"Can My Tree Catch the Flu?"

Activities for 4-H Marin S.E.T.
(Science, Engineering & Technology)

This series of activities helps increase youth awareness of Sudden Oak Death (SOD), a tree disease that has had devastating effects on oak populations in California. To provide an analogy to how a tree catches this disease, participants are introduced to a familiar situation – catching the flu. All activities were initially developed for a middle-school level audience but may easily be adapted to other ages and levels. The activities are interactive and engaging for the learner.

Any questions or comments about Sudden Oak Death can be directed to Janice Alexander, (jalexander@ucdavis.edu), and for 4-H or health to Jane Chin Young (jchin@ucdavis.edu). More information on Sudden Oak Death can be found at the website of the California Oak Mortality Task Force (www.suddenoakdeath.org).

Included in this kit are:

1. Suggested activities
   - "Where are there germs?" microbial multiplication activity
   - "How do germs spread?" aerosol activity
   - "How does a tree get sick?" activities
     - Tree cookies examination
     - Straw activity
   - "How clean are you?" activities
     - Part I: Hand-washing
     - Part II: Shoe sanitation
2. Suggested list of materials for activities
   - Aerosol spray bottles with water
   - AV equipment: laptop, projector, extension cords, screen
   - Clay
   - 2 dark surfaces that do not absorb water (tray, plate, hand etc.) OR two pre-sprayed and dried trays for aerosol demonstration
   - Display board for germ activity
   - Extra bread, plastic bags, and permanent marker for individual moldy bread experiments
   - Foot disinfectant mat
   - Glow-in-the-dark in the dark powder (such as Glitterbug) and black light
   - Kitchen timer
   - Laminated images or slides of appropriate visual aids, as needed
   - Magnifying glasses
   - Moldy and clean bread examples (or photos of such)
   - Movies of sneezing and *P. ramorum*
   - Multitude of small candy "germs"
   - Paper clips
   - Pencils and scratch paper
   - Ping-Pong balls (enough for about 1 per 1-2 people)
   - Hand-washing station OR baby wipes and hand sanitizer
   - Salt
   - Sealable plastic storage bags (at least 4) in various sizes
   - Straws (enough for 1 per person)

EXAMPLE: *Can My Tree Catch the Flu?* – One-hour classroom set-up

0:00 OFFICIAL SESSION START TIME

0:05 Show movies of slow-motion sneezing and *P. ramorum* in water (10 minutes)
Show first starter bag of "germs."

0:15 Aerosol activity – one person explains process while the other does the mixing and spraying. Ask group what they think will happen and what this demonstration is trying to show (10 minutes). Show second bag of germs (doubled).

0:25 Tree cookies and straw activity – each participant will take part; discuss how this relates to human diseases (10 minutes). Show third bag of germs (doubled again from # in second bag).

0:35 Sanitation for human and plant diseases – Review the results from the aerosol demonstration and show final bag of germs (doubled again from # in third bag) – ask for guesses as to total number of germs now in population; how can that number be reduced?. Glitterbug handwashing station and light for germs on hands; shoe sanitation for hitchhikers on shoes; discussion (15 minutes).

0:50 Discuss connections between diseases and forest life cycle (10 minutes).

1:00 OFFICIAL SESSION END TIME

EXAMPLE: *Can My Tree Catch the Flu?* – Exhibit set-up with suggested activities as stations
In-depth write-up on each activity begins on page 4

Station 1: "Where are there germs?" microbial multiplication activity

- Multiplying "germs" (candy, beans or Styrofoam pellets): explain that these germs will continue to grow in number as we are in this session; set the timer for 20 minutes to see how large the germ population has grown in that time
- Newspaper headlines about the flu
- Show poster/slide with micro-organism multiplication question; pass out pencils and scratch paper to those who want them.
- Show the moldy bread example and tape up on the display board next to the germs.
- Do you know anyone who has gotten the flu? Do you know about animals that have gotten sick? Do you know about any trees that have gotten sick?
- How SOD relates to the flu in humans, and what steps we can take to prevent diseases in our bodies and our forests.

Station 2: "How to Germs Spread" aerosol activity

- Show visuals of a sneeze and *P. ramorum* in water, such as a movie (~3 minutes); ASK: What did you see? What was similar in each of those movies? EXPLAIN: water from the sneeze and water from the infected leaves were both full of microscopic "germs"; for the people sneezing it was a flu virus, for the rain in the forest it was the pathogen that causes SOD (*Phytophthora ramorum*).

- Aerosol activity: Take two aerosol bottles, one with plain water only and one with very salty water. For each spray bottle, spray the surface of a black tray, showing the mist of water that looks the same from both water bottles. Show a second set of pre-prepared plates. ASK: What was hiding in one of the water bottles? How is that similar to germs on our hands or on the leaves of trees in the forest? How do we spread the germs between people? How do trees spread their germs to each other?
- There are "germs" on our hands and in our forests that can infect plants the same way we get sick. Why do you think it is important to keep trees healthy? How can water spread disease?

