Fall 2014 Syllabus
FOOD MICROBIOLOGY
ANFS 439/639

Instructor:	Dallas G. Hoover, Ph.D.	Teaching assistant: Pat Spanninger
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Lecture: 202 Worrilow Hall; TuTh 9:30-10:45 AM.
Laboratory: 202 Worrilow Hall; Tu 11:00 AM-1:45 PM, Th 11:00 AM-12:15 PM.

Text: *Food Microbiology: An Introduction* by T.J. Montville, K.R. Matthews & K.E. Kniel, Third edition, ASM Press, 2012.

Class home page: www.udel.edu/sakai

Class prerequisite: An introductory microbiology course with development of laboratory skills.

Course objectives:

At the completion of this course, you should:

1. Feel at ease when dealing with issues involving the microbiology of foods and beverages. A major part of this accomplishment is to know the language of the discipline and its context within food science and technology as well as other areas. Recognition of organism names and other jargon of the field should be understood to the extent that these terms do not intimidate nor confuse. Preparation for the exams and other exercises should help the student define the significant microorganisms with regard to their prevalence and importance in specific food groups, the growth characteristics of these microorganisms, the means of identifying/enumerating these organisms and detecting their important metabolites, and how problematic organisms can be controlled or eliminated in processed foods.
2. Appreciate and apply microbial concepts to the areas regarding safety, preservation, product development, fermentation, and sanitation that are relevant to foods.
3. Sharpen your skills to work effectively in a microbiology laboratory.
4. Strengthen your abilities to clearly and consistently communicate scientific information in both written and verbal forms.

Grading: ANFS 439 (undergraduate level)

Three written exams:	
September 25 (Thursday)	15%
October 23 (Thursday)	15%
December 2 (Tuesday)	15%
Final comprehensive oral exam, individually scheduled for Dec. 8 & 9 (Monday & Tuesday)	21%
Culture isolation project (cultures and descriptions by Dec. 2 *or earlier*)	12%
IMRAD exercise (first draft of paper due Nov. 11, revised paper due Nov. 25)	13%
Oral summary/critique of a food microbiology article	9%
	100%

Course letter grade assignment based on total points:

90% =	A	70 - 76% =	C
89% =	A-	69% =	C-
87 - 88% =	B+	67 - 68% =	D+
80 - 86% =	B	60 - 66% =	D
79% =	B-	57% =	D-
77 - 78% =	C+		

Attendance is considered mandatory for all students taking course for grade. All announcements will be made at the beginning of lecture and laboratory periods, so please be on time.

Grading: ANFS 639 (graduate level)

Three written exams:	
September 25 (Thursday)	15%
October 23 (Thursday)	15%
December 2 (Tuesday)	15%
Final comprehensive oral exam, individually scheduled for Dec. 8 & 9 (Monday & Tuesday)	21%
Culture isolation project (cultures and descriptions by Dec. 2 *or earlier*)	9%
Research proposal (research topic idea by Oct. 7; paper due Nov. 6)	10%
IMRAD exercise (first draft of paper due Nov. 11, revised paper due Nov. 25)	9%
Oral summary/critique	6%
	100%

Course letter grade assignment based on total points:

90% =	A	70 - 77% =	C
89% =	A-	69% =	C-
88% =	B+	68% =	D+
80 - 87% =	B	60 - 67% =	D
79% =	B-	59% =	D-
78% =	C+		

Attendance is considered mandatory for all students taking course for grade. All announcements will be made at the beginning of lecture and laboratory periods, so please be on time.

