

## Rationale

The objective of this document is to be a resource for teaching *Grade 12 Interdisciplinary Topics in Science (40S)*. It is designed to provide information to expose Manitoba students to the complexity of issues associated with Lake Winnipeg, and, through science investigations and problem-based approaches to learning, to encourage students to develop decision-making skills associated with the ecological and social dynamics of the Lake Winnipeg environment.

## Resource Overview

This resource focuses on environmental stewardship and Lake Winnipeg, and has been organized around the following five guiding or “essential” questions:

**Essential Question 1:** Why should we care about Lake Winnipeg?

**Essential Question 2:** How does the Lake Winnipeg watershed affect our ability to take care of the lake?

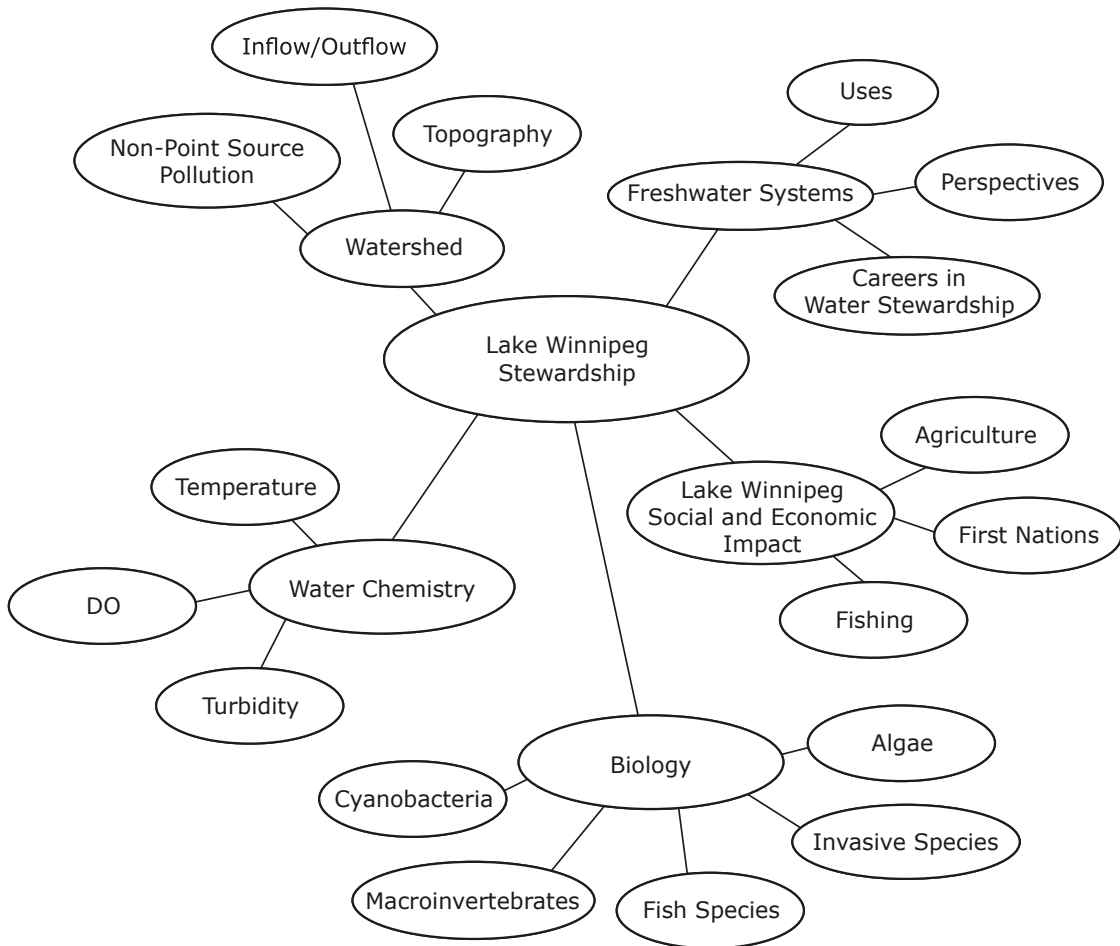
**Essential Question 3:** How are social and economic activities affecting the health of Lake Winnipeg?

