Water Quality Introduction

Living in the water-rich Great Lakes basin, many Michigan students take water for granted. The *MEECS Water Quality Unit* is designed to provide students with a solid foundation in understanding the critical importance of having adequate supplies of clean, available fresh water for the environment, Michigan's economy, and our quality of life. The unit provides a national and international perspective on water availability, an appreciation for Michigan's "dirty" water history, and an understanding of the challenges that Michigan faces in addressing water quality and quantity issues related to groundwater, streams and rivers, wetlands, inland lakes, and the Great Lakes. Not only can humans not survive a week without water, neither can an economy survive without sufficient supplies of clean water.

The *MEECS Water Quality Unit* contains nine core lessons and five extension lessons. All lessons are correlated to middle and high school benchmarks for science and social studies. The lessons and activities may be adapted for specific grades, as well as for non-formal education programs. In addition, six interactive online learning modules have been developed to support several lessons in the unit (http://techalive.mtu.edu/meec_index.htm). Both individual lesson assessments and a MEAP-like unit assessment are included. The embedded lesson assessments are either project-based or invite student reflection and discussion. Teachers also have the option of using a pre- and post-unit assessment. Use of a science journal throughout the unit is encouraged.

Topics addressed in the unit include the availability and distribution of water on Earth (Lesson 1); household water use and water used in the manufacture of goods and services in Michigan (Lesson 2); managing water quantity and movement within a watershed (Lesson 3); land uses and water pollution (Lesson 4); groundwater quality and potential contamination (Lesson 5); water quality standards and the history of water quality protection (Lesson 6); assessing the health of aquatic ecosystems with stream monitoring (Lesson 7); managing storm water runoff (Lesson 8); and bioaccumulation of contaminants in the Great Lakes (Lesson 9). Additional Great Lakes challenges that we face include invasive species, emerging contaminants, proposed out-of-basin export of Great Lakes water, over-pumping of groundwater, combined sewer overflows and storm water runoff, cleaning up Areas of Concern and Superfund sites, impacts of climate change on water levels and aquatic ecosystems, beach closures, loss of wetlands, and declining biodiversity. Students are encouraged to explore possible solutions to these challenges including pollution prevention strategies, using data to make management decisions, personal behavior and product choices, engaging in activities that inform their communities, and more. The role of government and environmental stewardship to protect water quality and quantity is woven into lessons throughout the unit.

The water management choices that Michigan residents make now and in the future will have significant environmental, economic, and social impacts for us as individuals, for our communities, the State of Michigan, and for our country. How can Michigan residents, businesses, and industry continue to meet their needs without compromising the ability of future generations to meet their water resource needs? In order to ensure a healthy, sustainable future, Michigan residents must have the knowledge and skills necessary to make informed data-based decisions about the water resource challenges facing us as residents of a Great Lakes state and as participants in a global economy.

The future of Michigan's environment, economy, and quality of life depends on the decisions made by *today's* youth as *tomorrow's* decision-makers. The *MEECS Water Quality Unit* will help Michigan students gain the knowledge and skills they need to become stewards of Michigan's water resources and to help keep this Great Lakes state GREAT!

Water Quality Overview

	Essential Questions	Core Lesson
1	Where is water found on Earth? How does water move on Earth? Is there enough water on Earth for everyone? Why are the Great Lakes unique?	**1. Where Is All the Water in the World? –** Students describe how water moves through the water cycle, where water is located on Earth, and how much fresh water is available for human use.
2	Why is clean, fresh, available water so important to humans? What are direct and indirect uses of water? How would having less water or more expensive water affect Michigan residents?	**2. How We Use Water –** Students identify the many ways we use water both directly for household activities, and indirectly in everything we consume. Students calculate their weekly water use and its cost compared to gasoline, and consider how water is an essential component of Michigan's economy and environment.
3	What is a watershed? Why care about watersheds? How does water in your watershed reach the Great Lakes? Why does the amount of streamflow differ between Michigan streams and for different months of the year?	**3. Do You Know Your Watershed? –** Students define watershed and the parts of a river; compare watershed size and stream flow in Michigan; examine their watersheds' relationship to the Great Lakes.
4	How does what we do on the land affect water quality? How does pollution get from one place to another? How can I learn about water pollution in my watershed?	**4. How Do Land Uses Affect Water Quality? –** Students build a simple watershed model to observe point & non-point pollution from different land uses; identify the types of pollution resulting from different land uses; give examples of best management practices to reduce pollution; and identify potential sources of water pollution in their watersheds.
5	How is groundwater connected to surface water? How does groundwater move? How can groundwater become polluted? Is there enough groundwater for all Michigan uses?	**5. Why Care About Groundwater? –** Students explore groundwater movement, how groundwater interacts with surface water, and groundwater uses in Michigan. Student build a model to see how groundwater can be pumped and recharged, and use Michigan data to explore how groundwater can be contaminated.
6	How do we know our water is safe to drink? What units are used to measure water pollution? Has our water always been clean? Who is responsible for protecting our drinking water?	**6. Would You Drink This Water? –** Students consider whether the 'look' and 'smell' of water is enough to indicate its quality; conduct a serial dilution to observe the tiny quantities that can be harmful to humans and aquatic organisms; and become familiar with who protects Michigan's water quality.
7	What is stream monitoring, and how is it done? How do you know if a stream is healthy? What are bioindicators? What makes good habitat for fish?	**7. How Healthy Is This Stream? –** Students identify characteristics of healthy streams and use real Michigan data to evaluate four streams for the presence of pollution-sensitive bioindicator organisms, appropriate habitat, and good water quality in order to select the best stream for planting brook trout.
8	Where does storm water come from and where does it go? What are potential contaminants in runoff? How do people affect the quantity and quality of runoff? How can communities grow without impacting aquatic ecosystems? How is storm water runoff different in urban areas versus rural areas?	**8. How Can We Stop Storm Water? –** Identify pollutants in storm water; use aerial photos to compare changes in land use and runoff quantity; identify best management practices to reduce storm water impacts.
9	Are the Great Lakes really great? How do I know if it's safe to eat fish from the Great Lakes? What types of contaminants are found in the Great Lakes? How can I help protect the Great Lakes?	**9. Bioaccumulation and the Great Lakes Ecosystem –** Student investigate the source and pathways for bioaccumulation of contaminants in Great Lakes food chains; identify locally contaminated rivers using the Michigan Family Fish Consumption Guide; and answer the question, "How can I help the Great Lakes?"

Enhancements and Extensions

1.
- Play *Incredible Journey* water cycle game from Project WET online www.projectwetusa.org/pdfs/incrediblejourney.pdf.
- Research environmental issues of Lake Baikal online http://www.bww.irk.ru.
- Explore the *World Lake Database* online http://www.ilec.or.jp/database/database.html.
- Compare the relative volume and surface areas of the five Great Lakes.
- Investigate the physical and chemical properties of water in the Project WET activity *Is There Water on Zork?* (on the MEECS Water Quality CD).

