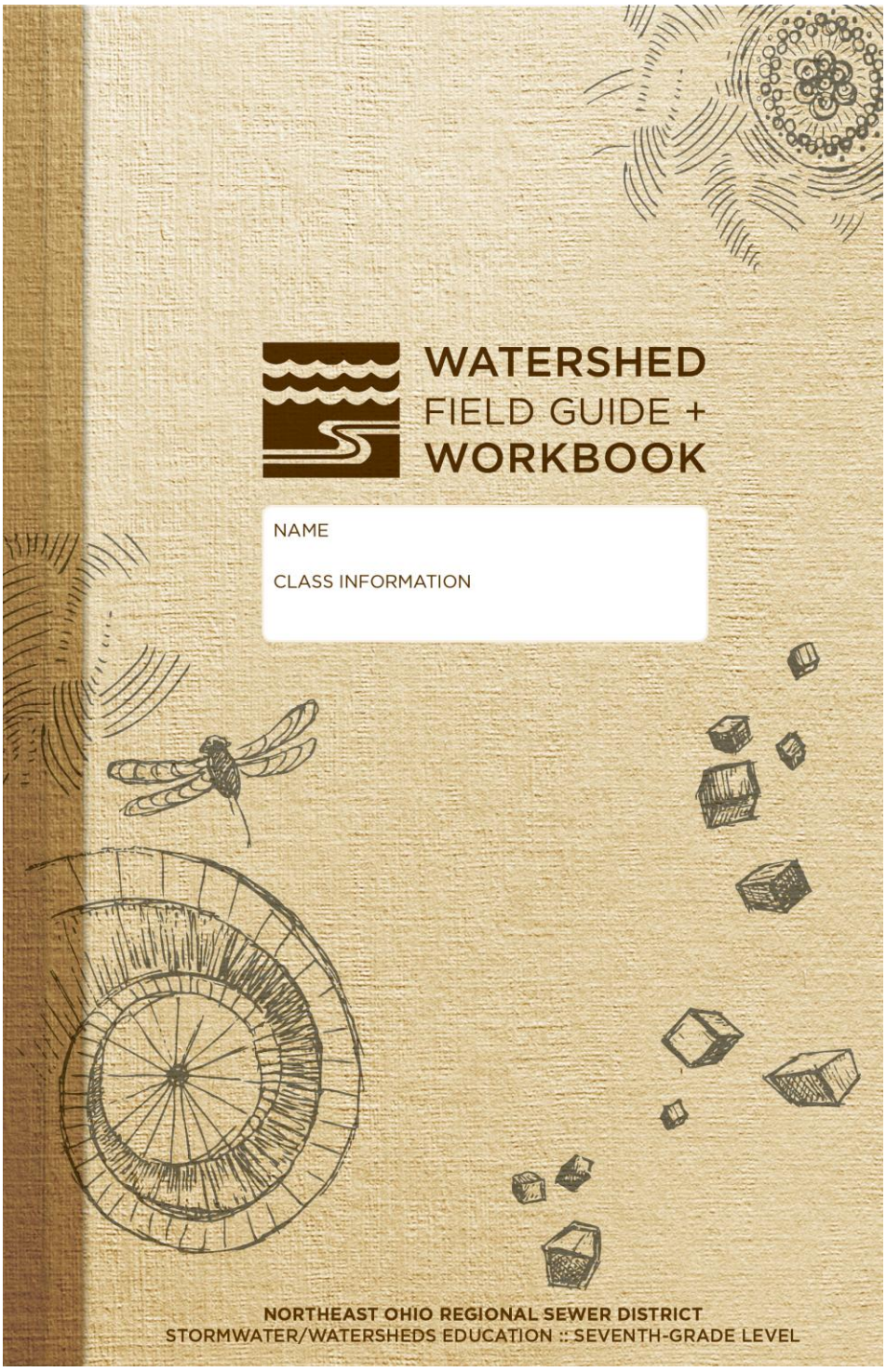

TEACHERS GUIDE

PRESENTED BY THE NORTHEAST OHIO REGIONAL SEWER DISTRICT

Northeast Ohio Regional Sewer District

To our Northeast Ohio teachers and friends:

This curriculum was written by a group of practicing teachers with the hope that your students will gain a broader awareness of the watershed of northeast Ohio, the Northeast Ohio Regional Sewer District and how they impact our daily lives.

