogonia, primary spermatocytes, secondary spermatocytes, spermatids, spermatozoa
- C. Primary spermatocytes, secondary spermatocytes, spermatogonia, spermatids, spermatozoa

16. What cells are formed after the second division of meiosis?



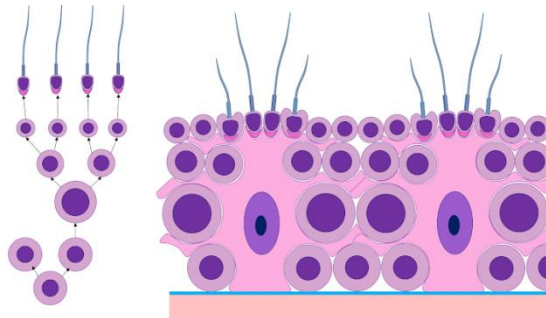
- A. Primary spermatocytes
- V. Sperm
- S. Secondary spermatocytes
- D. Spermatogonia
- E. Spermatids

17. Which cells divide by mitosis?



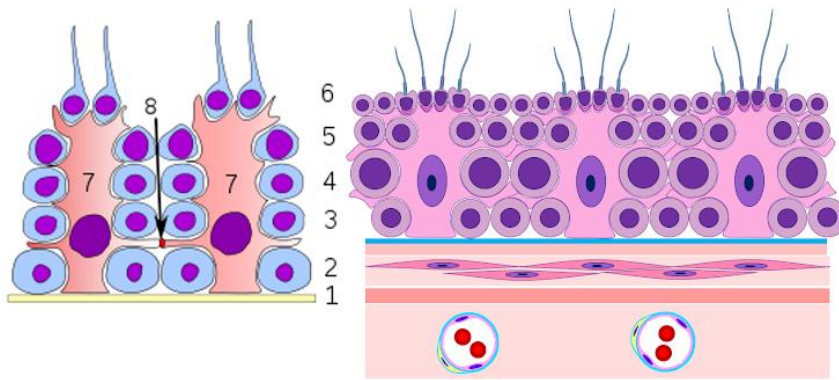
- A. Primary spermatocytes
- V. Spermatogonia
- S. Sperm
- D. Secondary spermatocytes
- E. Spermatids

18. The formation of which cells is the result of the formation period?



- A. \_ Spermatids
- In \_ Primary spermatocytes
- S. \_ Spermatozoa
- D. Secondary spermatocytes
- E. Spermatogonia

19. Choose the components of the blood-testicular barrier:



- 1) Serous membrane
- 2) Adventitia
- 3) Myoid layer
- 4) Fibrous layer
- 5) Capillary wall
- 6) Submucosa
- 7) Basal layer
- 8) Sertoli cells
- 9) Muscle layer
- 10) Mucous membrane

### Topics of reports/abstracts :

1. Abnormalities of spermatozoa (syndrome of immobile eyelashes, etc.) as a cause of male infertility.
2. Disorders of spermatogenesis.
3. Clonal nature of germ cells
4. Abnormal spermatozoa.
5. Chromosomal theory of heredity
6. Diagnostic technique for identification of gene abnormalities
7. Structural and molecular criteria for diagnosis of male infertility.

Summary:

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List of recommended literature.

Main:

1. Lutsyk O.D., Tchaikovsky Y.B. Histology, cytology, embryology Vinnytsia, New book, 2018.
2. Barinov E.F., Tchaikovsky Yu.B. special histology and embryology of internal organs: textbook. Kyiv: Medicine; 2013
3. Wojciech Pavlyna. Histology: textbook and atlas. VSV: Medicine, 2021.

Additional:

1. Histology and embryology of internal organs: teaching. help./ E.F. Barinov, Yu.B. Tchaikovsky, O.M. Sulaeva and others; under the editorship E.F.

- Barinova, Yu.B. Tchaikovsky. - K.: VSV "Medicine", 2013. - 472 p.
2. Cytology of human organs and tissues edited by L.S. Bolhova. Kyiv: Book-plus, 2018, p. 288

METHODODOLOGICAL DEVELOPMENT  
seminar class  
from the academic discipline of histology, cytology and embryology

Faculty, medical course III year  
Educational discipline histology, cytology and embryology

Approved:  
Meeting of the Department of Histology, Cytology and Embryology  
Odessa National Medical University

Protocol No. \_\_\_ of “ \_\_\_ ” \_\_\_\_\_ 20\_\_

Head of the department \_\_\_\_\_ (\_\_\_ Tiron  
O.I. \_\_\_\_\_)

Developers:  
(indicate surnames, scientific degrees, scientific titles and positions of developers;  
everyone who teaches the specified academic discipline must be among the  
developers)

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art.excl. Lyashevskaya O.O.

## Seminar session No. 2

**Topic:** Progenesis. Peculiarities of antenatal and postnatal development of female germ cells

**Purpose:** to give students an understanding of the basic principles of embryogenesis, progenesis, to form an idea about the origin of female germ cells, general features and peculiarities of their development and differentiation in the gonads, which can be used for diagnosis, treatment and prevention of various disorders of spermatogenesis. Knowledge of embryogenesis will be of great help to the doctor when he is forced to analyze the causes and mechanism of transmission of hereditary diseases.

### Basic concepts:

**Embryology** is a science that studies the patterns of embryo formation and the processes of its development.

**Ontogenesis** is the individual development of an organism, which begins from the moment of formation of a single-celled embryo and continues until death.

**Prenatal period** - from conception to birth.

**Postnatal period** - from birth to death.

**Progenesis** (gametogenesis) is the process of formation of mature germ cells

**Oogenesis** is the process of formation of female germ cells in the ovary.

**An ovum** is a female germ cell formed in the ovary as a result of oogenesis.

**Egg cells.** The number of eggs produced in mammals is many orders of magnitude smaller than that of sperm. Egg cells of different animals have the following common features. They are spherical in shape, and usually much larger than spermatozoa in size. A large volume is associated with the presence of reserve components in the cytoplasm. Among them is the yolk - a protein-lipid inclusion that provides nutrients for the development of the embryo (throughout or only in the early stages). There are usually several membranes around the ovum (performing trophic or protective functions). Oocytes, unlike spermatozoa, cannot move on their own. Mammalian ova The ovaries of mammals do not contain ova, but their precursors - oocytes, which are at one or another stage of maturation division (meiosis). Therefore, in the nuclei - not a haploid, but, as a rule, a tetraploid set of chromosomes. The ovule has an almost regular rounded shape. In its center is the nucleus, which contains deep heterochromatin and nucleoli. The cytoplasm is evenly filled with a relatively small amount of yolk. Around the egg there is a shiny shell (zona pellucida) and a granular layer of follicular cells. The shiny shell is formed by glycosaminoglycans produced by follicular cells and the egg itself. From the outside, the granular shell is limited by the basement membrane, behind which is the connective tissue shell - theca. Reduction bodies. In the process of the first division of meiosis, one of the daughter cells turns out to be very small and is called a reducing (or guiding) body. During the second division, the picture is repeated: from the "big" cell, an ovum of practically the same size and a small reduction body are formed. If the first reduction body also undergoes division, then, as a result, 1 egg cell and three reduction bodies are produced. All of them (including the egg) contain haploid sets of chromosomes. Such an asymmetric distribution of the cytoplasm allows you to preserve all its reserve components in one cell. Egg cell cytoplasm 1. Yolk granules. They are usually

separated by a membrane. Granules contain phospho- and lipoproteins (phosphovitin and lipovitelin). In the central part of the granules, they form denser crystal structures. These substances have, apparently, both endo- and exogenous origin: some of them are formed in the oocyte, and some - in the liver of the animal. Other specific structures are derivatives of lysosomes. A. Multivesicular bodies are a collection of small vesicles enclosed in a larger membrane sac. They appear in the process of digestion of phagocytosed particles. B. Cortical granules are located directly under the cytolemma. They contain hydrolytic enzymes that are released into the intercellular space during fertilization and take part in the so-called cortical reaction. The next feature of eggs is a very high content in the cytoplasm of components of the protein synthesis system - ribosomes, rRNA, mRNA, tRNA. After fertilization, they begin to actively form embryo proteins. The plasma membrane of the egg can form microvilli.

**Stages of oogenesis** Reproduction period Oogenesis - the process of development of female germ cells - includes three periods: reproduction, growth and maturation. The reproduction period lasts in the ovary of the fetus from the second to the fifth month of embryogenesis and consists in the reproduction of oogonium cells by the mitotic pathway. Oogonia are formed from primary germ cells of gonocytes, which have an extragonadal origin, migrate to the germ of the gonad, interact with cells of the follicular epithelium and turn into oogonia. Ovogonia, unlike gonocytes, have high mitotic activity. As a result of reproduction, the number of ovogens in one ovary reaches 1-5 million. In parallel with reproduction, there is a mass death of oogonium by apoptosis, so their number before birth is significantly reduced. After the last mitotic division, oogonia turn into preleptotene oocytes and enter the next phase of oogenesis - the growth period. Characteristics of the growth period in the process of oogenesis The growth period in human oogenesis begins from the third month of embryonic development and consists in the formation of primary oocytes (oocytes of the first order), in the nucleus of which a complex rearrangement takes place, which is preparation for the reduction of the number of chromosomes. At this time, the size of the oocyte itself increases, it is surrounded by follicular cells, follicles are formed. This process is called small growth. Oocytes of the first order enter the prophase of meiosis and, just as it happens in spermatocytes of the first order, pass through the stages of leptotene, zygotene (second to seventh months of embryogenesis), pachytene and diplotene (sixth and ninth months). But, unlike male meiosis, metaphase does not occur after prophase in oogenesis, but meiosis is blocked, and oocytes go into dictyotene for a long time - a kind of phase peculiar only to oogenesis. The arrest of the oocyte of the first order in the diplotene of the prophase of the 1st meiotic division is ensured by the so-called oocyte maturation inhibitor - OMI (English oocyte maturation inhibitor). In dictyotene, the chromosomes of the oocyte of the first order despiralize and become invisible before the end of the growth period. In humans and other mammals, oocytes go into dictyotene during the fetal period or immediately after birth and remain in this state for tens of years (from 10-13 to 45-50 years). In humans, different generations of oocytes undergo prophase at different stages of prenatal ontogenesis. Thus, in the third month of embryonic development, about 1% of oocytes reach the dictyotene stage, by the fourth month their number is already 20%, and by the eighth month - 90%. With the onset of puberty, oocytes enter the process of further growth (the so-called big growth). At the same time, the size of the oocyte increases, the yolk accumulates in its cytoplasm, the oocyte is surrounded by a transparent zone and a radiant crown. The transparent zone

has the properties of oxyphilia, it is clearly visible under a light microscope. It is formed by a complex complex of glycoproteins and proteoglycans. Microvilli of follicular cells penetrate the transparent zone and form slit contacts with the plasmolemma of the oocyte. Outside of the transparent zone are the follicular cells of the radiant crown, which transition without a sharp border into the cells of the egg-bearing tubercle. Characteristics of the ripening period in the process of oogenesis. The maturational period of oogenesis begins in mature follicles just before ovulation, when the oocytes resume meiosis, beginning with the metaphase of the first maturation division. Unblocking of meiosis occurs under the action of lutropin (LH). After the first division, two cells are formed: one large - the secondary oocyte (oocyte of order II), in which almost all the cytoplasm remains 16, and the second small - the first polar body (polocyte I). Each of these cells receives 23 dyads from the chromosomal set of the primary oocyte. The second division of maturation begins immediately after the first, but it is blocked at the stage of metaphase, it is completed only after the penetration of the sperm through the plasmolemma of the secondary oocyte. As a result of the second division of meiosis, a small cell is formed again - the second polar body (polocyte II) and a large one - a mature egg; both cells receive 23 monads each. Polar, or reduction, bodies contain about 1% of the egg cell cytoplasm. At the metaphase stage of the second division of maturation, the oocyte is released from the ovary as a result of ovulation and maturation is completed in the fallopian tubes after fertilization.

**Equipment:** slides , histological micropreparations, microscope, electronograms.

Plan:

Technological class map for face-to-face training

	Stages	Time	Teaching aids	Equipment	Venue
1	Greeting. Attendance check	5		Journal of success	Study room
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5	Independent work.	20	Atlas with micropreparations	Microscope, micropreparations,	



	Preparation of the protocol of the practical session.		and EG	album	
6	Analysis of results. Summing up	15	Checking the practical part of the lesson		

### Technological lesson map for online learning

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Questions to check basic knowledge on the topic of the seminar:

1. To interpret the general organization of the eukaryotic cell, the features of the egg cell structure and the role of the nucleus in its composition.
2. Principles of egg cell classification.
3. Concepts of phylogeny and ontogenesis.

#### 4. Periods of ontogenesis.

##### Tests

1. As you know, eggs are classified according to the presence of yolk and its cytotopography. According to this classification, what type does the lancelet egg belong to?

- A. Primary oligolecithal, isolecithal
- B. Secondary oligolecithal, isolecithal
- C. Polylecithal, isolecithal
- D. Polylecithal, mesolecithal
- E. Polylecithal, sharply tylolecithal.

2. As you know, eggs are classified according to the presence of yolk and its cytotopography. According to this classification, what type of mammalian ovum does it belong to?

- A. Primary oligolecithal, isolecithal
- B. Secondary oligolecithal, isolecithal
- C. Polylecithal, isolecithal
- D. Polylecithal, mesolecithal
- E. Polylecithal, sharply tylolecithal.

3. As you know, eggs are classified according to the presence of a yolk in them and its cytotopography. According to this classification, what type of bird ovum does it belong to?

- A. Primary oligolecithal, isolecithal
- B. Secondary oligolecithal, isolecithal
- C. Polylecithal, isolecithal
- D. Polylecithal, mesolecithal
- E. Polylecithal, sharply tylolecithal.

5. 1. As you know, eggs are classified according to the presence of yolk and its cytotopography. According to this classification, what type of amphibian egg belongs to?

- A. Primary oligolecithal, isolecithal
- B. Secondary oligolecithal, isolecithal
- C. Polylecithal, moderately telolecithal
- D. Polylecithal, mesolecithal
- E. Polylecithal, sharply telolecithal.

##### Discussion of theoretical issues:

1. Gametogenesis is the initial stage of ontogenesis.
2. Histophysiology of the ovum.
3. Classification of eggs.
4. Ovogenesis. Characteristics of the reproduction phase.
5. Characteristics of the growth phase.
6. Characteristics of the ripening phase. Morphological changes during maturation of gametes.
7. Comparative characteristics of spermatogenesis and oogenesis.
8. Comparative characteristics of the structure of sperm and egg.

##### Tests.

1. On the histological preparation of the ovary, follicles are identified, which contain

an oocyte of the first order, covered with a transparent membrane and multilayered follicular epithelium. Among the cells of the epithelium there are cavities of different sizes with liquid. Cover the follicles with theca. What phase of oogenesis do these follicles correspond to?

- A. \_ of great growth
- B. \_ reproduction
- C. \_ short stature
- D. \_ formation
- E. \_ maturation

2. On the histological preparation of the ovary, mature tritic follicles are determined in the cortical substance. In what period of oogenesis are they formed?

- A. \_ of great growth
- B. \_ reproduction
- C. \_ short stature
- D. \_ formation
- E. \_ maturation

3. The ovum contains a moderate amount of yolk, which is unevenly distributed. Did you identify the eggs?

- A. \_ alecital
- B. \_ telolecital
- C. \_ oligolecital
- D. \_ isolecital
- E. \_ mesolecithal

4. The ovum contains a small amount of yolk, which is distributed evenly. Did you identify the eggs?

- A. \_ alecital
- B. \_ tylolecithal
- C. \_ oligolecital
- D. \_ isolecital
- E. \_ mesolecithal

5. The ovum contains a large amount of yolk, which occupies almost the entire cytoplasm. Did you identify the eggs?

- A. \_ alecital
- B. \_ polylecithal
- C. \_ oligolecital
- D. \_ isolecital
- E. \_ mesolecithal

6. The ovum contains a small amount of yolk, which is located in the center of the cell. Did you identify the eggs?

- A. \_ centrolecital
- B. \_ telolecital
- C. \_ oligolecital
- D. \_ isolecital
- E. \_ mesolecithal

7. Human and mammalian ovum:

- A. \_ secondary isolecital
- B. \_ sharply telolecital
- C. \_ moderately tylolecithal
- D. \_ primarily isolecital
- E. \_ mesolecithal

8. Ovule of a lancelet:

- A. \_ oligolecital primary
- B. \_ telolecital
- C. \_ oligolecital secondary
- D. \_ isolecital
- E. \_ mesolecithal

9. Amphibian ovum:

- A. \_ secondary isolecital
- B. \_ sharply telolecital
- C. \_ moderately telolecital
- D. \_ primarily isolecital
- E. \_ mesolecithal

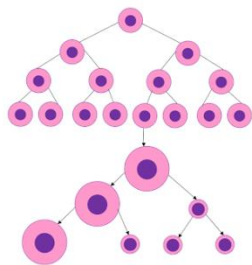
10. Egg cell of birds:

- A. \_ secondary isolecital
- B. \_ sharply telolecital
- C. \_ moderately tylolecithal
- D. \_ primarily isolecital
- E. \_ mesolecithal

11. As you know, eggs are classified according to the presence of a yolk in them and its cytotopography. According to this classification, what type does a human egg belong to?

- A. Primary oligolecital, isolecital
- B. Secondary oligolecital, isolecital
- C. Polylecithal, isolecithal
- D. Polylecithal, mesolecithal
- E. Polylecithal, acutely lecithal.

