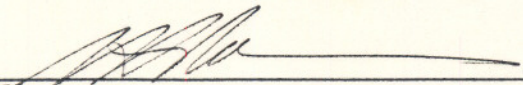
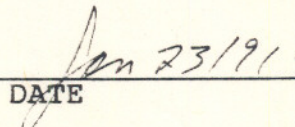


SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY
SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE TITLE: WATER POLLUTION (Outline & Lab Manual)
CODE NO.: BIO 129-4 SEMESTER: II, V
PROGRAM: WATER RESOURCES TECHNOLOGY/PULP & PAPER ENGINEERING TECHNOL.
AUTHOR: V. WALKER
DATE: JANUARY 1991 PREVIOUS OUTLINE DATED: JANUARY 1990

APPROVED: 
DEAN


DATE Jan 23/91

Water Pollution

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PREREQUISITE: AQUATIC BIOLOGY 125-3

I. PHILOSOPHY/GOALS:

This is a course designed to provide an introduction to the biological effects of water pollution and to ways of detecting, describing and quantifying these effects in the field and the laboratory. Types and sources of pollution, sampling strategies and legislation governing water quality will be discussed.

II. STUDENT PERFORMANCE OBJECTIVES:

Upon successful completion of this course the student will be able to:

1. Define pollution and discuss its complexity in aquatic ecosystems.
2. Discuss the physical, biological and ecological relationships in lentic versus lotic environments.
3. List and discuss the water pollution categories and their impact on aquatic systems.
4. List and discuss the major sources of water pollution.
5. Outline the procedure for setting up a bioassay and discuss the determination of LC50's, ET50's and toxicity curves.
6. Describe the transition in macroinvertebrates, bacteria, algae and fish with increasing eutrophy.
7. Demonstrate the use of various biotic and diversity indices to assess water quality.
8. Discuss the objectives and testing procedure of the Public Health Lab in Sault Ste. Marie.
9. List and discuss the various legislation governing water quality.

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III. TOPICS TO BE COVERED:

WEEK

1,2	UNIT 1	INTRODUCTION
		<ul style="list-style-type: none">- what is pollution?- complexity of pollution- the ecosystem concept- (Video: Great Lakes Troubled Waters)
2,3,4	UNIT 2	FRESHWATER SYSTEMS
		<ul style="list-style-type: none">- general characteristics- the lotic environment- the lentic environment- stability of ecosystems- seasonal production cycles
3	LAB 1	WINTER LAKE STUDY
4	TERM TEST #1	
5,6	UNIT 3	TYPES AND SOURCES OF POLLUTION
		<ul style="list-style-type: none">- Water pollution categories:- disease causing agents- inorganic chemicals and minerals- plant nutrients (nitrogen, phosphorus cycles)- sediments- heat- radioactive substances- oxygen demanding wastes- synthetic organic chemicals
5	LAB 2	PRIMARY PRODUCTION OF STANDING WATER
		<ul style="list-style-type: none">- major sources of water pollution- (Video: Early Warning)- (Speaker: Pollution Probe)
7	LAB 3	TEMPERATURE AND OXYGEN
7,8,9	UNIT 4	TOXICOLOGY
		<ul style="list-style-type: none">- types of toxic pollutants- toxicity- acute toxicity determination- factors affecting toxicity- (Video: H₂ Overview)
9	TERM TEST #2	