2014 FOOD MICROBIOLOGY LECTURE PERIOD OUTLINE

Date	***"Activities other than the usual"***
Aug. 26	Introduction/Game Plan
Aug. 28	-
Sept. 2	-
Sept. 4	Virtual lab exercise done outside of class
Sept. 9	9:30 AM Field trip - Eurofins Laboratory (New Holland, PA)
Sept. 11	Rolf Joerger - Modern rapid detection methods
Sept. 16	Rolf Joerger - Modern rapid detection methods
Sept. 18	-
Sept. 23	-
Sept. 25	Written exam 1
Sept. 30	-
Oct. 2	-
Oct. 7	-
Oct. 9	Student presentations 1 (5 students)
Oct. 14	-
Oct. 16	-
Oct. 21	Nancy Gregory – Food mycology
Oct. 23	Written exam 2
Oct. 28	-
Oct. 30	-
Nov. 4	Election Day – No classes
Nov. 6	Student presentations 2 (6 student presentations)
Nov. 11	-
Nov. 13	Student presentations 3 (6 student presentations)
Nov. 18	Kali Kniel – Food parasitology
Nov. 20	-
Nov. 25	-
Nov. 27	Thanksgiving break
Dec. 2	Written exam 3
Dec. 8 & 9	Individually scheduled comprehensive 30-min final oral exams starting in the morning at 10:00 AM

Chapter coverage in the textbook on general lecture topics

Intrinsic & extrinsic properties of foods (book chapter 2)
Traditional detection & enumeration methods (4)
Spores and thermal processing (3, 8, 10, 11, 27)
Microbial metabolism (2)
Lactic fermentations (19)
Food spoilage (21)
Food preservation (25, 26, 27)
Indicator organisms, criteria & regulations (6, 7)
Gram-negative pathogens (9, 12, 14, 15, 16, 17)
Gram-positive pathogens (13, 16)
Seafood toxins & prions (24)
Viruses (24)
Guest speakers -
R. Joerger – Modern rapid detection methods (5)
N. Gregory – Food mycology (22)
K. Kniel, parasites (23)

Sakai Titles of Lecture PowerPoints in approximate order

FACTORS
METHODS
STERILITY
SURROGATES
SPOILAGE
CHEMICAL PRESERVATIVES
BACTERIOCINS
GEORGE EVANCHO CASE STUDIES
CRITERIA & REGS
EMERGING PATHOGENS
GRAM-NEGATIVE BACTERIA
GRAM-POSITIVE BACTERIA
FUNGI
FERMENTATION BIOCHEMISTRY VIRUSES
PRIONS
SEAFOOD TOXINS
Guest speakers:
R. JOERGER – RAPID MOLECULAR AND SEROLOGICAL DIAGNOSTICS
N. GREGORY – FOOD MYCOLOGY
K. KNIEL – FOOD PARASITOLOGY

Food Microbiology Laboratory Schedule
Fall 2014

Tuesdays (11:00 AM to 1:45 PM)
Thursdays (11:00 AM to 12:15 PM)
202 Worrilow Hall

Tuesday date	Laboratory Exercise Title
Sept. 2	Exercise 1: Plate counts of dairy products and hamburger
Sept. 9	Field trip - Eurofins Microbiology Laboratory, New Holland, PA
Sept. 16	Exercise 2: Sporeformers/Exercise 3: Coliforms
Sept. 23	Exercise 4: Lactic acid bacteria & Nisaplin
Sept. 30	Exercise 5: Inoculated pack study (Newton Building – split class)
Oct. 7	Exercise 6: Yeasts & molds
Oct. 14	IMRAD project
Oct. 21	IMRAD project
Oct. 28	IMRAD project
Nov. 4	Election Day – no classes
Nov. 6 (Thursday)	Culture Isolation project
Nov. 11	Culture isolation project
Nov. 18	Culture isolation project
Nov. 25	Culture isolation project (Thanksgiving is 11/27)
Dec. 3	Cultures and abstract for culture isolation projects due

ORAL PRESENTATIONS

For the oral "journal club-style" presentation, I will give each student a paper to present/summarize. I am amenable to discuss another article if you dislike the one I select for you. Perhaps you have a better choice, but inform me of it as soon as possible. Please use PowerPoint for your presentation; it has become the standard format. The length of the oral presentation will be determined in part on the number of students enrolled in the class. This year student presentations will be divided through the semester. One conclusion I would like you to make in your presentation, is what is the "take-away message" in the article.