12. What is formed as a result of the second division of meiosis?



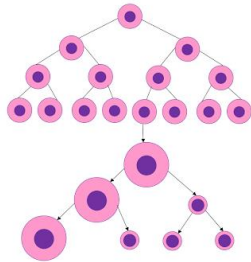
- A. Polar body
- B. Primary oocyte
- S. Egg cell
- D. Ovogonii

## E. Secondary oocyte

13. What is the difference between the period of growth in oogenesis and spermatogenesis?

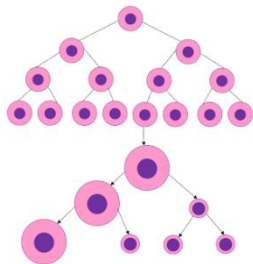
- A. The presence of periods of small and large growth, lasts for years
- B. The presence of an indifferent period
- S. The presence of a preparatory period
- D. There are no differences

14. What is formed as a result of the first division of meiosis?



- A. \_ Primary oocyte
- In \_ Ovogonia
- S. \_ Egg
- D. Secondary oocyte
- E. Polar body

15. What cells reproduce by mitosis?



- A. Egg cells
- V. Polar bodies
- S. Primary oocytes
- D. Ovogonii
- E. Secondary oocytes

## Topics of reports/abstracts

1. Gene mutation
2. Abnormal gametes.
3. Diagnostic technique for identification of gene abnormalities.
4. Structural and molecular criteria for diagnosing female infertility.

## Summary:

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### List of recommended literature

#### Main:

1. Lutsyk O.D., Tchaikovsky Y.B. Histology, cytology, embryology Vinnytsia, New book, 2018.
2. Barinov E.F., Tchaikovsky Yu.B. special histology and embryology of internal organs: textbook. Kyiv: Medicine; 2013
3. Wojciech Pavlyna. Histology: textbook and atlas. VSV: Medicine, 2021.

#### Additional:

4. Histology and embryology of internal organs: teaching. help./ E.F. Barinov, Yu.B. Tchaikovsky, O.M. Sulaeva and others; under the editorship E.F. Barinova, Yu.B. Tchaikovsky. - K.: VSV "Medicine", 2013. - 472 p.
5. Cytology of human organs and tissues edited by L.S. Bolhova. Kyiv: Book-plus, 2018, p. 288

# METHODOLOGICAL DEVELOPMENT

seminar class

from the academic discipline of histology, cytology and embryology

Faculty, medical course III year

Educational discipline histology, cytology and embryology

Approved:

Meeting of the Department of Histology, Cytology and Embryology

Odessa National Medical University

Protocol No. \_\_\_ of “ \_\_\_ ” \_\_\_\_\_ 20\_\_

Head of the department \_\_\_\_\_ (\_\_\_Tiron  
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## Seminar lesson No. 3

**Topic:** Development of the human embryo-1 (ovulation, fertilization, crushing, blastulation).

**Purpose:** Human embryonic development processes are extremely complex. The processes of the formation of germ cells, fertilization, and the formation of a multicellular embryo are the initial processes of embryogenesis, during which the embryo is most sensitive to the action of harmful factors. Knowledge of these processes, the mechanism of formation of a more differentiated organism will enable the doctor to prevent the development of pathological conditions, taking into account the influence of harmful factors on the embryo. Violations of the processes of embryogenesis lead to a wide range of developmental defects and congenital anomalies, some of which are incompatible with life. Knowledge about the processes of embryogenesis, its periods, the stages of the greatest vulnerability of the embryo are necessary for a doctor of any profile.

### Basic concepts:

**Ovulation** is the process of breaking the wall of a mature follicle and the surface of the ovary with the release of an oocyte.

**Fertilization.** Fertilization is usually divided into 3 phases, but in the description below, one more (fourth) phase is added.

- I. Convergence and remote interaction of gametes Convergence occurs due to the active movement of spermatozoa against the fluid flow and the passive movement of the ovum with the fluid flow (along the oviduct to the uterus). At close distances, the electrical interaction between differently charged gamete proteins can also be important. At the same time, the ovum and spermatozoa secrete a number of factors (gyno- and androgamones, respectively), some of which increase and others decrease the motility of spermatozoa. At the same time, capacitation occurs - a process as a result of which the membranes of the head and acrosome of spermatozoa acquire lability (which is necessary for the rupture of the acrosome and the release of its contents). This is facilitated by hormones - adrenaline (contained in seminal fluid) and progesterone (secreted by the ovary).
- II. Contact interaction of gametes Reaching the ovum, spermatozoa bind to its outer (granular) shell. A large number of spermatozoa develop an acrosome reaction. - The plasmolema of the head and the acrosome are torn. Acrosome enzymes cause dissociation and removal of follicular cells, softening of the adjacent area of the shiny membrane. One of the spermatozoa attaches to the plasmolemma of the egg cell. In this place, a protrusion of the cytoplasm of the egg cell will form - a receptive tubercle.
- III. Penetration of the spermatozoon into the ovum In the region of this tubercle, the head and part of the tail of the spermatozoon penetrate into the ovum (including, therefore, the nucleus and centrioles). This (by changing the oocyte membrane potential) stimulates a cortical response. At the expense of cortical granules (which slow down their contents), a space is created between the plasmolemma and the shiny shell. The shiny shell itself is compacted (many cross-links are formed in it and a hyaline layer appears). Therefore, other spermatozoa do not penetrate the egg cell.



IV. Preparation of the zygote for crushing In the formed zygote, the nuclei swell and converge. In particular, in the male nucleus, the chromosomes change from a sharply condensed state to a diffuse state (due to the disulfide bonds between nuclear proteins being broken). Swollen nuclei are called pronuclei, and two such close nuclei are called synkaryon. In humans, pronuclei do not merge into a single nucleus. In the process of convergence of nuclei, DNA doubling occurs in each of them (chromosomes, being in a diffusion state, acquire a two-chromatid structure). The centrioles brought in with the sperm also double (they are usually absent in the egg cell). Metabolic processes are activated in the cytoplasm of the zygote. When the pronuclei collide, their membranes are destroyed and the first mitotic division begins: the chromosomes condense and in metaphase form a single mother star.

**Fragmentation.**

**Fractionation** - a) complete, b) asynchronous (cells do not divide simultaneously), c) somewhat uneven (but not as sharp as in amphibians).

Crushing, as noted, occurs without the growth of daughter cells, so the volume of the embryo does not change. The type of fragmentation and resulting blastula depends on the amount and distribution of the yolk in the cytoplasm.

**B blastocyst** (embryonic vesicle).

Contains a) trophoblast - single-layered wall (then gives extra-embryonic organs); b) embryoblast - a cluster of blastomeres (in the form of a nodule) on the inner surface of the trophoblast at one of the poles.

**Equipment:** slides , histological micropreparations, microscope, electronograms.

Plan:

Organizational measures

Technological class map for face-to-face training

	Stages	Time	Teaching aids	Equipment	Venue
1	Greeting. Attendance check	5		Journal of success	Study room
2	Basic level check	15	Test questions, situational problems		
3	Correction of assimilation of theoretical material	20		Tables, slides, micropreparations	
4	Checking the initial level of training	15	Written assignments, surveys		

5	Independent work. Preparation of the protocol of the practical session.	20	Atlas with micropreparations and EG	Microscope, micropreparations, album	
6	Analysis of results. Summing up	15	Checking the practical part of the lesson		

### Technological lesson map for online learning

	Stages	Time	Teaching aids	Equipment	Venue
1	Greeting. Attendance check	3		Journal of success	Study room
2	Basic level check	15	Test questions, situational problems		
3	Correction of assimilation of theoretical material	10		Tables, slides, micropreparations	
4	Checking the initial level of training	15	Written assignments, surveys		
5	Independent work. Preparation of the protocol of the practical session.	15	Atlas with micropreparations and EG	Microscope, micropreparations, album	
6	Analysis of results. Summing up	2	Checking the practical part of the lesson		

Control of the reference level of knowledge

Tests:

1. Normal implantation of a human embryo can only occur if the endometrium of the uterus changes accordingly. What cells of the endometrium increase quantitatively?
  - A. Decidual cells
  - V. Fibroblasts
  - S. Neurons
  - D. Macrophages
  - E. Myocytes
  
2. The process of crushing the zygote ends with the formation of a blastula. What type of blastula is characteristic of a person?
  - A. Blastocyst.
  - V. Celloblastula.
  - S. Discoblastula.
  - D. Amphiblastula.
  - E. Morula.
  
3. In a blastocyst covered with a fertilization membrane, the synthesis of lytic hormones in trophoblast cells is genetically inhibited. What process of embryogenesis can be delayed?
  - A. Implantation
  - V. Delamination
  - S. Immigration
  - D. Gastrulation
  - E. Epibolia
  
4. The implantation process takes place in two stages: adhesion and invasion. The morphological manifestation of the blastocyst adhesion process is:
  - A. attachment of the blastocyst to the endometrium
  - Destruction of the endometrial epithelium
  - Destruction of endometrial connective tissue
  - D. destruction of endometrial vessels
  - E. formation of lacunae
  
5. As a result of the expression of individual components of the genome, cells acquire their characteristic morphological, biochemical and functional features. What is the name of this process?
  - A. Differentiation
  - V. Capacitance
  - S. Reception
  - D. Determination
  - E. Adhesion
  
6. In the process of acquisition by cells of morphological, biochemical and functional features specific to them, cells are limited in the choice of development paths. What is the name of such an acquired limitation?
  - A. Commitment
  - V. Reception
  - S. Capacitance

- D. Determination
- E. Adhesion

7. During the formation of a human embryo, one can observe the appearance of a cavity in its composition, light small blastomeres on the periphery and dark large blastomeres at one of the poles. What is the name of the embryo at this stage of development?

- A. Blastocyst
- V. Morula
- S. Zygota
- D. Gastrula
- E. Germ disc

8. Fertilization is the process of fusion of male and female germ cells, resulting in a one-celled embryo. What name does it have?

- A. Zygota
- V. Blastula
- S. Morula
- D. Gastrula
- E. Neyrula.

9. It is known that male and female germ cells contain a haploid set of chromosomes and after fusion form a one-celled embryo. Due to which functional features of spermatozoa, the process of fertilization becomes possible?

- A. The ability to retain its properties at any pH of the environment
- B. Keep the ability to fertilize for a week
- C. The ability of spermatozoa to move towards the ovum, responding to chemical signals and stimuli, against the flow of fluid
- D. The ability of spermatozoa to move passively
- E. Insignificant sensitivity of spermatozoa to changes in environmental temperature.

10. The electron microscopic photograph of an oocyte clearly shows its structures. Which of them protects the oocyte from polyspermy?

- A. Granular endoplasmic reticulum
- B. Golgi complex
- S. Plazmolema
- D. Cortical granules
- E. Ribosomes.

### **Discussion of theoretical issues:**

1. Subject and tasks of embryology. Medical embryology.
2. The ratio of ontogeny and phylogeny. Periodization of animal development.
3. Sex cells. The structure and functions of germ cells in mammals, the main stages of their development.
4. Meiosis as a mechanism of germ cell formation. Its occurrence.
5. Fertilization in mammals, its biological significance, phases. Conditions necessary for normal fertilization, capacitation phenomenon, acrosomal reaction, penetration of spermatozoa, formation of male pronucleus. Cortical reaction of the oocyte, completion of meiosis.
6. Zygote as a unicellular organism.

7. Crushing. Peculiarities of crushing the mammalian embryo, its characteristics. The structure and localization of the embryo during crushing. Types of blastomeres. Morula Blastocyst formation.
8. Implantation. Its mechanisms, stages, chronology, features in mammals.
9. Gastrulation.
10. Extra-embryonic organs of mammals.

### **Tests.**

1. A human embryo was found in the uterine cavity, not attached to the endometrium. What stage of development does this correspond to?
  - A. Blastocysts
  - V. Zygots
  - S. Moruli
  - D. Gastruly
  - E. Neyruly
  
2. In the first critical period in the fallopian tube, for an unknown reason, the fertilization membrane dissolved in the embryo. What complication of pregnancy is possible in this case?
  - A. Embryo implantation in the tube wall
  - V. The death of the embryo
  - S. Intussusception of the blastocyst wall
  - D. Return of the blastocyst back to the ampullary zone of the tube
  - E. Formation of two blastocysts
  
3. A human embryo built from two blastomeres was found. Name the place of its localization under the condition of its normal development?
  - A. fallopian tube,
  - B. cavity of the uterus
  - S. abdominal cavity
  - D. Mucous membrane of the uterus
  - E. ovary
  
4. Implantation of the embryo in the mucous membrane of the uterus consists of two phases - adhesion and invasion. The first phase is supported by:
  - A. Attaching the blastocyst to the surface of the endometrium
  - B. Destruction of the connective tissue of the endometrium
  - C. Destruction of epitheliocytes of the mucous membrane (endometrium) of the uterus
  - D. Activation of secretion of uterine glands
  - E. Suppression of secretion of uterine glands
  
5. Through the female genital tract, spermatozoa move towards the ovum against the fluid (distant stage of fertilization). What is the name of this directional movement?
  - A. Rheotaxis
  - V. Thermotaxis
  - S. Chemotaxis
  - D. Capacitance

E. Acrosomal reaction

6. During the microscopic examination of the female internal genital organs removed during the operation, an embryo built from two blastomeres was found. Name the place of its localization under the condition of normal development.

- A. Fallopian tube, near the ampullary part
- B. fallopian tube, near the uterine part
- S. uterine cavity
- D. abdominal cavity
- E. ovary

7. The diagram shows a human embryo at one of the early stages of development. What stage is this?

- A. Blastocyst
- V. Zygota
- S. Morula
- D. Gastrula
- E. Neyrula

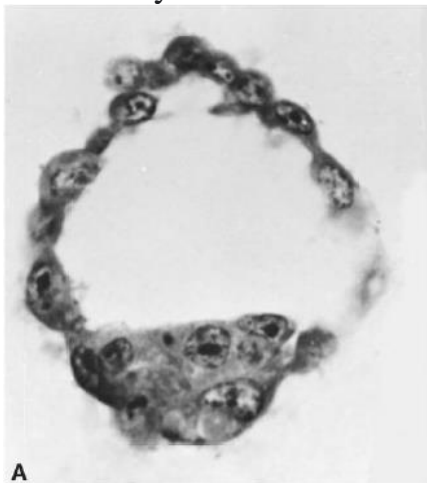
8. The preparation shows an oocyte at the time of its fertilization by a sperm. What is the main result of fertilization?

- A. Zygote formation
- V. Determination of the sex of the child.
- S. Oocyte completion of meiosis.
- D. Penetration by the spermatozoon of the ovolema.
- E. Cortical reaction.

9. Preparations of embryos at the developmental stage of discoblastula, amphiblastula, and blastocyst are presented at the educational stand. What structure is formed as a result of crushing a human zygote?

- A. Blastocyst
- V. Celloblastula
- S. Amphiblastula
- D. Discoblastula
- E. Periblastula.

10. Identify the structure :



- A. Zygote
- V. Morula
- S. Gastrula
- D. Neyrula
- E. Blastocyst

11. Identify the structure:



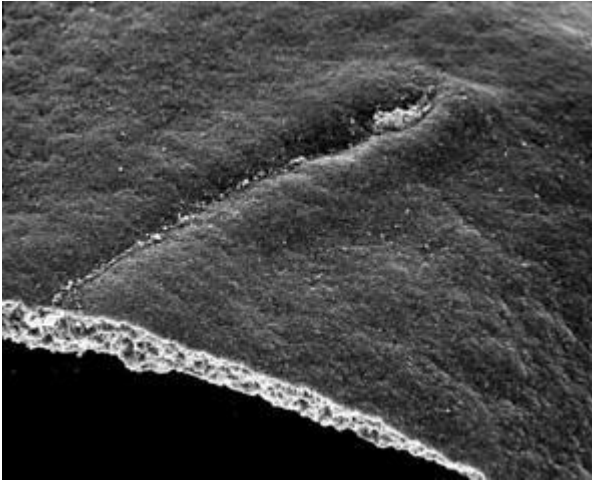
- A. Gastrula
- V. Morula
- S. Neyrula
- D. Zygota
- E. Blastocyst

12. Identify the drug :



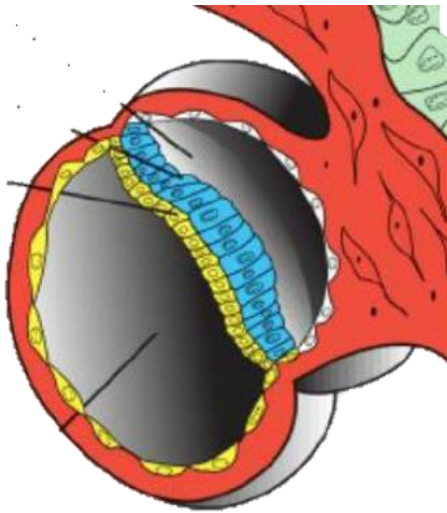
- A. Fertilization
- B. Primary strip
- S. Axial organs
- D. Crushing
- E. Formation of a trunk fold

13. Identify the structure :



- A. Germ shield, primary strip and primary nodule
- B. Neural tube
- S. Blastocyst wall
- D. Primary intestine

14. What is the name of the blue structure?



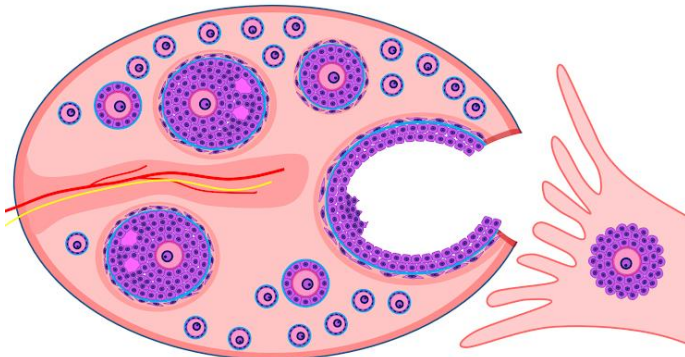
- 1) Mesenchyme
- 2) Horde
- 3) Somites
- 4) Epiblast
- 5) Mesoderm
- 6) Hypoblast
- 7) Nerve tube

15. Identify the process that occurs:





- 1) Migration
  - 2) Gastrulation
  - 3) Crushing
  - 4) Intussusception
  - 5) Implantation
  - 6) Delamination
  - 7) Neurulation
16. After ovulation, a cell complex consisting of:



- A. Ovogonia and shiny shell
- V. Ovogonia and granular layer
- C. Oocyte of the 2nd order, with a shiny shell and a radiant crown
- D. Ovocyte of the 1st order and a radiant crown

### Topics of reports/abstracts

1. Fertilization in humans, its biological significance, phases. Conditions necessary for normal fertilization, capacitation phenomenon, acrosomal reaction, penetration of spermatozoa, formation of male pronucleus. Cortical reaction of the oocyte, completion of meiosis.
3. Crushing. Peculiarities of crushing the mammalian embryo, its characteristics. The structure and localization of the embryo during crushing. Types of blastomeres. Morula Blastocyst formation.
4. Implantation. Its mechanisms, stages, chronology, features in mammals.

