Department Of General Histology

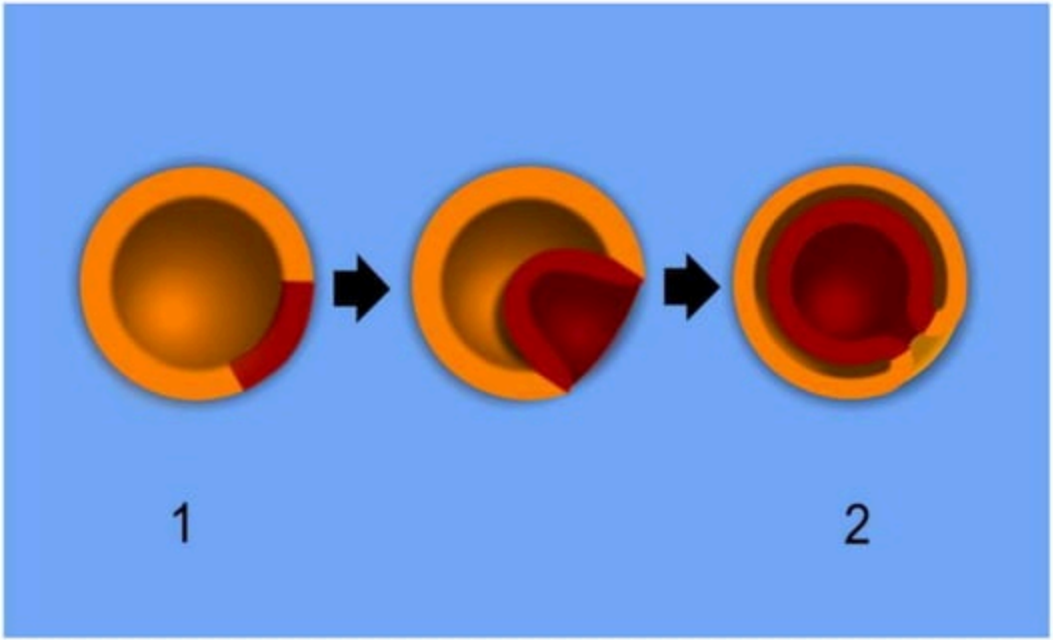
General Embriology

Introduction

- **Embryology** (from Greek ἔμβρυον, *embryon*, "the unborn, embryo"; and -λογία, *-logia*) is the science of the development of an embryo from the fertilization of the ovum to the fetusstage.

Embryonic development of animals

- After cleavage, the dividing cells, or morula, becomes a hollow ball, or blastula, which develops a hole or pore at one end.



1 - blastula,
2 - gastrula with blastopore;
orange - ectoderm, **red** - endoderm.

Morula

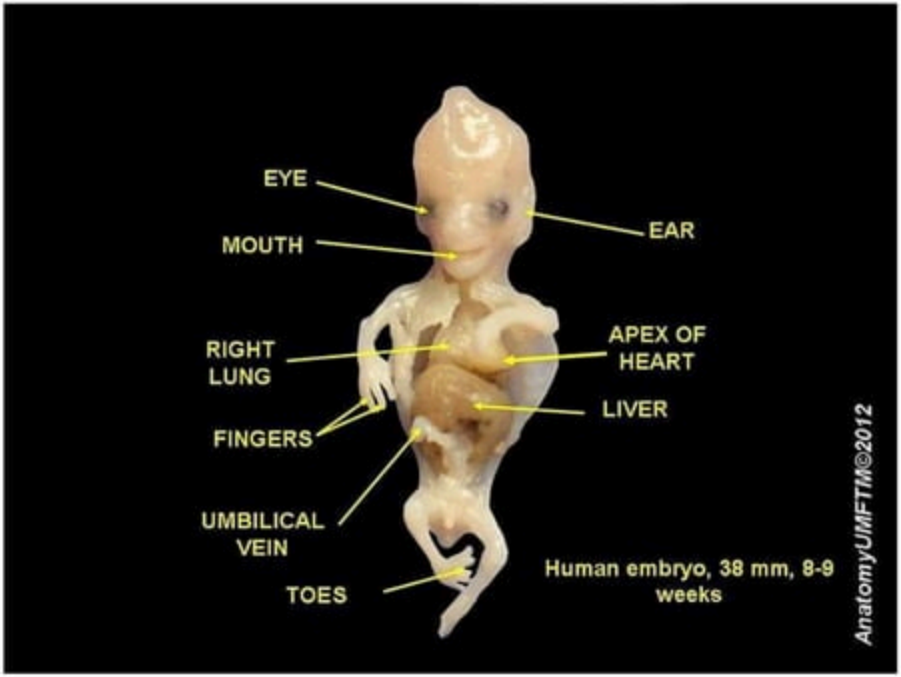
- A **morula** (Latin, *morus*: mulberry) is an embryo at an early stage of embryonic development, consisting of cells (called blastomeres) in a solid ball contained within the zona pellucida.[1]
- The morula is produced by embryonic cleavage, the rapid division of the zygote. Once the zygote has divided into 32 cells, it begins to resemble a mulberry, hence the name*morula* (Latin, *morus*: mulberry). Within a few days after fertilization, cells on the outer part of the morula become bound tightly together with the formation ofdesmosomes and gap junctions, becoming nearly indistinguishable. This process is known as compaction.The cells of the morula then secrete a viscousliquid[*specify*], causing a central cavity to be formed, forming a hollow ball of cells known as the blastocyst. The blastocyst's outer cells will become the first embryonic epithelium (the trophectoderm). Some cells, however, will remain trapped in the interior and will become the inner cell mass(ICM), and are pluripotent. In mammals (except monotremes), the ICM will ultimately form the "embryo proper", while the trophectoderm will form the placenta and other extra-embryonic tissues.

