Reproduction Activity 1 Name:_________

4-27-20 to 5-1-20

Read the attached textbook pages (Glencoe: chapter 8, section 3.)

Answer the section review questions

1. How does DNA make a copy of itself?

2. How are the codes for proteins carried from the nucleus to the ribosomes?

3. A single strand of DNA has the bases AGTAAC. Using letters, show a matching DNA strand from this pattern.

4. How is tRNA used when cells build proteins?

5. You begin as one cell. Compare the DNA in one of your brain cells to the DNA in one of your heart cells.

SECTION 3

DNA

As You Read

What You'll Learn

- **Identify** the parts of a DNA molecule and its structure.
- **Explain** how DNA copies itself.
- **Describe** the structure and function of each kind of RNA.

Vocabulary

DNA, gene, RNA, mutation

Why It's Important

DNA helps determine nearly everything your body is and does.

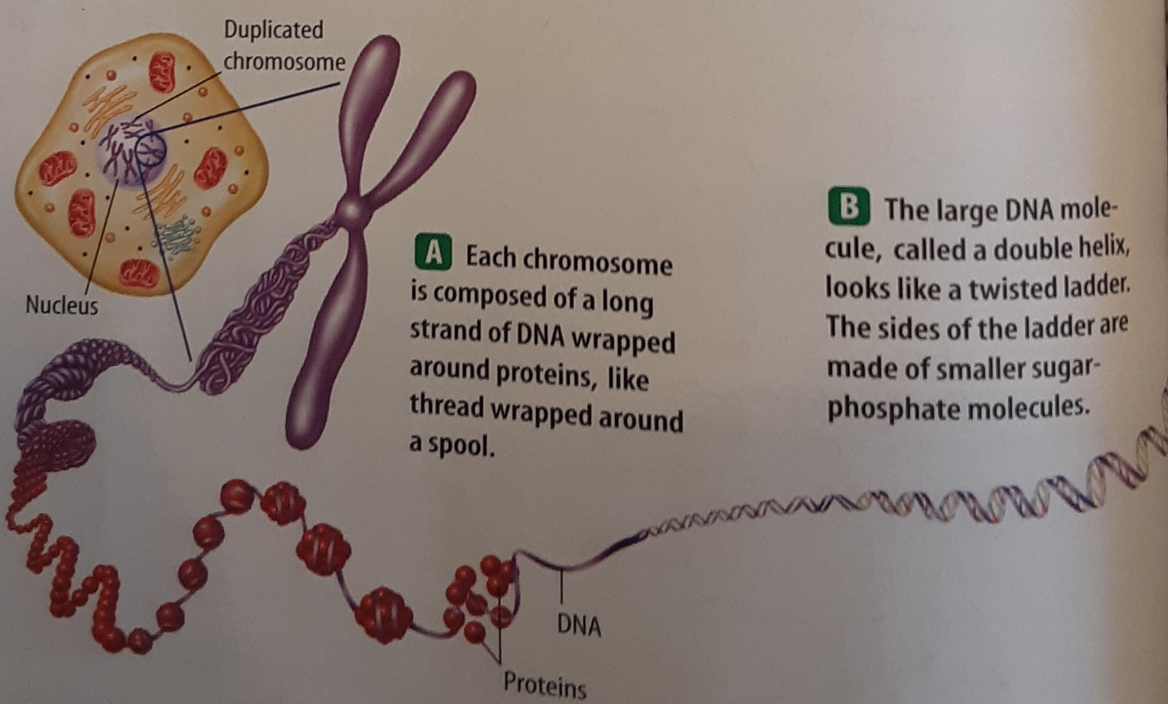
What is DNA?

Why was the alphabet one of the first things you learned when you started school? Letters are a code that you need to know before you learn to read. A cell also uses a code that is stored in its hereditary material. The code is a chemical called deoxyribonucleic (dee AHK sih ri boh noo klay ihk) acid, or **DNA.** It contains information for an organism's growth and function. **Figure 14** shows how DNA is stored in cells that have a nucleus. When a cell divides, the DNA code is copied and passed to the new cells. In this way, new cells receive the same coded information that was in the original cell. Every cell that has ever been formed in your body or in any other organism contains DNA.

