

Biology Lecture 7.1 - 7.8

Sect. 7.1: A zygote (fertilized egg) gives rise to many cells.

- At fertilization, haploid (n) cells unite to restore the diploid (2n) number of chromosomes.

I. Development – a set of events that converts a single cell into a fully formed individual. ie. *embryonic development*

- 3 basic activities:

1) cell division - mitosis

2) cell movement – cells migrate from one area to another.

3) cell differentiation/specialization – process by which new cells change in appearance/function, ie. they become more specialized in how they function.

Examples: muscle cells, bone cells or nerve cells, etc...

II. Early Cell division:

Cleavage – early cell division of the zygote; the cell is *cleaved* into smaller cells. Cleavage converts the zygote into a *blastula* (a hollow ball of cells). Cells migrate & change position; the result is a *gastrula*.

- **Gastrula** is made of 3 distinct tissue layers: (see pge.160)

1) Ectoderm – skin, hair, nails.

a) neural ectoderm – brain & spinal cord.

2) Mesoderm – muscle, bone, digestive tract, circulatory.

3) Endoderm – lining of body cavities, bladder.

Sect. 7.2:

Cell Differentiation is a major part of development.

Question? How does a zygote(single cell) develop muscle, blood, nerves, etc...?

Answer: each of these tissues (cells) are made of specific types of cells that have a specific function. ALSO, these cells make different proteins that regulate what the cell will be. Examples: blood cells make *hemoglobin*, intestine cells make digestive *enzymes*, muscle cells make the protein *actin*.

?? How is it that different cells make diff. functional proteins?

[because genes(DNA) controls what type of proteins the cell will make, scientists thought that ea. cell must have a diff. set of genes.]

Experiments with frog eggs: (see page 166, figure 7.3)

Concluded:

- 1) Almost every cell in the adult org. contains a set of genes identical to the set in the zygote.
- 2) If all cells in an org. contain identical, complete sets of genes, then there must be differences in the genes' activity. ie. as cells begin to specialize, diff. genes become activated while other genes are deactivated for certain lengths of time. "a synchronized event"

Question: Could outside factors affect this process?

- 3) The cytoplasm of the zygote contains *regulatory molecules* which activate certain genes of the dividing cell. [cells become *specialized* to perform a specific function during development]

Sect. 7.3: Interactions between cells influence differentiation.

- **Cell to Cell Communication** plays a role in differentiation. eg. during eye development, the cells of the embryonic brain (neural ectoderm) divide until they come in contact with the skin ectoderm; the skin ectoderm responds to this stimulus by thickening & pinching inward to form the eye/lens/retina/eye socket.

?? How can one cell type influence the differentiation of other cells?

ANSWER: regulatory molecules/chemical signals made by the cell. “Like a chain reaction” egs. some hormones

- ***Regulatory molecules*** stimulate differentiation by activating a gene which in turn induces a cell to become specialized. eg. a muscle cell, or a nerve cell. etc....
- **The 1st organ system to develop in an embryo is the nervous system, which triggers the development of other systems.**
- ***Neural tube*** – an embryonic structure which gives rise to the brain & spinal cord. (see page 168, figure 7.8)
- **Spina bifida** – failure of the neural tube to close; results in abnormalities of the nervous system or death. This can be a direct result of poor prenatal nutrition such as not enough *Vitamin A* (Folic Acid) taken by the mom.

Biology Lecture 7.4- 7.6

Section 7.4: Some Animals in an External Environment

- Some animals develop independently of their parents

Questions:

- a. All fertilized eggs need ____?____ in order to develop.
- b. Which *classes* of vertebrate animals develop independently of their parents?

Section 7.5: Mammalian embryos develop w/in the mother

Zygote >> blastula >> gastrula >> embryo >> fetus >> (birth) >> baby

Gestation period: ~38 weeks for humans

[at the beginning mammalian embryos have small amounts of nutrients & H₂O stored in the ovum (yolk sac). After the blastula implants (~ 6 days) in the uterine wall it relies on nutrients from mom's blood... via the ____?____]

I. Cells of the gastrula develop into embryonic membranes (structures): *see page 166

From inner most to outer most layers:

1. Amnion –membrane that encloses the embryo & fills w/ amniotic fluid. Contains cells shed by the fetus.
2. Chorion – membrane w/ *villi* (finger-like projections). The *villi* supply (nutrients) to the embryo.
3. Placenta – made from the chorion & the uterine wall. A membrane thru which the embryo obtains nutrients from mom & eliminates waste; called “afterbirth” when expelled from mom's body.

