

# **West Nile Virus: What is the Risk?**

by Dan Richards

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In collaboration with the Centers for Disease Control and Prevention's  
Owen Devine

The students will investigate (1) What happens when West Nile Virus (WNV) shows up in a remote mountain community? (2) What is the risk of an individual contracting the disease? (3) What can you do to lower your risk?

*Disclaimer: The findings and conclusions in this report are those of the author(s) and do not necessarily represent the views of the Centers for Disease Control and Prevention.*

## **West Nile Virus - What is the Risk?**

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### **Summary**

The students will investigate (1) What happens when West Nile Virus (WNV) shows up in a remote mountain community? (2) What is the risk of an individual contracting the disease? (3) What can you do to lower your risk?

### **Learning Outcomes**

- Students will be able to describe the life cycle of a mosquito and relate it to how humans become infected with WNV.
- Students will be able to identify risk factors that increase their exposure to WNV.
- Students will be able to determine statistically what the relative risk of contracting WNV is for various groups.
- Students will be able to assess the risk of intrauterine transmission of WNV from a mother to her unborn child.

### **Materials**

1. Students will need access to computers with an Internet connection.
2. Copies of all the handouts for each student.
3. A sign that reads "CDC Epidemic Investigation Headquarters".

### **Total Duration**

6.5 hours

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## **Procedures**

### **Teacher Preparation**

Prior to beginning the lesson, the teacher should read through the entire lesson plan, look up the Web resources, and review all supplemental documents. The teacher should copy all student documents and make any necessary arrangements for computer access with Internet. Also, QuickTime will need to be installed on any computer used to view the video in Step 3.

Since students will be playing the part of Centers for Disease Control and Prevention (CDC) epidemiologists the teacher may wish to better acquaint him or herself with CDC by visiting CDC's homepage included in the Web resources section below.

The teacher will need to recruit and provide information to the volunteers (teachers, parents, or other volunteers) who will play the part of infected patients. See Step 5 for more details.

### **Web Resource**

Title: Centers for Disease Control and Prevention Homepage

URL: <http://www.cdc.gov/>

Description: This homepage provides information about the CDC, its history, mission, and organization. Teachers might wish to check out the link on the left-hand side of the page to the Morbidity and Mortality Weekly Report. This online periodical provides a

wealth of information about diseases, their prevention, and recent news concerning health related topics.

### **Introduction**

**Duration: 20 minutes**

Before beginning the lesson the teacher should give the students a prequiz to see what they already know about West Nile Virus (WNV) and identify areas of misinformation. The teacher might wish to make up his or her own or use the 15-question true/false quiz described below. This quiz can be completed online, using a hard copy (included as the “West Nile Virus Prequiz” supplemental document), or as an oral quiz. The answers to quiz are provided on the Web site or in the “West Nile Virus Prequiz Answer Key”.

### **Web Resource**

Title: West Nile Virus Quiz

URL: <http://app.idph.state.il.us/envhealth/WNVQuiz/Quiz.aspx>

Description: This online quiz evaluates students' awareness of WNV. It is provided by the Illinois Department of Public Health.

### **Supplemental Documents**

Title: West Nile Virus Prequiz

File Name: WNV Prequiz.doc

Description: This document is a hard copy of the online quiz from the Illinois Department of Public Health listed above. This will serve as a way for the teacher to evaluate the level of knowledge of the students prior to beginning the lesson. A teacher's answer key is provided.

Title: West Nile Virus Prequiz Answer Key

File Name: WestNileVirusPrequizKey.doc

Description: This document is a hard copy of the answers to the online quiz from the Illinois Department of Public Health listed above. This answer key will help the teacher evaluate the level of knowledge of the students prior to beginning the lesson.

### **Step 2**

**Duration: 10 minutes**

Before students enter the room, place a sign over the door saying “CDC Epidemic Investigation Headquarters”. Tell the students that they are CDC epidemiologists and will be investigating an outbreak of WNV. This would be a good time for the teacher to make sure that students understand what CDC (Centers for Disease Control and Prevention) is and what an epidemiologist does. The teacher can brief the students by reading “The Mission!”

### **Supplemental Document**

Title: The Mission!

File Name: The Mission.doc

Description: This document describes a fictional WNV outbreak. Numbers and names could easily be changed to make the scenario more relevant or fun for the students.

### **Step 3**

**Duration: 1 hour**

Students will learn more about the insect that transmits WNV. Students will use the worksheet “Mosquitoes Suck!” and the Web resource “Life-Cycle of the Treehole Mosquito” to gather information about the life cycle of mosquitoes. A teacher's answer key is also provided.

Students will need to have access to the Internet (with a relatively fast connection since the file is quite large). Alternately, the teacher might wish to download the QuickTime file and show it to the class, if there is a projection system available, or install the video on individual computers.

### **Web Resource**

Title: Life-Cycle of the Treehole Mosquito

URL: <http://www.cdc.gov/ncidod/dvbid/arbor/neato.htm>

Description: This CDC site contains a link to the QuickTime movie “Life-Cycle of the Treehole Mosquito”. This is an excellent video that will allow students to see the different stages in the mosquito’s life cycle. The video also does a good job of explaining why mosquitoes are well suited for transmitting diseases, such as WNV. Teachers should note that this mosquito is not necessarily the same type of mosquito that transmits WNV in Idaho. However, this video is an excellent illustration of the general life-cycle of mosquitoes.

### **Supplemental Documents**

Title: Mosquitoes Suck!

File Name: MosquitoesSuck.doc

Description: This document will guide students through the video found in the “Life-Cycle of the Treehole Mosquito” Web resource and help them to pay attention to important facts about mosquitoes and their role in the spread of WNV.

