CANDY DNA MODEL

OVERVIEW
The purpose of this activity is to construct a DNA model using candy pieces. It will contain all of the parts of real DNA. This introductory activity will provide a foundation for further study of DNA and other biological concepts.

GRADE LEVEL: 6-12

OBJECTIVES
The students will:
- Describe the structure of the DNA molecule.
- Explain the rules of base pairing.
- Represent the structure of DNA in a candy model using different candies and colors of candies to accurately represent the sugar phosphate backbone and the nucleotide base pairs.

TIME ESTIMATE: 45 minutes

SUNSHINE STATE STANDARDS
Science 6-8: Processes of Life
- Standard 1 (SC.F.1.3): The student describes patterns of structure and function in living things.
- Standard 2 (SC.F.2.3): The student understands the process and importance of genetic diversity.

Science 9-12:
- Standard 1 (SC.F.1.4): The student describes patterns of structure and function in living things.
- Standard 2 (SC.F.2.4): The student understands the process and importance of genetic diversity.
  - knows that every cell contains a “blueprint” coded in DNA molecules that specify how proteins are assembled to regulate cells.

NATIONAL STANDARDS
Content Standard C: Life Science 5-8
- Reproduction and Heredity: Every organism requires a set of instructions for specifying its traits. Heredity is the passage of these instructions from one generation to another.

Content Standard C: Life Science 9-12:
- The Cell: Cells store and use information to guide their functions. The genetic information stored in DNA is used to direct the synthesis of the thousands of proteins that each cell requires.
The Molecular Basis of Heredity: In all organisms, the instructions for specifying the characteristics of the organism are carried in DNA, a large polymer formed from subunits of four kinds (adenine (A), guanine (G), cytosine (C), and thymine (T), with uracil (U) in place of T in RNA). The chemical and structural properties of DNA explain how the genetic information that underlines heredity is both encoded in genes (as a string of molecular ‘letters’) and replicated (by a templating mechanism). Each DNA molecule in a cell forms a single chromosome.

KEY TERMS
Deoxiribose: A sugar, C₅H₁₀O₄, that is a constituent of DNA.
Gene: A hereditary unit consisting of a sequence of DNA that occupies a specific location on a chromosome and determines a particular characteristic in an organism.
Phosphate: A salt or ester of phosphoric acid.
Protein: Any of a group of complex organic macromolecules that contain carbon, hydrogen, oxygen, nitrogen, and usually sulfur and are composed of one or more chains of amino acids. Proteins are fundamental components of all living cells and include many substances, such as enzymes, hormones, and antibodies that are necessary for the proper functioning of an organism.

BACKGROUND INFORMATION
DNA provides the instructions for building and operating all living things. The DNA instructions are divided into segments called genes. Each gene provides the information for making a protein, which carries out a specific function in the cell.

A molecule of DNA (Deoxyribonucleic Acid) is composed of two backbones and four types of chemical bases (nucleotides). A chain of alternating phosphate groups (phosphorous and oxygen) and deoxiribose (sugars) forms the backbone. Each sugar molecule in the backbone provides an attachment site for one of the chemical bases. The four types of chemical bases are: adenine, thymine, cytosine and guanine. They usually are represented by their first letters: A, T, C and G. The bases form pairs in a very specific way: A always pairs with T, and C always pairs with G. A pair of bases is connected by hydrogen bonds; A and T form a double hydrogen bond, and G and C form a triple hydrogen bond.

A DNA molecule is often compared to a ladder, with the two backbones forming the sides of the ladder and the base pairs forming the steps, or rungs. However, instead of a straight ladder, DNA looks like a twisted ladder, known as a double helix (“double” for the two backbones). The DNA sequence is the consecutive order of bases on one side, or strand, of the twisted ladder. The other
strand has a complementary sequence determined by the base pairing rules. The specific matching of the base pairs, A with T and C with G, provides a way for exact copies of DNA to be made. This process is called DNA replication. In DNA replication, the double helix ladder is untwisted and breaking the hydrogen bonds between the base pairs separates the two strands. Next, two new strands are made by reading each side of the DNA ladder, one step (base) at a time. At each step, the matching base fills in (with its associated sugar and phosphate) to complete the rung and lengthen the new DNA strand. When the process is complete, there are two identical DNA double helices, each containing one original and one new strand.

