

Great Lakes Watershed & Community Land Use

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Target Grade/Subject: 7th-8th grade integrated science students

Unit Overview

These lessons are designed to be taught as part of 3 units in the Livonia Public School's science curriculum. One is the 7th grade "Earth's Changing Surface" unit and another is the 8th grade "Weather" unit. These lessons will also reinforce/introduce concepts previously/yet to be learned in the 7th grade "Ecology" unit (taught every other year in our looping curriculum. I will teach all three units to 7th and 8th grade students as part of my looping curriculum for gifted and talented students. I will be able to teach the units consecutively, which will allow me to use this unit to address the topics of Great Lakes water drainage, toxins in the environment and bioaccumulation of toxins, and the impact of community design on the environment.

Books/Sources Consulted

Core curriculum. Livonia Public Schools. 7th Grade Integrated Science. September 2003.

Core curriculum. Livonia Public Schools. 8th Grade Integrated Science. September 2003.

Weather and Climate. Holt, Rinehart, and Winston. New York. 2002.

Earth's Changing Surface. Holt, Rinehart, and Winston. New York. 2002.

Ecology. Holt, Rinehart, and Winston. New York. 2002.

The Great Lakes: An Environmental Atlas and Resource Book. US EPA and Government Canada Chicago, IL. 1995. (Also available at <http://www.epa.gov/glnpo/atlas/index.html>)

The Great Lakes Basin. MSU Extension. E. Lansing, MI. 2000. (Also available at <http://www.dsisd.k12.mi.us/mff/Environment/greatlakes.htm>)

Back to the Future, Designs for Walkable Neighborhoods video. Citizens for a Better Environment. Milwaukee, WI.

Water: Our Life and Heritage. Detroit Free Press. Undated poster from Lake Guardian class.

Objectives

At the end of this unit, students will be able to:

1. Interpret different kinds of maps to identify local and regional landforms and watersheds
2. List the States and Provinces that are part of the Great Lakes Watershed and explain why management of the watershed requires a group effort
3. Relate rain to condensation nuclei and to the particulate and chemical materials that it can contain, with specific attention given to acid rain and chemical weathering
4. Describe the paths that water in Michigan can take when it flows toward the oceans
5. Explain how rain can become ground water and how that water can return to the surface of the earth
6. Explain the impact that community design has on surface water runoff and environmental quality.
7. Understand the political nature of community design and the impact that politics and economics can have on community design and public safety

Michigan Content Standards - SCIENCE

(EG) V.1.M.1	Describe and identify surface features using maps
(EH) V.2.M.1	Use maps of the Earth to locate water in its various forms and describe conditions under which they exist
(EH) V.2.M.3	Describe how surface water in Michigan reaches the ocean and returns
(R) II.1.M.5	Develop an awareness of and sensitivity to the natural world
(LEC) III.5.M.5	Explain how humans use and benefit from plant and animal materials
(LEC) III.5.M.6	Describe ways in which humans alter the environment
(EH) V.2.M.4	Describe the origins of pollution in the hydrosphere
(EH) V.2.M.3	Explain how water exists below the Earth's surface and how it is replenished.
(EAW) V.3.M.3	Explain the behavior of water in the atmosphere

Lesson Plan – Days 1 & 3

Subject: Earth's Changing Surface and Weather

Duration of Lesson: two 45 min classes

Lesson Topic: In this lesson, students will begin the unit by taking the pre-test/thought organizer (See appendix). After the pre-test, they will be asked to begin their "Where Does Michigan Water Go?" project, which will be due at the start of the third day of the unit.

Lesson Content

Introduction:

The pre-test will be used to guide instruction. Students will have their lessons differentiated based on their prior knowledge of the unit content. The self-guided efforts on the "Where Does Michigan Water Go?" project will be based on posters and textbook information and will be used as a lead-in to the types of air and water pollution and their movement through our environment. The pollution information will later be used to help the students understand bioaccumulation and biomagnification of toxins in the environment during their ecology unit.