Title: Mosquitoes Suck! Answer Key

File Name: MosquitoesSuckKey.doc

Description: This key provides the answers to the “Mosquitoes Suck!” worksheet.

## **Step 4**

**Duration: 1 hour**

Next, students will need to investigate WNV specifically. The teacher might wish to brainstorm with the class the specific questions that they have about the virus or they may use the worksheet “West Nile Virus: The Facts”. Students can then be directed to the CDC’s Web site on WNV to find their answers. Other sites can be used as well, but the teacher should ensure that accurate information is present on other sites before allowing students to use it.

### **Web Resource**

Title: West Nile Virus: Questions and Answers

URL: <http://www.cdc.gov/ncidod/dvbid/westnile/q&a.htm>

Description: This CDC site contains common and uncommon questions regarding WNV and authoritative answers. In particular, it explores the causes, symptoms, and prevention of WNV. In addition, students can research how many people are infected or die each year from WNV.

### **Supplemental Documents**

Title: West Nile Virus: The Facts

File Name: WNVtheFacts.doc

Description: This worksheet will serve as a guide to help students discover the facts about WNV.

Title: West Nile Virus: The Facts Answer Key

File Name: WNVtheFactsKey.doc

Description: This key provide the answers to the “West Nile Virus: The Facts” worksheet.

**Step 5****Duration: 1 hour**

After going over “West Nile Virus: The Facts”, students will create a questionnaire for the infected individuals as a class. See “Patient Questionnaire” for an example. The roles of infected people can be played by faculty, students from another class, or even students from the class conducting the investigation. A brief bio for each of the victims may be found “Patient Biographies”. These bios should be given to each of the victims in advance (see Teacher Preparation). Teachers might want to warn the student epidemiologists that the “patients” will also be asking them some questions. Some of these questions will be easy and some may take some research.

**Supplemental Documents**

Title: Patient Questionnaire

File Name: PatientQuestionnaire.doc

Description: This document may serve as an example of the type of questions that students will want to ask the WNV patients.

Title: Patient Biographies

File Name: PatientBios.doc

Description: This document contains the information each of the volunteer “patients” will need prior to being interviewed by the student epidemiologists. Also included are some suggestions of questions the patients might ask the epidemiologists.

**Step 6****Duration: 1 hour**

After the students have collected the information from the volunteer “infected” people, they will generate an Excel document to compile all the data. See “Patient Information Spreadsheet” for an example. From the data students will generate a list of possible “risk factors” for WNV disease. These risk factors might include type of occupation, use of DEET, type of clothing, etc.

**Supplemental Document**

Title: Patient Information Spreadsheet

File Name: PatientInfoSpreadsheet.xls

Description: This Excel document can serve as an example of how students can compile their data. Teachers may wish to omit some items or add some others. A copy of the spreadsheet may be given to each student to fill in as classmates report the results of their interviews.

Title: Patient Information Spreadsheet Key

File Name: PatientInfoSpreadsheetKey.xls

Description: This spreadsheet contains the risk factor information for each patient in the outbreak.

**Step 7****Duration: 1 hour**

Now that students have compiled the data, they should analyze the information they have collected to determine risk factors for WNV disease. The teacher should introduce the concept of 2 X 2 boxes using the PowerPoint presentation “How to Assess Your Risk of West Nile Virus Disease”.

Following the PowerPoint, the teacher will lead the students through example #1 from the worksheet, "Computing the Risk of West Nile Virus Disease in Meadows Valley". Then, students can work the remaining 2 X 2 boxes to calculate risk ratios for the remaining risk factors.

### **Supplemental Documents**

Title: How to Assess Your Risk of West Nile Virus Disease

File Name: 2X2Boxes.ppt

Description: This PowerPoint presentation shows students in an entertaining way how epidemiologist use 2X2 boxes to compute risk ratios. Several examples are provided.

Title: Computing the Risk of WNV Disease in Meadows Valley Worksheet

File Name: Computing the risk of WNV.ppt

Description: This worksheet will guide students through risk ratio calculations for the WNV outbreak in Meadows Valley.

Title: Computing the Risk of West Nile Virus Disease in Meadows Valley Worksheet Key

File Name: Computing the risk of WNV Key.ppt

Description: This Word document contains the answer key for the Computing the Risk of WNV Disease in Meadows Valley worksheet.

### **Conclusion**

**Duration: 1 hour**

To conclude the lesson, have students discuss ways to prevent WNV disease. Ask students to work in small groups to develop a list of prevention techniques. From this list they can create a brochure or a poster to educate the public about WNV and how to avoid it. The students can be graded using the "Rubric for Grading Student Posters/Brochures" in the Supplemental Documents.

### **Supplemental Document**

Title: Rubric for Grading Student Posters/Brochures

File Name: Rubric.doc

Description: This document can be used as a rubric for grading the WNV prevention brochures and posters that students create.

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### **Assessment**

A posttest is included. The teacher should feel free to add, delete, or modify questions at his/her discretion.

### **Supplemental Documents**

Title: West Nile Virus Posttest

File Name: WNV Posttest.doc

Description: This test can be used to assess the student's understanding of the unit. An answer key is included.

Title: West Nile Virus Posttest Answer Key

File Name: WNV Posttest Key.doc

Description: This test can be used to assess the student's understanding of the unit. An answer key is included.

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## **Modifications**

### **Extension**

If students want to learn more about epidemiology, Montclair State University has developed an extensive “Disease Detective” curriculum. The curriculum contains 5 modules that can be used for middle or high school students and is aligned with the National Science Education Standards.

