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In the human pancreas, acinar cells produce digestive enzymes and beta cells produce insulin. The best explanation for this is that

- (1) a mutation occurs in the beta cells to produce insulin when the sugar level increases in the blood
- (2) different parts of an individual's DNA are used to direct the synthesis of different proteins in different types of cells
- (3) lowered sugar levels cause the production of insulin in acinar cells to help maintain homeostasis
- (4) the genes in acinar cells came from one parent while the genes in beta cells came from the other parent

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Cloning an individual usually produces organisms that

- (1) contain dangerous mutations
- (2) contain identical genes
- (3) are identical in appearance and behavior
- (4) produce enzymes different from the parent

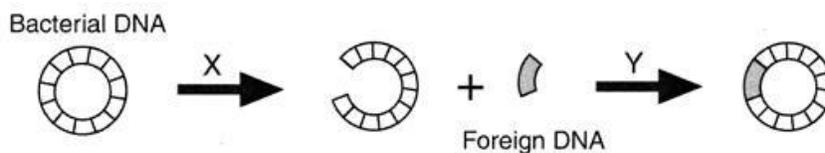
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A change in the order of DNA bases that code for a respiratory protein will most likely cause

- (1) the production of a starch that has a similar function
- (2) the digestion of the altered gene by enzymes
- (3) a change in the sequence of amino acids determined by the gene
- (4) the release of antibodies by certain cells to correct the error

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The diagrams below represent some steps in a procedure used in biotechnology.

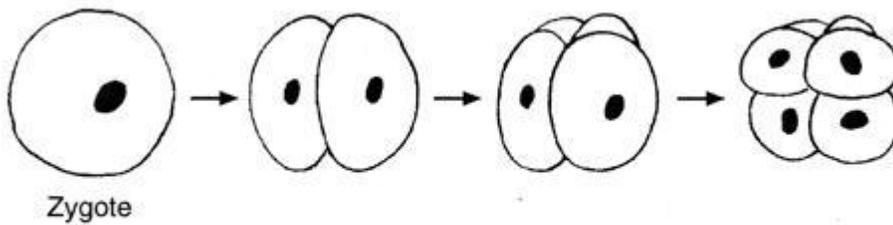


Letters X and Y represent the

- (1) hormones that stimulate the replication of bacterial DNA
- (2) biochemical catalysts involved in the insertion of genes into other organisms
- (3) hormones that trigger rapid mutation of genetic information
- (4) gases needed to produce the energy required for gene manipulation

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The diagram below represents some stages of early embryonic development.



Which process is represented by the arrows in the diagram?

- |                   |               |
|-------------------|---------------|
| (1) meiosis       | (3) mitosis   |
| (2) fertilization | (4) evolution |

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The sequence of subunits in a protein is most directly dependent on the

- (1) region in the cell where enzymes are produced
- (2) DNA in the chromosomes in a cell
- (3) type of cell in which starch is found
- (4) kinds of materials in the cell membrane

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The genetic code of a DNA molecule is determined by a specific sequence of

- |                     |                     |
|---------------------|---------------------|
| (1) ATP molecules   | (3) chemical bonds  |
| (2) sugar molecules | (4) molecular bases |

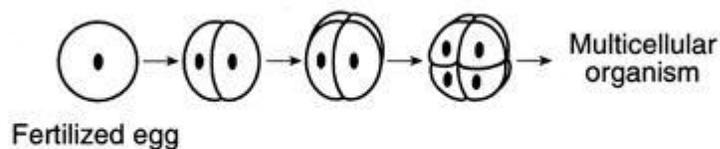
12

Which phrase does *not* describe cells cloned from a carrot?

- (1) they are genetically identical
- (2) they are produced sexually
- (3) they have the same DNA codes
- (4) they have identical chromosomes

13

Which phrase best describes a process represented in the diagram below?



- |                                  |                                  |
|----------------------------------|----------------------------------|
| (1) a zygote dividing by mitosis | (3) a gamete dividing by mitosis |
| (2) a zygote dividing by meiosis | (4) a gamete dividing by meiosis |

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Which statement best describes the relationship between cells, DNA, and proteins?

