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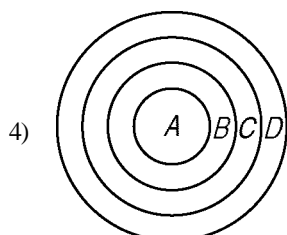
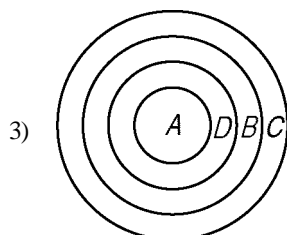
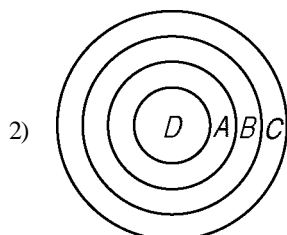
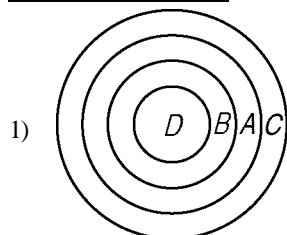
UNIT: GENETICS

TOPIC: DNA, GENES, CHROMOSOMES AND PROTEIN SYNTHESIS

- 1) Which diagram *best* represents the relative locations of the structures in the key below?

KEY:

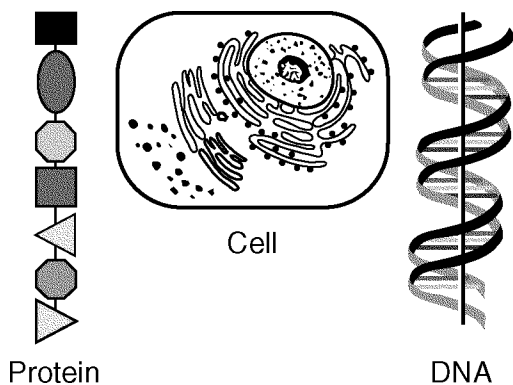
A = chromosome
B = nucleus
C = cell
D = gene



- 2) Hereditary information is stored inside the
- 1) nucleus, which has chromosomes that contain many genes
 - 2) ribosomes, which have chromosomes that contain many genes
 - 3) nucleus, which has genes that contain many chromosomes
 - 4) ribosomes, which have genes that contain many chromosomes

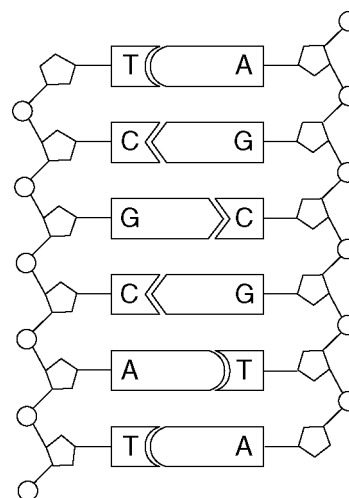
- 3) The *largest* amount of DNA in a plant cell is contained in
- 1) a chromosome
 - 2) a protein molecule
 - 3) an enzyme molecule
 - 4) a nucleus
- 4) Which two structures of a frog would most likely have the same chromosome number?
- 1) skin cell and fertilized egg cell
 - 2) kidney cell and egg cell
 - 3) zygote and sperm cell
 - 4) liver cell and sperm cell
- 5) Chromosomes can be described as
- 1) large molecules that have only one function
 - 2) coiled strands of genetic material
 - 3) folded chains of bonded glucose molecules
 - 4) reproductive cells composed of molecular bases
- 6) A mutation changes a gene in a cell in the stomach of an organism. This mutation could cause a change in
- 1) neither the organism nor its offspring
 - 2) both the organism and its offspring
 - 3) the organism, but not its offspring
 - 4) its offspring, but not the organism itself
- 7) The transfer of genes from parents to their offspring is known as
- 1) evolution
 - 2) immunity
 - 3) differentiation
 - 4) heredity
- 8) Hereditary traits are transmitted from generation to generation by means of
- 1) proteins in body cells
 - 2) carbohydrates in body cells
 - 3) specific starches making up DNA in reproductive cells
 - 4) specific sequences of bases in DNA in reproductive cells
- 9) In all organisms, the coded instructions for specifying the characteristics of the organism are directly determined by the arrangement of the
- 1) twenty-three pairs of genes on each chromosome
 - 2) strands of simple sugars in certain carbohydrate molecules
 - 3) four types of molecular bases in the genes
 - 4) twenty kinds of amino acids in each protein