### **Web Resource**

Title: Detectives in the Classroom

URL: <http://www.montclair.edu/detectives/index.html>

Description: This Web page is the home page for the “Disease Detective” epidemiology curriculum developed at Montclair State University.

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## **Education Standards**

### **National Science Education Standards:**

#### **SCIENCE AS INQUIRY, CONTENT STANDARD A:**

As a result of activities in grades 9-12, all students should develop

- **Abilities necessary to do scientific inquiry**
- **Understandings about scientific inquiry**

#### **LIFE SCIENCE, CONTENT STANDARD C:**

As a result of their activities in grades 9-12, all students should develop understanding of

- The cell
- Molecular basis of heredity
- Biological evolution
- Interdependence of organisms
- Matter, energy, and organization in living systems
- **Behavior of organisms**

#### **SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES, CONTENT STANDARD F:**

As a result of activities in grades 9-12, all students should develop understanding of

- **Personal and community health**
- Population growth
- Natural resources
- **Environmental quality**
- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

## West Nile Virus Prequiz

West Nile Virus – What is the Risk?  
Daniel Richards, CDC's 2005 Science Ambassador Program

1. West Nile virus can infect humans, birds, mosquitoes, horses and other animals.  
 True  
 False
2. Persons age 50 or older are more likely to develop serious illness from West Nile virus.  
 True  
 False
3. West Nile virus can be transmitted directly from person-to-person.  
 True  
 False
4. New York was the first state to report West Nile virus.  
 True  
 False
5. Only female mosquitoes bite.  
 True  
 False
6. Wearing long pants and long-sleeved shirts can help protect you against the West Nile virus.  
 True  
 False
7. Female mosquitoes need blood to lay their eggs.  
 True  
 False
8. DEET is a chemical that is used in most mosquito repellents.  
 True  
 False
9. Some species of mosquitoes are attracted to light-colored clothing.  
 True  
 False
10. Female mosquitoes lay eggs in flowing water.  
 True  
 False
11. Symptoms of West Nile fever are similar to the symptoms of the flu.  
 True  
 False

12. Leaving empty containers in the yard that collect water is a good way of keeping mosquitoes out of your yard.

True

False

13. Most people who become infected with the West Nile virus become extremely ill.

True

False

14. You can get WNV directly from a bird.

True

False

#### **Quiz From the Following Source**

Illinois Department of Public Health. West Nile Virus Quiz [online]. 2005. [cited 2005 July 11].

Available from URL: <http://app.idph.state.il.us/envhealth/WNVQuiz/Quiz.aspx>.

**West Nile Virus Prequiz**  
**Teacher's Answer Key**

West Nile Virus – What is the Risk?  
Daniel Richards, CDC's 2005 Science Ambassador Program  
**Answers are indicated in Green**

1. West Nile virus can infect humans, birds, mosquitoes, horses and other animals. **True**
2. Persons age 50 or older are more likely to develop serious illness from West Nile virus. **True**
3. West Nile virus can be transmitted directly from person-to-person. **False**
4. New York was the first state to report West Nile virus. **True**
5. Only female mosquitoes bite. **True**
6. Wearing long pants and long-sleeved shirts can help protect you against the West Nile virus. **True**
7. Female mosquitoes need blood to lay their eggs. **True**
8. DEET is a chemical that is used in most mosquito repellents. **True**
9. Some species of mosquitoes are attracted to light-colored clothing. **False**
10. Female mosquitoes lay eggs in flowing water. **False**
11. Symptoms of West Nile fever are similar to the symptoms of the flu. **True**
12. Leaving empty containers in the yard that collect water is a good way of keeping mosquitoes out of your yard. **False**
13. Most people who become infected with the West Nile virus become extremely ill. **False**
14. You can get WNV directly from a bird. **False**

**Quiz From the Following Source**

Illinois Department of Public Health. West Nile Virus Quiz [online]. 2005. [cited 2005 July 11]. Available from URL: <http://app.idph.state.il.us/envhealth/WNVQuiz/Quiz.aspx>.

## **The Mission!**

West Nile Virus – What is the Risk?  
Daniel Richards, CDC's 2005 Science Ambassador Program

Meadows Valley is an isolated valley in the central mountains of Idaho. There are 954 residents in the valley. The main industries are logging, ranching, and construction. Also, the U.S. Forest Service employs about 20 field people seasonally. There is a small town, New Meadows, located in the center of the valley. Of the valley's residents, 596 live in the town. Recently there has been an outbreak of West Nile Virus (WNV) in the valley. So far 7 people have been infected. One of those infected is a pregnant woman.

You and your crack team of epidemiologist are being sent to Idaho to investigate. Your first task is to learn as much as you can about the disease and the insects that serve as its vector. Better get to it! You leave for Meadows Valley tomorrow.

## Mosquitoes Suck!

West Nile Virus – What is the Risk?  
Daniel Richards, CDC's 2005 Science Ambassador Program

### **Directions**

Go to the Web site <http://www.cdc.gov/ncidod/dybid/arbor/neato.htm> and click on the QuickTime video "Life-Cycle of the Treehole Mosquito". Answer the following questions about the life cycle of a mosquito.