5. Ovulation. Hormonal regulation.
6. In vitro fertilization

Summary:

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List of recommended literature

Main:

1. Lutsik O.D., Tchaikovsky Y.B. Histology, cytology, embryology Vinnytsia, New book, 2018.
2. Barinov E.F., Tchaikovsky Y.B. special histology and embryology of internal organs: textbook. Kyiv: Medicine; 2013
3. Voytseh Pavlyna. Histology: textbook and atlas. VSV: Medicine, 2021.

Additional:

1. Histology and embryology of internal organs: teaching. help./ E.F. Barinov, Yu.B. Tchaikovsky, O.M. Sulaeva and others; under the editorship E.F. Barinova, Yu.B. Tchaikovsky. - K.: VSV "Medicine", 2013. - 472 p.
2. Cytology of human organs and tissues edited by L.S. Bolhova. Kyiv: Book-plus, 2018, p. 288

METHODODOLOGICAL DEVELOPMENT  
seminar class  
from the academic discipline of histology, cytology and embryology

Faculty, medical course III year  
Educational discipline histology, cytology and embryology

Approved:

The meeting of the department \_\_\_\_\_  
Odessa National Medical University

Protocol No. \_\_\_\_ of “ \_\_\_\_ ” \_\_\_\_\_ 20\_\_

Head of the department \_\_\_\_\_ ( \_\_Tiron  
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## **Seminar session No. 4**

**Topic:** Human embryo development-2 (gastrulation, implantation)

**Purpose:** Human embryonic development processes are extremely complex. The processes of the formation of germ cells, fertilization, and the formation of a multicellular embryo are the initial processes of embryogenesis, during which the embryo is most sensitive to the action of harmful factors. Knowledge of these processes, the mechanism of formation of a more differentiated organism will enable the doctor to prevent the development of pathological conditions, taking into account the influence of harmful factors on the embryo. Violations of the processes of embryogenesis lead to a wide range of developmental defects and congenital anomalies, some of which are incompatible with life. Knowledge about the processes of embryogenesis, its periods, the stages of the greatest vulnerability of the embryo are necessary for a doctor of any profile.

### **Basic concepts:**

In the previous topic, you considered the initial stages of embryogenesis - fertilization and cleavage. The second of them ends with the formation of a blastula. In this topic, acquaintance with the early stages of embryonic development continues. As it was determined, gastrulation leads to the appearance of 3 layers in the embryo - the outer - ectoderm, the middle - mesoderm and the inner - endoderm. Later, axial rudiments of organs develop from these layers. The formation of some axial primordia (for example, the notochord) occurs almost simultaneously with gastrulation. But for the convenience of presentation, the formation of all axial rudiments is highlighted by us in the next stage.

### **Factors causing gastrulation**

**Gastrulation** is carried out due to the movement of cells and their ongoing differentiation at this time. Differentiation is manifested in the fact that cells acquire all major biochemical and morphological differences from each other, and the possibilities of their further development are narrowing. For example, cells of the endoderm can further transform only into epithelial cells of the organs of the gastrointestinal tract. At the same time, it should be borne in mind that differentiation occurs at all stages of embryogenesis (starting with the zygote) and continues also in the adult organism. Formation of axial rudiments of organs Axial rudiments of organs are formed from the material of three germ layers (ectoderm, mesoderm, endoderm) at the next stage of embryogenesis. Consider this process using the example of birds. In other animals, including mammals, this stage of embryogenesis takes place in a similar way.

**Derived mesoderm.** Notochord. It is formed almost simultaneously with the formation of the mesoderm itself. Its forming cells migrate from the epiblast through the primary notochord. The notochord is an axial structure. One of its functions is to establish the axis of the body. Somites They are located on the sides of the notochord. Their key feature is that they are segments - compact clusters of mesodermal cells. A total of 10-11 pairs of somites will be formed along the axial line (in humans - 44 pairs). But all pairs of somites appear not simultaneously, but sequentially - in the direction from the front part of the embryo to the back. A little later, in each somite, it becomes possible to distinguish 3 parts: the dermatome (adjacent to the ectoderm) - the rudiment of the dermis (the inner layer of the skin), the myotome (the middle part) -

the rudiment of striated muscles, the sclerotum (adjacent to the chord) - the rudiment skeleton Nephrogonotomes, or segmental legs. They are located laterally to the somites and, as follows from the second name, are also segmented. They are the rudiments of the excretory system and gonads, which is why separate tubules appear in them quite early. Splanchnotomes. This is an unsegmented part of the mesoderm, which is located even laterally than the nephrogonotomes. Splits into 2 leaves: parietal leaf adjacent to the ectoderm, visceral leaf adjacent to the endoderm. Both of these leaves will form an epithelium that lines the internal cavities of the body (chest, abdomen). In addition, the visceral sheet is the beginning of the myocardium and epicardium. The cavity between the named leaves is called a coelom. This is a collection of mobile process cells that migrate from different places of the mesoderm (mainly from splanchnotomes). It is located both inside the embryo and outside it (extra-embryonic mesenchyme). In particular, vessels (including the aorta) and blood cells will form from the mesenchyme. **Derivatives of ectoderm** . Neural tube and ganglion plates. The neural tube is formed as a result of bending of the ectoderm lying above the chord. This bending (or sagging) of the ectoderm initially leads to the appearance of the neural groove and neural ridges. The groove collapses into a neural tube (unpaired primordium), and the neural ridges turn into paired ganglion plates lying between the neural tube and the ectoderm. It is believed that the formation of the neural tube occurs under the influence of inducers secreted by the chorda. This is almost the most important function of the chord. The neural tube is the beginning of the spinal cord and brain, the ganglion plates are the beginning of peripheral nerve nodes. Ectoderm. This is (with some exceptions) the remaining part of the ectoderm. It is the beginning of the epidermis of the skin and its derivatives, the epithelium of the initial and terminal parts of the gastrointestinal tract, and the epithelium of some other organs.

**Endoderm** Endoderm later also participates in the formation of the axial primordium (together with the visceral leaf of the splanchnotome) - the primary intestine. That is why the endoderm is called intestinal. The latter is the beginning of the epithelium of the organs of the digestive system (stomach, intestines, liver, pancreas).

**Equipment:** slides , histological micropreparations, microscope, electronograms.

Plan:

Organizational measures

Technological class map for face-to-face training

	Stages	Time	Teaching aids	Equipment	Venue
1	Greeting. Attendance check	5		Journal of success	Study room
2	Basic level check	15	Test questions, situational problems		
3	Correction of assimilation	20		Tables, slides, micropreparations	

	of theoretical material				
4	Checking the initial level of training	15	Written assignments, surveys		
5	Independent work. Preparation of the protocol of the practical session.	20	Atlas with micropreparations and EG	Microscope, micropreparations, album	
6	Analysis of results. Summing up	15	Checking the practical part of the lesson		

#### Technological lesson map for online learning

	Stages	Time	Teaching aids	Equipment	Venue
1	Greeting. Attendance check	3		Journal of success	Study room
2	Basic level check	15	Test questions, situational problems		
3	Correction of assimilation of theoretical material	10		Tables, slides, micropreparations	
4	Checking the initial level of training	15	Written assignments, surveys		
5	Independent work. Preparation of the protocol of the practical session.	15	Atlas with micropreparations and EG	Microscope, micropreparations, album	
6	Analysis of results.	2	Checking the practical part of		

	Summing up		the lesson		
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Control of the reference level of knowledge

Tests:

1. The woman got sick with the flu and it turned out that it happened during the early phase of gastrulation. What consequences should be expected?
  - A. Violation of the formation of ecto- and endoderm
  - B. Violation of mesoderm formation
  - C. Violation of mesenchyme formation
  - D. Violation of the epiboly process
  - E. Violation of the process of intussusception
  
2. In a blastocyst covered with a fertilization membrane, the synthesis of lytic hormones in trophoblast cells is genetically inhibited. What process of embryogenesis can be delayed?
  - A. Implantation
  - V. Delamination
  - S. Immigration
  - D. Gastrulation
  - E. Epibolia
  
3. Early gastrulation of the human embryo occurs by delamination of the embryoblast. In which structure is the beginning of the nervous system?
  - A. In the epiblast.
  - V. In the trophoblast.
  - S. In the hypoblast.
  - D. In the marginal zone of the hypoblast.
  - E. In the central zone of the hypoblast.
  
4. The implantation process takes place in two stages: adhesion and invasion. The morphological manifestation of the blastocyst adhesion process is:
  - A. attachment of the blastocyst to the endometrium
  - B. destruction of the endometrial epithelium
  - C. destruction of the connective tissue of the endometrium
  - D. destruction of endometrial vessels
  - E. formation of lacunae
  
5. In the first critical period in the fallopian tube, for an unknown reason, the fertilization membrane dissolved in the embryo. What complication of pregnancy is possible in this case?
  - A. Embryo implantation in the tube wall
  - V. The death of the embryo
  - S. Intussusception of the blastocyst wall
  - D. Return of the blastocyst back to the ampullary zone of the tube

E. Formation of two blastocysts

6. A human embryo built from two blastomeres was found. Name the place of its localization under the condition of its normal development?

- A. fallopian tube,
- B. cavity of the uterus
- S. abdominal cavity
- D. Mucous membrane of the uterus
- E. ovary

7. During gastrulation, the primary Hensen nodule was not sufficiently formed in the embryo. The development of which axial organ is inhibited?

- A. Hordy
- V. Nervous combs
- S. Nervous groove
- D. Neural tube
- E. Mantle layer of the neural tube

8. Implantation of the embryo in the mucous membrane of the uterus consists of two phases - adhesion and invasion. The first phase is supported by:

- A. Attaching the blastocyst to the surface of the endometrium
- B. Destruction of the connective tissue of the endometrium
- C. Destruction of epitheliocytes of the mucous membrane (endometrium) of the uterus
- D. Activation of secretion of uterine glands
- E. Suppression of secretion of uterine glands

9. In human embryogenesis, on the 20th day, the body of the embryo separates from the provisional organs. What does this process provide?

- A. Body fold
- B. Amniotic fold
- S. Whole
- D. Yolk stem
- E. Somit

10. During the forensic examination of a woman who died in a car accident, an embryo at the early gastrula stage was found. Name the place of its localization under the condition of its normal development.

- A. uterine wall
- B. ampullary part of the fallopian tube
- S. uterine part of the oviduct
- D. ovary
- E. abdominal cavity

11. In the period of early gastrulation of a person, ectoderm and endoderm are formed. By what mechanism are these leaves formed?

- A. delamination
- V. intussusception
- S. epibolia



- D. immigration
- E. intussusception, epiboly

12. In the preparation of a 10-day-old human embryo, 2 vesicles are visible in contact with each other (amniotic and yolk). What is the name of the structure that lies in the place of their contact?

- A. Germ shield.
- V. The bottom of the amniotic sac.
- S. The roof of the yolk sac.
- D. Amniotic leg.
- E. Extra-embryonic mesoderm.

Discussion of theoretical issues:

1. Implantation and its main mechanisms
2. Gastrulation and its main mechanisms.
3. Delamination. Structures formed as a result of delamination. Presumptive rudiments of provisional organs, epiblast, hypoblast.
4. Gastrulation. Formation of embryonic mesoderm.
5. Neurulation and formation of the axial complex of rudiments of organs. 63
6. Differentiation of germ leaves and their derivatives.

Tests.

1. At the late gastrula stage, a section of the dorsal mesoderm - the myotome - was damaged. The development of which structures will be disrupted?
  - A. Epidermis
  - V. Skeletal muscles
  - S. Spinal cord
  - D. Muscular membranes of all tubular organs
  - E. Muscular sheaths of the tubular organs of the reproductive system.
2. 14. As a result of differentiation, the unsegmented part of the middle germ layer (mesoderm) is separated into two layers - outer and inner. What structures are derivatives of the outer (parietal) sheet?
  - A. Meninges
  - B. Fasciae of skeletal muscles
  - S. Endocard
  - D. Pericardium
  - E. Membranes of the spinal cord.
3. In the experiment, the mesodermal stalk connecting the somites and the ventral mesoderm was damaged with a micromanipulator. The development of which body systems will be disrupted?
  - A. Travnoi
  - V. Krovotvornoi
  - S. Endocrine
  - D. Urinary
  - E. Dykhalny.
4. In the third week of human embryogenesis, the central part of the cells of the epiblast (ectoderm) bends and the process of neurulation begins. In what direction does the rest of the cells of the ectoderm differentiate?

- A. Intestines
- B. Somites
- C. Yolk bladder
- D. Skins
- E. Chords.

5. As a result of the unblocking of oncogenes in the embryo, the differentiation of one of the embryonic germs was disturbed. As a result, a malignant tumor developed from the muscular membrane of the small intestine. The development of which embryonic embryo was disturbed?

- A. Splanchnotoma
- B. Mesenchyme
- C. Myotoma
- D. Neural tube
- E. Skin ectoderm.

6. In the experiment, the sclerotium was destroyed in the embryo. Disruption of the development of which structure will be caused by this manipulation?

- A. Axial skeleton
- B. Stroma gonads
- C. Chords
- D. Connective skin tissue
- E. Stroma of internal organs.

7. In the neural tube of the human embryo, ectodermal cells differentiate into neuroblasts and spongioblasts. As a result of the movement of these cells in the neural tube, layers are formed. In which of the layers are the bodies of neuroblasts mainly localized?

- A. Mantle layer.
- V. Ependymy.
- S. Krayovai voali.
- D. White matter.
- E. Sheaths of the spinal cord.

14. The baby was diagnosed with microcephaly. Doctors believe that this is related to the woman's use of actinomycin D during pregnancy. Which embryonic leaves did it primarily affect is this a teratogen?

- A. Ectoderm
- B. All leaves
- C. Endoderm
- D. Mesoderm
- E. Endoderm and mesoderm

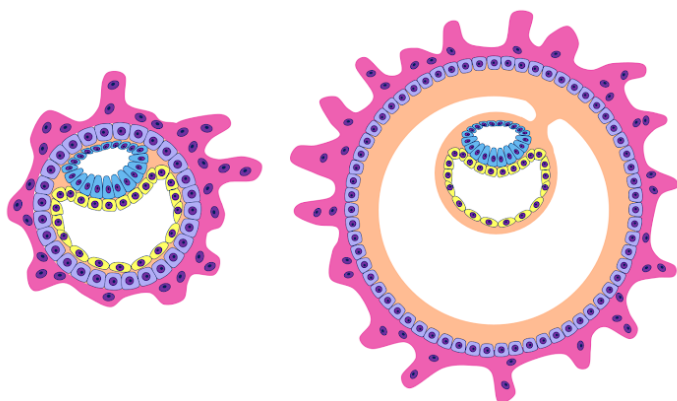
15. In the experiment, the myotome was destroyed in the embryo. Violation of the development of which structure is caused by this one

- A. Skeletal muscles
- V. Axial skeleton
- S. Connective tissue of the skin
- D. Smooth muscles
- E. Serous membranes

16. In the third week of embryogenesis, the central part of the cells of the epiblast (ectoderm) bends and the process of neurulation begins. In what direction does the rest of the cells, the ectoderm, differentiate?

- A. Skins
- V. Guts
- S. Somitiv
- D. Hordy
- E. Gallbladder

17. What is included in the composition of the chorion? Choose all the correct answers:



- 1) Cytotrophoblast
- 2) Symplastotrophoblast (syncytiotrophoblast)
- 3) Embryoblast
- 4) Extra-embryonic mesoderm
- 5) Extra-embryonic endoderm
- 6) Epiblast
- 7) Hypoblast
- 8) Extra-embryonic ectoderm

### Topics of reports/abstracts

- 1. Implantation and its main mechanisms
- 2. Gastrulation and its main mechanisms.
- 3. Differentiation of germ leaves and their derivatives.
- 4. Implantation. Its mechanisms, stages, chronology, human characteristics.
- 5. The concept of in vitro fertilization. Its medical and social significance.

Summary:

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List of recommended literature

Main:

- 1. Lutsik O.D., Tchaikovsky Y.B. Histology, cytology, embryology Vinnytsia,

New book, 2018.

2. Barinov E.F., Tchaikovsky Y.B. special histology and embryology of internal organs: textbook. Kyiv: Medicine; 2013

3. Voytseh Pavlyna. Histology: textbook and atlas. VSV: Medicine, 2021.

Additional:

1. Histology and embryology of internal organs: teaching. help./ E.F. Barinov, Yu.B. Tchaikovsky, O.M. Sulaeva and others; under the editorship E.F. Barinova, Yu.B. Tchaikovsky. - K.: VSV "Medicine", 2013. - 472 p.