Each lesson can easily be modified to fit your classroom and meet the needs of your individual students. The time frames indicated are the minimum amount of time to complete each activity. You will need to use your own judgment about how many class periods or days you will need to complete the unit.

We recommend that you add in vocabulary builders based on the prior knowledge of your class. You may use a Word Wall, graphic organizers, foldables or have the students create their own glossary depending on the needs of your group. A glossary has already been included in the student Field Guide; however, the pages can be removed prior to distribution to students.

Please be sure to have students review and follow your classroom safety rules and requirements for all lab activities. Included in the appendix, as well as the student field guide, is a copy of a lab safety contract that you may use with your class.

If you have questions about the lessons, activities, or would like supplemental material, you may email us at community@neorsd.org or call (216) 881-6600 and ask to speak with our Watersheds department.

Thank you for helping us keep our Great Lake great.

The following lessons are designed to meet **Ohio's College and Career Readiness Standards in Science** seventh grade. The lessons also address components of the math and ELA standards.

Science Inquiry and Application:

- Identify questions that can be answered through scientific investigations;
- Design and conduct a scientific investigation;
- Use appropriate mathematics, tools and techniques to gather data and information;
- Analyze and interpret data;
- Develop descriptions, models, explanations and predictions;
- Think critically and logically to connect evidence and explanations;
- Recognize and analyze alternative explanations and predications; and
- Communicate scientific procedures and explanations.

Grade Band Theme: Order and Organization
This theme focuses on helping students use scientific inquiry to discover patterns, trends, structures and relationships that may be described by simple principles. These principles are related to the properties or interactions within and between systems.

Strand Connections: Systems can exchange energy and/or matter when interactions occur within systems and between systems. Systems cycle matter and energy in observable and predictable patterns.

Topic: Patterns and Cycles of the Earth and the Moon
This topic focuses on Earth's hydrologic cycle, patterns that exist in atmospheric and oceanic currents, the relationship between thermal energy and the currents, and the relative position and movement of the Earth, sun and moon.

- The hydrologic cycle illustrates the changing states of water as it moves through the lithosphere, biosphere, hydrosphere and atmosphere.

Topic: Cycles of Matter and Flow of Energy
This topic focuses on the impact of matter and energy transfer within the biotic component of ecosystems.

- Matter is transferred continuously between one organism to another and between organisms and their physical environments.
- In any particular biome, the number, growth and survival of organisms and populations depend on biotic and abiotic factors.

DAY 1

PREREQUISITE KNOWLEDGE:

The different components of the hydrologic cycle (e.g., properties of water, changes of state, relationships of water to weather, effects of water on Earth's surface)
Calculating area of rectangles and triangles

STUDENTS WILL

1. Distinguish between pervious and impervious surfaces and how they relate to the water cycle.
2. Calculate the surface area of the school's parking lot.

DAY 1 AT A GLANCE

ESSENTIAL QUESTIONS

Where does the water we use go?

How much of our school grounds area is pervious and impervious?

_____

MATERIALS

- Video "Why are my sewer rates going up?" *
- Student Field Notebook
- Tape measure

Optional:
- Sod
- Large rock or blacktop (or other hard surface)
- 2 shallow baking dishes
- Pencil shavings

TIME FRAME

	Estimated
Video	15 min.
Discussion	10 min.
Activity	25 min.
TOTAL	50 min.