1. Where are mosquito eggs laid? \_\_\_\_\_
2. How many eggs can a mosquito lay in its life time? \_\_\_\_\_
3. What are mosquitoes called in the larval stage? \_\_\_\_\_
4. How do the larvae breathe? \_\_\_\_\_
5. What are the mosquitoes called in the pupa stage? \_\_\_\_\_
6. What do the pupae eat? \_\_\_\_\_
7. How do the pupae breathe? \_\_\_\_\_
8. How can you tell the difference between the male and female mosquito? \_\_\_\_\_  
\_\_\_\_\_
9. How does the female mosquito find its host? \_\_\_\_\_
10. What are two substances found in the saliva of a mosquito and what are their function?  
\_\_\_\_\_  
\_\_\_\_\_
11. How does WNV get into the host? \_\_\_\_\_  
\_\_\_\_\_
12. How many times her body weight in blood can a female mosquito ingest? \_\_\_\_\_
13. Why does only the female mosquito feed on blood?  
\_\_\_\_\_

**Mosquitoes Suck!**  
**Teacher's Answer Key**

West Nile Virus – What is the Risk?  
Daniel Richards, CDC's 2005 Science Ambassador Program  
Answers are shown in green

**Directions**

Go to the Web site <http://www.cdc.gov/ncidod/dvbid/arbor/neato.htm> and click on the QuickTime video "Life-Cycle of the Treehole Mosquito". Answer the following questions about the life cycle of a mosquito.

14. Where are mosquito eggs laid? **In water (1)**
15. How many eggs can a mosquito lay in its life time? **1000 eggs**
16. What are mosquitoes called in the larval stage? **"Wrigglers" or larvae**
17. How do the larvae breathe? **Through appendages, "siphons", on the end of its abdomen**
18. What are the mosquitoes called in the pupa stage? **"Tumblers" or pupae**
19. What do the pupae eat? **Nothing**
20. How do the pupae breathe? **Through tubes called "trumpets"**
21. How can you tell the difference between the male and female mosquito? **Males have feather-like antennae and females do not.**
22. How does the female mosquito find its host? **By smell and vision**
23. What are two substances found in the saliva of a mosquito and what are their function?  
**Anesthetic (so the host does not feel the bite) and anticoagulant (to prevent the blood from clotting in the feeding tube)**
24. How does WNV get into the host? **Through the saliva**
25. How many times her body weight in blood can a female mosquito ingest? **5 times**
26. Why does only the female mosquito feed on blood? **She needs them to develop her eggs.**

**Reference**

1. Centers for Disease Control and Prevention. Life-Cycle of the Treehole Mosquito. <http://www.cdc.gov/ncidod/dvbid/arbor/neato.htm>

## **West Nile Virus: The Facts**

West Nile Virus – What is the Risk?  
Daniel Richards, CDC's 2005 Science Ambassador Program

**Directions:** Go to the Centers for Disease Control and Prevention Website for Questions and Answers about West Nile Virus ( <http://www.cdc.gov/ncidod/dvbid/westnile/q&a.htm> ) to answer the following questions on a separate sheet of paper.

1. What are the symptoms of West Nile Virus (WNV)?
2. Are all people affected the same by WNV?
3. Who is at greatest risk of contracting WNV?
4. Are there any risks to unborn or newborn babies?
5. Can a person be tested for WNV?
6. What role do birds play in spreading WNV?
7. Can you get WNV from anything other than a mosquito?
8. How many people are really infected or die from WNV each year?
9. How long has WNV been in the U.S.?
10. Where does WNV normally occur?

11. What medical care is available to an infected person?

12. Is there a vaccine for WNV?

13. Do all mosquitoes carry WNV?

14. What can be done to protect yourself from being infected?

## West Nile Virus: The Facts Answer Key

West Nile Virus – What is the Risk?  
Daniel Richards, CDC's 2005 Science Ambassador Program

### 1. What are the symptoms of West Nile Virus (WNV)?

"It is estimated that about 20% of people who become infected with WNV will develop **West Nile fever**. Symptoms include fever, headache, tiredness, and body aches, occasionally with a skin rash (on the trunk of the body) and swollen lymph glands. While the illness can be as short as a few days, even healthy people have reported being sick for several weeks.

"The symptoms of **severe disease** (also called **neuroinvasive disease**, such as **West Nile encephalitis** or **meningitis** or **West Nile poliomyelitis**) include headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, and paralysis. It is estimated that approximately 1 in 150 persons infected with the West Nile virus will develop a more severe form of disease.

"Following transmission by an infected mosquito, West Nile virus multiplies in the person's blood system and crosses the blood-brain barrier to reach the brain. The virus interferes with normal central nervous system functioning and causes inflammation of brain tissue." (1)

### 2. Are all people affected the same by WNV?

"When someone is infected with West Nile virus (WNV) they will typically have one of three outcomes: No symptoms (most likely), West Nile fever (WNF in about 20% of people) or severe West Nile disease, such as meningitis or encephalitis (less than 1% of those who get infected)". (1)

### 3. Who is at greatest risk of contracting WNV?

"Serious illness can occur in people of any age, however people over age 50 and some immunocompromised persons (for example, transplant patients) are at the highest risk for getting severely ill when infected with WNV." (1)

### 4. Are there any risks to unborn or newborn babies?

"Based on the limited number of cases studied so far, it is not yet possible to determine what percentage of WNV infections during pregnancy result in infection of the fetus or medical problems in newborns.

In 2002, one case of transplacental (mother-to-child) transmission of WNV was reported to CDC. In this case, the infant was born with WNV infection and severe medical problems. It is unclear, however, whether WNV infection caused these problems or whether they were due to other causes." The CDC is continuing to study the problem. "Because of ongoing concerns that mother-to-child WNV transmission can occur with possible adverse health effects, pregnant women should take precautions to reduce their risk for WNV and other mosquito-borne infections by avoiding mosquitoes, using protective clothing, and using repellents containing DEET. Repellents with DEET are safe for pregnant women, and there are other options as well such as a soybean oil based repellent that provides good, though quite limited, protection" (1)

### 5. Can a person be tested for WNV?

"West Nile virus (WNV) infection can be suspected in a person based on clinical symptoms and patient history. Laboratory testing is required for a confirmed diagnosis.

