Name: _____   Date: _____

Student Exploration: Building DNA

Vocabulary: double helix, DNA, enzyme, lagging strand, leading strand, mutation, nitrogenous base, nucleoside, nucleotide, replication

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)
DNA is an incredible molecule that forms the basis of life on Earth. DNA molecules contain instructions for building every living organism on Earth, from the tiniest bacterium to a massive blue whale. DNA also has the ability to **replicate**, or make copies of itself. This allows living things to grow and reproduce.

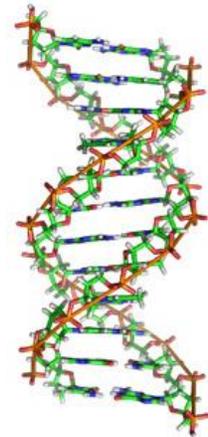1.   Look at the DNA molecule shown at right. What does it look like?

_____

This shape is called a **double helix**.
2.   Based on this picture, how do you think a DNA molecule makes a copy of itself? (Hint: Look at the bottom two "rungs" of the ladder.)

_____

_____

Gizmo Warm-up
The *Building DNA* Gizmo™ allows you to construct a DNA molecule and go through the process of DNA replication. Examine the components that make up a DNA molecule.
1.   What are the two DNA components shown in the Gizmo?

_____

2.   A **nucleoside** has two parts: a pentagonal sugar (deoxyribose) and a **nitrogenous base** (in color). When a nucleoside is joined to a phosphate, it is called a **nucleotide**.

How many different nitrogenous bases do you see? _____
Note: The names of these nitrogenous bases are adenine (red), cytosine (yellow), guanine (blue), and thymine (green).

Activity A:	Get the Gizmo ready:
Build a DNA molecule	• If necessary, click **Reset** to start the building process.

Question: What is the structure of DNA?

1. Build: Follow the steps given in the Gizmo to construct a molecule of DNA. (Note: For simplicity, this DNA molecule is shown in two dimensions, without the twist.)

Stop when the hint reads: "The DNA molecule is complete." In the spaces at right, list the sequence of nitrogenous bases on the left-hand strand, called the **leading strand**, and the right-hand strand, called the **lagging strand**

2. Explain: Describe the structure of the DNA molecule
A. What makes up the sides of the DNA molecule?
_____

B. What makes up the "rungs" of the DNA molecule?
_____

3. Fill in: Write the name of the nitrogenous base that joins to each of the bases below:
     Adenine (A) joins to _____

     Thymine (T) joins to _____

     Cytosine (C) joins to _____

     Guanine (G) joins to _____

Leading strand   Lagging strand

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____
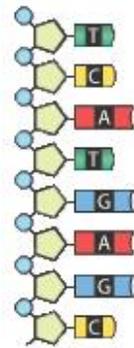
_____ _____

4. Practice: The leading strand of a DNA molecule is shown. **Draw a complementary lagging strand on the right side** of this molecule.

5. Challenge: This DNA strand consists of eight pairs of nitrogenous bases. How many different sequences of eight bases can you make? Explain how you found your answer.

_____

_____

Activity B:	Get the Gizmo ready:
DNA replication	• Be sure the hint reads: "The DNA molecule is complete." If not, click **Reset** and build a new DNA molecule.

Question: How does DNA make a copy of itself?
1.   Observe: An **enzyme** is a protein that facilitates certain cell processes. Click **Release enzyme** to release **DNA helicase**. What does this enzyme do to the DNA molecule?
_____

2.   Observe: Click **Release enzyme** to release **DNA polymerase**.

A.   Notice that two groups of **Nucleotides** appear on the right. What are the *three* parts of a nucleotide?

_____, _____, _____

B.   Drag one of the nucleotides to a corresponding nitrogenous base on one of the two strands. What is the

role of DNA polymerase in this process? _____

Build: Complete the two molecules of DNA by dragging nucleotides to their corresponding locations. When you

have finished, compare the two completed daughter DNA molecules. What do you notice about the two

molecules? _____

3. Sketch a picture: Click the **camera** to take a snapshot of the DNA molecules, and sketch the image in the space provided. Label the components of this diagram.

   How do these molecules compare to the original?

   _____

4. Think and discuss: Why is DNA replication such an important process?
   _____

   _____

5. Extend your thinking: Sometimes errors called **mutations** occur during DNA replication. What are some of the possible consequences of mutations?
   _____

