Outline and Assigned Reading
Fall 2015

Lecture Instructor: Tom Loynachan, 1126H Agronomy, teloynac@iastate.edu
Laboratory Instructor: Tom Loynachan, 1126H Agronomy, teloynac@iastate.edu
Laboratory Instructor: Omar de Kok-Mercado, 1027 Agronomy, omardkm@iastate.edu
WEB site address: http://www.public.iastate.edu/~teloynac/485out.html

I will attempt to follow university policies on academic dishonesty, disability accommodation, dead week, harassment and discrimination, and religious accommodation. Click here to see recommended policies.

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

A  COURSE INTRODUCTION, Text: 1-14; S 3-25.
A1  Text: Soil Microbiology, Ecology, and Biochemistry, Paul et al., 2015, 4th 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)
Syliva et al.--Principles and Applications of Soil Microbiology, 2005 (S)
Tate--Soil Microbiology, 2000 (T)

A3  Grading and exams

<table>
<thead>
<tr>
<th></th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lecture</strong></td>
<td></td>
</tr>
<tr>
<td>1-hr exam</td>
<td></td>
</tr>
<tr>
<td>October 1</td>
<td>100</td>
</tr>
<tr>
<td>November 5</td>
<td>100</td>
</tr>
<tr>
<td>Final (week of December 14)</td>
<td>150</td>
</tr>
<tr>
<td><strong>Laboratory</strong></td>
<td></td>
</tr>
<tr>
<td>Three quizzes @ 20 pts each</td>
<td>60</td>
</tr>
<tr>
<td>Final</td>
<td>40</td>
</tr>
<tr>
<td>Laboratory Notebook</td>
<td>50</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>500</td>
</tr>
</tbody>
</table>
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.

Student Learning Outcomes:
1. Develop an understanding of the living component (microorganisms and macroorganisms) of soil and their requirements for growth.
2. Understand the involvement of soil organisms in providing environmental stability and good soil health.
3. Understand the activities of soil organisms that influence plant growth, soil structure, and nutrient cycling for production of food, feed, fuel, and fiber.
4. Gain an understanding of standard soil biological techniques and appreciate the living component of soil through observations in the laboratory.

Overview of importance--Why study soil biology?

Historical accounts and the "Golden Age" of soil microbiology, C: 3-12.

SOIL AS A BIOLOGICAL ENVIRONMENT, Text: 15-39; 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.

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

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

Brief soil biota size/number overview

METABOLIC REQUIREMENTS and ENZYMES, Text: 245-272; 471-475; C: 14-26; K: 10-18; S: 54-98; T: 37-75, 133-154.

Water

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

Growth curves

Soil enzymes

BACTERIA, ARCHAEA, AND ACTINOMYCETES, Text: 41-76; C: 100-123; K: 93-104; S: 101-139.

What are soil bacteria and archaea?

General taxonomy, morphology, and metabolic diversity

Geochemical groupings

Actinomycetes in soil as a distinguishable group

Importance of actinomycetes

FUNGI, Text: 77-109; C: 86-99; S: 141-161.

Differences among bacteria, actinomycetes, and fungi

Taxonomy, selective media, and methods of investigation

Bacterial spore and fungal conidia comparison

Soil structure and fungal involvement

Fairy rings

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

Growth requirements and significance in soil

Kinds of soil algae and cyanobacteria

Lichens and soil formation
G VIRUSES, S: 201-221; C: 124-136.
G1 What are soil viruses?
G2 Determining presence in soil
G3 Activity and scope

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, TEXT: 119-149; C: 43-66.
I1 Neglected group
I2 Nematodes
I3 Earthworms
I4 Others

J1 Real world interactions
J2 Direct methods
J3 Molecular methods (Text: 151-155, 155-185—quick reading)
J4 Cultural methods and Biolog data (Text: 187-199, 199-204 quick reading)
J5 Product transformations (Text: 204-214, 204-222 quick reading)

K1 Carbon cycle
K2 Types of organics
K3 Assimilation
K4 Mineralization and immobilization
K5 The art of composting, Text: 560-562

L COMMON ORGANICS IN PLANTS AND WASTES, Text: 347-382; Handouts; S: 298-318
C: 291-305.
L1 Cellulose
L2 Starch
L3 Hemicellulose
L4 Lignin
L5 Other polysaccharides, chitin, pectin, protein, and lipids

M ORGANIC MATTER AND SOIL QUALITY, Text: 383-386, 408-412, 539-552, 386-408 quick reading; S: 318-332.
M1 Organic matter components
M2 Priming effect
M3 Management for high soil organic matter levels

N1 Human-produced organics (xenobiotics)
Conditions for biological growth vs. cometabolism
Microbial degradation pathways
Tough bonds to break

**BIOREMEDIATION TECHNOLOGIES IN SOIL, Text: 562-572; A: 325-349 S: 536-561.**
Criteria for bioremediation
Land farming
Phytoremediation
Bioventing
Alaska oil-spill research

**THE RHIZOSPHERE AND ORGANISMAL DISTRIBUTION WITHIN THE SOIL, Text: 311-322; S: 242-262; T: 218-235.**
Exudates
R/S ratios
Beneficial and harmful effects
Pathogenic relationships

**MYCORRHIZAE, Text: 322-338; S: 263-282; T: 235-244.**
Ectomycorrhiza
Endomycorrhiza
Environmental importance

**THE NITROGEN CYCLE, Text: 421-446; S: 333-278; T: 314-346.**
Historical--Schloesing and Muntz, Warington, and Winogradsky
Nitrifying bacteria
Environmental influences
Nitrification inhibitors
Denitrification
Environmental factors and significance

**BIOLOGICAL NITROGEN INPUTS, Text: 447-470; S: 373-432; T: 347-403.**
Nonsymbiotic
Symbiotic
The symbioses
Biochemistry of the fixation process

**NONCONVENTIONAL SOIL ADDITIVES, A: 299-323.**
Inoculants
Wonder products
Evaluation

**MICROBIAL PROCESSES AND THE ENVIRONMENT, (no required reading), Text: 475-503; S: 433-488; C: 183-194, 208-227; K: 79-92.**
Oxidation and reduction of sulfur (Why is the Black Sea black?)
Oxidation and reduction of iron
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.