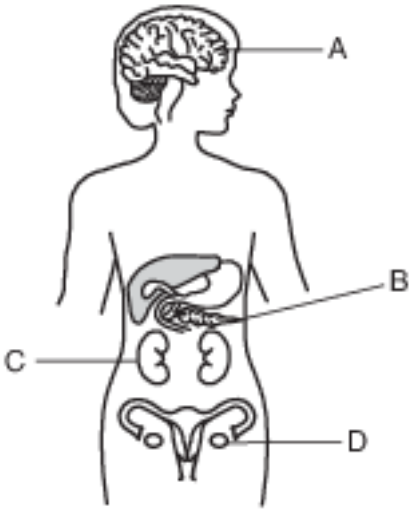
(Nysed) Mutations Caused Environmental Factors

1 Some organs in the human body are represented in the diagram below.



A sudden change in the DNA of cells developing in which organ could be passed to future generations?

(1) A (3) C
(2) B (4) D

2 The processes of deletion, insertion, and substitution can alter genes in a skin cell. The altered genes will most likely be passed on to
(1) sperm cells
(2) egg cells
(3) every cell that develops from that skin cell
(4) only a few of the cells that develop from that skin cell

3 A strand of DNA in a skin cell contains the bases:

A-T-G-C-C-A-T-C-G-G-T-A

After the cell is exposed to ultraviolet light, the strand contains the bases:

A-T-G-G-C-C-A-T-C-G-G-T-A

Which statement describes the result of this exposure?
(1) A new base has been inserted.
(2) A base has been deleted.
(3) One base has been substituted for another.
(4) There have been no changes in the bases.

4 The ameba, a single-celled organism, reproduces asexually. Variations in an ameba would most commonly occur through
(1) differentiation during development
(2) the fusion of gametes
(3) random mutations
(4) recombination during fertilization

5 Finches on the Galapagos Islands express a variety of traits. Variability in the offspring of these finches is a result of
(1) mutation and cloning
(2) meiosis and mutation
(3) mitosis and asexual reproduction
(4) mitosis and genetic recombination

6 Butterflies exposed to radiation leaking from a damaged nuclear power plant in Japan have been observed to have malformed legs, antennae, and wings. For future butterfly generations to have these similar structural abnormalities, gene mutations must be present in the affected butterflies’

(1) wing cells (3) antenna cells
(2) body cells (4) sex cells

7 A genetic change that occurs in a body cell of a mouse will not contribute to the evolution of the species because
(1) body cell mutations will cause the cell to die before it reproduces
(2) the evolution of a species can result from changes in reproductive cells, not body cells
(3) random changes are repaired by enzymes before they are passed on to offspring
(4) the evolution of a species is caused by natural selection, not genetic variation

8 A sample of body cells and samples of sex cells received from four members of a species are screened for the presence of a specific gene mutation. The results of the gene-testing procedure conducted on the cells are shown in the table below.

Species Member Tested	Type of Cells Tested and the Result (+ = mutation present, – = mutation absent)		
	Body Cells	Sperm	Egg
1	+		+
2	+	+	
3	–		+
4	+	–	

Which species member would be unlikely to pass the gene mutation on to its offspring?

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

9 Which event would most likely cause a change in a genetic sequence in an organism?

(1) eating certain foods high in saturated fats
(2) strenuous physical activity
(3) exposure to radiation
(4) a sudden exposure to cooler temperatures

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10 The number of amino acid differences in the protein cytochrome c between chimpanzees and some other animals is shown in the table below.

Comparison of Chimpanzee Cytochrome c to that of Other Animals

Animal	Number of Amino Acid Differences
Chimpanzee	0
Dog	8
Dogfish shark	24
Rattlesnake	12
Rhesus monkey	1

Explain how the data in the table can be used to determine possible evolutionary relationships. [1]

Base your answers to questions 11 on the information below and on your knowledge of biology.

Guppies are small, tropical freshwater fish that display wide variation in coloration. Some have bright splotches of blue, red, and orange, while others are quite drab and dull. Research has shown that females prefer to mate with brightly colored males; however, this trait makes them more likely to be seen. Guppies, like all species, must be able to both sur- vive and reproduce in order to avoid extinction.

11 Identify one process that is responsible for the variations in coloration observed in guppies. [1]

Base your answers to questions 12 on the information below and on your knowledge of biology.

Mutations cause many disorders in humans. Cystic fibrosis (CF) is a disorder that can be passed on from generation to generation. Skin cancer is a disorder that sometimes originates in skin cells as a result of overexposure to the Sun.

12 Explain why some disorders, such as CF, can be passed on from generation to generation, whereas some other disorders, such as skin cancer, cannot. [1]

Base your answer to question 13-15 on the information below and on your knowledge of biology.

