CDC Science Ambassador Workshop
2014 Lesson Plan

I Have a Gut Feeling . . .
E. coli O157:H7 Case Study

Developed by

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E. coli O157:H7 Case Study

Summary

The first step in the approach to addressing public health problems is to identify and define the problem. Epidemiologists, or Disease Detectives, routinely use surveillance data to identify public health problems. Surveillance is defined as the "ongoing, systematic collection, analysis, and interpretation of health data essential to the planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination to those who need to know.[1]"

This lesson plan demonstrates how surveillance can be used by epidemiologists to identify and define an outbreak or public health problem. Students will gain a basic understanding of public health surveillance terminology, systems, and applications. They also will have an opportunity to apply their knowledge in analyzing data from a case study of an outbreak of *Escherichia coli* infections. At the end of the lesson, students should have a stronger understanding of public health surveillance and its application in monitoring and ending outbreaks.

Figure 1: The symbol for CDC's Epidemic Intelligence Service (EIS), a 2-year postgraduate training program of service and on-the-job learning for health professionals interested in the practice of applied epidemiology. EIS officers, or Disease Detectives, provide service to public health and respond to urgent or emergent public health problems domestically and internationally.

This material is suitable for use in high school epidemiology, statistics, or biology classes and can be included as part of a lesson on epidemiology, public health, bacteria or foods and nutrition. Students should possess basic charting and graphing skills as well as a basic understanding of epidemiology, bacteria, and human biology.

Learning Outcomes

After completing this lesson, students should be able to

- identify priority health-related phenomena and determine which type of public health surveillance system (e.g., passive, active, and syndromic) would be used to collect data;
- use the appropriate models (e.g., charts, figures, graphs, or maps), on the basis of limitations and merits, to identify patterns in surveillance data and associations by person, place, or time; and
- formulate valid and reliable hypotheses about health-related phenomena based on evidence.

Duration

This lesson can be conducted as one-, 90-minute lesson, or divided into two-, 45-minute lessons.

[1] Adapted from: Thacker SB, Birkhead GS. Surveillance. In: Gregg, MB, ed. Field epidemiology. Oxford, England: Oxford University Press; 2008.

Procedures

Day 1: Introduction to Surveillance Data

Preparation

Before Day 1,

- Review materials, background material, online resources, and procedures.
- Make copies of Worksheet 1: I Have a Gut Feeling — *Escherichia coli* O157:H7 Case Study (Appendix 1A), 1 copy per group; Assessment 1: Formative Assessment on Surveillance (Appendix 2A), 1 copy per student.
- Make the Public Health Surveillance PowerPoint® (Microsoft Corp., Redmond, Washington) slide presentation available to students and ask them to review it in preparation for the lesson (flipped classroom).
- Download or cue the Killer Outbreaks – E. coli O157 video for Day 1.

Materials

- I Have a Gut Feeling: *Escherichia coli* O157:H7 case study (Appendix 1A), 1 copy per group.
  Description: This case study will encourage the students to apply their new or prior knowledge regarding surveillance, graphing, and modeling as they investigate an *E. coli* O157:H7 outbreak.
- Formative assessment on surveillance (Appendix 2A), 1 copy per student.
  Description: This assessment will gauge students' understanding of material before the lesson.
- PowerPoint: Public Health Surveillance.
  Description: This PowerPoint presentation was adapted from information provided by CDC subject-matter experts on surveillance. This resource can be used as is or tailored to meet classroom needs.
- Computer with Internet connection and attached to a projector.

Online Resources

- Killer Outbreaks – *E. coli* O157
  URL: https://www.youtube.com/watch?v=3ps_Kw4EX7A
  Description: This video introduces *E.coli* O157:H7 and presents basic information on illness and outbreaks caused by this bacteria.

Activity

1. Provide each student with the Formative Assessment on Surveillance (Appendix 2A) and ask them to complete it on the basis of the PowerPoint presentation previously viewed. Give students approximately 10 minutes to complete the worksheet.
2. Have students trade worksheets and correct as the teacher reviews answers aloud (Appendix 2B). Review concepts from PowerPoint presentation and fill in missing information on worksheets. Before continuing, students should understand the information presented.
3. Play Killer Outbreaks – *E. coli* O15 video clip from online resources.
4. Prompt discussion regarding the video (e.g., *E. coli* O157:H7 outbreaks and how surveillance data are used in evaluating an infectious disease outbreak) (approximately 10 minutes).
5. Divide students into learning groups (2–4 students/group is ideal).
6. Provide each group with I Have a Gut Feeling: *Escherichia coli* O157:H7 Case Study, Part 1.
7. As the students work, move among them to facilitate the case study analysis for the remainder of the period.

