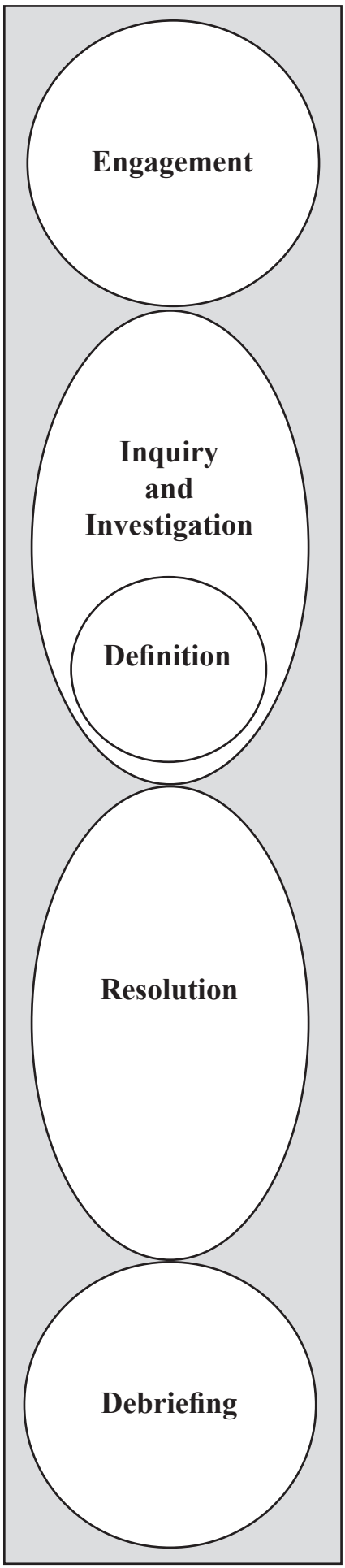


PROBLEM-BASED LEARNING
IN THE SCIENCES

Mosquito Coast

A Problem about West Nile Virus
and Mosquito-Borne Disease

NAGC Curriculum Award-Winner

Teacher Manual

Shelagh A. Gallagher

Royal Fireworks Press
Unionville, New York

Problem Narrative:
The Storyline for *Mosquito Coast*

Ideally, the direction of a Problem-Based Learning unit is decided through the questions students ask. To some extent, this is made manageable by the structure of the opening scenario presented during Problem Engagement. The opening scenario is carefully designed to point students in the direction of some predictable questions. For example, it would be hard to avoid asking about the nature of Sam Foss's disease or how the disease spreads. The narrative below and the lesson plans in this unit respond to these more predictable questions and address other desirable learning outcomes. They also provide a helpful guide for teachers new to PBL.

Experienced PBL teachers are encouraged to use this unit as a framework, selecting and sequencing lessons that fit the students' questions (and, as above, many should fit) and adding new lessons to address other questions.

Problem Engagement

The students are in the stakeholder role of medical entomologists who have been asked to consult in the case of Sam Foss. They learn the background of the case from written minutes of a recent meeting with Sam's mother, his pediatrician, and his school principal. Students also have access to Sam's medical file and family background. At first, it seemed that nine-year-old Sam had the flu, but his symptoms became more severe—so much so that he was hospitalized. In the meeting, Sam's distraught mother demands an answer: What's wrong with her son? An examination of symptoms and previous history shows that the boy has had no contact with a sick person, there is no contagious disease going around the school, and he has no genetic tendencies to chronic disease. Sam has shown no meaningful improvement from common drug interventions. Blood tests have been sent to a lab to test for an arbovirus, and those results are the current best hope for an answer, and hopefully a cure. While they are waiting for those results, students analyze Sam's symptoms and recent activities to make reasonable hypotheses as to the nature of the problem.

Test results are made available either at the end of the first day or the beginning of the second day, revealing that Sam has West Nile virus. (Note: It is not necessary to rely exclusively on the arrival of test results. A careful analysis of the symptoms, the requested medical tests, and a little research should lead students to a reasonable inference that the disease is West Nile virus or some other form of encephalitis. Teachers who are interested in having students learn the medical background of blood tests and results may want to devote some time to this exploration.) With a diagnosis in hand, students update the Learning Issues Board with new questions, including "How did Sam get West Nile virus?" and "How is West Nile virus treated?" Students end the first lesson by learning more about their job as medical entomologists.

Questions Students Should Ask

- Which of these symptoms seem particularly important?
- What diseases could this be?
- Where could Sam have contracted a disease?
- Is this disease genetically transferred or acquired?
- Is it a virus or bacterial infection?
- Is it contagious?
- How can spread of the disease be prevented?

Inquiry and Investigation

Inquiry and Investigation initially will follow two paths of inquiry: (1) Sam's case, its source, and recommendations for treatment, and (2) assessment of risk to others in the community. After researching treatment options for West Nile virus, a group of students can make recommendations to Sam's doctors, which should include treatment of symptoms and possibly treatment for meningitis. Students may need reminding that medical entomologists are not medical doctors and that physicians will take charge of Sam's case based on their recommendations. Their job is to investigate how West Nile virus came to the area and whether Sam's case was an anomaly or the first of many cases.