The most commonly used WNV laboratory test measures antibodies that are produced very early in the infected person. These antibodies, called IgM antibodies, can be measured in blood or cerebrospinal fluid (CSF), which is the fluid surrounding the brain and spinal cord. This blood test may not be positive when symptoms first occur; however, the test is positive in most infected people within 8 days of onset of symptoms.

In some instances, health departments may conduct or request additional testing from CDC before officially reporting a case to CDC's ArboNET Surveillance System. The state or CDC reference laboratory may repeat the initial IgM-antibody testing.

A state may also perform or ask CDC to perform an additional, different test on a specimen. This latter test (plaque reduction neutralization test [PRNT]) is usually performed when:

- the state finds its initial case(s) of human WNV illness,
- IgM results are not definitive due to equivocal laboratory testing results or insufficient specimens,
- the patient might have been exposed to other closely related viruses (like St. Louis encephalitis virus) which may result in a "false" positive laboratory test for WNV.

These additional tests require growth of the virus and may take a week or longer (plus shipping time) to conduct. The results from the PRNT are often needed before CDC considers a human WNV infection confirmed." (1)

#### 6. What role do birds play in spreading WNV?

"Mosquitoes become infected when they feed on infected birds, which may circulate the virus in their blood for a few days. Infected mosquitoes can then transmit West Nile virus to humans and animals while biting to take blood. The virus is located in the mosquito's salivary glands. During blood feeding, the virus may be injected into the animal or human, where it may multiply, possibly causing illness." (1)

#### 7. Can you get WNV from anything other than a mosquito?

"The main route of human infection with West Nile virus is through the bite of an infected mosquito. Mosquitoes become infected when they feed on infected birds, which may circulate the virus in their blood for a few days. The virus eventually gets into the mosquito's salivary glands. During later blood meals (when mosquitoes bite), the virus may be injected into humans and animals, where it can multiply and possibly cause illness.

Additional routes of human infection became apparent during the 2002 West Nile epidemic. It is important to note that these other methods of transmission represent a very small proportion of cases. Investigations have identified WNV transmission through transplanted organs and through blood transfusions."

It is possible that women may infect their unborn babies or infect their newborn babies through breastfeeding. The CDC is continuing to investigate this possibility.

"Although transmission of WNV and similar viruses to laboratory workers is not a new phenomenon, two recent cases of WNV infection of laboratory workers have been reported. These cases are detailed in CDC's MMWR Dec 20, 2002.

West Nile encephalitis is NOT transmitted from person-to-person. For example, you cannot get West Nile virus from touching or kissing a person who has the disease, or from a health care worker who has treated someone with the disease.

Infected mosquitoes are the primary source for West Nile virus. Although ticks infected with West Nile virus have been found in Asia and Africa, their role in the transmission and maintenance of the virus is uncertain. However, there is no information to suggest that ticks played any role in the cases identified in the United States.”

8. How many people are really infected or die from WNV each year?

“In 2005, there were 2949 human cases of WNV disease including 116 deaths. In 2004 there were 2539 human cases of WNV disease, including 100 deaths. In 2003, there were 9862 human cases of WNV disease reported, including 264 deaths. In 2002, there were 4156 human cases of WNV disease, including 284 deaths. Cases were reported throughout much of the US. In 2001, there were 66 human cases of severe disease and 9 deaths. In 2000, 21 cases were reported, including 2 deaths in the New York City area. In 1999, 62 cases of severe disease, including 7 deaths, occurred in the New York area.

There are no reliable estimates available for the number of cases of West Nile encephalitis that occur worldwide.

The CDC’s Statistics, Surveillance, and Control page (<http://www.cdc.gov/ncidod/dvbid/westnile/surv&control.htm>) contains maps showing the distribution of West Nile virus-related human disease cases, by state, in the U.S. in 2005.” The sites below provide detailed information concerning WNV in 2002-2004:  
[http://www.cdc.gov/ncidod/dvbid/westnile/surv&controlCaseCount04\\_detailed.htm](http://www.cdc.gov/ncidod/dvbid/westnile/surv&controlCaseCount04_detailed.htm)  
[http://www.cdc.gov/ncidod/dvbid/westnile/surv&controlCaseCount03\\_detailed.htm](http://www.cdc.gov/ncidod/dvbid/westnile/surv&controlCaseCount03_detailed.htm)  
<http://www.cdc.gov/ncidod/dvbid/westnile/surv&controlCaseCount2002.htm> (1)

9. How long has WNV been in the U.S.?

“It is not known how long it has been in the U.S., but CDC scientists believe the virus has probably been in the eastern U.S. since the early summer of 1999, possibly longer.” (1)

10. Where does WNV normally occur?

“West Nile Virus is a flavivirus commonly found in Africa, West Asia, and the Middle East. It is closely related to St. Louis encephalitis virus which is also found in the United States.” (1)

11. What medical care is available to an infected person?

“There is no specific treatment for West Nile virus infection. In more severe cases, intensive supportive therapy is indicated, often involving hospitalization, intravenous fluids, airway management, respiratory support (ventilator), prevention of secondary infections (pneumonia, urinary tract, etc.), and good nursing care.” (1)

12. Is there a vaccine for WNV?

“No. Currently there is no WNV vaccine available for humans. Many scientists are working on this issue, and there is hope that a vaccine will become available in the next few years.” (1)

13. Do all mosquitoes carry WNV?

“No. Even in areas where the virus is circulating, very few mosquitoes are infected with the virus. Even if the mosquito is infected, less than 1% of people who get bitten and become infected will get severely ill. The chances you will become severely ill from any one mosquito bite are extremely small.”