Day 2: Working with Surveillance Data — 45 minutes

Preparation

Before Day 2,

- Review materials, background material, online resources, and procedures.
- Make copies of Oregon map, if working in groups, or open map on a smart board or whiteboard.

Materials

- Oregon county-level map (see online resources), 1 copy per group.
  Description: Students will use this worksheet to graph population data. Modification: The map can be used with a smart board or whiteboard and a projector for the whole class.
- Graph paper, 2–3 pages per group.
- Colored pencils and rulers for graphing.
- Smart board or whiteboard with projector (optional).

Online Resources

- Oregon map with counties identified.
  URL: http://www.digital-topo-maps.com/county-map/oregon.shtml.
  Description: Map can be used to plot data on a smart board or whiteboard with projector or printed out for use by individual groups.

Activity

1. After the students complete Part 1, follow up with a class discussion; provide feedback by using the instructor guide for the case study.
2. Pass out graph paper, rulers, and colored pencils. Students should continue with Part 2 of the case study.
3. Class discussion on results.

Extensions

Videos and documentaries are available on the Internet regarding *Escherichia coli* O157:H7 outbreaks that can be used to further enhance concepts. Also, data can be collected regarding O157:H7 and other *E. coli* outbreaks from CDC's website and compared with historical data.

Extension: *Escherichia coli* Research — 45 minutes

Preparation

- Secure computers to allow students to research recent *E. coli* outbreaks by using CDC websites.

Materials

- Computers with Internet access (1 per pair of students)

Online Resources

- CDC *E. coli* website
  URL: http://www.cdc.gov/ecoli/.
  Description: Information on *E. coli* from CDC.

Activity

Students can research *E. coli* outbreaks related to other contaminated food sources or caused by other types of *E. coli* (e.g., those involving such foods as spinach, hazelnuts, romaine lettuce, cheese, or prepackaged cookie dough or those involving different strains such as O104, O26, or O121) and compare data from a recent outbreak with data from the case study.

Conclusion

Students will use graphing and modeling skills to analyze surveillance data from an *E. coli* O157:H7 outbreak. Through the use of a case study, students will identify how health-related phenomena can be characterized by person, place and time. Students will learn to how identify priority health-related phenomena, collect reliable public health data through surveillance systems, and use the appropriate visual model (e.g., charts, figures, graphs, or maps) to aid in the formulation of evidence-based hypotheses about the possible cause of disease.

Assessments

- Formative Assessment on Surveillance (Appendix 2A)
  Learning Outcome(s) Assessed:
  - identify priority health-related phenomena and determine which type of public health surveillance system (e.g., passive, active, and syndromic) would be used to collect data;

  Description: This assessment is to be administered before the case study. The worksheet will assess students' understanding of the public health surveillance information presented in the PowerPoint presentation. Use the answer results to reinforce or reteach key concepts from the presentation. The assessment uses open-ended responses and true or false and matching questions. Approximately 15 minutes will be needed to complete the assessment, and it should be reviewed before beginning the case study.

- I Have a Gut Feeling: *Escherichia coli* O157:H7 case study (Appendix 1A)
  Learning Outcome(s) Assessed:
  - identify priority health-related phenomena and determine which type of public health surveillance system (e.g., passive, active, and syndromic) would be used to collect data;
  - use the appropriate models (e.g., charts, figures, graphs, or maps), on the basis of limitations and merits, to identify patterns in surveillance data and associations by person, place, or time; and
  - formulate valid and reliable hypotheses about health-related phenomena based on evidence.

  Description: This case study will encourage students to apply new or prior knowledge regarding surveillance, graphing, and modeling as they investigate an *E. coli* O157:H7 outbreak.

Educational Standards

In this lesson, the following CDC's Epidemiology and Public Health Science (EPHS) Core Competencies for High School Students[1], Next Generation Science Standards (NGSS)[2] Science & Engineering Practices[2], and NGSS Cross-cutting Concepts[3] are addressed:

HS-EPHS2-1. Describe how to collect reliable data regarding priority health-related phenomena using public health surveillance systems.

NGSS Key Science & Engineering Practice[2]
Planning & Carrying out Investigations Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.
NGSS Key Crosscutting Concept[3]
Systems and System Models Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.

HS-EPHS2-3. Use models (e.g., mathematical models, figures) based on empirical evidence to identify patterns of health and disease in order to characterize a public health problem.

NGSS Key Science & Engineering Practice[2]
Analyzing and Interpreting Data Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.
NGSS Key Crosscutting Concept[3]
Patterns Mathematical representations are needed to identify some patterns.

HS-EPHS2-4. Use patterns in empirical evidence to formulate hypotheses.