2.
- Design and implement a home water conservation plan.
- Compare U.S. water use to that of other countries http://www.wateryear2003.org.
- Stack plastic gallon jugs to display the amount of water used for different activities.
- Investigate the claim of a looming "Global Water Crisis."

3.
- Visit the Terraserver website (http://terraserver.com) to view aerial photos of the local watershed.
- Compare extension lesson *Investigating Stream Flow in Michigan's Rivers* on the MEECS Water Quality CD.
- Try the interactive web modules *The Watershed Concept* and *Aquatic Ecosystems: Wetlands* at http://techalive.mtu.edu/meec_index.htm.
- Use a commercial stream table to demonstrate stream development under varying conditions.
- Play *Raging River* to model the confluence of tributaries into the main river channel.

4.
- Investigate water quality in your local river using Michigan Department of Environmental Quality websites listing contaminated water bodies and contaminated sites.
- Try the interactive web module *Water Quality: Pollutant Sources & Impacts* at http://techalive.mtu.edu/meec_index.htm.
- *Take a Watershed Tour* of your local area to meet with water users and managers, and see a variety of land uses, using the extension lesson on the MEECS Water Quality CD.
- Build erosion models to identify effective Best Management Practices.
- Compete in the activity *Runoff Races* from *WOW! The Wonder of Wetlands* by Project WET.
- Do *Sum of the Parts* activity from Project WET to explore the cumulative effects of streamside pollution (on the MEECS Water Quality CD).

5.
- Investigate *Groundwater Supply* & *Groundwater Contamination* using the online web modules at http://techalive.mtu.edu/meec_index.htm.
- Demonstrate groundwater movement and contamination using a groundwater model or enviroscape.
- Debate: Should groundwater withdrawals in Michigan be regulated?
- Have rural students download the well log for their home drinking water from http://www.deq.state.mi.us/well-logs/.
- Visit a local well driller to see an actual well being drilled.
- Install a shallow groundwater monitoring well at your school to monitor water table fluctuations.
- Try some lessons from Septic Educational Program to Instill Conservation (SEPTIC) (on the MEECS Water Quality CD).
- Conduct a porosity or permeability demonstration.

6.
- Take student on a tour of your local wastewater treatment facility.
- Investigate the safety of your community's drinking water by checking your local *Water Quality Consumer Confidence Report*.
- Investigate *Water and Wastewater Treatment* using the online web module http://techalive.mtu.edu/meec_index.htm.
- Engage students in researching and then debating current water issues.

7.
- Do the online web module *Stream Monitoring* or *Aquatic Ecosystems: Rivers & Streams* at http://techalive.mtu.edu/meec_index.htm.
- Have students "design a macroinvertebrate" to illustrate specific characteristics of different bioindicators.
- *Develop A Watershed Assessment* of your local watershed using the extension lesson on the MEECS Water Quality CD.

8.
- Do the activity *A-Maze-ing Water* from the Project WET Curriculum & Activity Guide.
- Develop a rain garden for your school grounds.
- Measure the water quality of storm water.
- Try *Measuring Watershed Runoff at Your School* using the extension lesson on the MEECS Water Quality CD.

9.
- Do the online web module *Aquatic Ecosystems: The Great Lakes* to learn more about the Great Lakes food chain at http://techalive.mtu.edu/meec_index.htm.
- Make a Great Lakes floor map using *Lake Effects Curriculum Guide*.
- *Investigate a Great Lakes Issue* using the extension lesson on the MEECS Water Quality CD.

Michigan Grade Level Content Expectations

Science Grades 6-7:

- Demonstrate scientific concepts through illustrations, performances, models, exhibits, and activities. **S.RS.M15**
- Describe the effect humans and other organisms have on the balance of the natural world. **S.RS.M17**
- Demonstrate, using a model or drawing, the relationship between warming by the sun and of the Earth and the water cycle as it applies to the atmosphere. **E.ES.07.11**
- Explain the water cycle and describe how evaporation, transpiration, condensation, cloud formation, precipitation, infiltration, surface runoff, ground water, and absorption occur within the cycle. **E.ES.07.81**
- Analyze the flow of water between components of a watershed, including surface features and groundwater. **E.ES.07.82**

Math Grades 6-7:

- Calculate part of a number given the percentage and the number. **N.FL.06.12**
- Solve word problems involving percentages. **N.FL.06.13**
- Express probabilities as fractions, decimals, or percentages between 0 and 1; know that "0" probability means that an event will not occur, and probability "1" means an event will occur. **D.PR.06.01**
- Compute probabilities of events from simple experiments with equally likely outcomes, e.g. tossing dice, flipping coins, etc. by listing all possibilities and finding the fraction that meets given conditions. **D.PR.06.02**

1

Social Studies Grade 6-7:

- Use historical perspective to analyze global issues faced by humans long ago and today. **6 - H1.4.3**
- Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere. **6 - G5.1.1**
- Explain that communities are affected positively or negatively by changes in technology. **7 - G2.2.2**
- Identify and explain factors (e.g. natural resources) that contribute to conflict and cooperation between and among cultural groups **7 - G4.4.1**
- Describe the effects that a change in the physical environment could have on human activities and the choices people would have to make in adjusting to the change. **7 - G5.2.1**

HS Earth Science:

- Describe that the water cycle includes evaporation, transpiration, condensation, precipitation, infiltration, surface runoff, groundwater, and absorption. **E4.p1A**
- Compare and contrast surface water systems and groundwater in regard to their relative sizes as Earth's freshwater reservoirs and the dynamics of water movement (inputs, outputs, residence times, sustainability). **E4.1A**
- Scientific Reflection and Social Implications (See HSCEs listed for Earth Science). **BI.2**

Science Grades 6-7:

- Predict possible consequences of overpopulation of organisms, including humans. **6-L.E.C.06.42, 7-L.E.C.06.42**

Social Studies:

- Use data to create thematic maps and graphs showing patterns of population, rainfall, etc., analyze the patterns about location and density of population. **6 - GI.2.3, 7 - GI.2.3**
- Apply the skills of geographic inquiry to analyze a problem or issue of importance to a region of the W. Hemisphere. **6 - GI.2.6, 7 - GI.2.6.**
- Contemporary investigations – Conduct research on contemporary global topics and issues, compose persuasive essays, and develop a plan for action. **6 - G6.1.1, 7 - G6.1.1.**
- Clearly state an issue as a question or public policy, trace the origins of the issue, analyze various perspectives, and generate and evaluate alternate resolutions. **6 - P3.1.1, 7 - P3.1.1**

2

Math Grades 6-8:

- Represent and interpret data using circle graphs, etc. and select appropriate representations to address specific questions. **D.RE.07.01**

HS Earth Science:

- Analyze how science and society interact from a historical, political, economic, or social perspective. **E1.2k**

Science Grades 6-7:

- Identify the living (biotic) and nonliving (abiotic) components of an ecosystem. **L.EC.06.31**
- Describe the origins of pollution in the atmosphere, geosphere, and hydrosphere and how pollution impacts habitats, climatic change, threatens or endangers species. **E.ES.07.42**
- Analyze the flow of water between components of a watershed, including surface features and groundwater. **E.ES.07.82**