   _____

6. How many chromosomes are in the adjacent cell?
   _____

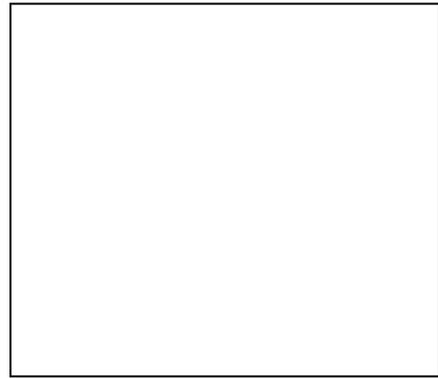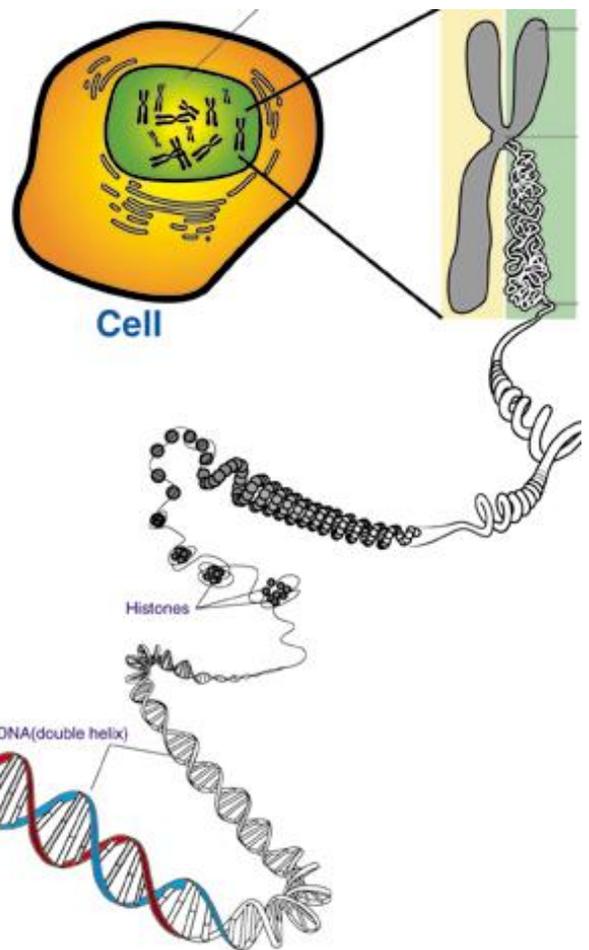7. How many **pairs** of chromosomes are in the adjacent cell?   _____

8. What is the diploid number of the adjacent cell?
   2n = _____

9. Label the following structures in the adjacent diagram:

   • Centromere

   • Sister chromatid

   • Super coil

   • Coil

   • Histones

   • DNA backbone

   • Hydrogen bonds

1. Label the phosphate groups in the below diagrams. Color them green.
2. Label the deoxyribose sugars groups in the below diagrams. Color them red.
3. Label the ribose sugars groups in the below diagrams. Color them pink.
4. Color and label all the adenines blue.
5. Color and label all the thymines purple.
6. Color and label all the cytosines yellow
7. Color and label all the guanines orange
8. Color and label all the uracils brown

DNA Molecule

Messenger RNA

A

C

D

P

P

R
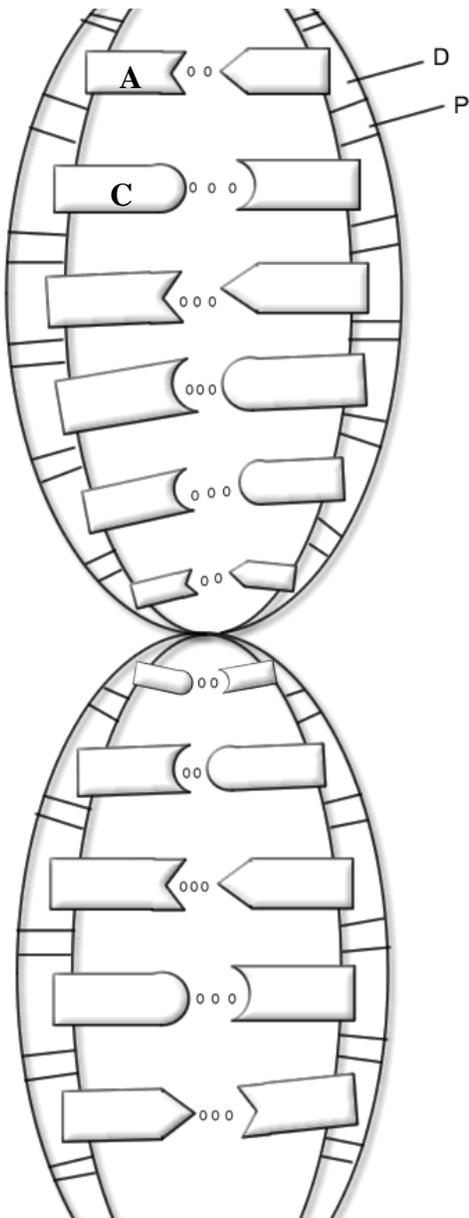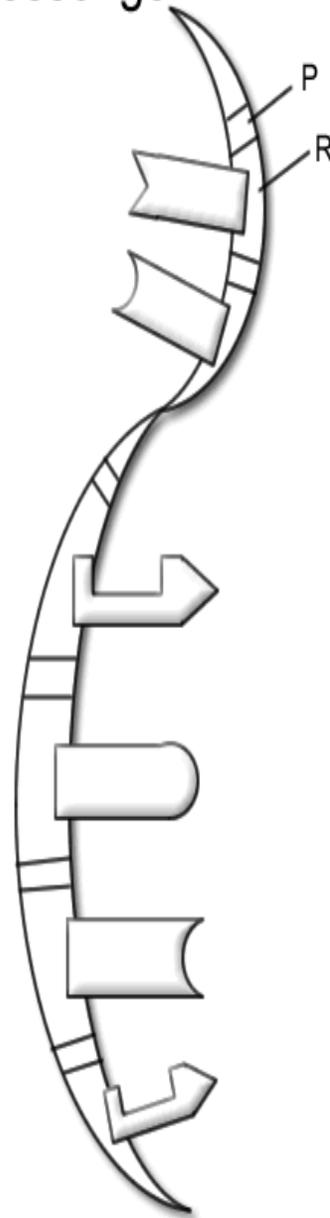
Note: this is **NOT** a correctly drawn double helix as the backbone strands should not touch each other