NGSS Key Science & Engineering Practice[2]
Asking Questions & Defining Problems Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information, that arise from examining models or a theory, to clarify and/or seek additional information and relationships, to determine relationships, including quantitative relationships, between independent and dependent variables, and to clarify and refine a model, an explanation, or an engineering problem.
NGSS Key Crosscutting Concept[3]
Patterns Empirical evidence is needed to identify patterns.

[2] NGSS is a registered trademark of Achieve. Neither Achieve nor the lead states and partners that developed the Next Generation Science Standards was involved in the production of, and does not endorse, this product.

[1] Centers for Disease Control and Prevention (CDC). Science Ambassador Workshop—Epidemiology and Public Health Science: Core Competencies for high school students. Atlanta, GA: US Department of Health and Human Services, CDC; 2015. Not currently available for public use.

[2] NGSS Lead States. Next Generation Science Standards: For States, By States (Appendix F–Science and Engineering Practices). Achieve, Inc. on behalf of the twenty-six states and partners that collaborated on the NGSS. 2013. Available at: http://www.nextgenscience.org/sites/ngss/files/Appendix%20F%20%20Science%20and%20Engineering%20Practices%20in%20the%20NGSS%20-%20FINAL%20060513.pdf

[3]NGSS Lead States. Next Generation Science Standards: For States, By States (Appendix G–Crosscutting Concepts). Achieve, Inc. on behalf of the twenty-six states and partners that collaborated on the NGSS. 2013. Available at: http://www.nextgenscience.org/sites/ngss/files/Appendix%20G%20-%20Crosscutting%20Concepts%20FINAL%20edited%204.10.13.pdf.

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Appendices: Supplementary Documents

Appendix 1A: I Have a Gut Feeling: *Escherichia coli* Case Study

I Have a Gut Feeling . . .

Escherichia coli O157:H7 Case Study

Name: _____ **Date: _____**

PART I

Dateline: 1986.

Infection with *Escherichia coli* O157:H7 was first recognized as a cause of human illness in 1982, when 26 persons in Oregon and 21 persons from Michigan experienced bloody diarrhea after eating hamburgers contaminated with the organism. Both outbreaks were associated with restaurants of the same fast-food chain. In 1986, three patients in eastern Washington State received diagnoses of *E. coli* O157:H7 after being hospitalized with hemorrhagic colitis and subsequent thrombotic thrombocytopenic purpura.

An epidemiologic investigation linked these 3 cases and 37 others in the same community to a local restaurant that had served ground beef, the suspected transmission vehicle. This outbreak was found to be part of a statewide increase in *E. coli* O157:H7 cases. Infections among nursing home residents and patients with hemolytic uremic syndrome (HUS) were reported across the state, and an increase in sporadic cases of hemorrhagic colitis was noted at a Seattle health maintenance organization.

Question 1. Health departments use public health surveillance to keep track of diseases that affect the public's health. What is public health surveillance?

Question 2. What is the difference between active and passive surveillance systems? When might you use each?

Each state has a list of diseases of public health importance that must be reported to the health department when diagnosed by a health care provider. Given the information on the previous page, public health officials in Washington and Oregon considered adding *E. coli* O157:H7 infection to their lists of notifiable diseases.

Question 3. What criteria would you use in deciding whether to add *E. coli* O157:H7 infection (or any other condition) to the reportable disease list in your state?

Dateline: January 1, 1993.
By 1993, *E. coli* O157:H7 had been recognized as an important foodborne pathogen that can cause serious illness. Multiple outbreaks across the country have been attributed to ground beef, roast beef, water, apple cider, and unpasteurized milk. Human infection occurs primarily through ingestion of food or water contaminated with bovine fecal material, but person-to-person transmission also occurs.

The organism can survive for extended periods in water, meat stored at subfreezing temperatures, soil, and acidic environments, but it can be destroyed by thorough cooking or pasteurization. Patients infected with *E. coli* O157:H7 typically present with severe abdominal cramps, bloody diarrhea, and low-grade fever. Children and older persons are at greatest risk for such complications as hemorrhagic colitis, HUS, and death.

In 1990, Oregon added *E. coli* O157:H7 to its reportable disease list. Oregon requires reporting by health care providers, health care facilities, and laboratories. Laboratories must also send isolates to the state laboratory.

Question 4. What attributes characterize an effective surveillance system?

You are an epidemiologist assigned to the Oregon Health Division and are responsible for reviewing surveillance data on a regular basis.

Question 5. What information should be collected when reporting a case of an *E. coli* infection (think person, place, and time)?

PART II

The following tables display *Escherichia coli* O157:H7 surveillance data collected in Oregon for August 1990–December 1992.

