

TO: AEESP Board of Directors

FROM: AEESP Education Committee, Textbook Survey Working Group

DATE: September 18, 2007

RE: **MICROBIOLOGY TEXTBOOK SURVEY REPORT**

1. Objectives:

Per a recommendation by the AEESP Board of Directors, the Education Committee Textbook Survey Working Group has assessed the use of Biology/Microbiology textbooks in courses emphasizing general biology, environmental microbiology, engineering microbiology, general microbiology, molecular biology, etc.

The objectives of this survey are as follows:

- Determine at which level the texts are used (e.g. junior level undergraduate, senior level undergraduate, graduate level) and in which program (e.g. environmental science, environmental engineering, public health, etc).
- Consider the specific content of the texts, including open-ended questions about what areas/topics a given book covers better or worse than the competition.
- Provide useful information for course instructors, authors of existing texts, and academics who may be preparing to write a textbook in this area.
- Given the textbook topic surveyed and the likelihood that these courses may attract students from various majors and at various levels, it was important to solicit information concerning typical student makeup of the course and how the course fits into the curriculum.
- Given the possibility that an instructor may teach different courses at the undergraduate and graduate levels using different texts, it was important for the survey to consider a single instructor's use of multiple texts. It was also important to survey the use of the same book for both undergraduate and graduate level courses.

2. The following preliminary list of textbooks was compiled:

Environmental or Engineering Biology/Microbiology Textbooks:

- Vaccari, D.A., Strom, P.F., and Alleman, J.E. 2006. Environmental Biology for Engineers and Scientists. Wiley, Hoboken, NJ.
- Bitton, G. 2005. Wastewater Microbiology, 3rd ed., Wiley.
- Sharma, P.D. 2005. Environmental Microbiology. Alpha Science International.
- Kjemba, P.K. 2004. Environmental Microbiology: Principles and Applications. Science Publishers.
- Rittmann, B.E. and McCarty, P.L. 2001. Environmental Biotechnology: Principles and Applications. McGraw Hill.
- Maier, R.M., Pepper, I.L., Gerba, C.P. 2000. Environmental Microbiology. Academic Press, San Diego, CA.
- Varnam, A.H. 2000. Environmental Microbiology. Manson.
- Sterritt, R.M. and Lester, J.N. 1988. Microbiology for Environmental and Public Health Engineers, E & FN Spon, London, UK.

Standard Microbiology Textbooks:

- Madigan, M. T.; Martinko, J. M.; Parker, J. 2006. Brock Biology of Microorganisms, 11th ed., Prentice Hall, Pearson Education, Inc., Upper Saddle River, NJ.

- Black, J. G. 2005. Microbiology: Principles and Applications, 6th ed., Wiley, NY, NY.
- Atlas, R.M. and Bartha, M. 1997. Microbial Ecology: Fundamentals and Applications, Benjamin Cummings.

3. Synopsis:

- 80 survey responses received
- Approximately 68 complete responses
- 7 textbooks evaluated in detail

4. Survey Results – Background Information and Course Data:

Where are you located?		
answer options	Response Percent	Response Count
United States	97.5%	78
Other Country	2.5%	2
<i>answered question</i>		80
<i>skipped question</i>		1

Other Country
Chile
Canada

What type of college or university?		
answer options	Response Percent	Response Count
Community College	0.00%	0
Non-Ph.D. Granting University (predominant undergraduate)	9.88%	8
Ph.D. Granting University	86.42%	70
Other (please specify)	3.70%	3
<i>answered question</i>		81
<i>skipped question</i>		0

Other
Institute of Technology--graduate students only
retired PhD granting
Publisher

What types of students are enrolled in your course?		
answer options	Response Percent	Response Count
Junior-level Undergraduate Course	15.28%	11
Senior-level Undergraduate Course	4.17%	3
Graduate-level Course	34.72%	25

Mixed Enrollment - Undergraduate & Graduate	45.83%	33
<i>answered question</i>		72
<i>skipped question</i>		9

Course offered through which department(s)? (Select all that apply)		
answer options	Response Percent	Response Count
Civil and Environmental Engineering	69.57%	48
Environmental Engineering	15.94%	11
Environmental Science	11.59%	8
Public Health	4.35%	3
Biology	4.35%	3
Other (please specify)	7.25%	5
<i>answered question</i>		69
<i>skipped question</i>		12

Other
Natural Sciences
Dept of Geography and Environmental Engineering
Engineering and Environmental Management
Chemical Engineering
Chemical and Environmental Engineering

Student audience (select all that apply):		
answer options	Response Percent	Response Count
mostly engineering majors	75.36%	52
mostly science majors	11.59%	8
a required class for most students	21.74%	15
an elective for most students	24.64%	17
taught within an engineering department	53.62%	37
taught within a science department	11.59%	8
<i>answered question</i>		69
<i>skipped question</i>		12

Emphasis of course objectives and content (choose all that apply)		
answer options	Response Percent	Response Count
general microbiology	72.46%	50
general biology	4.35%	3
engineering applications of microbiology	78.26%	54
biochemistry	28.99%	20
energy and metabolism (stoichiometry, bioenergetics and thermodynamics)	71.01%	49
microbial kinetics	71.01%	49

genetics	37.68%	26
enzymology	7.25%	5
molecular biology	39.13%	27
quantification of microorganisms and their activity	46.38%	32
plants and animals	4.35%	3
cell biology	14.49%	10
microbial taxonomy	17.39%	12
public health implications of microbiology	56.52%	39
microbial transformations and biodegradation pathways	63.77%	44
biogeochemical cycling of nutrients	56.52%	39
ecology and ecosystems	36.23%	25
toxicology	13.04%	9
Other (please specify)	10.14%	7
answered question		69
skipped question		12