- 10) A certain protein is found in mitochondria, chloroplasts, and bacteria. This provides evidence that plants and bacteria
- 1) digest proteins into simple sugars
 - 2) have some similar DNA base sequences
 - 3) contain certain pathogenic microbes
 - 4) can use carbon dioxide to make proteins
- 11) Genes involved in the production of abnormal red blood cells have an abnormal sequence of
- 1) amino acids
 - 2) ATP molecules
 - 3) sugars
 - 4) bases
- 12) Which statement *best* describes the relationship between cells, DNA, and proteins?
- 1) DNA is composed of proteins that carry coded information for how cells function.
 - 2) Cells contain DNA that controls the production of proteins.
 - 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.
- 13) Three structures are represented in the diagram below.



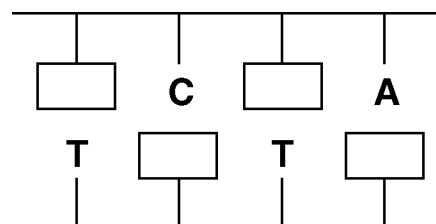
What is the relationship between these three structures?

- 14) The diagram below represents a portion of an organic molecule.



This molecule controls cellular activity by directing the synthesis of

- 1) fats
 - 2) minerals
 - 3) carbohydrates
 - 4) proteins
- 15) The diagram below represents an incomplete section of a DNA molecule. The boxes represent unidentified bases.



What will be the total number of bases represented by the letter A (both inside and outside the boxes) when the boxes are completely filled in?

- 1) 1
 - 2) 2
 - 3) 3
 - 4) 4
- 16) One *disadvantage* of a genetic mutation in a human skin cell is that it
- 1) may result in the production of a defective protein
 - 2) can lead to a lower mutation rate in the offspring of the human
 - 3) may alter the sequence of simple sugars in insulin molecules
 - 4) can alter the rate of all the metabolic processes in the human
- 17) A characteristic of a DNA molecule that is *not* characteristic of a protein molecule is that the DNA molecule
- 1) can be very large
 - 2) is composed of subunits
 - 3) is found in nuclei
 - 4) can replicate itself

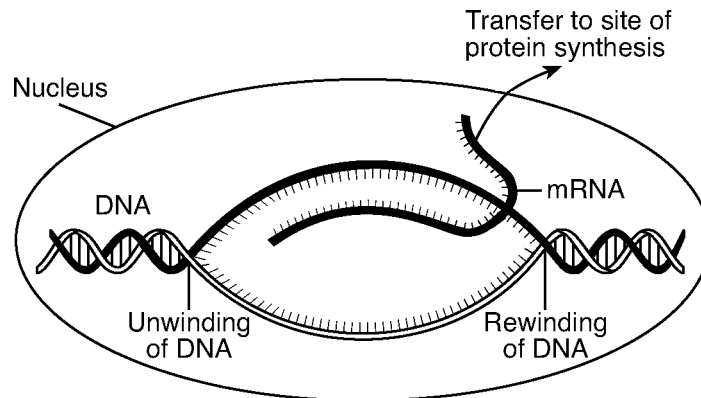
- 18) Two proteins in the same cell perform different functions. This is because the two proteins are composed of
- 1) chains folded the same way and the same sequence of amino acids
 - 2) chains folded differently and a different sequence of amino acids
 - 3) chains folded the same way and the same sequence of simple sugars
 - 4) chains folded differently and a different sequence of simple sugars

- 19) Animal cells utilize many different proteins. Discuss the synthesis of proteins in an animal cell. Your answer must include at least:
- (1) the identity of the building blocks required to synthesize these proteins
 - (2) the identity of the sites in the cell where the proteins are assembled
 - (3) an explanation of the role of DNA in the process of making proteins in the cell

20) Which nuclear process is represented below?

