

Activity #4

Plagues: Past and Present

Length:

Two class periods

Prerequisite Activity:

None

In Advance:

Order Glo Germ™ powder and ultraviolet light for Class Period Two. (Glo Germ™ powder and light can be purchased from: www.hdd.net/cgi-bin/glogerm/hazel.cgi, www.amazon.com and www.glogerm.com. A two-ounce bottle will last several years.)

Optional:

Assign parts for the reader's theater a day or two before class to allow students to practice. Have students read Student Pages "Plague On Our Shores" and highlight their parts.

Objectives:

- Investigate the impact of alien plants, animals, invertebrates, and pathogens on human health and public safety.
- Explore the historic outbreak of bubonic plague in Hawai'i.
- Create an action plan in response to a potential epidemic of rat lungworm disease.

Vocabulary:

Bubonic plague

Larvae

Pathogens

Contaminated

Lymph node

Quarantine

Epidemic

Meningitis

Epidemiology

Parasitic

● ● ● **Class Period One:** *Bubonic Plague in Hawai'i*

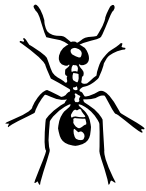
Materials & Setup

For each student:

- Student Pages "Plague on Our Shores" script and worksheet (pp. 45-53)

Note: If you have extra time, you can assign the script as homework and allow students practice their roles before performing in class. They can bring props and costume elements from home, such as police or firemen's hats, doctor's coats, brooms (which can double as rifles), plastic or plush rats, and fire hose.

The slideshow "Bubonic Plague in Honolulu 1899" is included with this curriculum and available for download at www.hoikecurriculum.org. It duplicates much of the information in the "Plague on Our Shores" script but includes historic photos of the events. If you think your students will have a hard



time following the script, or want to present the information in a visual format, you can show this slideshow as a precursor to their reader's theater.

Instructions

- 1) Use information provided in the Teacher Background "How Invasive Species Can Endanger Public Health and Safety," to lead a brief discussion on the topic.
- 2) Direct students in a reader's theater performance of "Plague on Our Shores." Use the Teacher Background "Readers' Theater Tips" as a guide. Break students into groups of five. Each group will perform one act of the play.
- 3) Pass out the Student Page "Plague on Our Shores Worksheet" and have the students in the audience to assume a role while listening. They can choose from: ship captain, ship passenger, doctor, epidemiologist, Chinese merchant, Hawaiian landlord, lawyer, fireman, church pastor, school-teacher, pregnant mother, plague victim, crematorium operator, or other relevant characters. They will discuss their various characters' reactions to the play at the end of class.
- 4) In addition to noting their characters' reactions, instruct students to listen for a) steps the Department of Health took to prevent the spread of the disease, b) what kind of resistance those steps were met with, and c) long-term effects of the bubonic plague outbreak in Hawaii. They will record their answers on the Student Page "Plague on Our Shores Worksheet."
- 5) Discuss worksheet answers as a class.

● ● ● Class Period One: *Responding to a Public Health Emergency*

Materials & Setup

Glo Germ™ powder

Ultraviolet light

Teacher Copy Master "Symptom Cards" (pp. 43-44)

For each student:

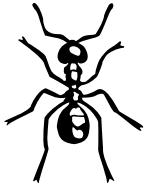
- Student Pages "Disease Diagnosis Chart" (pp. 54-55)
- "Rat Lungworm Disease Fact Sheet" (pp. 57-59)

For each group of students:

- Student Pages "Rat Lungworm Disease Response Strategy" (pp. 56-67)

Instructions

- 1) Before class, smear a light coating of Glo Germ™ powder onto five students' desks or chairs. (Alternately, apply it to your own hand and choose students to shake hands with.) Do not tell the students. This invisible powder is meant to simulate the slime trail of a slug infected with rat lungworm parasites.



