



**I. COURSE DESCRIPTION:**

This course provides students with the skills for the measurement and analysis of various chemical, physical and biological parameters within both aquatic and terrestrial environments. Standard methodologies in both laboratory and field settings will be performed to evaluate temperature, pH and oxygen and their influence on lake productivity, metabolic rates of aquatic organisms as related to temperature, toxicity of substances on living organisms as well as an assessment of the energy value of common wildlife foods through bomb calorimetry. Emphasis will be placed on proper laboratory techniques, data collection and technical report writing.

**II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:**

Upon successful completion of this course, students will demonstrate the ability to:

**1. Perform standard analytical methods in a laboratory setting.**

- Prepare standard and stock solutions as instructed
- Calibrate and operate various instruments and equipment
- Conduct titrations for CO<sub>2</sub>, DO and pH
- Set-up and perform a bioassay
- Prepare food pellets, set up and correctly use a bomb calorimeter

*This learning outcome will constitute approximately 10% of the course.*

**2. Present, interpret and discuss lab results and present in a concise written technical report**

- Display data in appropriate tables and figures
- Research relationships between environmental parameters measured
- Analyze and interpret data relative to established theories
- Prepare technical reports based on laboratory results

*This learning outcome will constitute approximately 70% of the course*

**3. Discuss selected pollutants in the Great Lakes and their associated effects on wildlife**

- List the eleven toxic chemicals of concern in the Great Lakes and discuss their significance
- Outline the effect on the environment of thermal and organic pollution
- Discuss the 42 different AOC's in the Great Lakes
- Summarize various physical abnormalities and reproductive failures of Great Lakes wildlife due to pollutants

*This learning outcome will constitute approximately 20% of the course*

**III. TOPICS TO BE COVERED:**

1. Primary Productivity in Standing Water
2. Temperature and Oxygen Consumption in Aquatic Animals
3. The Effect of Toxins on Living Organisms
4. Acid Precipitation on Lake Ecosystems
5. Bomb Calorimetry

**IV. REQUIRED RESOURCES/TEXTS/MATERIALS:**

1. Environmental Analysis Outline and Lab Manual
2. Environment Canada, Dept. of Fisheries and Oceans and Health and Welfare Canada, 1991. Toxic Chemicals in the Great Lakes and Associated Effects - Synopsis. Government of Canada, Ottawa, 51 pp.

**EQUIPMENT:**

- lab coat
- safety glasses

**V. EVALUATION PROCESS/GRADING SYSTEM:**

<b>Labs</b>	<b>85%</b>
<b>Presentation</b>	<b>15%</b>
	<b>100%</b>

Due to the practical nature of this course and the emphasis on laboratory technique and data interpretation, there will be no opportunity for a "rewrite". Students with a final grade of less than 60% will receive an "R" grade. All labs must be submitted for a passing grade.

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

**Method of Assessment (Grading Method) The following letter grade will be assigned:**

A+	Consistently outstanding	(90% - 100%)
A	Outstanding achievement	(80% - 89%)
B	Consistently above average achievement	(70% - 79%)
C	Satisfactory or acceptable achievement in all areas subject to assessment	(60% - 69%)
R	Repeat -- The student has not achieved the objectives of the course and the course must be repeated.	(Less than 60%)
CR	Credit exemption	
X	A temporary grade, limited to situations with extenuating circumstances, giving a student additional time to complete course requirements.	

**NOTE: Students may be assigned an "R" grade early in the course for unsatisfactory performance.**

## **VI. SPECIAL NOTES:**

### Special Needs

If you are a student with special needs (e.g. Physical limitations, visual impairments, hearing impairments, learning disabilities), you are encouraged to discuss required accommodations with the instructor and/or contact the Special Needs Office, Room E1204, Ext. 493, 717 or 491 so that support services can be arranged for you.

### Plagiarism

Students should refer to the definition of “academic dishonesty” in the “Statement of Students Rights and Responsibilities”.

Students who engage in “academic dishonesty” will receive an automatic failure for that submission and/or such other penalty, up to and including expulsion from the course, as may be decided by the professor.

In order to protect students from inadvertent plagiarism, to protect the copyright of the material referenced and to credit the author of the material, it is the policy of the department to employ a documentation format for referencing source material.

### Advanced Standing

Students who have completed an equivalent post-secondary course should bring relevant documents to the Coordinator, Natural Resources Programs.

### Retention of Course Outlines

It is the responsibility of the student to retain all course outlines for possible future use in gaining advanced standing at other post-secondary institutions.

Substitute course information is available at the Registrar’s Office.

## **VII. PRIOR LEARNING ASSESSMENT:**

Please contact the Prior Learning Assessment Office (E2203) for further information.

### **Viii. ADDITIONAL RESOURCE MATERIAL AVAILABLE IN THE COLLEGE LIBRARY:**

Adams, S. Marshall (ed.) 1990. Biological Indicators of Stress in Fish. American Fisheries Society Symposium 8. AFS. Bethesda, Maryland  
QL 639.1B55 1990

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 Word: 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, Theodora E. 1990. Great Lakes, Great Legacy? Conservation Foundation and Institute for Research on Public Policy in Canada. Halifax, N.S. TD 181.G73 G73 1990

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.

Environment Canada 1986. From Cradle to Grave. A Management Approach to Chemicals. Ministry of Supply & Services Ottawa. TD 196.C45T38 1986

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.

Evans, M. S. (ed). 1988. Toxic Contaminants and Ecosystem Health: A Great Lakes Focus. John Wiley and Sons, N.Y. TD180.A38V.21

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.

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.

McPhee, John 1989. The Control of Nature. Strauss, Farrar and Giroux, N.Y.

Minns, Charles Kenneth 1986. Project Quinte: point-source phosphorus control and ecosystem response in the Bay of Quinte, Lake Ontario. Cdn. Special Publication of Fisheries and Aquatic Sciences. Dept. of Fisheries & Oceans, Ottawa TD227.06 P73

Misener, A. D. and G. Daniel (eds.) 1982. Decisions for the Great Lakes. Great Lakes Tomorrow, Hiram, Ohio.

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

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.

Owen, O.S. 1985. Natural Resources Conservation - An Ecological Approach. MacMillan, New York

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. 6<sup>th</sup> edition, McGraw-Hill Book Co., Toronto.

Schmidtke, N. W. 1986. Toxic Contamination in Large Lakes. World Conference on Large Lakes. Lewis Publishers QH545.W3 W67 1986

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.

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  
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