Students will also learn that West Nile virus is transferred by a mosquito bite and that North Carolina is home to between 30 and 50 mosquito varieties, including all of those that carry the disease. Analysis of Sam's medical history will quickly isolate where Sam may have received a mosquito bite. The fact that there are dead crows in the area suggests, but does not prove, that additional West Nile virus cases could surface.

Research into mosquitoes and birds will reveal that birds bring West Nile virus into a geographic region. Some birds serve as hosts that are unaffected by the disease. Other birds, including crows, will die if infected with West Nile virus. Students will also learn that the disease moves from birds to humans via mosquito bite and that the mosquito population is increasing due to environmental changes, such as climate change, as well as to human behaviors that support mosquito proliferation by creating places that enable standing water to accumulate. These include agribusiness hog farms (and the associated hog lagoons), landscaping that drains poorly after rainstorms, and even such small places as flower pots and discarded car tires (*Lesson: Searching for Cause and Cure*). Students will also learn that mosquitoes transmit other diseases, including several varieties of encephalitis. They may choose to expand their investigation into different forms of mosquito-borne diseases. Data charts from the Centers for Disease Control and Prevention (CDC) help students engage in an evidence-based investigation of the incidence of West Nile virus (*Lesson*: *What's in the Numbers?*).

Students combine their research findings and apply them to the problem, answering their initial learning issues questions (*Lesson*: *Putting the Pieces Together*).

Content Students Should Encounter

- The rise in the mosquito population is due to changing environmental climate, catastrophic natural events like hurricanes, and human-made environmental pollutants.
- Mosquito varieties travel different distances, but most stay within one to three miles of where they are born. Male mosquitoes do not bite humans; females bite in order to fertilize their eggs, not for nourishment.
- A single female mosquito produces as many as 1,000 offspring.
- Mosquitoes are vectors, and birds are amplifier hosts for West Nile virus.
- Birds introduce West Nile virus to the area. Mosquitoes carry the disease to humans by biting a bird and then biting a human.

An unexpected letter arrives from a parent who is fearful of a potential epidemic of West Nile virus. She has gathered support for the idea of closing the school until everyone is sure that there are no mosquito breeding grounds on the school campus (*Lesson: Too Risky?*). Given the fact that West Nile virus has been found in the community, students must respond to the principal's request for assistance. This introduces a new set of questions to answer, and they set to the task of investigating the immediate environment to determine the risk of contracting West Nile virus (being bitten by a mosquito) around the school. Students are introduced to the concept risk and discuss the difference between the actual risk of contracting West

Nile virus as suggested by data and the perceived level of risk as presented in the media. They discuss how to describe the level of risk posed by West Nile virus.

Students conduct field research on the school grounds to determine whether or not the school does in fact harbor mosquito-friendly breeding grounds (*Lesson: Site Assessment*). They also take a closer look at how West Nile virus is transmitted (*Lesson: Spread of Mosquito-Borne Diseases*).

Content Students Should Encounter

- Leaving children in a high-risk situation is ethically unacceptable.
- Closing the school has substantial repercussions on children, families, and businesses.
- Data gathering has to be accurate, systematic, and swift.
- Female mosquitoes bite humans; males do not.
- In general, mosquitoes travel in a limited range.
- The first stage of West Nile virus transmission is when a female mosquito bites an infected bird.
- It is impossible to remove the risk completely; experts (like them) have to determine what constitutes an "acceptable level of risk."
- Perception of risk is dependent on knowledge and control. Control is related to the ability to decrease the threat of a risk. Knowledge can either increase or decrease the perception of risk.
- Public officials perceive risk differently than individuals do.
- A credible risk of mosquito-borne disease is increasing but still is not large.
- The risk that a member of a group will get a mosquito-borne disease is greater than the risk that any given individual will get a mosquito-borne disease.
- West Nile virus is a real and increasing threat, but it is not a crisis. Other diseases, such as tuberculosis, present more of a threat. In fact, thousands more people die in car accidents each year than from West Nile virus.

Problem Definition

In this unit, the problem definition may vary, depending on the results of the environmental survey. If the survey reveals a significant number of potential mosquito breeding grounds, the defined problem may focus on the need to minimize the risk of mosquito-borne illness while minimizing the potential for panic. If the survey reveals few or no breeding sites, then the problem definition will have more to do with providing information about offering a balanced message to the public without stirring up panic (the school grounds are reasonably safe, but that does not remove all risk). Regardless, by the end of the lesson, students should have a definition that contains both the issues to be resolved and the constraints that put limitations on their actions. The final definition should take the form:

*How can we (*issue*) in a way that takes into account (*constraints*)?*

Examples:

How can we minimize the risk of mosquito-borne disease at school in a way that takes into account timeliness (responds to the current need but is lasting), potential public panic, and keeping children safe?

How can we reduce the fear of a West Nile virus epidemic in the community in a way that takes into account the need to be accurate about the risk and that ensures that people know reasonable precautions to take to avoid mosquito bites?

Problem Resolution

To calm public panic (or to address legitimate concerns), the students prepare materials on how to keep the school site reasonably clear of mosquito breeding grounds, the risk of serious disease from mosquitoes, and methods of preventing mosquito bites. If they are preparing recommendations to keep children safe, they should consider not only environmental cleanup/change but also changes in human behavior (Should children stay inside for recess? Should outdoor sports be suspended?). If they are preparing documents to educate the community about the relatively safe school grounds, they must be ready to defend what they consider "reasonable risk," especially when one student has been infected. Included among their considerations could be an assessment of the efficacy and safety of different forms of adulticide pesticides.