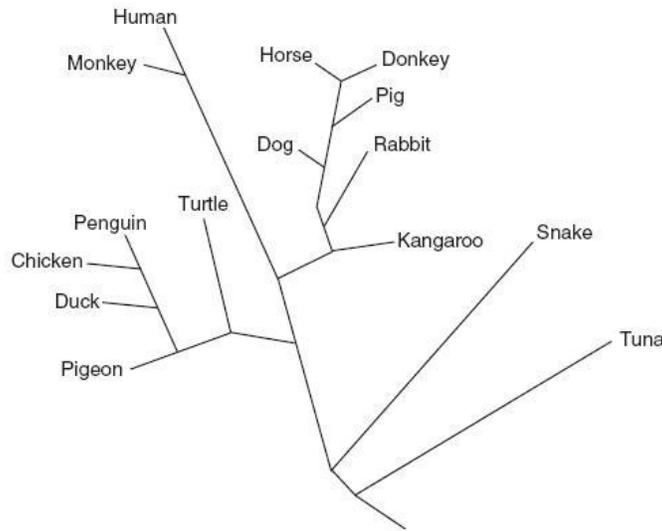
- (1) Cells contain DNA that controls the production of proteins.
- (2) DNA is composed of proteins that carry coded information for how cells function.
- (3) Proteins are used to produce cells that link amino acids together into DNA.
- (4) Cells are linked together by proteins to make different kinds of DNA molecules.

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Genes involved in the production of abnormal red blood cells have an abnormal sequence of

- (1) ATP molecules
- (2) amino acids
- (3) sugars
- (4) bases

Based on their analysis of the differences in amino acid sequences of one kind of protein, scientists prepared the evolutionary tree shown below. (Numbers 16-18)



16

According to this diagram, the DNA of which pair of organisms would show the greatest similarity?

- (1) penguin and turtle
- (2) horse and donkey
- (3) snake and tuna
- (4) turtle and rabbit

17

Older systems of classification always placed penguins, chickens, ducks, and pigeons in the bird group and turtles and snakes in the reptile group. Does this diagram support the older system of classification? Explain your answer. [1]

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18

According to this diagram, is the pig more closely related to the dog or the kangaroo? Justify your answer. [1]

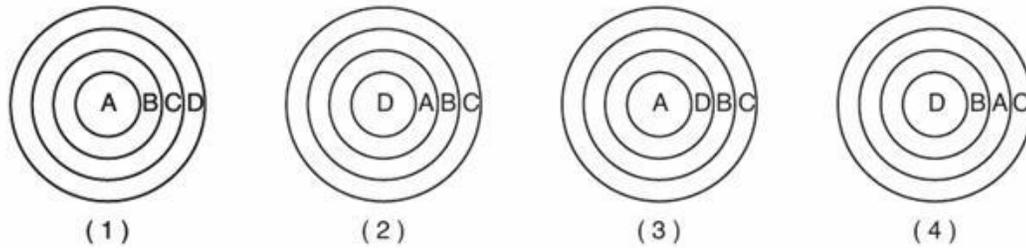
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Asexually reproducing organisms pass on hereditary information as

- (1) sequences of A, T, C, and G
- (2) chains of complex amino acids
- (3) folded protein molecules
- (4) simple inorganic sugars

Which diagram best represents the relative locations of the structures in the list below?

- A—chromosome
- B—nucleus
- C—cell
- D—gene



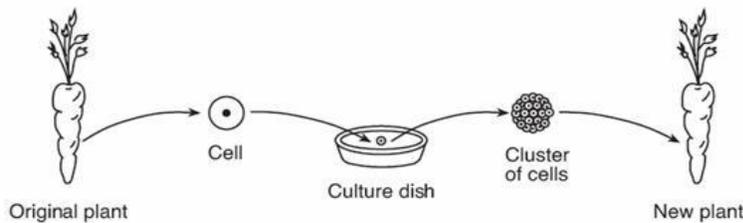
For centuries, certain animals have been crossed to produce offspring that have desirable qualities. Dogs have been mated to produce Labradors, beagles, and poodles. All of these dogs look and behave very differently from one another. This technique of producing organisms with specific qualities is known as

- (1) gene replication
- (2) natural selection
- (3) random mutation
- (4) selective breeding

Which process will increase variations that could be inherited?