Social Studies Grades 6-8:

- Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere. **6- G5.1.1, 7-G5.1.1**
- Describe how variations in technology affect human modifications of the landscape. **7- G5.1.2**
- Identify the ways in which human-induced changes in the physical environment in one place can cause changes in other places **7- G5.1.3**
- Describe the effects that a change in the physical environment could have on human activities and the choices people would have to make in adjusting to the change. **7- G5.2.1**

3

HS Earth Science:

- Explain how the impact of human activities on the environment can be understood through the analysis of interactions between the four major Earth systems. **E2.4B**
- Explain how physical and chemical weathering leads to erosion and the formation of soils and sediments. **E3.p1B**
- Describe that the water cycle includes evaporation, transpiration, condensation, precipitation, infiltration, surface runoff, groundwater, and absorption **E4.p1A**
- Analyze the flow of water within a watershed, including surface features and groundwater. **E4.p1B**
- Describe the river and stream types, features, and processes as they occur naturally and as they are impacted by land use decisions. **E4.p1C**
- Explain the types, process, and beneficial functions of wetlands. **E4.p1D**
- Compare and contrast surface water systems and groundwater in regard to their relative sizes as Earth's freshwater reservoirs and the dynamics of water movement **E4.1A**
- Explain how water quality in both groundwater and surface systems is impacted by land use decisions. **E4.1C**

Science Grade 6-7:

- Scientific Inquiry and Scientific Reflection and Social Implications **MGLCEs Gr. 6-7**
- Design solutions to problems through technology (e.g. best management practices). **S.RS.M16**
- Describe the effect humans and other organisms have on the balance of the natural world. **S.RS.M17**
- Describe how human beings are part of the ecosystem of the Earth and that human activity can purposefully, or accidentally, alter the balance of the ecosystem. **L.EC.06.41**
- Explain how physical and chemical weathering lead to erosion and the formation of soils and sediments. **E.SE.06.11**
- Explain how waves, wind, water, and glacier movement shape and reshape the land surface of the Earth by eroding rock and deposition sediments (stream turbidity and channel bottom materials). **E.SE.06.12, E.ES.07.41**
- Explain how human activities change the surface of the earth and affect the survival of organisms. **E.ES.07.42**
- Describe the origins of pollution in the atmosphere, geosphere, and hydrosphere and how pollution impacts habitats, climatic change, threatens or endangers species. **E.ES.07.42**

Social Studies Grades 6-8:

- Explain that communities are affected positively or negatively by changes in technology. **6 - G2.2.2.**
- Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere. **6 - G5.1.1**
- Contemporary investigations – Conduct research on contemporary global topics and issues, compose persuasive essays, and develop a plan for action. **6 - G6.1.1**
- Participate in projects to help or inform others (e.g. service learning projects). **7- P4.2.3, 8 - P4.2.3**

4

HS Earth Science:

- Scientific Inquiry and Scientific Reflection and Social Implications HSCEs
- Identify scientific tradeoffs in design decisions and choose among alternative solutions. **E1.2g**
- Explain how physical and chemical weathering leads to erosion and the formation of soils and sediments. **E3.p1B**
- Analyze the flow of water within a watershed, including surface features (lakes, stream, rivers, wetlands) and groundwater. **E4.p1B**
- Describe the river and stream types, features, and processes (e.g. cycles of flooding, erosion, deposition) as they occur naturally and as they are impacted by land use decisions. **E4.p1D**
- Explain the types, process, and beneficial functions of wetlands. **E4.p1C**
- Explain how water quality in both groundwater and surface systems is impacted by land use decisions. **E4.1C**
- Examine the negative impact of human activities. **B3.4C**

Science Grades 6-7:

- Explain how human activities change the surface of the earth and affect the survival of organisms. **E.ES.07.41**
- Describe the origins of pollution in the atmosphere, geosphere, and hydrosphere (car exhaust, industrial emissions, acid rain and **E.ES.07.42**
- natural sources) and how pollution impacts habitats, climatic change, threatens or endangers species
- Explain the water cycle and describe how evaporation, transpiration, condensation, cloud formation, precipitation, infiltration, surface runoff, ground water, and absorption occur within the cycle. **E.ES.07.81**

Social Studies Grades 6-8:

- Explain that communities are affected positively or negatively by changes in technology. **6 - G2.2.2**
- Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere. **6 - G5.1.1**
- Contemporary investigations – Conduct research on contemporary global topics and issues, compose persuasive essays, and develop a plan for action. **SS 6 - G6.1.1**

5

- Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere. **7 - G5.1.1**
- Describe how variations in technology affect human modifications of the landscape. **7 - G5.1.2**
- Identify the ways in which human-induced changes in the physical environment in one place can cause changes in other places (e.g. cutting forests upstream can cause flooding downstream). **7 - G5.1.3**
- Describe the effects that a change in the physical environment could have on human activities and the choices people would have to make in adjusting to the change. **7 - G5.2.1**
- Participate in projects to help or inform others (e.g. service learning projects). **8 - P4.2.3**

HS Earth Science:

- Compare and contrast surface water systems and groundwater . **E4.1A**
- Explain the features and processes of groundwater systems and how the sustainability of No. American aquifers has changed. **E4.1B.**
- Explain how water quality in both groundwater and surface systems is impacted by land use decisions. **E4.1C**

Science Grades 6-7:

- Describe the origins of pollution in the atmosphere, geosphere, and hydrosphere and how pollution impacts habitats, climatic change, threatens or endangers species. **E.ES.07.42**
- Analyze the flow of water between components of a watershed, including surface features (lakes, streams, rivers, wetlands) and groundwater **E.ES.07.82**

Social Studies Grades 6-8:

- Clearly state an issue as a question or public policy, trace the origins of the issue, analyze various perspectives, and generate and evaluate alternate resolutions **6 - P3.1.1, 7 - P3.1.1**
- Demonstrate knowledge of how, when, and where individuals would plan and conduct activities intended to advance views in matters of public policy, report the results, and evaluate effectiveness. **6 - P4.2.1**
- Identify the role of the individual in history and the significance of one person's ideas **7 - H1.2.6**
- Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere. **7 - G5.1.1**

6

- Explain how governments address national issues and form policies, and how the policies may not be consistent with those of other countries. **7-C4.3.1**

Math Grades 6-8:

- Understand division of fractions as the inverse of multiplication. **N.MR.06.01**
- Given an applied situation involving dividing fractions, write a mathematical statement to represent the situation. **N.FL.06.02**

HS Earth Science:

- Explain how water quality in both groundwater and surface systems is impacted by land use decisions. **E4.1C**

HS Biology:

- Examine the negative impact of human activities. **B3.4C**
- Recognize and describe how the physical or chemical environment may influence the rate, extent, and nature of population dynamics within ecosystems. **B3.5e**

Science Grade 6-7:

- Describe the effect humans and other organisms have on the balance of the natural world. **S.RS.M17**
- Classify organisms based on their source of energy for growth and development. **L.0L.06.51**
- Classify substances by their chemical properties **P.PM.07.11**
- List examples of physical and chemical properties of elements and compounds. **P.PM.07.24**
- Identify evidence of chemical change (e.g. water quality testing). **P.CM.07.21**
- Describe evidence that plants make, use and store food. **L.0L.07.63**
- Explain how human activities change the surface of the earth and affect the survival of organisms. **E.ES.07.41**
- Describe the origins of pollution in the atmosphere, geosphere, and hydrosphere and how pollution impacts habitats, climatic change, threatens or endangers species. **E.ES.07.42**
- Analyze the flow of water between components of a watershed, including surface features and groundwater. **E.ES.07.82**

Social Studies Grades 6-8:

- Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere. **6 – G5.1.1, 7 – G5.1.1**
- Engage in activities intended to contribute to solving a national or international problem. **6 – P4.2.2, 7 – P4.2.2, 8 – P4.2.2**
- Read and interpret data in tables and graph. **P2.2**
- Describe the effects that a change in the physical environment could have on human activities and the choices people would have to make in adjusting to the change. **7 - G5.2.1**
- Participate in projects to help or inform others (e.g. service learning projects). **7 - P4.2.3, 8 - P4.2.3**

7

HS Earth Science:

- Generate new questions that can be investigated in the lab or field. **E1.1A**
- Evaluate the uncertainties or validity of scientific conclusions **E1.1B**
- Conduct scientific investigations using appropriate tools and techniques. **E1.1C**
- Describe a reason for a given conclusion using evidence from an investigation. **E1.1E**
- Predict what would happen if variables, methods, or timing were changed **E1.1f**
- Based on empirical evidence, explain and critique the reasoning used to draw a scientific conclusion. **E1.1g**
- Design and conduct a systematic scientific investigation. **E1.1h**
- Critique whether specific questions can be answered through scientific investigations. **E1.2A**
- Evaluate scientific explanations in a peer review process or discussion format. **E1.2D**
- Explore future career and occupational opportunities of science fields. **E1.2E**
- Explain how water quality in both groundwater and surface systems is impacted by land use decisions. **E4.1C**

HS Biology:

- Scientific Inquiry (See HSCEs listed for Earth Science) **BI.1**
- Scientific Reflection and Social Implications (See HSCEs listed for Earth Science) **BI.2**
- Draw the flow of energy through an ecosystem. Predict changes in the food web when one or more organisms are removed. **B3.2C**
- Examine the negative impact of human activities. **B3.4C**
- Recognize that and describe how the physical or chemical environment may influence the rate, extent, and nature of population dynamics within ecosystems. **B3.5e**

Science Grades 6-7:

- Explain how human activities change the surface of the earth and affect the survival of organisms. **E.ES.07.41**
- Describe the origins of pollution in the atmosphere, geosphere, and hydrosphere and how pollution impacts habitats, climatic change, threatens or endangers species. **E.ES.07.42**
- Analyze the flow of water between components of a watershed, including surface features and groundwater. **E.ES.07.82**

Social Studies Grades 6-8:

- Use observations from air photos, etc. as the basis for answering geographic questions about the human and physical characteristics of places and regions. **7 - GI.2.3**
- Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere. **7 - G5.1.1**

8

- Describe how variations in technology affect human modifications of the landscape. **7 - G5.1.2**
- Identify the ways in which human-induced changes in the physical environment in one place can cause changes in other places (e.g. cutting forests upstream can cause flooding downstream). **7 - G5.1.3**
- Describe the effects that a change in the physical environment could have on human activities and the choices people would have to make in adjusting to the change. **7-G5.2.1**

Math Grades 6-8:

- Relate simple linear equations with integer coefficients, e.g. 3x=8 or x+5=10 A.FO.06.11

HS Earth Science:

- Examine the negative impact of human activities. **B3.4C**
- Recognize that and describe how the physical or chemical environment may influence the rate, extent, and nature of population dynamics within ecosystems. **B3.5e**

Science Grades 6-7:

- Explain how human activities change the surface of the earth and affect the survival of organisms. **E.ES.07.41**
- Analyze the flow of water between components of a watershed, including surface features (lakes, streams, rivers, wetlands) and groundwater. **E.ES.07.82**

Social Studies Grades 6-8:

- Conduct research on contemporary global topics and issues, compose persuasive essays, and develop a plan for action. **6 - G6.1.1**
- Clearly state an issue as a question or public policy, trace the origins of the issue, analyze various perspectives, and generate and evaluate alternate resolutions. **6 - P3.1.1**
- Demonstrate knowledge of how, when, and where individuals would plan and conduct activities intended to advance views in matters of public policy, report the results, and evaluate effectiveness. **6 - P4.2.1**
- Engage in activities intended to contribute to solving a national or international problem. **6 - P4.2.2**
- Participate in projects to help or inform others. **6 - P4.2.3**
- Identify and explain factors that contribute to conflict and cooperation between and among cultural groups. **7 - G4.4.1**
- Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere. **7 - G5.1.1**
- Identify the ways in which human-induced changes in the physical environment in one place can cause changes in other places (e.g. cutting forests upstream can cause flooding downstream). **7 - G5.1.3**
- Describe the effects that a change in the physical environment could have on human activities and the choices people would have to make in adjusting to the change. **7 - G5.2.1**
- Contemporary investigations – Conduct research on contemporary global topics and issues, compose persuasive essays, and develop a plan for action **7 - G6.1.1**
- Clearly state an issue as a question of public policy, trace the origins of the issue, analyze various perspectives, and generate and evaluate alternate resolutions. **7 - P3.1.1**

HS Earth Science:

- Explain why small amounts of some chemicals may be beneficial for life but are poisonous in large quantities. **E2.3b**
- Explain how the impact of human activities on the environment can be understood through the analysis of interactions between the four major Earth systems. **E2.4B**
- Explain how water quality in both groundwater and surface systems is impacted by land use decisions. **E4.1C**
- Draw the flow of energy through an ecosystem. Predict changes in the food web when one or more organisms are removed. **B3.2C**
- Examine the negative impact of human activities. **B3.4C**

9

Water Quality Master Materials List

Lesson 1. Where Is All the Water in the World?