4. Umbilical cord – a flexible cord that connects the embryo to the placenta. Gases/nutrients can **diffuse** from mom’s blood to the embryo’s circulatory system.
- Mom’s lungs & kidneys dispose of embryo’s waste!
 - Mom’s blood & embryo’s blood do not mix!

II. Prenatal Diagnosis:

1. High frequency sound waves “sonogram” – 4th month
 - Looks for gross abnormalities, ie. missing limbs
2. Amniocentesis – 16th week. Removal of amniotic fluid. Fetal cells are used to produce a **karyotype**.
 - Determines some genetic defects. Eg. Down’s syndrome
 - Sex of fetus
3. Chorionic villi sampling – 9th week. Withdrawal of some chorionic membrane cells (fetal cells). Fetal cells are used to produce a **karyotype**.
 - Determines some genetic defects. Eg. Down’s syndrome
 - Sex of fetus
 - Higher risk of spontaneous abortion

Section 7.6: Embryos Are Affected by Substances in Mom’s Blood
Physicians divide the total time needed for development (gestation period) into 3 periods or *trimesters*.

- 4) 1st trimester (12 weeks)– most organs are formed; embryo is especially sensitive to harmful substances. Eg, if mother drinks alcoholic beverages excessively than the child may develop *FAS*.

Fetal Alcohol Syndrome- mental retardation, facial deformities.

Cocaine- born addicted; slowed mental capacity.

Marijuana & cigarettes – low birth weights.

Prescription drugs can be harmful too.

2) 3rd trimester (last 12 weeks)- most rapid growth in size.

Biology Lecture 7.8 and 7.8

Section 7.7: Development is Usually Well Controlled

- **Embryonic development depends on proper cell division.**
 - **Fertilization initiates the beginning of cell division, cell differentiation & cell movement.**
- 1) **All cells have a particular task (function) to perform which is regulated by What?**
 - 2) **Cell aging is also genetically programmed for ea. species**
 - 3) **When an org. reaches adult size most cell divisions cease except for replacing worn out or lost/damaged cells.**

Examples of continued cell division????

- 5) **Cells can only divide a certain number of times because of *contact inhibition*. ie. Once cells touch ea. other, they stop dividing.**
- 6) **Cancer cells do not obey the rules of *contact inhibition*.**

Section 7.8: Cancer Cells Divide without Limit

- 3) **Cells divide uncontrollably; genetic control over normal cell division is altered. ie. *oncogenes & tumor- suppressor/ anti cancer genes* have gone awry.**
 - 4) **Cells can lose their identity (wrong ID markers on their cell surface) and can migrate to other body tissues(parts).**
 - 5) **Uncontrollable cell division (mitosis) can lead to a mass of cells = *tumor***
- **Tumors can be harmless or fatal/cancerous: 2 types of...**
1. **Benign tumor - noncancerous. Can be disfiguring.
Don't spread!**
 2. **Malignant tumor - a cancerous tumor "malignancy"
Can spread to other parts of the body!**

Q? Malignant tumors spread via what body systems??

B. Unique Properties of Malignant Tumors:

1. *Hyperplasia* - an increased number of cells and increased rate of cell division; very rapid.

4) Ability to undergo metastasis (spread) via the blood & lymph systems to other body cavities. * secrete AMF (automotility factor) - allows for spreading.

Eg. Pancreatic cancer spreads very quickly to the liver.

3. Compete w/ normal tissue cells for space & nutrients; eventually, normal tissue(cells) *atrophy* & die off.

4) cancer cells are highly vascularized cells; they “hog” the nutrients and blood supply from healthy tissue.

4. Lack *contact inhibition* - the malignant cells continue to migrate into healthy tissue areas even when in contact w/ other cells on all sides.