SICK!: TEACHER GUIDE

Subject: Life Science
Grade Level: Middle School
Last Updated: October 26, 2007

Case Summary

A young woman is suddenly stricken with gastro-intestinal distress and fatigue, and as time goes on she realizes she's not the only one. Is this a simple case of food poisoning, or a full-blown outbreak?

Credits

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Giardia image courtesy of CDC/Janice Carr, and is available from the Public Health Image Library at the Centers for Disease Control, http://phil.cdc.gov, image #8698.

Learning Objectives

At the end of the case, students will be able to:

1. Identify the organs of the digestive tract and describe and what each organ does.
2. Define diarrhea and list common causes. Distinguish between pathogenic and nonpathogenic causes of diarrhea.
3. Explain how diarrhea and dehydration are related. Discuss how this connection relates to the medical advice given for managing / treating diarrhea.
4. Define the following terms: pathogen, infection, outbreak, parasitic disease, food poisoning, sanitation.
5. Identify common diarrhea-causing water-borne pathogens in the U.S. and how people typically get infected.
6. Identify common pathogens that cause food poisoning in the U.S. and how people typically get infected.
7. List general recommendations to prevent food poisoning and waterborne diseases. Evaluate the effectiveness of these recommendations.
8. Properly use a microscope to identify organisms in a water sample.
9. Correctly identify organisms in a water sample (pond protests) using a taxonomic key.
10. Research specific organisms and make judgments about the ability of the organisms to be pathogenic.

11. Characterize members of the protist kingdom (plant-like vs. animal like), methods of locomotion, reproduction, and obtaining / using energy.
12. Work together to generate hypotheses and learning issues.
13. Distinguish between data, hypothesis, questions relevant to the case and learning issues.
14. Research learning issues using a variety of appropriate references.
15. Report research findings in a clear and organized manner.
16. Create and follow rules for working on the case as a group.
17. Evaluate the effectiveness of the group (and themselves) in working through the case, researching the learning issues, and learning about the different issues that came up during the course of the case.

Georgia Performance Standards

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science. (NSES Content Standard A, G).

b. Recognize that different explanations often can be given for the same evidence.

c. Explain that further understanding of scientific problems relies on the design and execution of new experiments which may reinforce or weaken opposing explanations

SCSh6. Students will communicate scientific investigations and information clearly. (NSES Content Standard G)

d. Participate in group discussions of scientific investigation and current scientific issues

SCSh8. Students will understand important features of the process of scientific inquiry. (NSES Content Standard A, G)

c. Scientists use practices such as peer review and publication to reinforce the integrity of scientific activity and reporting.

e. The ultimate goal of science is to develop an understanding of the natural universe which is free of biases.

f. Science disciplines and traditions differ from one another in what is studied, techniques used, and outcomes sought.

SCSh9. Students will enhance reading in all curriculum areas by:

a. Reading in all curriculum areas

c. Building vocabulary knowledge

d. Establishing context.

S7L1. Students will investigate the diversity of living organisms and how they can be compared scientifically. (NSES Content Standard C)

a. Demonstrate the process for the development of a dichotomous key.

b. Classify organisms based on physical characteristics using a dichotomous key of the six kingdom system (archaebacteria, eubacteria, protists, fungi, plants, and animals).

S7L2. Students will describe the structure and function of cells, tissues, organs, and organ systems. (NSES Content Standard C)

a. Explain that cells take in nutrients in order to grow and divide and to make needed materials.

b. Relate cell structures (cell membrane, nucleus, cytoplasm, chloroplasts, mitochondria) to basic cell functions.

c. Explain that cells are organized into tissues, tissues into organs, organs into systems, and systems into organisms.

d. Explain that tissues, organs, and organ systems serve the needs cells have for oxygen, food, and waste removal.

e. Explain the purpose of the major organ systems in the human body (i.e., digestion, respiration, reproduction, circulation, excretion, movement, control, and coordination, and for protection from disease).

National Science Education Standards (NSES), Content Standard F: As a result of activities in grades 9-12, all students should develop understanding of

- Personal and community health
- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

Assessment

1. Self and group evaluation listing and describing their own and their group members' contribution in identifying and addressing learning issues. (*see Self/Group Evaluation form in Student Materials*)
2. Lab observations worksheets and Table of Characteristics/Taxonomic Key (*see Student Materials*)
3. Create an education pamphlet describing the water borne disease of their choice. The pamphlet should include information on the pathogenic organism (bacteria, virus, protest), a picture if available, characteristics of the organism, symptoms of infection, treatment regimes, frequency (incidence) in the U.S., and prevention measures.