Reproducible Materials

per class

- *The Water Cycle* with no labels (transparency master)
- *The Water Cycle* with arrows and locations correctly labeled (transparency master/answer key)
- *Where Is Water on Earth?* (transparency master/answer key)
- *How Much of Earth's Water Is Available for Human Use?* (transparency master)
- *Great Lakes Physical Features and Population* (transparency master/answer key)
- *Water Cycle Scavenger Hunt* (answer key)

per small group

- *Water Cycle* with no arrows or labels (student activity)
- *Where Is Water on Earth? (Advanced/Basic)* (student activity)
- *Water Cycle Scavenger Hunt* (outdoor activity)

Materials in MEECS kit

per class

- MEECS Water Quality CD (*Is There Water on Zork activity from Project WET*)
- 1-2 inflatable globes

To be supplied by teacher

per class

- 3 100-ml graduated cylinders
- container of water (10-ml/student)
- cup of salt water (optional, for one student to taste)
- map of United States
- 1 green and 1 blue paper plate (optional)
- blue food coloring
- 1 clear plastic 2-L (2000 ml) bottle filled with (blue) water
- 5 clear plastic 9 oz. or 12 oz. cups
- permanent marker
- 1 water dropper
- paper towels
- scissors

per small group

- 1 clear plastic 2-L (2000 ml) bottle
- 100-ml graduated cylinder
- 5 clear plastic 9 oz. or 12 oz. cups
- 1 water dropper
- calculator
- 1 green and 1 blue paper plate (optional)
- scissors (optional)
- map of United States or Great Lakes watershed map
- sidewalk chalk

Lesson 2. How We Use Water

Reproducible Materials
per class
- *What Is Your Household Water Use?* (transparency master)
- *Calculate Your Household Water Use* (transparency master)
- *Percent Water Use in the Home by Activity* (transparency master)
- *Comparing Water Prices and Use in the United States and Other Countries* (transparency master)
- *How Is Water Used to Make a Hamburger?* (transparency master)
- *How Is Water Used in the Paper-Making Process?* (transparency master)
- *Indirect Water Use* (transparency master)
- *Made in Michigan Wood Products* (transparency master)
- *Grown in Michigan Products* (transparency master)
- *Total Water Withdrawals by Source in Michigan, 2004* (transparency master)
- *Total Water Withdrawals by Sector in Michigan, 2004* (transparency master)
- *Water Concept Map* (answer key)

per student
- *Calculate Your Household Water Use* (student activity)
- *Indirect Water Use* (student activity)
- *Water Concept Map* (student assessment)

Materials in MEECS kit
per class
- MEECS Water Quality CD

To be supplied by teacher
per class
- self-adhesive notes (optional)

per student
- calculator

Lesson 3. Do You Know YOUR Watershed?

Reproducible Materials
per class
- *Diagram of a Watershed* (transparency master)
- *Aerial View of a Stream* (transparency master)
- *Stream Channel Profile* (transparency master)
- *Watershed Labels* (transparency master)
- *Michigan Water World* (answer key)
- *Great Lakes Watershed and Political Boundaries* (transparency master)
- *Stream Hydrograph* (transparency master)
- *Stream Hydrograph Data* (transparency master)

per small group
- *Michigan's Water World* (student activity)
- *Watershed Labels* (transparency master)

Materials in MEECS kit
per class
- MEECS Water Quality CD (*Developing a Watershed Management Plan*, Extension Lesson *Investigating Stream Flow in Michigan Rivers,* list of USGS Stream Gaging and Precipitation Stations)
- *Michigan Water World* poster

per small group
- *Michigan's Water World* poster – teacher should laminate these before using
- Michigan highway map

To be supplied by the teacher
per class
- Spray bottle or (8) 5 oz. paper cups, partially filled with blue water
- 5' x 5' sheet of white plastic (shower curtain or tablecloth) or tarp
- 5-10 sheets of newspaper
- large tub or children's swimming pool (optional)

per small group
- 5-10 sheets of newspaper wadded up individually (or boxes or rocks)
- aluminum roasting pan, paint pan, dish tub, or other container (approximately 2' x 2' x 6")
- foil
- spray bottle filled with blue-colored water or rain cups

Lesson 4. How Do Land Uses Affect Water Quality?

Reproducible materials

per class

- *Water Quality and Possible Pollutants* (answer key/ transparency master)
- *Land Uses and Water Quality* (answer key)
- *Land Use Labels* (transparency master)
- *Line Drawings of Four Land Uses* (answer key/transparency master)
- *Plan for New Development* (answer key rubric)

per small group

- 5-6 *Land Use Labels*
- *Line Drawings of Four Land Uses* (student activity)
- *Plan for New Development* (student activity)

per student

- *Water Quality and Possible Pollutants* (student activity)
- *Land Uses and Water Quality* (student activity)

Materials in MEECS kit

per class

- MEECS Water Quality CD (Powerpoint: *Land Uses & Water Quality,* Extension Lesson *Taking A Watershed Tour,* list of Michigan Dept of Environmental Quality regional offices, *Guidebook of Best Management Practices for Michigan Watersheds* (MDEQ, 1998)
- *Point and Nonpoint Source* photos on MEECS Water Quality CD

per small group

- Michigan Sea Grant poster *Where Land Meets Water* or the MEECS *Michigan Land, Air, and Water* poster – teacher should laminate these before using

To be supplied by the teacher

per class

- computer projector
- overhead projector
- pollutants (label each container)
  - fertilizer = green powdered drink mix
  - herbicide/pesticide = red powdered drink mix
  - sediment = cocoa powder or potting soil
  - road salt = table salt
  - litter = torn paper
  - industrial wastes = colored water (point source) in a squeeze bottle
  - used motor oil = maple/chocolate syrup or molasses
  - small houses, cars and trucks, trees, etc.

per small group

- watershed models (from Lesson 3)
- small houses, trees, vehicles, and other items to represent land uses in the watershed
- spray bottle filled with blue-colored water or rain cups (made from Lesson 3)
- paper towels

Lesson 5. Why Care About Groundwater?

Reproducible materials

per class

- *Groundwater: Michigan's Hidden Resource* PowerPoint presentation (on MEECS Water Quality CD) or make transparency masters
- *Groundwater Model in A Cup* (answer key)
- *What Do You Know About Michigan's Hidden Resource?* (answer key)
- *Porosity and Permeability of Earth Materials* (transparency master)
- map of Michigan's 83 Counties (transparency master)
- 6 Michigan Groundwater Contamination maps (transparency masters) OR on MEECS Water Quality CD:
  (1) Contaminated Landfills, (2) Leaking Underground Storage Tanks, (3) Nitrate Contamination in Michigan Drinking Water Wells, (4) Sites Contaminated by Oil and Gas Drilling, (5) Superfund Sites in Michigan, (6) Contaminated Pesticide and Herbicide Storage Facility Sites
- *Michigan Groundwater Use in 2004* (transparency master)

per student

- *What Do You Know About Michigan's Hidden Resource?* (student activity)
- *Groundwater Model in A Cup* (student activity)

Materials in MEECS kit

per class

- MEECS Water Quality CD (Powerpoints: *What Do You Know About Michigan's Hidden Resource? Beginner version,* Groundwater Contamination Maps for Michigan Counties; *What Do You Know About Michigan's Hidden Resource? Advanced version,* SEPTIC Curriculum)

To be supplied by the teacher

per class

- self-adhesive notes
- computer projector
- overhead projector
- pollutants with plastic spoons
  - fertilizer = green drink powder
  - oil and gas contaminants = blue drink powder or soy sauce
  - pesticide = red drink powder
  - Superfund hazardous wastes = orange drink powder
  - leaking underground storage tanks = maple/ chocolate syrup or molasses
  - leaking landfill leachate = yellow drink powder

per student

- Non-edible Groundwater Model
  - 4-oz. water (1 c.)
  - 8-oz. clear plastic cup
  - 3-oz. paper cup
  - 1 straw OR dropper
  - 2" x 2" screen
  - 4 oz. gravel (1/2 c.)