2. Cytology of human organs and tissues edited by L.S. Bolhova. Kyiv: Book-plus, 2018, p. 288

METHODODOLOGICAL DEVELOPMENT  
seminar class  
from the academic discipline of histology, cytology and embryology

Faculty, medical course III year  
Educational discipline histology, cytology and embryology

Approved:

The meeting of the department \_\_\_\_\_  
Odessa National Medical University

Protocol No. \_\_\_ of “ \_\_\_ ” \_\_\_\_\_ 20\_\_

Head of the department \_\_\_\_\_ (\_\_\_ Tiron  
O.I. \_\_\_\_\_)

Developers:

Doctor of Medicine \_associate professor, Tiron O.I \_  
Doctor of Medicine, associate professor Kuvshinova I.I.  
Doctor of Medicine, Associate Professor Markova O.O.  
assistant Lyashevskaya O.O.

## **Seminar session No. 5**

**Topic:** Differentiation of the embryonic leaves of the human embryo. Histo- and organogenesis.

**Purpose:** Histogenesis is the development and formation of tissues, which is based on the process of differentiation of cells, which leads to their specialization. Simultaneously with histogenesis, organogenesis - the development of organs - occurs.

As a result of gastrulation, germ leaves were formed, the parts of which, influencing each other, induce the formation of new structures. This phenomenon was called *embryonic induction*.

The phases of histogenesis and organogenesis are *neurulation* — the formation of an axial complex of organs (neural tube, chord), *the formation of other organs* — the organs acquire structural features characteristic of adults. The study of the process of neurulation is necessary for understanding the patterns of formation of the nervous system, and also provides an opportunity to assess the effect of damaging factors at this stage, to investigate the causes of the development of anencephaly.

On the 20th day of embryonic development, *the somite period begins*. Somites, as they form, in sequence from front to back, each differentiate into three areas: dorsolateral: dermatome (mesenchymal rudiment of the connective tissue of the skin itself), medioventral — sclerotum (creating skeletogenic mesenchyme, which gives rise to cartilaginous and bone tissues of the axial skeleton), and located between them myotome (the beginning of skeletal striated muscles).

Understanding the complex morphogenetic processes of organogenesis is a prerequisite for preventing adverse effects of environmental factors on pregnancy.

### **Basic concepts:**

**Histology and organogenesis** of the embryo are carried out as a result of reproduction, migration, differentiation of the cells that make it up, the establishment of intercellular contacts and the death of part of the cells. From the 17th to the 20th, the three-somite period lasts, from the 20th day, the somite period of development begins. On the 20th day of embryogenesis, through the formation of trunk folds (cephalocaudal and lateral), the embryo itself is separated from the extraembryonic organs, and its flat shape is changed to a cylindrical one. At the same time, the dorsal areas of the mesoderm of the embryo are divided into separate segments located on both sides of the chord, **somites**. On the 21st day, the body of the embryo has 2-3 pairs of somites. Somites begin to form from the III pair, the I and II pairs appear a little later. The number of somites gradually increases: on the 23rd day of

development, there are 10 pairs of somites, on the 25th - 14 pairs, on the 27th - 25 pairs, at the end of the fifth week, the number of somites in the embryo reaches 43-44 pairs. Based on counting the number of somites, it is possible to roughly determine the term of development (somite age) of the embryo.

A dermatome arises from the outer part of each somite, a sclerotome from the inner one, and a myotome from the middle one. **The dermatome** becomes the source of the development of the dermis of the skin, **the sclerotome** of cartilage and bone tissue, and **the myotome** of the skeletal muscles of the dorsal part of the embryo. The ventral parts of the mesoderm - **the splanchnot** - are not segmented, but are divided into **visceral and parietal leaves**, from which the serous membranes of internal organs, the muscle tissue of the heart and the cortex of the adrenal glands develop. From **the mesenchyme of the splanchnotome**, blood vessels, blood cells, connective and smooth muscle tissue of the embryo are formed. The area of the mesoderm connecting the somites with the splanchnotome is divided into segmental legs - **the nephrogonotome**, which serve as the source of the development of the kidneys and gonads, as well as the paramesonephric ducts. The epithelium of the uterus and fallopian tubes is formed from the latter. In the process of differentiation of the embryonic ectoderm, the neural tube, neural crests, placodes, skin ectoderm and prechordal plate are formed. The process of neural tube formation is called **neurulation**. It consists in the formation of a slit-like depression on the surface of the ectoderm; the thickened edges of this depression (neural ridges) grow together to form the neural tube. From the cranial part of the neural tube, brain bubbles are formed, which are the germ of the brain. From both sides of the neural tube (between the latter and the skin ectoderm), groups of cells are separated from which **neural crests are formed**. Neural crest cells are capable of migration. Cells migrating in the direction of the dermatome give rise to pigment cells - melanocytes; the cells of the neural crests migrating in the direction of the abdominal cavity give rise to sympathetic and parasympathetic nerve nodes, the medulla of the adrenal glands. From **the cells of the neural crests** that have not migrated, ganglionic plates are formed, from which spinal cord and peripheral vegetative nerve ganglia develop. Ganglia of the head and nerve cells of the organ of hearing and balance are formed from **placodes**. **The prechordal** plate is the source of the development of the epithelium of the trachea, bronchi, lungs, as well as the oral cavity and esophagus.

From **the skin ectoderm**, the epidermis and its derivatives, the enamel and cuticle of the teeth, the epithelium of the lining of the oral cavity, the anal part of the rectum, and the vagina are formed. The endoderm of the embryo is the source of the formation of the epithelium of the middle part of the intestinal tube, liver and pancreas.

**Equipment:** slides, histological micropreparations, microscope, electronograms.

**Plan:**

## Organizational measures

### Technological class map for face-to-face training

	Stages	Time	Teaching aids	Equipment	Venue _
1	Greeting. Attendance check	5		Journal of success	Study room
2	Basic level check	15	Test questions, situational problems		
3	Correction of assimilation of theoretical material	20		Tables, slides, micropreparations	
4	Checking the initial level of training	15	Written assignments, surveys		
5	Independent work. Preparation of the protocol of the practical session.	20	Atlas with micropreparations and EG	Microscope, micropreparations, album	
6	Analysis of results. Summing up	15	Checking the practical part of the lesson		

### Technological lesson map for online learning

	Stages	Time	Teaching aids	Equipment	Venue
1	Greeting. Attendance check	3		Journal of success	Study room
2	Basic level check	15	Test questions, situational		



			problems		
3	Correction of assimilation of theoretical material	10		Tables, slides, micropreparations	
4	Checking the initial level of training	15	Written assignments, surveys		
5	Independent work. Preparation of the protocol of the practical session.	15	Atlas with micropreparations and EG	Microscope, micropreparations, album	
6	Analysis of results. Summing up	2	Checking the practical part of the lesson		

Control of the reference level of knowledge

### Tests

1. As a result of differentiation, the unsegmented part of the middle germ layer (mesoderm) is separated into two layers - outer and inner. What structures are derivatives of the outer (parietal) sheet?

- A. Meninges
- B. Fasciae of skeletal muscles
- S. Endocard
- D. Pericard
- E. Membranes of the spinal cord.

2. At the late gastrula stage, a section of the dorsal mesoderm - the myotome - was damaged. The development of which structures will be disrupted?

- A. Epidermis
- V. Skeletal muscles
- S. Spinal cord
- D. Muscular membranes of all tubular organs

E. Muscular sheaths of the tubular organs of the reproductive system.

3. In the third week of human embryogenesis, the central part of epiblast cells (ectoderm) bends and the process of neurulation begins. In which direction do the rest of the cells of the ectoderm differentiate?

A. Guts

V. Somitiv

S. Zhovtochnohomikhura

D. Skins

E. Hordy.

4. As a result of the unblocking of oncogenes in the embryo, the differentiation of one of the embryonic germs was disturbed. As a result, a malignant tumor developed from the muscular membrane of the small intestine. The development of which embryonic embryo was disturbed?

A. Splanchnotoma

V. Mesenchyme

S. Miotomu

D. Neural tube

E. Skin ectoderm

5. During the differentiation of the mesoderm, the following rudiments are formed:

A. ectoderm, endoderm

V. somite, nephrogonotoma, splanchnotoma

S. epiblast, hypoblast

D. embryoblast, trophoblast

E. somite, nephrogonotoma, neural plate

6. During histological examination, a human embryo consisting of an outer leaf - epiblast and an inner - hypoblast is determined. What rudiments are formed from the inner leaf?

A. Extra-embryonic ectoderm

B. Extra-embryonic mesoderm

S. Extra-embryonic endoderm

D. Embryonic mesoderm

E. Embryonic ectoderm

7. The embryonic period of embryogenesis continues:

A. The first week

A. Second to eighth week

S. Three weeks

D. Four weeks

E. 1-5 weeks

8. Derivatives of ectoderm are all the listed structures, except:
- A. Nervous system
  - B. Skin epithelium
  - S. Hair, nails
  - D. Skeletal muscles
  - E. Mammary glands
9. The woman got sick with the flu and it turned out that it happened during the early phase of gastrulation. What consequences should be expected?
- A. Violation of the formation of ecto- and endoderm
  - B. Violation of mesoderm formation
  - C. Violation of mesenchyme formation
  - D. Violation of the epiboly process
  - E. Violation of the process of intussusception
10. Early gastrulation of the human embryo occurs by delamination of the embryoblast. In which structure is the beginning of the nervous system?
- A. In the epiblast.
  - V. In the trophoblast.
  - S. In the hypoblast.
  - D. In the marginal zone of the hypoblast.
  - S. In the central zone of the hypoblast.

**Questions (test tasks) to check basic knowledge on the topic of the seminar :**

1. What is histogenesis?
2. What is embryonic induction, its role?
3. What are the main phases of histo- and organogenesis?
4. What cells are involved in the histogenesis of animals?
5. What is neurulation?
6. What structures are distinguished in the somite?
7. The beginnings of which structures are nephrogonotomas?
8. What is a coelom?
9. What structures develop from the splanchnotome?
10. What tissues, organs and organ systems arise from the ectoderm?
11. What are the derivatives of endoderm?
12. Name the critical periods of embryogenesis.
13. What is teratogenesis?

**Discussion of theoretical issues:**

1. Concepts of histogenesis, organogenesis, morphogenesis.
2. Neurulation and formation of the axial complex of rudiments of organs.
3. The role of intercellular interactions and embryonic induction.

4. Differentiation of germ leaves.
5. Derived mesoderm. Splanchnotomes. Nephrogonotomas.
6. Somite period (sclerotome, dermatome, myotome).
7. Derived ectoderms.
8. Derived endoderms.
9. Formation of spatial organization.

### Tests.

1. Early gastrulation of the human embryo occurs by delamination of the embryoblast. In which structure is the beginning of the nervous system?
  - A. In the epiblast.
  - V. In the trophoblast.
  - S. In the hypoblast.
  - D. In the marginal zone of the hypoblast.
  - E. In the central zone of the hypoblast.
2. During gastrulation, the primary Hensen nodule was not sufficiently formed in the embryo. The development of which axial organ is inhibited?
  - A. Hordy
  - V. Nervous combs
  - S. Nervous groove
  - D. Neural tube
  - E. Mantle layer of the neural tube
3. In the neural tube of the human embryo, ectodermal cells differentiate into neuroblasts and spongioblasts. As a result of the movement of these cells in the neural tube, layers are formed. In which of the layers are the bodies of neuroblasts mainly localized?
  - A. Mantle layer.
  - V. Ependymy.
  - S. Krayovai voali.
  - D. White matter.
  - E. Sheaths of the spinal cord.
4. The baby was diagnosed with microcephaly. Doctors believe that this is related to the woman's use of actinomycin D during pregnancy. Which embryonic leaves did it primarily affect  
is this a teratogen?
  - A. Ectoderm
  - B. All leaves
  - C. Endoderm
  - D. Mesoderm
  - E. Endoderm and mesoderm
5. In the experiment, the myotome was destroyed in a rabbit embryo. Violation of the

development of which structure is caused by this one

- A. Skeletal muscles
- V. Axial skeleton
- S. Connective tissue of the skin
- D. Smooth muscles
- E. Serous membranes

6. In the third week of embryogenesis, the central part of the cells of the epiblast (ectoderm) bends and the process of neurulation begins. In what direction does the rest of the cells, the ectoderm, differentiate?

- A. Skins
- V. Guts
- S. Somites
- D. Heart
- E. Gallbladder

7. On the micropreparation of the skin of the child's finger, we observe that the epidermis shows signs of insufficient development. Which embryonic sheet was damaged during development?

- A. Ectoderm
- B. Mesoderm
- S. Endoderm
- D. \_ Mesenchyme
- E. Ectomesenchyme

8. Violation of the differentiation of the endoderm was found in the embryonic material. Changes in the development of which organs can occur during this process?

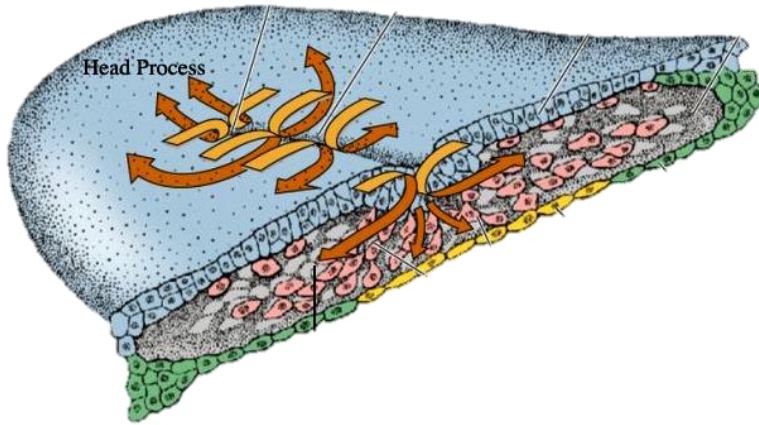
- A. Stomach
- V. Hearts
- S. Kidney
- D. \_ Aorta
- E. Salivary glands

9. Identify the drug:

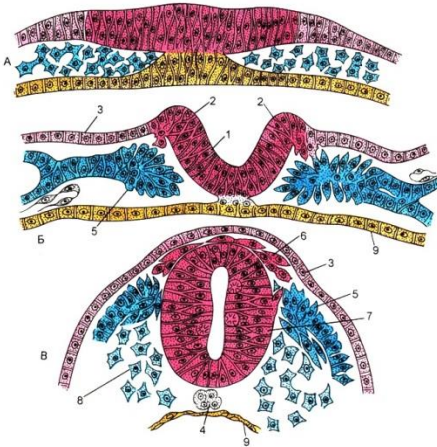


- A. \_ Fertilization
- In \_ Primary strip
- S. \_ Axis bodies
- D. Crushing
- E. Formation of a trunk fold

10. Define the process that takes place:

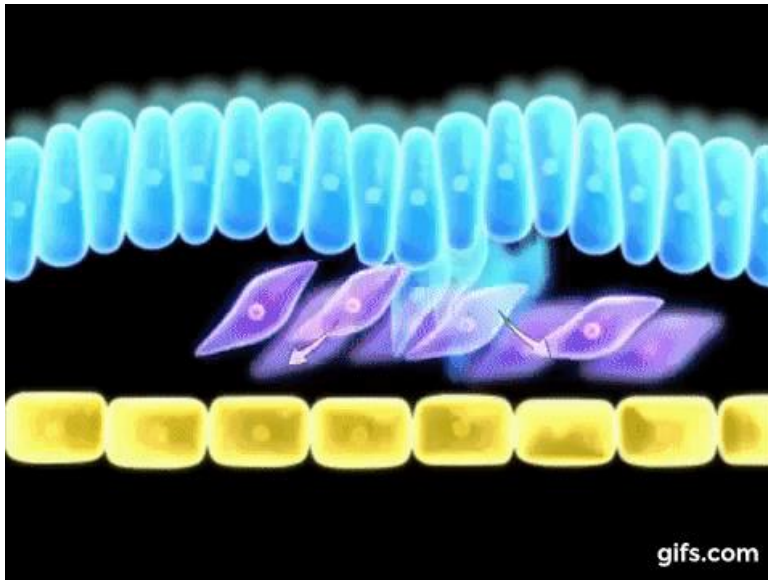


1. Late gastrulation, mesoderm formation
  2. Early gastrulation, notochord formation
  3. Early gastrulation, mesoderm formation
  4. Early gastrulation, endoderm formation
  5. Late gastrulation, notochord formation
  6. Late gastrulation, formation of endoderm
  7. Late gastrulation, formation of ectoderm
  8. Early gastrulation, formation of ectoderm
- 11 . Identify the process that occurs:



- A. Early gastrulation
- V. Late gastrulation
- S. Crushing
- D. Implantation
- E. Neurulation

12. Identify the process that occurs:



- A. \_ Neurulation
- In \_ Implantation
- S. \_ Early gastrulation
- D. Crushing
- E. Late gastrulation

**Topics of reports/abstracts :**

1. Somite period (sclerotome, dermatome, myotome).
2. Derived ectoderms.
3. Derived endoderms.
4. Formation of spatial organization.

Summary:

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List of recommended literature

Main:

1. Lutsik O.D., Tchaikovsky Y.B. Histology, cytology, embryology Vinnytsia, New book, 2018.
2. Barinov E.F., Tchaikovsky Y.B. special histology and embryology of internal organs: textbook. Kyiv: Medicine; 2013
3. Voytseh Pavlyna. Histology: textbook and atlas. VSV: Medicine, 2021.

