

Assess Your Understanding

The Genetic Code

What Forms the Genetic Code?

1a. **IDENTIFY** These letters represent the nitrogen bases on one strand of DNA: GGCTATCCA. What letters would form the other strand of the helix? _____

b. **EXPLAIN** How can a parent pass a trait such as eye color to its offspring? _____

got it?

I get it! Now I know that the genetic code of nitrogen bases specifies _____

I need extra help with _____

How Does DNA Copy Itself?

2a. **REVIEW** The (nitrogen base pattern/number of genes/size of DNA) determines how DNA is replicated.

b. **DESCRIBE** Where in the cell does DNA replication take place? _____

c. **CHALLENGE** What do you think would happen if the DNA code in a daughter cell did not match the code in the parent cell? _____

got it?

I get it! Now I know that DNA replication is the process in which _____

I need extra help with _____

Key Concept Summaries

The Genetic Code

What Forms the Genetic Code?

Parents pass traits to their offspring through chromosomes. Chromosomes are made of DNA and proteins. The DNA is shaped like a twisted ladder, or "double helix". The sides of the double helix are made up of sugar molecules called deoxyribose, alternating with phosphate molecules. DNA's full name, deoxyribonucleic acid, comes from this structure.	one specific protein. That code is a series of bases in a specific order—for example, ATGACGTAC. A single gene may contain several hundred to a million or more bases.
The rungs of DNA are made of nitrogen bases , molecules that contain nitrogen and other elements. DNA has four kinds of nitrogen bases: adenine (A), thymine (T), guanine (G), and cytosine (C). A gene is a section of a DNA molecule that contains the code for	The code each gene contains determines the structure of a protein. Remember that proteins are long-chain molecules made of individual amino acids. In the genetic code, a group of three DNA bases codes for one specific amino acid. For example, the three-base sequence CGT (cytosine-guanine-thymine) always codes for the amino acid alanine. The order of the three-base code units determines the order in which amino acids are put together to form a protein.

How Does DNA Copy Itself?

When a cell divides, it forms two daughter cells. Daughter cells need a complete set of DNA to survive, so DNA copies itself. DNA replication is the process in which an identical copy of a DNA strand is formed for a new cell. DNA replication begins when the two sides of a DNA molecule unwind and separate, like a zipper unzipping, between the nitrogen bases. Next	nitrogen bases in the nucleus pair up with the bases on each half of the DNA. Because of the way the nitrogen bases pair up, the order of the bases in each new DNA strand exactly matches the order in the original DNA strand. Adenine always pairs with thymine, while guanine always pairs with cytosine. Two identical DNA molecules are formed.
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On a separate sheet of paper, describe the structure of DNA and how it functions in genes.

Lesson Quiz

The Genetic Code

Fill in the blank to complete each statement.

1. The sides of a DNA molecule are made up of sugar molecules alternating with _____ molecules.
2. Chromosomes are made up mostly of _____.
3. In DNA, adenine always pairs with _____.
4. Each _____ on a chromosome contains the information to code for one specific protein.
5. Each group of three DNA bases on a gene codes for a single _____.

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.


6. _____ Each gene is located at a specific place on a(n) protein.
7. _____ DNA synthesis is the process by which DNA copies itself.
8. _____ The process of DNA copying itself begins when the two sides of the DNA molecule unwind and separate.
9. _____ The genetic code is determined by the sizes of the nitrogen bases.
10. _____ Nitrogen bases are molecules that contain nitrogen and other elements.

Assess Your Understanding

How Cells Make Proteins

How Does a Cell Make Proteins?

1a. **REVIEW** (Messenger RNA/Transfer RNA) carries the genetic information in DNA from the nucleus to the cytoplasm.

b. **ANSWER**  What does DNA do? _____

got it?

I get it! Now I know that protein synthesis is the process in which _____

I need extra help with _____

Use the outside corner, the corner away from the bottom line, in the corner of your copy machine to copy onto letter-size paper.

Key Concept Summary

How Cells Make Proteins

How Does a Cell Make Proteins?

During protein synthesis, the cell uses information from a gene on a chromosome to produce a specific protein. Proteins help determine the size, shape, and other traits of an organism by triggering cellular processes. Proteins are made up of molecules called amino acids. Although there are only 20 amino acids, cells can combine them in different ways to form thousands of different proteins. You can think of the 20 amino acids as being like the 26 letters of the alphabet. Those 26 letters can form thousands of words. The letters you use and their order determine the words you form. Just as a change in one letter creates a new word, a change in the type or order of amino acids can result in a different protein.

Protein synthesis takes place in the cytoplasm outside the cell's nucleus. Because the chromosomes are inside the nucleus, a messenger must carry the genetic code from the DNA outside to the cytoplasm. The genetic messenger is called RNA, or ribonucleic acid. Although both RNA and DNA are nucleic acids, they have some differences. RNA has only one strand

and contains a different sugar molecule than DNA. Another difference is in the nitrogen bases. Like DNA, RNA contains adenine, guanine, and cytosine. However, instead of thymine, RNA contains uracil.

Two types of RNA take part in protein synthesis. **Messenger RNA (mRNA)** copies the message from DNA in the nucleus and carries the message to the ribosome in the cytoplasm. mRNA is produced by a process similar to DNA replication. DNA unzips between its base pairs. Then the bases on one half of the DNA pair with nitrogen bases to form the mRNA. In the cytoplasm, a ribosome attaches to mRNA.

