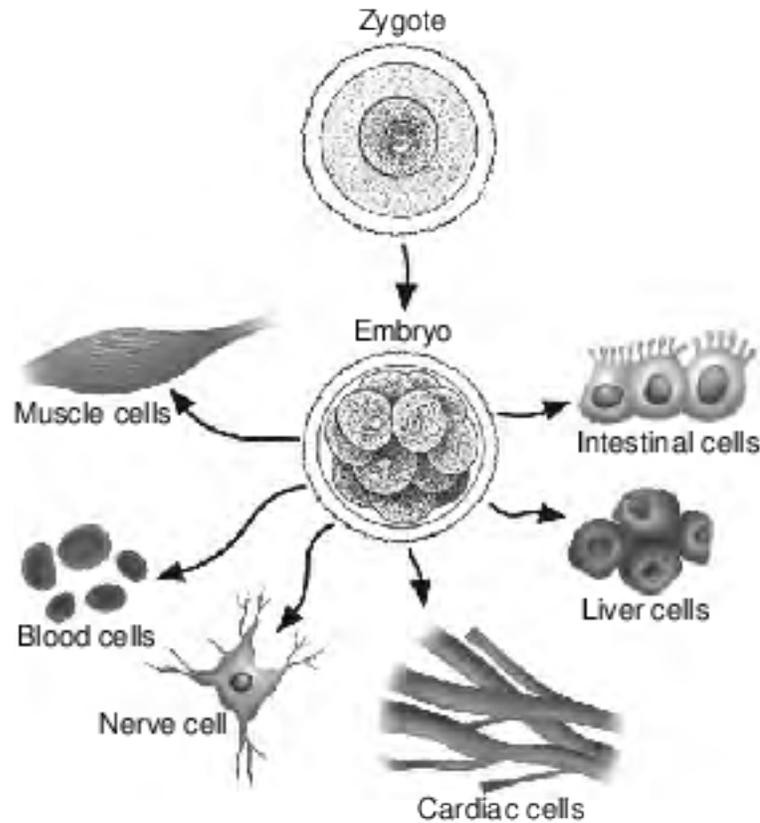


Gene Expression And Cell Differentiation

- 1 Although a liver cell and a muscle cell in a human developed from the same single cell, their appearance and functions are different. This is because the liver cell
 - (1) contains different genes than the muscle cell
 - (2) expresses different genes than the muscle cell
 - (3) destroys the muscle cell genes it contains
 - (4) lacks the genes found in muscle cells
- 2 Beta cells in the pancreas and human skin cells both contain the insulin gene. The beta cells can make insulin; however, skin cells cannot. Which process is responsible for this gene being expressed in one cell type and not in another cell type?
 - (1) mitosis
 - (2) replication
 - (3) differentiation
 - (4) meiosis
- 3 Eye color, hair color, and skin color often vary from person to person and even within a family. One explanation is that
 - (1) the glucose units in a DNA molecule are often rearranged
 - (2) the genetic material of the female parent has the most influence on offspring
 - (3) the inherited traits of individuals are determined by different gene combinations
 - (4) some extra parts of genetic material are often gained during fertilization
- 4 Although all of the cells of a plant contain the same genetic material, root cells and leaf cells are not identical because they
 - (1) use different genetic bases for the synthesis of DNA
 - (2) use different parts of their genetic instructions
 - (3) select different cells to express
 - (4) delete different sections of their enzymes
- 5 Body cells include nerve cells and muscle cells. Each makes a number of different proteins. For example, nerve cells make cholinesterase and muscle cells make myosin. Which statement best compares the DNA normally found in these two types of cells in an individual?
 - (1) The two cells have identical DNA sequences and use the same section of the DNA to make these two proteins.
 - (2) The two cells have identical DNA sequences, but use different sections of the DNA to make these two proteins.
 - (3) The two cells have different DNA sequences, but use the same section of the DNA to make these two proteins.
 - (4) The two cells have different DNA sequences and use different sections of the DNA to make these two proteins.

6 Following fertilization, a zygote divides and soon becomes a multicelled embryo with many different cell types, as represented below.