Additional:

1. Histology and embryology of internal organs: teaching. help./ E.F. Barinov, Yu.B. Tchaikovsky, O.M. Sulaeva and others; under the editorship E.F. Barinova, Yu.B. Tchaikovsky. - K.: VSV "Medicine", 2013. - 472 p.
2. Cytology of human organs and tissues edited by L.S. Bolhova. Kyiv: Book-plus, 2018, p. 288

METHODOLOGICAL DEVELOPMENT

seminar class

from the academic discipline of histology, cytology and embryology

Faculty, medical course III year

Educational discipline histology, cytology and embryology

Approved:

The meeting of the department \_\_\_\_\_

Odessa National Medical University

Protocol No. \_\_\_\_ of “ \_\_\_\_ ” \_\_\_\_\_ 20\_\_

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## **Seminar class #6**

**Topic:** Formation of extra-embryonic organs in the early stages of human embryogenesis. Formation of placenta and umbilical cord.

**Purpose:** Human embryonic development processes are extremely complex. Studying the processes of the formation of extra-embryonic organs that create conditions for the life, growth and development of the embryo and fetus. Knowledge of these processes, the mechanism of formation of a more differentiated organism will enable the doctor to prevent the development of pathological conditions, taking into account the influence of harmful factors on the embryo. Violations of the processes of embryogenesis lead to a wide range of developmental defects and congenital anomalies, some of which are incompatible with life. Knowledge about the processes of the formation of extra-embryonic organs, its periods, the stages of the greatest vulnerability of the embryo are necessary for a doctor of any profile.

### **Basic concepts:**

In this topic, acquaintance with the stages of human embryonic development continues. Formation of extra-embryonic organs and separation from them of the body of the embryo **Extra-embryonic organs** are otherwise called provisional (temporary). Another name is embryonic membranes.

**Yolk sac.** As we know, in birds at the stage of laying the axial organs, the embryo is spread out on a small area of the yolk. The extra-embryonic parts of the endoderm and the visceral leaf of the mesoderm begin to overgrow the yolk, forming a yolk sac. The embryo rises above the yolk. Therefore, four sheets: ectoderm, endoderm, parietal and visceral sheets of mesoderm - form body folds. At the same time, the embryonic endoderm turns into an intestinal tube. The embryo is connected to the yolk sac by an empty cord - the yolk stalk. **Functions of the yolk sac** : in its wall, blood cells (from the mesodermal germ) are formed for the first time. This is where germ cell precursors (which then move to the gonads) appear for the first time. The contents of the yolk sac are a source of building material for the embryo (trophic function).

A little later, the ectoderm and the parietal sheet of the mesoderm - in the body region of the embryo separate from the others and form amniotic folds. The latter crawl (from above and behind) on the embryo and fold over it, forming two new membranes - the amniotic membrane. The place of their fusion is called the amnioserous seam. The amniotic (or water) membrane directly covers the embryo. In it, the ectodermal sheet is turned inward (toward the embryo), and the parietal sheet of the mesoderm is turned outward. This membrane delimits the amniotic cavity, in which the space between the membrane and the embryo is filled with liquid. The latter plays a trophic and protective role.

**Allantois.** The allantois begins to form as an outgrowth in the posterior part of the primary intestine. It is formed by the same two leaves as the yolk sac - the visceral leaf of the mesoderm and the endoderm. Then the allantois, growing, grows into the gap between the amnion and the serous membrane. Allantois participates in the allocation of products of the germ's metabolism and in gas exchange.

**Amnion** A continuous membrane around the fetus, which, starting from the seventh week of embryogenesis, participates in the production of amniotic fluid. Yolk A bubble connected to the intestinal tube, the wall of which is lined with epithelium

from the inside of the bag, and is formed by connective tissue on the outside.

### **General plan of the structure of the placenta**

**Placenta** (placenta) is an organ that provides a permanent connection between the mother's body and the fetus. The human placenta belongs to the type of disk-shaped, hemochorial villous placentas. It is an important temporal organ with various functions. At the same time, the placenta creates a barrier between the blood of the mother and the fetus. Includes two constituent parts - maternal and fetal.

**The structure of the maternal part of the placenta** The maternal part of the placenta is formed by the mucous membrane of the uterus in the area where the villi of the fetal chorion grow into it. This is the so-called main shedding (deciduous) shell. In addition to it, in the endometrium of the uterus of a pregnant woman, there is a parietal waste membrane free of chorionic villus growths, as well as a bag waste membrane that separates the embryo from the uterine cavity. A characteristic feature of the connective tissue base of the endometrium is the presence of a significant number of decidual cells. These are large cells of a polygonal shape with oxyphilic cytoplasm that form clusters in the basal layer of the endometrium between the tips of the chorionic villi.

### **The structure of the fetal part of the placenta**

The fetal part of the placenta is formed by a villous chorion - a trophoblast derivative. There is a so-called branched chorion, the villi of which grow into the endometrium in the area of the main waste membrane, and a smooth chorion, which is the place of contact of the trophoblast with the bag waste membrane. Chorionic villi are tree-like branched outgrowths of the trophoblast in the area of its contact with the uterine mucosa. First, the trophoblast forms primary villi, which are built only from trophoblast elements. In the 2nd-3rd week of embryogenesis, with the beginning of ingrowth into the trophoblast of extraembryonic mesoderm, secondary epitheliomesenchymal villi are formed. Finally, secondary chorionic villi grow into the mesenchyme of the vessels of the microcirculatory channel, forming tertiary villi. Therefore, at the base of each tertiary villus of the chorion there is an embryonic connective tissue permeated with blood vessels, which includes a significant amount of collagen and elastic fibers.

**Cellular and tissue elements of the fetal part of the placenta** Among the cellular elements, we should mention Kashchenko-Hofbauer cells, which perform the function of macrophages, as well as fibroblasts - producers of collagen and elastic fibers. The mesenchyme of tertiary villi is separated from the surface epithelium by a basement membrane. Epithelium of villi - single-layer cubic - is called cytotrophoblast. The surface of the cytotrophoblast is covered with a syncytiotrophoblast, which is a fusion product of villous surface epitheliocytes and is formed by a mass of cytoplasm not divided into cells with a significant number of nuclei (symplast).

**Characteristics of the process of placentation** The process of formation of the human placenta occurs most intensively from the third to the sixth week of embryogenesis. This period is called placentation and is a critical period in the life of the embryo. The formation of the placenta is completed in the third month of prenatal ontogenesis. Note that during pregnancy, the villi of the chorion are subject to constant reconstruction. Thus, initially primary villi are replaced by secondary ones, and secondary ones, in turn, by tertiary ones. Starting from the 2nd month of pregnancy, the cytotrophoblast gradually thins and is replaced by a syncytiotrophoblast. Microvilli appear on the surface of the latter. In the second half

of pregnancy, the trophoblast part of the villi is reduced, and their surface is covered by a fibrin-like oxyphilic mass, Langhans's fibrinoid. During the process of placental formation, as the embryo penetrates the uterine mucosa, the trophoblastic epithelium first comes into contact with the epithelium of the endometrium and uterine glands. Under the action of proteolytic enzymes secreted by the trophoblast, the epithelium dissolves and the chorionic villi sink into the connective tissue base of the uterine mucosa. Further growth of the chorion causes the contact of chorionic villi with the endothelium and subsequent destruction of the vessel wall of the microcirculatory channel. The blood flowing from the damaged vessels fills the intervillous spaces, forming lacunae - blood-filled cavities in the endometrium. At the same time, the chorion mainly absorbs amino acids from maternal blood, from which embryo-specific proteins are synthesized in the placenta.

**Structural and functional unit of the placenta** The structural and functional unit of the placenta is the cotyledon. The latter corresponds to the branching territory of one stem villus, which is washed by maternal blood. The stem, or anchor, villi is a large outgrowth of the chorionic plate, tightly fused with the main waste membrane, from the lateral surface of which numerous branched branches of smaller chorionic villi depart. There are about 200 cotyledons in the human placenta. Neighboring cotyledons are separated by connective tissue partitions - septa, through which arterial vessels pass, carrying blood enriched with oxygen and nutrients to the lacunae of the placenta. In lacunae, lacunar veins open with wide openings, through which maternal blood flows from the placenta. The wall of the lacunae is formed by the connective tissue of the endometrium, which is covered with layers of an amorphous substance, the so-called Rohr's fibrinoid. The part of the main waste membrane, placed between the branched and smooth chorion along the edge of the placental disc, tightly grows with the chorion and forms the so-called closing plate, which prevents the flow of blood into the uterine cavity.

**Structure of the hemochorial (placental) barrier** of the placenta There is a hemochorial (placental) barrier that separates the blood of the mother from the blood of the fetus. The hemochorial barrier includes endotheliocytes and the basal membrane of the hemocapillaries of the chorionic villi, the connective tissue enriched with macrophages and fibroblasts surrounding the microcirculatory channel, the basal membrane of the chorionic villi, the syncytiotrophoblast layer, and the Langhans fibrinoid placed on the surface of the latter. Due to circulation in the placental circulatory system, the blood of the fetus is enriched with a number of substances - amino acids, glucose, lipids, electrolytes, vitamins, hormones, antibodies and oxygen, freed from carbon dioxide and other harmful products of metabolism. By producing progesterone, estrogens, placental lactogen, chorionic gonadotropin and other biologically active substances necessary for the normal course of pregnancy, the placenta plays the role of a temporary endocrine gland. Of these hormones, chorionic gonadotropin is released in a fairly significant amount and can be detected in a woman's blood already on the third or fourth day after the beginning of implantation, which is used in medical practice for early diagnosis of pregnancy. The hemoplacental barrier protects the embryo's body from many harmful factors of the external environment that can get from the mother's blood to the fetus. It should be remembered that the hemoplacental barrier is permeable to alcohol, nicotine, narcotic drugs, and many medicines, therefore, the use of these substances by a pregnant woman should be limited as much as possible, and better - excluded entirely.

**Functions of the placenta** The main functions of the placenta: Respiratory.

Transport of nutrients, water, electrolytes and immunoglobulins. Isolated. Endocrine Participation in the regulation of endometrial contraction. Breathing of the fetus is ensured due to oxygen, which joins the hemoglobin of maternal blood, which, by diffusion, enters the blood of the fetus through the placenta, where it combines with fetal hemoglobin (HbF). CO<sub>2</sub> associated with fetal hemoglobin in the blood of the fetus also diffuses through the placenta, enters the mother's blood, where it combines with maternal hemoglobin. The transport of all nutrients that are necessary for the development of the fetus (glucose, amino acids, fatty acids, nucleotides, vitamins, minerals) occurs from the blood of the mother through the placenta to the blood of the fetus, and vice versa, from the blood of the fetus to the blood of the mother, the products of metabolism, which are removed from his body (excretory function). Endocrine function is one of the important ones. The placenta is capable of synthesizing and secreting chorionic gonadotropin, placental lactogen, progesterone, pregnanediol, and estrogens. The placenta contains polyamines (spermine and spermidine), which affect the strengthening of RNA synthesis in the smooth muscle cells of the myometrium, as well as oxidases that destroy them. Aminoxidases that destroy biogenic amines (histamine, serotonin) are important. During pregnancy, their activity increases, which contributes to the destruction of biogenic amines and a decrease in the concentration of the latter in the placenta, myometrium, and the mother's blood.

**Structure and functions of the umbilical cord** The umbilical cord (umbilicus) is a cord formed by connective tissue, in which the main vessels (two arteries and one vein) pass, providing blood circulation between the fetal body and the placenta. In addition to blood vessels, on histological preparations of the umbilical cord, you can see the remains of the yolk stalk, which connects the yolk sac with the body of the embryo, as well as the allantois. At the base of the umbilical cord there is a mucous connective tissue - Warton jelly, which contains a significant amount of hyaluronic acid. The latter ensures turgor (elasticity) of the umbilical cord and non-collapse of the umbilical vessels, as a result of which there is a continuous connection between the mother's body and the fetus. Among the cellular elements in the composition of the umbilical cord, tissue basophils were found, which participate in the regulation of blood circulation in the vessels of the umbilical cord, as well as Kashchenko-Hoffbauer cells. The latter protect the fetus from intrauterine infection. The umbilical vein carries blood enriched with oxygen and nutrients from the placenta to the fetus. The umbilical arteries carry venous blood from the fetus to the placenta. The surface of the umbilical cord is covered with a single-layer cubic (amniotic) epithelium, which on one side becomes the epithelium of the amnion, and on the other - merges with the ectodermal covering of the skin of the embryo in the area of the umbilical ring.

**Equipment:** slides , histological micropreparations, microscope, electronograms.

Plan:

Organizational measures

Technological class map for face-to-face training

	Stages	Time	Teaching aids	Equipment	Venue
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1	Greeting. Attendance check	5		Journal of success	Study room
2	Basic level check	15	Test questions, situational problems		
3	Correction of assimilation of theoretical material	20		Tables, slides, micropreparations	
4	Checking the initial level of training	15	Written assignments, surveys		
5	Independent work. Preparation of the protocol of the practical session.	20	Atlas with micropreparations and EG	Microscope, micropreparations, album	
6	Analysis of results. Summing up	15	Checking the practical part of the lesson		

#### Technological lesson map for online learning

	Stages	Time	Teaching aids	Equipment	Venue
1	Greeting. Attendance check	3		Journal of success	Study room
2	Basic level check	15	Test questions, situational problems		
3	Correction of assimilation of theoretical material	10		Tables, slides, micropreparations	
4	Checking the initial level of training	15	Written assignments, surveys		

5	Independent work. Preparation of the protocol of the practical session.	15	Atlas with micropreparations and EG	Microscope, micropreparations, album	
6	Analysis of results. Summing up	2	Checking the practical part of the lesson		

### Control of the reference level of knowledge

#### Tests:

1. At the early stages of the development of the human embryo, a finger-like outgrowth of the ventral wall of the primary intestine appears, which grows into the amniotic leg. What is the name of this provisional body?

- A. Alantois
- V. Yolk sac
- S. Amnion
- D. Placenta
- E. Pupovina

2. The child inherits histocompatibility antigen from his father and mother. It is known that the expression of parental antigens in embryogenesis begins very early. But the mother's immune system does not reject the embryo. What provisional organ first prevents the mother's body from rejecting the embryo?

- A. Horion
- V. amnion
- S. Alantois
- D. Yolk sac
- E. Pupovina

3. The histological specimen shows an extra-embryonic organ, which is a bladder connected to the intestinal tube. Its wall from the inside is lined with epithelium, and the outside is formed by connective tissue. In the early stages of embryogenesis, it performs the function of a hematopoietic organ. Name this body.

- A. yolk sac
- V. Alantois
- S. Amnion
- D. umbilical cord
- E. placenta

4. During gastrulation, the embryo switches from a histiotrophic to a hematotropic mode of nutrition. Which provisional body provides this for the first time?

- A. Horion
- V. Trophoblast
- S. Yolk sac

- D. Amnion
- E. Alantois

5. Gonoblasts, the precursors of germ cells, were detected in the embryo at 2-3 weeks. In what material do these cells differentiate?

- A. In the yolk sac
- V. In mesenchyme.
- S. In embryonic ectoderm.
- D. In dermatomes.
- E. In the embryonic endoderm.

6. In the process of embryogenesis, the rudiment of an organ with an endocrine function is formed from the trophoblast. Enter the correct answer.

- A. villous chorion (fetal part of the placenta)
- V. amnion
- S. yolk sac
- D. allantois
- E. umbilical cord

7. A histological section of a human embryo shows a bubble connected to the intestinal tube, which is one of the provisional organs. Primary germ cells and primary erythrocytes (megaloblasts) are located in its wall. Identify which organ is this?

- A. Yolk sac
- V. Alantois
- S. Placenta
- D. Pupovina
- E. Amnion

8. It is known that some microorganisms that cause infectious diseases can pass through the placental barrier. Which structures from the following are part of it?

- A. All structural components of tertiary villi
- V. Chorion and amnion
- S. All structural components of secondary villi
- D. Allantois, yolk sac
- E. Basal plate of the endometrium with decidual cells

9. The extra-embryonic organ in the early stages of embryogenesis has a single-layer flat epithelium, which from the third month acquires a prismatic and cubic shape, participates in the production of amniotic fluid. Name this body:

- A. amnion
- V. yolk sac
- S. allantois
- D. umbilical cord
- E. placenta

10. The embryonic organ in which the first formed elements of blood as tissue are formed was studied. Name this body:

- A. Yolk sac
- B. Red bone marrow
- S. Pechinka
- D. Selezinka
- E. Thymus

11. A newborn child was diagnosed with blue asphyxia. Which vessel that brings oxygen from the mother's blood to the fetus was compressed during childbirth?

- A. Umbilical vein.
- V. Umbilical artery.
- S. Chorial vein.
- D. Chorial artery.
- E. Uterine artery.

12. At a certain stage of human ontogenesis, a physiological connection is established between the circulatory systems of the mother and the fetus. This function is performed by the provisional body:

- A. Placenta
- V. Alantois
- S. Amnion
- D. Serous membrane
- E. Yolk sac

13. Producing a number of hormones, the placenta plays the role of a temporary endocrine gland. What hormone can be determined in a woman's blood already on the third or fourth day after the beginning of implantation, which is used in medical practice for early diagnosis of pregnancy?

- A. Chorionic gonadotropin
- V. Somatostatin
- S. Progesterone
- D. Vasopressin
- E. Oxytocin

14. Histochemical examination of the inflamed umbilical cord revealed an increase in hyaluronidase activity. How does it affect the permeability of the main substance of the mucous membrane?

- A. Insight increases.
- A. Does not affect.
- S. Penetration decreases.
- D. Exchange processes slow down.
- E. The substance is compacted

15. During gastrulation, the embryo switches from a histiotrophic to a hematotrophic mode of nutrition. Which provisional body provides this for the first time?