Chemistry INTEGRATION

Discovering DNA Since the mid-1800s, scientists have known that the nuclei of cells contain large molecules called nucleic acids. By 1950, chemists had learned what the nucleic acid DNA was made of, but they didn't understand how the parts of DNA were arranged.

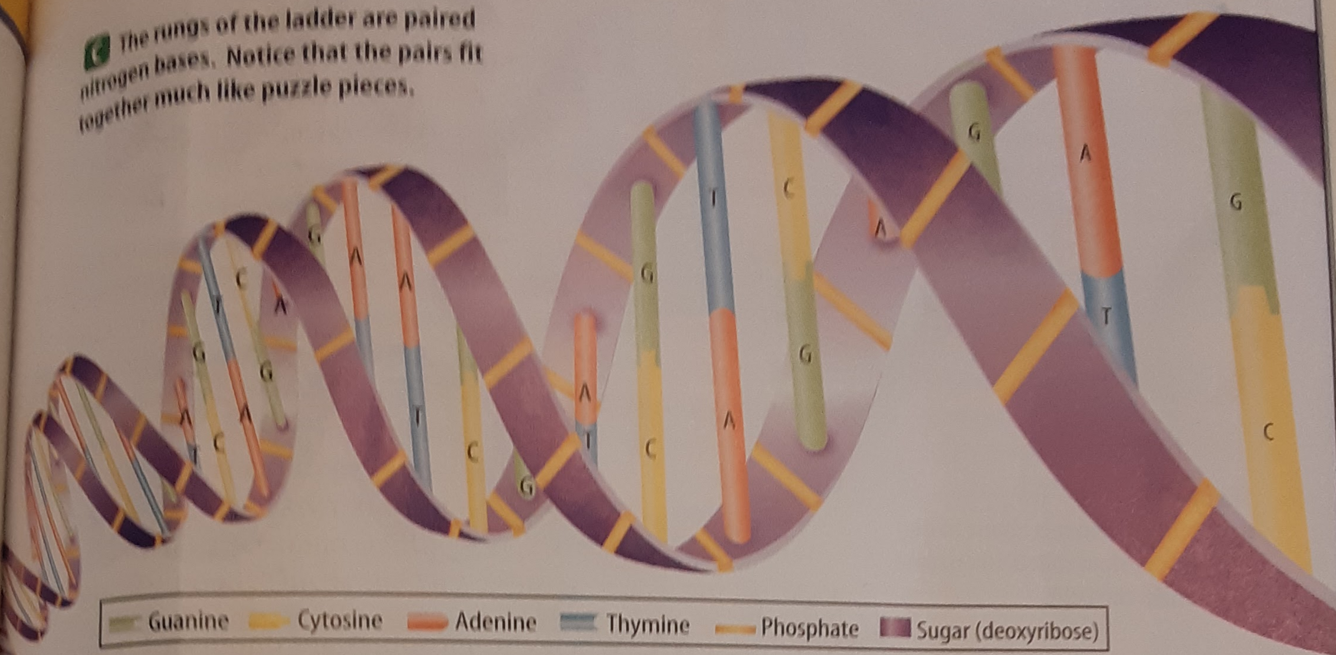
Figure 14
DNA is part of the chromosomes found in a cell's nucleus.



A Each chromosome is composed of a long strand of DNA wrapped around proteins, like thread wrapped around a spool.

B The large DNA molecule, called a double helix, looks like a twisted ladder. The sides of the ladder are made of smaller sugar-phosphate molecules.

C The rungs of the ladder are paired nitrogen bases. Notice that the pairs fit together much like puzzle pieces.



DNA's Structure In 1952, scientist Rosalind Franklin discovered that DNA is two chains of molecules in a spiral form. By using an X-ray technique, Dr. Franklin showed that the large spiral was probably made up of two spirals. As it turned out, the structure of DNA is similar to a twisted ladder. In 1953, using the work of Franklin and others, scientists James Watson and Francis Crick made a model of a DNA molecule.