A DNA molecule → untwists. → The two strands of DNA separate. → Molecular bases pair up. → Two identical DNA molecules are produced.

- 1) replication
 - 2) mutation
 - 3) recombination
 - 4) fertilization
- 21) 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) chromosome
- 2) gene
- 3) carbohydrate
- 4) ribosome

TOPIC: MUTATIONS AND GENETIC DISORDERS

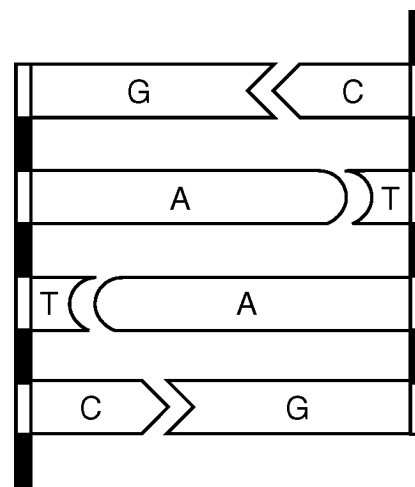
- 22) Some steps involved in DNA replication and protein synthesis are summarized in the table below.

Step A	DNA is copied and each new cell gets a full copy.
Step B	Information copied from DNA moves to the cytoplasm.
Step C	Proteins are assembled at the ribosomes.
Step D	Proteins fold and begin functioning.

In which step would a mutation lead directly to the formation of an altered gene?

- 1) A 2) B 3) C 4) D
- 23) A single gene mutation results from
- 1) a change in a base sequence in DNA
 - 2) the failure of chromosomes to separate
 - 3) blocked nerve messages
 - 4) recombination of traits
- 24) 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
- 25) Synthesis of a defective protein may result from an alteration in
- 1) the number of mitochondria
 - 2) cellular fat concentration
 - 3) vacuole shape
 - 4) a base sequence code
- 26) An error in genetic information present in a body cell of a mammal would most likely produce
- 1) rapid evolution of the organism in which the cell is found
 - 2) increased variation in the type of organelles present in the cell
 - 3) a mutation that will affect the synthesis of a certain protein in the cell
 - 4) an adaptation that will be passed on to other types of cells

- 27) The diagram below represents a portion of a type of organic molecule present in the cells of organisms.



What will most likely happen if there is a change in the base sequence of this molecule?

- 1) The amino acid sequence may be altered during protein synthesis.
 - 2) The chromosome number will decrease in future generations.
 - 3) The molecule will be converted into an inorganic compound.
 - 4) The chromosome number may increase within the organisms.
- 28) A mutation occurs in the liver cells of a certain field mouse. Which statement concerning the spread of this mutation through the mouse population is correct?
- 1) It will not spread because it is a recessive gene.
 - 2) It will spread because it is a dominant gene.
 - 3) It will spread because it is beneficial.
 - 4) It will not spread because it is not in a gamete.
- 29) Down syndrome is a genetic disorder caused by the presence of an extra chromosome in the body cells of humans. This extra chromosome occurs in a gamete as a result of
- 1) a gene mutation
 - 2) an error in meiotic cell division
 - 3) an error in the process of cloning
 - 4) replication of a single chromosome during mitosis
- 30) (a) Use appropriate letters to write a 9-base DNA sequence that could represent a portion of a gene.
- (b) Show *one* example of what could happen to the 9-base DNA sequence you wrote in *part (a)* if a mutation occurred in that gene.