**Essential Question 4:** How does knowing the water chemistry help improve our ability to care for Lake Winnipeg?

**Essential Question 5:** How can biotic parameters indicate the health of Lake Winnipeg?

---

A CONCEPT MAP OF THE MAIN IDEAS PRESENTED  
IN THIS RESOURCE



## Organization of This Resource

This resource is divided into five sections, with one section for each Essential Question. Each section begins with an introduction that describes the intent of the section, and outlines some activities and ideas that will be covered. This is followed by a list of resources that teachers can use to teach the section. Finally, there are a series of lessons that cover the ideas of the Essential Question.

Each lesson has some or all of the following components:

- Learning Outcomes
- Introduction
- Objectives
- Teacher Background
- Resources to Plan Your Teaching
- Three A's Learning Cycle: Activate, Acquire, and Apply
- Probing Questions
- Assessment

## Learning Outcomes for This Resource

As this document is a resource for the *Grade 12 Interdisciplinary Topics in Science (40S)* course, its learning outcomes can be found in the Manitoba Education document *Interdisciplinary Topics in Science (40s)* (see [www.edu.gov.mb.ca/k12/cur/science/gr12\\_interdisciplinary\\_draft.pdf](http://www.edu.gov.mb.ca/k12/cur/science/gr12_interdisciplinary_draft.pdf)).

Specific learning outcomes can be found for each of the learning experiences described, and the entire set of learning outcomes are attached in an appendix.

## Resources to Plan Your Teaching

The following resources are recommended. The Duguid and Brandson documents may be especially useful for students.

- Canadian Council for Geographic Education. "The River Lot Farms of the Red River." *The Canadian Atlas Online*. Ottawa, ON: Canadian Council for Geographic Education, n.d. Available online at [www.canadiangeographic.ca/atlas/LessonPlan.../MB6-8%20Red%20River.pdf](http://www.canadiangeographic.ca/atlas/LessonPlan.../MB6-8%20Red%20River.pdf).
- Carlesen, William S., Nancy M. Trautmann, & the Environmental Inquiry Team. *Cornell Scientific Inquiry Series Student Edition, Watershed Dynamics*. Arlington, VA: National Science Teachers Association Press, 2004. Available online at [www.nsta.org](http://www.nsta.org) and <http://ei.cornell.edu/pubs/wd.asp>.

- Duguid, Terry, & Norm Brandson. *Restoring the Health of Lake Winnipeg, Canada's Sixth Great Lake: A Report by the Lake Winnipeg Implementation Committee*. Winnipeg, MB: Lake Winnipeg Implementation Committee, 2005. Available online at <[http://manitobawildlands.org/water\\_lakewpg.htm](http://manitobawildlands.org/water_lakewpg.htm)>.
- ———. *Restoring the Health of Lake Winnipeg, Technical Annex, Canada's Sixth Great Lake*. Winnipeg, MB: Lake Winnipeg Implementation Committee, 2005. Available online at <[http://manitobawildlands.org/water\\_lakewpg.htm](http://manitobawildlands.org/water_lakewpg.htm)>.
- Grosshans, R.E., D.A. Wrubleski, & L.G. Goldsborough. *Changes in the Emergent Plant Community of Netley-Libau Marsh between 1979 and 2001*. Delta Marsh Field Station (University of Manitoba) Occasional Publication No. 4, Winnipeg, MB: University of Manitoba, 2004. Available online at <[www.gov.mb.ca/waterstewardship/iwmp/netley/documentation/netley\\_libau\\_marsh\\_report.pdf](http://www.gov.mb.ca/waterstewardship/iwmp/netley/documentation/netley_libau_marsh_report.pdf)>.
- Lake Winnipeg Stewardship Board. *Reducing Nutrient Loading to Lake Winnipeg and its Watershed: Our Collective Responsibility and Commitment to Action: Report to the Minister of Water Stewardship*. Winnipeg, MB: Lake Winnipeg Stewardship Board, 2006. Available online at <[www.lakewinnipeg.org/web/content.shtml?pf1=public/downloads.param&page=000101&op9.rf1=000101](http://www.lakewinnipeg.org/web/content.shtml?pf1=public/downloads.param&page=000101&op9.rf1=000101)> and <[http://manitobawildlands.org/water\\_lakewpg.htm](http://manitobawildlands.org/water_lakewpg.htm)>.
- Manitoba Wildlands. The Manitoba Wildlands site provides comprehensive information, history, and includes official documents for the following Manitoba subjects: Lake Winnipeg, Winnipeg Floodway, Trans-Boundary Initiatives, Manitoba Hydro projects, Wuskwatim Projects, Hydro Research & Reports, East Side of Lake Winnipeg, East Side Protected Areas, World Heritage Sites, Manitoba World Heritage Site, East Side Planning Initiative, Wabanong Nakaygum Okimawin (WNO), Aboriginal Rights & Title, Treaties & Traditional Territory among many more. Available online at <[www.manitobawildlands.org](http://www.manitobawildlands.org)>.