A DNA Model What does DNA look like? According to the Watson and Crick DNA model, each side of the ladder is made up of sugar-phosphate molecules. Each molecule consists of the sugar called deoxyribose (dee AHK sih ri bohs) and a phosphate group. The rungs of the ladder are made up of other molecules called nitrogen bases. Four kinds of nitrogen bases are found in DNA—adenine (AD un een), guanine (GWAHN een), cytosine (SITE uh seen), and thymine (THI meen). The bases are represented by the letters A, G, C, and T. The amount of cytosine in cells always equals the amount of guanine, and the amount of adenine always equals the amount of thymine. This led to the hypothesis that these bases occur as pairs in DNA. **Figure 14** shows that adenine always pairs with thymine, and guanine always pairs with cytosine. Like interlocking pieces of a puzzle, each base bonds only with its correct partner.

Reading Check *What are the nitrogen base pairs in a DNA molecule?*

TRY AT HOME
Mini LAB

Modeling DNA Replication

Procedure

1. Suppose you have a segment of DNA that is six nitrogen base pairs in length. On **paper,** using the letters A, T, C, and G, write a combination of six pairs remembering that A and T are always a pair and C and G are always a pair.
2. Duplicate your segment of DNA. On paper, diagram how this happens and show the new DNA segments.

Analysis

Compare the order of bases of the original DNA to the new DNA molecules.

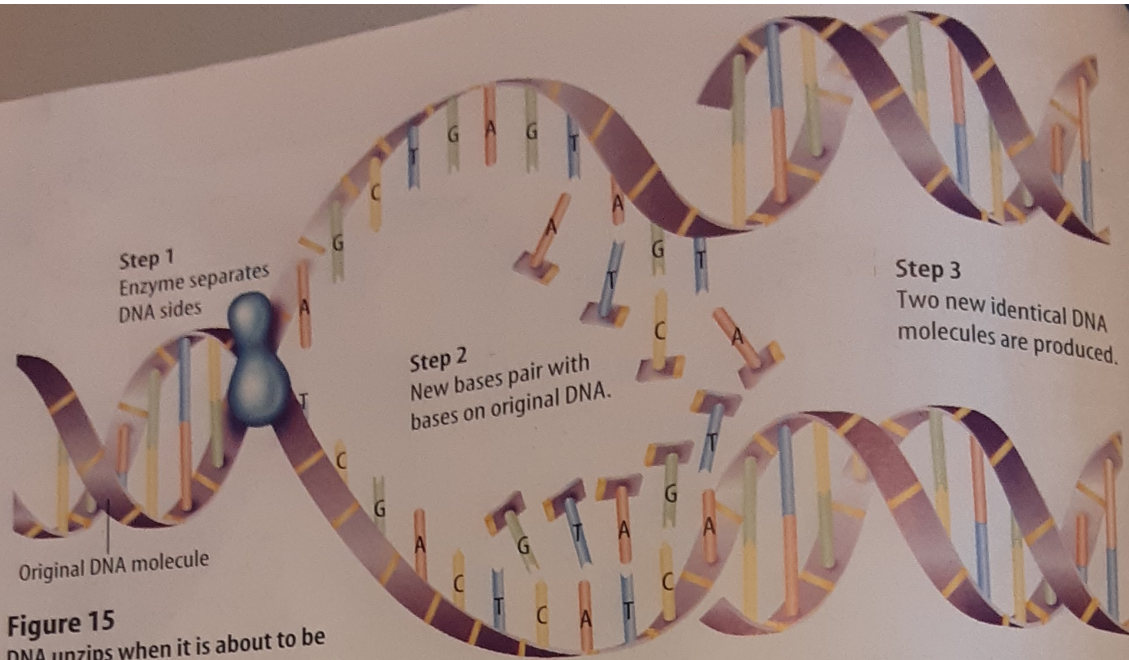
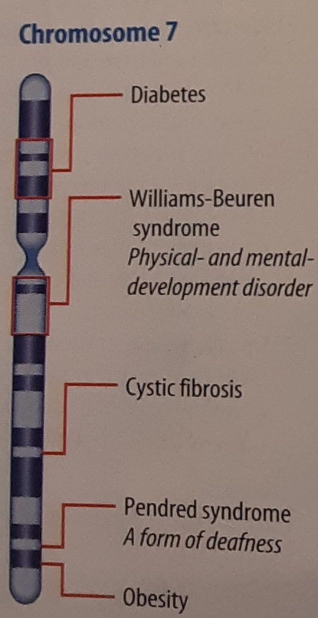


Figure 15
DNA unzips when it is about to be copied. A protein called an enzyme helps unzip the DNA.

