



Teaching Students to Solve Complex Problems Based on Large Bodies of Information



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THE CHALLENGE

- ❖ Students in the sciences are exposed to large bodies of detailed information within their chosen discipline.
- ❖ Instructors typically transmit that knowledge as discrete parcels of information via lectures, books or class notes.
- ❖ Students become adept at memorizing and temporarily storing that information in the context of the lecture, book or class notes.
- ❖ However, when asked to apply that information to solve complex problems based on real-life situations, students often struggle to perform at that higher cognitive level.

OBJECTIVES

- ❖ To develop learning tools that allow students to learn by directly linking the learning of the information to the solving of complex problems.
- ❖ To design web-based modules that help students understand how to apply the information and how to solve complex problems.

ONLINE LEARNING MODULE

- ❖ The course is ANSC 438, Lactation Biology. This upper-level course typically has 35 - 40 students registered each spring semester. Most students are juniors or seniors in Animal Sciences. Few students have significant backgrounds in the topic area.
- ❖ The case studies component of the online module is based on real-life case studies of dairy herd mastitis problems originally written by Dr. Dawn Morin (Veterinary Clinical Medicine, UIUC). The cases have multiple parts and are extensive in the detailed information about the dairy farms and Dr. Morin's observations. Mastitis is an inflammation of the mammary gland and is a major disease problem in cattle.
- ❖ The information contained in the cases is presented in a step-wise manner, with many steps asking the student to print the page as a worksheet and record their thoughts and interpretation of the case.
- ❖ Each step is linked to a mastitis resource that provides background information about mastitis-causing bacteria, mastitis syndromes, detection, how the disease is manifested, general aspects of dairy cattle management, and other related topics. The resource is the course notes.
- ❖ Sections of the resource have been modified to directly relate the background information to situations of on-farm mastitis problems.
- ❖ The online module, with two case studies and the mastitis resource, forms the cornerstone for student learning to solve other complex mastitis case studies, and subsequently other case studies in lactation biology.

Asynchronous and Synchronous

- ❖ Students initially solve the two online cases prior to in-class group discussions. This is accomplished asynchronously and individually.
- ❖ Aside from this online activity, all other components of the mastitis module are conducted in a group environment.
- ❖ The class visits the UIUC dairy farm where students become acquainted with their groups through an activity that helps them understand some of the terms and concepts underlying the cases.
- ❖ In-class, students initially share their observations, approach and conclusions in solving the online cases.
- ❖ Each group then is assigned three additional cases to solve. Group discussions occur during another two in-class sessions.
- ❖ After the initial in-class session, students are asked to identify aspects of the mastitis resources that they do not understand. A lecture then is developed to address these deficiencies.
- ❖ In the final session of the mastitis module, each group is responsible for the solution to their cases and for explaining each of their cases to the rest of the class.

Farmer Bo Vine's Problem

Step 1

Farmer Bo Vine has called you in August and indicated that he has a mastitis problem in his herd. He provides the following information. Mr. Vine has a 60-cow Holstein herd in Eastern Vermont. There has been a recent increase in the incidence of clinical mastitis cases in his herd. Four cows developed clinical mastitis this week and three cows developed clinical mastitis last week. This mastitis has been subacute (flakes or chunks in the milk) or acute (inflamed quarter and flakes or chunks in the milk). Most cases have responded well to oxytocin administration at milking time, followed by intramammary treatment with antibiotic (pirimycin HCl). A few cows have required more doses of antibiotic than recommended by the manufacturer. His cows are milked twice a day in a single-sided 4-cow parlor. It is a high-pipeline system and he does not have automatic take-offs. The cows are housed and fed in a tie-stall barn. They are turned out into a drylot once a day for exercise and barn cleaning.

Farmer Bo Vine's Problem

Step 2

Be sure that you know the meaning of all the terms used in this case and why they may or may not be relevant to the mastitis problem (see some examples below). If you are unsure of the terms, then go to the [Mastitis Resources](#) for further information.

- Season
- Herd location (region)
- Relevance of herd size
- Definition of clinical mastitis
- Incidence of clinical mastitis
- Subacute mastitis
- Acute mastitis
- Oxytocin administration
- Intramammary antibiotic
- Milking parlor
- High-pipeline system
- Automatic take-offs
- Tie-stall barn
- Drylot

Farmer Bo Vine's Problem

Step 3

Be sure that you understand the distinctions among the various types and modes of transmission of mastitis. If you are unsure of the types, then click on the term for further information.



Farmer Bo Vine's Problem

Step 4
PRINT THIS PAGE

Before traveling to Farmer Bo Vine's farm you will want to develop several lists of things that you want to consider in addressing this problem, based on the limited information that you have at this time. **Print out this page** and use it to develop your lists for the following:

1. Observations that you think are indicators that there is a mastitis problem in Farmer Bo Vine's herd.
2. Potential predisposing factors or factors that may be contributing to the mastitis problem.
3. Types of information that you will want to gather when you visit Farmer Bo Vine's herd.