14. What can be done to protect yourself from being infected?

“Protect yourself from mosquito bites:

- Apply insect repellent sparingly to exposed skin.” CDC recommends repellents containing DEET or picaridin. Oil of lemon eucalyptus, a plant- based repellent, is also registered with the Environmental Protection Agency as an insect repellent. In two recent scientific publications, when oil of lemon eucalyptus was tested against mosquitoes found in the US it provided protection similar to repellents with low concentrations of DEET.
- Repellents may irritate the eyes and mouth, so avoid applying repellent to the hands of children.
- Spray clothing with repellents containing permethrin or DEET since mosquitoes may bite through thin clothing. Do not apply repellents containing permethrin directly to exposed skin. If you spray your clothing, there is no need to spray repellent containing DEET on the skin under your clothing.
- When possible, wear long-sleeved shirts and long pants whenever you are outdoors.
- Place mosquito netting over infant carriers when you are outdoors with infants.
- Consider staying indoors at dawn, dusk, and in the early evening, which are peak mosquito biting times.
- Install or repair window and door screens so that mosquitoes cannot get indoors.

Help reduce the number of mosquitoes in areas outdoors where you work or play, by draining sources of standing water. In this way, you reduce the number of places mosquitoes can lay their eggs and breed.

- At least once or twice a week, empty water from flower pots, pet food and water dishes, birdbaths, swimming pool covers, buckets, barrels, and cans.
- Check for clogged rain gutters and clean them out.
- Remove discarded tires, and other items that could collect water.
- Be sure to check for containers or trash in places that may be hard to see, such as under bushes or under your home.

Note: Vitamin B and "ultrasonic" devices are NOT effective in preventing mosquito bites.” (1)

1. Centers for Disease Control and Prevention. West Nile Virus: Questions and Answers

<http://www.cdc.gov/ncidod/dvbid/westnile/q&a.htm>

## Patients' Biographies

West Nile Virus: What is the Risk?  
Dan Richards, CDC's 2005 Science Ambassador Program

**Instructions:** Thanks for playing this role. Feel free to ham it up, but be sure you answer all the interviewer's questions accurately, using the information below. If you are asked any questions for which the answers are not provided below, feel free to make up answers or go with "I don't remember". Also, be sure to ask the interviewing epidemiologists some questions.

Your name is **Bob A. Long**. You are a 63-year-old rancher. You have lived in Meadows Valley all your life, maybe longer! You are a manly man and you don't let any natural thing bug you. Least of all, bugs! You don't wear insect repellent, sunscreen, or deodorant! Your ranch is located in the southeast corner of Meadows Valley.

For the past week you have been feeling sick. You have been running a low-grade fever and are feeling extremely tired. Now you are getting really sick. Your head is splitting, your fever is up, and your food won't stay down. The doctors are worried you might die! You want your CDC epidemiologist to assure you that you will not die.

## Patients' Biographies

West Nile Virus: What is the Risk?  
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You are a 25-year-old logger named **Dahl Hatchet**. You and your crew have been logging in the south end of the valley. When you aren't logging you like to go swimming at the local swimming pool, which is near the middle of the valley. You like this slightly better than logging because you get to wear less clothes. When you are in the woods you wear insect repellent with DEET, but not at the pool because you don't think girls will dig the smell.

Two weeks ago you began having flu like symptoms. After about a week you started feeling better and now you are fully recovered. You had a blood test after you heard West Nile had been found in the valley and the test was positive. You want your CDC epidemiologist to tell you if you are going to get sick again and if you will be able to have children.

## Patients' Biographies

West Nile Virus: What is the Risk?  
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Your name is **Jack Hammor**. You are a 50-year-old construction worker who thinks he is still 18, but acts much younger. Living hard and partying harder has taken its toll on your once homely face. You have been working on the same house in the north end of the valley for the past 3 months. While at work you cover any exposed skin with repellent containing DEET. At night you usually party indoors, although occasionally you wake up in the morning face down in your front yard wearing nothing but a loin cloth. You suspect you might be a werewolf.

About 10 days ago you started feeling sick. You were having trouble keeping your liquid dinner down and you seemed to always have a hangover. A blood test showed positive for West Nile Virus (WNV). Your headaches seem to be getting worse and you feel dizzy all the time. You want your CDC epidemiologist to tell you if canids, like dogs and **wolves**, are susceptible to WNV.

## Patients' Biographies

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You are a 32-year-old homemaker named **Ima Carr**. You grew up in Meadows Valley and married your high school sweetheart, Otto. In fact, you now live right in the heart of the valley, in New Meadows. You have two children and are expecting your 3<sup>rd</sup>. Yes, you are 6 months pregnant! You and Otto are not well off. Your house is old and there are no screens on the windows. The house is so hot in the summer that you need the windows open just to sleep. You don't use DEET repellent (not that you would ever dream of wearing it to bed) because someone told you that it would hurt the baby.

After a week of being sick you went to the doctor and tested positive for West Nile Virus. You frantically keep asking your CDC epidemiologist if your unborn baby is in danger. Also you want to ask him/her if you should have used the DEET.

## Patients' Biographies

West Nile Virus: What is the Risk?  
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Your name is **Slam Bagger**. You work at the local grocery store. You are 37, but are still planning to go to college after you pay off your Harley and save enough money to move out of the house. You live and work in New Meadows, located in the center of Meadows Valley. You almost never wear DEET repellent because it costs too much.