VOCABULARY

- Combined sewer overflow (CSO)
- Green infrastructure
- Groundwater
- Impervious
- Lake
- Pervious
- Pond
- River
- Runoff
- Runoff
- Sanitary sewer
- Storm sewer
- Storm water
- Stream
- Tributary
- Watershed

* "Why are my sewer rates going up?" video can be found on NEORSD's website at http://www.neorsd.org/cleanlake

Anticipation Guide:

Ask students to tell what they know about where rain water goes and the sewer systems. Explain the difference between storm sewers (sewers for the excess storm water that is sent to Lake Erie) and sanitary sewers (that take away the wastes from our homes and businesses to the sewer treatment plants). How many have gardens or rain barrels? Why might these items be good for the environment? You may wish to write some of their ideas on the board for later discussion or have students jot down their own thoughts in the student Field Notebook on page 3. (Students will reference this on day 2)

Video Quest:

Have the students look at the questions in the Field Notebook and explain that the video they are about to watch will answer those questions. Students should pay close attention to the video to find the answers. Play the video, "Why are my sewer rates going up?" from the North East Ohio Regional Sewer District (NEORSD) website http://www.neorsd.org/cleanlake The entire video is 5 minutes and 24 seconds long. Stop the video frequently to allow students the chance to write down the answers and discuss what was said.

Discussion

Discuss the terms pervious and impervious and what types of surfaces are examples of each.

Optional: Demonstrate for students what storm water runoff and infiltration look like by placing a piece of asphalt or large rock in a shallow baking dish and a piece of sod in a separate shallow baking dish. Pour water over each and have students observe what happens. Add some pencil shavings or other "debris" onto the rock and add more water to show what happens to litter and natural debris. Talk about what happens to the debris they noticed on the school parking lot when there is a very heavy rain.

Tell students that the NEORSD is offering storm water credits to businesses and homeowners for best practices in reducing the amount of storm water flowing into the storm drains. Print and distribute information to the class or have them view the manual/factsheets at http://neorsd.org/stormwatercreditmanual.php and allow them a few minutes to explore the information. **Note**: The manual is approximately 80 pages. You should advise students to primarily at the first section, although they may explore further if time permits.

Ask students to brainstorm what some of the best practices might be. How can we reduce the amount of water running into the sewer drains, Cuyahoga River and Lake Erie? How can we keep it clean?

Activity

Ask the students: What is the school parking lot's surface area? Is this a pervious or impervious surface? Are there any pervious areas? Where does the water go?

Have the students draw a sketch of the school parking lot in their Field Notebooks. Divide the class into teams of 3-4 and assign each team an area of the parking lot to measure. Take the class outside to gather needed measurements. Have them record the measurements in the Field Notebook and mark any pervious areas in or around the lot as well. Have the students measure using feet and inches.

Students should then share their measurements/data with the other groups. Have them estimate the area of the parking lot. Depending on the shape of the lot at your school, you may wish to have each group calculate the area of the sections they measured and add each section together or have the whole class calculate the entire lot.

Exit Slip

Have students think about their own homes and how much pervious and impervious area surrounds their houses. Using their Field Notebook, students should record ideas about ways to lessen the amount of storm-water (run-off) at their homes.

Extensions

- Research how much water is used for basic daily tasks such as flushing the toilet, brushing teeth and taking a bath. Have students keep track of the water they use in a day. Calculate how much they use in a week, month and year.

Modifications

- Have students work in pairs to complete the video quest and stop the video more often.

DAYS 2 AND 3

PREREQUISITE KNOWLEDGE

The different components of the hydrologic cycle (e.g., properties of water, changes of state, relationships of water to weather, effects of water on Earth's surface)

STUDENTS WILL

1. Research green infrastructure and absorbent plants.
2. Model evaporation and transpiration.
3. Observe plants cleaning contaminated water through transpiration.

DAYS 2 AND 3 AT A GLANCE

ESSENTIAL QUESTIONS

How can plants affect the water cycle?

How can plants help clean water?

How can a garden help reduce runoff and water pollution?