Procedure:

1. Administer unit pre-test. Students will have the entire class period to take the test and hand their answers in to the teacher. The questions are to be filed in their science binders, and will be referred to during the progress of the unit. The questions will also appear on the post-test.
2. Following the test, and prior to leaving the classroom, students are to obtain their "Earth's Changing Surface" textbook and begin reading about the drainage of the Great Lakes into the ocean. Students will also be asked to review the information on the water cycle, if they feel that they did not master it in previous science classes.
3. The project assignment is as follows: Using one of the methods of communication listed in the directions, explain the path of water from a point of your choosing in Michigan to the ocean (see appendix for directions).

Materials Needed (other than paper, pencil, and textbook):

- Maps of the Great Lakes watershed and the area between Michigan and the oceans (Atlantic Ocean and Gulf of Mexico)
- The Great Lakes, an Environmental Atlas and Resource Book (also available at <http://www.epa.gov/glnpo/atlas/index.html>)
- The Great Lakes Basin pamphlet (also available at <http://www.dsisd.k12.mi.us/mff/Environment/greatlakes.htm>)
- Other materials for the method that you choose for your display or project (may include anything that you can find).
- Computer lab with internet access

Reading Assignment for Tomorrow: Read “Earth’s Water: Ground Water” lab – prepare to complete the exercise tomorrow during class – in the computer lab.

Lesson Plan – Day 2

Subject: Earth’s Changing Surface and Weather

Duration of Lesson: One 45 min class

Lesson Topic: students will complete their “Earth’s Water: Ground Water” lab. This will also be an opportunity for them to do research and learn more about the Great Lakes Watershed so that they can complete their previously assigned watershed projects.

Lesson Content:

A. Utilize lab worksheet and computer lab to complete the ground water lab at the USGS’s “Earth’s Water” website (<http://www.ga.usgs.gov/edu/mearth.html>). Of course, the teacher should walk around the room and discuss the questions with the students as they complete the work.

B. When students have completed the lab and answered the associated questions, they can continue to utilize the website and others to continue with their “Great Lakes Watershed” projects (due the day after tomorrow)

Materials Needed (other than paper, pencil, and textbook):

- Computer lab with internet access (<http://www.ga.usgs.gov/edu/mearth.html>)
- “Earth’s Water: Ground Water” lab

Homework: Continue to work on the “Where Does Michigan Water Go?” project – prepare to complete the exercise tomorrow during class – in the computer lab.

Lesson Plan – Day 4

Subject: Earth’s Changing Surface and Weather

Duration of Lesson: one 45 min class

Lesson Topic: students will present their “Where Does Michigan Water Go?” project.

Lesson Content: Students will present their “Where Does Michigan Water Go?” project in small groups of 6 students each (chosen by students or the teacher). When the small group presentations are completed, each group will elect one person to present their project to the entire class (based on interest or accuracy). Those 5-6 final presentations will be finished before the end of the class period. During the presentations, the students will be required to elucidate the highlights of their water’s path, and the landforms that it encounters along its route.

Materials Needed (other than paper, pencil, and textbook):

- Students’ projects and audio/video presentation equipment (as needed)
- The Great Lakes, an Environmental Atlas and Resource Book (also available at <http://www.epa.gov/glnpo/atlas/index.html>)
- The Great Lakes Basin pamphlet (also available at <http://www.dsisd.k12.mi.us/mff/Environment/greatlakes.htm>)
- “Earth’s Water: Ground Water” lab
- Photocopied handout on “Clouds,” which is page 40 of the “Understanding Weather” textbook
- “Earth’s Changing Surface” textbook

Homework: Read photocopied handout on “Clouds,” which is page 40 of the “Understanding Weather” textbook. Also read about Nancy Charbeneau, a watershed planner, on page 27 of your “Earth’s Changing Surface” textbook. As you read these articles, begin to think about the connections between the layout and use of our watershed and the relationship between land use, air pollution, and water pollution.

Lesson Plan – Day 5

Subject: Earth’s Changing Surface and Weather **Duration of Lesson:** one 45 min class

Lesson Topic: In this lesson, students will learn about particulate and non-particulate pollution. They will also relate these types of pollution to air and water pollution and persistent and non-persistent toxins. Also, the concept of point and non-point sources of pollution will be introduced and related to the local environment.

