

THE SCIENCE OF FRINGE

EXPLORING: BIOELECTRICITY

A SCIENCE OLYMPIAD THEMED LESSON PLAN
SEASON 2 - EPISODE 19: **THE MAN FROM THE OTHER SIDE**

Overview:

Students will learn about bioelectricity, the study of how electromagnetic fields interact with cells and tissues, with a focus on how the muscular system requires the use of electric potentials.

Grade Level: 9–12

Episode Summary:

A trio of shapeshifters are sent from the alternate universe, but one of them becomes stuck in an embryonic stage and is abandoned. The Fringe team discovers the embryo and while Walter tries to determine its nature, Olivia and Peter collect other evidence. The team discovers that the shapeshifters' mission is to open a portal to the other side at a certain time, but they don't know where. Walter is able to temporarily reanimate the third shapeshifter and obtain vital information from it, which allows them to determine the location of the portal and attempt to prevent it from opening.

Related Science Olympiad Event:

Anatomy & Physiology - This event encompasses the anatomy and physiology of selected body systems, this year limited to skeletal, muscular and endocrine systems.

Learning Objectives:

Students will understand the following:

- Tissues and organs utilize electrical potentials in order to function.
- Even after a creature has died, the application of electricity can cause muscles to operate.
- Certain disorders and medical conditions impact the bioelectrical characteristics of various organs.

Episode Scenes of Relevance:

- The Fringe team listening to the strange interference received the previous night.
- The Fringe team trying to reanimate the shapeshifter embryo.
- View the above scenes: <http://www.fox.com/fringe/fringe-science>

Online Resources:

- Fringe "The Man from the Other Side" full episode: <http://www.fox.com/watch/fringe>
- Science Olympiad Anatomy and Physiology event: http://soinc.org/anatomy_physiology_c
- National Skeletal Muscle Research Center: <http://muscle.ucsd.edu/musintro/>
- International Society for Bioelectromagnetism: <http://www.isbem.org/>
- Bioelectromagnetism online textbook: <http://www.bem.fi/book/index.htm>

Procedures:

1. Tell your students that they are going to learn about how tissues and organs utilize electricity in order to function properly.
2. Have your students research physiology topics with a focus on bioelectricity in resources such as physiology textbooks and websites and discuss what they have learned.
3. Present to the class an overview of Luigi Galvani's experiments with static electricity and frog legs, which was the first discovery of bioelectricity.
4. Ask your students to complete a virtual frog dissection available online at: http://www.froguts.com/flash_content/index.html (click on demo, then begin)
5. Discuss with the class the various tissues and organs they saw in the frog dissection and how they might be affected by electric potentials. Ask them to discuss what types of experiments could be conducted to determine the bioelectric nature of each organ.

Additional Discussion Suggestions:

- Some medical diagnostic devices, such as ECGs and EEGs, detect bioelectric signals, while others such as TENS units and pacemakers create bioelectric signals. What are the various differences between these types of devices and how they are utilized?
- If a tissue or organ is not able to utilize bioelectricity in a normal manner, what types of symptoms may be apparent in a patient? Examples of related conditions are heart attacks and multiple sclerosis.
- If you have the appropriate materials and lab space, replicate Galvani's experiment using a 9 volt battery and dissected frog.

Extension to Other Subjects:

History: Luigi Galvani and Alessandro Volta were colleagues, but disagreed on the nature of bioelectricity. Research their different opinions and how it led to the invention of the first battery.

Mathematics: Bioelectric signals travel at certain speeds through nerves and muscles. Calculate the differences in reaction times in various size animals as a result of the signals having to travel different distances.

Chemistry: Bioelectricity is the result of ion movements across cell walls. Ions involved include calcium, sodium, and potassium. Use the Nernst equation to calculate the equilibrium potential of these various ions.

National Science Standards Alignment:

C. Structure and function in living systems

M.C.1 Structure and function in living systems

- e. The human organism has systems for digestion, respiration, reproduction, circulation, excretion, movement, control, and coordination, and for protection from disease. These systems interact with one another.