

LESSON:

The Case of the Contaminated Maize

Summary: Students read a brief article detailing the investigation of an outbreak of aflatoxin poisoning, and then identify the stages of an epidemiologic investigation.

EHP Article: "Liver Cancer and Aflatoxin"
EHP Student Edition, March 2006, p. A837–A838
<http://ehp.niehs.nih.gov/docs/2005/113-12/ss.html#live>

Objectives: By the end of this lesson students should be able to:

1. describe the symptoms and environmental causes of aflatoxin poisoning;
2. distinguish the stages of the epidemiologic investigation process; and
3. identify the key data evaluated in the study.

Class Time: One hour in class or as homework

Grade Level: 9–12

Subjects Addressed: Environmental Health, Environmental Science, Health, Agricultural Science, Biology, Epidemiology

► Prepping the Lesson (10 minutes)

INSTRUCTIONS:

1. Download the entire March 2006 *EHP Student Edition* at <http://ehp.niehs.nih.gov/science-ed/>, or download just the article "Liver Cancer and Aflatoxin" at <http://ehp.niehs.nih.gov/docs/2005/113-12/ss.html#live>.
2. Read the article and the Background Information section of the lesson.
3. Make copies of the Student Instructions.

MATERIALS (per student):

- 1 copy of *EHP Student Edition*, March 2006, or 1 copy of the article "Liver Cancer and Aflatoxin"
- 1 copy of the Student Instructions

VOCABULARY:

- Adduct
- Aflatoxicosis
- Aflatoxin
- Albumin
- Antigen
- Geometric mean
- Granaries
- Hepatitis
- Jaundice
- Maize
- Malaise
- Malnutrition
- Serum

BACKGROUND INFORMATION:

The article "Liver Cancer and Aflatoxin" describes a case-control study related to an outbreak of aflatoxin poisoning in Kenya. A case-control study is a common research design used to investigate the causes of disease. Patients who have developed health problems are identified, and their exposure to the suspected cause is compared to controls who do not have the health



problem. The control group must be carefully matched with the diseased group so that the only difference between the groups can be attributed to the exposure to the suspected cause of the health problem.

The word “adduct” does not appear in most student-oriented dictionaries. “Adduct” when used in this sense is a chemistry term and means either “a chemical compound that forms from the addition of two or more substances” or “a compound formed by an addition reaction.” Other terms that may be helpful for students (depending on their reading level) are the following: “albumin,” “antigen,” “granaries,” “hepatitis,” and “malnutrition.” Students will define “maize,” “serum,” “acute,” “chronic,” and “jaundice” as part of the activity.

RESOURCES:

Environmental Health Perspectives, Environews by Topic page, <http://ehp.niehs.nih.gov>. Choose Food Safety and Regulation, Mycotoxins

CDC. 2004. Outbreak of aflatoxin poisoning—eastern and central provinces, Kenya, January–July 2004. *MMWR Morb Mortal Wkly Rep* 53(34):790–793; <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5334a4.htm>

FDA, FDA issues consumer alert on contaminated pet food, <http://www.fda.gov/bbs/topics/NEWS/2005/NEW01290.html>

Lewis L, Onsongo M, Njapau H, et al. 2005. Aflatoxin contamination of commercial maize products during an outbreak of acute aflatoxicosis in Eastern and Central Kenya. *Environ Health Perspect* 113:1779–1783; <http://ehp.niehs.nih.gov/members/2005/7998/7998.html>

► Implementing the Lesson

INSTRUCTIONS:

1. Hand out the article “Liver Cancer and Aflatoxin.”
2. Review the vocabulary words not assigned in the activity (see Background Information).
3. Assign the article and activity described in the Students Instructions as an in-class assignment or as homework.
4. Review the assignment upon completion to clarify points and advance understanding of the scientific method.

NOTES & HELPFUL HINTS:

- More senior students should be able to complete this exercise without supervision as a homework assignment. Younger students or those with a lower reading level should do the exercise as a class or with teacher support.
- Aflatoxin has recently been found in certain brands of pet food. As an extension activity, have students search news articles for reports about the contaminated pet food.