## Creating a Long-Term Data Set (Optional)

This resource is intended to help students understand the issues associated with the Lake Winnipeg ecosystem. The work can stand alone and be offered each year without the creation of a long-term data set, but some teachers may wish to develop their teaching so that the data collected from year to year contribute to a database that students can use to compare fluctuations in the ecosystem. In order to create a database that monitors the ecological health of a system, it is necessary to plan out the monitored area and water quality measures in the initial year of data collection.

Some planning items to consider:

1. Consider taking a field trip to Lake Winnipeg or a nearby aquatic site to take all necessary samples. Make sure to store them properly so protocols

and experiments can be conducted on them at a later date. The Education Outreach Coordinator with the Lake Winnipeg Research Consortium can assist by collecting data on the *Namao*, the research vessel based in Gimli.

2. Students should understand the benefits of ecological monitoring and how it can help people understand the freshwater ecosystem over the long term. They need to review protocols for sample collecting.
3. On the first trip to Lake Winnipeg or a nearby aquatic site, record a clear description of the physical geography and the proper co-ordinates using GPS units.

## Resources to Plan Your Teaching

The following resources would be helpful in planning for an ecological monitoring program:

- Taccogna, G., & K. Munro (eds). *The Streamkeeper's Handbook: A Practical Guide to Stream and Wetland Care*. Vancouver, BC: Salmonid Enhancement Program, Department of Fisheries and Oceans, 1995. *The Streamkeeper's Handbook* provides comprehensive information on watershed ecology, decree, and provides stream and wetland modules. Available online at [www.pskf.ca/publications/download.html](http://www.pskf.ca/publications/download.html).
- GLOBE Program: The GLOBE Program offers students an electronic environment to report and share collected data. The GLOBE Program provides educators with sets of protocols for various subject areas, including hydrology, which consists of the following topics:
  - Water transparency
  - Water temperature
  - Dissolved oxygen
  - Electrical conductivity
  - Salinity
  - pH
  - Alkalinity
  - Nitrate
  - Freshwater
  - Macroinvertebrates
  - Optional salinity titration
  - Protocol videos
  - Instrument specificationsAvailable online at [www.globe.gov/r](http://www.globe.gov/r).

- The Manitoba Waterways Project: This project offers Manitoba educators a list of protocols for the following parameters:
  - Stream profiles (temperature, odour, colour, etc.)
  - Dissolved oxygen level
  - Nitrate level
  - Phosphate level
  - Bacteria count
  - Macro-invertebrate representation score
  - pH
  - Biological oxygen demand
  - Velocity
  - Total dissolved solids/conductivity
  - Total suspended solids/turbidity (water clarity)

Available online at <<http://home.cc.umanitoba.ca/~lewthwai/mwp/>>.

- World Water Monitoring Day: World Water Monitoring Day is a month-long program that begins every year on September 18. Turbidity, temperature, DO, and pH test kits can be purchased online. Worksheets and lesson plans are available online. Students can post their data results online. Available online at <[www.worldwatermonitoringday.org](http://www.worldwatermonitoringday.org)>.
- Nature Watch: Nature Watch has the following monitoring programs: plant, ice, frog, and worm. Background information and observation sheets are available for download. Collected data is displayed on the website. Available online at <[www.icewatch.ca/english](http://www.icewatch.ca/english)>.
- The Stream Study (Virginia, USA): This website explains the importance of macro-invertebrates and the materials and procedures needed to set up a monitoring program. This site contains a helpful electronic macro-invertebrate identification book. Available online at <[people.virginia.edu/~sos-iwla/StreamStudy/StreamStudyHomePage/StreamStudy.HTML](http://people.virginia.edu/~sos-iwla/StreamStudy/StreamStudyHomePage/StreamStudy.HTML)>.

