

AGRONOMY 485/585*
SOIL & ENVIRONMENTAL MICROBIOLOGY



Outline and Assigned Reading
 Fall 2011

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*Students taking the course as Agron 585 have additional expectations (see website).

If you have a documented disability and anticipate needing accommodations in this course, please make arrangements to meet with me soon. Please request that Disability Resources staff send a SAAR form verifying your disability and specifying the accommodation you will need.

A COURSE INTRODUCTION

A1 Text: Principles and Applications of Soil Microbiology, Syliva et al., 2005, 2nd ed.
 Required readings for the course are in **bold** and enhanced readings (no test questions asked but likely will aid in better understanding of the topic) are in *italics*.
 Some enhanced readings are written at a lower level than your text, others at a more in-depth level.

A2 References (on reserve in library) (some required readings are available electronically from the library site and others are not, based on the fee the publisher charges to allow electronic posting...for some readings, you will need to visit the library and you may copy the materials if you desire) http://www.lib.iastate.edu/courses-browse_name/1013/2016.
 Alexander--Biodegradation and Bioremediation, 1999 (**A**)
 Coleman and Crossley--Fundamentals of Soil Ecology, 2004 (**CC**)
 Coyne--Soil Microbiology, 1999 (**C**)
 Konhauser--Introduction to Geomicrobiology, 2007 (**K**)
 Paul--Soil Microbiology, Ecology, and Biochemistry, 2007 (**P**)
 Tate--Soil Microbiology, 2000 (**T**)

A3 Grading and exams

	Points
Lecture	
1-hr exam	
October 6	100
November 3	100
Final (week of December 12)	150
Laboratory	
Three quizzes @ 20 pts each	60
Final	40
Laboratory Notebook	50
TOTAL	500

A4 This course will provide you with an understanding of soil organisms, their types, numbers, activities, and will discuss soil life in relation to human existence, land use, and the environment. **“To appreciate them, one must understand them.”** Observations, methods of isolation, enumeration, and means of studying transformations will be emphasized in the laboratory.

A5 Overview of importance--Why study soil biology?

A6 Historical accounts and the "Golden Age" of soil microbiology, **Text: 3-25; C: 3-12; P: 3-24.**

B SOIL AS A BIOLOGICAL ENVIRONMENT, Text: 26-53. If this is your first course in soil science, you also may wish to read *CC: 1-21* (good overview) and/or *C: 139-179; T: 1-29*. Confused with terms or concepts, ask to borrow an introductory soil science textbook from me.

B1 Soil composition--minerals, organic fractions, charge, size relationships

B2 Important variables--moisture tensions, atmospheric compositions, temperature, humus, pH

B3 Brief soil biota size/number overview

C METABOLIC REQUIREMENTS AND GENETICS, Text: 54-98; C: 14-26; K: 10-18; T: 37-75, 133-154.

C1 Water

C2 The Five Essentials--energy source (electron donor), electron acceptor, carbon source, minerals, and growth factors

C3 Growth curves

C4 Genetics and gene exchange

D BACTERIA, ARCHAEA, AND ACTINOMYCETES, Text: 101-139; C: 100-123; K: 93-104.

D1 What are soil bacteria and archaea?

D2 General taxonomy, morphology, and metabolic diversity

D3 Geochemical groupings

D4 Actinomycetes in soil as a distinguishable group

D5 Importance of actinomycetes

E FUNGI, Text: 141-161; C: 86-99.

E1 Differences among bacteria, actinomycetes, and fungi

E2 Taxonomy, selective media, and methods of investigation

E3 Bacterial spore and fungal conidia comparison

E4 Soil structure and fungal involvement

E5 Fairy rings

F CYANOBACTERIA AND ALGAE, Text: 162-180; C: 77-85; K 179-183.

F1 Growth requirements and significance in soil

F2 Kinds of soil algae

F3 Lichens and soil formation

G VIRUSES, Text: 201-221; C: 124-136.