Station 3: "How does a tree get sick?" activities – tree cookie examination and Sudden Oak Death straw activity

- **Tree cookie examination**: closely examine tree cookies to see the different parts of the tree's circulatory system that are in the trunk; Show the poster of the tree trunk components (bark, cambium, phloem, xylem, wood, etc.) and note their specific functions; Highlight that xylem cells form long tubes that bring water up from the roots to the rest of the tree while phloem cells bring sugars from the leaves down to the rest of the tree.
- **Sudden Oak Death straw activity**: (with and without "clogged" tubes)
- What happened? Why? What does the clogged tube represent? What happens when the flow of air is constricted in the tube? How does this relate to a tree getting water? How might it relate to our own bodies? Show the slide/poster of photomicrograph of *P. ramorum* in tanoak xylem and slide/poster of clear vs. clogged arteries. What happens when these important circulatory vessels get clogged? When *P. ramorum* grows in those water tubes, what do you think happens to the tree? How do you think this ends up being "sudden" oak death?

Station 4: "How clean are you?" activities – Part I: Hand-washing and Part II: Show sanitation

- Sanitation activity: For hands – use glow-in-the-dark powder and black light to show germs on hands; For shoes – stomp on disinfectant mat
- Signage on sanitation for hands, shoes, and animals
- *Alternative clean and healthy activity*: If a Glitterbug station is not available, a potential alternative would be for each participant to re-create the moldy bread experiment by placing their hand on a piece of bread and taking it home in a sealed plastic bag to see what happens. This wouldn't provide the same immediate "gross-out" of the black light germs, but could allow for a longer interaction with the idea as they watch the mold develop on the bread over the course of a few weeks.

"Where are there germs?" Microbial multiplication activity

Overview: Some microorganisms can cause disease, both in humans, other animals, and plants, but these pathogens are too small to see with the naked eye. Where can we find these invisible pests and how fast can they grow?
Appropriate audience: All ages
Setting: Indoors or outdoors in nice weather
Estimated time: As long as the session lasts
Materials needed: Sealable plastic storage bags in various sizes, multitude of small fake "germs," kitchen timer, display board, tape or staples, pre-made moldy bread examples or photos, extra plastic bags, extra bread, permanent marker, pencils and scratch paper, slide or laminated photo of multiplication question
Background: This activity was delivered by trained staff in a classroom setting at Marin County Peer Summit (~30 participants) and as part of an exhibit at Marin County Farm Day (~1600 participants)

Microorganisms can multiply very quickly to the point that they can cause disease in otherwise healthy humans, animals, and plants. Small fake "germs" represent a microorganism that doubles its population size every 20 minutes. Begin with one or more germs in a single plastic bag or container, and set the kitchen timer for 20 minutes. Double the number in another plastic bag and re-set the timer. Continue to double the population (4, 8, 16, 32, 64, 128, etc.) every 20 minutes for the length of the session. Tape or staple the separate bags to a wall or display board for the group to view during the session.

Germs on our hands might not be visible, but given the right environment, they can grow to levels large enough for us to see with our naked eyes. At least 2 weeks ahead of the session, take 2 slices of bread. With one "dirty" hand (you may want to rub your hand through the soil in your garden), wipe against one slice of bread. Sprinkling water on the dirty slice of bread will accelerate the growth of the mold. Thoroughly wash your hands and place a clean hand on the other slice of bread. Seal each bread slice in a plastic bag and mark "dirty" and "clean" accordingly. Present the aged slices, or photos of moldy bread, at the session. If you have time, and especially if you will see the group again after a set period of time, each participant may do this same activity and see their own results.

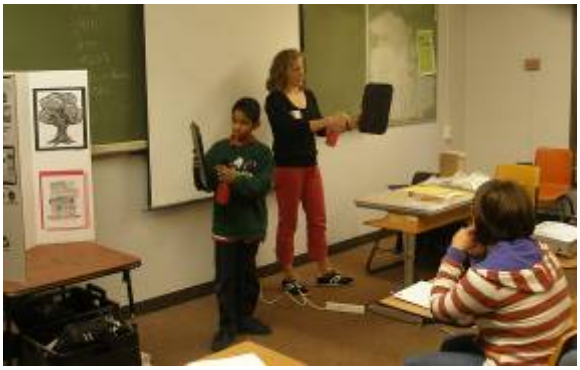
For participants with multiplication skills, have them use the pencils and scratch paper to figure out the following multiplication question: If the germ population doubles every 20 minutes, how many germs will you have after 7 hours? [Answer = 2,097,152]