  OR
- Edible Groundwater Model
  - 4-oz. milk
  - 8-oz. clear plastic cup
  - 3-oz. paper cup
  - 1 plastic spoon – 1 straw
  - ¼ cup each of 3 kinds of (unsweetened) cereal:
    - clay (Rice Krispies or Grape Nuts)
    - sand (Kix)
    - gravel (Chex)

Note: If you make the edible groundwater model, inquire about possible food allergies (peanuts, lactose intolerance, etc.).

Lesson 6. Would You Drink This Water?

Reproducible materials

per class

- *Maximum Contaminant Levels in Drinking Water* (transparency master)
- Serial Dilution (answer key)
- *Timeline of Important Events in Water History* with no dates (transparency master)
- *Timeline of Important Events in Water History* with dates (transparency master/answer key)
- *Who Cares About Water Quality? Why Do They Care?* (transparency master)
- *Water on Tap Questions (answer key)*
- *Lesson 6 Overview* PowerPoint (optional, on MEECS Water Quality CD)

per small group

- Serial Dilution (student activity)

per student

- *Water History Timeline* no dates (student activity—see Advanced Preparation)
- copy of *Water on Tap* by EPA (on MEECS Water Quality CD or see Additional Resources)
- *Water on Tap Questions* (student assessment)

Materials in MEECS kit

per class

- MEECS Water Quality CD (Powerpoint: Lesson 6 Overview, *Water on Tap* (EPA) *Understanding Water Sample Results* (MEHA), City of Houghton Water Quality Consumer Confidence Report, *Nitrate in Drinking Water*, Project WET Curriculum & Activity Guide: *Poison Pump* activity)

To be supplied by the teacher

per class

- red food coloring
- 3 clear 9 oz. plastic cups partially filled with water (add sand and vinegar)
- bar or meter stick

per small group

- 4-oz. cup labeled *well water*
- 4-oz. cup labeled *rinse water*
- 1 clear, plastic *Chemplate*® or white ice cube tray with cups numbered from 1-9
- white sheet of paper to place under *Chemplates*®
- 2 water droppers
- paper towel
- calculator

per student

- science journal or note paper

Lesson 7. How Healthy Is This Stream?

Reproducible materials

per class

- *Comparison of Two Streams* (on MEECS Water Quality CD)
- *Designing A Stream Monitoring Investigation* 15-minute PowerPoint (on MEECS Water Quality CD)
- *Designing A Stream Investigation* (answer key)
- *Aquatic Food Chain in a Stream* (transparency master)
- *Where Should the Brook Trout Be Planted? Stream Assessment Data Table* (answer key)
- Page with color photo of each river: Clinton River, Coles Creek, Gilkey Creek, and Au Sable River (on MEECS Water Quality CD)
- *Hart Middle School Students: First Responders to Erosion Mishap* (answer key)
- sample *Stream Health* concept map
- *Biological Assessment Data Form* (transparency master)
- *Stream Habitat Assessment Form* (transparency master)
- *Habitat Assessment* PowerPoint (on MEECS Water Quality CD) (optional)
- *Macroinvertebrate Identification* PowerPoint (on MEECS Water Quality CD) (optional)
- *Hart Middle School Students: First Responders to Erosion Mishap* photos (on MEECS Water Quality CD)

per small group

- Page with color photo of each river: Clinton River, Coles Creek, Gilkey Creek, and Au Sable River (on MEECS Water Quality CD)

per student

- Background Information/Student Reading
- *Designing a Stream Investigation* (student activity)
- *Where Should the Brook Trout Be Planted* Student Packet containing:
  - *Where Should the Brook Trout Be Planted?* instructions
  - Stream Assessment Data Table
  - Data page for each stream: Au Sable River, Clinton River, Coles Creek, Gilkey Creek
  - Stream Ecology: Temp/pH/DO
  - Biological Assessment Data Form
  - Stream Habitat Assessment Form
- *Who Is Protecting Michigan's Rivers and Streams?* (student activity)
- *Hart Middle School Students: First Responders to Erosion Mishap* (student assessment)
- *Stream Health* concept map (student activity)

Materials in MEECS kit

per class

- MEECS Water Quality CD (*Comparison of Two Streams*, Powerpoints: *Designing a Stream Investigation, Macroinvertebrate Identification, Habitat Assessment*; Michigan Frog & Toad Calling Survey; Michigan Frog & Toad Deformity Survey; Extension Lesson *Developing A Watershed Assessment;* Stream Monitoring Field Forms – biological assessment, water chemistry, physical channel measurements, habitat assessment, stream comparison forms; Project WET Curriculum & Activity Guide: *Sum of the Parts* activity; page with color photo of four rivers, Hart Middle School Stoney Creek photos)

To be supplied by the teacher

per class

- balance (optional)
- 1 gram weight per student (optional)
- computer projector
- samples of live or preserved benthic macroinvertebrates (optional)
- *Aquatic Invertebrates & Water Quality* video (optional)

Lesson 8. How Can We Stop Storm Water?

Reproducible materials
per class
- *Storm Water* PowerPoint presentation OR *After the Storm* DVD (30 minutes)
- *Storm Water Study Guide* (answer key)
- *Storm Water Runoff and Infiltration* (transparency master)
- *Comparing Aerial Photos* (answer key)

per small group
- 2 aerial photos of Huron Creek Watershed for different years (1975, 1998, and 2010 on MEECS Water Quality CD or in Activity Kit) OR 2 aerial photos of your watershed for two different years (optional)
- *Comparing Aerial Photos* (student activity)

per student
- Background Information and/or *Potential Impacts of Storm Water on Aquatic Ecosystems* (student resource) OR *After the Storm brochure (online)*
- *Storm Water Study Guide* (student activity)
- Brochure Assignment & Rubric (student assessment)

Materials in MEECS kit
per class
- MEECS Water Quality CD (Powerpoint: *Run-Away Storm Water;* Huron Creek aerial photos for 1975, 1998, and 2010; Extension Lesson: *Measuring Watershed Runoff at Your School*)
- Huron Creek Watershed aerial photos for different years (1975, 1998, and 2010)
- *After the Storm* DVD

To be supplied by the teacher
per class
- toy car
- pet leash
- toy snow shovel
- toy houses
- fast food bag
- plastic turf or golf ball
- paint brush
- Car wax or "soft cloth"
- packet of seeds
- toy bulldozer
- toilet paper
- computer projector

per small group
- paper and colored pencils OR computers

per student
- computer access
- self-adhesive notes

Lesson 9. Bioaccumulation and the Great Lakes Ecosystem

Reproducible materials
per class
- *A Lake Trout Food Web in the Upper Great Lakes* (transparency master)
- *Bioaccumulation of Contaminants in the Great Lakes Food Chain* (transparency master)
- *Bioaccumulation in the Great Lakes* PowerPoint (on MEECS Water Quality CD)
- *Toxic Tag* (transparency master)
- *Contamination in the Great Lakes* (answer key)
- *Maximum Contaminant Level in Drinking Water* (transparency master from Lesson 6)
- *Great Lakes Watershed and Political Boundaries* (transparency master from Lesson 3)

per small group
- Optional student resources (see Advanced Preparation)

per student
- *Bioaccumulation in the Great Lakes PowerPoint Study Guide*
- *Contaminants of Concern in Fish of the Great Lakes* (student resource)
- *Contamination in the Great Lakes* (student activity)