The culminating event for the unit could take a variety of forms, including a press conference, a visual presentation to a group of colleagues, a model of the safe school grounds, educational brochures for the public, and/or ongoing management plans.

Problem Debriefing

A variety of ideas are presented that would help students review and extend what they have learned during their investigation of West Nile virus, including the status of the disease in the U.S. or the study of other mosquito-borne diseases. Students should also be provided with an opportunity to reflect on the PBL process.

Optional Lessons

Two optional lessons are included in Appendix A. These could be taught as regular lessons or converted into learning center activities.

Mosquitoes Everywhere introduces the idea of population growth. Students calculate how quickly a mosquito population can grow in the absence of controls.

What Kinds of Mosquitoes? is a lab activity in which students identify the characteristics of different varieties of mosquitoes by looking at slides through a microscope or by looking at diagrams from a comprehensive mosquito guide.

Problem Engagement

Sam Foss

Minimum Recommended Time: One class period

Goals:

- Introduce students to the problem.
- Help students identify important questions.
- Develop issues on the Learning Issues Board.
- Prioritize learning issues, and identify next steps.

Grouping: Pairs or small groups; whole class

Generalization: Risk is defined, in part, by the possibility of suffering harm or loss.

Materials	Problem Log	Teacher Reference
Included in Unit • Opening Scenario • Meeting Minutes • Review of Symptoms • Exam Narrative • Lab test request form • Lab test results • Notes page • Learning Issues Board • Risk Thermometer • What Do Medical Entomologists Do? • Examples of Diseases Transferred by Bugs • Reflective Moments **Additional Materials** • Overnight mail envelope • Real or created map of school grounds (optional)	• Notes page • Learning Issues Board • Risk Thermometer • What Does a Medical Entomologist Do? • Examples of Diseases Transferred by Bugs • Reflective Moments	• Sample Learning Issues Board

Summary:

Students receive the opening scenario that introduces them to the medical case of Sam Foss. They analyze the information provided and discuss possible sources of the disease. An overnight envelope arrives with the diagnosis of West Nile virus, and the students refine their list of questions, identify the questions to answer first, and create a plan of action.

Notes: This unit was developed and pilot tested in North Carolina, which is why the lab reports have a North Carolina address on them and why we recommend North Carolina addresses on the overnight envelope. Feel free to change the return address on the envelope to match an organization in your region.

The problem could also be introduced with the assistance of "actors" in the roles of pediatrician, principal, and parent who come to meet with the students in their role of medical entomologists, instead of the meeting minutes provided in this unit. If you choose this more active beginning, the pediatrician should bring in the patient file and leave it before departing so that the students can analyze the information in detail after the visitors leave.

Sufficient information is included in the medical records for students to infer that the disease is West Nile virus, even before the arrival of the overnight envelope. Teachers who have time to help students work through the process of analyzing the information and reaching a tentative conclusion should do so. Otherwise, use the arrival of the overnight letter as a way to narrow the focus of the students' discussion after their initial analysis of the situation.

A map of a local school could help students locate places where Sam might have come into contact with the disease. Google Maps is a good source for realistic maps, or you could elect to draw a map. Either way, make sure that a dumpster is included on the map to be consistent with the details of the opening scenario. Later in the unit, a map is used again when students plan their site assessment.

The Risk Thermometer appears several times throughout the unit so that students can track their changing attitudes toward the problem. Using the thermometer early in the unit is particularly important as preparation for the Too Risky? lesson later in the unit.

A blank Learning Issues Board is included in the Problem Log. This could be used for students to brainstorm ideas, as a means of keeping a personal copy of the class Learning Issues Board, or to record new ideas as the unit progresses.

Things to Do Before Class:

1. Read through the materials in the opening scenario, and consider what questions to ask to help students identify issues associated with the problem.
2. Download, print, and make copies of the Opening Scenario page, Meeting Minutes page, Review of Symptoms page, Exam Narrative page, and lab report forms.
3. Prepare an overnight mail envelope (available at any U.S. post office). It should be addressed to *Wilson County Public Health Department* from the *North Carolina Department of Health.* The package itself will be a source of information. Put the lab test results in the envelope before sealing it.
4. Prepare a map of a local school, either by finding one on the internet or by creating one yourself.
5. Prepare a blank Learning Issues Board for the class using a whiteboard, smartboard, or butcher paper for whole-class discussion.

Things to Do During Class:

1. Introduce the problem by handing out the opening scenario and copies of Sam Foss's medical file (Meeting Minutes, Review of Symptoms, Exam Narrative, and lab test request form). Have students read the opening scenario, and ask them what they think might be going on. Record some of their initial ideas on the Learning Issues Board.
2. Ask students to identify the most efficient way of going through the information, perhaps giving them a time limit. In small groups or as a class (depending on their choice), have them conduct a think-pair-share or similar activity in which they use the Notes page in their Problem Logs to record facts from the medical file that seem particularly important. They could also use the Learning Issues Board in their Problem Logs to record questions or hunches that come to mind.
3. As whole class, have students share what they know and what they want to know more about after reading the problem. Help them sort out and record information and questions into three categories on the class copy of the Learning Issues Board: What We Know, Learning Issues, and Plan of Action. As the students generate questions, ask them to discuss their hunches or the assumptions that they are trying to follow with their questions. Record their hunches on the top section of the Learning Issues Board.