MATERIALS

- Student Field Guide
- Celery*
- Plastic cups or beaker*
- Bucket of water
- Petri dish*
- Food coloring
- Clear plastic bag*
- Paper towels
- Markers
- Paper*
- Shallow pan*
- Spray bottle with water

*ONE PER GROUP

TIME FRAME

	Estimated
Mini labs	30 minutes
Research project	50 minutes
Journaling	20 minutes
TOTAL	100 minutes

VOCABULARY

- Capillary action
- Condensation
- Erosion
- Evaporation
- Green infrastructure
- Infiltration
- Lake
- Pond
- River
- Storm water
- Stream
- Transpiration

Mini Lab Stations

The mini labs should be set up around the classroom and ready to begin immediately when students enter so that they can monitor what is occurring at frequent intervals during the class. Have enough materials for the labs so that each group of students can do the activity. Each group of students will be assigned a letter. Label the cups, petri dishes, and pans with a letter so that the groups can identify their materials. Make sure to mark the stations with the number of the lab so that students can easily find the corresponding sections in the field Notebook.

Lab one, "Absorption" shows how plants absorb the ground water along with whatever chemical contaminates it may contain. Have a cup with water already colored with food coloring. When students arrive to the station, they will add the stalk of celery and briefly observe and record what they see in the Field Notebook on page 7. During the class period, remind students to check back to observe and record any changes taking place.

Lab two, "Color in a dish" shows the students how contaminates can be separated out as water evaporates in the environment. In a petri dish or similar container, the students will place a small amount of colored water and let sit. Again, the students will record what they observe in the Field Notebook frequently. By the end of the period, only the color should remain at the bottom of the dish.

Lab three, "Follow the flow" gives students a quick look at the flow of water over land during a rain storm. Students will crumble a sheet of paper and partially smooth it out. They should be careful to leave some ridges to represent hills. Various colors will then be added to the creases with the markers. Students will then gently spray some water onto the paper and record their observations in the Field Notebook.

Lab four, "Reflections" will occur at end of class. Once the celery has absorbed the colored water and has changed color, remove it from the cup and pat it dry with a paper towel. Place the celery inside the plastic bag and tie the end. Again, have students record what they observe. Let the celery sit overnight. At the start of class on day 3, clean water should be condensed on the inside of the bag.

Research project

Review with the class the terms pervious and impervious. What types of surfaces are impervious? How do pervious areas reduce storm-water (runoff)? Remind students that plants can also help reduce erosion. Remind students to look at the notes they made on day 1 about how gardens and rain barrels may help the environment. Have the students brainstorm how that may help keep the Cuyahoga River and Lake Erie clean.

Tell the students that they will be researching green infrastructures and water absorbent plants. They should keep in mind the area in which they live and go to school to help identify plants and solutions that are in place or perhaps should be added. Students will record the information they gather using the graphic organizer in the student Field Notebook on page 15.

Be sure to walk around the room and monitor student progress and answer any questions they may have. You may wish to divide students into pairs or small groups.

Journaling

After students have completed their research, have them work in groups to determine/discuss plans for improving the pervious areas of the school parking lot. Have them write a letter to the principal explaining their ideas and how it would help reduce runoff from the property.

Extensions

- Develop ideas on how to add green infrastructure to other areas of the city.
- Invite speakers to discuss projects that are in the works around the city.

DAY 4

PREREQUISITE KNOWLEDGE

The different components of the hydrologic cycle (e.g., properties of water, changes of state, relationships of water to weather, effects of water on Earth's surface)

STUDENTS WILL

1. Calculate the amount of annual precipitation that falls on the school parking lot.
2. Create a Frayer model to demonstrate understanding of water pollution.

DAY 4 AT A GLANCE

ESSENTIAL QUESTIONS

1. Where does runoff water go?
2. What roll does our school play in the water cycle?

MATERIALS

- Student field guide

TIME FRAME

	Estimated
Measurement activity	30 min.
Discussion and vocabulary	20 min.
TOTAL	50 min.