Materials in MEECS kit
per class
- MEECS Water Quality CD (Powerpoints: *Bioaccumulation of Toxins in the Great Lakes, Emerging Contaminants in the Great Lakes* by Dr. Peter Adriaens; Extension Lesson *Investigate a Great Lakes Issue; Understanding Lake Data* by UW Extension; *Our Great Lakes Report; Michigan Family Fish Consumption Guide*)

per small group
- Michigan highway map
- *Michigan Water World* poster – teacher should laminate these before using

To be supplied by the teacher
per class
- computer projector
- 5 small squares of paper per student, mark 1/3 of squares with an X to designate toxic chemicals
- Small resealable plastic sandwich bags for minnows (1/3 of class)

per small group
- *Michigan Family Fish Consumption Guide*
- washable markers or dot stickers (4 colors: orange, purple, brown, green)

per student
- small plastic bag
- student journals or notebooks

Michigan Grade Level Content Expectations Correlation for Water Quality Unit

X- Addresses/Supports

			1. Where Is All the Water in the World?	2. How We Use Water	3. Do You Know YOUR Watershed?	4. How Do Land Uses Affect Water Quality?	5. Why Care About Groundwater?	6. Would You Drink This Water?	7. How Healthy Is This Stream?	8. How Can We Stop Storm Water?	9. Bioaccumulation and the Great Lakes Ecosystem
SCIENCE	Grades 6-7 Science	**S.RS.M15** Demonstrate scientific concepts through illustrations, performances, models, exhibits, and activities.	X								
		S.RS.M16 Design solutions to problems through technology (e.g. best management practices).				X					
		S.RS.M17 Describe the effect humans and other organisms have on the balance of the natural world.	X			X			X		
		E.SE.06.11 Explain how physical and chemical weathering lead to erosion and the formation of soils and sediments.				X					
		E.SE.06.12, E.ES.07.41 Explain how waves, wind, water, and glacier movement shape and reshape the land surface of the Earth by eroding rock and deposition sediments (stream turbidity and channel bottom materials).				X					
		E.ES.07.11 Demonstrate, using a model or drawing, the relationship between warming by the sun and of the Earth and the water cycle as it applies to the atmosphere.	X								
		E.ES.07.41 Explain how human activities change the surface of the earth and affect the survival of organisms.					X		X	X	X
		E.ES.07.42 Describe the origins of pollution in the atmosphere, geosphere, and hydrosphere and how pollution impacts habitats, climatic change, threatens or endangers species.			X	X	X	X	X	X	
		E.ES.07.42 Explain how human activities change the surface of the earth and affect the survival of organisms.				X					
		E.ES.07.81 Explain the water cycle and describe how evaporation, transpiration, condensation, cloud formation, precipitation, infiltration, surface runoff, ground water, and absorption occur within the cycle.	X				X				
		E.ES.07.82 Analyze the flow of water between components of a watershed, including surface features and groundwater.	X		X			X	X	X	X
		6-L.E.C.06.42, 7-L.E.C.06.42 Predict possible consequences of overpopulation of organisms, including humans.		X							
		L.0L.06.51 Classify organisms based on their source of energy for growth and development.							X		
		L.0L.07.63 Describe evidence that plants make, use and store food.							X		
		L.EC.06.31 Identify the living (biotic) and nonliving (abiotic) components of an ecosystem.			X						
		L.EC.06.41 Describe how human beings are part of the ecosystem of the Earth and that human activity can purposefully, or accidentally, alter the balance of the ecosystem.				X					
		MGLCEs Gr. 6-7 Scientific Inquiry and Scientific Reflection and Social Implications**.**				X					
		P.CM.07.21 Identify evidence of chemical change (e.g. water quality testing).							X		
		P.PM.07.11 Classify substances by their chemical properties.							X		
		P.PM.07.24 List examples of physical and chemical properties of elements and compounds.							X		

Michigan Grade Level Content Expectations (continued) **Correlation for Water Quality Unit** X- Addresses/Supports		Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Lesson 6	Lesson 7	Lesson 8	Lesson 9
SCIENCE / HS Earth Science	**E1.1A** Generate new questions that can be investigated in the lab or field.							X		
	E1.1B Evaluate the uncertainties or validity of scientific conclusions.							X		
	E1.1C Conduct scientific investigations using appropriate tools and techniques.							X		
	E1.1E Describe a reason for a given conclusion using evidence from an investigation.							X		
	E1.1f Predict what would happen if variables, methods, or timing were changed							X		
	E1.1g Based on empirical evidence, explain and critique the reasoning used to draw a scientific conclusion.							X		
	E1.1h Design and conduct a systematic scientific investigation.							X		
	E1.2A Critique whether specific questions can be answered through scientific investigations.							X		
	E1.2D Evaluate scientific explanations in a peer review process or discussion format.							X		
	E1.2E Explore future career and occupational opportunities of science fields.							X		
	E1.2g Identify scientific tradeoffs in design decisions and choose among alternative solutions.				X					
	E1.2k Analyze how science and society interact from a historical, political, economic, or social perspective.		X							
	E2.3b Explain why small amounts of some chemicals may be beneficial for life but are poisonous in large quantities.									X
	E2.4B Explain how the impact of human activities on the environment can be understood through the analysis of interactions between the four major Earth systems.			X						X
	E3.p1B Explain how physical and chemical weathering leads to erosion and the formation of soils and sediments.			X	X					
	E4.p1A Describe that the water cycle includes evaporation, transpiration, condensation, precipitation, infiltration, surface runoff, groundwater, and absorption.	X		X						
	E4.p1B Analyze the flow of water within a watershed, including surface features and groundwater.			X	X					
	E4.p1C Describe the river and stream types, features, and processes as they occur naturally and as they are impacted by land use decisions.			X	X					
	E4.p1D Explain the types, process, and beneficial functions of wetlands.			X	X					
	E4.1A Compare and contrast surface water systems and groundwater in regard to their relative sizes as Earth's freshwater reservoirs and the dynamics of water movement (inputs, outputs, residence times, sustainability).	X		X		X				
	E4.1B Explain the features and processes of groundwater systems and how the sustainability of No. American aquifers has changed.					X				
	E4.1C Explain how water quality in both groundwater and surface systems is impacted by land use decisions.			X	X	X	X	X		X
	BI.2 Scientific Reflection and Social Implications (See HSCEs listed for Earth Science).	X			X					
	B3.4C Examine the negative impact of human activities.				X		X	X	X	X

