

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

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Video V: Genetic Transfer

Investigative case-based learning is a collaborative process in which individuals work together to identify and understand the scientific issues involved in the case at hand. You are encouraged to work in a group as you consider *The Farmer and the Gene*. Begin by asking someone to read the case below. (Note: The case is in the form of a short interview. Several of the figures in this activity offer additional information you may wish to consider as well.)

A case analysis worksheet structures the process of considering carefully the microbiological information your group already knows and what your group wants to know more about. You will be asked to generate your own questions and to pose specific problems for study. Then, choose one of the problems that interests the group.

You will need to decide which tools or resources to use. There are a number of resources provided in this activity and in the related web sites. On the *Microbes Count!* CD, there is an additional resource you may wish to consider, a file containing Protein Data Base information for five different Bt endotoxins. Your group must decide on a methodology for investigating the problem.

You should collect data and present your conclusions about the problem. Make sure the conclusions are supported by your findings. The manner of presentation can be negotiated with your instructor. Perhaps you will do a full lab report, or you could generate a presentation to another group, write a brochure on the topic for a specific audience, create a poster display, submit information to a local legislator or planning board, etc.

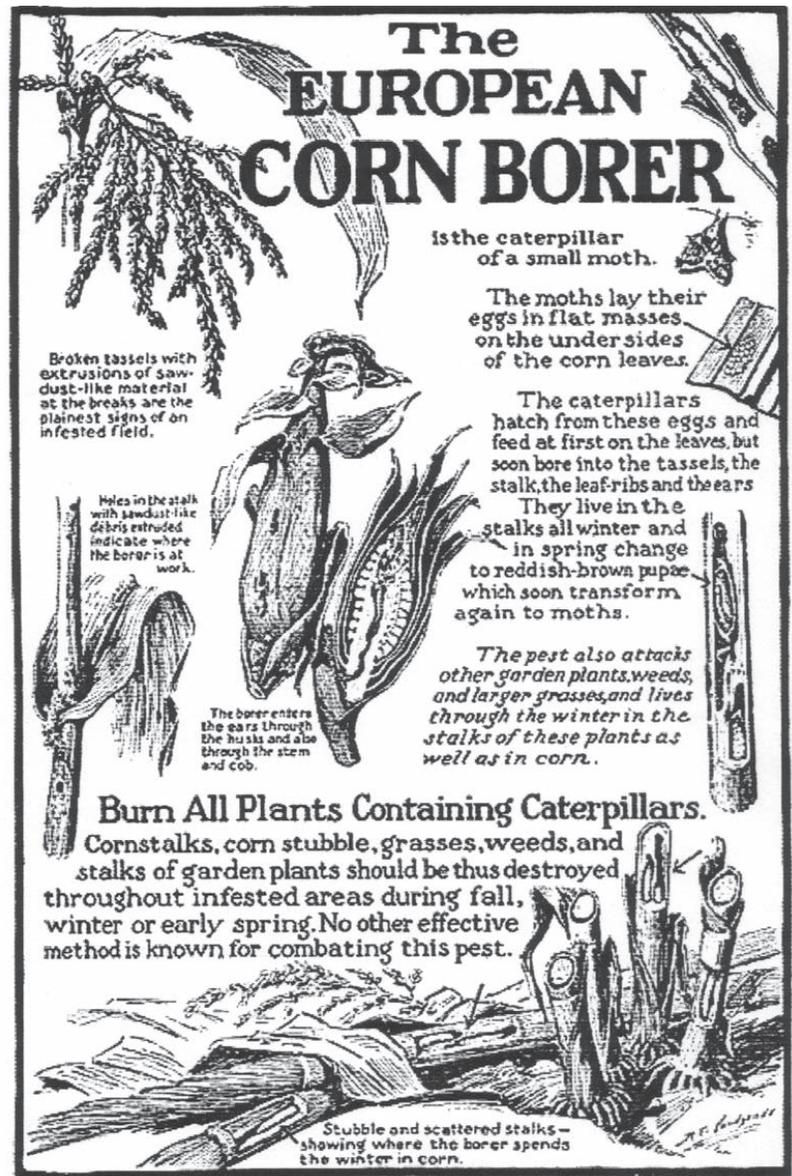


Figure 1. Control of the European corn borer in the United States circa 1920.

The Farmer and the Gene: An Interview

“Did you ever have to burn the corn fields to get rid of corn borers?”

“No, but my grandparents probably did. My Dad thought corn borers were a problem. I remember him checking the fields pretty regularly and spraying our corn with Bt—some kind of bacteria that killed the corn borers—at least a couple of times every summer. Now we just plant Bt corn.”

“Bt corn? Are the bacteria mixed in when you plant?”

“It’s corn that has a gene from the bacteria. I don’t know why, but the bacteria make a protein that kills the corn borer and other insects.”

“Do you think using Bt corn is safe?”

“I do. In fact, this year I’m planting a new hybrid that controls for rootworms as well as corn borers. Some folks think this is asking for trouble down the road. With the plants making Bt proteins in the field all season, the corn borers could get used to it. Some growers in the next county got mixed up in that StarLink fiasco, so they’re really avoiding all Bt corn.”



Figure 2. In the United States, Bt corn hybrids were grown on over 25 million acres in 2002.

Case Analysis Worksheet

(A 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.

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

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

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.

5. Produce materials that support understanding of the conclusions.

These products can take many forms, from traditional papers and scientific reports, to posters, videos, pamphlets, consulting reports, role playing, interviews, etc.

What sorts of products might be produced as a result of investigations of the questions identified here?