VOCABULARY

- Erosion
- Groundwater
- Impervious
- Infiltration
- Lake
- Nonpoint sources
- Pervious
- Point sources
- Pond
- River
- Storm-water
- Stream
- Water pollution
- Watershed

Review

Remind students to observe the celery stalk in the bag and record their observations in the Field Notebook. Talk about why the water droplets formed inside the bag and the term transpiration. Ask students to explain the terminology of the water cycle and fill in the terms in the diagram on pages 16-17 of their Field Notebook.

Measurement Activity

Have students recall the parking lot activity they completed on day 1. We have talked about the water that the plants soaked up as well as what infiltrated the ground, but what happened to the rest of that water? And how much water falls on that parking lot annually?

Have the students calculate the volume of rain that falls on the school parking lot annually using the guide in the student Field Notebook. Discuss where the storm water goes. If necessary, take the students back outside so they can determine where the water flows to and where the storm drains are. Also be sure to have students look at the amount of dirt, pebbles, litter and other debris that are on the lot.

Using the student Field Notebook, students will continue the measurement activity from day 1 by calculating the volume of water that falls on the school parking lot each year. According to the National Oceanic and Atmospheric Association, the mean annual rainfall in Cleveland is 36.6 inches.

Discussion and vocabulary acquisition

Continue the discussion of surface water pollution. Where does the pollution come from? How does it get into our surface and ground water? What can we do to help prevent it?

Students will now complete the Frayer Model in the student Field Notebook to demonstrate their individual understanding of water pollution.

Create a T-chart on the board to discuss point and nonpoint sources of contamination.

Extension

- Using recycled materials, have the students create a model the school showing the path that runoff would take.

DAY 5

SUMMARY AND BACKGROUND KNOWLEDGE

The different components of the hydrologic cycle (e.g., properties of water, changes of state, relationships of water to weather, effects of water on Earth's surface)

STUDENTS WILL

1. Identify uses of water
2. Discuss importance of water as non-renewable source
3. Explain 'Being a Good Steward of this Water resource relates to Common Good.'

DAY 5 AT A GLANCE

ESSENTIAL QUESTIONS:

Explain the importance of water.

Is water renewable?

Justify "Why it is for the common good to be a good steward of water."

MATERIALS

- Student Field Guide
- Glass of water
- Computer Access
- World map showing the physical features or globe

For the demo

- One 100 ml graduated cylinder
- Gallon bucket
- One pipette
- Permanent Marker
- 8 plastic cups
- A cup with water
- One 1000 ml Beaker with ice
- Heat source (Hot Plate)
- Wet paper towel

TIME FRAME

	Estimated
Quick write and discussion	10 min.
Demo for Distribution of water	10 min.
Creating a classroom newsletter and sharing	30 min.
TOTAL	50 min.

The demonstration is adapted from www.learningtogive.org's Water is Cool *lesson.*

VOCABULARY

- Common Good
- Conservation
- Cycles
- Ecology
- Environment
- Freshwater
- Great Lakes
- Lake Erie
- Lake level
- Matter
- Natural Resource
- Water
- Water table

Quick Write

Show students a world map showing the physical features of the world or a globe and ask students to complete a quick write explaining how much of the Earth's surface is really made of water. How much water is found in a human body? What is the significance of clean water? As students are working on their Quick Writes the teacher can prompt students, to assist in thinking, with the following:

1. Determine how much of the total water of the earth is readily available for human use.
2. Describe the kind of water we need.
3. Identify where on the Earth freshwater is located.
4. Where is the largest source of freshwater compared to where we are?

Randomly ask three or four students to share their quick write.

Discussion

Hold a cup full of water or place it on the desk and ask students how old the water is. At this time try explaining to the students that although this water may be a week old collected from the storm water it is the same water that the dinosaurs' drank millions of years ago. Explain that centuries ago water usage did not cost money.