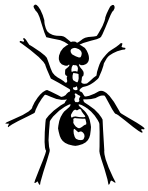
- 2) Review the material covered in class period one regarding how invasive species can endanger public health.
- 3) Tell students that members of their class have been infected with imaginary cases of a disease spread by invasive species. They will spend the rest of class working as a team to respond to this public health crisis.
- 4) Turn the overhead lights off and have students pass their hands under the ultraviolet light. The students with glowing hands are ill. Give the “sick” students symptom cards (Copy Master “Symptom Cards”), which they keep private from the other students. Tell the class that the students became ill after sharing a picnic lunch. At first they thought it was the flu or food poisoning. But when the symptoms didn’t disappear after a day, they suspected something more serious and went to the emergency room. Now it’s up to the class to diagnose their sick classmates and protect the public from an epidemic.
- 5) Pass out the Student Page “Disease Diagnosis Chart.” Students will take turns asking their “sick” classmates questions from the chart to determine what illness they are all suffering from. By process of elimination, the class will agree on a diagnosis.
- 6) After the correct diagnosis is made (rat lungworm disease), show the short video on rat lungworm disease. <http://animal.discovery.com/tv-shows/monsters-inside-me/videos/the-rat-lungworm.htm>
- 7) Pass out the Student Pages “Rat Lungworm Disease Fact Sheet,” to each student and read aloud together.
- 8) Break students into 4-5 groups to devise response strategies. Tell them to record their groups’ answers on Student Page “Rat Lungworm Disease Response Strategy.”
- 9) Go over worksheet answers in class.

Journal Ideas

- Speculate how cultural differences affected the spread of the plague. Might things have been different if the outbreak had started in the missionary or native Hawaiian communities?
- What would be different if an outbreak of plague occurred today?
- Rabies is another example of a disease spread by invasive species. Write a few paragraphs about how life in Hawai‘i would be different if rabies were present here. If you don’t know what rabies infections are like, ask your classmates, teacher, and friends if they have lived an area with rabid animals.

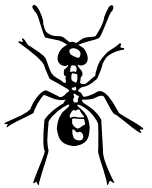
Assessment Tools

- Participation in readers’ theater and class discussion
- Participation in class activity: disease diagnosis
- “Plague on Our Shores” and “Rat Lungworm Response Strategy” worksheets
- Journal entries



Further Enrichment

- Show the students the video, Secrets of the Black Death by Nature Video available on YouTube: www.youtube.com/watch?v=pRZYb2Jl22g
- Have students research current public health and safety plans currently for Hawai'i. They can contact the Hawai'i Department of Health Maui Bioterrorism Preparedness Branch at 808-243-8640 or visit www.hawaii.gov/health



Teacher Background

How Invasive Species Can Endanger Public Health and Safety

What is an invasive species?

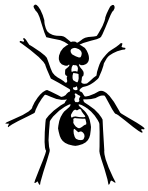
- A nonnative species that directly preys upon or outcompetes native species for resources
- An alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health

What types of organisms can be invasive?

- Plants
- Animals, including: birds, fish, reptiles, amphibians, mammals
- Insects
- Plant diseases
- Animal diseases

What are some ways that invasive species might affect public health and safety?

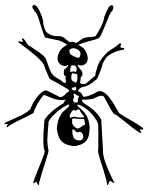
- Plants have toxins and can poison people or animals. Examples in Hawai'i: Fireweed (*Senecio madagascariensis*) is toxic to livestock and is widespread on several islands. Rubber vine (*Cryptostegia grandiflora*) has sap that burns skin and causes respiratory problems. It is contained on Maui, but is problematic on Molokai.
- Plants can create safety hazards, such as unpassable thickets. Examples in Hawai'i: Gorse (*Ulex europaeus*) is a thorny shrub that infests Maui ranchlands, restricting the ability of humans and livestock to move through areas. Tumbleweed (*Salsola tragus*) is a noxious pest that disrupts traffic when it rolls across rural roads.
- Plants can spread wildfires. Examples in Hawai'i: Fountain grass (*Cenchrus setaceus*) is fire-adapted, meaning it provides fuel for fires and readily re-sprouts after a fire. It is contained on Maui, but covers many acres on the island of Hawai'i.
- Animals can bite humans. Examples in Hawai'i: Venomous snakes, big cats, monitor lizards, piranhas have all been reported on Maui, though none of these alien species are known to be established here.
- Insects bite or sting humans. Examples in Hawai'i: Mosquitoes, centipedes, scorpions, brown recluse spiders, little fire ants, and stinging nettle caterpillars attack humans, causing varying degrees of pain or allergic response. All of these species are alien, introduced pests.
- Animals and insects can damage agriculture. Examples in Hawai'i: Because of the Mediterranean fruit fly (*Ceratitidis capitata*) infestation, Hawai'i cannot export many valuable fruit crops and must bear the expense of costly inspections. Nurseries and farms



