The DNA Molecule Model

DNA (deoxyribonucleic acid) is the genetic material of living organisms and is located in the chromosomes of each cell. What is its structure?

Deoxyribonucleic acid (DNA) is the hereditary molecule. DNA is made of individual units called nucleotides. Nucleotides are the building blocks of DNA. Each nucleotide is made of a phosphate group, a sugar (deoxyribose), and a nitrogen base.
- The phosphate and sugar form the sides of the molecule.
- Each rung contains a pair of bases held together by hydrogen bonds.
- There are four bases: thymine (T), adenine (A), guanine (G), and cytosine (C). T and A always pair up and G and C always pair up.

In this investigation you will model the structure of DNA using beads to represent the different parts of the DNA molecule.

Materials

- Red pop beads
- White pop beads
- Yellow pop beads
- Green pop beads
- Orange pop beads
- Blue pop beads
- Clear plastic connectors

□ Gather the required materials. Use Table 1 as a key for creating your DNA model.

Table 1: DNA model components

<table>
<thead>
<tr>
<th>Pop bead color</th>
<th>Molecule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td><strong>Phosphate group:</strong></td>
</tr>
<tr>
<td></td>
<td>White</td>
</tr>
<tr>
<td>Blue</td>
<td><strong>Bases:</strong></td>
</tr>
<tr>
<td>Orange</td>
<td>Cytosine (C)</td>
</tr>
<tr>
<td>Yellow</td>
<td>Guanine (G)</td>
</tr>
<tr>
<td>Green</td>
<td>Adenine (A)</td>
</tr>
<tr>
<td></td>
<td>Thymine (T)</td>
</tr>
</tbody>
</table>

□ Begin by creating two phosphate-sugar "backbones" that will provide the framework on which to build each strand of your DNA molecule. Connect alternating white and red pop beads. Each backbone should contain 10 red pop beads and 11 white pop beads.

□ Repeat step 1 to create the second phosphate-sugar backbone.

□ Attach a **base** to each sugar on one of the phosphate-sugar backbones. We will call this the original DNA strand. At this point, the order of the bases does not matter. Use blue to represent Cytosine (C), orange to represent Guanine (G), yellow to represent Adenine (A) and green to Thymine (T) (see Table 1).
Once you have created the original DNA strand, complete the first two columns of Table 2. Place the color of the bead followed by the letter of the base in order as they appear in your model.

Once you have indicated the sequence of bases on the original DNA strand in Table 2, determine the base sequence for the complimentary DNA strand. Remember, T pairs with A; and G pairs with C.

In Table 2, indicate the name of the complementary base and the color of the corresponding pop bead.

Using the second phosphate-sugar backbone that you created in step 2, make the complementary DNA strand using the information contained in Table 2.

Once you have created the complimentary DNA strand, use the clear plastic connectors to “bond” the base pairs together. These connectors represent the weak bonds that keep the base pairs together.

### Table 2: DNA molecule data (10 points)

<table>
<thead>
<tr>
<th>Original strand</th>
<th>Complimentary strand</th>
</tr>
</thead>
<tbody>
<tr>
<td>pop bead color</td>
<td>base</td>
</tr>
<tr>
<td>Example:</td>
<td>Blue Cytosine</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The DNA Molecule Model Page 2

☐ Draw a sketch of your DNA molecule in Figure 1. (Draw it untwisted and color code it.)

Figure 1: DNA molecule sketch. (5 points)

☐ Hold the model from the top, and gently twist the DNA ladder to the right. You should see that the DNA looks like a spiral staircase. The model now represents the helical structure of DNA. Your teacher may instruct you to take your model and attach all the DNA models together to make a longer strand of DNA. Do not do this until instructed by your teacher.

Thinking about observations (You do NOT need to write in complete sentences.) (2 pts. each)
1. Which molecules make up the backbone of the DNA molecule? ____________________________

2. Why is DNA called “deoxyribose nucleic acid”?
   ______________________________________________________________
   ______________________________________________________________

3. What type of bond keeps the bases paired together? ____________________________

4. Which base always pairs with adenine? ____________________________

5. Which base always pairs with cytosine? ____________________________