



Virtual Field Trip Educator Guide

Unraveling the Mystery of Biologics

OBJECTIVES

Students will:

- Identify STEM careers that match their skills, interests, and experiences.
- Describe the role of biologics in the treatment of medical illnesses.
- Develop methods of collecting data to determine the content of a mystery box.
- Compare healthy nerve cells with nerve cells that are affected by multiple sclerosis to determine how the disorder affects the transmission of information.
- Investigate five substances to identify one that could be sent for further research as a possible new medicine for multiple sclerosis.

OVERVIEW

This Virtual Field Trip takes you inside the cutting-edge AstraZeneca labs to discover the next generation of biologics. Biological products often represent the most up to date biomedical research and, in time, may offer the most effective means to treat a variety of medical illnesses and conditions that presently have no other treatments available. You will meet the team at AstraZeneca to learn how the scientific method is used to research, develop, and manufacture biologics to make them safe, effective drugs suitable for clinical trials and commercial production for human use. This field offers a variety of highly skilled careers in medicine, research, technology, and global marketing that work collectively to find creative ways to approach new challenges. This VFT showcases how innovative solutions are used to bring life-saving medicines to people across the globe.

The pre-field trip activities in this companion guide are designed to introduce students to the topics they will learn about during the VFT. The activities designed for completion during and post viewership connect and extend student learning to classroom concepts.

GRADE LEVEL

Middle School (6–8)

MATERIALS

Capture Sheets

- Applying Your Knowledge and Skills to Careers in Biologics
- Mystery Box
- What Goes Wrong in Multiple Sclerosis
- Using Cells to Look for New Medicines

MYSTERY BOX

- 12–24 small boxes (graham crackers or pop tarts)
- Objects of various sizes (corn, cotton balls, pencils, toy cars, soap, paper clips, etc.)
- Tape for boxes

WHAT GOES WRONG IN MULTIPLE SCLEROSIS

- Diagram of nerve cell and how it functions
- Diagram of healthy nerve cell and one affected by multiple sclerosis
- Prepared slides of neurons (optional extension)

USING CELLS TO LOOK FOR NEW MEDICINES

- Safety goggles
- Gloves
- 6 strips of pH paper for each group
- Well plate (six samples) for each group
- Test substances labeled A–E
 - (A) liquid soap
 - (B) water
 - (C) surface cleaner
 - (D) vinegar
 - (E) cleaning powder solution
- 6 pipettes for each group
- 1 beaker for each group

PRE-ACTIVITY

4 Corners Question Boot Up

Before you begin your journey, see what students already know about biologics. Designate one corner of the room to represent each response. You might want to use small white boards or signs to label each corner. State the question and ask students to write their response on an index card or small piece of paper. Then, ask students to take their cards to the designated corner. Direct students to form groups of 2–3 and share why they selected this option. Repeat directions for each question and reveal correct answers.

1. Biologics are drugs that are created from which of the following?

Chemicals

Cells **(correct answer)**

Plants **(correct answer)**

Bacteria **(correct answer)**

2. Which of the following biotechnology technique uses electrical charges to separate DNA fragments?

DNA sequencing

Gel electrophoresis **(correct answer)**

Polymerase chain reaction

Recombinant DNA

3. Which of the following is considered a biological drug?

Antibodies **(correct answer)**

Vaccines **(correct answer)**

Tylenol

Aspirin

4. What is the function of a bioreactor?

Create multiple copies of genes.

Provide a controlled environment for cell growth. **(correct answer)**

Create multiple copies of DNA.

Provide a controlled environment for restriction enzymes to produce recombinant DNA.

DURING-ACTIVITY

Applying Your Knowledge and Skills to Careers in Biologics

1. Distribute the Careers in Biologics capture sheet to students and review the background information.
2. Guide students to brainstorm their personal talents and interests and write them on the capture sheet.
3. Direct students to watch the Virtual Field Trip. While they watch, they should match some of their talents and interests with the careers featured.

POST-ACTIVITIES (REFLECTION AND POST-ACTIVITY)

Activity 1: Mystery Box

Scientists can spend years struggling to figure things out that can't be seen, touched, smelled, tasted, or felt. In this hands-on activity, students will work in pairs to develop methods of collecting data, other than sight, by trying to determine the contents of several small boxes. Students will capture their learning using the provided handout.

Activity 2: Using Cells to Look for New Medicines

Students will work in groups to examine diagrams of nerve cells. They will compare healthy nerve cells with nerve cells that are affected by multiple sclerosis to determine how the disorder disrupts communication within the body. Using this knowledge, they will design their own investigation testing five unknown substances to identify one that could be sent for further research as a possible new medicine for multiple sclerosis. Students will plan their own investigation using the provided handout.