infested with little fire ant (*Wasmannia auropunctata*) and coqui frog (*Eleutherodactylus coqui*), have to decontaminate their products before selling. Employees at orchards on the island of Hawai'i have quit due to little fire ant infestations. Axis deer (*Cervus axis*) devastate corn and pineapple fields and eat valuable pasture meant for cattle, costing farmers and ranchers hundreds of thousands of dollars each year.

- Plant diseases can damage agriculture. Examples in Hawai'i: Banana bunchy top virus and papaya ringspot virus can devastate entire crops.
- Insects carry diseases that affect humans. Examples in Hawai'i: In 1899, fleas infested with bubonic plague bit rats and humans in Hawai'i, resulting in the quarantine and eventual burning of Chinatowns in Honolulu and Kahului and numerous deaths. Recently, several outbreaks of dengue fever, which is spread by mosquitoes, infected many people on Maui. Malaria, a potentially fatal mosquito-borne disease, has not been reported in Hawai'i, primarily because the mosquito species (*Anopheles* spp.) that carries the disease is not found here—yet.
- Animal diseases can affect the human population. Feral animals such as deer carry giardia, which can infect humans and other animals that drink contaminated water or eat feces. Cats and birds carry toxoplasmosis, which can infect humans who come in contact with the animals' feces. Typhus and bubonic plague are carried by mice and other animals, and are spread to humans through fleabites. Rat lungworm multiplies in rats and is spread to humans via snails and snail slime. Swine flu, bird flu, and rabies are potential threats.

Infectious human diseases fall under the purview of the federal Center for Disease Control and the state Department of Health. When the diseases involve livestock, birds, or wild animals, natural resource managers have a role to play in halting the spread.



What is Rat Lungworm Disease?



The rat lungworm can cause a disease called angiostrongyliasis (rat lungworm disease) which can affect the brain and spinal cord. Symptoms may include severe headache, stiffness of the neck and back, skin tingling and sensitivity, sensitivity to light, hallucinations, nausea and vomiting.



Cuban Slug



Semi Slug

Foods such as raw produce, raw or undercooked snails, freshwater prawns, crabs and frogs can be contaminated by an unseen parasite *Angiostrongylus cantonensis* (rat lungworm). Fish do not spread this parasite. The rat lungworm is found most often in snails and slugs and has also been found in the flatworm. The worm infects rats, which pass the parasite to snails, slugs, freshwater prawns, crabs and frogs, not humans.



Baby Semi Slug on nickel



Giant African Snail

Prevention

DO NOT eat raw foods contaminated with the slime* from snails or slugs or visible snail or slugs. **WASH PRODUCE** completely and boil snails, freshwater prawns, crabs, and frogs for **AT LEAST 3-5 MINUTES**. Do not handle snails and slugs with bare hands. Apply slug bait to eliminate slugs from your garden. Cover your catchment tanks to prevent slugs and snails from having access. Controlling rodents can also help control the rat lungworm. *If you think you may have angiostrongyliasis, see your health care provider and let him/her know of your exposures.*

*Scientists are not sure whether exposure to slime can make you sick

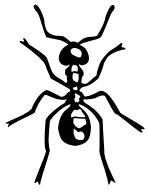
For more information call the Hawai'i District Health Office Disease Investigations office: 808-933-0912 or see CDC website: <http://www.dpd.cdc.gov/DPDx/HTML/Angiostrongyliasis.htm>



Hawai'i State Department of Health
Disease Investigation Branch
Chiyome L. Fukino, Director of Health
Linda Lingle, Governor of Hawai'i

January 29, 2009

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We provide access to our activities without regard to race, color, national origin, language, age, sex, gender identity or expression, sexual orientation, religion, or disability. For help with a problem, please contact the Disease Investigation Branch within 180 days of a problem. You may also contact our departmental Affirmative Action Officer at Box 3378, Honolulu, HI 96801-3378, or at 586-4616 (voice/tty).



