THE SCIENCE OF "FRINGE"

EXPLORING: DNA

A SCIENCE OLYMPIAD THEMED LESSON PLAN
EPISODE 405: Novation

Overview:
Students will learn about DNA and how it can be copied.

Grade Level: 9-12

Episode Summary:
The Fringe team discovers that the new shapeshifter has struck again, and the victim is a former scientist from Massive Dynamic who was involved in a project to replicate cells and DNA. The shapeshifter convinces the scientist, Dr. Truss, to help find a way to stabilize the cellular regeneration problems she is encountering. Meanwhile, looking for leads to the shapeshifters, the team allows Peter to analyze a memory disc and extract information from it. He finds it contains multiple DNA patterns, allowing the shapeshifter to take on any form it's previously used, as well as a tracking beacon that the team uses to locate Dr. Truss.

Related Science Olympiad Event:
Protein Modeling: Students will use computer visualization and online resources to guide them in constructing physical models of proteins.

Learning Objectives:
Students will understand the following:

- DNA is an important molecule contained in every cell that provides the instructions for all cellular functions.
- DNA is composed of two long backbones that bond to one of four types of molecules in a pattern, which encodes the information.
- During cell division, DNA is replicated by splitting each molecule in two lengthwise, and then recreating the missing pairs for each.

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Episode Scenes of Relevance:
- Nina, Lincoln and Olivia discussing Malcolm Truss (22:16 'one project' – 22:54 'like shapeshifting')
- Peter and Broyles discussing the memory disc data (39:25 'found something' – 40:27 'no way of knowing')

Online Resources:
- Fringe "Novation" full episode: http://www.fox.com/fringe/full-episodes
- Science Olympiad Protein Modeling event: http://soinc.org/protein_modeling_c
- Wikipedia page on DNA: http://en.wikipedia.org/wiki/Dna
- The Nobel Prize DNA game: http://www.nobelprize.org/educational/medicine/dna_double_helix/
- DNA Cloning simulation: http://www.blackwellpublishing.com/trun/artwork/Animations/cloningexp/cloningexp.html

Procedures:
1. Tell your students that they are going to learn about DNA and how it is copied.
2. Have your students research DNA in resources such as biology textbooks and websites and discuss what they have learned.
3. Divide your class into small groups. Have each group complete the following activity:
    a. Materials: several bags of multicolored jellybeans, toothpicks
    b. The task is to make a small model of a DNA molecule.
    c. Assign the colors of the jellybeans to represent the various molecules that comprise DNA. A suggested assignment is: White/Black – backbone molecules, Green – Base A, Orange, Base T, Yellow – Base C, Blue – Base G
    d. First create 2 backbones by joining backbone molecules with toothpicks into a long line.
    e. Next, add bases linked by toothpicks to join the backbones into a ladder type configuration. There should be 2 bases on each 'rung' of the ladder. Note that the bases need to paired up appropriately: A with T, and G with C.
    f. Split the DNA molecule lengthwise into 2 halves, each with a backbone and single set of bases. Trade one of the backbones with another group.
    g. Compare the different backbones. Note that you while you might be able to pair some of the bases back together, because the orders are different, you can't pair them all.
    h. Reconstruct each DNA molecule by adding the appropriately paired bases and backbone.
4. Discuss with the class the results of the activity. Be sure to address:
    a. How many matching pairs were you able to find between the 2 different DNA backbone strands?
    b. How easy was it to recreate the DNA molecule versus creating it from scratch?

Additional Discussion Suggestions:
- DNA naturally forms a double helix instead of a straight ladder shape. What advantage does this structure have?
- An enzyme called DNA Polymerase is instrumental in 'cloning' the single DNA backbone into a full DNA strand during replication. How might it go about doing that?

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Extension to Other Subjects:
Health Sciences: Many diseases have their roots in problems with a person's DNA, such as genetic mutations or damage. Research some of these diseases and what can be done to either prevent or treat them.

Social Studies: Genetically modified animals and crops are a controversial topic for many people, yet widely used in other parts of the world. Research some of the issues and uses of these and what factors contribute to whether or not they have been adopted widely within a region.

History: The discovery of the structure of DNA resulted in a Nobel Prize for Watson and Crick, as well as the birth of new areas of biology and medical sciences. Research some of these new areas and how they were initially developed.

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National Science Standards Alignment:

H.C.1 The Cell

c. 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.

H.U.2 Evidence, models and explanation

b. Models–Models are tentative schemes or structures that correspond to real objects, events, or classes of events, and that have explanatory power. The goal is to help students learn how to make and use many models, including physical objects, plans, mental constructs, mathematical equations, and computer simulations.

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