NATIONAL STANDARDS

Use the table to list standards.

Science

- **MS-LS1-2 From Molecules to Organisms: Structures and Processes**
Use argument supported by evidence for how the body is a subsystem of interacting subsystems composed of groups of cells.
- **MS-LS1-2 From Molecules to Organisms: Structures and Processes**
Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.
- **HS-LS1-2 From Molecules to Organisms Structures & Processes**
Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Technology Education Standards for Technological Literacy (grades 6–8)

- Standard 3: The Relationships Among Technologies and the Connections Between Technology and Other Fields
- Standard 10: The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving
- Standard 14: Medical Technologies

Mathematical Practice

- [Common Core](#)

English Language Arts

- [Common Core](#)

APPLYING YOUR KNOWLEDGE AND SKILLS TO CAREERS IN BIOLOGICS

Careers in biologics work together to develop life-changing medicines to people around the world.

The excitement about medicine, genomes, DNA tools and biotechnology result in strong job opportunities in this area. Your interests, abilities, and goals all influence your career choices.

What are your talents and skills? List at least four.

What are interests or hobbies you enjoy? List at least four.

While watching the Virtual Field Trip, match some of your talents and interests related to each career highlighted.

	List two skills that are critical for each <i>professional's</i> work.	List two talents or interests that <i>you</i> have related to this job.
Associate Director in Early Oncology	1. 2.	1. 2.
Electrophoresis Subject Matter Expert	1. 2.	1. 2.
Analytical Scientist	1. 2.	1. 2.
Downstream Process Scientist	1. 2.	1. 2.

List two careers from the table and **describe** how they match to your talents and/or interests.

MYSTERY BOX

Scientists use the scientific method to answer questions or explore observations for the purpose of sharing their conclusions with others. Some areas of science can be more easily tested than others. When direct experimentation is not possible, scientists modify the scientific method. Even when modified, the goal remains the same: to discover cause and effect relationships by asking questions, carefully gathering and examining the evidence, and seeing if all the available information can be combined in to a logical answer. Even though the scientific method is often shown as a series of steps, keep in mind that new information may cause a scientist to back up and repeat steps at any point in the process.

Directions: You will work with a partner to identify the contents within several mystery boxes. You will develop a hypothesis for each box and use multiple senses to gather information to draw your conclusion. Under no circumstances are you allowed to open any box!

Testable Question: _____

	Observations	Hypothesis	Actual Content(s)
Box 1			
Box 2			
Box 3			
Box 4			
Box 5			
Box 6			

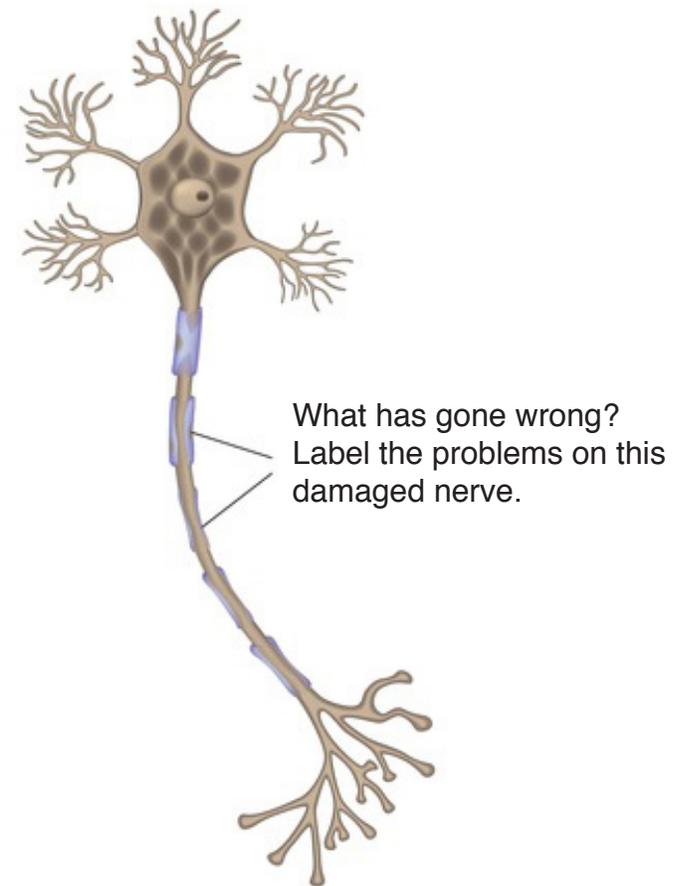
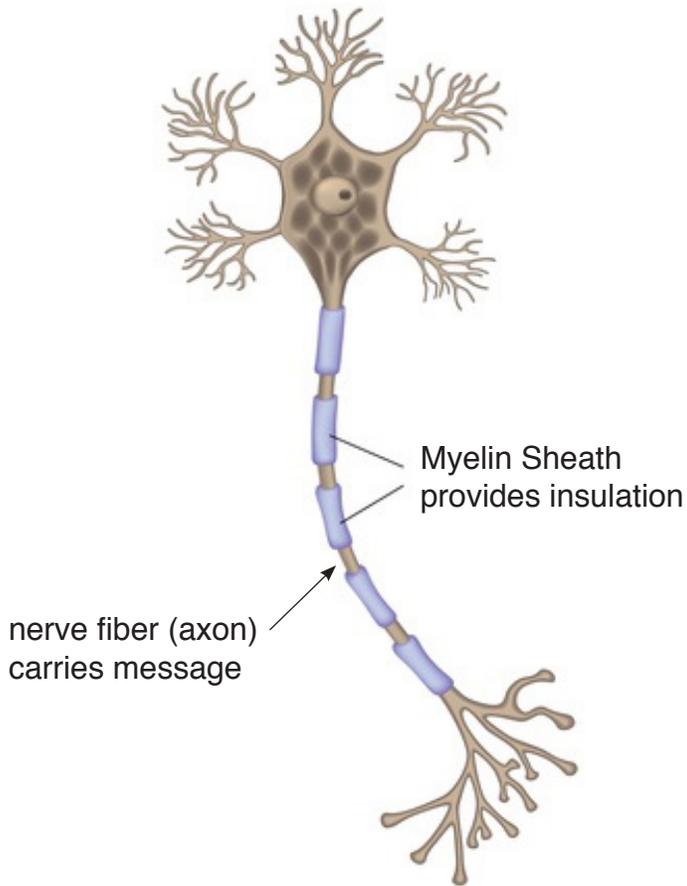
Reflection:

1. What sense did you use most often during your investigation that led you to your hypothesis?
2. How would you differentiate between a prediction and a hypothesis?
3. How many times did you change your hypothesis based on new observations that were gathered?
If you were able to collaborate and share your results with other groups, do you think this would have been beneficial or would have introduced bias?

WHAT GOES WRONG WITH MULTIPLE SCLEROSIS?

NORMAL

MULTIPLE SCLEROSIS



This nerve can carry a signal quickly

USING CELLS TO LOOK FOR NEW MEDICINES

Objective:

Plan and conduct an investigation to determine which of the unknown substances should be further tested as an ideal medicine to treat multiple sclerosis.

Materials:

- 5 unknown substances
- A tray of nerve cells grown from stem cells in a lab
- Water—think about how this could be used to draw more accurate conclusions

How will we decide which substance to further test?

Observe any changes in color.

Red = myelin sheath

Green = bare nerve

Procedure:

Describe or create a flowchart of your experimental design below.

Collect and record your data on the back.

Data Collection:

Unknown Substance	Color of Cells after Adding Substance
A	
B	
C	
D	
E	
Water	

Conclusion:

After completing our investigation and analyzing our results, we believe that substance _____
should be researched more extensively because _____

USING CELLS TO LOOK FOR NEW MEDICINES

Preparation:

1. Prepare unknown substances A–E in test tubes and place them in a centralized but supervised location within the room. These are the stock solutions for all groups to use. Emphasize the importance of using new pipettes for each solution to avoid contaminating the stock solutions.
2. Cut pH strips to place in each well of the plates. These will represent the nerve cells that were grown from stem cell in the lab. Cut additional pH strips in case they are needed later.
3. Students may not be familiar with how to use pipettes to measure solutions. A demonstration may be necessary.
4. Students should work together in a group of 3–4 to design their own investigation. The goal is to test the unknown substances A–E on their “nerve cells” (pH paper) and use the results to select a substance for further research as a potential new medicine.
5. Encourage students to identify variables that should be controlled to make sure their conclusion is more accurate. (same amount of unknown substances, different pipettes for each solution, using water as a control group)

Expected Results:

Red = myelin → Your drug is helping the nerve cells.

Green = bare nerve → Your drug is damaging the myelin.

Test Solution	Substance	Expected Color
A	Liquid soap	Green
B	Water	No change
C	Surface cleaner	Green
D	Vinegar	Red
E	Cleaning powder solution	Blue/green
Water (control)	Water	No change

Conclusion:

Students should select substance D for further research. Emphasize that much more research would be necessary before this medicine could be presented for clinical trials on patients.