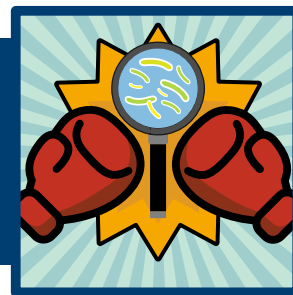


## Student Directions

### UNIT: TUBERCULOSIS

#### LESSON 3: ME VS. TB - BOOSTING THE IMMUNE SYSTEM TO DEFEAT AN ANCIENT ADVERSARY

#### ACTIVITY 3D: DON'T SPILL THE TB!! A SCIENCE THEATER



TEXAS BIOMEDICAL  
RESEARCH INSTITUTE

HEALTH STARTS WITH SCIENCE

### Activity Rationale

In this activity students will act out a dramatization of a cell undergoing necrosis due to a TB infection. Recall the two cell death pathways **apoptosis** (A-pop-toe-sis) and **necrosis** (neh-CROW-sis) mentioned in the article *Me vs. TB – Boosting the Immune System to Defeat an Ancient Adversary*. Apoptosis is the natural cell death, where the cell membrane does not break apart, keeping all cellular contents inside. When a cell is infected with TB, the bacteria deactivate the natural cell death pathway of apoptosis and activates the necrosis cell death pathway. The necrosis cell death pathway causes the cell membrane to break apart, releasing contents into the body. If the cell contains TB bacteria, the necrosis cell death pathway releases the bacteria into the body, contributing to the spread of TB throughout the body. Scientists are investigating how to boost the immune system to fight TB infection. By boosting the immune system, there will be less reliance on drug treatments which will also address drug-resistant TB. In this activity, students will act out the scientific method as they dramatize different therapeutic approaches to treating TB. During the activity, data is collected and analyzed to determine the best therapeutic approach to treating TB.

### Science Theater Plot

Ping pong balls are used to represent TB bacteria. Dropping a ping pong ball during the dramatization represents the necrosis cell death pathway caused by TB bacteria. To simulate different cell death pathways and how each affects the spread of TB, students will play one of the following roles: Macrophage, HDTs, Antibiotics and other Immune Cells. This theater production demonstrates how different cell death pathways affect the spread of TB. In the transformed article, *Me vs. TB*, compares data resulting from two TB treatments, HDT's and antibiotics. During the theatrical production, how scientists test possible treatments for TB are simulated applying the scientific method (control, separate tests for each treatment, test of treatment combinations). Each Act is timed at 15 minutes. After each Act, data will be collected and analyzed.

### Directions

The science theater includes four acts. During each act, students will act out their assigned roles. The "Director" (teacher) may display specific directions using a PowerPoint and provide the cast (class) the script for each act. Actors (students) assigned to play specific roles will receive character cards describing their role in the production. The Director will give direction to specific actors throughout the drama.

#### MIDDLE & HIGH SCHOOL LEVEL

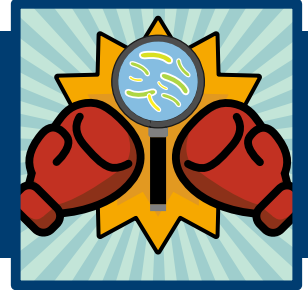
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NIH SEPA Project #1R25GM142021-01A1

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## SCRIPTS

### ACT 1: The Scientific Method - Control

- › The scientific method applies a control. A control in an experiment that examines what happens in a system when no actions or interventions are taken.
- › In Act 1, students dramatize how the immune system responds to a TB infection without introducing any therapeutics or medications.
- › Actors who portray Other Immune Cells use their arms to encircle TB, preventing Macrophages from picking up these ping pong balls. They represent granulomas which encapsulate TB bacteria.
- › The actors collect as many ping pong balls as possible in one hand. This represents apoptosis.
- › The macrophage actors use one hand to collect ping pong balls and transfer the ping pong balls to their other hand. They need to hold all collected TB in one hand. If a macrophage actor drops a ping pong ball, they must drop all their ping pong balls on the floor and sit down on the floor. This represents necrosis.
- › The above steps continue until the act ends (Director will end the scene).
- › **Data Collection:** At the end of Act 1, count the number of ping pong balls left on the floor and the number of macrophages left standing and those sitting on floor. Record the data in the data table.