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WEEK

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- | | | |
|--------|--------------|--|
| 10 | LAB 4 | BIOASSAY |
| 10,11 | UNIT 5 | BIOLOGICAL ASPECTS OF WATER POLLUTION |
| | | - eutrophication |
| | | - macroinvertebrates |
| | | - bacteria |
| | | - algae |
| | | - fish |
| | | - (Speaker: MOE) |
| 12 | LAB 5 | STANDARD BACTERIAL PLATE COUNT AND BACTERIAL STAINING |
| 12, 13 | UNIT 6 | STUDENT PRESENTATIONS |
| 14 | UNIT 7 | SAMPLING FOR WATER QUALITY |
| | | - (Speaker: EB Eddy representative) |
| | | - apparatus |
| | | - sampling sites |
| | | - sampling strategy |
| | | - (Speaker: APHU) |
| | | - index species (SCI, biotic, diversity, indices) |
| 15 | UNIT 8 | LEGAL ASPECTS OF WATER POLLUTION |
| | | - acts and legislation governing water quality - MOE speaker |
| | | - (Video: Speaking Out - The Politics of Garbage) |
| | | - (Video: Strike Force) |
| 15 | TERM TEST #3 | |

NOTE: Schedule subject to change

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IV. EVALUATION METHODS:

Oral Presentation:	10 marks	90% and over	- A+
Lab Reports:	50 marks,	80	- A
Term Tests (3):	40 marks	70	- B
		60	- C
	<u>100</u> marks	Under 60%	- R

Students with a final grade of less than 60% will receive an "R" grade. All labs must be submitted for a passing grade.

ATTENDANCE:

Lab attendance is **compulsory**. Students missing labs without documented reason run the risk of repeating the course.

V. REQUIRED STUDENT RESOURCES:

TEXTBOOK:

Water Pollution Outline and Lab Manual

OPTIONAL PURCHASES:

Mason, C.F., 1981. Biology of Freshwater Pollution. Longman Group Ltd., New York.

Vallentyne, J.R. 1974. The Algae Bowl. Lakes and Man. Canada Dept. of the Environment, Fish and Marine Service, Mosc. Spec. Pub. No. 22:186 pp.

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VI. ADDITIONAL RESOURCE MATERIAL AVAILABLE IN THE COLLEGE LIBRARY:

Alabaster, J.S. and R. Lloyd. 1982 Water Criteria for Freshwater Fish (2nd Edition). Butterworth's Inc., Yarmouth MA.

*American Public Health Association, American Water Works Association, and Water Pollution Control Federation, 1975, Standard Methods for the Examination of Water and Wastewater. 14th ed. Am. Publ. Health Assoc., Washington, D.C.

*American Society for Testing and Materials. 1977. Bacterial Indicators - Health Hazards Associated with Water. ASTM, Phil.

*American Society for Testing and Material. 1977. Aquatic Toxicology and Hazard Evaluation. ASTM, Philadelphia.

*Andrews, W. A. 1972. A Guide to the Study of Environmental Pollution. Prentice-Hall, Inc. Scarborough, Ontario.

Ashworth, W. 1989. The Late, Great Lakes: An Environmental History. Collins Publ., Stockton, California. QH 545.A1 A57 1989

Black, John A. 1977. Water Pollution Technology. Reston Publishing Company, Inc. Virginia.

Brewer, Richard. 1979. Principles of Ecology. Saunders, Philadelphia

Brown, Lester Russell. 1988. State of the World: A Worldwatch Institution Report on Progress Toward a Sustainable Society. W. W. Norton, New York

Burns, Noel M. 1985. Erie: The Lake that Survived. Rowman & Allanheld Pub., Totowa, N.J.

*Cairns, John Jr. 1982. Biological Monitoring in Water Pollution. Pergamon.

Cairns, V.W., Hodson, Peter V. and Nriagu, J.O. 1984. Contaminant Effects on Fisheries. John Wiley & Sons, New York.

Chant, D. A. 1970. Pollution Probe. New Press, Toronto.

Colborn, Theo and Davidson. 1990. Great Lakes, Great Legacy? Conservation Foundation and Institute for Research on Public Policy in Canada. Halifax, N.S. TD 181.G73 G73 1990

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VI. ADDITIONAL RESOURCE MATERIAL - 2

Delwiche, C.C. 1981. Denitrification, Nitrification and Atmospheric Nitrous Oxide. Wiley, New York

Edmondson, W. T. (1969). Eutrophication in North America. In - Eutrophication - Causes, Consequences, Correctives. pp. 124-49. National Academy of Sciences, Washington.

