Pathogen Tracker Game

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Stage One: Declare an Outbreak

Level I Student Worksheet

Answer Sheet

Vocabulary: biodiversity, colony, contaminate, database, DNA, *Escherichia coli* O157 :H7*,* foodborne illness, genetic fingerprint, isolate, *Listeria monocytogenes,* obtundation, outbreak, pathogen, Pathogen Tracker, PCR, phenotype, restriction enzyme, riboprint, ribosome, RNA, *Salmonella,* Southern blotting, species, strain, subspecies, zoonotic

BEFORE YOU BEGIN PLAYING THE GAME, please answer the following questions:

1.   What is a foodborne illness and why is it such a serious issue?

A foodborne illness is an infection or intoxication caused by the transfer of microbial or chemical contaminants from food or water to a human. An infection is caused by the ingestion of a pathogen such as a bacterium while intoxication results from the ingestion of a toxin or chemical produced by the bacterium.

The illness can be life threatening, particularly for young children, the elderly, and those with weakened immune systems. Some foodborne illnesses can cause pregnant women to abort their fetuses. These illnesses affect nearly a quarter of the American population each year, with approximately 5,000 of these cases ending in death.

2.   What is a foodborne illness outbreak?

A foodborne illness outbreak occurs when two or more cases of a similar illness result from eating the same food.

3.   List the steps you think scientists follow in finding the cause of a foodborne illness outbreak.

The answer that the student gives to this question may have errors. At the end of each stage, the student will be asked to revise the answer and give reasons for those revisions.

The following steps could be included in an answer to this question:

Patients come to doctors or emergency rooms displaying symptoms of a foodborne illness – diarrhea, fever, chills, and/or nausea;

Doctors make an initial diagnosis and send stool samples to a laboratory to be cultured;

The laboratory detects a foodborne pathogen in the culture and isolates the pathogen;

The pathogen is identified and compared with other foodborne illness pathogens to determine if an outbreak has occurred;

If sufficient data is present, an outbreak is declared.

Public health officials interview patients to determine which foods they have eaten to generate hypotheses regarding the possible cause of the illnesses;

A matched pairs analysis is done with a control group to determine which of the foods that the infected group ate could be the cause of the outbreak;

Patients are interviewed to find out where they might have eaten the contaminated food;

Health officials interview employees at the establishments where the patients have eaten and inspect those establishments;

Samples taken from the establishment are sent to the lab to be cultured; and,

Health officials analyze the results from the cultures and, if necessary, request a product recall or the closing of the establishment.

4.   Once a cause for a foodborne illness outbreak has been declared, what do you think officials can do to protect the public's health?

Officials can request that the contaminated food be recalled and that the plant where the food was manufactured be closed and thoroughly cleaned.

Public health officials and / or regulatory authorities may also issue press to alert the public to the outbreak and provide advice on how to protect one's health.

YOU ARE NOW READY TO PLAY THE GAME. As you play the game, answer the questions when you come to the appropriate page.

What are foodborne pathogens?

Foodborne pathogens are microorganisms such as bacteria, parasites, or viruses, that infect you when you eat contaminated food.

What symptoms were the patients with the suspected foodborne illness experiencing?

The symptoms that the patients with the suspected foodborne illness were experiencing included headache, vomiting, body aches, diarrhea, loss of balance, confusion and miscarriage.

Create a table to record the symptoms of the following foodborne pathogens: *Escherichia coli (E. coli)* O157:H7, *Listeria monocytogenes (L. monocytogenes),* and *Salmonella*.

Pathogen	Symptoms
Escherichia coli O157:H7	Sudden onset of abdominal pain and severe cramps, followed within 24 hours by diarrhea which may become watery and then bloody
Listeria monocytogenes	Fever, muscle aches, and gastrointestinal symptoms such as nausea or diarrhea; also, headache, stiff neck, loss of balance, confusion, obtundation or convulsions can occur. Infection during pregnancy can lead to miscarriage, infection of the newborn, or even stillbirth.
Salmonella	Diarrhea, often with fever and abdominal cramps; nausea and vomiting; diarrhea often includes mucus and is occasionally bloody

Which foodborne pathogen is responsible for the suspected foodborne illness outbreak? Be sure to give your detailed reasons for choosing this pathogen.

Listeria is responsible for the suspected outbreak – one of the patients experienced a miscarriage and that symptom is related only to *Listeria.*

Describe in detail the steps to follow in making a riboprint.