Other
biological treatment processes
There is a lab component that covers both culture-based and culture-independent (PCR, FISH) techniques
wastewater
limnology
bioremediation
microbial ecology of waste treatment systems
Special topics

5. Synopsis of Course Designations:

- CEE 7511 Microbiology for environmental engineers
- ENVE 4385/ CE 5385 Microbial Applications in Environmental Engineering
- EV396 Environmental Biological Systems
- CEE 671 Biological Phenomena in Environmental Engineering
- CE 390J Engineering Microbiology
- CE 250 Environmental Microbiology
- 570.411 Engineering Microbiology
- BIO 601 Environmental Microbiology
- CE 124 Biological Processes in Environmental Engineering
- CE 574 - Biological Principles for Environmental Engineers
- Environmental Sciences 411 and 510
- CEE 274P Environmental Health Microbiology Lab & CEE 274E Pathogens in the Environment
- 11-375:201 Biological Principles of Environmental Science
- CE 5551 Environmental Microbiology
- CE 497 Environmental Microbiology
- CE 536 Biological Wastewater Treatment
- CE555 Microbial Aspects of Environmental Engineering
- EN 575 Environmental Biology
- ENVE 641 Biological Processes in Environmental Engineering
- 12-729 Environmental Microbiology for Engineers
- CEEGR 341 Environmental Biology

- EVEN 6316 Environmental Biotechnology
- CEEN 158 Environmental Engineering Microbiology
- 840:151 General Microbiology
- EnvE 262 Biological principles
- CEE 453/653 Environmental Microbiology
- CEE 598 Advanced Environmental Biotech
- CAE 541 Environmental Microbiology
- CE 584 Environmental Microbiology
- CENG441 Environmental Engineering Biotechnology
- CEE 540 Biological Processes
- CEE 2500 Environmental Engineering Microbiology
- CIEG 501 Environmental Microbiology
- CE 579 Biological principles of environmental engineering
- CEE646 (Micro)Biology of Environmental Systems
- CE 573/ 773 Biological Principles of Environmental Engineering Processes
- E544 Subsurface Microbiology and Bioremediation
- ENCE 637 Biological Principles
- 16-375:531 Biological Waste Treatment
- CIE 472 Applied Environmental Microbiology
- CE 60430 Environmental Biotechnology
- EHS570 Environmental Health Microbiology
- ENV 6932 Bioremediation
- CEE 2511 Environmental Analysis
- BIOL Environmental Microbiology
- CEE 451 Microbiology for Environmental Engineering
- CEE 444 Environmental Engineering Principles, Biological
- CE210A Control of Water-Related Pathogens
- ENVR 412 Ecological Microbiology
- CE 352 Biological Principles of Environmental Engineering
- ECEE 528 Engineering and Molecular Biology Techniques
- CEE 476 Environmental Engineering Microbiology
- CEGR 4090 Environmental Biotechnology
- CEE 5194 Environmental Engineering Microbiology
- CE 114 Environmental Microbiology

6. Selected Catalog Descriptions:

- Introduction to microbiology and biochemistry; bacteria, fungi, algae, protozoa, and viruses; structure, function, synthesis, and degradation of lipids, proteins, nucleic acids, and carbohydrates; nutritional requirements for microbial growth; waterborne disease; indicator organisms; microbial ecology; and microbiology of the nitrifiers, methanogens, and sulfur bacteria.
- The course presents information regarding bacterial cell structure and microbial genetics; metabolism and the role of microbes in the design of treatment processes; and water/wastewater reuse issues.
- This course will examine biology from a practical environmental engineering and environmental science perspective. The foci of the course are applied public health, microbiology and microbial energetics. Specific topics include the biological health issues associated with drinking water, microbial aspects of industrial and domestic waste treatment and protection or restoration of natural water bodies from environmental contaminants. Students are also introduced to medical geography and the spatial biological health issues associated with a deployment. Laboratory exercises are used to introduce the student to water quality analyses and practices commonly used in the fields of environmental engineering and the environmental sciences.
- Lecture and lab. The major biological phenomena and processes used in environmental control. Fundamentals of microbiology and biochemistry as applied to wastewater treatment, drinking water treatment, and hazardous waste remediation.
- Develop fundamental aspects of microbiology and biochemistry as related to environmental engineering.