"How do germs spread?" Aerosol activity

Overview: What invisible menaces might lurk in clear fluids? This activity compares a human sneeze infested with flu virus to wind-blown rain infested with *Phytophthora ramorum*.
Appropriate audience: All ages
Setting: Classroom or exhibit, indoors or outdoors
Estimated time: 10 minutes
Materials needed: 2 aerosol bottles, water, salt, 2 dark-colored trays or plates, video of sneezes/pathogen spread, AV equipment to play video
Background: This activity was delivered by trained staff in a classroom setting at Marin County Peer Summit (~30 participants), Marin County 4-H SET Summit (~12 participants), and as part of an exhibit at Marin County Farm Day (~1600 participants)

P. ramorum spreads in cool, wet weather – particularly during windy rain events. How does this microscopic organism get from the leaves of one tree onto the trunk of an oak to cause an infection?

Show the video or other visual of a human sneeze versus *P. ramorum* sporulating in water. Ask what these two enactments had in common [Answer = water].



Mix a solution of water with salt. Measurements are not necessary but, dissolve enough salt to create a very salty solution. Pour solution into the spray bottle. Spray the surface of a tray plate, hand, etc. Wait until the water evaporates and look at the surface sprayed and/or taste what is left on the surface. You should see a "film" left on the surface, or tastes a solution that is salty. The spray of salt water is an example of an aerosol. The salt crystals represent the microscopic pathogen that can be carried invisibly in drops of water from leaf to leaf and tree to tree. How does this compare to a flu virus that travels from person to person? Does distance matter? Does weather matter?

What sanitation measures might you take to stop a flu virus from spreading? What could you do to keep *P. ramorum* from spreading? Connection could be made directly to "How clean are you?" activities with hand-washing for human diseases and shoe sanitation for forest diseases.

"How does a tree get sick?" Tree cookie examination

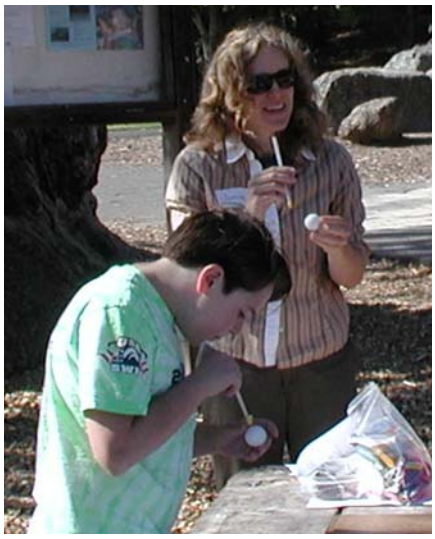
Overview: Identify the different internal structures of a tree trunk to see how it relates to the human body's circulatory system and what may lead to tree diseases.
Appropriate audience: All ages
Setting: Indoors or out
Estimated time: 10 minutes
Materials needed: Tree cookies, magnifying glasses, slides or laminated photos of tree structures
Background: This activity was delivered by trained staff at Marin County Peer Summit (~30 participants); Marin County 4-H SET Summit (~12 participants), and as part of an exhibit at Marin County Farm Day (~1600 participants)

What is a tree made of? Identify the different parts of the tree visible on the tree "cookie" (bark, cambium, phloem, xylem, wood, etc.) and note their specific functions. What parts of the trunk do we use and how? (wood for building, paper, etc.; bark for tanning [e.g. "tanbark oak"]). Are these uses sustainable? (yes, if the trees can re-grow at a fast enough rate and we are willing to use the natural resource) When we use trees for these purposes, what services do we lose? (wildlife habitat, soil stability, shade, natural beauty, etc.)

"How does a tree get sick?" Sudden Oak Death straw activity

Overview: This activity allows participants to experience the way a tree moves water from its roots to its leaves, and what happens when that flow of water is impeded by the growth of the Sudden Oak Death pathogen.
Appropriate audience: Ages 6+
Setting: Indoor or out; smaller groups can do individual straws, while exhibits should employ vacuum pumps.
Estimated time: 15 minutes
Materials needed: straws, ping-pong balls, clay, paper clips (for smaller groups); vacuum pumps*, ping-pong balls, clay (for large exhibits)
Background: The smaller group activity was delivered by trained staff at Marin County Peer Summit (~30 participants) and the Marin Count 4-H SET Summit (~12 participants)

When the microscopic pathogen *Phytophthora ramorum* lands on the trunk of certain trees, it uses tiny openings in the bark to enter the tree and consume its tissues. Given that this is a fungus-like organism that loves moisture, where in the tree do you think it prefers to live? (xylem tubes that take water from roots up to leaves)



Take a straw and place it over a Ping-Pong ball laying on a table. With some force, you can suck the ball up with the straw and pick it up off the table. Next, completely pack the end of a second straw with a bean-sized lump of clay. Unbend a paperclip and use it to poke a small hole through the clay plug. Now try to suck through the straw and lift the ball off the table.

