THE SCIENCE OF “FRINGE”

EXPLORING: REVERSE ENGINEERING

A SCIENCE OLYMPIAD THEMED LESSON PLAN
EPISODE 322: The Day We Died

Overview:
Students will learn about reverse engineering and disassembling devices.

Grade Level: 9-12

Episode Summary:
Fifteen years in the future, our universe has survived the activation of the doomsday machine, but is now having many Fringe events similar to the alternate universe. Terrorists are trying to take advantage of the unstable situation by placing “electrilights” in “soft spots” to act as bombs and rip apart the fabric of the universe. They are hoping to bring about the end of days, but the Fringe team discovers a dud “electrilight” and reverse engineers it to hopefully discover the manufacturer before it is too late.

Related Science Olympiad Event:
Forensics: Students will identify polymers, solids, fibers, and other materials in a crime scenario.

Learning Objectives:
Students will understand the following:

- Many devices function through hidden mechanisms.
- Disassembling devices to reveal mechanisms can provide engineering information about the device.
- When disassembled with care, broken components can often be fixed and the device functionality restored.

FOX CODE
FOR SMARTPHONES

Episode Scenes of Relevance:
- The Fringe team discusses the found electrilight (6:04 “we found an electrillight” – 6:55 “It shouldn’t be working at all”)
- Walter realizes the device is more complicated than he thought (15:50 “Any Luck?” – 16:10 “diagnostics on the canister”)

Online Resources:
- Fringe “The Day We Died” full episode: : http://www.fox.com/watch/fringe
- Science Olympiad Forensics event: http://soinc.org/forensics_c
- Wikipedia page for Reverse Engineering: http://en.wikipedia.org/wiki/Reverse_engineering
- Make: magazine forums (many resources on disassembly): http://forums.makezine.com/
- Ifixit.com teardowns: http://www.ifixit.com/Teardown

Procedures:
1. Tell your students that they are going to learn about reverse engineering and forensics.
2. Have your students research reverse engineering in resources such as science textbooks and websites and discuss what they have learned.
3. Have your class complete the following activity in small group:
    a. Materials: Disposable camera (or other small, cheap mechanical devices), safety glasses, small tool set including small screwdrivers and pliers, pencil, paper.
    b. Have the students draw what components they think might be inside a disposable camera (or other small mechanical device), paying attention to major components.
    c. Have the students disassemble the camera. Note: always wear safety glasses while disassembling the camera and never press the flash button to prevent electrical shocks.
    d. While the students disassemble the camera, have them draw components they remove.
    e. Compare the drawings made before and after disassembly.
4. Discuss with the class the results of the activity. Be sure to address:
    a. How similar were the two drawings? Were there components they expected to find but didn’t? Were there any unexpected components? What purpose does every component serve?
    b. Can you determine anything about the design or assembly process through disassembly?

Additional Discussion Suggestions:
- The design process includes many factors, including price considerations, durability and more. Which of these do you think was most important for the camera you took apart?
- Are there any modifications you would make to improve the design?

Extension to Other Subjects:
Computer Science: Programmers frequently reverse engineer each others’ software in order to determine functionality. How might this be different from taking apart a mechanical device? How has this activity affected software development?

Government Studies: Reverse engineering can be a controversial activity. While law frequently protects it, some versions of it are illegal. Furthermore, some argue patent applications should make reverse engineering unnecessary. What are some of the related legal and ethical issues surrounding various types of reverse engineering?

History: There have been a number of famous instances of reverse engineering, such as the allied cracking of the German Enigma machines in World War II. What are some other famous examples and how did engineers change the course of history?

National Science Standards Alignment:

H.A.1 Abilities necessary to do scientific inquiry

c. Use technology and mathematics to improve investigations and communications.
d. Formulate and revise scientific explanations and models using logic and evidence.
f. Communicate and defend a scientific argument

H.U.2 Evidence, models, and explanation

a. Evidence–Evidence consists of observations and data on which to base scientific explanations. The goal is to help students use evidence to understand interactions and predict changes.
c. Explanations–Explanations provide interpretation, meaning, or sense to objects, organisms, or events. Explanations incorporate existing scientific knowledge and new evidence from observations, experiments, or models into internally consistent, logical statements, such as hypotheses, laws, principles, and theories. The goal is to help students create explanations which incorporate a scientific knowledge base, logic, and higher levels of analysis.