Bilaterans

- In bilateral animals, the blastula develops in one of two ways that divides the whole animal kingdom into two halves (see: *Embryological origins of the mouth and anus*). If in the blastula the first pore (blastopore) becomes the mouth of the animal, it is aprotostome; if the first pore becomes the anus then it is a deuterostome.
- Theprotostomes include most invertebrate animals, such as insects, worms and molluscs, while the deuterostomes include the vertebrates.
- In due course, the blastula changes into a more differentiated structure called the gastrula.

- The gastrula with its blastopore soon develops three distinct layers of cells (the germ layers) from which all the bodily organs and tissues then develop:
- The innermost layer, or endoderm, gives rise to the digestive organs, the gills, lungs or swim bladder if present, and kidneys or nephrites.
- The middle layer, or mesoderm, gives rise to the muscles, skeleton if any, and blood system.
- The outer layer of cells, or ectoderm, gives rise to the nervous system, including the brain, and skin or carapace and hair, bristles, or scales.
- Embryos in many species often appear similar to one another in early developmental stages. The reason for this similarity is because species have a shared evolutionary history. These similarities among species are called homologous structures, which are structures that have the same or similar function and mechanism, having evolved from a common ancestor.

Dissection of human embryo, 38 mm - 8 weeks



History of embryology

- As recently as the 18th century, the prevailing notion in human embryology was preformation: the idea that semen contains an embryo — a preformed, miniature infant, or "*homunculus*" — that simply becomes larger during development. The competing explanation of embryonic development was *epigenesis*, originally proposed 2,000 years earlier by Aristotle. Much early embryology came from the work of the great Italiananatomists: Aldrovandi, Aranzio, Leonardo da Vinci, Marcello Malpighi, Gabriele Falloppio, Girolamo Cardano,Emilio Parisano, Fortunio Liceti, Stefano Lorenzini, Spallanzani, Enrico Sertoli, Mauro Rusconi, etc.
- According to epigenesis, the form of an animal emerges gradually from a relatively formless egg. Asmicroscopy improved during the 19th century, biologists could see that embryos took shape in a series of progressive steps, and epigenesis displaced preformation as the favoured explanation among embryologists.

After 1827

- Karl Ernst von Baer and Heinz Christian Pander proposed the germ layer theory of development; von Baer discovered the mammalian ovum in 1827. Modern embryological pioneers include Charles Darwin, Ernst Haeckel, J.B.S. Haldane, and Joseph Needham. Other important contributors includeWilliam Harvey, Kaspar Friedrich Wolff, Heinz Christian Pander, August Weismann, Gavin de Beer,Ernest Everett Just, and Edward B. Lewis.

After 1950

- After the 1950s, with the DNA helical structure being unravelled and the increasing knowledge in the field of molecular biology, developmental biology emerged as a field of study which attempts to correlate the genes with morphological change, and so tries to determine which genes are responsible for each morphological change that takes place in an embryo, and how these genes are regulated.