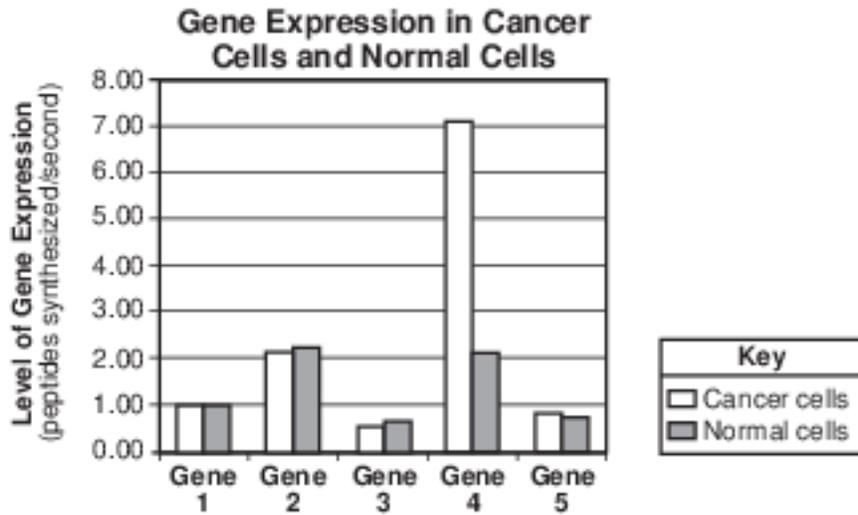


Source: Adapted from <http://www.buzzle.com/articles/cell-differentiation.html>
and <https://en.wikipedia.org/wiki/embryogenesis>

Which statement best explains this development?

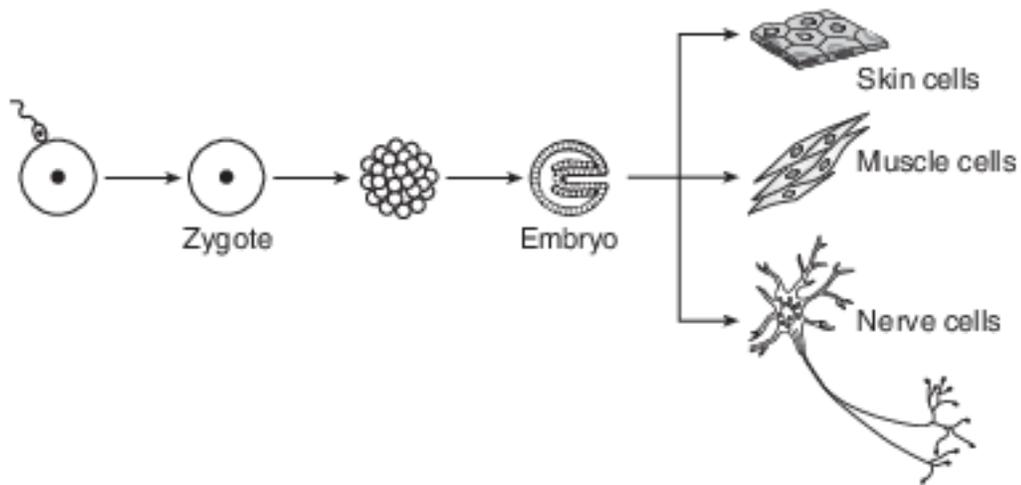
- (1) Specialization occurs, resulting in the formation of a great variety of cell types.
 - (2) Genes are inserted into the zygote to allow for the formation of different cell types.
 - (3) The expression of genes responsible for the different cell types is controlled by the placenta.
 - (4) The genetic information in the zygote is divided to produce a complete set for each cell type.
- 7 In an organism, a muscle cell has the same DNA as a nerve cell, yet the cells perform different functions. This is possible because
- (1) different mutations occur in each cell type, changing the genetic instructions
 - (2) temperature variations within the body alter DNA
 - (3) proteins in each cell type change the structure of DNA
 - (4) different parts of the genetic instructions are used in each type of cell

Base your answer to question 8 on the graph below and on your knowledge of biology. The graph shows the level of gene expression of five different genes in normal and cancerous cells.



- 8 Which statement is a valid inference that can be made based on the data in this graph?
- (1) The change in the level of gene expression in gene 4 could indicate it plays a major role in the development of cancer.
 - (2) Slight decreases in gene expression will always result in the formation of cancer cells.
 - (3) Cells will develop cancer if the gene expression of these five genes remains below four peptides per second.
 - (4) An increase in the level of gene expression in these five genes is necessary for cancer to develop in cells.