Implementation Strategy

Previous Knowledge/Skills: Students should be able to use a dictionary, search the Internet, find information in an encyclopedia, use the index of textbooks, and read on a 5th grade level. Students should have some familiarity with the digestive system (elementary level), some fundamental knowledge that organisms cause disease and that allergies are not caused by a disease but by the body's own actions is helpful. Distinguishing between viruses, bacteria and simple protists (simplicity vs complexity) would also help but is not necessary as it is covered in the case.

The case falls during or after the unit on bacteria/viruses/protists. Each day will encompass a 55-minute class period. Students should be broken up into groups of 4-5.

Day 1 — Scenes 1-3. Students will identify important data in the case, ask questions specific to the case and generate hypotheses and learning issues to research. Each student will then be assigned one or two learning issues to research. It is better if students share a learning issue to cover bases in case things are not researched thoroughly

Days 2 - 3 — Research days. Allow the students to have library time to research their learning issues from Day 1. Students should prepare a written summary of

their learning issue and be prepared to discuss their findings and answer questions on Day 4. The written summary should contain references and handouts for other students would be helpful though not necessary.

Day 4 — Discussion of learning issues (LIs). Review the case data and hypotheses and discuss how the LIs are applicable to the case. Students can then evaluate hypotheses and determine which to eliminate and which to keep based on their findings.

Day 5 — Lab day. Students will receive Scene 4 and will learn skills in class. What pathogenic means and what the CDC is could be a homework assignment or a classroom discussion. Discussion of scene 4 and the lab instructions should take about 7 minutes total and then students can spend the rest of the class period on the identification lab.

Day 6 — Wrap-up day. Spend about 5-7 minutes reviewing the case and what is known to date. Students will then receive Scenes 5✦ and 6 and 7. Scene 5 should take about 7 minutes, Scene 6 should take 5-10 minutes, and Scene 7 should take 5 minutes. The rest of the time (20 minutes) should be spent addressing any other learning issues, student objectives and whether the students know them and finally evaluations of self and group dynamics. If any of the learning objectives are not met, the students are to all research the objectives that they do not know. Extra credit learning issues may also be provided. Work on pamphlets may begin here or the following day.

Day 7-8 — Work on pamphlets and present final products to class.

Case Notes

This was the first true PBL case that we did with the students. Overall, I think the students got very excited about this case and were motivated to learn. I think however, they were frustrated with having to do research, especially when the resources weren't user-friendly (i.e., not written at their level).

Some good points about the case:

1. Students seemed to enjoy the subject and stayed interested and enthused throughout the case – in other words, we had a good story line.
2. Students were engaged in discussion and on task during the large majority of the time, students were able to generate the learning issues without much prompting by facilitators – in other words, the story invited the identification of learning issues.

✦ *Scene 5 contains an image of the Giardia protozoa and refers students to look in their textbooks to find out what organism it is. If a similar image cannot be found in your science textbook, use the alternate version of Scene 5 (provided on page 11 of this document), which directs students to find the image on the CDC web site in order to identify the organism.*

3. Students worked well in the PBL system. They enjoyed generating hypotheses and learning issues and worked well to keep everyone in their group up to speed.
4. I had less behavior problems with this case than with any other case.

Some points for improvement:
1. We had groups that were too big: 5-6 students is too many for middle school.
2. Students were not motivated to do their learning issue research – I believe there were problems on several fronts here… there were no consequences enforced for not doing the research, Internet resources were cumbersome because there were a limited number of computers and the school system's firewall often blocked key websites.
3. A system of organizing student information was needed so that students could keep up with their data, hypothesis, learning issues, and questions and their reports and so that the teacher could easily grade the students work throughout the case.