Key Questions:

- *What do you think is going on in this situation?*
- *What hunches do you have about what might be going on?*
- *What is our role in this situation?*
- *What is an entomologist?*
- *What kind of issues might we be facing as medical entomologists in this problem?*
- *What can you tell from the way Sam's mother behaved?*

4. Students may guess that the disease is West Nile virus. If they do, treat this as a hunch, and ask them what evidence they have to support their speculation and what questions they would need to have answered to determine that the hunch is correct. Also introduce the notion that the media may have an impact on the way everyone—even doctors—think, and this may bias their thinking.

Key Questions:

- *What does the medical record tell us?*
- *What terminology do we need to investigate to understand the medical history?*
- *Which symptoms seem most important at this point?*
- *How confident are you that you have all the information you need?*
- *What questions do you have about Sam's symptoms? About Sam's family?*
- *Why do you suppose the school principal was at the meeting?*
- *What hunches do you have right now about Sam's disease?*
- *What terminology is unclear on the lab test request form? What clues are on that form?*
- *What influence do you think the media has on your thinking? What are the potential advantages and disadvantages of having your thinking influenced by the media?*

5. When the students seem to be running out of questions, introduce the overnight mail envelope containing the results of the lab tests, perhaps by having someone bring it to the classroom. Return to the Learning Issues Board, and update it based on the diagnosis, including a reassessment of the students' hunches.

Key Questions:

- *What new information did we get from the lab tests?*
- *Looking back, which information in our case file ended up being most important?*
- *Does the knowledge that Sam has West Nile virus end the problem for us?*
- *What questions can we take off of the Learning Issues Board?*
- *What new questions do you have now that we know the disease is West Nile virus?*

6. After the students have finished listing their Learning Issues, ask them to identify the two or three questions that they need to answer first in order to make progress on the problem. As a class, discuss the students' question rankings, and expand the list to four or five questions for the first round of research during Inquiry and Investigation.

Key Questions:

- *Which of these questions do we need to answer first?*
- *How can we find answers? Who could we ask? What should we look at?*
- *Look at the list of questions you selected, and make sure that these questions are the responsibility of medical entomologists. What do you think?*
- *Where else, other than the internet, could we get answers to some of these questions?*

7. Before class ends, introduce students to the Risk Thermometer as a means of assessing how "hot" or risky a problem seems. Ask the students to "take the temperature" of the situation as they understand it right now.
8. Have the students complete one of the Reflective Moments in their Problem Logs at the end of class or as homework.

Opening Scenario

What a morning! It's been a half an hour since the others left your office, and your head is still reeling. Your secretary has just brought you the meeting minutes, a hurried job since time could be a real factor. You flip through the pages of the report in front of you. The child's record, the pediatrician's list of symptoms, the school principal's history of the past few days, and an almost hysterical mother.... At least the pediatrician had enough sense to send for the right tests. In fact, the results were already supposed to be here. Of all days for the overnight delivery service to be late!

Yes, what a morning. But the rest of the day could be even worse.

Offices of the County Health Department
Medical Entomologist

Meeting Minutes

In attendance: Medical entomology team; Dr. Olsen, pediatrician; Mr. Wright, principal, Southwest Elementary School; Mrs. Joy Foss, mother of the patient

Meeting agenda: Diagnosis for Sam Foss

Attachments: Pediatrician's summary of symptoms, laboratory test request

The meeting convened at 8 a.m. at the request of Dr. Olsen, the pediatrician for the Foss child.

The meeting opened with a presentation of symptoms by Dr. Olsen (attached). Nine-year-old Sam Foss became ill with a fever and general lethargy approximately four days ago. His mother took him to Dr. Olsen at that point, and he was diagnosed with a mild flu and sent home. Twenty-four hours later, he spiked a high fever, and swollen lymph glands were observed. The child has not responded to any of the traditional treatments for cold, allergy, or common childhood viruses. He was admitted to the hospital yesterday morning. The night nurse reported a rash on his trunk and muscular weakness, leading Dr. Olsen to send a blood sample to the local lab and to request the current meeting.

Mr. Wright, principal at the Foss child's elementary school, reported that there were no unusual illnesses present at the school. Indeed, according to Mr. Wright, it has been an unusually mild fall for childhood illnesses.

Mr. Wright reported that the Foss child's teacher, Ms. Fox, noticed no unusual behavior from the boy. During a recent recess period, Foss had been playing with friends near an old dumpster but came away when called. Other than a few mosquito bites, there seemed to be no ill effects of his exploration. The Foss child fell during a recent kickball game and skinned the outside of his left leg, but the abrasion was limited to the surface and was immediately cleaned with Betadine and bandaged. No other incidents were noted. No report was made of fighting with other children or unusual encounters with animals.

