

Figure 2. Label from a crate of clementines purchased at a Philadelphia fruit market. Of what significance is the phrase, *Not for distribution in AZ, CA, FL, LA, TX, Puerto Rico, and any other U.S. Territories?*



Worksheet for the Citrus Canker Case Analysis

(A printable copy of this worksheet is available on the *Microbes Count!* CD.)

1. Recognize potential issues. List terms or phrases that seem to be important for understanding what the case is about.
2. Brainstorm for connections. Briefly discuss the following with the group.

What is this case about?

What are its major themes?

Keep track of major issues and questions that arise with the Know/Need To Know chart.

Identify one question or issue from the “need to know” list that your group wants to explore.

What do we already know?	What do we still need to know?

3. Obtain additional references or resources to help answer or explore questions. These may include print resources, informational articles, data sets, results of simulations, maps, interviews, etc.

List four different resources you think would be important to use to learn more.

4. Design and conduct scientific investigations relevant to the question.

Investigations could be laboratory, field or computer-based experiences that the instructor arranges for the entire class or may be entirely student generated. Describe your plans.

- Communicate your understanding of the outcomes of your work on the question.

Produce materials which outline the problem and support your conclusions. These artifacts can take many forms, from traditional papers and scientific reports, to posters, videos, pamphlets, consulting reports, role playing, interviews, etc. Decide what products would be best for this case investigation.



Figure 3. A collection of citrus products from the local supermarket. A quick scan of the labels reveals the origin of these citrus products to include Florida, California, Texas, Mexico, Brazil, Argentina, Curacao, Portugal and China.

Citrus Canker Case Team Projects

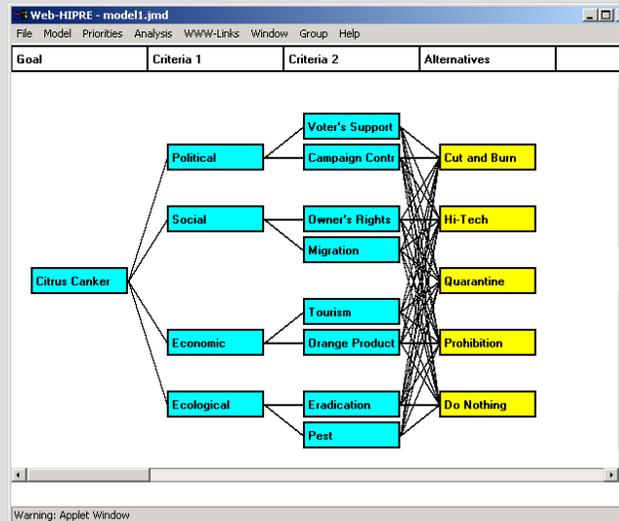
The following were identified as research questions of interest by students in environmental biology at a local college.

- What is citrus canker?
 - Describe the biology and life cycle of the causative agent(s).
 - What are the possible host species?
 - Does the canker organism (or its by-products) affect humans?
- When and where was citrus canker first discovered in the world? In the U.S.?
 - Where in the world and in the U.S. does it occur today? (Include maps.)
 - How does it spread?
- Describe all aspects of historical and current control measures in the U.S.
 - Have they been effective?
- Describe all aspects of historical and current control measures in Brazil.
 - Have they been effective?
- Describe the economic impact of the citrus industry in Florida, the U.S., and at least two other countries in the world.
- How can biotechnology assist scientists attempting to solve the citrus canker problem?

Figure 4. This model looks at five different alternatives proposed to control citrus canker with respect to political, social, economic, and ecological goals.

Optional Activity: Decision Making and Control of Citrus Canker

There are several options that could be used to deal with the problem of citrus canker. You can construct decision making models to examine these options at the Web-HIPRE Hierarchical Preference Analysis site at <http://www.hipre.hut.fi>. A sample model is shown in Figure 4.



Possible options for the control of citrus canker include:

1. Cut and burn potentially infected trees as needed regardless of ownership.
2. Fund research to look for high tech solutions to control citrus canker.
3. Quarantine areas with infected trees to provide barriers to transmission.
4. Prohibit the planting of new citrus trees by homeowners
5. Do nothing

You should:

- Identify several community stakeholders in a town facing citrus canker control
- Be prepared to role play one of these stakeholders
- Discuss the control methods and the impact each has on the goals from the stakeholder's perspective.

Web Resources in this Activity

Web-HIPRE Hierarchical Preference Analysis site
<http://www.hipre.hut.fi>

Additional Resources

Available on the *Microbes Count!* CD

Text

A PDF copy of this activity, formatted for printing

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Related *Microbes Count!* Activities

Chapter 5: The Farmer and the Gene: A Case Approach to Bt Corn

Chapter 12: Souvenirs: Investigating a Disease Outbreak

Unseen Life on Earth Telecourse

Coordinates with Video IX: Microbial Control

Relevant Textbook Keywords

Agriculture, Control, Pathogen

Related Web Sites

Citrus Leaf Miner Life Cycle

http://primera.tamu.edu/citrus_entomology.htm

http://primera.tamu.edu/citrus_leafminer_parasites.htm

Citrus Canker Maps

<http://www.citruscanker.com/canker0726map.gif>

<http://doacs.state.fl.us/canker/cankerflorida.pdf>

<http://doacs.state.fl.us/canker/images/canker-by-year.jpg>

<http://www.nass.usda.gov/fl/gif/cprd0001.gif>

Control of Citrus Canker

http://www.imok.ufl.edu/plant/docs/canker_indian_river_2002.pdf

<http://cancer.lbi.ic.unicamp.br/xanthomonas/citri/Maps/M2/1.1.html>

http://www.agriculture.com/default.sph/agNotebook.class?FNC=ArticleList__Aarticle_html___3097___7

(note: there are multiple underlines in this URL)

<http://preserve.nal.usda.gov:8300/jag/v14/v14i9/140337/a140337.htm>

Hurricanes

<http://www.escambia-emergency.com/images/hcanemap.jpg>

<http://www.fema.gov/nwz99/images/hurr0819.gif>

<http://www.met.fsu.edu/explores/Tropical/at12.htm>

<http://www.edrinc.com/edr-hurricane.jpg>

Xanthomonas axonopodis pv. *citri* Gene Map

<http://cancer.lbi.ic.unicamp.br/xanthomonas/citri/Maps/1.1.html>

Figure and Table References

- Figure 1. Modified from the *Miami Herald*, July 26, 2001
<http://www.citruscanker.com/canker0726map.gif>
- Figure 2. Courtesy of Ethel Stanley
- Figure 3. Courtesy Margaret Waterman
- Figure 4. Screen shot of citrus canker scenario using Web-HIPRE
Hierarchical Preference Analysis
<http://www.hipre.hut.fi>