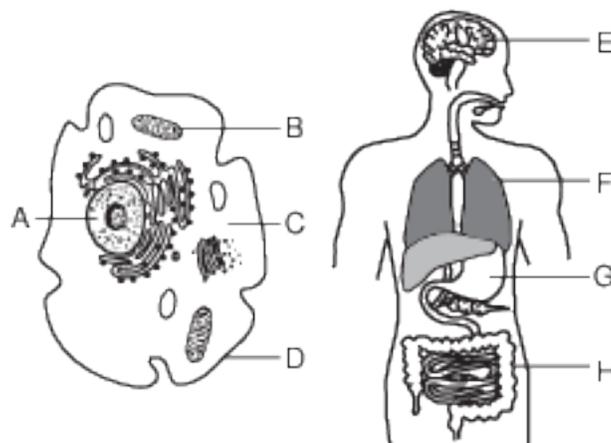
9 The development of nerve, muscle, and skin cells is represented in the diagram below.



Which statement best explains how each of the different cell types can develop from the same embryo?

- (1) The cells have identical genetic instructions, but different parts of these instructions are being expressed in each cell.
- (2) The cells have identical genetic instructions, and all parts of these instructions are being expressed in each cell.
- (3) The cells are produced by asexual reproduction and contain identical genetic instructions.
- (4) The cells contain genetic instructions from two different parents and will express the instructions from one parent, only.

Base your answers to questions 10 on the diagrams below and on your knowledge of biology. The diagrams represent a single-celled organism and a multicellular organism.



10 Cells from structure E and cells from structure G are similar in that they

- (1) have the same structure and function
- (2) contain the same genetic material
- (3) are identical in structure, but different in function
- (4) contain only the genetic information needed for their specific job

11 Which statement best explains why different body cells of the same individual look and function differently?

- (1) Each cell contains different genes.
- (2) Different genes are activated in different kinds of cells.
- (3) Cells are able to change to adapt to their surroundings.
- (4) Half of the genes in the cells came from the mother and half from the father.

12 Which factor would cause two specialized tissues that contain identical chromosomes to function differently?

- (1) Specific sections of DNA molecules in the chromosomes are activated.
- (2) All of the sections of DNA molecules in the chromosomes are activated.
- (3) Specific sections of the amino acid molecules in the cytoplasm are activated.
- (4) All of the amino acid molecules in the cytoplasm are activated.

Base your answers to questions 13 on the information and photograph below and on your knowledge of biology.

Scientists Investigate Sex Determination in Alligators

The sex of some reptiles, including the American alligator, is determined by the temperature at which the eggs are incubated. For example, incubating them at 33°C produces mostly males, while incubation at 30°C produces mostly females.

Scientists recently discovered a thermosensor protein, TRPV4, that is associated with this process in American alligators. TRPV4 is activated by temperatures near the mid-30s, and increases the movement of calcium ions into certain cells involved with sex determination.

A baby alligator emerges from its egg shell during hatching



Source: <http://www.dailymail.co.uk/news/article-2190839/>

13 Which information was most essential in preparing to carry out this scientific investigation?

- (1) a knowledge of the variety of mutations found in American alligator populations
- (2) the arrangement of the DNA bases found in the TRPV4 protein
- (3) the effects of temperature on the incubation of alligator eggs
- (4) a knowledge of previous cloning experiments conducted on alligators and other reptiles

Base your answers to questions 14 on the information below and on your knowledge of biology.

The testes of a human male produce gametes. The process that produces these gametes differs from the process that produces new skin cells in the same individual.

14 How does the genetic makeup of the skin cells differ from the genetic makeup of the gametes?

[1]

Answer Keys

1 2

2 3

3 3

4 2

5 2

6 1

7 4

8 1

9 1

10 2

11 2

12 1

13 3

14 Allow 1 credit. Acceptable responses include, but are not limited to:

- — Skin cells contain the full number of chromosomes for the individual. Gametes contain half the number of chromosomes.
- — Skin cells of an individual are normally genetically identical and gametes have variation.
- — Skin cells = $2n/46$ /diploid; gametes = $n/23$ /haploid.
- — Skin cells have twice as much genetic material.