SCIENCE 9
UNIT 4: REPRODUCTION
WORKSHEET 3: Gene Mutations

Gene Mutation, or mutation for short, is a change in the genetic material (DNA) of a gene. Changes to DNA may cause proteins to be made incorrectly or with an incorrect shape. A base may be added, deleted or substituted for another.

Mutagens are factors in the environment, that can cause mutations (Changes in genetic code).

There are two ways to classify mutagens:

1. Natural

Ex. Solar radiation
Radioactive gases

2. Human Activity

Ex. Chemicals such as pesticides
Cigarette smoke

Effects of Mutations:

1. Positive Mutation: Benefits an individual

Example:

Some plants carry a mutated gene that protects them from certain diseases. Some people have a mutated gene that produces a special kind of protein. This protein prevents the virus called HIV from infecting the person. This type of mutation benefits an individual.

2. Negative Mutation Harms the individual. It reduces the probability that the individual will produce offspring or survive in their environment.

Example:

For example, some people are born with a mutated gene that makes their red blood cells have a curved shape instead of the normal disc shape. The curved shape prevents the cells from carrying oxygen well and blocks blood flow in blood vessels.

3) Neutral Mutation Most mutations have no effect on an organism. Does not affect the individual

Example,

The Spirit Bears of coastal British Columbia have a mutated gene that makes their fur white instead of black. This mutation does not affect their lives in any important way

Can mutations be fixed?

Some mutations can be treated with drugs or surgery. New techniques for treating gene mutations are called gene therapy. In one form of gene therapy, researchers replace a mutated gene with a healthy copy of the gene. The healthy gene must first attach to a chromosome within a patient's cells. Then the gene needs to make the correct type and amount of protein. These techniques are still experimental at this time.

PART A: MULTIPLE CHOICE

1. Which of the following statements about gene mutation is false?

   (A) A gene mutation always results in the death of the organism
   (B) If a gene sequence of nitrogen bases is CGATA, then an example of a mutated form of the gene sequence might be AGATA
   (C) Radiation, such as X-rays or UV rays, is an example of a potential mutagen
   (D) A faulty gene could potentially mutate into a healthy gene

2. To protect the population of B.C. spirit bears (white kermode bears) the black bear population must also be protected. Why?

   (A) If black bears were not protected, the entire population of bears would eventually be white
   (B) Black bears also carry the mutated gene that produces white bears
   (C) White bears are born only when there are a substantial number of black bears in a population
   (D) Black bears protect the white bears

3. Which of the following is an example of a positive mutation?

   (A) The disease, cystic fibrosis, is caused by any of over 1300 mutations on a single gene
   (B) A white bear is produced in the B.C. black bear population
   (C) A human carries a mutated gene that makes that individual resistant to HIV infection
   (D) People who carry the sickle cell gene have c-shaped red blood cells that can block blood flow

4. Which of the following mutations should be classified as a negative mutation?

   (A) A gene mutation produces a healthy cat with six toes
   (B) A change in a gene results in misshaped blood cells that cannot carry oxygen properly
   (C) A base pair is deleted from a strand of junk DNA
   (D) A mutation occurs in a gene for brown hair. Yet that gene still produces brown hair

5. Which of the following is least likely to be a mutagen?

   (A) Second hand cigarette smoke
   (B) Hypothermia (when the body is cooled below normal temperature)
   (C) Sunlight
   (D) A biological virus

6. Scientists are injecting genes that make the coat protein of hepatitis B virus into young banana trees. Which of the following is not a potential advantage of this experiment?

   (A) Bananas can be eaten raw, so the coat protein is not deactivated by cooking
   (B) Banana trees could make antibodies to hepatitis B virus and kill it
   (C) Bananas are a potential inexpensive way to deliver a vaccine against hepatitis B
   (D) Humans that eat the bananas will ingest the virus coat protein and make antibodies to it

7. Mutations are most often

   (A) Beneficial
   (B) Harmful
   (C) Neutral
   (D) Deadly

8. Which of the following is an example of a neutral mutation?

I	white fur instead of black fur
II	a mutated gene protects a plant from a disease
III	curved red blood cells instead of discshaped cells

(A) I
(B) II
(C) III
(D) none of the above

9. Which type of mutation is beneficial to an organism and, therefore, aids in the organism's ability to survive?

(A) Neutral
(B) Positive
(C) Negative
(D) Deletion

10. Errors in the DNA that appear to neither harm nor help an organism are called

(A) Neutral
(B) Positive
(C) Negative
(D) Substitutions

11. Which of the following can cause mutated genes?

I	cigarette smoke
II	radiation
III	curved red blood cells instead of discshaped cells

(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II, and III

12. The coat colour of the Spirit Bear is due to

(A) Change of the seasons
(B) Global warming
(C) A mutated gene
(D) Environmental stresses

13. Most mutations

(A) are helpful to the organism
(B) are harmful to the organism
(C) have no effect on the organism
(D) can be treated in an organism

PART B: FILL IN THE BLANK

Use the terms in the vocabulary box to fill in the blanks. You will not need to use every term. You may use terms more than once.

DNA		negative mutations
gene mutation		neutral mutations
gene therapy		organism
healthy gene		positive mutations
mutagens		proteins
mutated gene		

1. A_____ is a change in the genetic material of a gene.

2. Changes to DNA may cause _____ to be made incorrectly or with an incorrect shape.

3. Factors in the environment, called_____ can cause mutations.

4. Radiation, cigarette smoke, and pesticides are examples of _____ .

5. Mutations that are harmful to an organism are called _____ .

6. Mutations that are helpful to an organism are called _____ .
For instance, some plants carry a mutated gene that protects them from disease.

7. Mutations that have no effect on an organism are called _____ .

8. New techniques for treating gene mutations are called _____
and may involve replacing a_____with a _____.

PART C: MATCHING

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once

Term	Descriptor
1. _____ gene mutation	A. techniques developed to replace mutated genes
2. _____ gene therapy	B. a mutation that does not affect the organism
3. _____ mutagens	C. a mutation that harms an organism
4. _____ negative mutation	D. a change in the genetic material
5. _____ neutral mutation	E. a mutation that benefits an organism
6. _____ positive mutation	F. a healthy gene
	G. substance or factor that can cause mutations in DNA