What we learned from this case that we applied to subsequent cases.
1. Smaller groups – 4 per group is ideal. We also want to play around with the idea of single sex groups.
2. Creating a grading system for the case so that students are aware, from the beginning what is required of them to help with motivation to do learning issue research, student product, and evaluation work.
3. Creating a notebook system that could aid with organization and grading… the notebook system contained a rubric that students could use.
4. More preparation for research days is needed before students are set loose. Librarians need to be involved in the case – to pull books, to organize websites, to create quick links, and to provide help to students with the research process.
5. It may also be beneficial to have an extra pair of hands (parent, media specialist, other school staff, university partners) available to help on research days.
6. We created a self / group evaluation rubric and a notebook rubric that we will continually modify for future use

Facilitator Guide

Contents of a Boxchart for Case Analysis

1. *Data*: Students record all *important or relevant facts/data from the case* on the "data" quadrant of the boxchart (large poster board or piece of paper that is hung on a wall or draped on a table if no available wall) – this is all information that is needed or is considered important that is taken directly from the case
2. *Questions*: Students will record all case-specific questions on the "questions" quadrant of the boxchart. These are questions you might ask the characters in the scene, or the author of the scene, but they are questions to which you could research the answers on your own (contrast with Learning Issues, below). For example, the students may wonder how old a character is, or where the case is taking place, or what is the homelife of the main character? These are specific questions that may or may not be answered in upcoming scenes. Probing students as to what they are thinking when they ask certain questions may lead them to generate more broad hypotheses.
3. *Hypotheses*: Students will use the data and questions to generate hypotheses about what is going on in the case. These will be recorded in the "hypotheses" quadrant of the boxchart.
4. *Learning Issues*: Questions to which the student could find the answer through research are considered learning issues. These are written on the "learning issues" quadrant of the boxchart. Learning issues typically address case objectives and students are often guided by the facilitator to arrive at them. Examples: What causes diarrhea? What are the organs of the digestive tract? How do you treat giardia? These are questions that most likely will not be answered by the text of the case and can be researched by the student. Students will choose specific learning issues to research and present on (to the rest of the team).

Topics (other than the learning objectives) that might come up due to the nature of this case.

1. Past illnesses, symptoms, causes of team members – students will want to talk about their own experiences with illness / food poisoning / water poisoning etc.
2. Students my make the leap that Shelby contracted the illness from her friend Carly or her roommate and issues of homosexuality may come up. Clarifying how diarrheal diseases are transmitted may keep students on-task
3. Religious issues surrounding food preparation and handling – traditional meals and eating customs or holidays may be brought up… i.e. – keeping kosher to prevent disease, fasting during certain times of the year.
4. Prevention of foodborne and waterborne diseases – students will tend to talk with experience here.
5. Issues of why people get sick / disease transmittance based on morality, religion, poverty – students may have preconceived notions as to who gets sick and why due to parental, cultural, religious beliefs.
6. Appropriate hygiene / sanitation? This could be a sensitive topic for students going through puberty and may be a way for students to tease each other.

Facilitator Guide: Day 1 (Scenes 1-3)

Scene 1

Facilitation: 15 minutes. Let the students come up with data, hypotheses, questions and learning issues

Possible learning issues:

- Define diarrhea and list common causes;
- Disorders of the digestive system / learn organs and functions
- What is food poisoning and how can it be contracted / prevented

DATA	LEARNING ISSUES & QUESTIONS
Symptoms (dizzy, fatigue, watery diarrhea)	What did Shelby eat for lunch
Gets sick after lunch	What types of things cause watery diarrhea
Thinks its something she ate in the cafeteria	Is it contagious
Friend at Georgia Southern is also sick	Do Shelby and her friend go to same school? Have they been around each other recently
Beginning of school (fall)	What is the physiology of diarrhea
Thursday after school starts	

Scene 2

Facilitation: 20 minutes

Potential learning issues:

- Food poisoning vs. Food allergies
- Contagious sickness
- How diarrhea and dehydration are related
- Define normal temperature, blood pressure, and heart rate for the human body

DATA	LEARNING ISSUES & QUESTIONS
Shelby is at GSU	Are the vitals normal (HR, Temp, BP)
Fatigued with diarrhea	What causes skin symptoms (what determines skin elasticity)
2 days since first episode	What causes dry mouth
Visits health center	What types of foods are associated with food poisoning outbreaks
roommate doesn't appear sick yet	What are common pathogens responsible for food poisonings
She is 18 or so (freshman)	Are other students at the school sick
All symptoms from Doctor's report	
What she ate the day the diarrhea started	

Scene 3

Facilitation: 20 minutes (include about 10 minutes assigning learning issues and make sure students jot down their research learning issues in their lab notebook.