- Fundamentals of microbiology and biochemistry as they apply to environmental engineering. General topics include cell chemistry, microbial metabolism, bioenergetics, microbial ecology and pollutant biodegradation.
- Develop fundamental aspects of microbiology and biochemistry as related to environmental pollution and water quality control processes, biogeochemical cycles, microbiological ecology, energetics and kinetics of microbiological growth, and biological fate of pollutants.
- Fundamentals of microbiology related to biological environmental engineering processes. Topics include microbial metabolism, molecular biological tools, mass balance, and reactor models. Applications to include unit processes in wastewater treatment, bioremediation and biofiltration.
- CE 573 prepares you to use fundamental biological principles to analyze important biological processes in environmental engineering. Specific applications include: the biological treatment of municipal and industrial wastes, public health microbiology, and microbial ecology of engineered and natural systems. The course will cover basic microbiology (what is a cell?), survey key microbial groups and their metabolisms (how do they make a living?), cover biodegradation/catabolism of the basic macromolecules (carbohydrates, lipids, proteins), and introduce microbial ecology concepts, including molecular approaches.
- Microorganisms in carbon, nitrogen, sulfur cycling, biogeochemical processes, and water and wastewater treatment systems; biodegradation strategies and pathways; and bioremediation of toxic contaminants in the environment.
- Hazardous agents, pollution, population interactions and dynamics; biogeochemical cycles in damaged and remediated ecosystems; environmental risk, management, and remediation; human health impacts.
- This course will serve as an introduction to the topic of environmental microbiology. Information about basic microbiology and biochemistry, microbial ecology, and pollution microbiology will be incorporated, providing the student with both an understanding of basic microbiology (although not in great detail) and of the potential of microorganisms to influence our environment. The course will also provide instruction in basic laboratory techniques for the culture, isolation, and identification of microbes (culture-based) and also some instruction on non-culture based techniques for microbial identification.
- An introductory microbiology course for engineers comprised of two main sections: (1) the fundamentals of microbial structure, function, nutrition, growth, and ecology for students with no prior formal instruction in microbiology; and (2) the application of these fundamental microbial principles to environmental systems. The goal of the course is to provide a solid foundation in microbial principles to complement undergraduate and graduate courses addressing biological processes in environmental systems, and to provide a framework for research of microbial systems.
- Principles & design of wastewater treatment systems which are dependent on biological organisms. Processes covered included suspended culture and fixed culture systems, nutrient removal, hybrid systems, land application & on-site treatment systems. Emphasis is placed on fundamental interaction between the organisms, wastes and receiving body of water.
- Environmental microbiology for engineering students with emphasis on microbially mediated chemical cycles, microbial ecology, and industrial microbiology.
- A survey of biological topics concerning the environment; ecology, population dynamics, pollution microbiology, aquatic biology, bioconcentration, limnology, stream sanitation, nutrient cycles, and toxicology.
- Fundamental aspects of microbiology and biochemistry, including stoichiometry, kinetics, and energetics of biochemical reactions, microbial growth, and microbial ecology as they pertain to biological processes for the transformation of environmental contaminants; principles for analysis and design of aerobic and anaerobic processes, including suspended- and attached-growth systems, for treatment of conventional and hazardous pollutants in municipal and industrial wastewaters and in groundwater.
- A general introduction to microorganisms in natural, engineered and artificial environments. Selected topics include: cellular architecture, energetics and energy conservation, growth and catabolism; evolution and genetics; population and community dynamics; water and soil microbiology; biogeochemical cycling; biofilms; and microorganisms in wastewater, pollution attenuation, and bioremediation.
- Overview of microbiology fundamentals and development of quantitative tools for describing stoichiometry, microbial energetics, microbial kinetics, biofilm kinetics, and bioreactor mass balances. Application of these tools for designing biological treatment processes.
- Includes microbiological and biochemical properties of microorganisms important in environmental engineering practice. General fundamentals of environmental microbiology and their application to drinking water treatment and distribution, water pollution control, and natural systems.
- This course describes the principles of biological sciences as they relate to and impact environmental systems.

- Microbial systems serve as models to demonstrate the complex interactions between living organisms and the physical/chemical environment. The role of microorganisms and microbial processes in environmental problems, both positive and negative, will be investigated. Specific topics include microbial physiology and genetics, aerobic and anaerobic systems, biochemical pathways, nutrient cycles, pathogens and waste-water, and bioremediation of soils and ground water.
- Introduction to the function of organisms related to environmental engineering. The course focuses on both the application of organisms to removing contaminants and the effects of contaminants on organisms.
- Course covers the fundamental biological and biochemical principles involved in natural and engineered biological systems.
- Introduction to fundamental and applied microbiological principles in environmental engineering with emphasis on microbial growth and metabolism in biological processes.
- Advanced topics in environmental biotechnology and microbiology. These include biofilm modeling, molecular microbial ecology, detoxification, bioenergy processes, and other topics that change from year to year.
- Classification of microorganisms. Microbial agents of infectious diseases and modes of disease transmission. Control of pathogens through water and waste treatment, food protection, and insect control. Microbial ecology and bioremediation systems. Laboratory exercises in microbiology.
- Microbiology fundamentals and application, introduction to epidemiology.
- An integrated approach to studying the role of microorganisms in environmental waste management. The microbiology of air, water, soil and sewers are addressed. Emphases are placed on the public health implications of microbes and their products in the environment, and the role of microbes in bioremediation of hazardous chemical wastes.
- Improper disposal of hazardous waste, leaking underground storage tanks, and other activities have resulted in widespread pollution of the environment by inorganic and organic chemicals. Bioremediation is often considered the technology of choice when considering alternatives for remediation of hazardous waste sites. Bioremediation frequently offers the potential for (i) complete destruction or (ii) detoxification of a contaminant without the production of hazardous ash, sludges, or other waste products. In situ bioremediation involves using microorganisms, i.e., bacteria and fungi, in the subsurface to degrade or detoxify pollutants. A thorough understanding of the process requires knowledge about the microorganisms present in the subsurface, the physiology and biochemistry of degradation processes, and the control and enhancement of these processes in environmental matrices.
- In general, this course will explore how microorganisms and microbial processes affect the transformation of organic and inorganic chemicals in the subsurface. Specifically, the course will include study of the following topics:
 - 1) Microbiology of the subsurface including relevant aspects of microbial physiology and genetics;
 - 2) Ecological interactions in the subsurface;
 - 3) Interactions of microbial processes with nutrient cycling and geochemistry;
 - 4) Enumeration of microorganisms and measurement of microbial activity in the subsurface;
 - 5) Microbial degradation / transformation of petroleum hydrocarbons, halogenated organic compounds, and metals.
- This course will examine biology from a practical environmental engineering and environmental science perspective. The foci of the course are applied public health, microbiology and microbial energetics. Specific topics include the biological health issues associated with drinking water, microbial aspects of industrial and domestic waste treatment and protection or restoration of natural water bodies from environmental contaminants. Students are also introduced to medical geography and the spatial biological health issues associated with travel abroad. Laboratory exercises are used to introduce the student to water quality analyses and practices commonly used in the fields of environmental engineering and the environmental sciences.
- An examination of biological principles directly affecting man and his environment, with particular emphasis on microbiological interactions in environmental engineering related to air, water and land systems; microbiology and biochemistry of aerobic and anaerobic treatment processes for aqueous wastes.
- Advanced topics in biological waste treatment, particularly activated sludge, focusing on microbial ecosystems.
- General principles and application of environmental microbiology and microbial processes. Role of microbes in water pollution control, environmental health, and element cycling in the environment.
- Environmental biotechnology is the application of biological processes to the solution of environmental problems. Applications include municipal and industrial wastewater treatment, drinking water treatment,

remediation of soils and groundwaters, remediation of surface waters and sediments, and control of air contaminants.

