Executive Summary For Teachable Unit

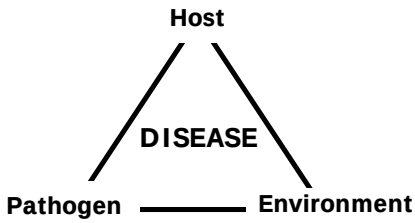
I. Title: An Introduction to Aflatoxins and Their Epidemiology

II. Developer: Dan Larkin

III. Learning goals

- *Primary* learning goals
  - Students gain insight into the **scientific process** by trying to solve an epidemiological mystery and learning about Turkey "X" disease
  - Students learn about **aflatoxins** and their relevance to health
  - Students gain perspective that disease results from organisms' interactions with each other and their environment through lessons on the *disease triangle*

- *Secondary* learning goals
  - Students' knowledge of microbes will be expanded
  - Students will view science as investigative
  - Students will hone cooperation and logic skills



IV. Scientific teaching themes: See TU Review Rubric for guidelines.

Describe how the unit addresses the following themes:

- **Scientific teaching**
  - Uses active learning approaches, incorporates diversity, and builds-in pre, post, and in-class assessment
  - Requires students to "act like" scientists by generating hypotheses and thinking about how to test them, and provides examples of science-in-action

- **Diversity**
  - Students are exposed to diverse learning methods: traditional lecture; short video clip; individual work, paired work, and whole class discussion
  - Students see how different branches of science can cooperate to solve complex problems (agronomy, ecology, medicine, etc.)
  - Students learn about case studies from U.S., U.K., India, and Kenya

- **Active learning**
  - Think-pair-share activity
  - Whole class discussion eliciting factors contributing to disease outbreak
  - Concept map of complex interactions involved in Diamond dog poisoning
  - Take-home individual work extending knowledge to new situations

- **Assessment**
  - Pre-quiz will help instructors evaluate prior knowledge
  - Think-pair-share exercise will gauge student understanding of scientific method (hypothesis testing, experimental design, controls…)
  - Whole class discussion will demonstrate understanding of factors that contribute to disease and basic epidemiology
  - Diamond case concept map demonstrates student understanding of interactions

V. Teaching Plan

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Time	Topic	Activity/ Assessment	Goals
Pre-class	**Prior knowledge**	*Pre-quiz*	Assess student prior knowledge
0-20	**Veterinary mystery**	*Think-pair-share*	Sci. process: Hypothesis generation, exptl design
	Engage/Explore: Students read "Vet Detectives" scenario and, in pairs, discuss their ideas for what might be causing the sickness and how they could test these hypotheses. Pairs share w/ class.		
20-30	**Turkey "X" Disease, Intro. to Aflatoxins**	*Mini lecture*	Science is investigative, Aflatoxin basics
	Explain: After pairs share their ideas, teacher segues into story of Turkey "X" disease, U.K. 1960: "Just like you, scientists faced a pressing mystery… Like you, tested…" Then *learning objectives* for today (PP slide) and aflatoxin basics (PP slides).		
30-35	**Disease outbreak factors**	*Whole class discussion*	Students see disease outbreak as confluence of factors
	Elicit: What factors contribute to disease outbreaks? Why do some people get sick when others don't? Why are some diseases present in only certain regions? Or occur more often at certain times of year?		
35-45	**Disease triangle**	*Mini lecture, discussion*	Students see disease as outcome of interactions
	Explain: Introduce disease triangle as way of conceptualizing how pathogen, host, and environmental factors interact in disease outbreak. *Explain:* Pre and post-harvest risk factors for aflatoxin contamination.		
40-50	**Liver function and toxicology**	*Mini lecture*	Students understand the liver is the primary organ affected by aflatoxins
	Explain: Basics about what the liver is and how it works. Biotransformation, aflatoxicosis, etc. (PP slides).		

Teaching Plan

Time	Topic	Activity/ Assessment	Goals
50-60	**Aflatoxin outbreaks**	*Mini lecture*	Aflatoxins are relevant. Can kill humans and outbreaks still occur, even in U.S.
	Elaborate: Present case studies from India and Kenya of human aflatoxin poisoning, show how pre and post-harvest risk factors and human health contributed to outbreaks (PP slides). Video on recent pet food contamination in U.S.		
60-70	**Complex interactions**	*Concept map*	Evaluate student learning
	Evaluate: "As can see, disease results from complex interactions, not just disease triangle w/ aflatoxins b/c have to consider (1) disease in plants and (2) disease in humans or animals…" In groups, create a concept map/flow diagram for Diamond case that incorporates the following terms: Moisture, temperature, soil conditions, crop conditions, *Aspergillus* abundance, aflatoxin contamination, storage conditions, dog health, dosage, bioactivation, aflatoxicosis, death.		

Vet Detectives

You and your partner are veterinarians in a Wisconsin farming community. On a hot July morning you get a frantic call from Paul, a local turkey farmer. An illness is killing his birds and he asks you to come over right away. When you get there, a horrible scene awaits: of the farm's 5,000 birds, 300 are dead and the rest are showing signs of illness.

Paul tells you that over the last week many of the birds seemed fatigued. The first deaths happened two days ago. He had been worried about the unusually high temperatures and humidity during the past month. To make matters worse, a ventilation fan in his feed storage area burned out a couple weeks back and replacement parts have been slow to arrive. When you walk over to the feed storage area, a rank, musty odor nearly overwhelms you. The room is hot and dank and big piles of dried corn that are used as turkey feed look like they've seen better days.

You begin a thorough investigation of the turkeys, dissecting several dead animals. The most obvious symptoms are swelling and rupturing of their livers. You both suspect a contagious disease. Being scientists, you decide to verify this back at your lab by placing healthy birds from another farm in close contact with some of the sick birds. You are surprised to find that none of the healthy birds develop symptoms, even after you directly expose them to waste, mucus, and blood from sick birds.

You are relieved that the disease does not seem to be infectious but frustrated that the problem remains unsolved. In the meantime, more of Paul's turkeys are dying. Without a quick solution, he'll be out of business.

Questions:

- What are some possible causes of the mysterious outbreak?
- How could you test these possibilities?

Pre-quiz

1) Briefly describe the steps of the scientific method.

2) What are some factors that contribute to outbreaks of disease?

3) What are some potential human health risks associated with the food supply?

4) In the U.S., we have strong regulations in place to control toxins and pathogens in the food supply. What are some potential obstacles to keeping the food supply safe in less developed countries?

5) What is the primary organ in vertebrates that breaks down toxic chemicals?

References

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Ritchie, JC. 2002. Chapter 1: Aflatoxin. In RH Waring, GB Steventon, and SC Mitchell, eds. Molecules of Death. World Scientific Publishing Co. http://www.worldscibooks.com/medsci/etextbook/p108/p108_chap1.pdf

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Diamond Pet Foods case:
http://video.msn.com/v/us/msnbc.htm?g=4f5b9130-f6fc-4134-9857-65b223f1efd2&f=00
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