Potential learning issues:

- How to clean water: filtering, adding iodine tablets, boiling, etc
- What a stool sample can test for (tentative)
- What IV fluids are and what they are used for (tentative)
- What types of diseases can you get from drinking unfiltered water?
- Identify common diarrhea causing water-borne diseases in the US and how people typically get infected

DATA	LEARNING ISSUES & QUESTIONS
No other students sick on campus	What type of pathogens are in stream water
Drank from stream on hiking trip	What types of things can you learn from a stool sample
Hiking trip was one weekend before school started	Why does she need IV fluids?
Hiking trip was in North Georgia	

Prompts (for facilitators to use in guiding students towards key topics or avenues of inquiry):

- What system of the body is involved in diarrhea?
- What are possible causes of diarrhea?
- What is an allergy?
- What is food poisoning?
- What is a food allergy?
- Which system of the body fights infections?
- What does it mean for something to be infectious or contagious?

Potential hypothesis generated: She got infected drinking unfiltered water with a pathogen

Learning Issues to be researched:

1. What is diarrhea? What is its physiology and causes? How does watery diarrhea differ from other types of diarrhea?
2. Are Shelby's vitals (temp, HR, BP) normal for a person her age?
3. What do her skin symptoms mean and how do her skin symptoms relate to diarrhea?
4. What types of foods are typically associated with food poisoning?
5. What are common pathogens associated with food poisoning? What are their symptoms?
6. How can food poisoning be prevented?
7. What types of pathogens can you be contaminated with if you drink unclean water? What are their symptoms?
8. How can you prevent a waterborne disease?
9. How is a stool sample performed? What types of things can you learn from a stool sample in this setting? What's in IV fluids and what are their purposes?

Facilitator Guide: Days 2/3

Prompts (for facilitators to use in guiding students towards key topics or avenues of inquiry):

- What are examples of valid research sources?
- What is the best way to present my findings to my group?
- How do I summarize / organize my research findings so that I can give a 5 minute talk to my group?

Facilitator Guide: Day 5 (Scene 4 and Lab)

Scene 4

Facilitation: 7 minutes—classroom discussion or class assignment

Learning Issues / Discussion:

- What is the CDC
- Define pathogenic
- Distinguish between pathogenic and nonpathogenic causes of diarrhea

Lab

Facilitation: 45 minutes—students work in groups of 2 or 3 (split previous groups)

Potential learning issues / things to cover:

- How to use a microscope to identify cellular organisms
- How to identify giardia under a microscope and by looking at pictures
- How to use a taxonomic key
- Identify and classify aquatic organisms, specifically members of the plant, fungus and protist kingdom (using a taxonomic key when looking under the scope) and which ones are pathogenic

Prompts (for facilitators to use in guiding students towards key topics or avenues of inquiry):

- How do I prepare a wet mount slide?
- How do I change magnifications on a microscope?
- What is the range of magnification on a light microscope?
- What are protists? How are protists distinguished from each other?
- What are the different ways protists can move / eat / reproduce?
- Are protists single-celled or multicellular?
- What characteristics make protists either plant-like or animal-like?
- What are three examples of animal like protists and three examples of plant-like protists?
- Protists don't have organs… which parts of their "body" perform the following functions? Brain, movement (locomotion), food / energy processing, excretion, creating new proteins / parts?

Facilitator Guide: Day 6 (Scenes 5-7)

Scene 5

Facilitation: 7 minutes

- **NOTE:** Scene 5 contains an image of the Giardia protozoa. If a similar image cannot be found in your science textbook, use the alternate version of Scene 5 (provided on the next page), which directs students to find the image on CDC's web site in order to identify the organism.
- Discuss characteristics that can be seen (how complex does it look – is it a virus, bacteria, or protist and how can they tell -- how does it move, how do they think it eats, etc.)
- Discussing characteristics will help the students know where to look in their textbooks to find a picture.

Scene 6

Facilitation: 7 minutes: Discuss, define any new terms

Scene 7

Facilitation: 10 minutes –

- Discuss potential extra credit learning issues: prevention and treatment of giardia
- Discuss pamphlets, let students choose pamphlet to create
- Discuss learning objectives (consider handing them out to students)

Prompts (for facilitators to use in guiding students towards key topics or avenues of inquiry):

- How do protists, bacteria, and viruses differ from each other?
- What types of things do they have in common?
- What is a pathogenic organism?
- What is a parasite?
- What is a host?

