

ScienceNews

IN HIGH SCHOOLS | EDUCATOR GUIDE



MICROCEPHALY: Building a case against Zika



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MICROCEPHALY: Building a case against Zika

About the Guide

The *Science News* article “Microcephaly: Building a case against Zika” covers what scientists have learned about the link between a virus spreading across the Americas and a recent surge in birth defects.

“Microcephaly: Building a case against Zika” can be used across a wide range of curricula, with a focus on **health** and **biology**. The activities, questions and discussions in this educator guide can be used to support the following education standards:

Next Generation Science

From Molecules to Organisms: Structures and Processes: [HS-LS1-2](#)

Earth's Systems: [HS-LS2-2](#)

Engineering Design: [HS-ETS1-1](#), [HS-ETS1-3](#)

Reinforcement for Middle School:

From Molecules to Organisms: Structures and Processes: [MS-LS1-1](#)

Common Core

ELA Standards: [Reading Informational Text](#) (RI): 1, 3

ELA Standards: [Writing](#) (W): 1, 2, 4, 6, 7, 8, 9

ELA Standards: [Speaking and Listening](#) (SL): 1, 2, 4

ELA Standards: [Language](#) (L): 1, 6

ELA Standards: [Reading for Literacy in History/Social Studies](#) (RH): 1, 3, 7

ELA Standards: [Reading for Literacy in Science and Technical Subjects](#) (RST): 1, 2, 5, 6, 7, 9

ELA Standards: [Writing Literacy in History/Social Studies and Science and Technical Subjects](#) (WHST): 1, 2, 6, 7, 8, 9

Prior to reading

Guide student reading by pointing out connections between this article and what students are learning in class. Here, find ideas for standard-aligned paths to follow while reading:

- Ask students if they know the difference between a bacterium and a virus. How do the infections differ? (*Bacteria are single-celled microorganisms that live in many environments across the planet, including inside our bodies. They reproduce by dividing. Many bacteria are beneficial — they help us digest food, for example — but bacteria can also cause illnesses. When we get a bacterial infection, we can take antibiotics, which are drugs designed to kill or inhibit the growth of bacteria. A virus needs a living host in order to survive and multiply. Some people debate whether viruses should even be considered “alive.” When a virus invades your cells, it uses the cells’ structures to help it reproduce. Antibiotics don’t work against viruses, which are harder to treat for numerous reasons including: 1. They reproduce inside your cells, where they are protected in part from the immune system. 2. They can hijack human proteins; targeting such proteins with drugs can do more harm than good because the drugs would also disrupt healthy cellular processes. 3. They often mutate faster than bacteria.*)
- Ask students to think about the terms “correlation” and “causation.” What does each mean? How are they different? (*A correlation describes a relationship between two phenomena or sets of data that vary or occur together. Correlations can be positive or negative. Causation describes a scenario in which one event or situation makes another happen; one is the cause and one is the effect. Correlations are sometimes clues to causation, but not always.*) [Blackline Master 1](#) lists a number of real-world correlations. Ask students to think about whether the two phenomena are merely correlated or whether they might be causally related. If students think there is causation, which is the cause and which is the effect? Can they think of other explanations for the correlation? What type of evidence would help them confirm causation? (*Students might mention ruling out other possible causes as one approach. Also, scientists often look for plausible mechanisms to add evidence for causation.*) As students read the article, they can think about why scientists had trouble saying whether Zika virus causes microcephaly.