Copying DNA When chromosomes are duplicated before mitosis or meiosis, the amount of DNA in the nucleus is doubled. The Watson and Crick model shows how this takes place. The two sides of DNA unwind and separate. Each side then becomes a pattern on which a new side forms, as shown in **Figure 15.** The new DNA has bases that are identical to those of the original DNA and are in the same order.

Figure 16
This diagram shows just a few of the genes that have been identified on human chromosome 7. The bold print is the name that has been given to each gene.



Genes

Most of your characteristics, such as the color of your hair, your height, and even how things taste to you, depend on the kinds of proteins your cells make. DNA in your cells stores the instructions for making these proteins.

Proteins build cells and tissues or work as enzymes. The instructions for making a specific protein are found in a **gene** which is a section of DNA on a chromosome. As shown in **Figure 16,** each chromosome contains hundreds of genes. Proteins are made of chains of hundreds or thousands of amino acids. The gene determines the order of amino acids in a protein. Changing the order of the amino acids makes a different protein. What might occur if an important protein couldn't be made or if the wrong protein was made in your cells?

Making Proteins Genes are found in the nucleus, but proteins are made on ribosomes in cytoplasm. The codes for making proteins are carried from the nucleus to the ribosomes by another type of nucleic acid called ribonucleic acid, or **RNA.**

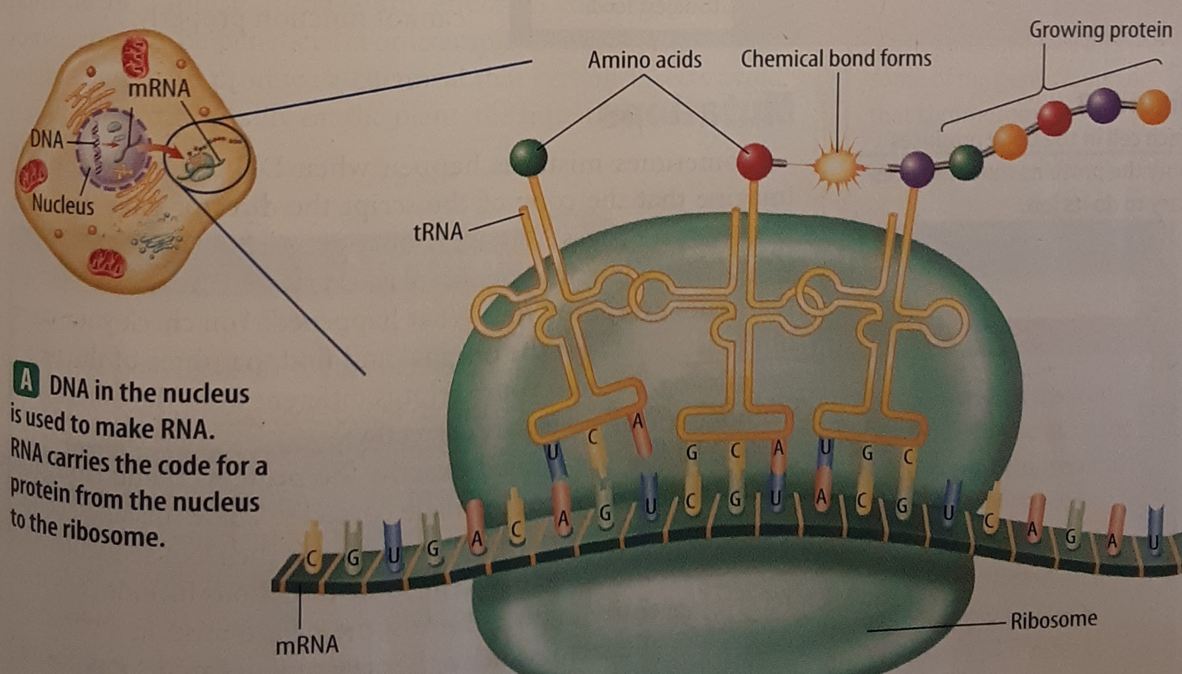
Ribonucleic Acid RNA is made in the nucleus on a DNA pattern. However, RNA is different from DNA. If DNA is like a ladder, RNA is like a ladder that has all its rungs sawed in half. Compare the DNA molecule in **Figure 14** to the RNA molecule in **Figure 17.** RNA has the bases A, G, and C like DNA but has the base uracil (U) instead of thymine (T). The sugar-phosphate molecules in RNA contain the sugar ribose, not deoxyribose.