Sick!: Scene 5

Shelby's condition is worsening and the doctor needs to know the pathogenic organism so that he can prescribe the correct medication. A member of your group has isolated a suspicious organism under the microscope and has prepared a photograph for you to use:

some kind of protozoan parasite? Check CDC PHIL website

Group Participation Evaluation Form

The following form is to be completed by the facilitator, using the student evaluations and the facilitator's observations. SS = student self-evaluation score (if any); Peer Eval score = scores the student received by their peers (list all separately or the average); Facilitator score = the score the facilitator gives each student (scale of 1-5 based on score criteria provided to students).

Facilitator: _____ Class Period

Case Name: _____

DATE: _____ DAY _____

Student Name	_____	_____	_____	_____	_____
SS Eval Score	_____	_____	_____	_____	_____
Peer Eval Score	_____	_____	_____	_____	_____
Facilitator Score	_____	_____	_____	_____	_____

Comments _____

_____

_____

_____

DATE: _____ DAY _____

Student Name	_____	_____	_____	_____	_____
Self Eval Score	_____	_____	_____	_____	_____
Peer Eval Score	_____	_____	_____	_____	_____
Facilitator Score	_____	_____	_____	_____	_____
Learning Issues	_____	_____	_____	_____	_____

Comments _____

_____

_____

_____

DATE: _____ DAY _____

Student Name _____ _____ _____ _____ _____

Self Eval Score _____ _____ _____ _____ _____

Peer Eval Score _____ _____ _____ _____ _____

Facilitator Score _____ _____ _____ _____ _____

Learning Issues _____ _____ _____ _____ _____

Comments _____

_____

_____

_____

Please use the rest of this space to comment on the team and the case in general (how the team handled the case material; how the case went; what could have been improved in team performance, etc.):

Resources

Diarrhea facts

eCureMe, Inc. (2003). Diarrhea. Retrieved June 22, 2007 from http://www.ecureme.com/emyhealth/data/Diarrhea.asp

Waterborne diseases

United States Environmental Protection Agency. (2006). Drinking water and health: What you need to know. Retrieved June 22, 2007 from http://www.epa.gov/ogwdw000/dwhealth.html

Massachusetts Water Resources Authority. (n.d.). Lesson 10: Diseases and their pathogens. Retrieved June 22, 2007 from http://www.mwra.state.ma.us/germs/germ10.htm

Massachusetts Water Resources Authority. (n.d.). Lesson 6: What is water's role? Retrieved June 22, 2007 from http://www.mwra.state.ma.us/germs/germ6.htm

Massachusetts Water Resources Authority. (n.d.). Lesson 7: What can water suppliers do? Retrieved June 22, 2007 from http://www.mwra.state.ma.us/germs/germ7.htm

Waterborne Disease Center. (2002). Fact sheet series: Microbes in drinking water. Retrieved June 22, 2007 from http://www.waterbornediseases.org/FactSheets/microbes.htm

Food allergies

eHealthMD.com. (2002). Digestive health: What is food allergy & food intolerance? Retrieved June 22, 2007 from http://health.yahoo.com/health/centers/digestive/126.html

Food poisoning

Shuman, T. C. (2005). Health and diet: Understanding food poisoning – the basics. Retrieved June 22, 2007 from http://my.webmd.com/content/healthwise/59/14622

Centers for Disease Control and Prevention, Division of Bacterial and Mycotic Diseases. (2005). Foodborne illness. Retrieved June 22, 2007 from http://www.cdc.gov/ncidod/dbmd/diseaseinfo/foodborneinfections_g.htm

Food and Drink Federation. (2002). Foodlink: Your complete guide to food safety. Retrieved June 22, 2007 from http://www.foodlink.org.uk/default.asp

Digestive System

Dowshen, S. (2007). KidsHealth for kids: The real deal on the digestive system. Retrieved June 22, 2007 from http://www.kidshealth.org/kid/body/digest_SW.html

Giardia Info

Centers for Disease Control and Prevention, Division of Parasitic Diseases. (2004). Fact sheet: Giardiasis. Retrieved October 26, 2007 from http://www.cdc.gov/ncidod/dpd/parasites/giardiasis/factsht_giardia.htm

Centers for Disease Control and Prevention. (2005). Public health image library. Retrieved October 26, 2007 from http://phil.cdc.gov