## Social Aspects and Impacts to the Lake Winnipeg Ecosystem

In addition to the physical, chemical, and biological components of the Lake Winnipeg ecosystem, this resource includes the social and economic importance of the Lake Winnipeg ecosystem and the impacts that result if the ecosystem is disrupted by natural or human events.

A variety of learning experiences can be found in the third section of this resource, and teachers can cover these as a separate section or integrate them into the lessons.

### Materials Required

- Lab equipment:
- Aquarium
- Thermometer
- Dissolved oxygen kit
- pH kit (or pH paper)
- Secchi disc
- Compound microscopes
- Microscope slides and cover slips
- Ocular micrometer
- Palmer counting chambers
- 300 mL BOD bottle or Pasteur pipette
- Manganous sulfate
- Alkaline iodide
- Starch solution
- Sulphuric acid ( $H_2SO_4$ )
- Standardized thiosulphate working solution (or PAO)
- Aluminum foil
- Graduated cylinder
- Erlenmeyer flask
- Burette
- Algae cultures

## Resources to Plan Your Teaching

- Carlesen, William S., Nancy M. Trautmann, & the Environmental Inquiry Team. *Cornell Scientific Inquiry Series Student Edition, Watershed Dynamics*. Arlington, VA: National Science Teachers Association Press, 2004. An overview of the publication and online resources to accompany the book are available at <[ei.cornell.edu/pubs/wd.asp](http://ei.cornell.edu/pubs/wd.asp)>.
- Taccogna, G., & K. Munro (eds). *The Streamkeeper's Handbook: A Practical Guide to Stream and Wetland Care*. Vancouver, BC: Salmonid Enhancement Program, Department of Fisheries and Oceans, 1995. Available online at <[www.pskf.ca/publications/download.html](http://www.pskf.ca/publications/download.html)>. This guide was developed to help teachers implement water quality measures in their local area. The guide contains procedures for water quality measures and student worksheets for recording data. Available online at <[www.pskf.ca/publications.html](http://www.pskf.ca/publications.html)>.

## Videos

- Meeches, Lisa. "The Living Earth." *The Sharing Circle*, season 16, episode 6.
- ———. "The Voice of the Lake, Parts 1 and 2." *The Sharing Circle*, season 14, episodes 16 and 17. Available online at <[www.thesharingcircle.com](http://www.thesharingcircle.com)>. Available from the Manitoba Education Library (IRU #D-10548).
- Perkins, Lynsay. *Fat Lake: How Too Much of a Good Thing is Hurting Lake Winnipeg*. Available from the Manitoba Education Library (Instructional Resources Unit). Call #: D-12176.
- Siamandas, George. *Lake Winnipeg's Paradise Beaches*. Prairie Public Television, 2001. This video can be purchased through Prairie Public Television at <<http://archive.prairiepublic.org/features/beaches/index.htm>>, and is also available at the Winnipeg Public Library (VHS 917.1272).



## Assessment Plan

Suggestions for assessment *for* learning and assessment *of* learning for each of the learning experiences.

### Essential Question 1: Why Should We Care about Lake Winnipeg?

#### **Lesson: Beautiful Lake Winnipeg! A Conservation Ethic?**

*Assessment for Learning:* Provide students with feedback on their participation in the discussion. Ask students to submit an exit slip that describes the environmental ethic they agree with the most.

*Assessment of Learning:* Assess students on the clarity of their letter. Use the following criteria:

1. Identifies why Lake Winnipeg is important to him or her
2. Clearly identifies the ethic depicted in the postcard
3. Provides a justification for assigning the ethics to the picture

#### **Lesson: Identifying the Importance of Lake Winnipeg as a Freshwater Ecosystem**

*Assessment for Learning:* Provide students with feedback on their participation in discussion.

#### **Lesson: What Is a Watershed? What Water Systems Characterize Lake Winnipeg?**

*Assessment for Learning:* Have students submit answers to questions, and provide them with feedback.