Clinical Syndromes Associated with Mastitis

Clinical syndromes are based upon the severity of the inflammatory response. Symptoms include - Redness, Swelling, Heat, Pain, and Loss of Function including decreased production, change in composition, and change in appearance. The clinical syndromes include **Peracute, Acute, Subacute, and Chronic**. **Subclinical** syndromes is also discussed.

Peracute Mastitis : Peracute mastitis is characterized by a sudden onset, severe inflammation of the udder, serous milk. Peracute mastitis can lead to agalactia. The inflammation may result from the organism itself, enzymes (from the tissue or the bacteria), toxins (endo or exo), or leukocyte products. The systemic illness is due to septicemia or toxemia, results in fever, anorexia, depression, decreased rumen motility, dehydration, and sometimes death of the cow. Systemic illness often precedes the symptoms manifested in the milk and mammary gland.

Treatment of peracute mastitis includes: stripping the gland frequently to remove organisms and toxins (at 1 or 2 hr intervals), injecting oxytocin to facilitate milk letdown, IV infusion or oral administration of fluids, administration of anti-inflammatory drugs, analgesics, antipyretics (given systemic), and/or antibiotics (systemic or intramammary).

Acute Mastitis : Acute mastitis is characterized by a sudden onset, moderate to severe inflammation of udder, decreased production, and serous milk/fibrin clots. Systemic signs are similar but less severe than the peracute form.

Treatment of acute mastitis includes: stripping frequently, administration of antibiotics (systemic or intramammary), administration of fluids if needed, and administration of anti-inflammatory drugs, analgesics, and/or antipyretics.

Mastitis Resources

Types of Mastitis/Modes of Transmission

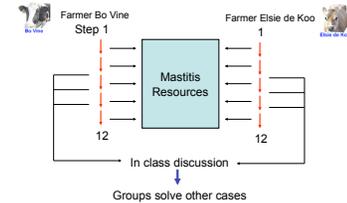
This resource describes the modes of transmission of mastitis-causing bacteria, including **Contagious Mastitis, Environmental Mastitis, Test Skin to Udder, Mouth to Udder, and Flies**.

Contagious Mastitis Contagious mastitis is sometimes referred to as Cow-to-Cow mastitis because it is generally spread from cow to cow. The primary habitat of bacteria causing contagious mastitis is on the udder and in teat lesions. These bacteria have poor survival in the environment when not associated with the skin or in the gland. Contagious mastitis is the type of mastitis in chronic or subclinical mastitis. The infection is transmitted by milk-contaminated fomites at milking, by a sponge used to wash the cow's teats, by the milker's hands, and by the milking machine. The major organisms causing contagious mastitis are *Streptococcus agalactiae*, *Staphylococcus aureus*, or *Mycoplasma*.

Environmental Mastitis Environmental Mastitis is sometimes referred to as Environment-to-Cow mastitis. In this case the bacteria that cause the mastitis are found in the cow's environment. The incidence of environmental mastitis tends to increase as the incidence of contagious mastitis decreases. The primary habitat of bacteria causing environmental mastitis is in the environment (feces, soil, bedding, or water). It can occur during environmental contact of the teats at milking time or between milkings. The major organisms causing environmental mastitis include the coliforms, the environmental *Streptococcus* species, and *Pseudomonas* species, but other organisms found in the cow's environment can cause mastitis, too.

Test Skin to Udder This is usually caused by

Design of Mastitis Detective Cases Module



FINDINGS

Instructor's perspective:

- ❖ This approach results in most students coming into the group discussions having already invested the time to solve the online cases.
- ❖ As a result, they are prepared to move rapidly into solving the newly assigned cases.
- ❖ Working in groups helps limit the impact of the fact that few of the students have personal knowledge of dairy cattle.
- ❖ Students give clear indications of enhanced confidence with the material, with solving complex problems, and with working in a group environment.

Students' perspective:

- ❖ Survey results from students: "**How valuable** did you find each of the online laboratory modules in your efforts to learn about the respective topic?" [scale 1 to 5; not at all valuable to very valuable]
- ❖ Results: 4.8 ± 0.1
- ❖ Sample student response at end of semester: "In this class, I can't promise that I will remember everything, but I know that if I encounter a farmer that had a problem with mastitis I am sure I can give the farmer some pointers."

CONCLUSIONS

- ❖ Having students focus on solving a complex problem, rather than primarily memorizing a large body of information, provides the student with a framework in which to both recall the information and to apply the information.
- ❖ Using a case study approach to solving complex problems also encourages students to respond at multiple cognitive levels, in the process of deriving the cause of the problem, making recommendations for the dairy producer about how to solve their problem, and designing a mastitis control program to prevent the problem from returning.
- ❖ It is important to teach students not only **what** information we think they should learn, but to teach them **how** they can best go about gaining that knowledge and **how** to get the most value from their learning efforts.

Acknowledgements

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- ❖ Mastitis Detective Module is part of the the ANSC 438 Compass website. The same module can be found on the Lactation Biology website at: <http://classes.aces.uiuc.edu/ANSC308/>