After reading: Comprehend

You can adapt and print these questions ([Blackline Master 2](#)) to check for comprehension and analysis before or after discussion:

1. **What is the main topic of the article?** (*The Zika virus is a leading suspect in the rise in cases of a birth defect called microcephaly, but scientists are still looking for evidence to cement the link.*)
2. **Why do researchers believe that Zika might be responsible for the increase in cases of microcephaly?** (*The virus has been spreading across the Americas and its rise in Brazil coincided with an increase in the numbers of microcephaly cases; virus RNA has been found in the placenta, amniotic fluid and brain tissue of stillborn babies with microcephaly; researchers found antibodies indicating Zika virus infection in the cerebrospinal fluid of babies born with microcephaly; and nearly 30 percent of pregnant women in a Brazilian study who had been exposed to Zika were found to have fetuses with abnormalities. Also, in lab dishes, Zika targets a kind of cell that will later make up the bulk of the brain. Zika messed with the growth cycle of these cells and sometimes killed them outright.*)

3. **Why, according to the article, is it difficult to pin down Zika as a cause of microcephaly?** (Antibody-based blood tests can give false positives for Zika infection or fail if testing is done too long after symptoms arise. Researchers also don't have a good diagnostic test for microcephaly yet. Another complicating factor is that there are other, known causes of microcephaly that have to be ruled out.)
4. **What other theories for the rise in microcephaly have been suggested?** (One proposal blamed microcephaly on a pesticide called pyriproxyfen that Brazil has added to the water supply to combat mosquitoes, but there's no evidence the pesticide is harmful to humans. It's also highly unlikely that genetically modified mosquitoes are transmitting Zika or causing microcephaly, as some people have suggested.)
5. **Why will scientists and officials be watching Colombia in the coming months?** (Zika virus cases there have soared in pregnant women. Researchers and public health experts want to know whether a spike in cases of microcephaly will accompany the rise in Zika infections.)

After reading: Analyze

1. **Ernesto Marques says in the article, "We have a victim, and we have a suspected criminal with a gun. We have to prove who pulled the trigger." Why is this an effective metaphor? Why isn't it a perfect metaphor?** (Students might say that this metaphor likens the investigation of Zika's spread to a criminal investigation. People have been harmed and scientists want to know if the suspect is guilty or not. Once they know Zika's guilt, officials can take action against it. The image is powerful and gets the attention of the public. Yet, it is not completely accurate from a biological standpoint. The virus is not a criminal but is reproducing to survive.)
2. **How, according to the article, have doctors been identifying children who may have microcephaly? Why is this method imperfect?** (Doctors have been flagging cases where the baby has a head circumference of less than 32 centimeters. The method is imperfect because head size is a range and many babies without birth defects still fall into this range. Some babies may have more minor birth defects but fall outside this range. Also, the approach doesn't consider sex or gestational age, other factors that contribute to variation in head size.)
3. **The article mentions that Zika has existed in humans in Africa and Asia since the 1950s, but these cases didn't raise the degree of alarm seen today. Why is there so much concern about Zika now?** (Students should know that infection rates depend in part on immunity and that populations long exposed to Zika might have built up immune defenses and might be less likely to be infected. North and South American populations, previously unexposed, might be more vulnerable. Also, only now is the disease being linked to a rise in microcephaly. Students might also mention increased international travel and changes in climate that are altering the distribution of mosquitoes. They might realize that people react differently to threats closer to home. Infections in the Americas are a more immediate and visible threat for people in the United States.)
4. **Does public awareness of the rise in microcephaly make it easier or harder for researchers to study the disease? Why?** (Answers will vary, but students should defend their choice. In many ways it is easier because there is a greater awareness so more people are watching for Zika and microcephaly, and their symptoms. Doctors are being trained to better spot microcephaly. That being said, the greater awareness can generate panic that might lead to misdiagnoses or might artificially inflate the number of actual cases.)

Discuss and Assess

After students read the article independently, return as a group to the concepts outlined prior to reading. Invite students to share their answers and observations from the article and lead a class discussion that further underscores your current curriculum. The discussion can serve as an informal assessment. Ideas for further reading discussion or writing prompts include:

- Have students examine the map provided in the article. Ask them what information the map provides and track their answers. (Answers include the countries with infections and the dates Zika was first reported in those countries.) Students can add arrows to the map to trace the spread of Zika from country to country. Ask students to describe how the map tells the story in a visual way. What other information would they like to add to the map to help tell the story? (Answers may include: the cities where Zika has been identified, the number of cases by location, whether those cases originated from travelers or from within the country, and so on.) How do students think the map will change with new data? How would they alter the map for different audiences?
- Explain that this story is still developing and new information about Zika and its link to microcephaly might now be available. In mid-April, for example, the U.S. Centers for Disease Control and Prevention confirmed that Zika does cause microcephaly and other birth defects. Students can independently research updates and share them with the class. How is the state of knowledge different now than it was when this article was published? Have doctors or researchers changed their approaches or their thinking? (Science News has a page devoted to Zika coverage [here](#).) What new information can be confirmed by multiple, reliable sources? Are people more worried about Zika or less worried? Did students find any information that is unreliable or outdated? Discuss with your students the challenges of staying up to date on rapidly developing news.

- Ask students to imagine that they are the heads of a government agency and they've been asked to review the existing data on the spread of Zika and its link to microcephaly. Students should decide if they are from a country that is already experiencing a Zika outbreak or not. If not, is the risk from Zika imminent? Depending on their choice, what possible actions might they propose to protect their population? What might they do to increase public awareness? Once students have brainstormed a list of potential policies and actions, ask them to evaluate the risks and benefits associated with each. Students should consider not only health consequences, but also economic, social, political and cultural impacts. Which policies and actions would students choose to implement? What arguments would they make? What evidence would they use to support their decisions?

Extend

Offer students other ways to explore the content of the article as it relates to your curriculum, such as:

MATHEMATICS OF MICROCEPHALY

With [Blackline Master 3](#) as a guide, students can use an [interactive calculator](#) to determine the combination of variables (sex, age, head circumference) that result in a diagnosis of microcephaly. Divide the class in half, one group focused on female babies and the other on male babies. Within each group, assign a pair of students a specific age to examine (1-month-old, 2-month-old, 3-month-old and so on). In pairs, students should collect data on what head circumferences lead to a microcephaly diagnosis. Students will have to use trial and error to find head circumferences that fall within and outside the diagnostic range. Once students have their own data, they should return to their group and create a graph that plots all the data for their sex group. Encourage them to think about how they will most clearly chart their data. They might, for example, want to use different colors for positive and negative diagnoses. Students can draw a line of best fit to show where the cut-off points for a positive microcephaly diagnosis are. Students can also compare the lines for the two sexes. What patterns do they see? How do their results compare with the 32 centimeters mentioned in the story? Why might their results differ?

INFECTION AWARENESS

Beginning with the information provided on [Blackline Master 4](#), students can research and analyze various infectious diseases. Ask students what an infectious disease is, what causes infectious diseases and how they are transmitted. Have students heard of any of the diseases described on [Blackline Master 4](#)? Are any of these diseases common in their community? Working alone or in pairs, students can select a disease to focus on and conduct additional research about the disease. Once they have completed their research, students can create a poster of their findings to inform fellow students about the disease. Encourage students to think carefully about transmission methods in order to propose actions they could take to break the cycle of transmission.

FOLLOW THAT DISEASE

Purpose: Students will be introduced to a model to demonstrate disease transmission.

Background: Since we can't see viruses, students may not understand how they can be transmitted or why some illnesses spread quickly through a population. Yet, there are simple things students can do to keep themselves healthy. This simulation is designed to spark conversation about how diseases spread and how personal choices can affect that spread. The goal of the exercise is not to encourage students to avoid all physical contact, but to remind them of the importance of good hygiene.