Transfer RNA (tRNA) carries amino acids to the ribosome and adds them to the growing protein. One at a time, the bases on tRNA attach to the ribosome, "read" the message, and pair with bases on mRNA. Amino acids are linked together and form a growing chain. The three-code bases on the mRNA determine their order on the chain. The protein continues to grow until the ribosome reaches a three-base code that signals it to stop. The protein is released.

On a separate sheet of paper, briefly describe the roles messenger RNA and transfer RNA play in protein synthesis inside a cell.

Use a copy machine to copy onto letter-size paper.

Lesson Quiz

How Cells Make Proteins

Fill in the blank to complete each statement.

1. The process of making proteins is called protein _____.
2. Proteins are made of smaller molecules called _____.
3. In RNA, adenine pairs with _____.
4. The sides of RNA and DNA molecules are made up of different _____.
5. The genetic code in DNA is copied and carried to the ribosomes by _____.

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

6. _____ After an amino acid is added to a protein, the transfer RNA picks up another amino acid.
7. _____ RNA is a(n) double strand.
8. _____ Changes to the type or order of amino acids can result in a different protein.
9. _____ Amino acids are carried to a ribosome by messenger RNA.
10. _____ A transfer RNA with the bases CGA will line up with a section of messenger RNA with the bases CGU.

Assess Your Understanding

Mutations

How Can Mutations Affect an Organism?

1a. **EXPLAIN** Mutations that occur in body cells (can/cannot) be passed on to offspring. Mutations that occur in sex cells (can/cannot) be passed on to offspring.

b. **APPLY CONCEPTS** Drug resistance in bacteria is a beneficial mutation for the bacteria, but how can it be harmful for humans? _____

got it?

I get it! Now I know that mutations affect an organism's traits by _____

I need extra help with _____

How Is Cancer Related to Mutations and the Cell Cycle?

1a. **LIST** What are the options for treating cancer? _____

b. **DRAW CONCLUSIONS** Based on the fact that people can get cancer regardless of their genetics, what are some things you can do to lower your risk of getting cancer? _____

got it?

I get it! Now I know that cancer is related to mutations and the cell cycle because _____

I need extra help with _____

Use a ruler to cut along the dotted line, in the corner of your copy machine to copy onto letter-size paper.

Key Concept Summaries

Mutations

How Can Mutations Affect an Organism?

A **mutation** is any change in the DNA of a gene or chromosome. **Mutations can cause a cell to produce an incorrect protein during protein synthesis. As a result, the organism's trait may be different from what it would normally be.** If a mutation occurs in a body cell, such as a skin cell, the mutation will not be passed on to the organism's offspring. But if a mutation occurs in a sex cell (egg or sperm), the mutation can be passed on to an offspring and affect the offspring's traits.

another, or one or more bases may be deleted from a section of DNA. Other mutations may occur when chromosomes don't separate correctly during the formation of sex cells. This can leave a cell with too many chromosomes, too few, or extra segments of chromosomes.

Mutations can be harmful, helpful, or neither. A mutation is harmful if it reduces an organism's chances for survival or reproduction. Helpful mutations increase an organism's ability to survive and reproduce.

Some mutations are the result of small changes in an organism's DNA. During DNA replication, a base pair may be added, a base pair may be substituted for

How Is Cancer Related to Mutations and the Cell Cycle?

Cancer is a disease in which cells divide and grow uncontrollably, damaging the parts of the body around them. Inherited traits make some people more likely to develop cancer. Factors in the environment, such as tar in cigarettes, ultraviolet light, or a high-fat diet, may also lead to cancer.

cells to divide in an uncontrollable way. Cells may grow too large and divide too often. A **tumor** is a mass of abnormal cells that develop when cells divide and grow uncontrollably. Tumors often take years to grow to a noticeable size. If some of the cancerous cells break off from the tumor and enter the bloodstream, cancer can spread to other areas of the body. Possible treatments for cancer include surgery, radiation, and drugs that destroy cancer cells. **Chemotherapy** is the use of drugs to treat a disease.

Scientists think that cancer starts when something damages a portion of the DNA in a chromosome, causing a mutation. **Cancer begins when mutations disrupt the normal cell cycle, causing**

On a separate sheet of paper, explain what a mutation is and describe several ways that a mutation may occur. Then briefly explain how a mutation can cause cancer.

Place the outside corner, the corner away from the dotted line, in the corner of your copy machine to copy onto letter-size paper.

Lesson Quiz

Mutations

Fill in the blank to complete each statement.

1. The use of drugs to treat disease is called _____.
2. A mutation can be passed to offspring only if it takes place in a(n) _____ cell.
3. A mutation is any change in the _____ of a gene or chromosome.
4. Cancer is treated with surgery, _____, and drugs that destroy the cancer cells.
5. A mutation can occur if a base pair is _____, deleted, or substituted for another.

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

6. _____ Mutations are sometimes helpful to the organism.
7. _____ Cancer is a disease in which cells divide slowly.
8. _____ If chromosomes do not separate correctly during the formation of sex cells, the organism that forms can end up with too many or too few chromosomes.
9. _____ Cancer causes the growth of tumors.
10. _____ Scientists think that cancer begins when something damages a cell's proteins.