Mrs. Foss was agitated throughout the meeting. She expressed frustration with her child's medical treatment to date. "He went to school Monday feeling a little bad but basically okay, and by 11:30 he was so sick that he had to be hospitalized!" she said. And later she stated, "FLU! You said it was the FLU! That's just crazy. His neck is swollen, his fever is still high, and now he's having trouble walking. None of his friends are sick. His sisters aren't sick. The dog isn't sick. The only sick animals within blocks were the stupid birds they were poking with a stick last week, and I told them to stop right away and wash their hands. None of the doctors seems to have a clue what to do for my son, and I have no idea why we're here talking to bug people!" She became even more agitated when the meeting ended with no concrete recommendations for her child's treatment.

Recommended actions: (1) Provide supportive services to the family, (2) review the child's medical history, and (3) continue to seek the source of the disease.

Wilson Pediatrics

Caring for Children and Families

Review of Symptoms

Physical Examination

Skin:	Normal
Head:	Symmetric
Eyes:	Conjunctive normal; extraocular movements are intact; pupils sensitive to light; funduscoeic-normal discs and vessels
Ears:	Normal
Nose:	Normal
Pharynx:	Normal
Neck:	Swollen lymph glands on both left and right
Lung:	Raspy
Cardiac:	S1 and S2 normal; no murmurs, rubs, or gallops; femorla, dorsalis pedis, and posterior tibial pulses are intact
Abdomen:	Pain
GI:	Nausea, vomiting, diarrhea
Extrem:	No clubbing or edema; tremors observed in left hand; left foot not reactive to pin prick
Neuro:	The patient has progressed from conscious to semi-conscious and is occasionally disoriented.

Assessment and Plan

1. The patient failed to respond to typical treatment for mononucleosis, flu, cold, strep, or other typical childhood diseases. The second assessment revealed a deterioration of symptoms, initiating a more aggressive investigation of the possible cause of the disease.
2. As soon as possible, make contact with medical entomologists.
3. Maintain palliative care until consultation is complete and special test results are received.

Wilson Pediatrics

Caring for Children and Families

Exam Narrative

Chief Complaint

Sam Foss was in for a return assessment after prior treatment for what was assumed to be flu or mononucleosis. Symptoms have increased in severity since that time, and the mother brought the child back in with concern over sustained high fever and signs of disorientation.

History of Present Illness

Sam first came into the office three days ago complaining of headache, lethargy, fever, and other flu-like symptoms. Traditional treatments for flu were prescribed at the time, along with penicillin to treat any possible development of strep associated with the flu. Tests for mono were negative.

Past Medical History

Sam has been unusually healthy child. He broke his arm in a biking accident at age six and had the usual childhood diseases, but mildly.

Family History

The family is also fairly healthy. Mother reports that father is on medication for high blood pressure. Maternal grandmother has a well-controlled case of diabetes. There is no history of sickle cell anemia in the family.

Social History

Sam is in grade four in a middle school in Wilson, North Carolina. His social adjustment at school and home are excellent, he has many friends, and he gets along well with his mother (who has custody) and his siblings. Sam sees his father twice a year and looks forward to the visits.

Arbovirus Case Report Form

When completed, fax or mail this form to:
Epidemiology and Response Division
1190 Franklin Way, Ste-1350
Cary, NC 27511
Phone: (919) 555-0006 Fax: (919) 555-0013

Case Status (Office of EPI Use Only):
☐ Confirmed
☐ Probable
☒ Suspect
☐ Asymptomatic Blood Donor

Date Received 02-23-2016 | Date Interviewed 02-22-2016 | NC-EDSS Number: HX-F120506

Arbovirus & Clinical Syndrome

☒ WNV ☐ CHKV ☐ DENV ☐ YFV ☐ Other:_____

☐ Asymptomatic ☐ Uncomplicated Fever ☐ Meningitis ☐ Encephalitis/Meningoencephalitis ☐ Hepatitis/Jaundice ☐ Unk
☐ Dengue ☐ Dengue-Like Illness ☐ Severe Dengue ☐ Multi-System Organ Failure ☐ Other Neuroinvasive ☐ Other Clinical

Patient Demographics

Patient Name (last, first): Foss, Sam

DOB: 12-05-2006 | Sex ☒ Male ☐ Female | Patient's Age 9 Years 2 Months

Phone Number (Home) (252) 555-2371 | Phone Number (Work) (252) 555-3847 | Phone Number (Cell) (252) 555-4492

Address (Street): 339 Sardis Way

Race: ☐ Am Indian/Alaskan native ☐ Asian/Pacific Islander ☐ White ☒ Black ☐ Unknown

Ethnicity: ☐ Hispanic ☐ Non-Hispanic

City: Wilson | County: USA | State: NC | ZIP: 27895

Parent/Spouse/Guardian Name (Last, First): Foss, Joy

Physician/Provider Name (Last, First): Olsen, Robert

Phone Number (Physician/Provider): (252) 555-7670

Laboratory Results

Blood or Serum		**Cerebral Spinal Fluid**	
Name of Laboratory		Name of Laboratory	
Date	**CBC results**	Date	**CSF results**
WBC Count	Leucopenia ☐ yes ☐ no	WBC Count	Leucopenia ☐ yes ☐ no
ELISA IgM	☐ positive ☐ negative ☐ equivocal	ELISA IgM	☐ positive ☐ negative ☐ equivocal
ELISA IgG	☐ positive ☐ negative ☐ equivocal	ELISA IgG	☐ positive ☐ negative ☐ equivocal
PCR or NAT	☐ positive ☐ negative ☐ equivocal	PCR or NAT	☐ positive ☐ negative ☐ equivocal
Hematocrit	Increasing ☐ yes ☐ no	PRNT	☐ positive ☐ negative ☐ equivocal
Platelets	Decreasing ☐ yes ☐ no		