- Advanced theory and applications of biological systems for the treatment of wastes; lab techniques to assess treatability and to provide design parameters.
- Analysis of Chemical and Biological fundamentals as applied to the description and evaluation of natural environments and environmental quality control systems.
- Application of principles of biochemistry and microbiology to air and water quality, wastes, and their engineering management; biological mediated changes in water and in domestic and industrial wastewater
- Comprehensive strategies for the assessment and control of water-related human pathogens (disease-causing microorganisms). Transmission routes and life cycles of common and emerging organisms, conventional and new detection methods (based on molecular techniques), human and animal sources, fate and transport in the environment, treatment and disinfection, appropriate technology, regulatory approaches, water reuse.
- Introduction and application of environmental microbiological concepts to the solution of problems of water pollution and its control.
- Fundamentals of microbiology and biochemistry applied to natural and engineered environmental systems. Systems ecology, energetics and kinetics of microbial growth, nutrition and toxicology, use of microorganisms for pollution monitoring and control. Pathogenicity and disease transmission, water quality using biological indices.
- The course uses a problem-based learning format to introduce the theory and applications of molecular biology techniques such as FISH, PCR, microarrays, etc. to engineering problems."
- The goal of this course is to help students gain appreciation for the role and nature of biological processes in engineered and natural systems. At the end of this course, the student will be able to:
 - Identify structures and their functions for various biological cells.
 - Explain how these structures and functions can be used as indicators in environmental biology.
 - Define the central dogma of molecular biology and explain its importance within environmental biological systems.
 - Distinguish between phenotypic information and phylogenetic information, and explain how each is used in understanding environmental systems.
 - Define various metabolisms that pertain to environmental microbiology (e.g., respiration, fermentation, catabolism of various synthetic organic chemicals, distinguish electron acceptors and donors).
 - Define and identify inductive and deductive applications of the scientific method.
 - Interpret and critically evaluate technical literature that pertains to microbiological aspects of environmental systems.
 - Construct and communicate an experimental plan for microbiological study of an environmental system."
- Basic principles of biology and biochemistry as applied to problems of environmental control and wastewater treatment; kinetic and energetic aspects.

7. Textbook Use:

What textbook do you use for this course? Is it required or recommended on the syllabus?			
answer options	Required	Recommended	Response Count
Vaccari, D.A., Strom, P.F., and Alleman, J.E. 2006. Environmental Biology for Engineers and Scientists. Wiley, Hoboken, NJ.	7	4	11
Bitton, G. 2005. Wastewater Microbiology, 3rd ed., Wiley.	1	5	6
Sharma, P.D. 2005. Environmental Microbiology. Alpha Science International.	0	0	0
Kjemba, P.K. 2004. Environmental Microbiology: Principles and Applications. Science Publishers.	0	0	0

Rittmann, B.E. and McCarty, P.L. 2001. Environmental Biotechnology: Principles and Applications. McGraw Hill.	10	4	14
Maier, R.M., Pepper, I.L., Gerba, C.P. 2000. Environmental Microbiology. Academic Press, San Diego, CA.	7	6	13
Varnam, A.H. 2000. Environmental Microbiology. Manson.	1	0	1
Sterritt, R.M. and Lester, J.N. 1988. Microbiology for Environmental and Public Health Engineers, E & FN Spon, London, UK.	0	0	0
Madigan, M. T.; Martinko, J. M.; Parker, J. 2006. Brock Biology of Microorganisms, 11th ed., Prentice Hall, Pearson Education, Inc., Upper Saddle River, NJ.	35	6	39
Black, J. G. 2005. Microbiology: Principles and Applications, 6th ed., Wiley, NY, NY.	3	0	3
Atlas, R.M. and Bartha, M. 1997. Microbial Ecology: Fundamentals and Applications, Benjamin Cummings.	1	2	3
OTHER	4	4	10
<i>answered question</i>			69
<i>skipped question</i>			12

OTHER responses include:

- Alvarez P.J.J. and W. Illman (2006). Bioremediation and Natural Attenuation of Groundwater Contaminants: Process Fundamentals and Mathematical Models. John Wiley & Sons. ISBN No. 0-471-65043-9.
- Metcalf & Eddy, 2003, Wastewater Engineering, McGraw-Hill
- Bacterial Metabolism (2nd Edition) By Gerhard Gottschalk
- Wanner, O., H. Eberl, E. Morgenroth, D. Noguera C. Picioreanu, B. E. Rittmann, and M. C. M. van Loosdrecht (2006). Mathematical Modeling of Biofilms. Report of the IWA Biofilm Modeling Task Group, Scientific and Technical Report No. 18, IWA Publishing, London.
- Bioremediation Principles, J.B. Eweis, S.J. Ergas, D.P.Y. Chang, E.D. Schroeder, McGraw-Hill 1998.
- Environmental Microbiology, A Laboratory Manual, I.L. Pepper, C.P. Gerba, J.W. Brendecke, Academic Press, 1995.
- Chapelle, Groundwater Microbiology and Geochemistry, Wiley

8. Detailed textbook evaluation:

Notes:

1. For cases where a survey reflected that a given text was required and one or more others were recommended, it was assumed that the survey response referred to the required text. For five of the collected surveys, it appeared that the primary textbook for the course was recommended (no required textbook) with supplemental materials supplied by the instructor.