Materials:

- Glow Germ Gel ([source](#)). The 2 oz bottle is sufficient for 30 to 50 repetitions.
- UV light ([source](#), plus many others). Prices are from \$7 up.
- A sink or two large tubs filled with water (for washing hands).
- Liquid soap (for washing hands).
- Paper towels

Directions:

1. Before students enter the room (or out of view of the students), liberally coat your hands with Glow Germ Gel.
2. Begin a conversation, asking students what they know about viruses. Explain that not everyone who gets a virus has symptoms immediately; the virus could be incubating. Sometimes symptoms never present themselves in an infected person; that person is known as a "carrier."
3. Ask students if they know the different ways that viruses spread (*through the air, via physical contact, from animal bites, through sexual transmission*). As you explain the concept of transmission by physical contact, stress the idea by circulating the room and shaking about a third of students' hands. Remind students that an infected person showing no symptoms can still be contagious. We don't always know who has been infected and who has not.
4. To symbolize the next wave of transmission, have each student who shook your hand shake the hand of one or two additional students (either students who have been previously touched or not).
5. Throughout the process, ask students to think about the many ways they might be in contact with another person (*shaking or holding hands, playing sports, touching an object just touched by an infected person, and so on*).

6. Discuss the probability of student-to-student transfer, reinfection and no infection at all.
7. Reveal to students that you have been spreading a fictitious virus. If you, one person with a virus, enters a population, such as their classroom, how many students are likely to be infected? Chart student responses to the question. Remind them that some students shook your hand while others shook hands with someone who shook your hand.
8. Shine a UV light on your hands to show the residue from the gel. Explain that you put a gel on your hands to symbolize an infected person entering a population. Have students put out their hands and shine the UV light on their hands too. Look closely and count all students who have any gel residue and discuss the findings. How do they compare with the predictions?
9. Ask students what they can do to minimize transmission of this fictitious disease. When students say they can wash or disinfect their hands (and objects), suggest that they do so. Give students time to go to a sink and wash their hands.
10. Have students again predict how many of them will have gel residue after washing their hands. Chart their predictions and then check results under the UV light. Discuss the difference in findings before and after handwashing. Ask students to think about the importance of personal hygiene and healthy practices that can reduce the spread of disease.
11. How do these findings relate to Zika, which is not spread through direct contact but primarily through mosquitoes? In the case of Zika, discuss preventative measures such as using insect repellent, staying away from mosquito-infested areas and reducing travel to areas with high rates of Zika infection.

MICROCEPHALY: Building a case against Zika

What is causation?

Directions: Below you'll find sets of phenomena that have been found to be correlated in recent research studies. Discuss whether these phenomena are also causally related. If you think there is causation, decide which phenomena might cause the other. When considering causation, be sure to think about whether there might be alternative explanations. In each case, what explanations (other than causation) can you come up with?

Eating breakfast regularly and academic performance.	Infection with a common cat parasite known as <i>Toxoplasmosis</i> and outbursts of anger.
Demand for a particular product and the product's price.	Amount of exercise and calories burned.
Amount of soda consumed and likelihood of obesity in kids.	Amount of time spent playing violent video games and likelihood of getting into arguments with teachers at school.
Number of Nobel Prize winners from a given country and the country's consumption of chocolate.	Annual highway fatality rate in the United States and number of lemons imported to the U.S. from Mexico.

In which cases do you think there might be causation?

What type of evidence would be needed to assess causation?

Now it's your turn. Describe two phenomena that you know to be correlated. Is this also an example of causation or not? Explain your thinking.

MICROCEPHALY: Building a case against Zika

Comprehend

After reading the article "Microcephaly: Building a case against Zika," answer these questions:

1. What is the main topic of the article?
2. Why do researchers believe that Zika might be responsible for the increase in cases of microcephaly?
3. Why, according to this article, is it difficult to pin down Zika as a cause of microcephaly?
4. What other theories for the rise in microcephaly have been suggested?
5. Why will scientists and officials be watching Colombia in the coming months?

Analyze

1. Ernesto Marques says in the article, "We have a victim, and we have a suspected criminal with a gun. We have to prove who pulled the trigger." Why is this an effective metaphor? Why isn't it a perfect metaphor?
2. How, according to the article, have doctors been identifying children who may have microcephaly? Why is this method imperfect?
3. The article mentions that Zika has existed in humans in Africa and Asia since the 1950s, but these cases didn't raise the degree of alarm seen today. Why is there so much concern about Zika now?
4. Does public awareness of the rise in microcephaly make it easier or harder for researchers to study the disease? Why?