- (1) mitotic cell division
- (2) active transport
- (3) recombination of genes
- (4) synthesis of proteins

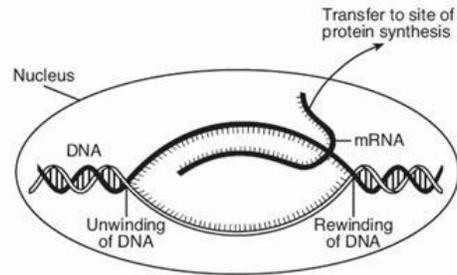
The diagram below represents the cloning of a carrot plant.



Compared to each cell of the original carrot plant, each cell of the new plant will have

- (1) the same number of chromosomes and the same types of genes
- (2) the same number of chromosomes, but different types of genes
- (3) half the number of chromosomes and the same types of genes
- (4) half the number of chromosomes, but different types of genes

The diagram below shows some of the steps in protein synthesis.



The section of DNA being used to make the strand of mRNA is known as a

- |                  |                |
|------------------|----------------|
| (1) carbohydrate | (3) ribosome   |
| (2) gene         | (4) chromosome |

A change in the base subunit sequence during DNA replication can result in

- (1) variation within an organism
- (2) rapid evolution of an organism
- (3) synthesis of antigens to protect the cell
- (4) recombination of genes within the cell

Even though each body cell in an individual contains the same DNA, the functions of muscle cells and liver cells are *not* the same because

- (1) mutations usually occur in genes when muscle cells divide
- (2) liver tissue develops before muscle tissue
- (3) liver cells produce more oxygen than muscle cells
- (4) liver cells use different genes than muscle cells

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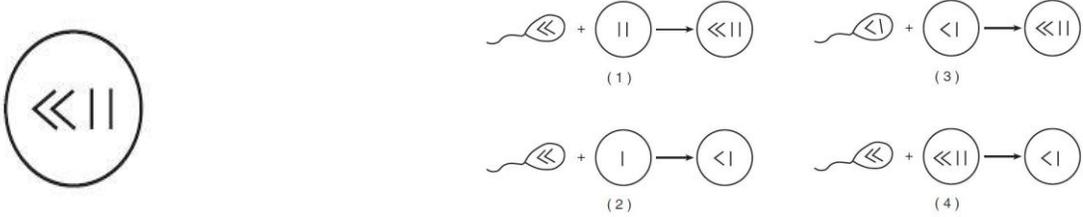
The flounder is a species of fish that can live in very cold water. The fish produces an "antifreeze" protein that prevents ice crystals from forming in its blood. The DNA for this protein has been identified. An enzyme is used to cut and remove this section of flounder DNA that is then spliced into the DNA of a strawberry plant. As a result, the plant can now produce a protein that makes it more resistant to the damaging effects of frost. This process is known as

- (1) sorting of genes
- (2) genetic engineering
- (3) recombination of chromosomes
- (4) mutation by deletion of genetic material

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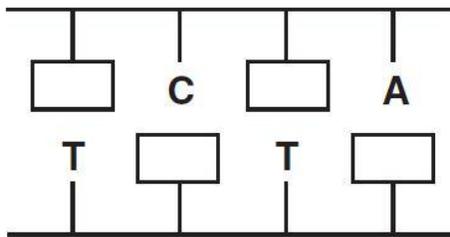
The diagram below represents a nucleus containing the normal chromosome number for a species.

Which diagram best illustrates the normal formation of a cell that contains all of the genetic information needed for growth, development, and future reproduction of this species?



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The diagram below represents an incomplete section of a DNA molecule. The boxes represent unidentified bases.



When the boxes are filled in, the total number of bases represented by the letter A (both inside and outside the boxes) will be

- (1) 1
- (2) 2
- (3) 3
- (4) 4

30

In preparation for an electrophoresis procedure, enzymes are added to DNA in order to

- (1) convert the DNA into gel
- (2) cut the DNA into fragments
- (3) change the color of the DNA
- (4) produce longer sections of DNA

31

If 15% of a DNA sample is made up of thymine, T, what percentage of the sample is made up of cytosine, C?