Lesson Content

A. Introduction: Use the overhead projector or chalkboard to begin the class with an “Entrance Poll.” The questions are: 1. Given your knowledge of our local Rouge River watershed, how might you, acting as a watershed planner, reduce the impact of the local communities in regards to water and air pollution. 2. What do you think is/are the connection(s) between air pollution and water pollution?

B. Procedure: After an initial discussion of the entrance poll questions, students will be reading from their textbooks, The Great Lakes, an Environmental Atlas and Resource Book, and The Great Lakes Basin pamphlet as they seek to determine the sources and the names of at least 4 particulate and 4 non-particulate types of pollution. We will use that information as well as the “Water: Our Life and Heritage” poster as you create an envirocube with definitions and examples of these six topics on the six sides: (see appendix for a master of the cube and a large font list of the topics for the 6 sides – to make a transparency) 1. Persistent and non-persistent toxins, 2. Point and non-point sources and types of pollution, 3. Particulate and non-particulate pollution, 4. Bioaccumulation, 5. Eutrophication and phosphorous concentration, and 6. Sediments and sediment resuspension. You may work with a partner, the cubes are due tomorrow.

Materials Needed (other than paper, pencil, and textbook):

- The Great Lakes, an Environmental Atlas and Resource Book (also available at <http://www.epa.gov/glnpo/atlas/index.html>)
- The Great Lakes Basin pamphlet (also available at <http://www.dsisd.k12.mi.us/mff/Environment/greatlakes.htm>)
- “Water: Our Life and Heritage” poster
- Copies of envirocube sheet and transparency for directions
- Map of Rouge River watershed
- Photocopied handout on “Clouds,” which is page 40 of the “Understanding Weather” textbook
- “Earth’s Changing Surface” textbook
- Back to the Future, Designs for Walkable Neighborhoods worksheet

Homework: Answer the following questions in your science notebook:

1. Explain how it is that some oil or a pesticide that is dripped on your driveway or lawn can wind up in Lake Erie, or possibly even in your drinking water (also indicate where our local drinking water comes from – 2 sources).

2. Why/how might the design of a community have an impact on the water and air quality in the local watershed? What impact might our local decisions regarding water and air pollution have on other areas of the world?

Homework – Part 2: Read *Back to the Future, Designs for Walkable Neighborhoods* worksheet

Lesson Plan – Day 6

Subject: Earth's Changing Surface and Weather **Duration of Lesson:** one 45 min class

Lesson Topic: In this lesson, students will learn more about why and how the design of a community can have an impact on the lives of the residents as well as on water and air quality in the local watershed. We will also begin to discuss the impact that our local decisions regarding water and air pollution have on other areas of the world (and how other areas have an impact on us). This lesson is provided as a link between our water and air quality and the design of model communities that the students will be creating as an integrated project in their 4 core classes (math, science, English, social studies)

Lesson Content:

A. Introduction: Use the overhead projector or chalkboard to begin the class with another “Entrance Poll” question: People talk about “throwing things away” all the time. What is wrong with that statement? Explain your answer.

- While students are answering the question, the teacher may go around the room to give them credit for completing last night's homework questions.

B. Procedure:

1. Have students spend 2 minutes in engaging their seat partner(s) in a brief class discussion of last night's homework questions: 1) Explain how it is that some oil or a pesticide that is dripped on your driveway or lawn can wind up in Lake Erie, or possibly even in your drinking water (also indicate where our local drinking water comes from – 2 sources). 2) Why/how might the design of a community have an impact on the water and air quality in the local watershed? What impact might our local decisions regarding water and air pollution have on other areas of the world?

2. Utilize 5 more minutes of class to have a class discussion regarding the entrance poll and last night's homework question. Use this as an introduction to the movie.

3. Students will watch the video “Back to the Future, Designs for Walkable Neighborhoods.” While watching the video, students will have an opportunity of answering the questions associated with the video, which they should have read last night.