MICROCEPHALY: Building a case against Zika

Mathematics of microcephaly

Directions:

1. Find a microcephaly calculator, such as <http://reference.medscape.com/calculator/infant-head-circumference>.
2. Record the sex you will research in the space provided.
3. Record the age you will research in the space provided.
4. Begin with a head circumference of 20 centimeters and record the percentile ranking and diagnosis. Try other head circumferences until you have at least 10 data points. Your data should include a mix of positive and negative diagnoses.

Sex: _____

Age: _____

Head circumference (cm)	Percentile	Microcephaly? (Y/N)
20	0.1	

You are now going to graph the data from your entire sex group and draw a best fit line to show the minimum healthy head circumference for each age. Before graphing your points, consider how best to represent the data. Consider what goes on the X axis and what goes on the Y axis. Will you use any colors or symbols to make your information clearer? Once you've come up with your line of best fit, compare your results to the other sex group. What patterns do you see?

MICROCEPHALY:

Building a case against Zika

Infectious disease details

Disease	Cause	Transmission	Vaccine	Deadly	Notes
Bubonic plague	Bacteria	Bites from infected fleas	Not for general use	Yes	Killed 66 percent of infected people in the United States in the era before antibiotics.
Chagas disease	Protozoan	Bite from "kissing bugs," blood transfusion	No	Yes	As many as 8 million people in Mexico, Central America and South America have it.
Chicken pox	Virus	Direct contact, through the air	Yes	Yes	Can be reactivated as shingles.
Chlamydia	Bacteria	Sexually transmitted	Not yet	No	Left untreated, chlamydia can lead to serious health problems.
Cholera	Bacteria	Fecal contamination of food or water	Available in some cases	Yes	Left untreated, it can kill a person within hours.
Cold	Virus	Direct contact, through the air	No	Not usually	Hundreds of viruses can cause colds.
Dengue fever	Virus	Mosquito bite	No	Yes	Fatality rate for dengue fever is less than 1 percent, but higher for people with the more severe dengue hemorrhagic fever.
Gonorrhea	Bacteria	Sexually transmitted	Not yet	Not usually	Resistant to several existing antibiotics.
Hepatitis A	Virus	Contaminated food and water, direct contact	Yes	Rarely	Symptoms include nausea, fatigue, fever and the disease can cause liver failure.
Hepatitis B	Virus	Sexually transmitted, through bodily fluids	Yes	Yes	Chronic infection can lead to high risk of death from cirrhosis or liver cancer.
Hepatitis C	Virus	Contact with contaminated blood	No	Yes	Chronic infection can lead to liver failure.
Herpes	Virus	Direct oral contact, sexually transmitted	No	No	Herpes can spread without any signs of symptoms.
Malaria	Protozoa	Mosquito bite	Not yet	Yes	1,500 cases diagnosed in the U.S. each year.
Measles	Virus	Direct contact, through the air	Yes	Yes	Washington State reported a measles death in 2015, the first in the U.S. since 2003.
Mumps	Virus	Direct contact, through the air	Yes	Rarely	Mumps in adults can lead to inflammation of the brain, ovaries and testicles, as well as deafness.
Pneumonia	Virus, bacteria, fungi	Direct contact, through the air	Yes	Yes	Among the leading causes of death in children under age 5 worldwide.
Rabies	Virus	Animal bite	Yes	Yes	Vaccine is typically only given to humans at high risk of exposure; rabies vaccine is given commonly to pets.
Salmonella	Bacteria	Undercooked chicken; contaminated water and soils	No	Yes	Associated with food poisoning.
Strep throat	Bacteria	Saliva, through the air	No	No	Bacteria can live on toothbrushes for 15 days.
Tuberculosis	Bacteria	Through the air	Available in some cases	Yes	Over 95 percent of cases and deaths are in developing countries.
West Nile virus	Virus	Mosquito bite	No	Yes	Birds are a reservoir of the virus.