Embryogenesis of chordates

General characteristics anamny and amniotes.

- Based on the characteristics of embryonic development, all chordates are divided into two groups: anamny and amniotes. Anamny (an - a negative particle, amnion - water shell) are animals that during embryonic development are not formed embryonic shell as the amnion, or water shell, and allantois. By anamniyam include chord, leading first-vichnovodny life and lower chordates, is closely linked to water during reproduction and embryonic development of embryos - jawless fish and amphibians.

- Thus, the embryonic development of amniotes as anamny is carried out in an aqueous medium, which is an indicator of the phylogenetic continuity of all chordates. However, amniotic fluid can not provide optimal conditions for the developing fetus breathing, allocation and supply. These functions are performed by the allantois, which develops a dense network of blood vessels, by which the embryo is gas exchange with the environment and the allocation of the allantoic cavity of the end products of metabolism, as is the case in reptiles, birds, and egg-laying mammals! Through other mammalian embryo allantois contacts the body of the mother, getting away from it all for development.

Types of placentas

- Epiteliohorial Placenta type or semiplacenta, characterized some marsupials, such as marsupial badger, and placental mammals: pigs, horses, camels, hippos, dolphins, etc. The placenta of this type is characterized by the chorionic villi of the fetus only in contact with the uterine epithelium. Chorionic villi are only deepening the endometrium - the uterine glands and the holes do not destroy them.

Desmohorial placenta

- Desmohorial (desmos - link), or a connective-chorion, placenta characterized two-pairs ruminants. The placenta of this type is characterized by the chorionic villi of the embryo in the uterine epithelium submerged, destroying it and penetrate into the underlying connective tissue. Thus, the chorionic villi of the fetus are already closer to the bloodstream of the uterus. The connection of the embryo with the mother also is not very close, but this is offset by a significant increase in the surface of the chorion.

Especially embryogenesis in mammals

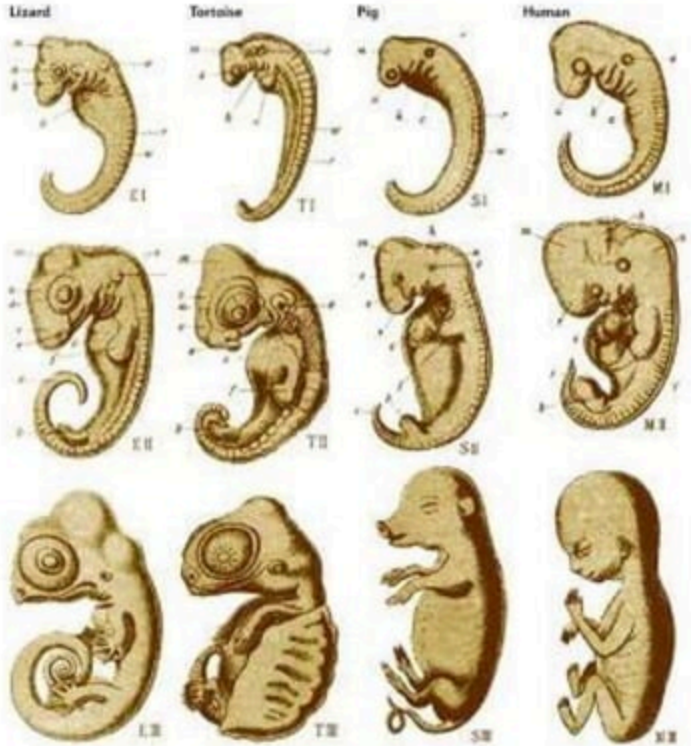
- In mammals, the zygote is very small and contains a small amount of yolk. With this first cleavage occurs uniformly and grab all the zygote. In fact, human embryos and sea stars are very similar, while the number of their constituent cells will not exceed one hundred. With the ongoing fragmentation of mammalian forms a hollow sphere - blastocysts (blastodermichesky bubble).
- It consists of an outer layer of cells and clusters inside. Embryo itself, as well as a number of surrounding membranes formed from the inner clusters of cells. Outer cell blastocyst give rise to chorion - very important embryonic shell, through which the power of the fruit. The large number of yolk alters not only the course of crushing a zygote, and a method of forming mesoderm. In Amphioxus mesoderm arises from invaginations endoderm.