#### **Lesson: Characteristics of Lake Winnipeg: Lake Winnipeg Portfolio Assignment and Report Card**

*Assessment for Learning:* Provide feedback to students as they progress through the report card assignment.

*Assessment of Learning:* Use the rubric provided to assess the report card. The summative assessment would not be completed until the end of the course.

### Essential Question 2: How Does the Lake Winnipeg Watershed Affect Our Ability to Take Care of the Lake?

#### **Lesson: Stream Order**

*Assessment for Learning:* Provide students with feedback on their participation in discussion and their ability to identify stream order in one of the rivers in the Lake Winnipeg watershed.

### **Lesson: Inflow to Lake Winnipeg and Flood Forecasting**

*Assessment for Learning:* Using a checklist, provide students with feedback on their computer skills and ability to work with electronic databases.

*Assessment of Learning:* Assess the answers to the questions at the end of the lesson.

### **Lesson: Bathymetry of Lake Winnipeg's North and South Basin**

*Assessment for Learning:* Using a checklist, provide students with feedback on their computer skills and ability to work with electronic databases.

*Assessment of Learning:* Collect student responses to questions and provide feedback.

### **Lesson: How to Best Restore Lake Winnipeg from Shoreline Erosion**

*Assessment for Learning:* Have students peer-edit each other's reports prior to submitting them.

*Assessment of Learning:* Collect and assess research reports on the shoreline erosion problem using the rating scale provided.

### **Lesson: Changes in the Netley Marsh**

*Assessment for Learning:* Collect responses to questions and provide feedback, or go through the answers to the questions as a class, or have students peer-review answers to questions.

*Assessment of Learning:* Have students submit completed maps and summary paragraphs, and assess responses according to clarity and use of the literature to justify any claims.

## **Essential Question 3: How Are Social and Economic Activities Affecting the Health of Lake Winnipeg?**

### **Lesson: The Living Earth**

*Assessment for Learning:* Review responses in the exit slip, and provide comments on the student's use of evidence.

### **Lesson: Agricultural Operations**

*Assessment for Learning:* Provide feedback to students on their participation in the town hall.

*Assessment of Learning:* Assess the report using the attached rating scale.

## Essential Question 4: How Does Knowing Water Chemistry Help Improve Our Ability to Care for Lake Winnipeg?

### **Lesson: Introduction to Limnology**

*Assessment for Learning:* Provide feedback to students on their participation during the creation of the cluster diagram of physical, chemical, and biological properties of Lake Winnipeg.

*Assessment of Learning:* Have students submit an inquiry-based project on one question they would like to answer on the chemical parameters of Lake Winnipeg.

### **Lesson: Water Quality**

*Assessment for Learning:* Have students complete the probing questions for each of the protocols, and provide them with feedback.

### **Lesson: Phosphorus in Lake Winnipeg**

*Assessment for Learning:* Have students complete the probing questions for the nitrogen and phosphorus fluctuation in the lake.

### **Lesson: Exploring the Sources of Nitrogen and Phosphorus in Lake Winnipeg**

*Assessment for Learning:* Using an exit slip, provide feedback to students on their participation in the debate.

*Assessment of Learning:* Students will submit a section in the report card on the chemical parameters they examined.

## Essential Question 5: How Can Biotic Parameters Indicate the Health of Lake Winnipeg?

### **Lesson: Prokaryotes in Lake Winnipeg**

*Assessment for Learning:* Collect student responses to the cyanobacteria scavenger hunt, and provide them with feedback.

### **Lesson: Understanding Algae**

*Assessment for Learning:* Provide students with feedback on their use of the microscope and creation of wet mounts.

*Assessment of Learning:* Assess the lab report using a rubric.

### **Lesson: Lake Productivity**

*Assessment for Learning:* Provide students with feedback on their lab skills using a checklist.

*Assessment of Learning:* Assess the lab report using a rubric.

### **Lesson: Macroinvertebrates as Indicators of Water Quality**

*Assessment for Learning:* Provide students with feedback on their participation in the discussion.

*Assessment of Learning:* Collect the individual conclusions students have drawn to the results collected by the class.

### **Lesson: Fish Populations**

*Assessment of Learning:* Assess the presentation using a rubric.