In these cases, the recommended text was evaluated in the survey, and these data are reported below.

2. In several cases (e.g. Atlas and Bartha, 1997), surveys indicated that a given book was required, but the remainder of the survey was fully incomplete. These surveys were deleted for the purposes of detailed textbook evaluations.

- Vaccari, D.A., Strom, P.F., and Alleman, J.E. 2006. Environmental Biology for Engineers and Scientists. Wiley, Hoboken, NJ.

- n = 8; 6 required, 2 recommended

answer options	strongly agree	agree	neutral	disagree	strongly disagree	Response Count
This textbook is well organized	4	2	2	0	0	8
This textbook is sufficiently comprehensive in breadth and depth	4	2	1	1	0	8
There are adequate examples and problems	3	1	2	2	0	8
The text has sufficient emphasis of environmental engineering/public health applications of fundamentals (relevance)	5	0	3	0	0	8

The instructor's manual is helpful:

answer options	Response Percent	Response Count
strongly agree	12.5%	1
agree	25.0%	2
neutral	12.5%	1
disagree	0.0%	0
strongly disagree	0.0%	0
not available	50.0%	4
TOTAL	100.0%	8

- Comments on organization, comprehensiveness, example problems, and emphasis:
 - For my class, VS&A is overly strong on human biology and lacking some in kinetics and kinetic applications. The latter may be structural rather than content. The organization is clear but seem aimed at biology more than application.
 - The book covers more than is required for the course, as it should be.
 - I will be using this textbook for the first time this fall, so it is hard for me to evaluate at this point.
- Advantages of this textbook:
 - Covers the chemostat
 - It has almost everything I teach.
 - Well organized, Chapters fit topics--nice breakdown of information
 - It's the only textbook that covers all three areas of biology that are relevant to the environmental field: microbiology, ecology, and toxicology
 - Covers variety of topics; covers toxicology, which most books don't
- Disadvantages of this textbook:
 - Does not cover all the unit processes in detail
 - Students don't love it, maybe because it is boring to look at (compare to Brock microbiology).
 - It is not a brief book; some students might prefer a book that only covers what they "need to know."
- What areas/topics does this book cover better or worse than other texts that you also considered for this course?
 - Comment: I am a coauthor of the text - perhaps this should disqualify my responses!
 - Rittmann & McCarty is weaker in biology and biochemistry, much stronger in theoretical applications and kinetics. Brock is more readable, but woefully lacking for math of most any type.
 - Specialized books in the different topics may cover their respective areas better. For example, a book only on limnology would do a better job on describing stream ecology.
 - Toxicology - better

- Bitton, G. 2005. Wastewater Microbiology, 3rd ed., Wiley.

- n = 2; 1 required, 1 recommended

answer options	strongly agree	agree	neutral	disagree	strongly disagree	Response Count
This textbook is well organized	0	1	1	0	0	2
This textbook is sufficiently comprehensive in breadth and depth	0	1	1	0	0	2
There are adequate examples and problems	0	0	2	0	0	2
The text has sufficient emphasis of environmental engineering/public health applications of fundamentals (relevance)	0	1	1	0	0	2

The instructor's manual is helpful:		
answer options	Response Percent	Response Count
strongly agree	0.0%	0
agree	0.0%	0
neutral	50.0%	1
disagree	0.0%	0
strongly disagree	0.0%	0
not available	50.0%	1
TOTAL	100.0%	2

- Comments on organization, comprehensiveness, example problems, and emphasis:
 - None
- Advantages of this textbook:
 - Customized hand-outs that students get up to date research articles to compare. their work towards, as well as learn from primary literature.
 - Focus on microbiology relevant to environmental engineering & water/wastewater management.
- Disadvantages of this textbook:
 - Class changes every year and there is a lot of preparation that goes into making new reference lists, making new projects.
 - Instructor manual would be helpful
- What areas/topics does this book cover better or worse than other texts that you also considered for this course?
 - None

- **Rittmann, B.E. and McCarty, P.L. 2001. Environmental Biotechnology: Principles and Applications. McGraw Hill.**

- n = 9; 8 required, 1 recommended

answer options	strongly agree	agree	neutral	disagree	strongly disagree	Response Count
This textbook is well organized	6	3	0	0	0	9
This textbook is sufficiently comprehensive in breadth and depth	4	2	3	0	0	9
There are adequate examples and problems	2	4	1	2	0	9
The text has sufficient emphasis of environmental engineering/public health applications of fundamentals (relevance)	3	4	1	1	0	9

The instructor's manual is helpful:		
answer options	Response Percent	Response Count
strongly agree	0.0%	0
agree	33.3%	3
neutral	22.2%	2
disagree	22.2%	2
strongly disagree	0.0%	0
not available	22.2%	2
TOTAL	100.0%	9

- Comments on organization, comprehensiveness, example problems, and emphasis:
 - We use a coursepak, but the text I listed is the one we suggest students can buy as a reference. Student resources include handouts, websites, and brief lectures that supplement the research they conduct to solve problem scenarios.
 - The textbook provides a good balance between microbiology fundamentals and biological treatment processes, which this course attempts to cover in one semester course with lab. I've had a lot of trouble with end of chapter problems - not very well worded and missing key information. Also, example problems are somewhat limited. However, I keep using it because it does provide the balanced treatment in a slim volume. I supplement extensively with my own course notes and material from Brock and M&E.
- Advantages of this textbook:
 - Strong in engineering aspects.
 - Clear, well organized, simple.