- A. Horion
- V. Trophoblast
- S. Yolk sac
- D. Amnion



E. Allantois

16. In the process of embryogenesis, the rudiment of an organ with an endocrine function is formed from the trophoblast. Enter the correct answer.

A. villous chorion (fetal part of the placenta)

V. amnion

S. yolk sac

D. allantois

E. umbilical cord

17. The histological preparation shows a cross-section of an organ, the basis of which is formed by mucous connective tissue, two arteries and a vein. What kind of organ is this?

A. Pupovina

V. Allantois

S. Yolk sac

D. Amnion

E. Placenta

18. There was compression of the umbilical cord of the fetus, but the blood circulation between the fetus and the mother was not disturbed. The presence of which structures contributed to this in the first place:

A. Mucous connective tissue

V. Remainder of the allantois

S. Sheath of arteries

D. Sheath of the vein

E. Remainder of yolk stem

19. It is known that some microorganisms that cause infectious diseases can pass through the placental barrier. Which structures from the following are part of it?

A. All structural components of tertiary villi

V. Chorion and amnion

S. All structural components of secondary villi

D. Allantois, yolk sac

E. Basal plate of the endometrium with decidual cells

Discussion of theoretical issues:

1. The value of the amniotic membrane for the embryo. The structure of the amnion.
2. The structure and functions of the yolk sac.
3. Structure and functions of the allantois.
4. Morphofunctional characteristics of the chorion
5. The value of the amniotic membrane for the embryo.
6. Placenta An organ that provides a permanent connection between the mother's body and the fetus.
7. Umbilical cord A cord formed by connective tissue in which the main vessels (two arteries and one vein) pass, providing blood circulation between the fetal body and the placenta.
8. General plan of the structure of the placenta.

9. The structure of the maternal part of the placenta.
10. The structure of the fetal part of the placenta. Cellular and tissue elements of the fetal part of the placenta.
11. Characteristics of the process of placentation. Structural and functional unit of the placenta.
12. The structure of the hemochorial (placental) barrier. Functions of the placenta.
13. Structure and functions of the umbilical cord.

#### Tests.

1. The terminal villi of the chorion are covered with:
  - A. Cytotrophoblastoma and syncytiotrophoblastoma
  - B. Endothelium of maternal vessels
  - S. Serous membrane
  - D. Mucous tissue
  - E. Mucous membrane
2. The stroma of the terminal villus of the chorion is formed by:
  - A. Syncytiotrophoblastoma
  - B. Cytotrophoblastoma
  - C. Embryonic connective tissue, contains blood capillaries
  - D. Decidual cells and collagen fibers, contains lymphatic capillaries
  - E. Mucous tissue
3. The yolk sac of a human embryo exists until:
  - A. 20-22nd week of embryogenesis
  - B. the beginning of implantation
  - P. of the 8th-9th week of embryogenesis
  - D. the end of the fetal period
  - E. 14-18 days of embryogenesis
4. In the preparation of a 10-day-old human embryo, 2 vesicles in contact with each other (amniotic and yolk) are visible. What is the name of the structure that lies in the place of their contact?
  - A. the roof of the yolk sac
  - B. the bottom of the amniotic sac
  - S. embryonic shield
  - D. amniotic leg
  - E. extraembryonic mesoderm
5. In human embryogenesis, on the 20th day, the body of the embryo separates from the provisional organs. What does this process provide?
  - A. whole
  - V. amniotic fold
  - S. trunk fold
  - D. yolk sac
  - E. somites
6. During the ultrasound examination of a pregnant woman, polyhydramnios was diagnosed. This pathological condition can be associated with a violation of the activity of which extra-embryonic organs?
  - A. Amniotic membrane

- B. Chorion
- C. Placenta
- D. Yolk sac
- E. Alantois

7. "A man was born in a shirt." What "shirt" does this proverb refer to?

- A. Amniotic
- V. Zhovtkov
- S. Serozna
- D. Khorialna
- E. Trophoblastic

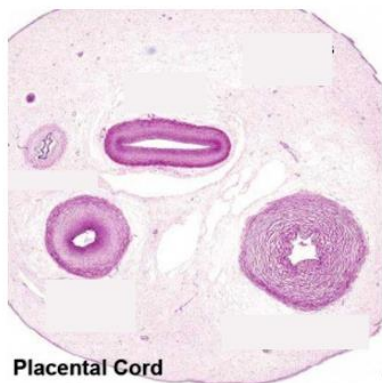
8. During the study of amniotic fluid obtained during amniocentesis (puncture of the amniotic membrane), cells whose nuclei contain sex chromatin (Barr body) were found. What of the above can this indicate?

- A. Development of the fetus of the female article
- B. Development of the fetus of the male article
- S. Genetic disorders in fetal development
- D. Trisomy
- E. Polyploidy

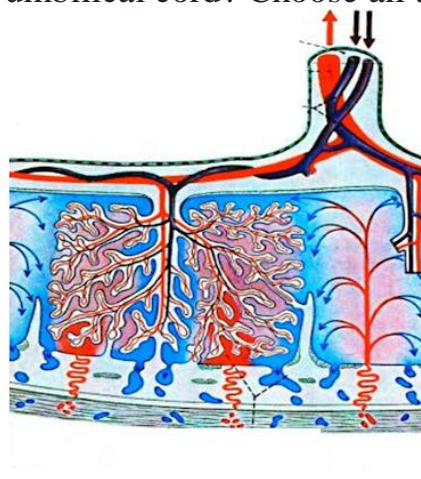
9. The histological specimen shows an extra-embryonic organ, which is a bladder connected to the intestinal tube. Its wall from the inside is lined with epithelium, and the outside is formed by connective tissue. In the early stages of embryogenesis, it performs the function of a hematopoietic organ. Name this body.

- A. yolk sac
- V. Alantois
- S. Amnion
- D. Pupovina
- E. Placenta

10 . What is included in the umbilical cord? Choose all that are correct:



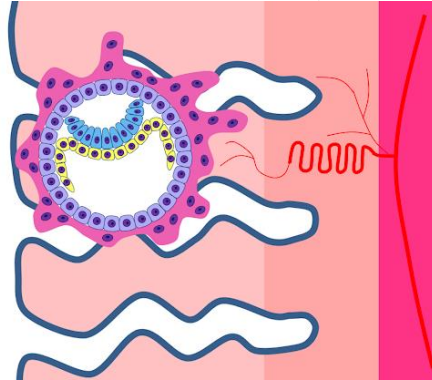
Placental Cord



- 1) Two veins
- 2) One vein
- 3) Yolk duct
- 4) Extraembryonic ectoderm (amniotic epithelium)
- 5) Trophoblast
- 6) Two arteries

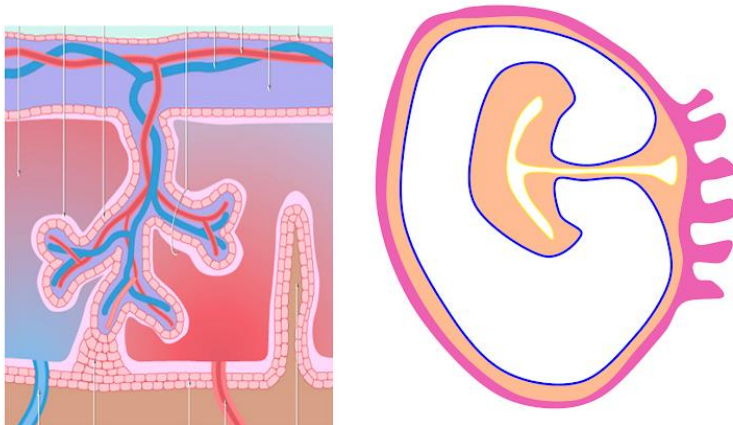
- 7) One artery
- 8) Allantois
- 9) Mucous connective tissue

11. When is the nutrition of the embryo according to the histiotrophic type?



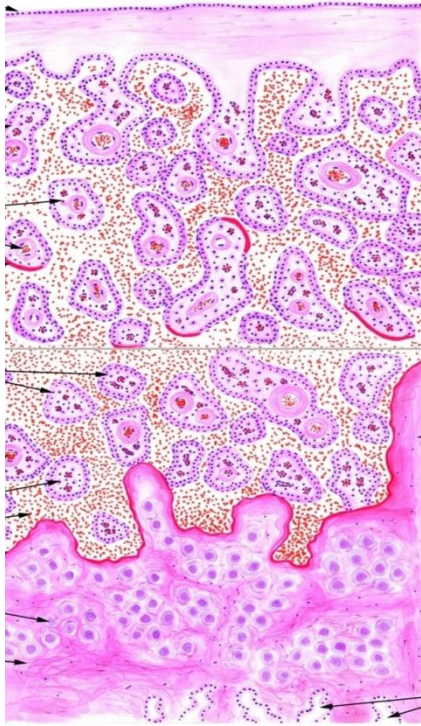
- 1) During the entire pregnancy
- 2) 2nd - 4th week of ontogenesis
- 3) Starting from the 3rd-4th week of ontogenesis and until birth
- 4) 1st week of ontogenesis

12. What covers the fetal part of the placenta from the side of the amniotic sac cavity?



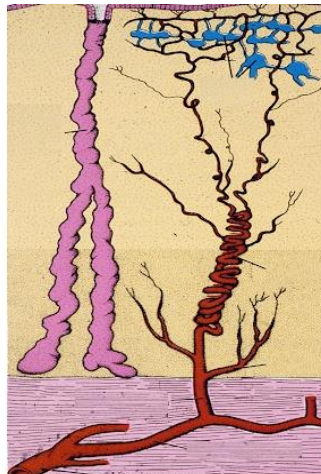
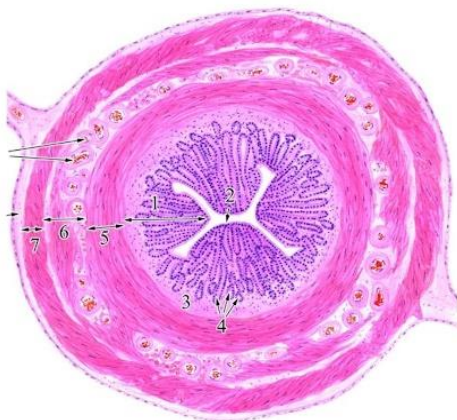
- 1) Symplastotrophoblast (syncytiotrophoblast)
- 2) Extra-embryonic endoderm
- 3) The basal layer of the endometrium
- 4) Cytotrophoblast
- 5) Extraembryonic ectoderm (amniotic epithelium)
- 6) Endothelium

13. What is Rohr's fibrinoid?



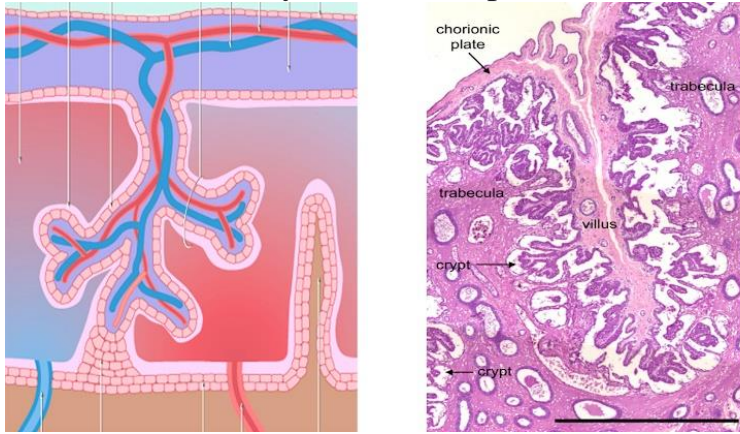
- 1) The branching area of one stem villi
- 2) Villus formed by mesenchyme and trophoblastic epithelium
- 3) Oxyphilic mass lining the exposed areas of the lacunae of the endometrium in the maternal part of the placenta from the inside
- 4) Villus formed by trophoblastic epithelium
- 5) Oxyphilic mass covering the chorionic villi in the fetal part of the placenta

14. What structures of the uterine wall are involved in the formation of the waste membrane?



- 1) Perimeter
- 2) All layers of the uterine wall
- 3) Endometrium and myometrium
- 4) Myometrium
- 5) Both layers of the endometrium
- 6) The basal layer of the endometrium
- 7) Functional layer of the endometrium

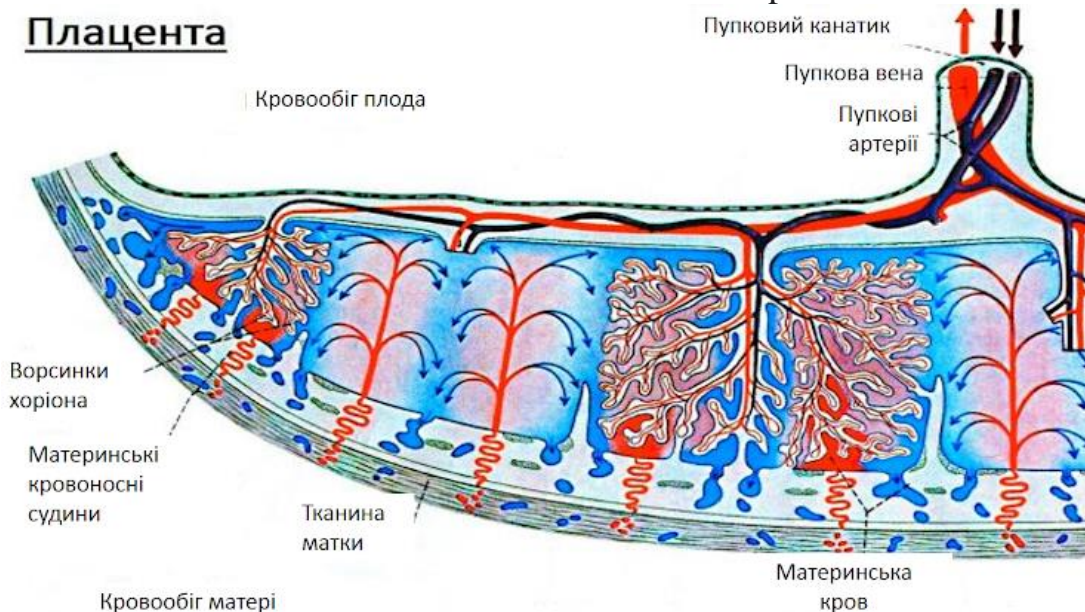
15. What is the cotyledon of the placenta?



- 1) Territory branching one trunk villi
- 2) Oxyphilic mass that \_ covers chorionic villi
- 3) Villus , formed epithelium trophoblast
- 4) Vorsinka , that consists from mesenchyme and epithelium trophoblast

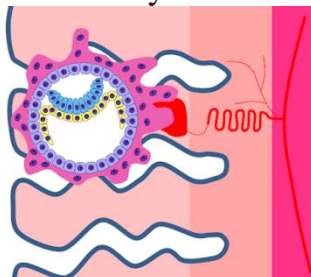
16. What is the structural and functional unit of the placenta?

### Плацента

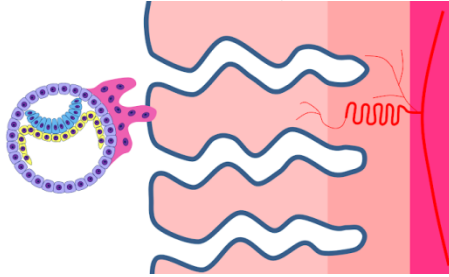


- 1) Secondary villus of the chorion
- 2) Cotyledon
- 3) The primary villus of the chorion
- 4) Tertiary villus of the chorion
- 5) Lacuna with maternal blood
- 6) Chorion

17. When is the embryo nourished by the hematotrophic type?



- 1) 1st week of ontogenesis
  - 2) Starting from the 3rd-4th week of ontogenesis and until birth
  - 3) 2nd - 4th week of ontogenesis
  - 4) During the entire pregnancy
18. What is the embryo called at the time of implantation?



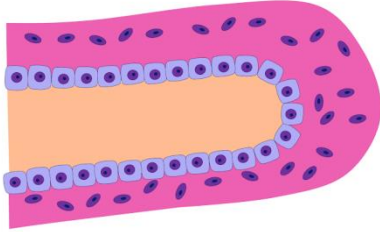
- 1) Neyrula
- 2) Blastocyst
- 3) Zygote
- 4) Morula
- 5) Fruit

19. What is Langhans fibrinoid?



- 1) Oxyphilic mass covering the chorionic villi in the fetal part of the placenta
- 2) Villus formed by trophoblastic epithelium
- 3) Oxyphilic mass lining the exposed areas of the lacunae of the endometrium in the maternal part of the placenta from the inside
- 4) Villus formed by mesenchyme and trophoblastic epithelium
- 5) The branching area of one stem villi

20. Determine which type of chorionic villus is shown in the diagram:



- 1) Primary
- 2) Tertiary
- 3) Secondary

### Topics of reports/abstracts

1. The value of the amniotic membrane for the embryo. The structure of the amnion.
2. Morphofunctional characteristics of the yolk sac.
3. Morphofunctional characteristics of the allantois.
4. Morphofunctional characteristics of the chorion
5. The importance of the hemochorial (placental) barrier.
6. Anomalies of placenta formation
7. Hormonal function of the placenta and its significance
8. Pharmacological teratogenic factors
9. Comparative characteristics of parts of the placenta

Summary:

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List of recommended literature

Main:

1. Lutsik O.D., Tchaikovsky Y.B. Histology, cytology, embryology Vinnytsia, New book, 2018.
2. Barinov E.F., Tchaikovsky Y.B. special histology and embryology of internal organs: textbook. Kyiv: Medicine; 2013
3. Voytseh Pavlyna. Histology: textbook and atlas. VSV: Medicine, 2021.