Two days ago you started having flu-like symptoms and immediately went in to be tested for West Nile Virus. It was positive. You want your CDC epidemiologist to tell you what your risk of dying is, and whether or not you have to go to college to be an epidemiologist.

## Patients' Biographies

West Nile Virus: What is the Risk?  
Dan Richards, CDC's 2005 Science Ambassador Program

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You are a 47-year-old ski instructor named **I.C. Slopes**. In the summer you work for the U.S. Forest Service helping with wildlife studies because you love all things fuzzy and buzzy. This summer you have been working in the woods in the northwest part of the valley. The reason you are there is because the Forest Service is investigating reports of large numbers of dead birds. You haven't found any, but you have found large numbers of mosquitoes. Even though you know mosquitoes have their place in the grand circle of life, you use DEET repellent liberally. Still, you manage to get a few bites every day.

After your supervisor, Warr E. Wort, learned West Nile Virus had been discovered in the valley, he ordered you to be tested. So two days ago you were given a blood test. Sure enough, you tested positive, but you feel fine (at least you think you do). You want your CDC epidemiologist to tell you what your chances of getting sick or dying are.

## Patients' Biographies

West Nile Virus: What is the Risk?  
Dan Richards, CDC's 2005 Science Ambassador Program

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Your name is **Justin Case**. You are 12 and you are annoying. You don't think of yourself as a little kid, but your squeaky voice gives you away. You are the human version of the Energizer Bunny. From the time you get up, until the time you go to bed, you are on the go. You would never think to put on DEET repellent, you are lucky if you remember to put on clothes. You live in the southeast part of the valley on a ranch. You are very excited about your new toys – dead birds!

About 3 weeks ago you became sick. It only lasted a few days, but with all the talk about West Nile Virus your mom decided to have you tested. The results came back positive. You want to ask your CDC epidemiologist how come you got sick and if you will get sick again.

## Patient Questionnaire

West Nile Virus: What is the Risk?  
Dan Richards, CDC's 2005 Science Ambassador Program

27. Patient's name \_\_\_\_\_
28. Age \_\_\_\_\_
29. Sex (circle only one) male    female
30. General Health (prior to contracting West Nile Virus)
- \_\_\_\_\_
31. Date when patient began feeling sick. \_\_\_\_\_
32. If female, the patient is (circle one) pregnant    not pregnant  
    If pregnant, in what month of pregnancy \_\_\_\_\_
33. Does the patient recall having mosquito bites? Yes    No
34. Does the patient recall seeing mosquitoes in their home? Yes    No
35. Occupation \_\_\_\_\_
36. Does this occupation require the patient to work outdoors? Yes    No  
    If yes, how many hours? \_\_\_\_\_
37. Approximately how many nonwork hours are spent outdoors, on average, per day by the patient? \_\_\_\_\_
38. Does the patient use DEET insect repellent when outside? Yes    No
39. When outside what type of clothing does the patient wear?
- \_\_\_\_\_
40. Where in Meadows Valley does the patient spend time outdoors? (list locations starting with where most time is spent)
- \_\_\_\_\_

**Comments/Questions:**



Patient Information Spreadsheet Key  
 West Nile Virus: What is the Risk?  
 Dan Richards, CDC's 2005 Science Ambassador Program

Patient name	Sex	Pregnant?	Age	Health	Mosquito bites?	Mosquitoes in home?	Date of illness
Last, First	M/F	Y/N/NA		(brief description)	Y/N	Y/N	(approx.)
Long, Bob A	M	NA	63	?	Yes	?	1 week ago
Hatchet, Dahl	M	NA	25	?	Yes	?	2 weeks ago
Hammor, Jack	M	NA	50	?	Yes	?	10 days
Carr, Ima	F	Yes	32	?	Yes	yes	1 week ago
Bagger, Slam	M	NA	37	?	?	?	2 days ago
Slopes, I.C.	M	NA	47	?	Yes	?	2 days ago
Case, Justin	M	NA	12	good-hyper	Yes	?	3 weeks ago

Patient name	Occupation	Ave. work /school hours outside	Ave. non-work/non-school hours outside	Uses DEET	Type of clothing worn	Location in Meadows Valley
Last, First	Indoor/Outdoor	(average hours)	(average hours)	Y/N/Sometimes		
Long, Bob A	outdoor	?	?	no	?	SE corner
Hatchet, Dahl	outdoor	?	?	sometimes	?	S and center
Hammor, Jack	outdoor	?	?	sometimes	loin cloth	North half
Carr, Ima	indoor	?	?	no	?	New Meadows
Bagger, Slam	indoor	?	?	no	?	center
Slopes, I.C.	outdoor	?	?	yes	?	NW corner
Case, Justin	outdoor	?	Most of the day	no	?	SE corner



2. Is a person more or less likely to contract WNV disease if they do not use repellent with DEET? Use a 2 X 2 box show how you arrived at your answer.

		Outcome (has WNV disease)	
		Yes	No
Risk factor	Did not use DEET	<input type="checkbox"/>	<input type="checkbox"/>
	Used DEET	<input type="checkbox"/>	<input type="checkbox"/>
		<input type="checkbox"/>	<input type="checkbox"/>

3. Write a hypothesis about how you think a person's sex affects their chances of contracting WNV disease.

Check your hypothesis with a 2 X 2 box. Is your hypothesis correct?

