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Activity: BUILDING A MODEL DNA

Purpose: To help you understand how sugars, phosphates and bases fit together to form DNA, you and your partner will make a model of DNA with string, dried pasta, and different colored pipe cleaners.

Objectives: Students will…

1. Understand that the genetic code is transmitted biochemically through molecules call deoxyribonucleic acid (DNA).
2. Understand that DNA molecules are in the nucleus of a cell and carry genes.
3. Understand that genes are smaller segments of DNA that code for traits.
4. Understand the structure of the DNA molecule.

Materials: For each *pair* of students:

- Two 35-centimeters pieces of string
- Four 7.5-centimeters pieces of green pipe cleaners
- Four 7.5-centimeters pieces of white pipe cleaners
- Four 7.5-centimeters pieces of black pipe cleaners
- Four 7.5-centimeters pieces of red pipe cleaners
- Sixteen pieces of dried pinwheel pasta
- Sixteen pieces of dried ziti pasta

Procedures:

1. First, get 2 pieces of string, 16 pieces of pinwheel pasta, 16 pieces of ziti pasta and four of each different colored pipe cleaners. The materials represent the following:
    - Pinwheel Pasta = Pentose Sugar Component
    - Ziti Pasta = Phosphate Component
    - Different Colors of Pipe Cleaners = Each Type of Base
2. Thread a piece of pinwheel pasta on the string and tie it to the end of the string.
3. Next, add a piece of ziti pasta; alternate with the pinwheel and ziti pasta until you have 8 of each threaded on the string. Tie off the last piece of ziti pasta with the tail end of the string.
4. After pasta has been strung on both lines, each line should have a total of 16 alternating pieces of pasta and they should not fall off either end of the string. Cut off any excess string.
5. Lay the two strings side by side. One string should have a piece of pinwheel pasta as its top piece. Flip the other string to have a piece of ziti pasta as its top piece (pinwheel should be across from ziti).
6. Here is the color coding for the bases.
    - Red Pipe Cleaner represents adenine.
    - Green Pipe Cleaner represents thymine.
    - Black Pipe Cleaner represents cytosine.
    - White Pipe Cleaner represents guanine.
7. Represent base pairing by looping the appropriate pipe cleaners around each other. Wrap just the tip of each color around the tip of the corresponding color (to make the base pairs longer to work with).
    - Loop the four red pipe cleaners and the four green pipe cleaners together (making a total of four red-green pairs).
    - Likewise, loop the black pipe cleaners and the four white pipe cleaners together (making a total of four brown-white pairs).

8. Now, create a “ladder” using the strings of pasta as the sides and the looped pipe cleaners as the rungs. Beginning at the top, connect the two ends of a looped piper cleaner set to the two top pinwheel pasta pieces on the two lines. (Yes, one string should have a ziti pasta piece on top and the other string will not.)
9. Reminder: you can place the looped pipe cleaner sets (base pairs) in *any order* down the sides of the ladder. (The red-green do NOT have to alternate with the white-brown).
10. Then, using a second looped pipe cleaner set, connect the next two pinwheel pasta pieces down the sides of the ladder.
11. Continue building your ladder, one step at a time, until you have connected the last two pieces of pinwheel pasta. After all the pipe-cleaners have been woven, your DNA model is complete!

Analysis:

Note: #1-2 must be done before class ends for successful completion of the rest of the analysis.

1. Draw a picture of your final model of DNA. Label the following:
    - A phosphate molecule and what kind of pasta represents it.
    - A sugar molecule and what kind of pasta represents it.
    - What base does each color represent?
2. Using the letters A, T, G, C, give the sequence of bases on one side of your DNA molecule.
3. Take your model/diagram/sequence up to your teacher to get it checked off.`
4. How do the bases pair up in a DNA molecule? How does your model help you figure this out?
5. What differentiates one DNA molecule from another (compare your DNA model to another group’s DNA model)? How could you change your DNA model to reflect changes among DNA molecules?
6. What is the relationship between DNA molecules and genes and between chromosomes and genes?

Note: Do a little research online to help you answer questions 7 and 8.

7. In 1999, scientists finished mapping the sequence of the human genome (all of the genes in a human)-that is, all the instructions needed for making a human being. Aptly call the “Human Genome Project,” it is considered on e of th e biggest milestones in scientific history. Why do you think this project is so important? What types of information could it provide?
8. In 1997, scientists were able to clone a sheep. What do you think the potential of cloning is?
9. What does “complimentary base pairing” mean?
10. How many individual sugar-phosphate strands did you make when creating your DNA?
11. Give the sequence of bases for the strand that is complimentary to the strand in #2.
12. Draw a picture of one nucleotide. Us the pasta and the pipe cleaners to represent the different structures of the nucleotide. Label each part.