Teacher Background

Readers' Theater Tips

Tell students that they will be performing a dramatic re-enactment of real-life events that happened in Honolulu in 1899. Encourage them to act with flourish. Their classmates will depend on their actions to know what is happening.

Tell students that an effective reader....

- Reads with expression
- Enunciates, using his/her voice effectively to convey meaning
- Faces the audience and projects his/her voice
- Shows emotion
- Uses props, when appropriate (the script can be a prop)

Almost everyone will get a chance to die. They should maximize their turn to shine in the spotlight. Show emotion! Die in agony! After dying, they should stand up to read their next lines.

Divide class into groups of five students. Each group will perform an act. After each act, use the talking points below to go over what happened. Students should listen carefully so they can fill in their worksheets as the play unfolds.

Talking points:

Act I: The Infection

What happened in this act?

A freighter unloaded cargo at Honolulu wharf. Large numbers of rats died. You Chong contracted plague.

How did You Chong contract the plague?

From a fleabite.

Have you ever heard of bubonic plague before? Did you know that it came to Hawai'i?

The next act explains the history of this dreaded disease.

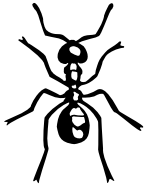
Act II: History of the Black Death

What happened in this act?

Three waves of bubonic plague struck: first in Constantinople (now called Istanbul, the largest city in Turkey), then Europe, and finally in Asia. The European epidemic killed a third of the population—40 million people. Scientists investigated the cause of the disease. Four more people died in Chinatown. Health inspectors visited Chinatown and found filthy conditions, perfect breeding grounds for the plague.

Who lived and worked in Chinatown?

Chinese and Japanese rented from Hawaiian and *haole* landowners.



Did scientists know how the plague is spread at this time?

No. They knew rats caught the disease, but they did not know how it spread from rats to humans.

What is the plague and how is it spread?

Plague is a bacterial disease caused by *Yersinia pestis*. Rats, wild rodents, cats, and dogs can become infected with plague, which is then spread by fleas. Humans can contract plague if bitten by infected animals or fleas.

Listen to the next act for examples of how the Hawai‘i Board of Health responded to this crisis.

Act III: Rapid Response

What happened in this act?

The Board of Health quarantined Chinatown, built a hospital, camp, and crematorium. They deputized citizens to search for plague victims. They raided private homes and sanitized them with lime. They burnt peoples' belongings and built new toilets. They closed schools and halted marine traffic. They charged taxes on imported goods to pay for all of the quarantine measures. Under pressure, they lifted the quarantine.

What is lime?

Quicklime is calcium oxide, a powerful disinfectant made by burning limestone. It is strongly alkaline and destroys pathogenic microorganisms. It is rarely used today because of its hazardous side effects. It is extremely caustic and causes skin burns and respiratory inflammation.

Closing the port of Honolulu in that era would be like closing the airports today. Can you imagine what would happen if all airline flights to the Islands were canceled? Who would be inconvenienced? If quarantine lasted for more than a few days, how would people get food and supplies? What would the general atmosphere be like in a quarantine zone, where no one could leave and no new supplies could be delivered?

How long was quarantine in effect?

Seven days, from Dec 12 to Dec 19, 1899.

Why did the Board lift the quarantine?

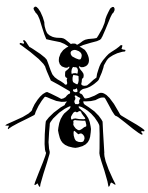
Chinatown residents wanted freedom and fresh supplies. Business owners wanted to do business. Ship captains wanted to move on.

Do you think they should have lifted the quarantine?

The next act will reveal whether the choice was a good one.

Act IV: The Great Chinatown Fire

What happened in this act?



The Board of Health reinstated the quarantine and burned contaminated houses and shops down. The Chinese community bore the brunt of the property damage and felt unfairly targeted. Dozens more people died of plague. A controlled burning spread to a nearby church. All of Chinatown caught on fire. Police prevented people from leaving the quarantine zone, even though it was burning down around them.