Michigan Grade Level Content Expectations (continued) **Correlation for Water Quality Unit** X- Addresses/Supports			Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Lesson 6	Lesson 7	Lesson 8	Lesson 9
SCIENCE	HS Biology	**BI.1** Scientific Inquiry (See HSCEs listed for Earth Science)							X		
		BI.2 Scientific Reflection and Social Implications. (See HSCEs listed for Earth Science)							X		
		B3.2C Draw the flow of energy through an ecosystem. Predict changes in the food web when one or more organisms are removed.							X		X
		B3.5e Recognize and describe how the physical or chemical environment may influence the rate, extent, and nature of population dynamics within ecosystems.						X	X	X	
SOCIAL STUDIES	Grades 6-7 Social Studies	**6 - G5.1.1** Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere.	X			X	X				
		6 - G6.1.1, 7 - G6.1.1 Contemporary investigations – Conduct research on contemporary global topics and issues, compose persuasive essays, and develop a plan for action.		X							
		6 - GI.2.3, 7 - GI.2.3 Use data to create thematic maps and graphs showing patterns of population, rainfall, etc., analyze the patterns about location and density of population.		X							
		6 - GI.2.6, 7 - GI.2.6 Apply the skills of geographic inquiry to analyze a problem or issue of importance to a region of the W. Hemisphere.		X							
		6 - H1.4.3 Use historical perspective to analyze global issues faced by humans long ago and today.	X								
		6 - P3.1.1, 7 - P3.1.1 Clearly state an issue as a question or public policy, trace the origins of the issue, analyze various perspectives, and generate and evaluate alternate resolutions.		X				X			
		7 - G2.2.2 Explain that communities are affected positively or negatively by changes in technology.	X								
		7 - G4.4.1 Identify and explain factors (e.g. natural resources) that contribute to conflict and cooperation between and among cultural groups.	X								X
		7 - G5.2.1 Describe the effects that a change in the physical environment could have on human activities and the choices people would have to make in adjusting to the change.	X		X		X			X	X
	Grades 6-8 Social Studies	**6 - G2.2.2** Explain that communities are affected positively or negatively by changes in technology.				X	X				
		6- G5.1.1, 7-G5.1.1 Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere.			X				X	X	
		6 - G6.1.1 Conduct research on contemporary global topics and issues, compose persuasive essays, and develop a plan for action.				X					X
		6 - P3.1.1 Clearly state an issue as a question or public policy, trace the origins of the issue, analyze various perspectives, and generate and evaluate alternate resolutions.									X
		6 - P4.2.1 Demonstrate knowledge of how, when, and where individuals would plan and conduct activities intended to advance views in matters of public policy, report the results, and evaluate effectiveness.						X			X
		6 - P4.2.2 Engage in activities intended to contribute to solving a national or international problem.									X

Michigan Grade Level Content Expectations (continued) **Correlation for Water Quality Unit** X- Addresses/Supports			Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Lesson 6	Lesson 7	Lesson 8	Lesson 9
SOCIAL STUDIES	Grades 6-8 Social Studies (continued)	**6 - P4.2.3** Participate in projects to help or inform others.									X
		6 – P4.2.2, 7 – P4.2.2, 8 – P4.2.2 Engage in activities intended to contribute to solving a national or international problem.							X		
		7 - GI.2.3 Use observations from air photos, etc. as the basis for answering geographic questions about the human and physical characteristics of places and regions.								X	
		7-C4.3.1 Explain how governments address national issues and form policies, and how the policies may not be consistent with those of other countries.						X			
		7 - G5.1.1 Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere.					X	X			X
	Grades 6-8 Social Studies	**7- G5.1.2** Describe how variations in technology affect human modifications of the landscape.			X		X			X	
		7- G5.1.3 Identify the ways in which human-induced changes in the physical environment in one place can cause changes in other places (e.g. cutting forests upstream can cause flooding downstream).			X		X			X	X
		7 - G5.2.1 Describe the effects that a change in the physical environment could have on human activities and the choices people would have to make in adjusting to the change.							X		
		7 - G6.1.1 Contemporary investigations – Conduct research on contemporary global topics and issues, compose persuasive essays, and develop a plan for action.									X
		7 - H1.2.6 Identify the role of the individual in history and the significance of one person's ideas						X			
		7 - P3.1.1 Clearly state an issue as a question of public policy, trace the origins of the issue, analyze various perspectives, and generate and evaluate alternate resolutions.									X
		7 - P4.2.3, 8 - P4.2.3 Participate in projects to help or inform others (e.g. service learning projects).				X			X		
		8 - P4.2.3 Participate in projects to help or inform others (e.g. service learning projects).					X				
		P2.2 Read and interpret data in tables and graph.							X		
		SS 6 - G6.1.1 Contemporary investigations – Conduct research on contemporary global topics and issues, compose persuasive essays, and develop a plan for action.					X				

Michigan Grade Level Content Expectations (continued) **Correlation for Water Quality Unit** X- Addresses/Supports			Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Lesson 6	Lesson 7	Lesson 8	Lesson 9
MATH	Math Grades 6-7	**N.FL.06.12** Calculate part of a number given the percentage and the number.	X								
		N.FL.06.13 Solve word problems involving percentages.	X								
		D.PR.06.01 Express probabilities as fractions, decimals, or percentages between 0 and 1; know that "0" probability means that an event will not occur, and probability "1" means an event will occur.	X								
		D.PR.06.02 Compute probabilities of events from simple experiments with equally likely outcomes, e.g. tossing dice, flipping coins, etc. by listing all possibilities and finding the fraction that meets given conditions.	X								
	Math Grades 6-8	**D.RE.07.01** Represent and interpret data using circle graphs, etc. and select appropriate representations to address specific questions.		X							
		N.MR.06.01 Understand division of fractions as the inverse of multiplication.						X			
		N.FL.06.02 Given an applied situation involving dividing fractions, write a mathematical statement to represent the situation.						X			
		A.FO.06.11 Relate simple linear equations with integer coefficients, e.g. 3x=8 or x+5=10.								X	

The *Water Quality Unit* addresses the following "Big Ideas" or "Enduring Understandings:" Upon completion of the unit, students will understand that:

1. (Awareness) Good quality water and an adequate supply of water are essential to Michigan's communities and to our quality of life.

2. (Connections) All Michigan residents live in a watershed that is part of the Great Lakes watershed, a unique global resource of unprecedented importance to Michigan, the United States and the world.

3. (Concern) Our activities have past, present, and future impacts on Michigan's water resources.

4. (Knowledge) Water quality standards have been established to protect the many uses of Michigan's water.

5. (Knowledge) We can assess the health and water quality of Michigan's streams, rivers, lakes, and groundwater by collecting and analyzing appropriate data.

6. (Knowledge) We need to know where our drinking water comes from and where our wastewater goes.

7. (Decision-making) We need data to make decisions about protecting and restoring Michigan's water resources.

8. (Stewardship and sustainability) It is up to every citizen to be a steward of Michigan's water resources.