Environmental Protection Agency. 198_. Water Quality Criteria. E.P.A. R3-73-033. Washington, D.C.

*Environmental Studies Board. 1983. Committee on Atmospheric Transport and Chemical Transformation in Acid Precipitation. Acid Deposition: Atmospheric Processes in Eastern North America. National Academy Press, Washington, D.C.

Freeman, A.M., Robert Haveman and Allen Kneese. 1984. The Economics of Environmental Policy. R.E. Krieger Publishing Co., Inc., Florida

*Goldman, Charles R. and A. J. Horne. 1983. Limnology. McGraw-Hill, Toronto.

*Gordon, Malcolm S. 1982. Animal Physiology: Principles and Adaptations (4th edition). MacMillan Publishing Co., Inc. New York.

Gore, James A. 1985. The Restoration of Rivers and Streams: Theories and Experience. Butterworth Publishing Co., Boston

Hammer, Mark J., 1986. Water and Wastewater Technology. John Wiley and Son Inc., New York.

Heath, Alan G. 1987. Water Pollution and Fish Physiology. CRC Press Inc., Boca Raton, Florida. SH174.H43 1987

*Hoar, W. S. 1983. General and Comparative Physiology (3rd Edition). Prentice-Hall, Inc., New Jersey.

Hoar, W. S., and D.J. Randall, (eds.). 1979. Fish Physiology. Vol.7: Locomotion Academic Press, Inc., London.

*Hoar, W.S., D.J. Randall and J.R. Brett (eds). 1979. Fish Physiology. Vol.8: Bioenergetics and Growth. Academic Press, Inc., London.

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ADDITIONAL RESOURCE MATERIAL - 3

Hocutt, Charles H. and Jay R. Stauffer Jr. (eds). 1980. Biological Monitoring of Fish. Lexington Books, Lexington, Mass.

Huntley, R.V. and R.Z. Rivers (eds). 1986. Proceedings of the Acid Rain Evaluation Seminar. Dept. of Fisheries and Oceans, Ottawa.

*Hynes, H. B. N. 1970. The Ecology of Running Waters. University Toronto Press, Toronto.

_____. 1974. The Biology of Polluted Waters. University Toronto Press, Toronto.

Isom, Billy G., S.D. Dennis, J.M. Bates. 1986. Impact of Acid Rain and Deposition on Aquatic Biological System. ASTM, Philadelphia.

Johnson, Raymond E. 1982. Acid Rain/Fisheries: Proceedings of an International Symposium on Acidic Precipitation and Fishery Impacts in Northeastern North America, Cornell University, Ithaca, New York, August 2-5, 1981. American Fisheries Assoc., Bethesda, Md.

Kimball, John W. 1978. Biology. 4th Ed. Addison-Wesley, Don Mills, Toronto.

*Krenkel, P.A. and Parker, F.L. 1973. Nation Symposium on Thermal Pollution Proceedings: Biological Aspects of Thermal Pollution.

*Larkin, P.A. 1974. Freshwater Pollution Canadian Style. McGill-Queen's University Press, Montreal.

*Laws, Edward A. 1981. Aquatic Pollution - An Introductory Text. John Wiley and Sons, Toronto.

Mason, C. F. 1981. Biology of Freshwater Pollution. Longman.

McKane, L. and Kandel J., 1985. Micro-Biology Essentials and Applications. McGraw-Hill Book Co., Toronto.

*McNeely, R. N., V. P. Neimanis and L. Dwyer. 1979. Water Quality Sourcebook Guide to Water Quality Parameters. Environment Canada, Inland Waters Directorate, Water Quality Branch, Ottawa.

Morgan, James and Werner Stum. 1981. Aquatic Chemistry: An Introduction Emphasizing Chemical Equilibrium in Natural Waters. Wiley, New York

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ADDITIONAL RESOURCE MATERIAL - 4

Murty, A.S. 1986. Toxicity of Pesticides to Fish. CRC Press. Boca Raton, FLA.

