**Development and Fate of the Three Embryonic Germ Layers**

**Youtube link :** Germ layers derivatives https://youtu.be/coRini4

**Objectives:**

**1.The development of 3 Embryonic Germ Layers.**

**2.The fate of Endoderm, Mesoderm and Ectoderm**

[Fertilization](https://en.wikipedia.org/wiki/Fertilisation) leads to the formation of a [zygote](https://en.wikipedia.org/wiki/Zygote). During the next stage, [cleavage](https://en.wikipedia.org/wiki/Cleavage_%28embryo%29), [mitotic](https://en.wikipedia.org/wiki/Mitosis) cell divisions transform the zygote into a hollow ball of cells, a [blastula](https://en.wikipedia.org/wiki/Blastula). This early embryonic form undergoes [gastrulation](https://en.wikipedia.org/wiki/Gastrulation), forming a [gastrula](https://en.wikipedia.org/wiki/Gastrula) with either two or three layers (the germ layers). In all [vertebrates](https://en.wikipedia.org/wiki/Vertebrate), these progenitor cells differentiate into all adult tissues and organs.

In the [human embryo](https://en.wikipedia.org/wiki/Human_embryogenesis), after about three days, the zygote forms a solid mass of cells by mitotic division, called a [morula](https://en.wikipedia.org/wiki/Morula). This then changes to a [blastocyst](https://en.wikipedia.org/wiki/Blastocyst), consisting of an outer layer called a [trophoblast](https://en.wikipedia.org/wiki/Trophoblast), and an inner cell mass called the [embryoblast](https://en.wikipedia.org/wiki/Embryoblast). Filled with uterine fluid, the blastocyst breaks out of the [zona pellucida](https://en.wikipedia.org/wiki/Zona_pellucida) and undergoes [implantation](https://en.wikipedia.org/wiki/Implantation_%28human_embryo%29). The inner cell mass initially has two layers: the [hypoblast](https://en.wikipedia.org/wiki/Hypoblast) and [epiblast](https://en.wikipedia.org/wiki/Epiblast). At the end of the second week, a [primitive streak](https://en.wikipedia.org/wiki/Primitive_streak) appears. The epiblast in this region moves towards the primitive streak, dives down into it, and forms a new layer, called the [endoderm](https://en.wikipedia.org/wiki/Endoderm), pushing the hypoblast out of the way (this goes on to form the [amnion](https://en.wikipedia.org/wiki/Amnion).) The epiblast keeps moving and forms a second layer, the [mesoderm](https://en.wikipedia.org/wiki/Mesoderm). The top layer is now called the [ectoderm](https://en.wikipedia.org/wiki/Ectoderm).

**The germ layers**

**Endoderm :** The **endoderm** is one of the germ layers formed during animal [embryogenesis](https://en.wikipedia.org/wiki/Embryogenesis). Cells migrating inward along the archenteron form the inner layer of the gastrula, which develops into the [endoderm](https://en.wikipedia.org/wiki/Endoderm).

The endoderm consists at first of flattened cells, which subsequently become columnar. It forms the epithelial lining of the whole of the [digestive tract](https://en.wikipedia.org/wiki/Gastrointestinal_tract) except part of the mouth and pharynx and the terminal part of the rectum (which are lined by involutions of the ectoderm). It also forms the lining cells of all the glands which open into the digestive tract, including those of the liver and pancreas; the epithelium of the auditory tube and tympanic cavity; the trachea, bronchi, and alveoli of the lungs; the [bladder](https://en.wikipedia.org/wiki/Urinary_bladder) and part of the urethra; and the follicle lining of the thyroid gland and thymus.

The [endoderm](https://en.wikipedia.org/wiki/Endoderm) forms: the stomach, the colon, the liver, the pancreas, the bladder, the epithelial parts of trachea, the [lungs](https://en.wikipedia.org/wiki/Lungs), the pharynx, the thyroid, the parathyroid, and the intestines. **The** [**endoderm**](https://en.wikipedia.org/wiki/Endoderm) **produces tissue within the** [**lungs**](https://en.wikipedia.org/wiki/Lung)**,** [**thyroid**](https://en.wikipedia.org/wiki/Thyroid)**, and** [**pancreas**](https://en.wikipedia.org/wiki/Pancreas)**.**



**Mesoderm :** The **mesoderm** germ layer forms in the [embryos](https://en.wikipedia.org/wiki/Embryo) of [triploblastic](https://en.wikipedia.org/wiki/Triploblastic) [animals](https://en.wikipedia.org/wiki/Animal). During [gastrulation](https://en.wikipedia.org/wiki/Gastrulation), some of the cells migrating inward contribute to the [mesoderm](https://en.wikipedia.org/wiki/Mesoderm), an additional layer between the endoderm and the [ectoderm](https://en.wikipedia.org/wiki/Ectoderm). The formation of a mesoderm leads to the development of a [coelom](https://en.wikipedia.org/wiki/Coelom). Organs formed inside a coelom can freely move, grow, and develop independently of the body wall while fluid cushions and protects them from shocks.