Questions 31 through 33 refer to the following:

Sickle-cell anemia is an inherited disease that occurs mainly in people from parts of Africa where malaria is common. It is caused by a gene mutation that may be harmful or beneficial.

A person with two mutant genes has sickle-cell disease. The hemoglobin of a person with sickle-cell disease twists red blood cells into a crescent shape. These blood cells cannot circulate normally. Symptoms of the disease include bleeding and pain in bones and muscles. People with sickle-cell disease suffer terribly in childhood and, until modern medicine offered treatment, most of them died before reproducing. An individual who has one mutant gene is protected from malaria because the gene changes the hemoglobin structure in a way that speeds removal of malaria-infected cells from circulation. A person with two normal genes has perfectly good red blood cells, but lacks resistance to malaria.

- 31) Define the term mutation.
- 32) Based on the reading passage, which statement about having one sickle-cell gene is correct?
- 1) It is beneficial or harmful depending on whether it is common or rare.
 - 2) It is fatal to anyone who inherits the gene.
 - 3) It is beneficial in certain environments.
 - 4) It is beneficial to anyone who inherits the gene.
- 33) Based on the reading passage, explain why the percentage of the population with one mutant sickle-cell gene is higher in areas where malaria is common.

Questions 34 through 37 refer to the following:

WHERE IS THE BEEF? OUT BEING IRRADIATED

E. coli bacteria in food cause an estimated 73,000 cases of infection leading to some deaths in the United States each year. Until recently, the only way to guarantee meat free of *E. coli* was to heat it to 160°F, which kills *E. coli*. The rare hamburgers preferred by many people are not heated to this temperature, and just a few *E. coli* may cause severe illness.

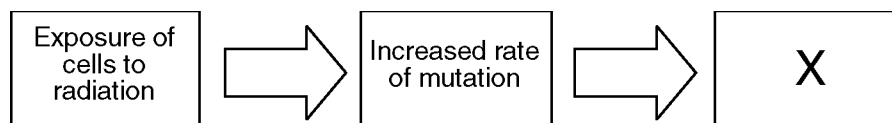
Recently, ground beef has been decontaminated by irradiation using electron beam technology. The packaged ground beef is scanned by an electron beam that disrupts the genetic structure of the pathogens. This kills them or leaves them unable to reproduce.

This process is considered safe and has been endorsed by various governmental groups in this country, as well as the World Health Organization. Irradiation is effective in preserving only certain foods, such as herbs, wheat flour, fresh fruits, vegetables, and some meats. Although some methods of irradiation can change the taste of some foods, this is not an effect of electron beam technology on ground beef.

Opponents of irradiating food are concerned that the process may result in the formation of chemicals that may be harmful or result in a loss of vitamins. Supporters claim that irradiation is safe and should be considered as just another technique for preservation of food.

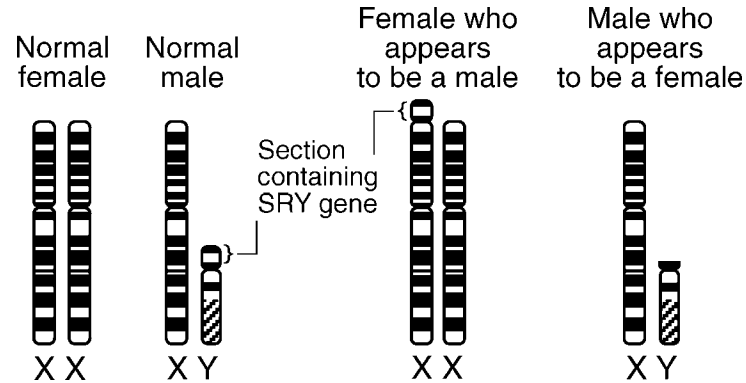
- 34) According to the reading passage, identify *one* specific pathogen found in ground beef.
- 35) Identify the specific group of molecules in bacteria whose function would be interfered with by heating them to 160°F.
- 36) Based on the reading passage, explain how irradiation helps preserve meat.
- 37) Based on the reading passage, explain how irradiation could interfere with the process of reproduction in bacteria that survive the irradiation.