Symptoms & Outcome

Symptomatic ☒ yes ☐ no ☐ unk	Onset Date 02-18-2016	Headache ☒ yes ☐ no ☐ unk
Acute Flaccid Paralysis ☐ yes ☒ no ☐ unk	Fever Temperature: ☒ yes ☐ no ☐ unk	Chills/Rigors ☒ yes ☐ no ☐ unk
Fatigue/Malaise ☒ yes ☐ no ☐ unk	Rash ☒ yes ☐ no ☐ unk	Conjunctivitis ☐ yes ☒ no ☐ unk
Nausea/Vomiting ☒ yes ☐ no ☐ unk	Diarrhea ☒ yes ☐ no ☐ unk	Myalgia ☒ yes ☐ no ☐ unk
Arthralgia ☐ yes ☒ no ☐ unk	Arthritis ☐ yes ☒ no ☐ unk	Paresis/Paralysis ☒ yes ☐ no ☐ unk
Stiff Neck ☒ yes ☐ no ☐ unk	Ataxia ☐ yes ☒ no ☐ unk	Parkinsonism/ Cogwheel Rigidity ☐ yes ☒ no ☐ unk
Altered Mental Status ☒ yes ☐ no ☐ unk	Seizures ☐ yes ☒ no ☐ unk	Retro-Orbital Pain ☐ yes ☒ no ☐ unk
Tourniquet Test Positive ☐ yes ☐ no ☒ unk	Abdominal Pain/ Tenderness ☒ yes ☐ no ☐ unk	Persistent Vomiting ☒ yes ☐ no ☐ unk
Extravascular Fluid Accumulation ☐ yes ☒ no ☐ unk	Mucosal Bleeding ☒ yes ☐ no ☐ unk	Liver Enlargement ☒ yes ☐ no ☐ unk
Severe Plasma Leakage ☐ yes ☐ no ☒ unk	Severe Bleeding ☐ yes ☒ no ☐ unk	Severe Organ Involvement ☐ yes ☒ no ☐ unk
Other Symptoms		Serotype (Dengue Only) ☐ DEN-1 ☐ DEN-2 ☐ DEN-3 ☐ DEN-4

Patient's Name	Foss, Sam		DOB 12-05-2006
Hospitalized ☒ yes ☐ no ☐ unk		Name of Hospital Wilson Regional Hospital	
Date of Admit 02-20-2006		Date of Discharge 02-22-2006	☒ Survived ☐ Died
Date of Death		Autopsy Performed ☐ yes ☐ no ☐ unk	Date of Autopsy

Risk Factors for Infection

Does the patient report mosquito bites in the two weeks before illness onset? ☒ yes ☐ no ☐ unk
If yes, where and when

Patient's teacher reported child playing near dumpster on school grounds at recess; mosquito bites observed afterward

Did the patient travel outside his/her home county, state or country in the two weeks before illness onset? ☐ yes ☒ no ☐ unk
If yes, destination(s) and dates spent (at each)

Did the patient receive any blood products or organs in the month before illness began? ☐ yes ☒ no ☐ unk
Date received Product type

Did the patient donate any blood products or organs in the month before illness began? ☐ yes ☒ no ☐ unk
Date donated Product type

Is the patient pregnant? ☐ yes ☒ no ☐ unk	Due date or date of delivery
Is the patient a breast fed infant? ☐ yes ☒ no ☐ unk	Infected in utero ☐ yes ☒ no ☐ unk

Interviewer Information

Interviewer Name no interview, from file	Interviewer Phone

Comments

Arbovirus Case Report Form

When completed, fax or mail this form to:
Epidemiology and Response Division
1190 Franklin Way, Ste-1350
Cary, NC 27511
Phone: (919) 555-0006 Fax: (919) 555-0013

Case Status (Office of EPI Use Only):
☒ Confirmed
☐ Probable
~~☒ Suspect~~
☐ Asymptomatic Blood Donor

Date Received 02-23-2016 | Date Interviewed 02-22-2016 | NC-EDSS Number: HX-F120506

Arbovirus & Clinical Syndrome

☒ WNV ☐ CHKV ☐ DENV ☐ YFV ☐ Other:_____

☐ Asymptomatic ☐ Uncomplicated Fever ☐ Meningitis ☐ Encephalitis/Meningoencephalitis ☐ Hepatitis/Jaundice ☐ Unk
☐ Dengue ☒ Dengue-Like Illness ☐ Severe Dengue ☐ Multi-System Organ Failure ☐ Other Neuroinvasive ☐ Other Clinical

Patient Demographics

Patient Name (last, first): Foss, Sam

DOB 12-05-2006 | Sex ☒ Male ☐ Female | Patient's Age 9 Years 2 Months

Phone Number (Home) (252) 555-2371 | Phone Number (Work) (252) 555-3847 | Phone Number (Cell) (252) 555-4492