Table 1. *Escherichia coli* O157:H7 cases, by year and month of onset — Oregon, 1990–1992

Month	1990	1991	1992	Total
January	*	2	1	**3**
February	*	2	2	**4**
March	*	2	7	**9**
April	*	5	5	**10**
May	*	1	12	**13**
June	*	10	25	**35**
July	2	26	41	**69**
August	14	28	17	**59**
September	19	15	19	**53**
October	12	13	7	**32**
November	5	6	9	**20**
December	7	1	11	**19**
Total	**59**	**111**	**156**	**326**

*Missing or Data unavailable.

Adapted from: Centers for Disease Control and Prevention (CDC). Surveillance for *E. coli* 0157:H7—information for action. Atlanta, GA: US Department of Health and Human Services, CDC, Epidemiology Program Office; 2003. Case Studies in Applied Epidemiology no. 941-903. Available at: http://www.cdc.gov/eis/casestudies/Xecoli.903.student.pdf.

Using a separate sheet of graph paper, graph the data in 2 different formats (e.g., line graph, bar graph, or pie chart).

Question 6. On the basis of the data graphed, what are three interpretations you can make? Was one type of graph easier to interpret? Why or why not?

Table 2. *Escherichia coli* O157:H7 cases, by year of onset and county — Oregon, 1990–1992

Month	1990	1991	1992	Total
Baker	0	1	0	**1**
Benton	1	4	11	**16**
Clackamas	7	11	21	**39**
Columbia	1	2	5	**8**
Coos	0	0	1	**1**
Deschutes	2	0	0	**2**
Douglas	2	4	4	**10**
Grant	0	0	2	**2**
Jackson	1	0	4	**5**
Jefferson	0	0	2	**2**
Josephine	0	0	1	**1**
Lane	6	9	16	**31**
Lincoln	2	1	1	**4**
Linn	4	4	5	**13**
Malheur	3	0	1	**4**
Marion	9	8	10	**27**
Multnomah	11	36	41	**88**
Polk	1	1	3	**5**
Umatilla	1	0	3	**4**
Wasco	0	2	1	**3**
Washington	7	26	19	**52**
Yamhill	1	2	5	**8**
Total	**59**	**111**	**156**	**326**

Adapted from: Centers for Disease Control and Prevention (CDC). Surveillance for *E. coli* 0157:H7—information for action. Atlanta, GA: US Department of Health and Human Services, CDC, Epidemiology Program Office; 2003. Case Studies in Applied Epidemiology no. 941-903. Available at: http://www.cdc.gov/eis/casestudies/Xecoli.903.student.pdf.

As a class, chart the previous information on *E. coli* O157:H7 outbreaks on a map provided by your teacher.

Question 7. On the basis of your newly created map of Oregon counties and *E. coli* O157:H7 reported cases, make two inferences regarding the outbreak of *E. coli* O157:H7. Explain your reasoning.

Table 3. *Escherichia coli* O157:H7 cases, by 10-year age groups — Oregon, 1990–1992

Age group (yrs)	1990	1991	1992	Total
0–9	10	35	39	**84**
10–19	10	11	31	**52**
20–29	8	19	20	**47**
30–39	7	14	10	**31**
40–49	5	8	13	**26**
50–59	6	8	14	**28**
60–69	4	8	15	**27**
70–79	6	5	8	**19**
80–89	2	3	3	**8**
90–99	0	0	3	**3**
Unknown	1	0	0	**1**
Total	**59**	**111**	**156**	**326**

Adapted from: Centers for Disease Control and Prevention (CDC). Surveillance for *E. coli* 0157:H7—information for action. Atlanta, GA: US Department of Health and Human Services, CDC, Epidemiology Program Office; 2003. Case Studies in Applied Epidemiology no. 941-903. Available at: http://www.cdc.gov/eis/casestudies/Xecoli.903.student.pdf.

Table 4. Total population by age — Oregon, 1990 (N = 2,842,321)

Age group (yrs)	Population	% of N
0–4	205,649	7.24
5–9	208,902	7.35
10–14	200,742	7.06
15–19	191,070	6.72
20–24	189,859	6.68
25–29	212,127	7.46
30–34	239,715	8.43
35–39	250,218	8.80
40–44	223,537	7.86
45–49	165,811	5.83
50–54	128,860	4.53
55–59	115,362	4.05
60–64	120,704	4.25
65–69	122,332	4.30
70–74	101,583	3.57
75–79	78,200	2.75
80–84	49,383	1.74
≥85	38,267	1.34

Adapted from: Centers for Disease Control and Prevention (CDC). Surveillance for *E. coli* 0157:H7—information for action. Atlanta, GA: US Department of Health and Human Services, CDC, Epidemiology Program Office; 2003. Case Studies in Applied Epidemiology no. 941-903. Available at: http://www.cdc.gov/eis/casestudies/Xecoli.903.student.pdf.