- Comprehensive, provides fundamentals as well as engineering applications
 - Systematically organized, comprehensive coverage, well written, has examples
 - Well organized. Clearly presents the fundamentals. Provides homework problems.
 - strong engineering fundamentals
 - Comprehensive, good treatment of microbial fundamentals, energetics, kinetics, reactor design, activated sludge, biofilms, BNR, anaerobic treatment processes.
 - o Disadvantages of this textbook:
 - Some chapters are outdated (e.g., biological phosphorus removal)
 - Could have greater depth, especially in microbiology of biofilms.
 - It does not cover enough of the microbiology and ecology fundamentals. It also should be updated (second edition)
 - The figures are not as clear as other textbooks (e.g., the Madigan text).
 - Too little emphasis on pathogens
 - Not enough design oriented problems and examples. Errors in equations and end of chapter problems.
 - o What areas/topics does this book cover better or worse than other texts that you also considered for this course?
 - Stoichiometry
 - Good: Stoichiometry, kinetics, wide range of applications. Worse: Basics of microbiology, biochemistry
 - Clearly presents microbial energetics. However, no discussion of biofuels.
 - Covers stoichiometry better than other texts.
 - I've used both M&E and the Grady textbook and both were not comprehensive enough in the microbiology fundamentals as Rittmann and McCarty, so I wound up providing a lot of supplemental material. The organization is a bit better too. Students are also much more likely to read a slimmer volume! We use M&E in the design class so the students wind up being exposed to both.
- Maier, R.M., Pepper, I.L., Gerba, C.P. 2000. Environmental Microbiology. Academic Press, San Diego, CA.

o n = 7; 6 required, 1 recommended

answer options	strongly agree	agree	neutral	disagree	strongly disagree	Response Count
This textbook is well organized	3	2	2	0	0	7
This textbook is sufficiently comprehensive in breadth and depth	3	1	2	1	0	7
There are adequate examples and problems	1	2	2	2	0	7
The text has sufficient emphasis of environmental engineering/public health applications of fundamentals (relevance)	0	5	2	0	0	7

The instructor's manual is helpful:		
answer options	Response Percent	Response Count
strongly agree	0.0%	0
agree	0.0%	0
neutral	14.3%	1
disagree	0.0%	0
strongly disagree	0.0%	0
not available	85.7%	6
TOTAL	100.0%	7

- o Comments on organization, comprehensiveness, example problems, and emphasis:
 - Lacks fundamental information on cell biology that is necessary for more advanced work - I have needed to supplement with course notes, use of Rittman's book and more recently Vaccari.
- o Advantages of this textbook:
 - Clearly written, comprehensive
 - Covers a reasonable breadth of areas of relevance to environmental engineers and scientists, well illustrated and not over-detailed
 - The textbook is very well written and gives a great overview.
 - Covers environmental micro topics thoroughly
- o Disadvantages of this textbook:
 - Getting a bit old
 - Some of the more important basics are missing or given inadequate treatment

- There are very few problems and no true supplements created by the authors.
- More problems, either qualitative or quantitative would be excellent. I often have to make up my own homework problems.
- What areas/topics does this book cover better or worse than other texts that you also considered for this course?
 - Applications are covered well -- especially for science student population

• Varnam, A.H. 2000. Environmental Microbiology. Manson.

- n = 1; 1 required, 0 recommended

answer options	strongly agree	agree	neutral	disagree	strongly disagree	Response Count
This textbook is well organized	0	0	0	1	0	1
This textbook is sufficiently comprehensive in breadth and depth	0	0	1	0	0	1
There are adequate examples and problems	0	0	1	0	0	1
The text has sufficient emphasis of environmental engineering/public health applications of fundamentals (relevance)	0	0	1	0	0	1

The instructor's manual is helpful:

answer options	Response Percent	Response Count
strongly agree	0.0%	0
agree	0.0%	0
neutral	100.0%	1
disagree	0.0%	0
strongly disagree	0.0%	0
not available	0.0%	0
TOTAL	100.0%	1

- Comments on organization, comprehensiveness, example problems, and emphasis:
 - None
- Advantages of this textbook:
 - None
- Disadvantages of this textbook:
 - None
- What areas/topics does this book cover better or worse than other texts that you also considered for this course?
 - None

• Madigan, M. T.; Martinko, J. M.; Parker, J. 2006. Brock Biology of Microorganisms, 11th ed., Prentice Hall, Pearson Education, Inc., Upper Saddle River, NJ.

- n = 35; 33 required, 2 recommended

answer options	strongly agree	agree	neutral	disagree	strongly disagree	Response Count
This textbook is well organized	19	15	1	0	0	35
This textbook is sufficiently comprehensive in breadth and depth	15	12	4	4	0	35
There are adequate examples and problems	5	9	10	10	1	35
The text has sufficient emphasis of environmental engineering/public health applications of fundamentals (relevance)	2	9	10	12	2	35

The instructor's manual is helpful:

answer options	Response Percent	Response Count
strongly agree	25.7%	9
agree	45.7%	16
neutral	20.0%	7
disagree	5.7%	2
strongly disagree	0.0%	0
not available	2.9%	1
TOTAL	100.0%	35

- Comments on organization, comprehensiveness, example problems, and emphasis:
 - I used Brock simply as background. I would say that my primary "textbook" is really the peer-reviewed literature, which I use quite a bit in the class to give context to the basic principles, which Brock covers fairly well. Overall, I don't lean on a text much in this class and use my notes extensively.
 - The quality and comprehensiveness balance the fact that Biology of Microorganisms is really not targeted at an undergraduate Environmental Engineering student. In addition, there are numerous used older versions (8, 9 and 10) cheaply available that are still technically acceptable.