Additional:

1. Histology and embryology of internal organs: teaching. help./ E.F. Barinov, Yu.B. Tchaikovsky, O.M. Sulaeva and others; under the editorship E.F. Barinova, Yu.B. Tchaikovsky. - K.: VSV "Medicine", 2013. - 472 p.
2. Cytology of human organs and tissues edited by L.S. Bolhova. Kyiv: Book-plus, 2018, p. 288



METHODODOLOGICAL DEVELOPMENT  
seminar class  
from the academic discipline of histology, cytology and embryology

Faculty, medical course III year  
Educational discipline histology, cytology and embryology

Approved:

The meeting of the department \_\_\_\_\_  
Odessa National Medical University

Protocol No. \_\_\_\_ of “ \_\_\_\_ ” \_\_\_\_\_ 20\_\_

Head of the department \_\_\_\_\_ (\_\_\_\_ Tiron  
O.I. \_\_\_\_\_)

Developers:

Doctor of Medicine \_associate professor, Tiron O.I \_  
Doctor of Medicine, associate professor Kuvshinova I.I.  
Doctor of Medicine, Associate Professor Markova O.O.  
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## Seminar lesson No. 7

**Topic:** Critical periods of human development.

**Purpose:** In the process of ontogenesis, there are periods of increased sensitivity of the body to the harmful effects of environmental factors. These periods were called critical periods of development. The basis for the emergence of critical periods is the transition of the embryo organism from one morphofunctional stage to the next, qualitatively different from the previous one. At the same time, the qualitative reconstruction of the organism is accompanied by the proliferation, determination and differentiation of the cells that are its components.

Knowledge of the processes that occur during critical periods of human development is necessary for the future doctor for the rational prevention of anomalies and developmental defects of the fetus. It makes it possible to consider and evaluate the entire cycle of biological phenomena that accompany pregnancy, to prevent the consequences of adverse effects of environmental and household factors.

### **Basic concepts:**

For the first time, the concept of critical periods of development was formulated by the Australian doctor Norman Greg in 1944. A significant contribution to the development of the provisions of the theory of critical periods was made by the Russian embryologist P. G. Svetlov.

Such periods of increased sensitivity in progenesis are meiosis (stage of maturation of germ cells), as well as the process of fertilization.

In prenatal ontogenesis, critical periods include **implantation** (6-8 days), **placentation** and **the development of axial rudiments of organs** (3-8 weeks), the period of enhanced **brain development** (15-20 weeks), the period of **formation of the main functional systems** of the body (20-24th week), as well as **the birth process** .

In postnatal ontogenesis, critical periods of development include the newborn period (the first year of a child's life), the period of puberty (11-16 years). Chemical substances (including medicines), ionizing radiation (including X-rays for diagnostic purposes), hypoxia, starvation, narcotic drugs (including nicotine and alcohol) can have a harmful effect on the body, especially during critical periods of its development. , viruses, bacteria. Chemical substances that can pass through the hemoplacental barrier are especially dangerous in the first months of pregnancy, as they have the ability to accumulate in the tissues and organs of the fetus. In this case, the probability of their damaging effect increases significantly.

**Equipment:** slides , histological micropreparations, microscope, electronograms.

### **Plan:**

Organizational measures

Technological class map for face-to-face training

	Stages	Time	Teaching aids	Equipment	Venue
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1	Greeting. Attendance check	5		Journal of success	Study room
2	Basic level check	15	Test questions, situational problems		
3	Correction of assimilation of theoretical material	20		Tables, slides, micropreparations	
4	Checking the initial level of training	15	Written assignments, surveys		
5	Independent work. Preparation of the protocol of the practical session.	20	Atlas with micropreparations and EG	Microscope, micropreparations, album	
6	Analysis of results. Summing up	15	Checking the practical part of the lesson		

### Technological lesson map for online learning

	Stages	Time	Teaching aids	Equipment	Venue
1	Greeting. Attendance check	3		Journal of success	Study room
2	Basic level check	15	Test questions, situational problems		
3	Correction of	10		Tables, slides, micropreparations	

	assimilation of theoretical material				
4	Checking the initial level of training	15	Written assignments, surveys		
5	Independent work. Preparation of the protocol of the practical session.	15	Atlas with micropreparations and EG	Microscope, micropreparations, album	
6	Analysis of results. Summing up	2	Checking the practical part of the lesson		

Control of the reference level of knowledge

### Tests

1. During gastrulation, the primary Hensen nodule was not sufficiently formed in the embryo. The development of which axial organ is inhibited?

A. Hordy

V. Nervous combs

S. Nervous groove

D. Neural tube

E. Mantle layer of the neural tube

2. In the neural tube of the human embryo, ectodermal cells differentiate into neuroblasts and spongioblasts. As a result of the movement of these cells in the neural tube, layers are formed. In which of the layers are the bodies of neuroblasts mainly localized?

A. Mantle layer.

V. Ependymy.

S. Krayovai voali.

D. White matter.

E. Sheaths of the spinal cord.

3. The infant was diagnosed with microcephaly. Doctors believe that this is related to the woman's use of actinomycin D during pregnancy. Which germ layers did this

teratogen primarily affect?

- A. Ectoderm
- B. All leaves
- C. Endoderm
- D. Mesoderm
- E. Endoderm and mesoderm

4. In the experiment, the myotome was destroyed in a rabbit embryo. Violation of the development of which structure is caused by this one

- A. Skeletal muscles
- V. Axial skeleton
- S. Connective tissue of the skin
- D. Smooth muscles
- E. Serous membranes

### **Discussion of theoretical issues:**

1. Characteristics of the main critical periods in human ontogenesis:

- fertilization
- implantation (8-10 days)
- development of axial organs (3-4 weeks)
- placentation (3-8 weeks)
- brain development (15-20 weeks)
- active development of body systems (20-24 weeks)
- birth
- the first year of life
- the period of puberty (11-16 years)

### **Tests.**

1. In the third week of embryogenesis, the central part of the cells of the epiblast (ectoderm) bends and the process of neurulation begins. In what direction does the rest of the cells, the ectoderm, differentiate?

- A. Skins
- V. Guts
- S. Somitiv
- D. Hordy
- E. Gallbladder

2. On the micropreparation of the skin of the child's finger, we observe that the epidermis has signs of insufficient development. Which embryonic sheet was damaged during development?

- A. Ectoderm
- B. Mesoderm
- S. Endoderm
- D. \_ Mesenchyme
- E. Ectomesenchyma

3. Violation of endoderm differentiation was found in the embryonic material. Changes in the development of which organs can occur during this process?

A. Stomach

V. Hearts

S. Kidney

D. \_ Aorta

E. Salivary glands

4. In the third week of human embryogenesis, the central part of epiblast cells (ectoderm) bends and the process of neurulation begins. In which direction do the rest of the cells of the ectoderm differentiate?

A. Intestines

B. \_ Somitov

C. \_ Yolk bladder

D. \_ skins

E. \_ Chords

5. As a result of the unblocking of oncogenes in the embryo, the differentiation of one of the embryonic germs was disturbed. As a result, a malignant tumor developed from the muscular membrane of the small intestine. The development of which embryonic embryo was disturbed?

A. \_ Splanchnotoma

B. \_ Mesenchyme

C. \_ Myotoma

D. \_ Neural tube

E. \_ Skin ectoderm

### **Questions to test basic knowledge on the topic of the seminar.**

1. Derivatives of the neural crest are:

A. Pyramidal neurons of the cerebral cortex.

B. Melanocytes.

S. Olfactory neurons.

D. Dermis of the skin.

E. Vertebrae and bones of the cerebral skull.

2. Derivatives of neurogenic placodes are:

A. Pyramidal neurons of the cerebral cortex.

B. Melanocytes.

S. Olfactory neurons.

D. Dermis of the skin.

E. Vertebrae and bones of the cerebral skull.

3. Mesoderm in mammals is formed from:

A. Teloblastiv.

V. Mesoblastiv.

S. Epiblast.

- D. Primary endoderm.
- E. Mesenchyme
- 4. During the differentiation of the mesoderm, the following rudiments are formed:
  - A. ectoderm, endoderm
  - V. somite, nephrogonotoma, splanchnotoma
  - S. epiblast, hypoblast
  - D. embryoblast, trophoblast
  - E. somite, nephrogonotoma, neural plate
- 5. The embryonic period of embryogenesis continues:
  - A. The first week
  - A. Second to eighth week
  - S. Three weeks
  - D. Four weeks
  - E. 1-5 weeks
- 6. The woman got sick with the flu and it turned out that it happened during the early phase of gastrulation. What consequences should be expected?
  - A. Violation of the formation of ecto- and endoderm
  - B. Violation of mesoderm formation
  - C. Violation of mesenchyme formation
  - D. Violation of the epiboly process
  - E. Violation of the process of intussusception

**Topics of reports/abstracts :**

1. Characteristics of the main critical periods in human ontogenesis
  2. Birth defects. Pharmacological teratogenic factors
  3. Congenital defects. Chemical and physical teratogenic factors
  4. Congenital defects. Social teratogenic factors
  5. Congenital defects. Infectious teratogenic factors

Summary:

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List of recommended literature

Main:

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## METHODOLOGICAL DEVELOPMENT

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Odessa National Medical University

Protocol No. \_\_\_\_ of “ \_\_\_\_ ” \_\_\_\_\_ 20\_\_

Head of the department \_\_\_\_\_ (\_\_\_\_Tiron  
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Developers:

Doctor of Medicine \_associate professor, Tiron O.I \_

Doctor of Medicine, associate professor Kuvshinova I.I.



Doctor of Medicine, Associate Professor Markova O.O.  
assistant Lyashevska O.O.

### Seminar session No. 8

**Topic:** Control of theoretical knowledge. Credit class. Final control of mastering the discipline.

Technological map of classes for face-to-face training

	Stages	Time	Teaching aids	Equipment	Venue
1	Greeting. Attendance check	5		Journal of success	Study room
2	Control of theoretical knowledge	70			
3	Analysis of results. Summing up	15	Checking the practical part of the lesson		

Technological lesson map for online learning

	Stages	Time	Teaching aids	Equipment	Venue
1	Greeting. Attendance check	5		Journal of success	Study room
2	Control of theoretical knowledge	40			
3	Analysis of results.	15	Checking the practical part of		

	Summing up		the lesson		
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Tests.

**1 .** In the first critical period, the fertilization membrane dissolved in the embryo in the fallopian tube. What complication of pregnancy is possible in this case?

- A.** \_ \* Embryo implantation in the tube wall
- B.** \_ Embryo death
- C.** \_ Intussusception of the blastocyst wall
- D.** \_ Return of the blastocyst back to the ampullary zone of the tube
- E.** \_ Formation of two blastocysts

**2 .** An early human embryo is built from two blastomeres. Name the most likely place of its localization under the condition of normal course of prenatal development.

- A.** \_ \* Fallopian tube, near its ampullary part
- B.** \_ Fallopian tube, near its uterine end
- C.** \_ Uterine cavity
- D.** \_ Abdomen
- E.** \_ Ovary

**3 .** A human embryo built from two blastomeres was found. Name the place of its localization under the condition of its normal development?

- A.** .\*Uterine tube, near its ampullary part
- B.** \_ Uterine cavity
- C.** \_ Abdomen
- D.** \_ Uterine tube
- E.** \_ Ovary

**4 .** In human embryogenesis, the following periods are distinguished: initial, presomite, somite, implantation, placentation. At what time does placentation occur?

- A.** \_ \*third - eighth week
- B.** \_ 7-8 days

C. \_ 17 - 20 days

D. \_ 21 - 35 days

E. \_ 1-7 days

5 . During the formation of a human embryo, one can observe the appearance of a cavity in its composition, light small blastomeres on the periphery and dark large blastomeres at one of the poles. What is the name of the embryo at this stage of development?

A. \_ \*Blastula

B. \_ Morula

C. \_ Zygote

D. \_ Gastrula

E. \_ Germ disc

6 . The diagram shows a human embryo in one of the early stages of development (multicellularity, presence of a cavity) before implantation. What is this stage?

A. \_ \*Blastocyst

B. \_ Zygote

C. \_ Morula

D. \_ Gastrula

E. \_ Nerula

7 . During gastrulation, the primary mesodermal (Hensen's) nodule was insufficiently formed in the embryo. The development of which axial organ is inhibited?

A. \_ \* Chords

B. \_ Nerve combs

C. \_ Nerve groove

D. \_ Neural tube

E. \_ Mantle layer of the neural tube

8 . During an ultrasound examination, an abnormality in the development of the fetal brain was detected in a pregnant woman. The woman's history is chronic alcoholism.

What critical period of human embryogenesis can correspond to this severe pathology?

A.  \*15-20 week of development

B.  20-24 week of development

C.  7-8 days of embryogenesis

D.  3-8 week of development

E.  Period of newborns

9 . During the examination of the pregnant woman, the doctor paid attention to the anamnesis data, which indicated that the woman suffered an acute infectious disease during the 3rd to 4th week of pregnancy. What stage of embryogenesis of the fetus is most likely to be disturbed?

A.  \*Formation of the intestinal tube

B.  Implantation

C.  Placentation

D.  Brain development

E.  Formation of the reproductive system

10 . In a conditional experiment, at an early stage of embryogenesis, the mesenchyme in the wall of the yolk sac of a mammalian embryo was destroyed. What will be the consequences of such manipulation?

A.  \*The formation of blood vessels will be disrupted

B.  The embryo's trophism will be disrupted

C.  The release of metabolic products will be disturbed

D.  The formation of the allantois will be disturbed

E.  The formation of the amnion will be disturbed

11 . In the blastocyst covered with the fertilization membrane, the synthesis of lytic hormones in trophoblast cells is genetically inhibited. What process of embryogenesis can be delayed or not carried out?

A.  \*Implantation

B.  Delamination

**S.** \_ Immigration

**D.** \_ Gastrulation

**E.** \_ Epibolia

**12 .** During microscopic examination of the germinal material in the preparation, a yolk sac is determined. Specify the main function of this organ.

**A.** \_ \*Hematopoietic

**B.** \_ Trophic

**C.** \_ Production of amniotic fluid

**D.** \_ Excretory

**E.** \_ Protective

**13 .** During the examination of the patient, an abnormality in the development of the liver was revealed. What embryonic source is damaged?

**A.** \_ \*The endoderm of the front wall of the trunk intestine

**B.** \_ Endoderm of the back wall of the trunk intestine

**C.** \_ The endoderm of the foregut

**D.** \_ Mesonephric duct

**E.** \_ Endoderm of the hindgut

**14 .** During the microscopic examination of the embryonic material in the preparation, a provisional organ, the chorion, is determined. What is the main function of this organ?

**A.** \_ \*Exchange of substances between the organism of the mother and the fetus

**B.** \_ Hematopoietic

**C.** \_ Production of amniotic fluid

**D.** \_ Formation of primary germ cells

**E.** Formation and growth of blood vessels

**15 .** Gonoblasts, the precursors of germ cells, were detected in the embryo at 2-3 weeks. In what material do these cells differentiate for the first time?

A. \_ \*In extra-embryonic endoderm

B. \_ In the mesenchyme

C. \_ In the embryonic ectoderm

D. \_ In dermatomes

E. \_ In the embryonic endoderm

16 . Early gastrulation of the human embryo occurs by delamination of the embryoblast. In which structure is the beginning of the nervous system?

A. \_ \*In the epiblast

B. \_ In the trophoblast

C. \_ In the hypoblast

D. \_ In the marginal zone of the hypoblast

E. In the marginal zone of the epiblast

17 . It is known that neural crest cells migrate long distances and are the progenitors of many types of cells in the human body. What cells never develop from the neural crest?

A. \_ \*Myocytes

B. \_ Neurots of autonomic ganglia

C. \_ The medulla of the adrenal glands

D. \_ Melanocytes

E. Sensitive nuclei of cranial nerves

18 . The process of crushing the zygote ends with the formation of a blastula. What type of blastula is characteristic of mammals and humans?

A. \_ \*Blastocyst

B. \_ Celloblastula

C. \_ Discoblastula

D. \_ Amphiblastula

E. \_ Morula

**19 .** The extra-embryonic organ in the early stages of embryogenesis has a single-layer flat epithelium, which from the third month acquires a prismatic and cubic shape, participates in the production of amniotic fluid. Name this body:

**A. \_** \*Amnion

**B. \_** Yolk sac

**C. \_** Alantois

**D. \_** Umbilical

**E. \_** Placenta

**20 .** Polyhydramnios was diagnosed during an ultrasound examination of a pregnant woman. This pathological condition can be associated with a violation of the activity of which extra-embryonic organs?

**A. \_** \*Amniotic membrane

**B. \_** Yolk sac

**C. \_** Chorion

**D. \_** Alantois

**E. \_** Placenta

**21 .** In a pregnant woman, on the second day after fertilization, separation of light and dark blastomeres occurred as a result of crushing. What is the likely consequence of this type of fragmentation?

**A. \_** \*Birth of identical twins

**B. \_** Birth of Siamese twins

**C. \_** Termination of embryogenesis

**D. \_** The birth of a boy

**E. \_** The birth of a girl

**22 .** The woman gave birth to Siamese twins, who shared the amnion and yolk sac during embryogenesis. In what period of embryogenesis did the division of the embryo into two parts take place?

**A. \_** \*After the ninth day

**B. \_** 1-3 days

C. \_ 4-5 days

D. \_ 21-28 days

E. \_ 30-35 days

**23 .** During gastrulation, the embryo switches from a histiotrophic to a hematotrophic mode of nutrition. Which provisional body provides this for the first time?

A. \_ \* Chorion

B. \_ Trophoblast

C. \_ Yolk sac

D. \_ Amnion

E. \_ Alantois

**24 .** A man with the genetic Kartegener syndrome, which is based on the lack of movement of eyelashes and flagella, came to the hospital. What are the molecular mechanisms of this pathology?