Materials Needed (other than paper, pencil, and textbook):

- *Back to the Future, Designs for Walkable Neighborhoods* video.
- *Back to the Future, Designs for Walkable Neighborhoods* worksheet (see appendix)
- *The Great Lakes, an Environmental Atlas and Resource Book* (also available at <http://www.epa.gov/glnpo/atlas/index.html>)
- *The Great Lakes Basin* pamphlet (also available at <http://www.dsisd.k12.mi.us/mff/Environment/greatlakes.htm>)
- “Earth's Changing Surface” textbook

Earth's Changing Surface and Weather Pre-Test / Thought-Organizer

The following questions are based on the state's science objectives and represent the "big picture" ideas that you should be able to accurately discuss by the end of this unit. Please answer these questions on a separate sheet of paper, which you will then turn in before the end of the period.

1. Trace at least 2 possible natural routes that a raindrop might take to reach the ocean AFTER it has landed on Michigan during a storm. Explain each of these in terms of the water cycle. Also explain how that water might later return to Michigan.
2. List the States and Provinces that are part of the Great Lakes Watershed.
3. Compare and contrast the Great Lakes Watershed with our local Rouge River Watershed. List at least three things that they have in common and three things that are different. Describe 3 ways that water might leave the surface waters in the watershed. Also list the main features that define a watershed.
4. What is the relationship between air pollution, rain and water pollution?
5. Give 4 examples of air-borne particulates and at least 3 examples of non-particulate air pollution.
6. Explain how it is that some oil or a pesticide that is dripped on your driveway or lawn can wind up in Lake Erie, or possibly even in your drinking water (also indicate where our local drinking water comes from – 2 sources).
7. Why/how might the design of a community have an impact on the water and air quality in the local watershed? What impact might our local decisions regarding water and air pollution have on other areas of the world?
8. People talk about "throwing things away" all the time. What is wrong with that statement? Explain your answer.

“Where Does Michigan Water Go?”

Directions: Using one of the methods of communication listed below, explain the path of water from a point of your choosing in Michigan to the ocean. You will have three consecutive nights and the class period the day after tomorrow to complete your project. The project is worth a total of 100 points. Students will lose 10% of their grade each day it is late.

A. Methods:

- 1) Write a story
- 2) Write a poem
- 3) Draw a cartoon
- 4) Write and sing a song
- 5) Make a model
- 6) Create a video or website

B. Requirements (assessment):

- 1) A map of from Michigan to the ocean, with a logical and natural route clearly labeled. Also label any large lakes and rivers, mountains, valleys, and other important landforms (to be determined) found along the route (25 points)
- 2) Writing to accompany and explain the water's path to the ocean (appropriate to explain the method that you chose from above) (25 points)
- 3) A rationale or explanation of why water takes the path that you chose (25 points)
- 4) Present your final product to the class (25 points)

“Earth’s Water: Ground Water” lab

This will be an opportunity for you to do research and learn more about the Great Lakes Watershed so that you can complete your previously assigned watershed projects. Utilize this lab worksheet and computer lab to complete the ground water lab at the USGS’s “Earth’s Water” website (<http://www.ga.usgs.gov/edu/mearth.html>). **Answer the questions on a separate sheet of paper!!!**

Click on What is Ground Water? Read and answer the following

1. What is ground water?
2. How does gravity affect ground water?
3. How can water move through bedrock?
4. Click on the Camera icon located in the second paragraph. How can you explain what is happening in this picture?
5. Does water flow all the way to the center of the earth? Why or why not?

Click on the back button to return to the Earth’s Water topics. Click on Ground Water Topics, and the Ground Water Flow Diagrams. Look at the diagram labeled “Natural Conditions.”

6. Using the diagram, describe the flow of ground water in your own words. Start your description at the point at which the water originates. (See homework question #1 also)
7. Look at the diagram titled “Water level declines.” How does the pumping well affect the ground water flow?

Click on the back button to return to Ground Water topics, and click on Pesticides in Ground Water.

8. My water testing company tells me that I should be less worried about the oil that Comcast spilled in my yard last winter and more worried about what the people who lived in my house did in the yard 50 years ago. Why?

Click on the back button to return to Ground Water topics, and click on the aquifers.