- (1) 15%

- (2) 35%
- (3) 70%
- (4) 85%

**32**

Even though identical twins have the same genetic material, they may develop slightly different characteristics because

- (1) each twin receives different chromosomes from the egg
- (2) one twin may only have genes from the father
- (3) gene expression may be influenced by factors that switch genes on and off
- (4) a gene mutation may have occurred before the zygote divided

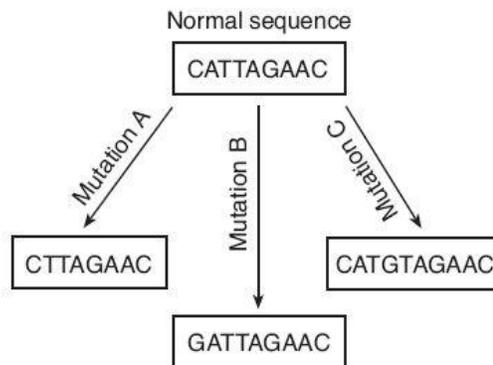
**33**

What normally happens immediately after fertilization in sexual reproduction?

- (1) specialization of cells to form a fetus from an egg
- (2) production of daughter cells having twice the number of chromosomes as the parent cell
- (3) production of daughter cells having half the number of chromosomes as the parent cell
- (4) division of cells resulting in the development of an embryo from a zygote

**34**

The diagram below shows a normal gene sequence and three mutated sequences of a segment of DNA.



Which row in the chart below correctly identifies the cause of each type of mutation?

Row	Mutation A	Mutation B	Mutation C
(1)	deletion	substitution	insertion
(2)	insertion	substitution	deletion
(3)	insertion	deletion	substitution
(4)	deletion	insertion	substitution

**35**

The chart below compares the size of three structures: a gene, a nucleus, and a chromosome.

Size	Structure
smallest in size	A
↓	B
greatest in size	C

Based on this information, structure A would most likely be a

- (1) chromosome that is part of structure C
- (2) chromosome that contains structures B and C
- (3) nucleus that contains both structure B and structure A
- (4) gene that is part of structure B

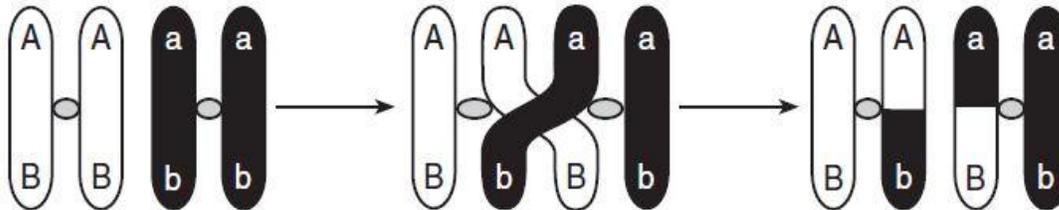
**36**

A student added an enzyme to a test tube containing a sample of DNA. After a period of time, analysis of the DNA sample indicated it was now broken into three segments. The purpose of the enzyme was most likely to

- (1) cut the DNA at a specific location
- (2) move the DNA to a different organism
- (3) copy the DNA for protein synthesis
- (4) alter the DNA sequence in the segment

**37**

The diagram below shows a process that affects chromosomes during meiosis.

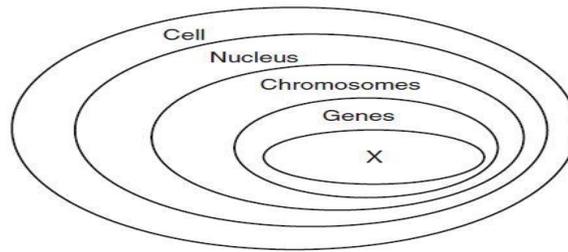


This process can be used to explain

- (1) why some offspring are genetically identical to their parents
- (2) the process of differentiation in offspring
- (3) why some offspring physically resemble their parents
- (4) the origin of new combinations of traits in offspring

**38**

The diagram below represents levels of organization within a cell of a multicellular organism.



The level represented by X is composed of

- (1) four types of base subunits
- (2) folded chains of glucose molecules
- (3) twenty different kinds of amino acids
- (4) complex, energy-rich inorganic molecules

**39**

A chemical known as 5-bromouracil causes a mutation that result in the mismatching of molecular bases in DNA. The offspring of organisms exposed to 5-bromouracil can have mismatched DNA if the mutation occurs in

- (1) the skin cells of the mother
- (2) the gametes of either parent
- (3) all the body cells of both parents
- (4) only the nerve cells of the father