► Aligning with Standards

SKILLS USED OR DEVELOPED:

- Communication (note taking, oral, written—including summarization)
- Comprehension (listening, reading)
- Critical thinking and response
- Experimentation (data analysis)

SPECIFIC CONTENT ADDRESSED:**Unifying Concepts and Processes Standard**

- Systems, order, and organization
- Evidence, models, and explanation
- Change, constancy, and measurement
- Form and function

Science As Inquiry Standard

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Science in Personal and Social Perspectives Standard

- Personal and community health
- Natural resources
- Environmental quality
- Natural and human-induced hazards
- Science and technology in local, national, and global challenges



▶ Assessing the Lesson

Definitions may vary depending on the dictionary used by students. The following definitions were taken from the *American Heritage Dictionary, Third Edition*, Houghton Mifflin, 1996.

Step 1: Use a dictionary to define the following terms. If there are multiple definitions listed, choose the one that seems most relevant to health:

Maize: Corn

Acute: Having a rapid onset and following a short but severe course.

Chronic: Lasting for a long period of time, or marked by frequent recurrence, as certain diseases.

Jaundice: Yellowish discolorations of the whites of the eyes, skin, and mucous membranes caused by the deposition of bile salts in these tissues. It occurs as a symptom of various diseases, such as hepatitis, that affect the processing of bile.

Serum: The clear yellowish fluid obtained upon separating whole blood into its solid and liquid components.

Step 3: The table below shows the basic stages of an investigation into a disease epidemic, a key area of the science of epidemiology. Fill in the table by describing specific actions taken by the investigators in Kenya at each stage of the study.

Stages of Investigation	Kenya Aflatoxin Study
1. Identify an outbreak in place, time, and number of cases/fatalities	Eastern Kenya, Africa, January–June 2004 317 people sought treatment, 125 died
2. Develop a hypothesis about a possible cause	Aflatoxin was suspected as a cause after doctors ruled out a virus.
3. Design a study to test the hypothesis	A case–control study was planned, using 40 patients and 80 randomly selected controls.
4. Collect data on a) the subjects b) the environment	Questionnaires assessed environmental factors like grain storage, consumption. Blood samples were taken and tested for signs of aflatoxin and hepatitis B antigen. Samples of maize were tested for the presence of aflatoxin.
5. Summarize findings and evaluate your hypothesis	Cases had 10 times the levels of toxin in their blood of the controls, and had significantly high concentrations of the toxin in the maize found in their homes. Among cases, 44% had hepatitis B versus 7% of the controls. Cases who died had higher levels of aflatoxin in their blood than those who survived. The hypothesis that aflatoxin was the cause of the health problems was confirmed by the findings.
6. Make recommendations for future control and prevention efforts	Actively monitor toxin levels in crops, watch for cases of acute jaundice to screen for aflatoxin poisoning, and use the antigen-specific blood test when aflatoxicosis is suspected.



Step 4: What was the purpose of the control group in the investigation?

The purpose of the control group was to determine a comparison baseline for the measured information in the study for the people in the general population who were not hospitalized with acute jaundice. If the people who were hospitalized had higher exposures to aflatoxin than the controls, then it is reasonable to conclude that the acute jaundice was related to exposure to aflatoxin. Without a control group, you would not know if exposure to aflatoxin was higher for the acute jaundice patients than for the general population.

► Authors and Reviewers

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Give us your feedback! Send comments about this lesson to ehpscienced@niehs.nih.gov.



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Step 1: Use a dictionary to define the following terms. If there are multiple definitions listed, choose the one that seems most relevant to health:

Maize:

Acute:

Chronic:

Jaundice:

Serum:

Step 2: Now read the article "Liver Cancer and Aflatoxin."

Step 3: The table below shows the basic stages of an investigation into a disease epidemic, a key area of the science of epidemiology. Fill in the table by describing specific actions taken by the investigators in Kenya at each stage of the study.

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