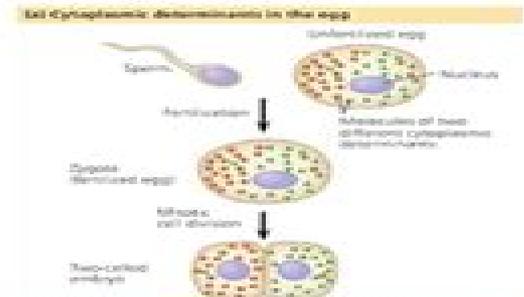


Chapter 16 – Development, Stem Cells, and Cancer

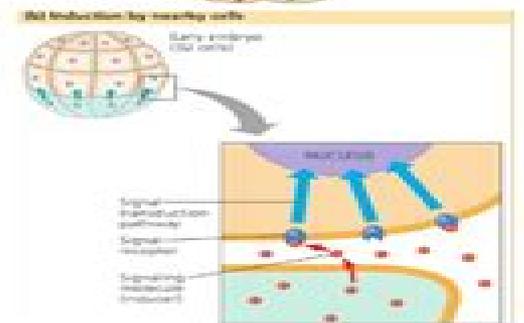
- ~ The development of a fertilized egg into an adult requires a precisely regulated program of gene expression.
- ~ Understanding this program has progressed mainly by studying **model organisms**.
- ~ Stem cells are key to the development process.
- ~ Orchestrating proper gene expression by all cells is crucial for life.

16.1 A program of differential gene expression leads to the different cell types in a multicellular organism

- ~ A fertilized egg gives rise to many different cell types.
- ~ Cell types are organized successively into tissues, organs, organ systems, and the whole organism.
- ~ Gene expression orchestrates the developmental program of animals.
- ~ The transformation from zygote to adult results from cell division, cell differentiation, and morphogenesis.
- ~ **Cell differentiation** is the process by which cells become specialized in structure and function.
- ~ The physical processes that give an organism its shape constitute **morphogenesis**.
- ~ Differential gene expression results from genes being regulated differently in each cell type.



- ~ Materials in the egg can set up gene regulation that is carried out as cell divide.
- ~ Materials in the egg can set up gene regulation that is carried out as cells divide.
- ~ An egg's cytoplasm contains RNA, proteins, and other substances that are distributed unevenly in the unfertilized egg.
- ~ **Cytoplasmic determinants** are maternal substances in the egg that influence early development.
- ~ As the zygote divides by mitosis, the resulting cells contain different cytoplasmic determinants, which lead to different gene expression.
- ~ The other major source of developmental information is the environment around the cell, especially signals from nearby embryonic cells.
- ~ In the process called **induction**, signal molecules from embryonic cells cause transcriptional changes in nearby target cells.
- ~ Thus, interactions between cells induce differentiation of specialized cell types.



- ~ **Determination** commits a cell irreversibly to its final fate.
- ~ Determination precedes differentiation.
- ~ Today, determination is understood in terms of molecular changes, the expression of genes for tissue-specific proteins.
- ~ The first evidence of differentiation is the production of mRNAs for these proteins.
- ~ Eventually, differentiation is observed as changes in cellular structure.
- ~ To study muscle cell determination, researchers grew embryonic precursor cells in culture and analyzed them.
- ~ They identified several "master regulatory genes," the products of which commit the cells to becoming skeletal muscles.
- ~ One such gene is called *myoD*.
- ~ While most cells are differentiating in a developing organism, some are genetically programmed to die.
- ~ **Apoptosis** is the best-understood type of "programmed cell death".
- ~ Apoptosis also occurs in the mature organism in cells that are infected, damaged, or at the end of their functional lives.



Chapter 16 Development Stem Cells And Cancer

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