		Outcome (has WNV disease)	
		Yes	No
Risk factor	Male	<input type="checkbox"/>	<input type="checkbox"/>
	Female	<input type="checkbox"/>	<input type="checkbox"/>
		<input type="checkbox"/>	<input type="checkbox"/>

4. Now write another hypothesis based on the other information listed at the top of page one. Then use a 2 X 2 box to check your hypothesis. Was your hypothesis correct?

		<b>Outcome (has WNV disease)</b>		
		Yes	No	
<b>Risk factor</b>	Yes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	No	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Calculating Risk of West Nile Virus Disease Worksheet Answer Key

### West Nile Virus – What is the Risk?

Daniel Richards, CDC's 2005 Science Ambassador Program

Remember that Meadows Valley has a population of 954. You have already interviewed the 7 people diagnosed with West Nile Virus. Further investigation reveals the following information about the population:

- 596 people live in the town of New Meadows- 358 live outside the city limits
- 525 are female- 429 are male
- 320 work outdoors- 634 do not work outdoors
- 598 are 0-49 years old- 356 are 50 or over
- 315 use DEET repellent when outdoors 639 use it sometimes or not at all
- 410 live or work in the southern half of Meadows Valley or in New Meadows- 544 live in the northern half

**Now use what you have learned to compute the following:**

1. Use a 2 X 2 box and the data collected from the WNV patients to determine the risk ratio for a person living in the town of New Meadows. What does this number mean?

		Outcome (has WNV disease)		
		Yes	No	
Risk factor (lives in town)	Yes	1	595	596
	No	6	352	358
		7	947	954

$$\text{Risk Ratio (RR)} = \frac{\text{incidence in exposed group}}{\text{Incidence in unexposed grp.}} = \frac{1/596}{6/358} = 0.100$$

This means that a person would be 1/10<sup>th</sup> as likely (10 times less likely) to contract WNV disease if the person lives in New Meadows.

2. Is a person more or less likely to contract WNV disease if they do not use repellent with DEET? More likely Use a 2 X 2 box show how you arrived at your answer.

		Outcome (has WNV disease)		
		Yes	No	
Did not use DEET		6	633	639
	Used DEET	1	314	315
		7	947	954

$$\text{Risk Ratio (RR)} = \frac{\text{incidence in exposed group}}{\text{incidence in unexposed grp.}} = \frac{6/639}{1/315} = 2.96$$

This means that a person would be 3 times more likely to contract WNV disease if a person does not use DEET.

3. Write a hypothesis about how you think a person's sex affects their chances of contracting WNV.

Males are more likely to contract WNV disease than females.

Or

Females are more likely to contract WNV disease than males.

Check your hypothesis with a 2 X 2 box. Is your hypothesis correct?

If we use the hypothesis that males are more likely to contract WNV than the following 2 X 2 box would apply:

		Outcome (has WNV disease)		
		Yes	No	
Male		6	423	429
	Female	1	524	525
		7	947	954

$$\text{Risk Ratio (RR)} = \frac{\text{incidence in exposed group}}{\text{incidence in unexposed grp.}} = \frac{6/429}{1/525} = 7.34$$

So the numbers do support the hypothesis. However, this does not necessarily mean that males are more susceptible simply because they are male. It may be related to the fact that

more men work outdoors than women or that men are more likely to use repellent than women or some other reason.

If the opposite hypothesis were tested the answer would be 0.136 indicating that being a women is somehow protective against WNV disease for the same reasons listed above.

(WNV disease strikes both sexes equally!)

4. Now write another hypothesis based on the other information listed at the top of page one. Then use a 2 X 2 box to check your hypothesis. Was your hypothesis correct?  
Answers will vary depending on the hypothesis made

5. Make a list of the risk factors that increase a person's chances of contracting WNV disease.

Answers should include not wearing insect repellent, an outdoors occupation, being over 50, living in the south half of the valley, etc.

## **Rubric for Grading Student Posters/Brochures**

West Nile Virus- What is the Risk?  
Daniel Richards, CDC's 2005 Science Ambassador Program

The student's posters or brochures may be graded on a scale of 0-3 using the criteria suggested below.

**Creativity/Originality** (this obviously is a subjective category and requires the teacher's judgment)

- 0 = The poster/brochure is nearly identical to a sample poster/brochure.
- 1 = The poster/brochure shows only a small amount of originality or creativity.
- 2 = The poster/brochure is very original or creative.
- 3 = The poster/brochure is truly unique in its originality or creativity.

### **Informative**

- 0 = Very little or none is provided.
- 1 = Information is provided, but there are serious omissions or misinformation is provided.
- 2 = The topic is covered well, but some information is missing.
- 3 = The poster/brochure does an excellent job of covering the information.

### **Use of graphics/visual appeal**

- 0 = The poster/brochure uses no graphics or artwork only text.
- 1 = There is a minimal amount of visual appeal.
- 2 = The poster/brochure is visually appealing overall, but some of the graphics are misleading or unnecessary.
- 3 = The poster/brochure is visually appealing. The graphics compliment the text, but do not distract from it.

### **Grammar/Punctuation**

- 0 = There are numerous (10 or more) mistakes in grammar and punctuation.
- 1 = There are several (5-10) mistakes in grammar and punctuation.
- 2 = There are few (0-5) mistakes in grammar and punctuation.
- 3 = There are no mistakes in grammar and punctuation.

### **Neatness**

- 0 = The poster/brochure is smudged, wrinkled, and/or contains messy artwork.
- 1 = The poster/brochure is somewhat messy and shows a lack of attention to detail.
- 2 = The poster/brochure is neat overall, but contains one or two blemishes.
- 3 = The poster/brochure is neat and shows great attention to detail.