Table 5. Total population by county — Oregon, 1990 (N = 2,842,321)

Item	County	Population	% of N
1	Multnomah	583,887	20.54
2	Washington	311,554	10.96
3	Lane	282,912	9.95
4	Clackamas	278,850	9.81
5	Marion	228,483	8.04
6	Jackson	146,389	5.15
7	Douglas	94,649	3.33
8	Linn	91,227	3.21
9	Deschutes	74,958	2.64
10	Benton	70,811	2.49
11	Yamhill	65,551	2.31
12	Josephine	62,649	2.20
13	Coos	60,273	2.12
14	Umatilla	59,249	2.08
15	Klamath	57,702	2.03
16	Polk	49,541	1.74
17	Lincoln	38,889	1.37
18	Columbia	37,557	1.32
19	Clatsop	33,301	1.17
20	Malheur	26,038	0.92
21	Union	23,598	0.83
22	Wasco	21,683	0.76
23	Tillamook	21,570	0.76
24	Curry	19,327	0.68
25	Hood River	16,903	0.59
26	Baker	15,317	0.54
27	Crook	14,111	0.50
28	Jefferson	13,676	0.48
29	Grant	7,853	0.28
30	Morrow	7,625	0.27
31	Lake	7,186	0.25
32	Harney	7,060	0.25
33	Wallowa	6,911	0.24
34	Sherman	1,918	0.07
35	Gilliam	1,717	0.06
36	Wheeler	1,396	0.05

Adapted from: Centers for Disease Control and Prevention (CDC). Surveillance for *E. coli* 0157:H7—information for action. Atlanta, GA: US Department of Health and Human Services, CDC, Epidemiology Program Office; 2003. Case Studies in Applied Epidemiology no. 941-903. Available at: http://www.cdc.gov/eis/casestudies/Xecoli.903.student.pdf.

Question 8. On the basis of this new population data, why do you think Multnomah County has the highest number of reported cases of *E. coli* O157:H7 infections?

Question 9. Which age groups reported the highest incidence of *E. coli* O157:H7? On the basis of the population data, can you make a hypothesis about which age group was most at risk for *E. coli* O157:H7 infections? Why do you think that age group is at higher risk to the infection?

Adapted from: Centers for Disease Control and Prevention (CDC). Surveillance for *E. coli* 0157:H7—information for action. Atlanta, GA: US Department of Health and Human Services, CDC, Epidemiology Program Office; 2003. Case Studies in Applied Epidemiology no. 941-903. Available at: http://www.cdc.gov/eis/casestudies/Xecoli.903.student.pdf.

Appendix 1B: I Have a Gut Feeling: *Escherichia coli* O157:H7 Case Study, Teachers Guide

I Have a Gut Feeling . . .

Escherichia coli O157:H7 Case Study
Teachers Guide

Note: At the request of other teachers and trainers who use these case studies and to preserve the effectiveness of these case studies as a teaching tool, we ask that you not distribute the answer key to the students and that you not post the answers online in any form (e.g., online slide sets, lecture notes, or the answer key itself). In addition, we recommend that the facilitators not publicize the existence of the answer key when leading the case study because it makes the students focus too much on getting the right answer from the teacher rather than learning from each other and realizing that many questions do not have a single correct answer.

PART I

Dateline: 1986.

Infection with *Escherichia coli* O157:H7 was first recognized as a cause of human illness in 1982, when 26 persons in Oregon and 21 persons from Michigan experienced bloody diarrhea after eating hamburgers contaminated with the organism. Both outbreaks were associated with restaurants of the same fast-food chain. In 1986, three patients in eastern Washington State received diagnoses with *E. coli* O157:H7 after being hospitalized with hemorrhagic colitis and subsequent thrombotic thrombocytopenic purpura.

An epidemiologic investigation linked these 3 cases and 37 others in the same community to a local restaurant that had served ground beef, the suspected transmission vehicle. This outbreak was found to be part of a statewide increase in *E. coli* O157:H7 cases. Infections among nursing home residents and patients with hemolytic uremic syndrome (HUS) were reported across the state, and an increase in sporadic cases of hemorrhagic colitis was noted at a Seattle health maintenance organization.

Question 1. Health departments use public health surveillance to keep track of diseases that affect the public's health. What is public health surveillance?

Answer: Answers may vary, but common features might include

- ongoing, systematic collection of data;
- analysis and interpretation of data;
- information provided to those who need to know; or
- guide public health decisions and actions.

Question 2. What is the difference between active and passive surveillance systems? When might you use each?

Answer: Answers may vary, but should include the following

- Passive: Laboratories, health care provides, or others regularly report cases of disease or death to the local or state health department (e.g., a doctor's office reports 2 cases of measles to the state health department).
- Active: Local or state health departments initiate information collection from laboratories, health care providers or others (e.g., Youth Risk Behavior Surveillance Survey).

