

Section

11.3

Genetic Changes**Before You Read**

If you have had an X ray taken, you may remember that before they took it they covered the part of your body not being X rayed with a heavy lead shield. Think about why the technician protects you from X rays and write the reason on the lines below. After you read this section, check your answer. You may want to add new information that you learned.

Read to Learn**STUDY COACH****Mark the Text****Identify Main**

Ideas As you read this section, highlight the main idea in each paragraph. Stop after every paragraph and put what you just read into your own words.

✓ Reading Check

1. When is a mutation helpful?

Mutations

Every day millions of cells correctly transfer DNA information to proteins. Occasionally, however, there is a change in the DNA sequence. Any change in the DNA sequence is called a **mutation**. Mutations can be caused by errors in replication, transcription, or cell division. Forces outside of the cell can cause changes to DNA. You will learn about each of these mutations in this section.

Can a mutation be a good thing?

Imagine that the nucleotide sequence of a sperm or egg cell changes. If that sperm or egg cell results in fertilization, then the change in sequence would become part of the offspring. The mutation could result in a protein that does not work correctly and the offspring may not survive. Sometimes a mutation is helpful. The mutation may produce a new trait. Maybe the mutation results in the ability to see farther or run faster. The offspring may survive better in its environment. It can pass the new trait on to its own offspring. Later you will learn how mutations played a role in evolution. ✓

Mutations in body cells are usually caused by outside forces. Radiation from the sun, X rays, or radioactive materials can change the DNA of skin, muscle, or bone cells. Since these cells are not sex cells, the changes in the DNA are not passed on to offspring. However, the organism may be harmed by the mutation. When mutated cells divide they pass on the mutation. For example, damage to a stomach cell may cause it to lose its ability to make

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the acid needed to digest food. When that cell divides, the new cells will have the same mutation.

Sometimes a mutation in a body cell affects the way the cell divides. This may cause the cells to grow and divide too quickly, producing cancer. Too much exposure to ultraviolet radiation in sunlight mutates skin cells, causing skin cancer.

What is happening at the DNA level?

Recall how information flows from DNA to mRNA to protein. If the DNA is mutated, what will happen to the mRNA? It will take the changed information into the cytoplasm and tRNA will bring the wrong amino acids to the rRNA. The protein that is created will be based on the mutated information.

Mutations occur in two different ways at the DNA level. The first type of mutation is called a point mutation. A **point mutation** happens when there is a change in a single base pair in DNA. If the DNA sequence should be A-A-G U-U-U-G-G-C but is A-A-G-U-U-U-A-G-C then the amino acid chain is made with serine instead of glycine. A point mutation is a little like a letter change in a sentence.

THE DOG BIT THE CAT
THE DOG BIT THE CAR

As you can see, it changes the meaning of the whole sentence.

A frameshift mutation involves more than a single codon. It happens when a nitrogenous base is deleted or added. The illustration on the right shows what happens when a base is deleted. It changes everything that follows it. If we use our sentences as an example, we can see what the result might be.

THE DOG BIT THE CAT
(correct)
THE DOB ITT HEC AT
(deleted base (G))
THE DOC GBI TTH ECA T
(added base (C))

As you can see, a **frameshift mutation** occurs when a single nitrogenous base is added or deleted from the DNA sequence. It shifts the reading of the codon by one base. A frameshift mutation is usually more harmful to an organism than a point mutation.

