

Teacher Directions

UNIT: CHIKUNGUNYA

LESSON 4: MAKING THE CASE AGAINST CHIKV

Activity 4B: Most Likely to Go Viral!



TEXAS BIOMEDICAL
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HEALTH STARTS WITH SCIENCE

Educational Objective

Students will relate the rate of change of RNA replication to pathogenesis.

Instructional Objective

Students will interpret the stage of pathogenesis based on the rate of change of RNA replications.

Activity Summary

In this activity, students work in small groups of newly hired lab assistants. Even teachers have a role to play: Lab Supply Manager! To prepare for their job, students will read either a transformed version of a research article about the Chikungunya virus (CHIKV) or the Student Background which is a shorter version of the article. They will calculate and evaluate data obtained from figures within the article. Specifically, they will calculate the rate of change of viral RNA replication across various time intervals. The primary goal is for students to mathematically relate these rates of change to the specific stages of viral pathogenesis. Utilizing provided figures, students calculate rates of change (slopes) and color-code their data table to identify key trends. To assess the instructional objective, students will refer to the article or Student Background, *evaluating* the rate of change data and data trends to sequence pathogenesis stages. To assess the educational objective, students complete a "Processing Out" section in which they will apply what they have learned to analyze species susceptibility and justify scientific claims using empirical evidence to support their claim.

Education Standards: Identifies Texas Essential Knowledge and Skills (TEKS) and Next Generation Science Standards (NGSS). This lesson addresses:

TEKS: High School Biology, Anatomy & Physiology, Pathophysiology, and Health

NGSS: Middle School and High School Life Science

Materials

- Article (choose one):
 - ➔ Chikungunya: Silly Name, Serious Virus Article (1 per student)
 - ➔ CHIKV: Student Background (1 per student)
- Student Directions (1 per student)
- Processing Out (1 per student)
- 3 Color Highlighters (Suggested colors: Pink, Yellow, Green)
- Scissors
- Glue



MIDDLE & HIGH SCHOOL LEVEL

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Rate of Change Activity (Suggested time 30 minutes)

Step 1: Distribute the Student Background (or full CHIKV article). Students read the text. This can be done individually or within groups. Using context clues, students define the following terms in Student Directions:

- › Pathogenesis (path-oh-**JEN**-eh-sis):
- › In vitro:
- › Murine:
- › Macrophage:
- › Multiplicity of Infection (MOI):
- › RNA replication:



Calculating rate of change across different time intervals. While students are working in groups, monitor students' progress with calculating rate of change. Students can use coordinates given in the table labeled Estimated coordinates for Figure 2. ***It may be necessary to review 10ⁿ calculations.***

Use Figure 2 and Figure 3 from the Student Background to calculate the rate of change at each time interval. Students can use the formula below to calculate the rates of change. The figures are also included on page 4 of the activity.

$$\text{Rate of Change} = \frac{\Delta y}{\Delta x} = \frac{(y_2 - y_1)}{(x_2 - x_1)}$$

Note: Have students use the formula for rate of change and the starting and ending point at each interval to find rate of change for each time interval.

$$\frac{10^2 - 10^7}{2 - 0} = -4,999,950$$

****Students can round to the nearest whole exponent**

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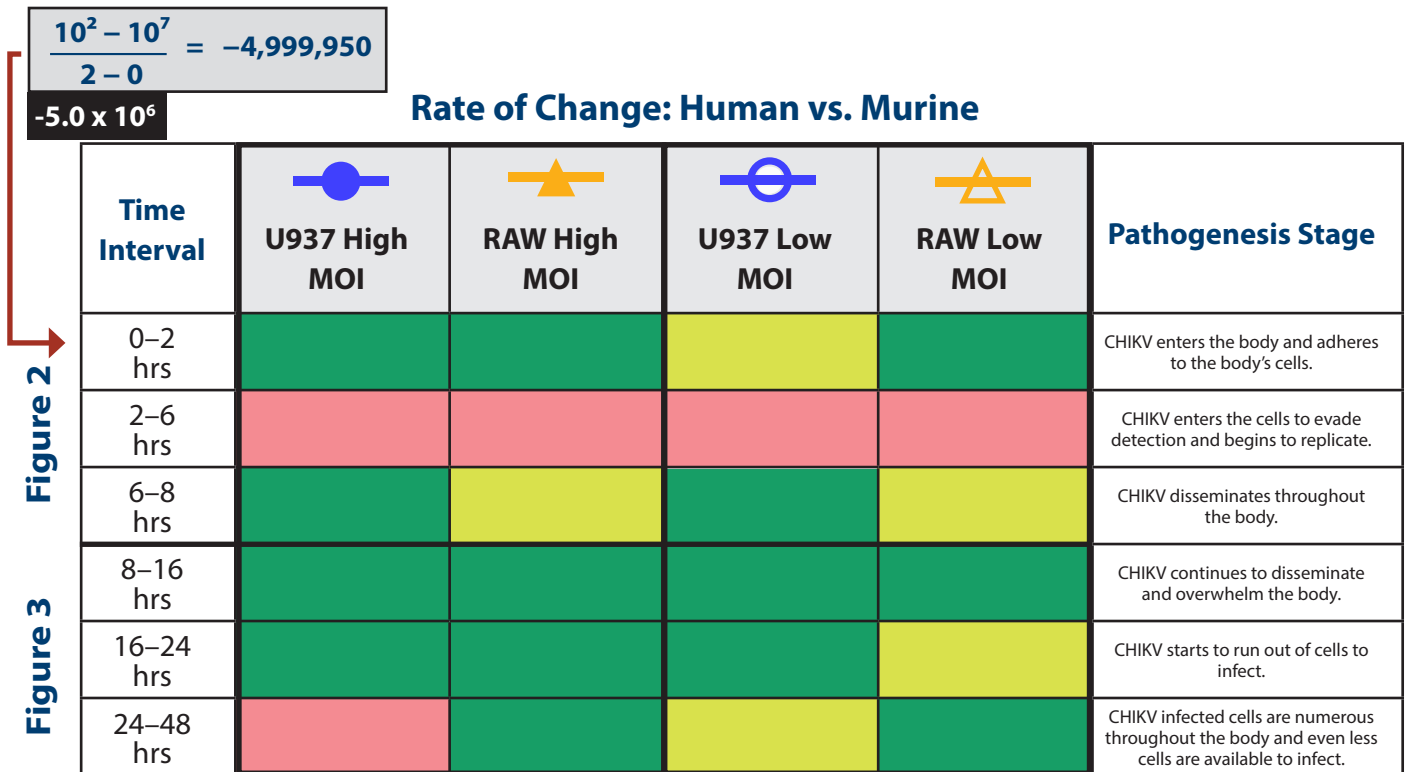
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Data: Students will color code their table based on the key in the student directions. Students compare each MOI pair to identify which data set has the greatest, and lowest or no rate of change. Similar rates of change should be highlighted in the same color.



