THE SCIENCE OF FRINGE

EXPLORING: PROTEIN MODELING

A SCIENCE OLYMPIAD THEMED LESSON PLAN
SEASON 3 - EPISODE 9: **MARIONETTE**

Overview:
Students will learn about 3-dimensional protein models and how their use allows scientists to predict biological behavior.

Grade Level: 9–12

Episode Summary:
The Fringe team investigates a crime victim that had his heart surgically removed but stayed alive for several minutes after EMTs arrived. They discover the crime follows a pattern of organ theft from several different people who received organs from one donor. The team realizes that the abductor is injecting the victims with a protein that prevents the bodies and organs from degrading, and surmise he is reuniting the organs to possibly reanimate the donor.

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:
- Proteins are composed of some combination of amino acids.
- Different combinations fold in specific ways, which distinguish one protein from another and characterize their behavior.
- Protein "flattening" is a contributing factor to cellular decay.

Episode Scenes of Relevance:
- The Fringe team discusses the first victim
- Walter demonstrates how the corpse is not decaying
- View the above scenes: http://www.fox.com/fringe/fringe-science

FOX CODE

FOR SMARTPHONES

Online Resources:

- Fringe "Marionette" full episode: http://www.fox.com/watch/fringe
- Science Olympiad Protein Modeling event: http://soinc.org/protein_modeling_c
- RCSB Protein Data Bank: http://www.pdb.org/pdb/home/home.do
- Center for BioMolecular Modeling (CBM): http://cbm.msoe.edu/stupro/so/index.html
- 3D Molecular Designs Toobers: http://www.3dmoleculardesigns.com/scienceolympiad.asp
- Wikipedia Page for Proteins: http://en.wikipedia.org/wiki/Protein

Procedures:

1. Tell your students that they are going to learn about protein modeling and cellular decay.
2. Have your students research proteins and protein modeling in resources such as science textbooks and websites and discuss what they have learned. Have them specifically look at the RCSB protein database and the CBM's protein structure tutorial.
3. Have your class complete the following activity:
    a. Materials: Either colored pipe cleaners and plastic coated wire ties or the Mini-Toober kit available from 3D Molecular Designs.
    b. Have the students choose one or two proteins from the RCSB database to model.
    c. As a class, make several models, either using pipe cleaners as alpha helixes and wires as beta sheets or the Mini Toober kits.
    d. "Denature" your proteins by first flattening individual folds and then straightening the entire protein.
4. Discuss with the class the results of the activity. Be sure to address:
    a. How did individual folds affect the overall structure of the protein? Would making one small adjustment affect the biological behavior the protein?
    b. In what ways are amino acids the building blocks for proteins?
    c. How do protein degradation and denaturation differ?
    d. How might protein degradation contribute to cellular decay?

Additional Discussion Suggestions:

- Cells decay by multiple mechanisms, not just protein degradation. What other components within a cell are more likely to decay first.
- Many amino acids are chiral, that is they create proteins that are mirror images of one another. Can you make equivalent, yet opposite proteins based on folding?

Extension to Other Subjects:

Health Science: Many nutritional supplement powders contain amino acids and proteins. What are some of the common amino acids and proteins in these drinks and how do they support muscle growth (instead of degradation?

Forensics: Crime scene investigators frequently study decaying bodies in order to identify various factors in the crime, including cause and time of death. What are some of the stages of decay and what are the biological causes of these stages?

Literature: Zombies and vampires are examples of fictional beings that have returned from the dead. Are these beings theoretically possible? What are some of the scientific concepts that would allow or prevent their existence?

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.