IMRAD PROJECT & PAPER

The purpose of this exercise is to have each student pair experience experimental design and technical writing involving original data. It is the intent that each student pair structure their own experiments, conduct the work, and explain what they did and what problems they had. The IMRAD paper will be submitted by student pairs as co-authors.

We will do this as follows:

1. Each student pair will receive a description of a laboratory problem for investigation on **October 2.** For example, a few years ago one project was "Antimicrobial effectiveness of a lactic acid dip on cherry tomatoes." The objective was to investigate the effect of an acid dip on whole tomatoes by measuring the surviving microorganisms after treatment and storage of the tomatoes. The questions asked were: How does one do this? What is the best way to do this? Of course, there is more than one answer.

2. Before **October 14**, each student pair will meet with me in my office to briefly outline their approach to investigate their problem.

3. On **October 14** in the lab, each pair will conduct their initial experiment, and over the following two weeks, will respond to results from the previous week to make the next week's data more meaningful by improving technique, eliminating problems, and *investigating an experimental variable that was not included in the initial experiment*.

4. On **November 11**, your results should be handed-in as a first draft for a manuscript for publication written in the IMRAD format.

5. This draft will be returned to you with suggestions. The final revised manuscript for grade is due **November 25.**

CULTURE ISOLATION PROJECT

These projects are done *individually* by students. Over the course of the project I will work with each student to discuss different approaches to problems and troubleshooting.

General directions:

1. **You will obtain your own food samples.** You are to isolate two cultures from two different project groups as specified below using two food sources.

2. You will prepare in advance a written outline of the procedures that you intend to use in the isolation of each organism. Please submit this outline to me by **October 28.** Your outlines should include *brief* explanations of 1) how you will enrich for your organisms, 2) how you will purify your organisms, and 3) how you will identify your organisms to the appropriate level. You should consider enrichment, purification, and identification to be three distinct steps, which you must perform in that order. Attempting to isolate a rare organism from an unenriched source or attempting to do identification tests on an impure culture wastes media and produces confusing results.

3. Notes on enrichment: Some of the organisms you have been asked to isolate are present in very low numbers in the food. You should choose conditions of enrichment which will selectively favor the growth of the organism you want. In previous microbiology courses you may have "enriched" by plating your source material on a medium selective for your organism. This approach works well only if the desired organism is present in the source material in large numbers. In this course we will most probably use a different approach. We will incubate your sample itself under conditions that will favor the growth of the desired organism. Conditions which you can vary include temperature, pH, salt concentration, sugar concentration, length of incubation and oxygen tension. (Oxygen tension can be varied by sealing or not sealing a container, or by using a deep or shallow layer of sample in a container.) In some instances, it may be advantageous to apply a controlled heat treatment to your sample before incubating for enrichment. This can be done by placing the container of food in a beaker of water on a hot plate. Design your enrichments carefully; this step is crucial to the success of your isolations. For information helpful in designing enrichments, I can discuss with you some of the previous work students in this class have done with different source materials.

4. Turn in your isolates and written reports no later than **December 2** (but you can hand them in earlier). For each isolate make *fresh inoculations of the media specified below* and give the inoculated media to me. Each isolate must be accompanied by a report (one or two pages is usually sufficient) which explains the procedures that you used in your isolation and the test results by which you identified your organism.

Label all cultures clearly with your name and the name of the organism and the date of inoculation.

5. Criteria for grading isolations:
a) Purity and viability of the culture. There is a grade penalty for mixed or dead cultures.
b) The logic and correctness of the procedures used for enrichment, purification, and identification of the organism.
c) Correct identification of the organism to the genus level.
d) The organization and legibility of the isolation report.
e) The quality of the streak plate handed in (isolated colonies are essential).

6. You are encouraged to discuss your isolation work with your classmates; however, you must do your own lab work. You may not share cultures with your classmates. For example, you should not inoculate anyone else's tubes.