Interpreting Data: To support development of interpretation skills, students need to explain what the data in the table means. In other words, what does a low rate of change indicate and what does a higher rate of change indicate? Students are to provide their interpretations for 6 selected time intervals in the table provided. Their answers will vary. Accept explanations that are supported by data. Do their responses make sense?

Time Interval	U937 High MOI vs. RAW High MOI	U937 Low MOI vs. RAW Low MOI
0-2 hrs	Answers will vary	
2-6 hrs		
24-48 hrs		

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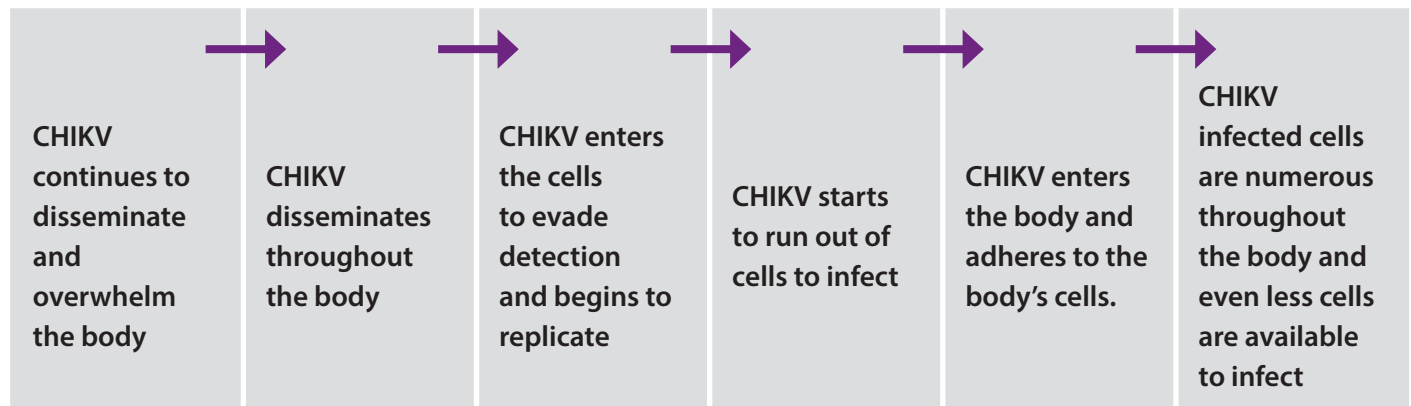
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Correlating Data to Pathogenesis Stages: Distribute pathogenesis cards. Instruct students to place the pathogenesis stage cards in the appropriate row in the table. Be sure to check for the correct sequence in the table before allowing students to glue down pieces! *Answers are in the table above.*

****NOTE:** The pathogenesis card sort is not a full description of the pathogenesis process due to the time frame that the study was conducted, however the steps follow the initial pathogenesis process**.

Pathogenesis Stages



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Rate of Change: Human vs. Murine

Figure 2
Figure 3

Time Interval	 U937 High MOI	 RAW High MOI	 U937 Low MOI	 RAW Low MOI	Pathogenesis Stage
0–2 hrs					
2–6 hrs					
6–8 hrs					
8–16 hrs					
16–24 hrs					
24–48 hrs					

Rate of Change: Human vs. Murine

Figure 2
Figure 3

Time Interval	 U937 High MOI	 RAW High MOI	 U937 Low MOI	 RAW Low MOI	Pathogenesis Stage
0–2 hrs					
2–6 hrs					
6–8 hrs					
8–16 hrs					
16–24 hrs					
24–48 hrs					