Name:

DNA Structure Lab

Structure of the DNA Molecule

*The term "DNA" is short for **deoxyribonucleic acid**. In this activity, you will build a DNA molecule and then examine its structure.*

Go to ExploreLearning.com and click on "Browse Gizmos". Select "Biology" and then "Heredity and Genetics" from the list. Select "Launch Gizmo" for the "Building DNA" activity.

Notice the representation of the **nucleus** in the center of the screen. To begin, drag one of the **nucleotides** from the right side of the screen to the nucleus. Each **nucleotide** consists of a pentagonal sugar, called **deoxyribose**, attached to a **nitrogen base**. The four possible nitrogen bases are **adenine (A)**, **thymine (T)**, **cytosine (C)** and **guanine (G)**.

1. The bases _____ and _____ are slightly longer.
2. The bases _____ and _____ are slightly shorter.
3. Which nitrogen base did you pick to start your DNA strand? _____
4. The nucleotides are connected to one another by **phosphate** molecules, which attach to the two "legs" on the left side of the deoxyribose pentagon. Drag and attach two **phosphates** to your nucleotide.
5. Continue building the DNA molecule by stacking **nucleotides** vertically. Be sure to attach **phosphates** to each nucleotide, but do *not* attach a p**hosphate** to the bottom of the last nucleotide in your sequence.
6. From top to bottom, what is the sequence of nitrogen bases in your rail?
   _____
7. You have now completed the left strand of your DNA molecule, called the **leading strand**. The Gizmo now provides another set of nucleotides and phosphates that will form the right strand, also called the **lagging strand**. Each nitrogen base will form a hydrogen bond with another nitrogen base.
8. Based on shape, what nitrogen base will bond to adenine (A)? _____
   Test your prediction by dragging the appropriate nucleotide to one of the adenine bases on your rail. Does it attach? (If not, try another.)
9. Which base will bond to cytosine? _____ Drag this nucleotide and attach it to one of the cytosine bases on your rail.

10. Using the same reasoning, attach the remaining nucleotides and phosphates to form the lagging strand. The direction of this strand is opposite the first, so attach the last phosphate molecule to the bottom of this strand. (This represents the beginning of this strand.) When all the molecules have been placed, your DNA molecule is complete! From bottom to top, what is the sequence of nitrogen bases on the lagging strand of the DNA molecule?
    _____

11. A DNA strand can be thought of as a ladder. The molecules _____ and _____ make up the horizontal "rungs" of the ladder. The _____ make up the vertical "rails" of the ladder. In reality, this ladder is twisted, forming a spiral structure called a **double helix**.

12. One of the key experimental findings that led to Watson and Crick's solution was that the amount of adenine in a DNA molecule is always equal to the amount of thymine. Similarly, the amount of cytosine is always the same as amount of guanine. Based on the DNA molecule you have constructed, why is this the case?
    _____
    _____
    _____

BUILDING A DNA MODEL:
Now use the DNA model kit to construct a model of DNA

Procedure:

1. Find a 4-pronged black bead. Attach long green straw to the top and 2 inch green straws to the bottom. This is your stand.

2. Push 6 white, 2-pronged beads onto the long straw and space them out evenly. These are the hydrogen bonds that will hold the base pairs together.

3. Start building the rest of your model by pairing up the correct nitrogen bases in the correct order on the white prongs. The left side of the DNA model should be in the following sequence: A C G G T A
   Using the base-pairing rules for DNA, you must determine the sequence of the right side of the DNA model.
   Adenine (A): blue straw
   Thymine (T): red straw
   Guanine (G): green straw
   Cytosine (C): grey straw

4. Now you need to connect the sugars to each of the bases. The sugar is represented by the 3-pronged black beads.

5. Attach phosphates (red beads) to two ester bonds (yellow straws). You will make 10 of these.

6. Take the phosphates/ester bonds and connect sugars to them. You will begin to see a ladder shape.

7. Twist to form a double helix.

8. At the top of your DNA strand, attach an ester bond and a phosphate to one of the sugar prongs. Attach only an ester bond to the other side.

9. On the bottom of your DNA strand, do the same as in #8, except that the phosphate and ester bond should be on the opposite strand as the one on the top.

10. Show your completed model to your teacher and get a stamp here:

_____

DNA Replication

*In this activity, you will examine DNA **replication**, in which the DNA molecule splits and makes a copy of itself.*

Click "**release enzyme"** on the left side of the screen to release an enzyme called **DNA helicase**. What does this enzyme do to the DNA molecule?

_____

_____

Click "**release enzyme"** again to release an enzyme called **DNA polymerase**. Two sets of **nucleotides** will appear to the right of the screen.

1. What three components make up each nucleotide?

   _____

2. Drag each of the **nucleotides** to the nucleus and attach it to the complementary site on the DNA molecule.

3. What is present each time you drag a nucleotide to one of the DNA molecules?

   _____

   This represents the key role that DNA polymerase plays in this process.

4. How do the two resulting strands of DNA compare?

   _____

5. Are the sequences of nitrogen bases the same as they were when you made the first DNA molecule? Explain.

   _____

   _____

6. In your own words, describe the process of DNA replication, based on what you have observed in this Gizmo.