G1 What are soil viruses?

G2 Determining presence in soil

G3 Activity and scope

- H PROTOZOA, Text: 181-200; C: 67-76; CC: 79-89; P: 163-169.**
- H1 Most-probable-number (MPN) technique
 - H2 How to identify soil protozoa
 - H3 Motility and classification
 - H4 Cysts formation and separation from vegetative cells
 - H5 Environmental influences and significance
- I NONPROTOZOA FAUNA, CC: 89-128, 169-181; C: 43-66; P: 169-186.**
- I1 Neglected group
 - I2 Nematodes
 - I3 Earthworms
 - I4 Others
- J ECOLOGY AND METHODS FOR STUDY, Text: 222-241; T: 37-94; P: 53-83, 85-118.**
- J1 Real world interactions
 - J2 Direct methods
 - J3 Cultural methods and Biolog data
 - J4 Molecular methods
 - J5 Product transformations
- K DECOMPOSITION OF ORGANICS, Text: 285-297; K: 11-17, 206-208; T: 284-313.**
- K1 Carbon cycle
 - K2 Types of organics
 - K3 Assimilation
 - K4 Mineralization and immobilization
 - K5 The art of composting, **Text: 587-606**
- L COMMON ORGANICS IN PLANTS AND WASTES, Text: 298-318; Handouts; C: 291-305; P: 312-325.**
- L1 Cellulose
 - L2 Starch
 - L3 Hemicellulose
 - L4 Lignin
 - L5 Other polysaccharides, chitin, pectin, protein, and lipids
- M ORGANIC MATTER AND SOIL QUALITY, Text: 318-332.**
- M1 Organic matter components
 - M2 Priming effect
 - M3 Management for high soil organic matter levels
- N BIOREMEDIATION AND RECALCITRANT ORGANICS, Text: 510-535; A: 393-406; K: 133-138; T: 464-494.**
- N1 Human-produced organics (xenobiotics)
 - N2 Conditions for biological growth vs. cometabolism
 - N3 Microbial degradation pathways
 - N4 Tough bonds to break
- O BIOREMEDIATION TECHNOLOGIES IN SOIL, Text: 536-561; A: 325-349.**
- O1 Criteria for bioremediation
 - O2 Land farming
 - O3 Phytoremediation
 - O4 Bioventing

P THE RHIZOSPHERE AND ORGANISMAL DISTRIBUTION WITHIN THE SOIL, Text: 242-262; T: 218-235.

- P1 Exudates
- P2 R/S ratios
- P3 Beneficial and harmful effects
- P4 Pathogenic relationships

Q MYCORRHIZAE, Text: 263-282; P: 259-267; T: 235-244.

- Q1 Ectomycorrhiza
- Q2 Endomycorrhiza
- Q3 Environmental importance

R THE NITROGEN CYCLE, Text: 333-278; P: 341-364; T: 314-346.

- R1 Historical--Schloesing and Muntz, Warington, and Winogradsky
- R2 Nitrifying bacteria
- R3 Environmental influences
- R4 Nitrification inhibitors
- R5 Denitrification
- R6 Environmental factors and significance

S NITROGEN FIXATION, Text: 373-432; P: 364-387; T: 347-403.

- S1 Nonsymbiotic
- S2 Symbiotic
- S3 The symbioses
- S4 Biochemistry of the fixation process

T NONCONVENTIONAL SOIL ADDITIVES, A: 299-323.

- T1 Inoculants
- T2 Wonder products
- T3 Evaluation

U MICROBIAL PROCESSES AND THE ENVIRONMENT, (no required reading), Text: 433-488; C: 183-194, 208-227; K: 79-92.

- U1 Oxidation and reduction of sulfur (Why is the Black Sea black?)
- U2 Oxidation and reduction of iron
- U3 Heavy metal impacts in the environment and affects on organisms



Please let me know at anytime throughout the course how I can be of help.