Each state has a list of diseases of public health importance that must be reported to the health department when diagnosed by a health care provider. Given the information on the previous pages, public health officials in Washington and Oregon considered adding *E. coli* O157:H7 infection to their lists of notifiable diseases.

Question 3. What criteria would you use in deciding whether to add *E. coli* O157:H7 infection (or any other condition) to the reportable disease list in your state?

Answer: Possible answers include

- disease occurrence or distribution changes,
- transmission rate,
- morbidity or mortality,
- social and economic factors,
- public perception, and
- vaccine preventability.

Dateline: January 1, 1993.

By 1993, *E. coli* O157:H7 has been recognized as an important foodborne pathogen that can cause serious illness. Multiple outbreaks across the country have been attributed to ground beef, roast beef, water, apple cider, and unpasteurized milk. Human infection occurs primarily through ingestion of food or water contaminated with bovine fecal material, but person-to-person transmission also occurs.

The organism can survive for extended periods in water, meat stored at subfreezing temperatures, soil, and acidic environments, but it can be destroyed by thorough cooking or pasteurization. Patients infected with *E. coli* O157:H7 typically present with severe abdominal cramps, bloody diarrhea, and low-grade fever. Children and older persons are at greatest risk for complications (e.g., hemorrhagic colitis, HUS, and death).

In 1990, Oregon added *E. coli* O157:H7 to its reportable disease list. Oregon requires reporting by health care providers, health care facilities, and laboratories. The laboratories must also send isolates to the state laboratory.

Question 4. What attributes characterize an effective surveillance system?
Answer: Answers may vary. Possible answers include

- simple,
- timely,
- representative,
- flexible,
- sensitive,
- strong predictive value,
- acceptable to public health care providers, and
- cost-effective.

You are an epidemiologist assigned to the Oregon Health Division and are responsible for reviewing surveillance data on a regular basis.

Question 5. What information should be collected when reporting a case of an *E. coli* O157:H7 infection (think person, place, and time)?
Answer: Answers may vary. Possible answers include

- patient identifying information (name, address, and phone number);
- demographic information (age, sex, and race/ethnicity);
- clinical information (date, signs, symptoms, laboratory results, and whether hospitalized); and
- risk factors for the particular infection being reported (occupation, travel, immunization status, and possible exposure).

Part 2

The following tables display *Escherichia coli* O157:H7 surveillance data collected in Oregon for August 1990–December 1992.

Table 1. *Escherichia coli* O157:H7 cases, by year and month of onset — Oregon, 1990–1992

Month	1990	1991	1992	Total
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March	*	2	7	**9**
April	*	5	5	**10**
May	*	1	12	**13**
June	*	10	25	**35**
July	2	26	41	**69**
August	14	28	17	**59**
September	19	15	19	**53**
October	12	13	7	**32**
November	5	6	9	**20**
December	7	1	11	**19**
Total	**59**	**111**	**156**	**326**

* Missing or Data Unavailable.

Adapted from: Centers for Disease Control and Prevention (CDC). Surveillance for *E. coli* 0157:H7—information for action. Atlanta, GA: US Department of Health and Human Services, CDC, Epidemiology Program Office; 2003. Case Studies in Applied Epidemiology no. 941-903. Available at: http://www.cdc.gov/eis/casestudies/Xecoli.903.student.pdf.

Using a separate sheet of graph paper, graph the data in two different formats (e.g., line graph, bar graph, or pie chart).

Question 6. On the basis of the data graphed, what are two interpretations you can make? Was one type of graph easier to interpret? Why or why not?
Answer: Answers will vary. Answers should include that the number of cases increased over time (by year) and that the season affected the number of cases (i.e., more cases in the warmer months than in the colder months were reported). Students could also indicate a linear relationship between the temperature and number of cases might exist.

Table 2. *Escherichia coli* O157:H7 cases, by year of onset and county — Oregon, 1990–1992

Month	1990	1991	1992	Total
Baker	0	1	0	**1**
Benton	1	4	11	**16**
Clackamas	7	11	21	**39**
Columbia	1	2	5	**8**
Coos	0	0	1	**1**
Deschutes	2	0	0	**2**
Douglas	2	4	4	**10**
Grant	0	0	2	**2**
Jackson	1	0	4	**5**
Jefferson	0	0	2	**2**
Josephine	0	0	1	**1**
Lane	6	9	16	**31**
Lincoln	2	1	1	**4**
Linn	4	4	5	**13**
Malheur	3	0	1	**4**
Marion	9	8	10	**27**
Multnomah	11	36	41	**88**
Polk	1	1	3	**5**
Umatilla	1	0	3	**4**
Wasco	0	2	1	**3**
Washington	7	26	19	**52**
Yamhill	1	2	5	**8**
Total	**59**	**111**	**156**	**326**

Adapted from: Centers for Disease Control and Prevention (CDC). Surveillance for *E. coli* 0157:H7—information for action. Atlanta, GA: US Department of Health and Human Services, CDC, Epidemiology Program Office; 2003. Case Studies in Applied Epidemiology no. 941-903. Available at: http://www.cdc.gov/eis/casestudies/Xecoli.903.student.pdf.