The [mesoderm](https://en.wikipedia.org/wiki/Mesoderm) has several components which develop into tissues: [intermediate mesoderm](https://en.wikipedia.org/wiki/Intermediate_mesoderm), [paraxial mesoderm](https://en.wikipedia.org/wiki/Paraxial_mesoderm), [lateral plate mesoderm](https://en.wikipedia.org/wiki/Lateral_plate_mesoderm), and chorda-mesoderm. The chorda-mesoderm develops into the notochord. The intermediate mesoderm develops into kidneys and gonads. The paraxial mesoderm develops into cartilage, skeletal muscle, and dermis. The lateral plate mesoderm develops into the circulatory system (including the heart and spleen), the wall of the gut and wall of the human body.

Through cell signaling cascades and interactions with the ectodermal and endodermal cells, the mesodermal cells begin the process of [differentiation](https://en.wikipedia.org/wiki/Cellular_differentiation).

The [mesoderm](https://en.wikipedia.org/wiki/Mesoderm) forms: muscle ([smooth](https://en.wikipedia.org/wiki/Smooth_muscle_tissue) and [striated](https://en.wikipedia.org/wiki/Striated_muscle_tissue)), [bone](https://en.wikipedia.org/wiki/Bone), [cartilage](https://en.wikipedia.org/wiki/Cartilage), [connective tissue](https://en.wikipedia.org/wiki/Connective_tissue), [adipose tissue](https://en.wikipedia.org/wiki/Adipose_tissue), [circulatory system](https://en.wikipedia.org/wiki/Circulatory_system), [lymphatic system](https://en.wikipedia.org/wiki/Lymphatic_system), [dermis](https://en.wikipedia.org/wiki/Dermis), [genitourinary system](https://en.wikipedia.org/wiki/Genitourinary_system), [serous membranes](https://en.wikipedia.org/wiki/Serous_membrane), and [notochord](https://en.wikipedia.org/wiki/Notochord). **The** [**mesoderm**](https://en.wikipedia.org/wiki/Mesoderm) **aids in the production of** [**cardiac muscle**](https://en.wikipedia.org/wiki/Cardiac_muscle)**,** [**skeletal muscle**](https://en.wikipedia.org/wiki/Skeletal_muscle)**,** [**smooth muscle**](https://en.wikipedia.org/wiki/Smooth_muscle)**, tissues within the** [**kidneys**](https://en.wikipedia.org/wiki/Kidney)**, and** [**red blood cells**](https://en.wikipedia.org/wiki/Red_blood_cell)



**Ectoderm :** The **ectoderm** generates the outer layer of the embryo, and it forms from the embryo's [epiblast](https://en.wikipedia.org/wiki/Epiblast). The [ectoderm](https://en.wikipedia.org/wiki/Ectoderm) develops into the surface ectoderm, neural crest, and the neural tube.

The surface ectoderm develops into: [epidermis](https://en.wikipedia.org/wiki/Epidermis_%28skin%29), [hair](https://en.wikipedia.org/wiki/Hair), [nails](https://en.wikipedia.org/wiki/Nail_%28anatomy%29), [lens of the eye](https://en.wikipedia.org/wiki/Lens_of_the_eye), [sebaceous glands](https://en.wikipedia.org/wiki/Sebaceous_glands), [cornea](https://en.wikipedia.org/wiki/Cornea), [tooth enamel](https://en.wikipedia.org/wiki/Tooth_enamel), the epithelium of the mouth and nose.

The neural crest of the ectoderm develops into: [peripheral nervous system](https://en.wikipedia.org/wiki/Peripheral_nervous_system), [adrenal medulla](https://en.wikipedia.org/wiki/Adrenal_medulla), [melanocytes](https://en.wikipedia.org/wiki/Melanocytes), facial cartilage, [dentin](https://en.wikipedia.org/wiki/Dentin) of teeth.

The neural tube of the ectoderm develops into: [brain](https://en.wikipedia.org/wiki/Brain), [spinal cord](https://en.wikipedia.org/wiki/Spinal_cord), [posterior pituitary](https://en.wikipedia.org/wiki/Posterior_pituitary), [motor neurons](https://en.wikipedia.org/wiki/Motor_neurons), [retina](https://en.wikipedia.org/wiki/Retina). **The** [**ectoderm**](https://en.wikipedia.org/wiki/Ectoderm) **produces tissues within the** [**epidermis**](https://en.wikipedia.org/wiki/Epidermis_%28skin%29)**, aids in the formation of** [**neurons**](https://en.wikipedia.org/wiki/Neuron) **within the brain, and constructs** [**melanocytes**](https://en.wikipedia.org/wiki/Melanocytes)**.**

**\*\***Note: The anterior pituitary develops from the ectodermal tissue of Rathke's pouch.



**Neural crest**

Because of its great importance, the [neural crest](https://en.wikipedia.org/wiki/Neural_crest) is sometimes considered a fourth germ layer. It is, however, derived from the ectoderm. It forms neurons within ganglia(dorsal root, cranial and autonomic) , schwann cells, pia and archnoid, adrenal medulla, melanocytes, aorticopulmonary septum, bones of neurocranium and pharangeal arch bones (maxilla, mandible, malleus and incus).

**Neuroectoderm**

All neurons within brain and spinal cord, retina, optic nerve (CN II), dilator and sphincter pupillae muscles, astrocytes, oligodendrocytes,ependymocytes,tanycytes , choroid plexus cells, neurohypophysis and pineal gland.