- One of the best out there. A little weak on the applications side but good at everything else.
- The book is superb for basic microbiology at all levels, but the engineering applications must come from the instructor
- Too much detail for this course. Also, many of the chapters we don't even touch. As for problems, there are not enough substantive problems (mostly memorization type).
- I plan to switch textbooks because it is too focused on infectious disease. I would like a better introduction to water quality, wastewater treatment, and bioremediation. The first seven chapters are excellent.
- The web resources (for students), and suggestions for further reading make this text adjustable to many educational levels and student interests.
- Brock is a good resource about microbiology in general but I supplement the course material with more engineering-related content as needed.
- The text covers much more than what we cover in the courses and does not cover some things which I teach. But it is an excellent reference book for my students to have as part of their personal library
- This text is much more than I need, but other non-majors texts are insufficient. I've decided to go with the too-much option.
- The book covers the basics incredibly well. I feel that I can cover the application, but it's more important for the students to have an excellent and clear textbook for the more difficult concepts in microbiology. There really aren't any problems given in the book, but the figures are excellent.
- Microbiology depth and breadth is covered. More details on environmental processes would be nice
- The book is great for teaching microbiology concepts. I supplement it with an extensive set of course notes to provide both a more quantitative treatment of the subjects and the give environmental engineering applications (e.g., biological nutrient removal)
- Excellent book in every sense except the incredible speed of new editions (almost a new edition every other year)
- o Advantages of this textbook:
 - Comprehensive Updated regularly to keep pace with advances in microbiology; this is a major disadvantage of competing textbooks
 - Brock is fairly well versed at basic microbiology principles. I only use about 30% of it, but it is a good resource for students to look up anything they want.
 - Very broad, covers a lot of items
 - Comprehensive
 - Comprehensive, detailed, readable, lavishly illustrated
 - Good coverage of basic microbial physiology and genetics; decent coverage of all other topics
 - Thoroughness and depth
 - Thoroughness, up-to-date information, visuals, instructional materials
 - Good overview of basic scientific principles (genetics, taxonomy, metabolism)
 - Widely used; great long term reference as well as text for class.
 - Well explained, clear, excellent illustrations
 - Very general, and easy for students to use as a reference in later years.
 - Systematically organized, comprehensive coverage, well written, has examples
 - Excellent general reference
 - Breadth and depth in relevant topics.
 - Great Powerpoint slides and very good basic information to build chemistry deficient backgrounds of civil engineers.
 - For all of the foundational material, I don't need to supplement with anything. There is much more detail than I expect the students to know for this course.
 - As I said, it is an excellent reference on general microbiology. Lab techniques are also covered in terms of theory, which is nice. The figures are wonderful and the

- supporting material for the instructor is great (almost all of the figures in the book are included as high quality color overheads and also on a CD)
- Madigan is a classic, and covers all important aspects of general microbiology for a general audience.
 - Depth and general microbial ecology
 - Very good discussion of principles, nice illustrations.
 - Good resource on fundamentals of microbiology. It is good to have on an engineer's bookshelf.
 - Very complete. Makes a great reference.
 - Well written; great visual aids to help students understand concepts
 - Visuals (figures and texts) and the coverage in terms of breadth and depth.
- Disadvantages of this textbook:
 - Very broad coverage to allow for use in introductory microbiology courses, so a fair amount of the material isn't needed for environmental engineering
 - It is not designed for environmental engineering microbiology, so many of the examples specific to our field are not in sufficient depth and, in some cases, are just wrong.
 - Too broad not enough specific examples of molecular biology techniques, not enough physiology
 - Rather advanced for undergraduates, with lots of material that is not used.
 - Cost, weak on applications
 - Little to no application to engineering issues
 - Too much depth/detail in most areas. Not enough practical application of the material to environmental issues.
 - Insufficient details on environmental applications
 - Not focused on engineering applications
 - There is a new edition almost every year, which makes it more expensive for students.
 - It does not cover enough of the microbiology and ecology fundamentals. It also should be updated (second edition)
 - Not engineering oriented
 - Lack of engineering examples and problems to work through.
 - Too much detail, always responding to questions from students on what they will be expected to know, since my lectures only pull a fraction of the detail.
 - There is little information on application, but I feel that this is not really a disadvantage, it is just material that I need to fill in for the students.
 - Lacks a homework problems section
 - Covers a lot more than needed for environmental microbiology
 - Can be too daunting for CE students
 - Written for biologists that tend to memorize facts. There are limited numbers of engineering examples and applications.
 - Too complete. Students easily are overwhelmed.
 - Insufficiently quantitative; do not address environmental engineering applications much
 - In some cases, it tends to become too detailed for environmental engineering students.
 - What areas/topics does this book cover better or worse than other texts that you also considered for this course?
 - There is a lack of environmental microbiology, especially pertaining to engineered systems. However, that is readily accomplished with supplemental materials.
 - It is best for the basic principles and the preliminary biochemistry that one needs to teach before diving into microbiology.
 - The general microbiology is strong, but it doesn't go into enough depth
 - Better- biology, microbiology, ecology, geochemistry, public health microbiology. Worse-water & wastewater treatment processes, soil remediation (overall engineering applications must be supplemented in class).
 - taxonomy, physiology, ecology

- This is the best text for introductory level microbial metabolism and genetics; more advanced info necessary should use the D. White text.
- Good: Stoichiometry, kinetics, wide range of applications. Worse: Basics of microbiology, biochemistry
- Very strong on micro in general, but not engineering focused.
- Very good coverage for biogeochemical cycling.
- Worse - molecular community characterization methods, and environmental engineering applications/implications.
- Covers microbial ecology and environmental issues best of all micro textbooks.
- Better - first 4 chapters. Worse - engineering applications.
- It has a nice section on the characteristics of different microorganisms.
- Haven't considered a new book in a long time, so don't know.

- Black, J. G. 2005. Microbiology: Principles and Applications, 6th ed., Wiley, NY, NY.