*National Research Council of Canada. 1985. TFM and Bayer 73: Lampricides in the Aquatic Environment. Pub. No. NRCC 22488, Ottawa.

Palmer, C. Mervin. 1980. Algae and Water Pollution. Castle House Publications, Ltd., England.

Pavoni, J.L., 1977. Handbook of Water Quality Management Planning. Van Nostrand Reinhold Co., Litton Educational Publishing Inc., New York.

Pickering, A.D. 1981. Stress and Fish. Academic Press, San Diego, California. QL639.1 S74 1981

Rand, Gary M and Sam, R. 1985. Fundamentals of Aquatic Toxicology; Methods and Applications. Hemisphere Publications, Washington.

*Reid, George K. 1961. Ecology of Inland Waters and Estuaries. Van Nostrand Reinhold Co., Toronto.

*Ruttner, F. 1963. Fundamentals of Limnology. University of Toronto Press, Toronto.

Salle, A.J., 1967, Fundamental Principles of Bacteriology. 6th edition, McGraw-Hill Book Co., Toronto.

Shubert, Elliot L. 1984. Algae as Ecological Indicators. Academic Press, San Diego, California. QK 565.A46 1984

*Smith, R. L. 1974. Ecology and Field Biology. Harper and Row Publishers, New York.

*Sprague, J. B. 1973. The ABC's of pollution bioassay using fish. Biological Methods for the Assessment of Water Quality, ASTM STP 528, American Society for Testing and Materials, 1973, pp. 6-30. (Reprint available)

Suffet, Irwin H. 1977. Fate of Pollutants in the Air and Water Environments. Wiley, New York.

Tinsley, Ian J. 1979. Chemical Concepts in Pollution Behaviour. Wiley Interscience, New York.

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ADDITIONAL RESOURCE MATERIAL - 5

Tourbier, J. and R. W. Pierson, Jr. (eds.). 1976. Biological Control of Water Pollution. University of Pennsylvania Press, Inc., PA.

Tu, Anthony T. (ed). 1982. Survey of Contemporary Toxicology, Vol. 2. Wiley, New York.

Vallentyne, J. R. 1974. The Algae Bowl. Lakes and Man. Canada Department of the Environment, Fish and Marine Service, Misc. Spec. Pub. No. 22: 186 pp.

Viessman, W.Jr. and M.J. Hammer. 1985 Water Supply and Pollution Control. Harper and Row, Publishers, New York.

Wagner R. H., 1971. Environment and Man. Norton, New York.

Warren, C. E. 1971. Biology and Water Pollution Control. Saunders, Philadelphia.

Wetzel, Robert G. 1983. Limnology (2nd Edition). Saunders. College Publishing, Toronto.

Wetzel, R. G., and G. E. Likens, 1979. Limnological Analyses. Saunders, Philadelphia.

*Wilber, Charles G. 1969. The Biological Aspects of Water Pollution. Charles C. Thomas. Illinois.

*Worf, D. L. 1980. Biological Monitoring for Environmental Effects. Lexington Books, San Diego, CA

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Wildlife Aging References

Bagenal, T.B. (ed). 1974. The Aging of Fish. Proceedings of an International Symposium (University of Reading, England, 1973), Unwin Brothers Ltd., Surrey, England

Nielsen, Larry A. and David L. Johnson (eds). 1983. Fisheries Techniques. American Fisheries Society. Southern Printing Co., Inc., Blacksburg, Virginia

Summerfelt, Robert C. and Gordon E. Hall (eds). 1987. Age and Growth of Fish. Iowa State University Press. Ames, Iowa

Weatherley, A.H. and H.S. Gill. 1987. The Biology of Fish Growth. Academic Press. Toronto, Ontario

*ON RESERVE AT THE COLLEGE LIBRARY