Address (Street): 339 Sardis Way

Race: ☐ Am Indian/Alaskan native ☐ Asian/Pacific Islander ☐ White ☒ Black ☐ Unknown

Ethnicity: ☐ Hispanic ☐ Non-Hispanic

City: Wilson | County: USA | State: NC | ZIP: 27895

Parent/Spouse/Guardian Name (Last, First): Foss, Joy

Physician/Provider Name (Last, First): Olsen, Robert

Phone Number (Physician/Provider): (252) 555-7670

Laboratory Results

Blood or Serum		Cerebral Spinal Fluid	
Name of Laboratory		Name of Laboratory	
Date	**CBC results**	Date	**CSF results**
WBC Count	Leucopenia ☐ yes ☐ no	WBC Count	Leucopenia ☐ yes ☐ no
ELISA IgM	☒ positive ☐ negative ☐ equivocal	ELISA IgM	☐ positive ☐ negative ☐ equivocal
ELISA IgG	☒ positive ☐ negative ☐ equivocal	ELISA IgG	☐ positive ☐ negative ☐ equivocal
PCR or NAT	☒ positive ☐ negative ☐ equivocal	PCR or NAT	☐ positive ☐ negative ☐ equivocal
Hematocrit	Increasing ☐ yes ☐ no	PRNT	☐ positive ☐ negative ☐ equivocal
Platelets	Decreasing ☐ yes ☐ no		

Symptoms & Outcome

Symptomatic ☒ yes ☐ no ☐ unk	Onset Date 02-18-2016	Headache ☒ yes ☐ no ☐ unk
Acute Flaccid Paralysis ☐ yes ☒ no ☐ unk	Fever Temperature: ☒ yes ☐ no ☐ unk	Chills/Rigors ☒ yes ☐ no ☐ unk
Fatigue/Malaise ☒ yes ☐ no ☐ unk	Rash ☒ yes ☐ no ☐ unk	Conjunctivitis ☐ yes ☒ no ☐ unk
Nausea/Vomiting ☒ yes ☐ no ☐ unk	Diarrhea ☒ yes ☐ no ☐ unk	Myalgia ☒ yes ☐ no ☐ unk
Arthralgia ☐ yes ☒ no ☐ unk	Arthritis ☐ yes ☒ no ☐ unk	Paresis/Paralysis ☒ yes ☐ no ☐ unk
Stiff Neck ☒ yes ☐ no ☐ unk	Ataxia ☐ yes ☒ no ☐ unk	Parkinsonism/ Cogwheel Rigidity ☐ yes ☒ no ☐ unk
Altered Mental Status ☒ yes ☐ no ☐ unk	Seizures ☐ yes ☒ no ☐ unk	Retro-Orbital Pain ☐ yes ☒ no ☐ unk
Tourniquet Test Positive ☐ yes ☐ no ☒ unk	Abdominal Pain/ Tenderness ☒ yes ☐ no ☐ unk	Persistent Vomiting ☒ yes ☐ no ☐ unk
Extravascular Fluid Accumulation ☐ yes ☒ no ☐ unk	Mucosal Bleeding ☒ yes ☐ no ☐ unk	Liver Enlargement ☒ yes ☐ no ☐ unk
Severe Plasma Leakage ☐ yes ☐ no ☒ unk	Severe Bleeding ☐ yes ☒ no ☐ unk	Severe Organ Involvement ☐ yes ☒ no ☐ unk
Other Symptoms		Serotype (Dengue Only) ☐ DEN-1 ☐ DEN-2 ☐ DEN-3 ☐ DEN-4

Patient's Name	Foss, Sam		DOB	12-05-2006
Hospitalized	☒ yes ☐ no ☐ unk	Name of Hospital	Wilson Regional Hospital	
Date of Admit	02-20-2006	Date of Discharge	02-22-2006	☒ Survived ☐ Died
Date of Death		Autopsy Performed	☐ yes ☐ no ☐ unk	Date of Autopsy

Risk Factors for Infection

Does the patient report mosquito bites in the two weeks before illness onset? ☒ yes ☐ no ☐ unk
If yes, where and when

Patient's teacher reported child playing near dumpster on school grounds at recess; mosquito bites observed afterward

Did the patient travel outside his/her home county, state or country in the two weeks before illness onset? ☐ yes ☒ no ☐ unk
If yes, destination(s) and dates spent (at each)

Did the patient receive any blood products or organs in the month before illness began? ☐ yes ☒ no ☐ unk
Date received Product type

Did the patient donate any blood products or organs in the month before illness began? ☐ yes ☒ no ☐ unk
Date donated Product type

Is the patient pregnant? ☐ yes ☒ no ☐ unk	Due date or date of delivery
Is the patient a breast fed infant? ☐ yes ☒ no ☐ unk	Infected in utero ☐ yes ☒ no ☐ unk

Interviewer Information

Interviewer Name	no interview, from file	Interviewer Phone	

Comments

West Nile virus confirmed

Notes Page

Directions: Use this space to list up to 10 facts that seem important to this problem. Also make note of questions that come to mind as you read, especially information that seems to be missing from this account that would help you understand the problem better.