The three main kinds of RNA made from DNA in a cell's nucleus are messenger RNA (mRNA), ribosomal RNA (rRNA), and transfer RNA (tRNA). Protein production begins when mRNA moves into the cytoplasm. There, ribosomes attach to it. Ribosomes are made of rRNA. Transfer RNA molecules in the cytoplasm bring amino acids to these ribosomes. Inside the ribosomes, three nitrogen bases on the mRNA temporarily match with three nitrogen bases on the tRNA. The same thing happens for the mRNA and another tRNA molecule, as shown in **Figure 17.** The amino acids that are attached to the two tRNA molecules bond. This is the beginning of a protein. The code carried on the mRNA directs the order in which the amino acids bond. After a tRNA molecule has lost its amino acid, it can move about the cytoplasm and pick up another amino acid just like the first one. The ribosome moves along the mRNA. New tRNA molecules with amino acids match up and add amino acids to the protein molecule.

SCIENCE Online

Data Update The Human Genome Project was begun in 1990. One of its goals is to identify all of the genes on human chromosomes. To find out how the project is progressing, visit the Glencoe Science Web site at **science.glencoe.com.** Communicate to your class what you learn.

Figure 17
Cells need DNA, RNA, and amino acids to make proteins.



A DNA in the nucleus is used to make RNA. RNA carries the code for a protein from the nucleus to the ribosome.

B At the ribosome, the RNA's message is translated into a specific protein.

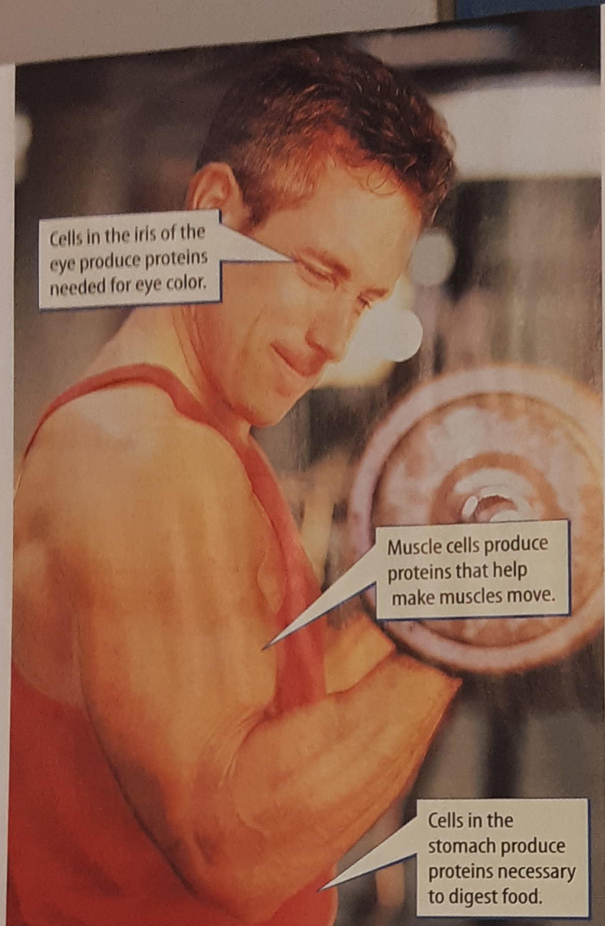


Figure 18
Each cell in the body produces only the proteins that are necessary to do its job.