The concept of water being non-renewable resource should be introduced. Some scientists believe that all the water that exists in the form of solid, liquid and gas on the earth has been since the beginning. It needs to be recycled. If we do not take care of it water resource all life is going to suffer.

DEMO: Distribution of water around the world

Use the 1,000 ml beaker to fill the bucket with 10,000 ml of water. Tell the students that you are going to pretend that the 10,000 ml of water (about 2 ½ gallons) represents all of the water on Earth.

Label each cup with a different name from the following list:

1. Icecaps/ glaciers
2. Groundwater
3. Freshwater lakes
4. Great Lakes
5. Saltwater Lakes/seas
6. Atmosphere

7. Rivers/Streams
8. Unaccounted for

Using the 100 ml cylinder, take 200ml of water from the bucket and place it in the cup labeled Icecaps/glaciers. This will represent all of the water on Earth that is located in icecaps and glaciers.

Use the following table to determine how much water needs to be in the remaining cups. The water that remains in the bucket represents all of the water in the Earth's oceans. **Teacher Note:** You may want to determine how many drops using pipette are in 1ml so you can tabulate the number of drops needed to represent some of the smaller amounts, (* 20 drops = 1 ml, so 1 drop = 1/20 ml (.05), or you can simply use a single drop from the eyedropper to represent each amount that is too small to be measured with the cylinder.

If all of the water on Earth was equal to 10,000 ml, you would find the following amounts in these locations:

Oceans	9,720.0 ml
Icecaps/Glaciers	200.0ml
Groundwater	62.0ml
Great Lakes	0.18ml = 4drops
Freshwater Lakes	0.72ml = 14 drops
Inland Seas / Salt Lakes	0.8ml =16 drops
Atmosphere	0.1ml = 2 drops
All Rivers, Streams	0.01ml = dab it
Unaccounted for	16.19ml

At this time students can work on the questions in the field Notebook and then discuss the answers. Be sure to point out to students that cup labeled "Freshwater Lakes" represents **all** other freshwater lakes with the only exception of the Great Lakes.

Remind students that the Great Lakes is the largest source of freshwater in the world!
Lead the class to a discussion about how they as individuals can think of how water is important and how they can take care of it. Ask students what they think the main concern in the Cleveland area would be. Remind students about the video they watched on day 1. What was Project Clean Lake and what did it focus on? This could be a group activity where three students work together towards the final assessment.

Have students explain why water is important in our lives and why we must take care of it. Choose one of the following activities for your students, or allow the individual groups to choose which one they would like to do:

1. Create a classroom newsletter. The newsletter could include such aspects as an informational piece, a letter to the editor, a comic strip and a game or puzzle using the vocabulary from the lesson and share.
2. Create a video advertisement.
3. Create a poster.
4. Create a brochure.

The above project should include information learned through-out the unit. Be sure to have students focus on the Lake Erie and Cuyahoga River watersheds. This assignment is meant to be a quick, yet fun assessment of what the students learned. Students can create simple outlines or a layout of the option chosen. It can easily become a more detailed project if you provide the students more time or require them to work on it independently at home. A rubric is included on page 15. You may need to adjust the rubric based on how you approached this project.

Extension

- Using topographical maps of the local area and the internet, have students research the water quality in the Cleveland area (Cuyahoga River, Lake Erie and the tributaries) finding out about temperature, pH, dissolved oxygen and heavy metals. Why are these items measured? Why are they important to the wellness of a community/ecosystem? Discuss changes over time – is water quality improving? When was it the worst? Why?
- Using the information gathered during research, create graphs that compare time and temperature, pH and dissolved oxygen.

Student Safety Contract

A copy of this contract is Page 1 of the students' Watershed Workbook.

I will

- ○ Read the lab investigation before coming to class.
- ○ Wear protective equipment as directed to protect my eyes, face, hands and body while conducting activities.
- ○ Follow all instructions given by the instructor.
- ○ Conduct myself in a responsible manner at all times.