- 38) Which of the following phrases belongs in box X of the flowchart below?



- 1) Decrease in genetic variability of offspring
- 2) Increase in the production of functional gametes
- 3) Increased chance of cancer
- 4) Decreased number of altered genes

- 39) The *Y*-chromosome carries the *SRY* gene that codes for the production of testosterone in humans. Occasionally a mutation occurs resulting in the *SRY* gene being lost from the *Y*-chromosome and added to the *X*-chromosome, as shown in the diagram below.

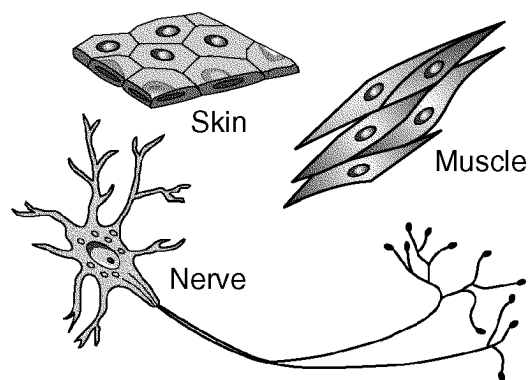


Based on the diagram, which statement is correct?

- 1) The production of testosterone influences the development of male characteristics.
- 2) Normal female characteristics develop from a single *X*-chromosome.
- 3) Reproductive technology has had an important influence on human development.
- 4) Male characteristics only develop in the absence of *X*-chromosomes.

TOPIC: GENE EXPRESSION

- 40) Which of the following statements indicates that different parts of the genetic information are used in different kinds of cells, even in the same organism?
- 1) Replicated chromosomes separate during gamete formation.
 - 2) As an embryo develops, various tissues and organs are produced.
 - 3) The cells produced by a zygote usually have different genes.
 - 4) Offspring have a combination of genes from both parents.
- 41) The characteristics of a developing fetus are *most* influenced by
- 1) circulating levels of white blood cells in the placenta
 - 2) hormone production by the father
 - 3) gene combinations and their expression in the embryo
 - 4) milk production in the mother
- 42) A human liver cell is very different in structure and function from a nerve cell in the same person. This is *best* explained by the fact that
- 1) different genes function in each type of cell
 - 2) liver cells contain fewer chromosomes than nerve cells
 - 3) liver cells can reproduce while the nerve cells cannot
 - 4) different DNA is present in each type of cell
- 43) Research has shown that certain body cells, known as stem cells, can develop into a variety of specialized cells. Various factors can cause stem cells to develop into different types of mature cells. These different types of mature cells result from
- 1) similar steps in the development of the cells and a reduction in the number of chromosomes in each cell
 - 2) different environments of the cells and the functioning of different parts of the genetic code
 - 3) different antibodies and mitotic cell division
 - 4) identical genetic codes and meiotic cell division
- 44) The enzyme pepsin is produced in the cells of the stomach, but not in the cells of the small intestine. The small intestine produces a different enzyme, trypsin. The reason that the stomach and small intestine produce different enzymes is that the gene that codes for pepsin is
- 1) mutated in the small intestine
 - 2) digested by the trypsin in the small intestine
 - 3) in the cells of the stomach, but not in the cells of the small intestine
 - 4) expressed in the stomach, but not expressed in the small intestine
- 45) The types of human cells shown below are different from one another, even though they all originated from the same fertilized egg and contain the same genetic information.



Explain why these genetically identical cells can differ in structure and function.