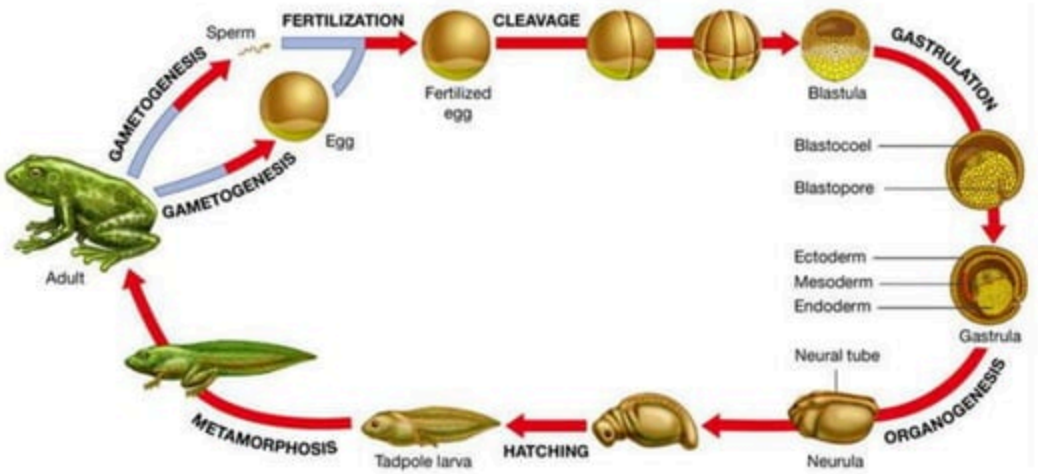
- Cavities within these invaginations persist and create a body cavity, or large. In frogs, some cells are derived from the mesoderm endoderm sites located on the dorsal side of the primary ulcer, but most of the mesoderm arises from the upper (dorsal) blastopore lip at the point of contact of ecto-and endoderm. This area is generally very active in producing cells and largely regulate their differentiation. In higher vertebrates, the mesoderm formation involved cells, separated from the endoderm near the primitive streak. Primitive streak - is invagination of the ectoderm, which in lower vertebrates blocks a blastopore, in relation to the nerve groove, from which are obtained in the future brain and spinal cord, the strip at the rear, in the tail of the embryo.

- Strips separated from the cells, which are then distributed to the side, they that give rise to the mesoderm. Later in the mass of cells on the right and on the left there are cavities that form a whole. Most of the tissues in the body comes from the vertebrate mesoderm. Gradually in the bud mesoderm is divided into three parts. Formed part of the spinal muscles and skeleton, from the middle - the kidneys and the abdominal - the walls of the digestive and tissue lining the body cavity. Thus, the whole completely lined with mesoderm. Endoderm forms the lining of the digestive tract, from the ectoderm forms the skin and the entire nervous

Vertebrates

- Lower vertebrates (anamnii) - cyclostomes, fish, amphibians, - usually oviparous. Live birth is found in all groups except cyclostomes and birds, mammals - is the main form of reproduction. Higher vertebrates - reptiles, birds and mammals - characterized by the care of posterity and to a lesser extent (security, eggs and young fish) it is expressed in some lower vertebrates. Usually modern vertebrates belong to seven classes; cyclostomes, cartilaginous fish, bony fish, amphibians, reptiles, birds, mammals. Cyclostomes as jawless contrast to all other vertebrate chelyustnorotym, anamny - amniotes. The number of species (40-45 thousand) Pozvonoyne significantly inferior invertebrates, but more diverse prisposobitelnym, types and forms of life. This is due not only to the general high level of complexity and organization of vertebrates, but also a great lability in adapting to a variety of environmental conditions - from the ocean floor to the high mountains and arid deserts. Vertebrates are important play in biosphere processes, usually ending food chain in ecosystems. Value for human vertebrate great and varied: among vertebrates. - Home and many game animals. Some vertebrates carrier of infectious agents.




Sperm
FERTILIZATION
CLEAVAGE
GASTRULATION
GAMETOGENESIS
Fertilized egg
Blastula
Egg
Blastocoel
Blastopore
GAMETOGENESIS
Adult
Ectoderm
Mesoderm
Endoderm
Gastrula
Neural tube
ORGANOGENESIS
METAMORPHOSIS
Tadpole larva
HATCHING
Neurula

Thank you for attention!