Controlling Genes You might think that because most cells in an organism have exactly the same chromosomes and the same genes, they would make the same proteins, but they don't. In many-celled organisms like you, each cell uses only some of the thousands of genes that it has to make proteins. Just as each actor uses only the lines from the script for his or her role, each cell uses only the genes that direct the making of proteins that it needs. For example, muscle proteins are made in muscle cells, as represented in **Figure 18,** but not in nerve cells.

Cells must be able to control genes by turning some genes off and turning other genes on. They do this in many different ways. Sometimes the DNA is twisted so tightly that no RNA can be made. Other times, chemicals bind to the DNA so that it cannot be used. If the incorrect proteins are produced, the organism cannot function properly.

Mutations

Sometimes mistakes happen when DNA is being copied. Imagine that the copy of the script the director gave you was missing three pages. You use your copy to learn your lines. When you begin rehearsing for the play, everyone is ready for one of the scenes except for you. What happened? You check your copy of the script against the original and find that three of the pages are missing. Because your script is different from the others, you cannot perform your part correctly.

If DNA is not copied exactly, the proteins made from the instructions might not be made correctly. These mistakes, called **mutations,** are any permanent change in the DNA sequence of a gene or chromosome of a cell. Some mutations include cells that receive an entire extra chromosome or are missing a chromosome. Outside factors such as X rays, sunlight, and some chemicals have been known to cause mutations.

Reading Check *When are mutations likely to occur?*

Figure 19
Because of a defect o... the mutant fruit fly h... and cannot fly. *Could... transferred to the mut... Explain.*

Results of a M...
Without correc... repair, or maint... can change the t...
If the mutati... be life threaten... occurs in a sex ... sex cell will ha... species when t... harmful to org... tions do not a... some can even ... might cause it ... If these insects ... plant survive.

1. How doe...
2. How are ... from the ...
3. A single ... AGTAAC. ... DNA stra...
4. How is t...
5. **Think C...** Compare... to the D...

Figure 19
Because of a defect on chromosome 2, the mutant fruit fly has short wings and cannot fly. *Could this defect be transferred to the mutant's offspring? Explain.*

Results of a Mutation Genes control the traits you inherit. Without correctly coded proteins, an organism can't grow, repair, or maintain itself. A change in a gene or chromosome can change the traits of an organism, as illustrated in **Figure 19.**

If the mutation occurs in a body cell, it might or might not be life threatening to the organism. However, if a mutation occurs in a sex cell, then all the cells that are formed from that sex cell will have that mutation. Mutations add variety to a species when the organism reproduces. Many mutations are harmful to organisms, often causing their death. Some mutations do not appear to have any effect on the organism, and some can even be beneficial. For example, a mutation to a plant might cause it to produce a chemical that certain insects avoid. If these insects normally eat the plant, the mutation will help the plant survive.

SCIENCE Online

Research Visit the Glencoe Science Web site at **science.glencoe.com** for more information about what genes are present on the chromosomes of a fruit fly. Make a poster that shows one of the chromosomes and some of the genes found on that chromosome.

Section 3 Assessment

1. How does DNA make a copy of itself?
2. How are the codes for proteins carried from the nucleus to the ribosomes?
3. A single strand of DNA has the bases AGTAAC. Using letters, show a matching DNA strand from this pattern.
4. How is tRNA used when cells build proteins?
5. **Think Critically** You begin as one cell. Compare the DNA in one of your brain cells to the DNA in one of your heart cells.

Skill Builder Activities

6. **Concept Mapping** Using a network tree concept map, show how DNA and RNA are alike and how they are different. **For more help, refer to the Science Skill Handbook.**
7. **Using a Word Processor** Use a word processor to make an outline of the events that led up to the discovery of DNA. Use library resources to find this information. **For more help, refer to the Technology Skill Handbook.**