Imagine what it would feel like to be trapped in a quarantine zone where your neighbors were dying of a horrific disease. Consider how it would feel if all of your privacy was stripped and your belongings thrown into the street and burnt. Then imagine your home catching on fire. You aren't allowed to leave. How would you feel? Now consider it from another perspective: how would you feel if you were on the outside looking in?

Did the Board of Health need to burn peoples' belongings and houses? Why?

No. The plague is spread by fleas and infected rodents. If they controlled the fleas, they wouldn't have had to place people in quarantine or destroy their possessions.

The Board of Health did the best they could with the information they had at the time. Still, their actions had major consequences for the people living in Honolulu.

Act V: An End to the Plague—We Hope

What happened in this act?

Four thousand people were trapped in a stone church while Chinatown was burned to the ground. No one died, but many were homeless. The fire burned the plague-infested fleas and rats as well. Because the quarantine was lifted too early, ships carried the plague to other islands. The Chinese population in Hawai'i dropped from 20 to 5 percent.

Why did the Chinese population drop?

Their homes and businesses were destroyed. They probably felt angry at how they were treated and scared that they might be treated that way again. Most likely they moved to other cities with large Chinese communities.

Does plague still exist?

Yes.

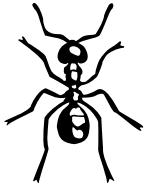
Does it kill people?

Very few. It can now be treated with antibiotics.

Could it be deadly again in the future?

Yes, the disease could mutate into an antibiotic resistant strain.

What did you learn about epidemics and invasive species from this lesson? What did the Board of Health do well? What could they have done better? Remember this, because tomorrow you will be reacting to an imaginary epidemic in your classroom!



Teacher Version

“Plague on Our Shores” Worksheet - Answer Key

As an audience member, what character were you?

Describe your reactions to:

Act I: [Accept any reasonable response; students will be missing answers for the act they perform in.]

Act II:

Act III:

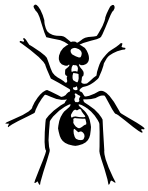
Act IV:

Act V:

List at least five steps the Department of Health took to prevent the spread of the bubonic plague in Honolulu.

Answers include:

- Quarantined Chinatown;
- Built temporary hospital, camp, and crematorium outside of town at Sand Island;
- Sent anyone with signs of plague to the temporary hospital;
- Sent anyone who had been in contact with plague victims to the temporary camp;
- Closed schools;
- Deputized a volunteer brigade of private citizens to locate plague cases and infected premises;
- Disinfected houses with lime; destroyed toilets and dug new cesspools; burnt belongings and rubbish;



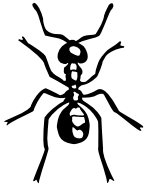
- Closed the port of Honolulu to both incoming and outgoing vessels;
- Forbade any vessel to leave Honolulu Harbor without the prior clearance from the Board of Health;
- Cancelled shore leave for mariners and passengers aboard vessels anchored offshore;
- Ordered all offshore ships to stay offshore, declared them plague-free as long as no contact was made with the shore and no human case of plague developed onboard ship within seven days;
- Ordered all foreign ships already docked at the wharf to move a minimum of six feet away from the dock, grease mooring lines, and attach rat-guards on lines anchored to the shore;
- Exchanged cargo via shuttlecrafts to minimize contact with land;
- Loaded export cargo under the strict supervision of a Board of Health inspector, to insure that it was plague-free;
- Taxed imports to defray quarantine costs. Used tax monies to combat rats;
- Burned infected homes and stores.

What kind of resistance did the Department of Health encounter?

- People resisted quarantine;
- Chinese people accused the Department of Health of racism;
- Shop owners demanded compensation for destroyed goods;
- Business interests demanded the re-opening of the harbor.

What long-term effects did the bubonic plague outbreak have on Hawai‘i?

- 337 people died;
- Chinatowns on O‘ahu and Maui were destroyed;
- Local businesses lost revenue or closed permanently;
- Chinese population dramatically declined, from 20 percent of the total population to less than 5 percent.