I, _____,
(Print your name)
have read and agree to abide by the safety regulations as set forth above, as well as any printed instructions provided by my instructor or the school district.

I agree to follow all other written and oral instructions given in class.

Signature: _____

Date: _____

DAY 5 PROJECT RUBRIC

Student Name: _____

CATEGORY	4	3	2	1
Content - Accuracy	All facts are accurate. Information included is relevant to the Lake Erie and Cuyahoga River watersheds.	Most of the facts are accurate. Information included is relevant to the Lake Erie and Cuyahoga River watersheds.	Many inaccurate facts or the information is not relevant to the Lake Erie and Cuyahoga River watersheds.	Fewer than 80% of the facts are accurate. The information is not directly related to the Lake Erie and Cuyahoga River watersheds.
Attractiveness & Organization	The product has exceptionally attractive formatting and well-organized information.	The product has attractive formatting and well-organized information.	The product has well-organized information.	The product's formatting and organization of material are confusing to the reader/audience.
Sources	Careful and accurate records are kept to document the source of 95-100% of the facts and graphics.	Careful and accurate records are kept to document the source of 94-85% of the facts and graphics.	Careful and accurate records are kept to document the source of 84-75% of the facts and graphics.	Sources are not documented accurately or are not kept on many facts and graphics.
Knowledge Gained	All students in the group can accurately answer all questions related to the facts presented and to technical processes used to create the product.	All students in the group can accurately answer most questions related to the facts presented and to technical processes used to create the product.	Most students in the group can accurately answer most questions related to the facts presented and to technical processes used to create the product.	Several students in the group appear to have little knowledge about the facts or technical processes used in the product.
Writing - Vocabulary	The authors correctly use several new words and define words unfamiliar to the reader.	The authors correctly use a few new words and define words unfamiliar to the reader.	The authors try to use some new vocabulary, but may use 1-2 words incorrectly.	The authors do not incorporate new vocabulary.
Required Elements	The product includes all required elements as well as additional information.	All required elements are included in the product.	All but 1 of the required elements are included in the product.	Several required elements were missing.

FIELD NOTEBOOK RUBRIC

Name _____

CATEGORY	4	3	2	1
Quality of Work	Provides work of the highest quality.	Provides high quality work.	Provides work that occasionally needs to be checked/redone by other group members to ensure quality.	Provides work that usually needs to be checked/redone by others to ensure quality.
Contributions	Routinely provides useful ideas when participating in the group and in classroom discussion. A definite leader who contributes a lot of effort.	Usually provides useful ideas when participating in the group and in classroom discussion. A strong group member who tries hard!	Sometimes provides useful ideas when participating in the group and in classroom discussion. A satisfactory group member who does what is required.	Rarely provides useful ideas when participating in the group and in classroom discussion. May refuse to participate.
Requirements	All of the required content was present.	Almost all the required content was present.	At least 75% of the required content was present.	Less than 75% of the required content was present.
Accurateness	Accurately completed all areas of Field Notebook. Used complete sentences.	Completed all areas of Field Notebook. Used complete sentences in most areas.	Completed at least 80% of Field Notebook. Used complete sentences rarely.	Completed less than 80% of the Field Notebook. Did not use complete sentences, answers were incomplete.

GRADE 7 ANSWER KEY:

Page 4-5:

1. 90 billion gallons
2. Local water ways
3. Sewers that move both wastewater and stormwater
4. 3
5. Lake Erie & Cuyahoga River
6. Too much storm water causes waste water to overflow into the environment; answers will vary
7. A project designed to reduce the level of CSO. Project duration: 20 to 30 years
8. 9 billion; 4.5 billion; 494 million
9. Sustainable projects to store, absorb and/or evaporate storm water above ground
10. Answers will vary

NOTES

NOTES

Northeast Ohio Regional Sewer District
3900 Euclid Avenue
Cleveland, Ohio 44115

(216) 881-6600 | community@neorsd.org

2013 EDITION