1. _____

_____

2. _____

_____

3. _____

_____

4. _____

_____

5. _____

_____

6. _____

_____

7. _____

_____

8. _____

_____

9. _____

_____

10. _____

_____

Learning Issues Board

Hunches:

What We Know	Learning Issues	Plan of Action

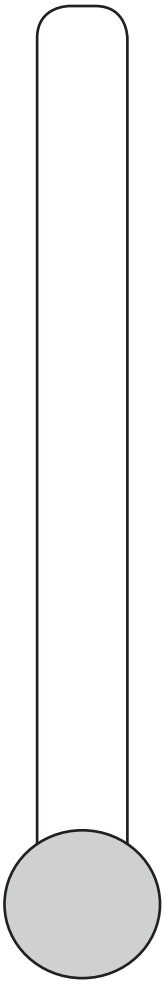
Risk Thermometer

Directions: Mark the place on the thermometer that indicates how risky the situation seems to you right now. A higher temperature indicates greater risk. To determine the risk rating, think about:

- *Factors that make a situation more risky or less risky*
- *Facts you know about this situation right now*

Use facts from the case to justify your risk rating on the lines below.

Grading criteria: (1) Multiple reasons are provided to explain the risk rating, (2) ideas are consistent with the rating, (3) the facts provided are accurate, and (4) the opinions provided are justified.



HIGH Risk

MODERATE Risk

LOW Risk

What Do Medical Entomologists Do?

Medical entomologists study diseases that are transmitted by insects and arthropods. Professionals in this field conduct research on how insect-borne diseases enter and take hold in a community. They consider insect and human behavior and identify *vectors* and *hosts* that allow disease to be transferred from insects to humans, and sometimes to other animals as well.

Medical entomologists are research scientists, not physicians. However, they do participate in public health projects and provide information to communities about the risk of insect-borne diseases. They are sometimes involved in the development of public policy, helping state and local officials develop recommendations, rules, and regulations to keep the public safe from disease.

Medical entomologists find jobs at universities, in private companies, or in local, state, or government agencies. The military hires medical entomologists to protect troops from insect-borne diseases in foreign lands. There have been many times in military history when more people have died from insect-related diseases than from actual combat, leading historian Hans Zinsser to say, "Soldiers have rarely won wars. They more often mop up after the barrage of epidemics. And Typhus, with its brothers and sisters—plague, cholera, dysentery—has decided more campaigns than Caesar, Hannibal, Napoleon, and all the inspector generals of history."*

* Zinsser, H. (1935). *Rats, lice, and history*. Boston: Little, Brown, & Co.

Examples of Diseases Transferred by Bugs

Ticks

- Lyme disease
- Tick-borne encephalitis
- Relapsing fever
- Heartland virus disease
- Rocky Mountain spotted fever

Mosquitoes

- Dengue fever
- Yellow fever
- Malaria
- West Nile virus
- Eastern equine encephalitis
- Zika virus

Sandflies

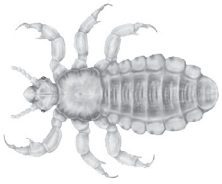
- Sandy fever
- Leishmaniasis

Fleas

- Plague
- Typhus

Lice

- Trench fever



Reflective Moment: **Sam Foss, Option A**

Look at the list of questions on the Learning Issues Board. Identify one question that is particularly important to you in your role as a medical entomologist. Explain why it is important. If you think there is an important question missing from the Learning Issues, list it below, and justify why it should be added to the list.

A quality response: (1) addresses the question, (2) stays on topic, (3) is plausible or reasonable, and (4) gives enough detail to make your ideas clear.

✎ Problem Log

Reflective Moment: **Sam Foss, Option B**

> Based on what you understand so far, who is at risk in this problem? Consider who might be *directly* at risk and who might be *indirectly* at risk. What is the difference between those directly and indirectly at risk? What relationships do they share?

A quality response: (1) addresses the question, (2) stays on topic, (3) is plausible or reasonable, and (4) provides facts to support and clarify your ideas.

Sample Learning Issues Board

Hunches:

Sam did not catch this from someone at school. He got the disease from some kind of bug or animal. The disease can't be passed from person to person.

What We Know	Learning Issues	Plan of Action
• Sam got sick suddenly. His mom is very upset. • Some drugs have been tried but didn't work. A blood sample has been sent somewhere. • We are medical entomologists. • Sam was playing near a dumpster. He scratched himself while playing. • He doesn't seem to have a common illness. • He poked a sick bird with a stick. • He has a fever, swollen lymph glands, and disorientation. --- (After students receive test results) • Sam has West Nile virus.	• What is an entomologist? Why did the Health Department send information to us? • Where was the blood sample sent? What could have bitten Sam? • Who else might be sick? • Is Sam's father sick? • Where is the dumpster? What was in it? • Did Sam touch the sick bird? --- (After students receive test results) • **What is West Nile virus?** • **How do people get West Nile virus?** • Is it contagious? • **How do you cure West Nile virus?** • How can we keep others from getting it? • Is there still time to save Sam? • **Where did Sam get West Nile virus?** • What is a lymph gland, and why is it important? • Do all mosquitoes carry West Nile virus?	• Go to the library, and read about West Nile virus. • Call a doctor to ask about viruses. • Look up terminology online. • Ask the school nurse about viruses. • Check the symptoms on the internet.

** Questions in bold represent students' top priorities for research.*