9. Define the following terms (you may click on the words): Porosity, Permeability, Aquifers, and Wells.
10. Scroll down to the pictures of creviced rock and gravel. How would a person determine the location of where the water table begins?
11. What is the difference between a pumped well and an artesian well? (By the way, there are 2 local artesian wells that I have seen in Farmington and Farmington Hills)

Use the back button to return again to Ground Water topics. Click on Water Wells.

12. Why are water wells important to all societies?
13. Water levels in aquifers do change. What causes these changes?
14. How are wells recharged?

Return back to Earth’s Water topics. Click on Runoff.

15. In which direction does most rain and snow go, and which process occurs as a result of this movement?
16. What do you consider to be the top 6 physical characteristics affecting runoff?
17. List the two most common and problematic nutrients that can be present in runoff. Note that they are both present in most lawn fertilizers, and lawns are now the largest crop grown in the US.

Go back to *Earth's Water*, then click on *Where is Earth's Water?*

18. How much of the Earth's water is currently usable by humans?

Go back to *Earth's Water*, then click on *Earth's Water Distribution*

19. Scroll down to the data table. How much of the earth's water is in the form of groundwater, freshwater lakes, and rivers – the only 3 readily usable forms of water on the planet?

Homework:

1. We just had an extreme attack of stupidity and polluted the water at the origination point in question #6 with some oil and a persistent toxin like the lead from old paint or a car battery that we" threw away" instead of using the recycling site. List the places that the pollution could contaminate.
2. Look at the Rouge River Watershed map. Try to determine which branch of the Rouge River water from your neighborhood enters.
3. Where does runoff of the surface water from our local streets go? What do newer businesses and neighborhoods do with their water runoff that was not done when the areas around the school were built up in the past 50 years?

Brain Teaser #1: Some people have proposed installing new dumps in the middle of areas with high ground water. They think that such dumps would be a better idea than similarly constructed dumps places in areas above and away from ground water. How can this be a good idea?

Brain Teaser #2: (Refer to question #12) A good example of water levels in aquifers changing is right here on the nature trail at the school, which used to be a much more wet place, even including a shallow pond 30 years ago. What might have caused our changes? (There was a hint to the answer when you looked at the picture for question #4)

ENVIROCUBE

1. Persistent and non-persistent toxins
2. Point and non-point sources and types of pollution
3. Particulate and non-particulate pollution
4. Bioaccumulation
5. Eutrophication and phosphorous concentration
6. Sediments and sediment resuspension

You may work with a partner, the cubes are due tomorrow.

Back to the Future, Designs for Walkable Neighborhoods worksheet

Read these questions prior to the start of class. Answer the questions during and after the time that we watch the video. We will be discussing these questions tomorrow.

1. Why was it hard for Bob to run his errand on foot?
2. For what type of travel are most communities designed?
3. What is good about having zoning that promotes mixed land use?
4. Which of the following do pedestrian friendly communities offer?
 - a. Pedestrian-scaled design
 - b. Neighborhoods with many dead-end streets
 - c. Concentration of services and destinations
 - d. Mixture of different land uses
 - e. Neighborhoods with wide streets
5. What makes the neighborhoods around Frost friendlier to pedestrians than most newer neighborhoods? What has caused the dramatic change in the way that our neighborhoods are built?
6. What is encouraged by narrow streets with garages in the rear and porches up front on houses?
7. Name 3 ways that we can make a Livonia more pedestrian friendly.
8. Where is the nearest public bus stop?
9. When was the last time you rode non-school-related public transportation. Why have/haven't you used public transportation?
10. How far would you have to walk from your house to go shopping for food, clothes, and to go to an ice cream shop?
11. How far do your family members have to go to get to work?
12. What does all of this community design stuff have to do with water and air quality? List at least 3 things, be specific in your explanation of why you chose each of those items, and be prepared to discuss this as we begin to build our model communities in the next few days.

Extra Credit

An additional lesson regarding the effect of community design and location on the life of those living in the community is based on The Buffalo Creek Disaster: <http://www.wvculture.org/history/buffcreek/bctitle.html> This would be a useful extra credit or extension project by students who might need or desire something additional. It is a recent flood-type of disaster that was caused by negligence and compounded by politics. It is certainly a great example of what not to allow as a community is designed or modified.