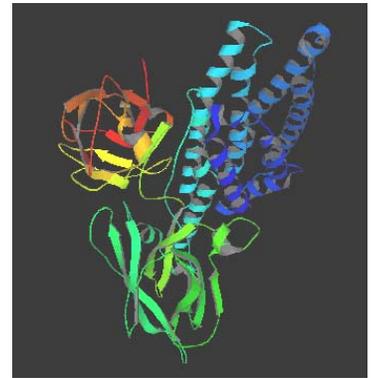


Figure 3. The structure of Cry3Bb, an insecticidal Bt protein that attaches to the lining of the insect gut and forms channels. This protein is effective against corn rootworms as well as corn borers.



Figure 4. The increasing use of Bt corn hybrids raises concerns. In the left image, note the proximity of the milkweed plant (preferred food of the Monarch butterfly) in the foreground to the corn in the background. In the right image, the mature tassels distribute pollen containing the Bt toxin over a large area.

Additional Resources

Available on the *Microbes Count!* CD

Text

A PDF copy of this activity, formatted for printing

Case Analysis Worksheet

Optional Assignment: Extending the Bt Corn Case

PDB Summary of Bt Endotoxins

Student Notes for Using Cases

Related *Microbes Count!* Activities

Chapter 9: Mold Fights Back: A Challenge for Sanitation

Chapter 9: Citrus Canker: Alternatives for Control

Chapter 9: A Plague on Both Houses: Modeling Viral Infection to Control a Pest Outbreak

Chapter 10: Controlling Potato Blight: Past, Present and Future

***Unseen Life on Earth* Telecourse**

Coordinates with Video V: Genetic Transfer

Relevant Textbook Keywords

Bacillus thuringiensis (Bt), Endotoxin, Hybrids, Stacked genes

Related Web Sites (accessed on 1/20/03)

Biology of the European Corn Borer

<http://www.bio.org/food&ag/ncfap/corn.htm>

Bt Corn Insect Refuge Calculator

<http://profitablefarming.com/WebServices/BtCorn/InsectRefugeCalculator.asp>

Bt crops suspected to hurt soil ecology

<http://www.psrast.org/btsoilecol.htm>

Bt toxin resources

<http://www.nalusda.gov:80/bic/BTTOX/bttoxin.htm>

Coming to terms with GM food, links to BBC resources

http://www.checkbiotech.org/root/index.cfm?fuseaction=briefings&keyword_id=3545

Corn Growers Fear Losses

<http://bioquest.org/llsummer00/localnws.html>

Data on expression levels of Cry3Bb

http://www.ucsusa.org/food/Cry3Bb_tables.pdf

Engineer a Crop (From PBS/Nova)

<http://www.pbs.org/wgbh/harvest/engineer/>

Ethics and GMO's – quite comprehensive outline

<http://www.public.iastate.edu/~cfford/342EthicsandGMOs.htm>

EPA registration material for Cry 1Ab Bt toxin

<http://www.epa.gov/pesticides/biopesticides/factsheets/fs006444t.htm>

European corn borer damage in Bt corn

<http://www.ent.iastate.edu/imagegal/plantpath/corn/ecb/bteardam.html>

Extending the Bt Corn Case

<http://www.bioquest.org/lifelines/fract.html>

Glossary of Biotech terms

<http://www.ncbiotech.org/biotech101/glossary.cfm>

Guess what's coming to dinner? Fun way to see impact of GE on food

<http://www.pbs.org/wgbh/harvest/coming/coming.html>

History of Bt

http://www.bt.ucsd.edu/bt_history.html

Harmony between agriculture and environment

<http://www.ers.usda.gov/Emphases/Harmony/issues/genengcrops/terms.htm>

Introduction: The European Corn Borer

<http://www.ent.iastate.edu/pest/cornborer/intro/intro.html>

LifeLines OnLine

<http://bioquest.org/lifelines/index.html>

Look What's Out There: March 2003

<http://www.wvu.edu/~agexten/lookwhat/lwot303.pdf>

Microbial mutation clock

<http://www.pbs.org/wgbh/evolution/survival/clock/>

Microbes Count! Website

<http://bioquest.org/microbescount>

Pesticide use likely to feel bite of new biotech corn (June 2002) Bt for rootworm

<http://www.ohio.com/mld/beaconjournal/news/nation/3616259.htm>

Pros and Cons of Genetically Engineered crops

<http://www.wvu.edu/~agexten/ipm/animals/genetic2.htm>

Refuges for Resistance Management: Bt Corn and European Corn Borers

<http://spectre.ag.uiuc.edu/cespubs/pest/articles/199904d.html>

Should I plant Bt corn?

<http://msucares.com/crops/corn/corn13.html>

Student Notes for Using Cases

<http://www.bioquest.org/snotes2.html>

Union of Concerned Scientists comments to EPA about new Cry3Bb for corn rootworm: Detailed; discusses also antibiotic resistance markers used in genetic engineering

http://www.ucsusa.org/food_and_environment/biotechnology/page.cfm?pageID=1014

Unseen Life on Earth: A Telecourse

http://www.microbeworld.org/htm/mam/is_telecourse.htm

US Distribution of Bt corn

<http://www.ncga.com/biotechnology/BtMaps/USMaps1.htm>

References

Stanley, E. D. and M. A. Waterman (2000). LifeLines OnLine: Curriculum and Teaching Strategies for Adult Learners. *Journal of College Science Teaching*, March/April 2000, 306-310.

Waterman, M.A. (1998). Investigative case study approach for biology learning. *Bioscene: Journal of College Biology Teaching* 24(1): 3-10.

Figure and Table References

Figure 1. Caffrey, D. J. (1919). The European corn borer. Farmers' Bulletin 1046. United States. Dept. of Agriculture

Figure 2. Courtesy Ethel Stanley

Figure 3. Modified images from the Protein Data Bank web site
<http://www.rcsb.org/pdb/>

Figure 4. Courtesy Ethel Stanley