What does the clay represent? What happens when the clay constricts the flow of air? When *P. ramorum* grows in those tissues, what do you think happens to the tree? How do you think this ends up being "sudden" oak death?

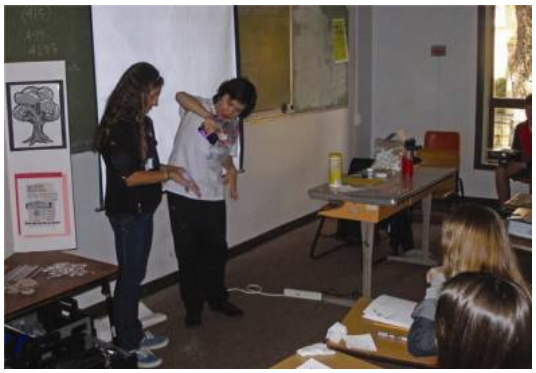
Additional connection that could be made: Straw activity shows tree circulation system and can be an analogy to the human circulatory system with open versus clogged arteries (refer to diagram of clear versus clogged arteries).

* See Vacuum Pump project at the end of this activity book.

"How clean are you?" Sanitation activities

Overview: These activities make clear how visible "cleanliness" does not always mean true sanitation, both for hands (with human germs) and shoes (for forest pathogens).
Appropriate audience: All ages
Setting: Indoors or out
Estimated time: 10 minutes
Materials needed: Black light, glow-in-the-darkw-in-the-dark powder or lotion, hand-washing station or wipes & hand sanitizer gel, white paper, foot disinfectant mat or shoe cleaning kit
Background: This activity was delivered by trained staff in a classroom setting at Marin County Peer Summit (~30 participants) and as part of an exhibit at Marin County Farm Day (~1600 participants)

What sanitation measures might you take to stop a flu virus from spreading? What could you do to keep *P. ramorum* from spreading? Our hands can easily spread germs. In a forest, dirty shoes might spread pathogens to new areas. You can do one or both of these sanitation activities to highlight the role of thorough cleaning in the effort to stop disease spread.



Part I: Hand-washing

1. Instruct individual to wash hands thoroughly.

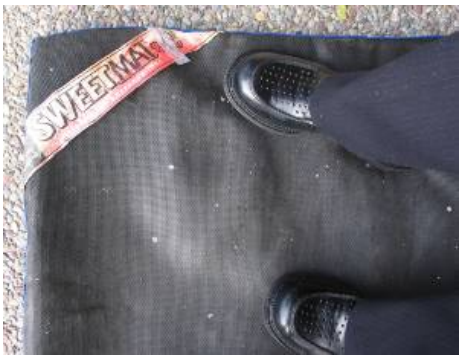
2. Have individual rub a bit of glow-in-the-dark powder over their hands and wrists.

3. Turn down the room lights or go to a dark place and look at the hands under a black light.

4. The audience will mostly likely see the missed dirt spots that glow in the dark, particularly under fingernails, at the base between fingers, and the wrists.

5. If there is time, have the individual wash their hands again, emphasizing using warm soapy water for at least 20 seconds. Then repeat the black light activity. Chances are good that there are less dirt spots that glow!

Part II: Shoe sanitation



1. Check how clean your shoes are by stomping on a clean, white sheet of paper on the ground.

2. Do a shoe cleaning with brushes or disinfectant mats. Allow a few minutes for shoes to dry.

3. Check shoes again by stomping on a clean sheet of paper to show less dirt.

* **Making a vacuum pump for straw activity in larger exhibit venues**
This activity is by Jeanette Cain and is borrowed from Light-science.com (http://www.light-science.com/airpumpcleaner.html). The air pump project shows the basic principles of a vacuum cleaner. You may need to read Hydraulic Lifter to view or review the meaning of hydraulic machines.

MATERIALS NEEDED: Large plastic bottle; Scissors; Hammer; Small Nails; Dowel or wooden stick; Tape; Ping-pong ball; String
FIRST, about 1/3 up from the bottom of the plastic bottle, cut around it. Cut a slit down the bottle's bottom part to allow it to slide INSIDE the top part. You will need an adult to help you nail the bottle's bottom to the end of a dowel or wooden stick. This is the piston for your air pump.
NEXT, tape the string to the ball and feed this through the neck of the bottle, then tape it down so that the ball is held close to the neck. Push the bottom part of the bottle, which is your piston, into the top part, which is the cylinder.
THEN, move the piston in and out: sucking air into the bottle and out of the hole. Try picking up tiny bits of paper by pulling the piston out sharply.