As a class, chart the previous information on *E. coli* O157:H7 outbreaks on a map provided by your teacher.

Question 7. On the basis of your newly created map of Oregon counties and *E. coli* O157:H7 reported cases, make 2 inferences regarding the outbreak of *E. coli* O157:H7. Explain your reasoning.
Answer: Answer will vary. Examples of inferences include that the majority cases occurred in Multnomah and Clackamas Counties and approximately 50 more cases occurred each year.

Table 3. *Escherichia coli* O157:H7 cases, by 10-year age groups — Oregon, 1990–1992

Age group (yrs)	1990	1991	1992	Total
0–9	10	35	39	**84**
10–19	10	11	31	**52**
20–29	8	19	20	**47**
30–39	7	14	10	**31**
40–49	5	8	13	**26**
50–59	6	8	14	**28**
60–69	4	8	15	**27**
70–79	6	5	8	**19**
80–89	2	3	3	**8**
90–99	0	0	3	**3**
Unknown	1	0	0	**1**
Total	**59**	**111**	**156**	**326**

Adapted from: Centers for Disease Control and Prevention (CDC). Surveillance for *E. coli* 0157:H7—information for action. Atlanta, GA: US Department of Health and Human Services, CDC, Epidemiology Program Office; 2003. Case Studies in Applied Epidemiology no. 941-903. Available at: http://www.cdc.gov/eis/casestudies/Xecoli.903.student.pdf.

Table 4. Total population by age — Oregon, 1990 (N = 2,842,321)

Age group (yrs)	Population	% of N
0–4	205,649	7.24
5–9	208,902	7.35
10–14	200,742	7.06
15–19	191,070	6.72
20–24	189,859	6.68
25–29	212,127	7.46
30–34	239,715	8.43
35–39	250,218	8.80
40–44	223,537	7.86
45–49	165,811	5.83
50–54	128,860	4.53
55–59	115,362	4.05
60–64	120,704	4.25
65–69	122,332	4.30
70–74	101,583	3.57
75–79	78,200	2.75
80–84	49,383	1.74
≥85	38,267	1.34

Adapted from: Centers for Disease Control and Prevention (CDC). Surveillance for *E. coli* 0157:H7—information for action. Atlanta, GA: US Department of Health and Human Services, CDC, Epidemiology Program Office; 2003. Case Studies in Applied Epidemiology no. 941-903. Available at: http://www.cdc.gov/eis/casestudies/Xecoli.903.student.pdf.

Table 5. Population of all ages, all races, both sexes, by county — Oregon, 1990 (N = 2,842,321)

Item	County	Population	% of N
1	Multnomah	583,887	20.54
2	Washington	311,554	10.96
3	Lane	282,912	9.95
4	Clackamas	278,850	9.81
5	Marion	228,483	8.04
6	Jackson	146,389	5.15
7	Douglas	94,649	3.33
8	Linn	91,227	3.21
9	Deschutes	74,958	2.64
10	Benton	70,811	2.49
11	Yamhill	65,551	2.31
12	Josephine	62,649	2.20
13	Coos	60,273	2.12
14	Umatilla	59,249	2.08
15	Klamath	57,702	2.03
16	Polk	49,541	1.74
17	Lincoln	38,889	1.37
18	Columbia	37,557	1.32
19	Clatsop	33,301	1.17
20	Malheur	26,038	0.92
21	Union	23,598	0.83
22	Wasco	21,683	0.76
23	Tillamook	21,570	0.76
24	Curry	19,327	0.68
25	Hood River	16,903	0.59
26	Baker	15,317	0.54
27	Crook	14,111	0.50
28	Jefferson	13,676	0.48
29	Grant	7,853	0.28
30	Morrow	7,625	0.27
31	Lake	7,186	0.25
32	Harney	7,060	0.25
33	Wallowa	6,911	0.24
34	Sherman	1,918	0.07
35	Gilliam	1,717	0.06
36	Wheeler	1,396	0.05

Adapted from: Centers for Disease Control and Prevention (CDC). Surveillance for *E. coli* 0157:H7—information for action. Atlanta, GA: US Department of Health and Human Services, CDC, Epidemiology Program Office; 2003. Case Studies in Applied Epidemiology no. 941-903. Available at: http://www.cdc.gov/eis/casestudies/Xecoli.903.student.pdf.