7. Possible food sources for isolations:
a) Hamburger
b) Fish
c) Sugar and cornstarch
d) Ground pepper
e) Milk (raw or pasteurized)
f) Early-stage sauerkraut (you will need to make this)
g) Raw poultry
h) Nonfermented meats
I) Others - with approval and discussion

Organisms to be isolated on required media to accompany each final report:

Choose two genera of bacteria from two different groups. For the final transfer all organisms should be freshly inoculated into the indicated medium for that isolate. All bacteria should be identified to the genus level. **You do not identify to species.**

Group 1: *Enterobacter* or *Escherichia*
One TSA streak plate and/or one EMB streak plate
Group 2: *Micrococcus* or *Staphylococcus*
One TSA streak plate
Group 3: *Pseudomonas*
One *Pseudomonas* F agar plate (or similar selective medium)
Group 4: *Bacillus* or *Clostridium*
Bacillus: One TSA streak plate
Clostridium: One TSA streak plate, possibly one BCP-glucose agar shake tube

Group 5: Lactic acid bacteria
Lactococcus, Pediococcus, Lactobacillus or *Leuconostoc*
One MRS streak plate
Group 6: *Enterococcus*
One TSA plate

Most of the methods that you will use in your isolation work will be familiar to you from work done earlier in the term. Part of your responsibility is media preparation. We may choose to organize preparation in a team approach in order to reduce waste. *REMEMBER* to anticipate your media needs. Media preparation takes organization and time, and without it, we don't want you to start.

SAMPLE ISOLATION PLAN

Your isolation plan should be organized into three major parts:

1. Selective Enrichment - The objective here is to provide suitable conditions for the growth of the organism in question and to eliminate the possible growth of other organisms. This is not meant to eliminate *all* other organisms, and you *should not* approach it from that standpoint. Usually, manipulation of various environmental conditions (*i.e.*, temperature, 0_2 level) is utilized.
2. Purification - From your selective enrichment step, you have not isolated single colonies that you believe may be the organism you want. Now you should perform basic biochemical tests (*i.e.,* catalase, Gram stain, and others) that will provide you with information that will either confirm or deny your suspicions, but be sure you are working with a pure culture. You may assume it is pure while you do your biochemical tests (this can save time), but your results will have to be discarded if you find your colony is not pure. Purification usually involves three transfers from your enrichment plate to other media - each time streaking for *isolated* colonies.
3. Identification - Before going on to this step you should have a pure culture that conforms to the specific biochemical characteristics of the organism. In the previous steps you have eliminated many other types of organisms but not all of them. You now have to look at the remaining possibilities and pick tests that will eliminate the rest of these.

Reminders: Throughout this plan, do not base your hopes on one colony. *Please* remember this! *Always* keep a multiple number of "prospective" colonies, and *do not* throw anything out until you are sure you have your organism. Then *clean-up* all your stuff.

An example: One time a student had isolated an organism on PCA agar. The day before the student was to hand it in for credit the student streaked it on another PCA agar plate and incubated it. The old plate was discarded. The next day the organism did not grow - it was found that instead of using PCA, PDA was used. The medium was mislabeled. If the old plate had been kept, it possibly could have been handed in for grade.

Also, *don't procrastinate*. Microorganisms grow quickly, but not instantaneously nor on command. Allow yourself some time for mistakes. In the past, it has been rather common for students to change the category or type of bacteria they're trying to isolate after several attempts using different foods failed. In this exercise one is playing the odds that a certain kind of bacterium will be present in the selected food in numbers and conditions favorable for isolation.

VIRTUAL LABORATORY EXERCISE: SUBLETHAL HEAT INJURY OF STAPHYLOCOCCI

This exercise will be introduced in lecture. Students will be assigned a treatment temperature and access the link to conduct the experiment via computer. The educational goal is for the student to better understand injury and recovery as well as determination of *D* and *z* values. Injury curves will be handed in at a date to be determined. Data can be entered online.