The steps include:

Samples are taken from the infected people while they are under the care of a health care provider and cultured in the lab;

After growing or culturing the bacteria in the sample, a colony of the likely pathogen is isolated. This colony is referred to as an "isolate."

The DNA is purified and extracted. This DNA is then cut by restriction enzymes into many exact fragments;

Once the DNA is divided, it is treated in one of two ways. The DNA is either "amplified" with primers specific for ribosomes and transferred onto a gel using polymerase chain reaction (PCR), or probed with ribosomal DNA probes if using Southern blotting;

No matter which technique is used, banding patterns will appear on the gel or blotter, creating a riboprint. These banding patterns are what we use to compare the different subtypes in the database.

In the table below record the names of the patients who had the same riboprints, the date on which their symptoms first appeared, and the state in which they live.

Patient Name	Date	State
Amodini Khan	8/02	New York
Matt Rufello	8/13	New York
Roger Martin	8/09	Ohio
Franklin Spoon	8/30	Ohio
Aimee Ferguson	9/06	North Carolina

What is Pathogen Tracker and how is it be used to track a foodborne illness outbreak?

Pathogen Tracker is an innovative web-based tool for information exchange on bacterial subtypes and strains, and for studies of bacterial biodiversity and strain diversity. Pathogen Tracker allows researchers and public health professionals to upload digital images produced in their labs and to compare these images against others stored in the database to track a foodborne illness outbreak.

When the screen shown on the right is reached, you should read the **INSTRUCTIONS** and then use the back button to return to the **PT DATABASE**.
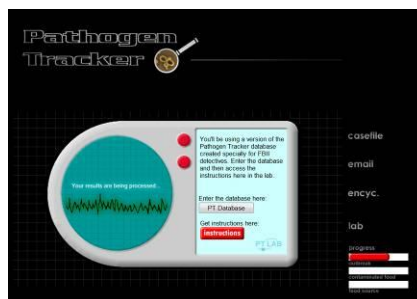
Explain in detail how the Pathogen Tracker database can be used to identify the strain of *L. monocytogenes* responsible for the foodborne illness outbreak.

The patients' riboprints are submitted to the Pathogen Tracker database. The PT database tries to match the submitted riboprints with riboprints from its own database. The "percent" column shows what percent of each riboprint in the database matches the submitted riboprint. The "rank" column shows the order of the matches, with the closest match ranked one. To find the strain of *Listeria monocytogenes* for the submitted riboprint, one identifies the closest match in the PT database results. You look in the column "RIBO" for the strain ID.

Which strain of *L. monocytogenes* was identified as being present in the patients? Explain how you determined that the strain found in the patients was the same as a strain already in the Pathogen Tracker database?

The strain of *L. monocytogenes* found in the patients was DUP-1042B. Comparing its riboprint with the riboprints in the PT database identified the strain.

What parameters are necessary in order for a foodborne illness outbreak to be declared?

For an outbreak to be declared, the number of foodborne illnesses reported over the past few months that were caused by the strain being investigated are compared with the number of foodborne illnesses reported over the same period of time that were caused by other strains of the same pathogen and species (e.g., background rate). If the number of illnesses caused by the strain being investigated seems unusually high compared to the number caused by other strains, an outbreak can officially be declared.

Why is the first graph "Foodborne Illness Incidences Over the Last Five Months" not adequate to declare an outbreak and why is the second graph adequate?

The first graph shows only 'Foodborne Illness Incidences Over the Last 5 Months" in NY, OH, and NC. The second graph shows the same data but also includes the strain of *L. monocytogenes* with which each patient was infected. The first graph does not have enough data to declare an outbreak, while the second graph does.

Now that you have completed Stage One of Pathogen Tracker, return to question 3 at the beginning of this worksheet and review the steps you listed. What revisions, if any, would you make to these steps? Be sure to explain why you are making these revisions.

To reply to this question, the student refers back to the answer that was given to question 4 and compares the actual steps in Stage One with the steps he/she listed in answering the question.

These are the steps that have occurred:

> Patients come to doctors or emergency rooms displaying symptoms of a foodborne illness – diarrhea, fever, chills, and/or nausea;
>
> Doctors make an initial diagnosis and send stool samples to a laboratory to be cultured;
>
> The laboratory detects a foodborne pathogen in the culture and isolates the pathogen;
>
> The pathogen is identified and compared with other foodborne illness pathogens to determine if an outbreak has occurred;
>
> If sufficient data is present, an outbreak is declared.

Password to go onto Stage Two: Find the Contaminated Food: - Listeria