Question 8. On the basis of this new population data, why do you think Multnomah County has the highest number of reported cases of *E. coli* O157:H7 infections?
Answer: Multnomah County has the largest population, is the most urban area (Portland), and has more fast-food chains than other counties.

Question 9. Which age groups reported the highest incidence of *E. coli* O157:H7? On the basis of the population data, can you make a hypothesis about which age group was most at risk for *E. coli* O157:H7 infections? Why do you think that age group is at higher risk to the infection?
Answer: The age group with the highest reported incidence is age 0–9 years. Age groups who were most at risk include younger and older persons. These groups are at greater risk of infection because they have underdeveloped or compromised immune systems. They might also have more exposure to fast food.

Adapted from: Centers for Disease Control and Prevention (CDC). Surveillance for *E. coli* 0157:H7—information for action. Atlanta, GA: US Department of Health and Human Services, CDC, Epidemiology Program Office; 2003. Case Studies in Applied Epidemiology no. 941-903. Available at: http://www.cdc.gov/eis/casestudies/Xecoli.903.student.pdf.

Appendix 2A: Formative Assessment on Surveillance

Formative Assessment on Surveillance

Name: _____ Date: _____

1. True or False. Public health surveillance is a single random collection of health data by the media to help public health officials plan, implement, and evaluate public health practice.

   Explain your choice:

2. Matching: Use the following letters to match the form of surveillance with the example provided.
   A. Active B. Passive C. Syndromic

   _____ Doctor's office report of 2 cases of measles during the last month.
   _____ Survey provided to students at school regarding bike helmet use.
   _____ Taking water samples from a town beach to monitor bacteria counts.
   _____ Veterinarian office encounters 3 cases of rabies in a dog.
   _____ Three persons are admitted to the local emergency room with acute respiratory problems.
   _____ A laboratory reports findings of hepatitis B in blood samples.
   _____ Four local pharmacies order an increasing amount of antidiarrheal medication.
   _____ Questionnaire administered at a doctor's office regarding the age of a patient's house.

3. List 4 uses of public health surveillance data with a specific example of each.

4. What makes an illness reportable? Give an example of a mandatory reportable disease and a reason why it might have made the reportable list.

5. Would the following scenarios be effective forms of public health surveillance? Explain your reasoning.
   A. A 5-page written report focusing on health of Lancaster County citizens from 1983.

   B. Death certificates of persons who died from acute kidney failure during the last month.

Appendix 2B: Formative Assessment on Surveillance

Formative Assessment on Surveillance

Name: _____Answer Key_____ Date: _____

1. True or False. Public health surveillance is a single random collection of health data by the media to help public health officials plan, implement, and evaluate public health practice.
   Answer: False — Surveillance is an ongoing, systematic collection of data by multiple sources to be used by public health officials in the planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination to those who need to know.

2. Matching: Use the following letters to match the form of surveillance with the example provided.
   A. Active B. Passive C. Syndromic

   __**B**____ Doctor's office report of 2 cases of measles during the last month.
   __**A**____ Survey provided to students at school regarding bike helmet use.
   __**A**____ Taking water samples from a town beach to monitor bacteria counts.
   __**B**____ Veterinarian office encounters 3 cases of rabies in a dog.
   __**C**____ Three persons are admitted to the local emergency room with acute respiratory problems.
   __**B**____ A laboratory reports findings of hepatitis B in blood samples.
   __**C**____ Four local pharmacies order an increasing amount of antidiarrheal medication.
   __**A**____ Questionnaire administered at a doctor's office regarding the age of a patient's house.

3. List 4 uses of public health surveillance data with a specific example of each.
   Answer: Answers may vary, but should include
   - estimate size of health problem; detect epidemics;
   - determine geographic location;
   - portray history of disease;
   - generate hypothesis during;
   - monitor changes in infectious agents causing disease in the population;
   - detect changes in health practices; or
   - facilitate emergency planning.

4. What makes an illness reportable? Give an example of a mandatory reportable disease and a reason why it might have made the reportable list.
   Answer: Same answers as for Question 3.

5. Would the following instruments or sources of data be effective forms of public health surveillance? Explain your reasoning.
   A. A 5-page written report focusing on health of Lancaster County citizens from 1983.
      Answer: Limitations include that it is not simple, timely, or cost-effective, and it does not measure positive predictive value.
   B. Death certificates of persons who died from acute kidney failure during the last month.
      Answer Answers will vary. Death certificates are simple, representative, acceptable, sensitive, and often timeliness. The limitations are lack of flexibility and, in some cases, timeliness.