### ACT 2: The Scientific Method - Introducing Antibiotics

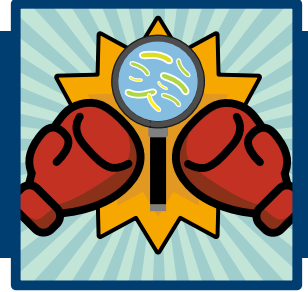
- › The scientific method examines how variables affect a system.
- › In Act 2, students dramatize how antibiotics treat a TB infection.
- › Actors who portray Other Immune Cells continue their role to encircle TB, making the TB inaccessible to Macrophages.
- › Macrophage actors collect as many ping pong balls as possible. If they drop a ping pong ball, they need to drop all the ping pong balls on the floor and “die” (sit down on the floor). This represents necrosis.
- › Antibiotic actors take a single ping pong ball from the floor and deposit in a bucket. Repeat until the Director calls time.
- › **Data Collection:** At the end of Act 2, count the number of ping pong balls left on the floor and the number of macrophages left standing. Record the data in the data table.

## Student Directions

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##### ACTIVITY 3D: DON'T SPILL THE TB!! A SCIENCE THEATER

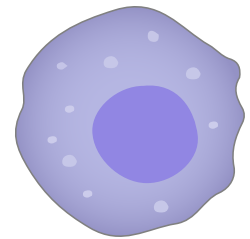


### ACT 3: The Scientific Method - Introducing HDTs, a New Variable

- › The scientific method tests different variables and their impact on a system.
- › In Act 3, students dramatize how HDTs treat a TB infection. Unlike Act 2 which dramatized a variable's impact on the TB infection, Act 3 dramatizes how HDT's impact the immune system on TB infection.
- › Macrophage actors continue to collect as many ping pong balls as possible. If they drop a ping pong ball, they need to drop all ping pong balls on the floor and sit down on the floor (necrosis).
- › HDTs tell Macrophage actors they are holding too many ping pong balls. The Macrophages then deposit their ping pong balls in a container and "die" (they take a seat, not on the floor). This represents apoptosis.
- › The actors who were originally Other Immune Cells continue to act as Immune Cells.
- › The above steps continue until the Act ends.
- › **Data Collection:** At the end of Act 3, count the number of ping pong balls left on the floor and the number of macrophages left standing. Record the data in the data table.

### ACT 4: Combining HDTs and Antibiotics

- › Actors originally cast as Antibiotics return to their Antibiotic role.
- › HDT actors continue their role.
- › The actors who were originally Other Immune Cells continue to act as Immune Cells.
- › There are now 15 actors portraying Macrophages.
- › If Macrophages drop a ping pong ball, they drop their ping pong balls on the floor and sit down on the floor (necrosis).
- › Antibiotic actors continue picking up ping pong balls one at a time and depositing them into the container.
- › If an HDT connect with a Macrophage, the Macrophage deposits their ping pong balls in the container and sits down in a chair (apoptosis).
- › The above steps continue until the Act ends.
- › **Data Collection:** At the end of Act 4, count the number of ping pong balls left on the floor and the number of macrophages left standing. Record the data in the data table.