Link: http://ag.udel.edu/anfs/faculty/hoover/hsi/index.html

Food Microbiology Laboratory Safety Rules

1. Always wipe your bench with disinfectant before and after working there. Disinfect all spills promptly. **Wash your hands thoroughly when leaving the laboratory!**
2. No mouth pipetting. To avoid ingestion of infectious material use remote pipetting devices.
3. Never eat or drink in the lab. Make it a habit to keep your hands away from your face and your pens away from your mouths.
4. Do not bring any articles of clothing, books, or papers into the lab which will not be necessary for the work to be conducted during the lab period. **Please do not put personal items on the bench surface.**
5. To avoid burns beware of hot burners. Do not place your burner in a position on your bench where you or your partner will have to reach over it. Long hair should be tied back. Turn-off burners before leaving the lab for any reason (such as a fire drill).
6. To avoid production of dangerous aerosols:

* Heat wet inoculating loops and needles slowly when flaming.
* Never touch a hot loop to moist, infectious material.
* Do not jar a wet loop.

7. Discard contaminated material properly, *i.e*., this involves autoclaving.

* Place used pipets in pipet buckets, tips down, immediately after use.
* Agar plates should be discarded in white plastic buckets.
* Tubes and jars that have been inoculated should be placed on the cart in 202 to be autoclaved. It is the responsibility of each lab group to label all plates, tubes, etc., clearly before placing them in the incubators, and to properly discard this material when they are done using it. Failure to clean up your lab area, to replace microscopes with oil removed and low power lens in position, and to discard old cultures from incubators and refrigerators can affect your lab grade.

8. If you are going to use the autoclave, **make sure you receive instruction on how to use this unit first**. Residual steam will be released when the door is opened upon completion of its cycle.
9. Any sore should be properly covered. Bandages and rubber gloves are available in the lab. For routine work in microbiology, gloves are not necessary. Immediately report accidents or injury to instructor or teaching assistant.
10. Labeling cultures: All of your cultures must be clearly labeled with the following:

Your Name (not initials)
Date
Identity of the inoculum

Cultures not properly labeled will be discarded.

11. Before coming to lab: Please read all handouts concerning any exercise to be done.

The objectives of ANFS 439/639 are aligned to integrate according to the learning goals for the ANFS curriculum and the ten goals of undergraduate education at UD which are as follows:

Assessment Student-learning Program - Mission statement

The Department of Animal & Food Sciences is committed to provide education, service and leadership for regional, national and international stakeholders through development, integration and dissemination of knowledge of animals used for food, fiber, companion, and recreational purposes; and for safe, responsible, ecologically sustainable, and competitive food production.

Learning goals for the ANFS curriculum

1. Students will demonstrate oral communication skills important for communicating scientific ideas (communications goal).
2. Students will demonstrate written communication skills important for communicating scientific ideas (communications goal).
3. Students will use critical thinking and reasoning, skeptical inquiry and scientific approach to solve problems (critical-thinking goal).
4. Students will demonstrate knowledge of the major core concepts in the animal and food sciences (content goal).

General Education at UD - Ten goals of undergraduate education

1. Attain effective skills in oral and written communication, quantitative reasoning, and the use of information technology
2. Learn to think critically to solve problems.
3. Be able to work and learn both independently and collaboratively.
4. Engage questions of ethics and recognize responsibilities to self, community, and society at large.
5. Understand the diverse ways of thinking that underlie the search for knowledge in the arts, humanities, sciences and social sciences.
6. Develop the intellectual curiosity, confidence, and engagement that will lead to lifelong learning.
7. Develop the ability to integrate academic knowledge with experiences that extend the boundaries of the classroom.
8. Expand understanding and appreciation of human creativity and diverse forms of aesthetic and intellectual expression.
9. Understand the foundations of U.S. society including the significance of its cultural diversity.
10. Develop an international perspective in order to live and work effectively in an increasingly global society.