DNA replication is an important part of the cell division process. Before a cell divides, it first duplicates its DNA so that the new cell will have the same genetic information. The specific base pair matching during replication ensures that exact DNA copies are made.

MATERIALS
For each student (or pair):
- 10 Gummy Savers (preferably the same color)
- 2 Twizzlers (cut into 12 equal pieces with the ends removed) (**small round pasta can be used instead)
- 10 spice/gum drops (or colored marshmallows): 2 orange, 2 red, 3 green, 3 yellow (Colors can be different, but numbers must stay the same if using the student worksheet. If different colors are substitute, change the color information on the student worksheet to correspond.)
- 2 chenille stems (pipe cleaners)
- 2 wooden craft sticks (or Popsicle sticks)
- 6 Toothpicks
- Scissors (if students will be cutting the Twizzlers on their own)
- Plastic Ziploc bag
- Student handout
- Colored pencils

ADVANCE PREPARATION
1. Cut the Twizzlers into the smaller pieces for the students (most easily done by cutting through many with a large knife)
2. Prepare a Ziploc bag for each student or pair or lay out all of the materials the day of the activity and let the students collect them in their Ziploc bag.
3. Create your own DNA candy model to use as an example.

LESSON PROCEDURE
1. (20 minutes) Begin lesson with a discussion on the structure and components of DNA. Make sure to cover the "backbone," base pairs, hydrogen bonds, and the twisted double helix.
2. (5 minutes) Discuss what each material in the activity represents in the DNA structure:
   - Twizzlers (or pasta): phosphate groups
   - Gummy savers: deoxyribose (sugars, which have ring structure)
• Spice/gum drops: nucleotides (chemical bases)
  o Green- G, Yellow- C, Red- A, and Orange- T (change as needed based on the color spice/gum drops being used)

3. (2 minutes) Hand out student sheets explaining how to assemble the model.
4. (10-15 minutes) Students will create their models

ASSESSMENT
Students should be evaluated on their ability to recall and apply the information gained on the structure of DNA.

ACCOMODATIONS
If a student is unable to assemble the candy DNA model himself or herself, have them work with a partner or use the interactive DNA model building at [http://gslc.genetics.utah.edu/units/basics/builddna/](http://gslc.genetics.utah.edu/units/basics/builddna/).

RESOURCES
• [http://gslc.genetics.utah.edu](http://gslc.genetics.utah.edu) (*background information and images*)
• [http://katra.vdbaan.net/](http://katra.vdbaan.net/) (*image*)

ADDITIONAL RESOURCES
• [http://www.dnai.org/](http://www.dnai.org/)
• [http://molvis.sdsc.edu/dna/moredna.htm](http://molvis.sdsc.edu/dna/moredna.htm)
• [http://gslc.genetics.utah.edu/units/basics/builddna/](http://gslc.genetics.utah.edu/units/basics/builddna/)
  o A fun way for students to understand DNA (using a character called Deo),
    More appropriate for middle grades.
Candy DNA Model

Your task is to construct a DNA model using candy pieces. It will contain all of the parts of real DNA.

A DNA molecule is often compared to a ladder, with the two backbones forming the sides of the ladder and the base pairs forming the steps, or rungs. To create the two backbones you will need to alternate Twizzler pieces (or pasta -- representing the phosphate groups) and Gummy Savers (representing the deoxyribose or sugars) on a pipe cleaner. Leave room at both ends of the pipe cleaner to wrap around the craft sticks at the end (this will hold your model together).

For this model, we will be using a specific sequence. One strand of the DNA molecule is filled in the table below. Fill in the bases that will be paired with the ones given. Using the following colors to represent the bases: adenine-red, thymine-orange, cytosine-yellow, and guanine-green, color in the chart. This will give you the entire sequence you are to create.

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<table>
<thead>
<tr>
<th>A</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td></td>
</tr>
<tr>
<td>T</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>
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To create the base pairs, you will place two gumdrops on a toothpick. Because the bases attach to the sugars in the backbone, insert the toothpick into the Gummy Savers on both sides. After you have attached the pipe cleaners to the craft sticks, your model is done!

Don’t forget to gently twist your model to accurately represent the twisted double helix of DNA molecules.