- n = 2; 2 required, 0 recommended

answer options	strongly agree	agree	neutral	disagree	strongly disagree	Response Count
This textbook is well organized	1	1	0	0	0	2
This textbook is sufficiently comprehensive in breadth and depth	0	1	0	1	0	2
There are adequate examples and problems	0	1	0	1	0	2
The text has sufficient emphasis of environmental engineering/public health applications of fundamentals (relevance)	0	0	1	1	0	2

The instructor's manual is helpful:

answer options	Response Percent	Response Count
strongly agree	0.0%	0
agree	50.0%	1
neutral	50.0%	1
disagree	0.0%	0
strongly disagree	0.0%	0
not available	0.0%	0
TOTAL	100.0%	2

- Comments on organization, comprehensiveness, example problems, and emphasis:
 - The text is suitable for the introductory microbiology part of the course. However, it is deficient on several of the course topics including energetics, disinfection, kinetics, and biogeochemical cycling of nutrients.
- Advantages of this textbook:
 - Cell types/structure/function presented well
 - Great coverage of basic microbiology and science related applications.
- Disadvantages of this textbook:
 - Focused on micro courses
 - Lack of coverage of engineering applications.
- What areas/topics does this book cover better or worse than other texts that you also considered for this course?
 - NA
 - Much simpler and easier to understand the basic microbiology. Brock is too complex for this type of course. It also has a better coverage of applications. While the other books cover more applications that apply to this course, they go to much in-depth and do not cover basic microbiology in enough detail.

All data:

Textbook Evaluation:						
answer options	strongly agree	agree	neutral	disagree	strongly disagree	Response Count
This textbook is well organized	31	25	8	1	0	65
This textbook is sufficiently comprehensive in breadth and depth	25	20	12	8	0	65
There are adequate examples and problems	12	15	19	18	1	65
The text has sufficient emphasis of environmental engineering/public health applications of fundamentals (relevance)	10	19	21	13	2	65
<i>answered question</i>						65
<i>skipped question</i>						16

The instructor's manual is helpful:		
answer options	Response Percent	Response Count
strongly agree	15.38%	10
agree	32.31%	21
neutral	21.54%	14
disagree	6.15%	4
strongly disagree	0.00%	0
not available	24.62%	16
<i>answered question</i>		65
<i>skipped question</i>		16

9. Suggestions for a new textbook:

A new textbook in this area would be beneficial to my course:		
answer options	Response Percent	Response Count
strongly agree	20.00%	13
Agree	26.15%	17
Neutral	33.85%	22
Disagree	18.46%	12
strongly disagree	1.54%	1
<i>answered question</i>		65
<i>skipped question</i>		16

Suggestions for a new textbook (e.g. topics to be added, types of problems to be covered, etc.):

- I would love a text that covers the topics I want, which most general microbiology texts do not address environmental issues adequately enough. However, the environmental microbiology text assumes they have had a general micro class first, so I have to provide that material through supplemental instruction.
- We need a book that has sufficient coverage of basic microbiology, but also has in-depth coverage of Environmental Engineering applications of the material. For example, kinetics, BOD, DO, Bioremediation. But not so in-depth that it confuses the students.
- It would be nice if Rittmann would revise and improve the textbook.

- Something that would combine the great graphics of Brock with environmental engineering applications. Personally, I think a supplement to Brock would be the best way to go, since an environmental engineering text is unlikely to sell enough to justify all the fancy graphics that are in Brock.
- Brock without the biomedical genetics and more environmental applications.
- Less of the minor details (while still catching the main basic concepts), and then more on applications in environmental engineering systems.
- If there were a companion guide to Brock with engineering applications, problems and examples it would be perfect.
- Textbooks focused on engineering give too little emphasis to pathogens
- Biofuels and bioreactor landfills
- I would welcome a text more specifically focused on environmental engineering microbiology.
- Include McCarty & Rittmann's thermodynamics, more exposition of kinetics (terse at present), a chapter on biofilms. I also teach a section on measurements (from MPN & BOD to ELISA and FISH) and a supporting section in a textbook would help me. Showing overall cell pathways (biochemistry) would be nice. Add some disinfection information including CT.
- Need a text with more engineering applications
- A textbook that contains the fundamentals of microbiology and environmental microbiology, but that focuses on environmental engineering applications would be helpful.
- Topics that would be applicable to our course include:
 - Fundamentals of Biochemistry
 - Cell types/structure/function
 - Public Health (e.g. regs, growth of indicator organisms)
 - Reaction Kinetics/Growth Models
 - Cell Metabolism/Energetics
 - Biochemical/Chemical Oxygen Demand
 - Limnology & Eutrophication
 - Biogeochemistry/ Nutrient Cycling
 - Disinfection Methods
- Techniques sections should be updated and made more specific. Expand sections on cell biology and basics of cell composition, metabolism and growth
- Less engineering and more biochemistry and chemistry using consistent and relevant units.
- Updated use of molecular biology to describe organisms present in complex systems
- A mix of basic micro (cell structure, function); biochemistry; thermo/stoichiometry; applications in public health, remediation, and bioprocesses.
- A specific textbook that focuses on public health microbiology. It should include basic microbiology, types of pathogens, detection methods, treatment methods (removal and inactivation), fate and transport in the environment, intro to epidemiology and risk assessment
- Include a comprehensive section on molecular biology techniques
- The techniques used by molecular biology change so rapidly, that my biology colleague hesitates to use journal articles much more than 2-3 years old. I don't know that any text can keep up with these changes unless it was offered on-line.

- I think the peer reviewed literature is the best textbook for a true environmental engineering microbiology course. Any textbook developed will be out of date quickly. Brock provides sufficient principles and then the literature provides an opportunity for linking to the context of environmental engineering and science problems plus it provides an opportunity for active learning exercises.