Teacher Version

Rat Lungworm Response Strategy - Answer Key

Are quarantine measures for sick patients required? Why or why not?

No, the disease is not contagious nor spread by human-to-human contact.

Do any invasive species need to be controlled? If so, which ones? What methods will be used to control them?

Rodents and slugs should be controlled, particularly the semi-slug *Parmarion martensi*. Rat traps and slug bait could be dispersed to areas where those animals occur. Biological controls for the semi-slug could be explored.

What kind of expertise do you need to respond to this emergency? Which agencies need to be involved?

Expertise could include: knowledge of how diseases spread (epidemiology), knowledge about slugs and rats.

Agencies could include: Hawai'i Department of Health; Hawai'i Department of Land and Natural Resources, Division of Forestry and Wildlife; Invasive Species Committees on each island; pest control companies; media outlets: radio, T.V., and newspapers.

What kinds of decontamination procedures are necessary?

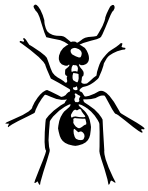
Regularly disinfect cooking surfaces, utensils, toothbrushes, and any areas that might be infested with slugs.

Inspect and wash fruits and vegetables before eating.

Examine produce before washing. Remove any dirt, debris, insects, snails or slugs, and discard leaves that might have been damaged by snails or slugs. Clean raw vegetables and fruits well before peeling, cutting, eating, or cooking. Wash produce under a cold-water spray and then soak it in distilled water for 1-2 minutes. Use a vegetable brush for produce with thick skin (melons, cucumbers, winter squash, citrus, potatoes). Waxy-skinned citrus fruits and cucumbers also may have pathogens sticking to the outside peel. With bunched fruit (blueberries, grapes, raspberries, strawberries, and similar fruits) spray or rinse in a colander with cold water. Remove all visible dirt and blot dry with a paper towel.

Use protective gear (gloves and/or tongs) when handling infected rats, slugs, or other animals.

Dispose of infected rats, slugs, and other animals. (Seal slugs in a plastic bag so that their slime will not be spread.)



List equipment that will be needed:

- rat traps
- slug bait
- gloves
- plastic bags

What is your general plan? Describe steps to be taken.

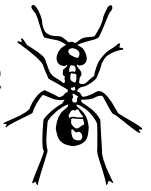
- Control rats and slugs
- Wash produce and cooking surfaces/implements
- Inform public about threat, recommend prevention methods

When and for how long will the plan be implemented?

Indefinitely

What information will be shared with the public? How and when will the public be alerted?

Basic information about the disease, how it spreads, and prevention methods should be shared with the public. Public should be notified immediately. Press releases should be sent to local newspapers and T.V. and radio stations.



Symptom Cards

Student 1:
 After sharing a picnic lunch of fried chicken, organic green salad, and fruit salad, you and your friends all reported feeling sick. At first you thought it was food poisoning. But when the symptoms didn't disappear after a day, you suspected something more serious.

Your symptoms:

- Severe headaches
- Skin tingling and sensitivity

Student 2:
 After sharing a picnic lunch of fried chicken, organic green salad, and fruit salad, you and your friends all reported feeling sick. At first you thought it was food poisoning. But when the symptoms didn't disappear after a day, you suspected something more serious.

Your symptoms:

- Severe headaches
- Vomiting

Student 3:
 After sharing a picnic lunch of fried chicken, organic green salad, and fruit salad, you and your friends all reported feeling sick. At first you thought it was food poisoning. But when the symptoms didn't disappear after a day, you suspected something more serious.

Your symptoms:

- Stomach cramps
- Muscle spasms

Student 4:
 After sharing a picnic lunch of fried chicken, organic green salad, and fruit salad, you and your friends all reported feeling sick. At first you thought it was food poisoning. But when the symptoms didn't disappear after a day, you suspected something more serious.

Your symptoms:

- Sensitivity to light
- Hallucinations

Student 5:
 After sharing a picnic lunch of fried chicken, organic green salad, and fruit salad, you and your friends all reported feeling sick. At first you thought it was food poisoning. But when the symptoms didn't disappear after a day, you suspected something more serious.

Your symptoms:

- Severe headaches
- Inability to urinate