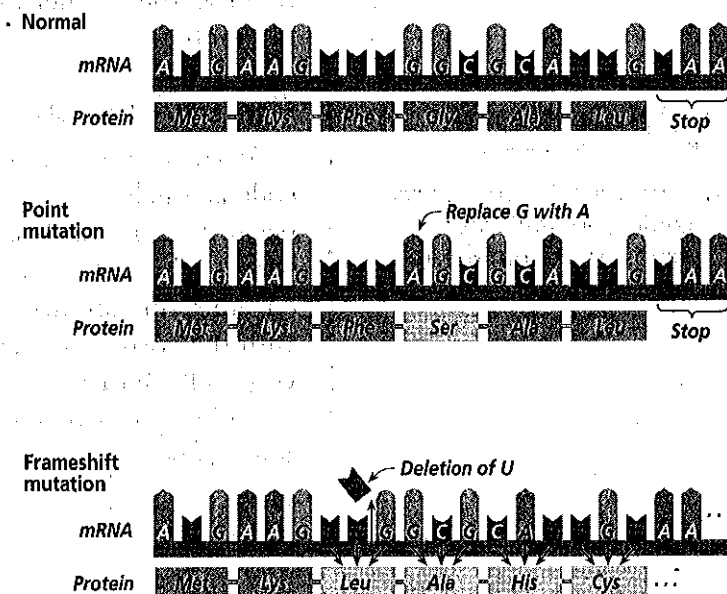


Think it Over

2. **Infer** Why is a mutation in a body cell not passed on to offspring?



Identify Details Point to each type of mutation as you read about it.



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Genetic Changes, *continued***Chromosomal Alterations**

Changes occur to chromosomes as well as the DNA sequence on the chromosomes. Sometimes parts of the chromosomes break off during mitosis or meiosis. The pieces may join to the wrong chromosomes, join backwards, or join in the wrong places. Occasionally the broken pieces get lost. These structure changes in chromosomes are called **chromosomal mutations**.

Chromosomal mutations can happen in any organism, but they are especially common in plants. As you remember from an earlier chapter, mutations affect the way genes are distributed during meiosis. Some of the gametes have too many chromosomes; some of the gametes don't have enough chromosomes. Few chromosomal mutations are passed on because the fertilized egg usually dies. If the organism does develop, it is often not able to reproduce, so the mutation is not passed on. ☺

Causes of Mutations

Some mutations seem to just happen. They are mistakes in base pairing during DNA replication. These mutations are said to be spontaneous. Many mutations are caused by environmental factors. Any outside agent that can cause a change in DNA is called a **mutagen** (MYEW tuh jun). Mutagens include radiation, chemicals, and high temperatures. ☺

Some mutagens cause DNA to break apart. This can change the sequence of the bases. A base may disappear, or two bases may fuse together. Other mutagens cause one base to be substituted for another.

Can DNA be repaired?

As you can see from observing the world around you, the genetic code is usually passed on accurately. But mistakes or mutations can occur. Because of this, repair mechanisms are present in organisms. Cells contain enzymes that check the DNA sequence. If the enzymes find an incorrect sequence of nucleotides, they replace it with the correct sequence. The repair mechanisms usually work very well. But the more an organism is exposed to a mutagen, the more likely it is that a mistake will not be corrected. For this reason it is best to limit exposure to mutagens.

 **Reading Check**

3. Are chromosomal mutations more common in plants or animals?

 **Reading Check**

4. What is a mutagen?

**Think it Over**

5. **Conclude** In what ways could you limit your exposure to mutagens?

After You Read

Mini Glossary

chromosomal mutation: mutation that occurs when parts of the chromosomes break off during mitosis or meiosis and join to the wrong chromosome, or join backwards or in the wrong place on the chromosome

frameshift mutation: mutation that occurs when a single nitrogenous base is added or deleted from the DNA sequence; causes a shift in the reading of codons by one base

mutagen (MYEW tuh jun): any outside agent that can cause a change in DNA; includes high temperatures, radiation, or chemicals

mutation: any change in a DNA sequence

point mutation: a change in a single base pair in DNA

1. Read the key terms and definitions in the Mini Glossary above. Why is a frameshift mutation usually more harmful than a point mutation? Write your answer on the lines below.

2. Use the partially completed outline below to help you review what you have read. Fill in the blanks where information is missing.

I. Mutations occur

A. In reproductive cells

B. In _____ cells

II. Types of Mutations

A. _____ mutations

B. _____ mutations

C. _____ mutations

III. Causes of Mutations

A. Just happens = Spontaneous

B. Environmental factor = _____



Visit the Glencoe Science Web site at science.glencoe.com to find your biology book and learn more about genetic changes.