TOPIC: HEREDITY AND THE ENVIRONMENT

- 46) Genes are inherited, but their expressions can be modified by the environment. This statement explains why
- 1) some animals have dark fur only when the temperature is within a certain range
 - 2) offspring produced by means of sexual reproduction look exactly like their parents
 - 3) animals can be cloned, but plants cannot
 - 4) identical twins who grow up in different homes have the same characteristics
- 47) Some mammals have genes for fur color that produce pigment only when the outside temperature is above a certain level. This pigment production is an example of how the environment of an organism can
- 1) destroy certain genes
 - 2) stop the process of evolution
 - 3) influence the expression of certain genes
 - 4) cause new mutations to occur
- 48) Which of the following statements *best* explains the change shown in the diagram below?



- 1) Sorting and recombination of genes can be influenced by very cold temperatures.
 - 2) Molecular arrangement in existing proteins can be altered by environmental factors.
 - 3) Certain rabbits produce mutations that affect genes in specific areas of the body.
 - 4) Gene expression in an organism can be modified by interactions with the environment.
- 49) The brown summer feathers of ptarmigans, small Arctic birds, are replaced by white feathers after winter arrives. Which statement *best* explains this observation?
- 1) Holes in the ozone layer vary in size depending on the season.
 - 2) Mutations occur only during certain seasons.
 - 3) The expression of genes can be modified by the environment.
 - 4) Acids in rain bleach the brown feathers of the birds.

- 50) At warm temperatures, a certain bread mold can often be seen growing on bread as a dark-colored mass. The same bread mold growing on bread in a cooler environment is red in color. Which statement most accurately describes why this change in the color of the bread mold occurs?
- 1) Every organism has a different set of coded instructions.
 - 2) The DNA was altered in response to an environmental condition.
 - 3) There is no replication of genetic material in the cooler environment.
 - 4) Gene expression can be modified by interactions with the environment.
- 51) A student notices that fruit flies with the curly-wing trait develop straight wings if kept at a temperature of 16°C, but develop curly wings if kept at 25°C. The *best* explanation for this observation is that
- 1) wing shape is controlled by behavior
 - 2) gene mutations for wing shape can occur at high temperatures
 - 3) wing shape is influenced by light intensity
 - 4) gene expression can be modified by interactions with the environment
- 52) Plants inherit genes that enable them to produce chlorophyll, but this pigment is not produced unless the plants are exposed to light. This is an example of how the environment can
- 1) affect one plant species, but not another
 - 2) influence the expression of a genetic trait
 - 3) result in the appearance of a new species
 - 4) cause mutations to occur
- 53) In one variety of corn, the kernels turn red when exposed to sunlight. In the absence of sunlight, the kernels remain yellow. Based on this information, it can be concluded that the color of these corn kernels is due to the
- 1) composition of the soil
 - 2) process of selective breeding
 - 3) rate of photosynthesis
 - 4) effect of environment on gene expression
- 54) Which statement *best* explains the fact that some identical twins appear different from one another?
- 1) Their DNA is essentially the same and the environment plays a significant role in the expression of their genes.
 - 2) Their DNA is essentially the same and the environment plays little or no role in the expression of their genes.
 - 3) Their DNA is very different and the environment plays little or no role in the expression of their genes.
 - 4) Their DNA is very different and the environment plays a significant role in the expression of their genes.

- 55) The females of certain species of turtles will sneak into a nest of alligator eggs to lay their own eggs and then leave, never to return. When the baby turtles hatch, they automatically hide from the mother alligator guarding the nest and go to the nearest body of water when it is safe to do so.

Which statement *best* explains the behavior of these baby turtles?

- 1) The baby turtles' ancestors who learned to behave this way taught the behaviors to their offspring.
- 2) More of the turtles' ancestors who acted in this way survived to reproduce, passing this behavioral trait to their offspring.
- 3) Turtles are not capable of evolving, so they repeat the same behaviors generation after generation.
- 4) The baby turtles are genetically identical, so they behave the same way.

- 56) Which of the following statements *best* explains the observation that clones produced from the same organism may *not* be identical?

- 1) Gene expression can be influenced by the environment.
- 2) Differentiated cells have different genes.
- 3) Half the genetic information in offspring comes from each parent.
- 4) Events in meiosis result in variation.