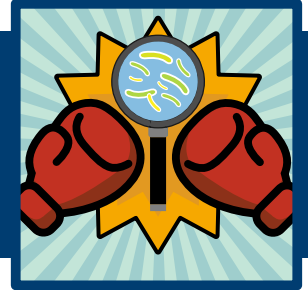
Macrophage

# Student Directions

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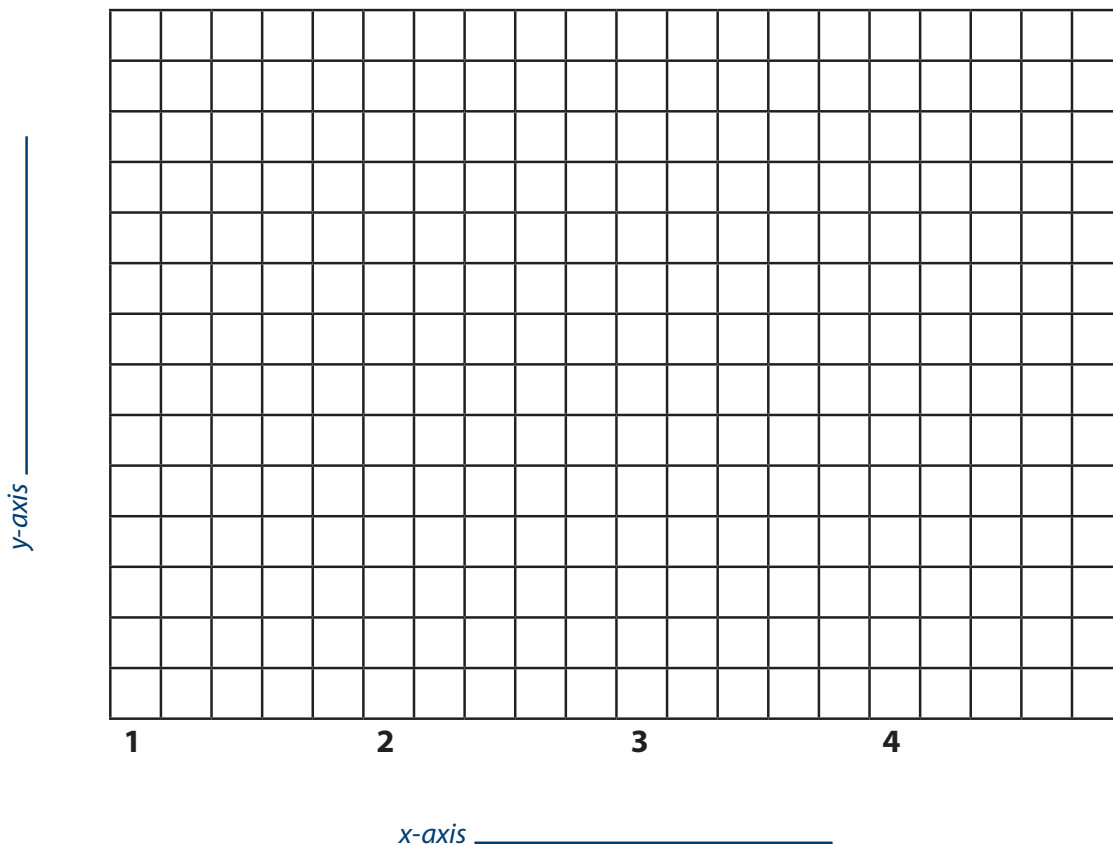
#### ACTIVITY 3D: DON'T SPILL THE TB!! A SCIENCE THEATER



Don't Spill the TB!! A Science Theater Experience	Number of TB Remaining on the Floor	Number of Macrophages Still Standing	Apoptosis Macrophages (seated in chairs)	Necrosis Macrophages (seated on floor)
ACT 1: Control				
ACT 2: Introducing Antibiotics				
ACT 3: Introducing HDTs				
ACT 4: Combining Antibiotics and HDTs				

Use the data from the data table to create a graph. As always, label each axis, include a title, and create a legend.

Title \_\_\_\_\_



Include the graph title, label the X and Y axis, and create a legend identifying X axis numbers (acts) and what 'treatment' was used each act.

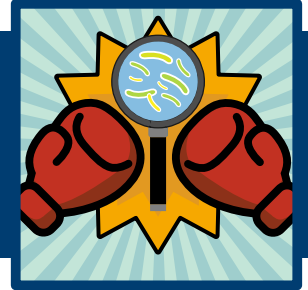
#### MIDDLE & HIGH SCHOOL LEVEL

## Student Directions

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**Claim/Hypothesis:** Look at your graph. What do you observe? Write your claim based on your observations. Hypotheses are not educated guesses. Hypotheses are informed by observations, not assumptions. Hypotheses are proposed explanations about the observations, not “if/then” statements. A claim or hypothesis is limited to one sentence.

**Evidence/Data:** Interpret the bar graph. Describe what you see. This is the evidence or data that supports your claim.

**Reasoning/Data Analysis:** Ascribe meaning to your evidence. This means giving meaning to the data. In other words, how does the evidence support your claim?