Information From the Cat Gene Database

A database is being used to trace the evolutionary history of wild and domestic cats. Comparisons show that there are very few differences between the genes present in domestic cats and the genes present in wild cats, such as tigers and lions. Research has also shown that wild cats and domestic cats last shared a common ancestor about 11 million years ago. Since then, there has been very little change in the entire cat genome (the complete set of genes for all the species). This indicates that the cats are well-adapted to change. Yet, there are some important differences.

Big cats share about 1,376 genes that set them apart from other animals. These genes are related to muscle strength and the ability to digest protein. In addition, there are genes that have been found in specific cats that live in specific environments. Genes related to smell, visual perception, and nerve development are evolving rapidly in Siberian tigers. Snow leopards have three mutations related to the use of oxygen at high altitudes. The database is also being used to study diversity within various cat species.

13-15 Discuss the importance of establishing a genome database for a cat species. In your answer, be sure to:
• state one example of a genetic variation that is important for the survival of one specific cat species [1]
• identify a specific technique that can be used to analyze the genomes of organisms and explain how the results are used [1]
• explain how genes for a trait, such as a specific fur color, can increase in frequency in a population over time [1]

16 Explain why a mutation that occurs in a body cell will not contribute to the evolution of a species. [1]

Base your answers to questions 17 on the information below and on your knowledge of biology.

Turtle Cells and Human Skin

New research has demonstrated that turtles and humans may have had a common ancestor 310 million years ago. A recent study looked at the genes responsible for the skin layers of turtle shells compared to the genes for human skin. The findings of the study suggest that about 250 million years ago, when turtle evolution split from other reptiles, a mutation in a specific group of genes occurred. The basic organization of this group of genes is similar in turtles and humans, and they produce the important skin proteins that produce shells in turtles and protect against infection in the skin of humans.

17 Describe how the mutation in the genes of a turtle ancestor turned out to be a beneficial evolutionary adaptation. [1]

Answer Keys

1 4

2 3

3 1

4 3

5 2

6 4

7 2

8 4

9 3

10 Allow 1 credit. Acceptable responses include, but are not limited to:
- — The more closely related the organisms, the fewer amino acid differences.
- — A greater number of differences probably means that they are not closely related.

11 Allow 1 credit. Acceptable responses include, but are not limited to:
- — mutation
- — sexual reproduction
- — meiosis/crossing-over
- — recombination of genes
- — natural selection
- — sexual selection

12 Allow 1 credit. Acceptable responses include, but are not limited to:
- — The mutations that cause some disorders are present in all the cells, including the
- reproductive cells, while the mutations that cause some other disorders only occur in body cells.
- — The mutations that occur in body cells/skin cells cannot be passed on to offspring.

13-15 The student’s response to the bulleted items in the question need not appear in the following order.

- 13. Allow 1 credit for stating one example of a genetic variation that is important for the survival of one specific cat species. Acceptable responses include, but are not limited to:
- — Siberian tigers have genes that increase their ability to smell prey.
- — Snow leopards have mutations related to the use of oxygen at high altitudes.
- — A lion that is more muscular has a better chance of catching prey.
- 14. Allow 1 credit for identifying a specific technique that can be used to analyze the genomes of organisms and for explaining how this technique is used. Acceptable responses include, but are not limited to:
- — Electrophoresis can be used to study the DNA patterns of organisms. The resulting bands can be used to compare the genetic makeup of the organisms.
- — Genes can be cut from the DNA of organisms using special enzymes and can then be analyzed/compared with each other.
- — Bioinformatics can be used to compare a data set with a reference genome.
- Note: Do not allow credit for biotechnology. It is a field of science, not a technique.
- 15. Allow 1 credit for explaining how genes for a trait, such as a specific fur color, can increase in a population. Acceptable responses include, but are not limited to:
- — Certain traits help the big cats survive in the environment; as a result, they are able to reproduce and pass on the genes for the trait to their offspring.
- — When more cats with a certain fur color trait survive and reproduce, the number of big cats with genes for the trait increases.
- — The cats with a specific fur color gene are more successful at catching prey than those without it. They then pass this on to their offspring.
- — The fur color makes them more successful in mate selection. They reproduce and pass on the fur color.
- — Natural selection can lead to beneficial traits increasing in frequency.

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

- — Genetic information in body cells isn’t passed on to offspring.
- — The mutation isn’t in sperm or egg cells.
- — Mutations must be in gametes to be passed on to offspring.

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

- — The turtles produced proteins that strengthened skin, resulting in a tough shell for a
- defense mechanism.
- — The mutation results in a shell with better protection.
- — They produced skin proteins that protect against infection in humans.
- — The turtles were protected from predators.