A. \_ \* Absence of dynein

B. \_ Excess dynein

C. \_ Absence of tubulin

D. \_ Deficiency of spectrins

E. \_ Lack of hyaluronidase

**25 .** The child inherits histocompatibility antigen from his father and mother. It is known that the expression of parental antigens in embryogenesis begins very early. But the mother's immune system does not reject the embryo. What provisional organ first prevents the rejection of the embryo by the mother's body?

A. \_ \* Chorion

In \_ Cytotrophoblast

S. \_ Alantois

D. \_ Yolk sac

E. \_ Placenta



**26.** On the micropreparation of a human embryo taken from an involuntary miscarriage, an embryonic shield was found, in which two layers of cells are recognized: ento- and ectoderm. At what stage of embryonic development was the embryo?

A.  \*Gastrulations

B.  Progenesis

C.  Neurulation

D.  Histogenesis

E.  Organogenesis

**27 .** Normal implantation of a human embryo can only occur if the endometrium of the uterus changes accordingly. Which cells of the endometrium increase quantitatively?

A.  \* Decidual cells

B.  Macrophages

C.  Endotheliocytes

D.  Fibroblasts

E.  Neurons

**28 .** During the forensic examination of a woman who died in a car accident, an embryo at the early gastrula stage was found. Name the place of its localization under the condition of its normal development.

A.  \* C uterine lining

B.  The ampullary part of the fallopian tube

C.  The uterine part of the fallopian tube

D.  Ovary

E.  Abdomen

**29 .** Gastrulation or the formation of germ leaves of the embryo is carried out in different ways. How is ectoderm and endoderm formed in humans?

A.  \*Delamination

B.  Intussusception

C. \_ Epibolia

D. \_ Immigration

E. \_ Intussusception, epiboly

**30** \_ A woman came to the women's consultation with a complaint about infertility. In which part of the female reproductive system does fertilization take place?

A. \_ \*Ampullary part of the fallopian tube

B. \_ The uterine part of the fallopian tube

C. \_ Uterine cavity

D. \_ Ovary

E. \_ Abdomen

**31** \_ Through the female genital tract, spermatozoa move toward the ovum against the fluid (distant stage of fertilization). What is the name of this directional movement?

A. \_ \* Rheotaxis

B. \_ Thermotaxis

C. \_ Chemotaxis

D. \_ Capacitance

E. \_ Acrosomal reaction

**32** . The domestic embryologist PS Svetlov described 8 critical periods of embryo development. When does the first critical period of embryo development occur?

A. \_ \*On the seventh-eighth day of development

B. \_ On the first - fourth day of development

C. \_ In the second - third week of development

D. \_ On the third - sixth week of development

E. \_ On the tenth - twelfth week of development

**33** . Implantation of the embryo in the mucous membrane of the uterus consists of two phases - adhesion and invasion. The adhesion phase is accompanied by:

- A. \_ \*Attachment of the blastocyst to the surface of the endometrium
- B. \_ Destruction of the connective tissue of the endometrium
- C. \_ Destruction of epitheliocytes of the mucous membrane (endometrium) of the uterus
- D. Activation of the secretion of the uterine glands
- E. Suppression of the secretion of the uterine glands

34 . In human embryogenesis, on the 20th day, the body of the embryo separates from the provisional organs. What structures ensure this process?

- A. \_ \*Torso fold
- B. \_ Amniotic fold
- C. \_ As a whole
- D. \_ Yellow stem
- E. \_ Somite

35 . Producing a number of hormones, the placenta plays the role of a temporary endocrine gland. What hormone can be detected in a woman's blood already on the third or fourth day after the start of implantation, and is used in medical practice for early diagnosis of pregnancy?

- A. \_ \* Chorionic gonadotropin
- B. \_ Somatostatin
- C. \_ Progesterone
- D. \_ Vasopressin
- E. \_ Oxytocin

36 \_ An extra-embryonic organ is visible on the histological preparation, which is a bladder connected to the intestinal tube. Its wall from the inside is lined with epithelium, and the outside is formed by connective tissue. In the early stages of embryogenesis, it performs the function of a hematopoietic organ. Name this body.

- A. \_ \* Yolk sac
- B. \_ Alantois
- C. \_ Amnion

D. \_ Umbilical

E. \_ Placenta

37 \_ The implantation process takes place in two stages: adhesion and invasion. The morphological manifestation of the blastocyst adhesion process is:

A. \_ \*Attachment of the blastocyst to the endometrium

B. \_ Endometrial epithelium destruction

C. \_ Destruction of endometrial connective tissue

D. \_ Destruction of endometrial vessels

E. \_ Formation of gaps

38 . In the process of embryogenesis, the rudiment of an organ with an endocrine function is formed from the trophoblast. Enter the correct answer.

A. \_ \* Villous chorion (fetal part of the placenta)

B. \_ Amnion

C. \_ Yolk sac

D. \_ Alantois

E. \_ Umbilical

39 \_ A human embryo was found in the uterine cavity, not attached to the endometrium. What stage of development does the embryo correspond to?

A. \_ \*Blastocysts

B. \_ Zygotes

C. \_ Moruli

D. \_ Gastrula

E. \_ Neurons

40 \_ During the examination of a pregnant woman with the help of ultrasound (ultrasound), the doctor found a violation of the development of the brain of the fetus. The mother has a history of chronic alcoholism. What critical period of human embryogenesis does this pathology correspond to?

A. \_ \*15-20 week of development

- B. \_ 20-24 week of development
- C. \_ 7-8 days of embryogenesis
- D. \_ 3-8 week of development
- E. \_ Birth period

41 \_ When examining the amniotic fluid obtained during amniocentesis (puncture of the amniotic membrane), the cells whose nuclei contain sex chromatin (Barr body) were found. What of the above can this indicate?

- A. \_ \*Fetal development of the female article
- B. \_ Development of the fetus of the male article
- C. \_ Genetic disorders in fetal development
- D. \_ Trisomy
- E. \_ Polyploidy

42 . The newborn child was diagnosed with blue asphyxia. Which vessel that brings oxygen from the mother's blood to the fetus was compressed during childbirth?

- A. \_ \*Umbilical vein
- B. \_ Umbilical artery
- C. \_ Chorionic vein
- D. \_ Chorionic artery
- E. \_ Uterine artery

43 . In the preparation of a 10-day-old human embryo, 2 vesicles in contact with each other (amniotic and yolk) are visible. What is the name of the structure that lies in the place of their contact?

- A. \_ \* Germ shield
- B. \_ The bottom of the amniotic sac
- C. \_ The roof of the yolk sac
- D. \_ Amniotic leg
- E. \_ Extraembryonic mesoderm

**44 .** The preparation shows an oocyte at the moment of its fertilization by a sperm. What is the main result of fertilization?

- A. \_** \*Renewal of the diploid set of chromosomes
- B. \_** Determination of the sex of the child
- C. \_** Oocyte completion of meiosis
- D. \_** Oocyte sperm penetration
- E. \_** Cortical reaction

**45 .** The myocardial plate was destroyed in the fetus. The development of which of the following tissues will be disturbed?

- A. \_** \*Cardiac muscle tissue
- B. \_** Connective tissue
- C. \_** Smooth muscle tissue
- D. \_** Skeletal muscle tissue
- E. \_** Epithelial tissue

**46 .** The laying of axial organs has begun in the human embryo. What is the period of pregnancy from the following?

- A. \_** \*17 days
- B. \_** 1 month
- C. \_** 2 months
- D. \_** 12 days
- E. \_** 3 months

**47 \_** It is known that some microorganisms that cause infectious diseases can pass through the placental barrier. Which structures from the following are part of it?

- A. \_** \*All structural components of tertiary villi
- B. \_** Chorion and amnion
- C. \_** All structural components of secondary villi
- D. \_** Allantois, yolk sac

E. \_ Basal plate of the endometrium with decidual cells

**48 .** Malformations of the urinary system occur, according to statistics, in 10-14% of newborns. From which of the following sources is the development of the urinary system?

A. \_ \* Intermediate mesoderm

B. \_ Dorsal mesoderm

C. \_ Visceral sheet of ventral mesoderm

D. \_ Parietal sheet of ventral mesoderm

E. \_ Embryonic mesenchyme

**49 .** One of the reasons for poor healing of the umbilical cord wound in newborn children is non-union of the primary urinary tract - urachus. From which of the following sources is the urinary bladder and urachus formed?

A. \_ \* Mesonephric duct

B. \_ Cloaca

C. \_ Urogenital sinus

D. \_ Paramesonephric duct

E. \_ Allantois

**50 .** At the early stages of the development of the human embryo, a finger-like outgrowth of the ventral wall of the primary intestine appears, which grows into the amniotic leg. What is the name of this provisional body?

A. \_ \* Allantois

B. \_ Yolk sac

C. \_ Amnion

D. \_ Placenta

E. \_ Umbilical

**51 \_** The histological preparation shows a cross-section of the organ, the basis of which is formed by mucous connective tissue, two arteries and a vein. What kind of organ is this?

A. \_ \* Umbilical

**B.** \_ Alantois

**C.** \_ Yolk sac

**D.** \_ Amnion

**E.** \_ Placenta

**52 .** A histological section of a human embryo shows a bubble connected to the intestinal tube, which is one of the provisional organs. Primary germ cells and primary erythrocytes (megaloblasts) are located in its wall. Define what is this provisional body?

**A.** \_ \* Yolk sac

**B.** \_ Alantois

**C.** \_ Placenta

**D.** \_ Umbilical

**E.** \_ Amnion

**53 .** The umbilical cord of the fetus was compressed, but the blood circulation between the fetus and the mother was not disturbed. The presence of which structures contributed to this in the first place?

**A.** \_ \*Mucous connective tissue

**B.** \_ The rest of the allantois

**C.** \_ The lining of arteries

**D.** \_ Vein sheath

**E.** \_ The rest of the yolk stalk

**54 .** During fertilization, as a result of insufficient acrosomal reaction, there was no dissolution of the contacts between the follicular cells of the granular zone of the oocyte. What process broke:

**A.** \_ \*Denudation

**B.** \_ Capacitance

**C.** \_ Cortical reaction

**D.** \_ Elimination



**E. \_** Modification

**55 .** Against the background of hormonal changes in the patient, the process of attachment of the blastocyst to the uterine mucosa was disrupted. The lack of synthesis of which hormone caused the following changes:

**A. \_** \*Progesterone

**B. \_** Estradiol

**C. \_** Folliculin

**D. \_** Testosterone

**E. \_** Somatostatin

**56 \_** The woman got the flu and it turned out that it happened on the 7-14th day of pregnancy. What consequences should be expected:

**A. \_** \*Disturbances in the formation of ecto- and endoderm

**B. \_** Violation of mesoderm formation

**C. \_** Violation of mesenchyme formation

**D. \_** Violation of the epiboly process

**E. \_** Violation of the process of intussusception

**57 .** What is the biological significance of the fertilization process that occurs when the male and female gametes fuse?

**A. \_** \*The diploid set of chromosomes is restored, the genetic sex of the embryo is determined, fragmentation is initiated

**B. \_** A blastocyst is formed

**C. \_** Blastomeres are formed

**D. \_** Implantation is initiated

**E. \_** A morula is formed

**58 .** One of the critical periods of human embryogenesis is the implantation of the embryo in the wall of the uterus during the 7th day. What process of gastrulation occurs in the embryoblast during this period?

**A. \_** \*Delamination

**B.** \_ Migration

**C.** \_ Epibolia

**D.** \_ Intussusception

**E.** \_ Neurulation

**59** \_ During one of the phases of spermatogenesis, changes in the nucleus and cytoplasm of spermatids are observed, which lead to the formation of mature germ cells. Name the phase of gametogenesis.

**A.** \_ \* Formation

**B.** \_ Maturation

**C.** \_ Growing up

**D.** \_ Reproduction

**E.** \_ Proliferation

**60** \_ The diagram shows a human embryo at one of the early stages of development. What stage is this?

**A.** \_ \* Blastocyst

**B.** \_ Zygote

**C.** \_ Morula

**D.** \_ Gastrula

**E.** \_ Nerula

**61** . A chorion is determined by microscopic examination of the embryo's membranes. What is the main function of this organ?

**A.** \_ \*Exchange of substances between the organism of the mother and the fetus

**B.** \_ Hematopoietic

**C.** \_ Production of amniotic fluid

**D.** \_ Formation of primary germ cells

**E.** \_ Formation of lymphocytes

**62 .** Gonoblasts, the precursors of germ cells, were detected in the embryo at 2-3 weeks. In what material do these cells differentiate?

- A. \_ \*In a yolk sac
- B. \_ In the mesenchyme
- C. \_ In the embryonic ectoderm
- D. \_ In dermatomes
- E. \_ In the embryonic endoderm

**63 .** Human blastocyst implantation begins. What is the name of the period of embryogenesis that begins at the same time?

- A. \_ \*Gastrulation
- B. \_ Intussusception.
- C. \_ Differentiation
- D. \_ Histogenesis
- E. \_ Fragmentation

**64 .** In the third week of embryogenesis, the central part of the cells of the epiblast (ectoderm) bends and the process of neurulation begins. In what direction do the rest of the cells of the ectoderm differentiate?

- A. \_ \*Skins
- B. \_ Guts
- C. \_ Somites
- D. \_ Chords
- E. \_ Yolk bladder

**65 .** "A man was born in a shirt." What "shirt" does this proverb refer to?

- A. \_ \* Amniotic
- B. \_ Zhovtkovo
- C. \_ Serous
- D. \_ Chorion

E. \_ Trophoblastic

66 . A breast biopsy revealed star-shaped cells located between the basal membrane and lactocytes. Name the source of development of these cells?

A. \_ \*Skin ectoderm

B. \_ Sclerotoma

C. \_ Myotome

D. \_ A dermatome

E. \_ Nephrogonotoma

67 \_ The preparation shows the oocyte at the moment of its fertilization by a sperm. What is the main result of fertilization?

A. \_ \*Zygote formation

B. \_ Determination of the sex of the child

C. \_ Oocyte completion of meiosis

D. \_ Oovolema sperm penetration

E. \_ Cortical reaction

68 . A human embryo built from two blastomeres was found. Name the place of its localization under the condition of its normal development?

A. \_ \*Uterine tube

B. \_ Uterine cavity

C. \_ Abdomen

D. \_ The mucous membrane of the uterus

E. \_ Ovary

69 . In the process of embryogenesis, there was a violation of the formation of the anterior part of the primary intestine. Specify the possible localization of developmental anomalies?

A. \_ \*Organ of the oral cavity

B. \_ Stomach

C. \_ Liver

D. \_ Pancreas

E. \_ Jejunum

**70** \_ A woman got the flu and it turned out that it happened during the early phase of gastrulation. What consequences should be expected?

A. \_ \*Disturbances in the formation of ecto- and endoderm

B. \_ Violation of mesoderm formation

C. \_ Violation of mesenchyme formation

D. \_ Violation of the epiboly process

E. \_ Violation of the process of intussusception

**71** \_ During the embryogenesis of the heart, a violation of the development of one of its membranes, namely the endocardium, was noted. What source of development was damaged?

A. \_ \*Mesenchyme

B. \_ Ectoderm

C. \_ Endoderm

D. \_ Visceral sheet of mesoderm

E. \_ Parietal sheet of mesoderm

**72** . The newborn was diagnosed with a developmental disorder of the ventricular myocardium. This pathology is associated with a developmental disorder of which embryonic source?

A. \_ \* Myoepicardial plate

B. \_ Parietal splanchnopleura

C. \_ Endoderms

D. \_ Ectoderms

E. \_ Mesenchyme

**73** . Cells with large nuclei, high glycogen content and high alkaline phosphatase activity are found in the wall of the yolk sac. These cells with blood in the vessels

migrate to the genital ridges. What cells of the male reproductive system do they differentiate into?

- A.  \*Spermatogenic cells
- B.  Leydig cells
- C.  Fibroblasts
- D.  Blood cells
- E.  Supporting cells

74 . When studying the early stages of human embryogenesis, the beginning of a provisional organ is determined in the form of an elastic cord covered with amniotic epithelium, which surrounds the mucous connective tissue. Name this body.

- A.  \*Umbilical
- B.  Yolk sac
- C.  Alantois
- D.  Placenta
- E.  Amnion

75 \_ One of the critical periods of human embryogenesis is the implantation of the embryo in the wall of the uterus for 5-7 days. What process takes place in the embryoblast during this period?

- A.  \*Delamination
- B.  Migration
- C.  Blastulation
- D.  Neurulation
- E.  Intussusception

76. During the histological examination of fruit membranes, it was found that one of them includes a structure consisting of a cellular layer and a symplast. Name this shell.

- A.  \* Trophoblast
- B.  Amnion

- C. \_ The main waste shell
- D. \_ Wall waste membrane
- E. \_ Yolk sac

78 . The outer serous membrane is identified on the histological micropreparation of the stomach section. What type of epithelium does her epithelium belong to?

- A. \_ \*Coelomic
- B. \_ Skin
- C. \_ Intestinal
- D. \_ Angiodermal
- E. \_ Ependymo-glial

79 \_ A single-layered epithelium of renal tubules is observed on a micro-preparation made from a kidney. Violation of which germ layer will lead to morphological changes of this epithelium?

- A. \_ \*Intermediate mesoderm
- B. \_ Ventral mesoderm
- C. \_ Ectoderm
- D. \_ Endoderm
- E. \_ Mesenchyme

80 . On the micro-preparation made from the ventricles of the brain, we can observe the ependymo-glial epithelium lining these brain cavities. In the event of damage to which germ layer, changes in this epithelium will occur?

- A. \_ \* Ectoderm
- B. \_ Endoderm
- C. \_ Intermediate mesoderm
- D. \_ Ventral mesoderm
- E. \_ Mesenchyme

