Grades 4-6, 9-12

Helping Hands

Restoring Great Lakes Habitat

Connecting students with scientific principles through local sediment and habitat projects

ALIGNED TO NGSS, NSES, AND STATE STANDARDS

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UNIVERSITY OF ILLINOIS
EXTENSION

IISG-16-011

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Introduction:

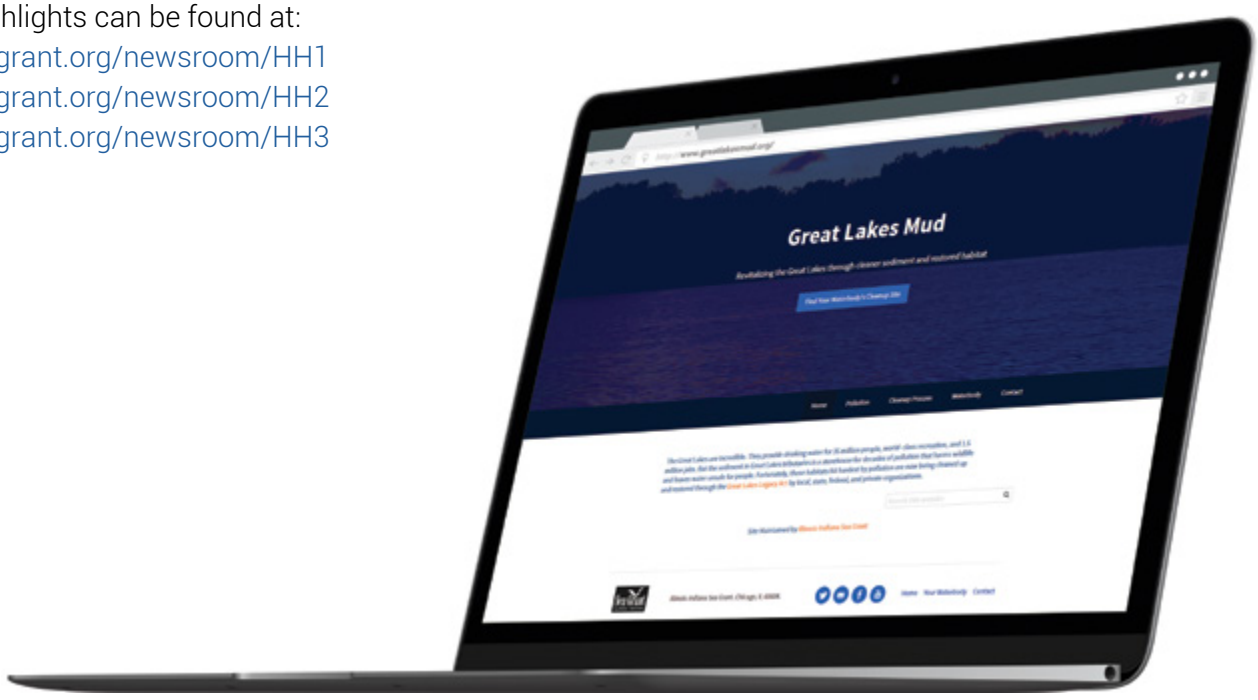
This curriculum project provides an opportunity to engage upper elementary and high school students in Great Lakes environmental stewardship. The lessons and hands-on activities apply to schools located in Great Lakes communities where large scale environmental cleanup and restoration projects are taking place. These places are called Areas of Concern due to years of degradation and pollution.

Through participation in the curriculum, students will be connected with local aquatic habitats and improve scientific and Great Lakes literacy. Students will learn ecological concepts such as water quality, pollution, and habitat restoration, while gaining an understanding about significant environmental cleanups happening near their school.

The curriculum is available online, along with additional resources to carry out lessons, such as PowerPoint files and alignment to standards. Specifically, each lesson has been aligned with National Science Education Standards, Next Generation Science Standards, and Great Lakes Literacy Principles: www.greatlakesmud.org/education.html.

Teachers interested in learning more about implementing this curriculum in their classrooms can contact Illinois-Indiana Sea Grant. This curriculum was initially implemented with schools in the Grand Calumet River Area of Concern in northwest Indiana by Caitie Nigrelli: www.iiseagrant.org/staff/nigrelli.php.

Project highlights can be found at:
www.iiseagrant.org/newsroom/HH1
www.iiseagrant.org/newsroom/HH2
www.iiseagrant.org/newsroom/HH3



High School Curriculum

Grades 9-12

Lesson 1:

Why Should We Keep the Great Lakes Great?

Grade Level: 9-12

Time: 55 Minutes

Vocabulary:
Native, invasive, sediment, U.S. Environmental Protection Agency, remediation, restoration.

Great Lakes Literacy Principles:

Principle 2
Concept E

Principle 5
Concept I

Principle 6
Concepts D, E, F

Principle 8
Concept F

Summary:
Students create a PowerPoint and learn about an environmental cleanup in their community, including details about scope and design.

Objectives:
- Describe the benefits of the Great Lakes.
- Discuss the effect of historical pollution on today's economy, society, and environment.
- Describe the technical aspects of an environmental cleanup.

Materials:
An example PowerPoint (editable .ppt file) can be found on www.greatlakesmud.org/education.html.

Procedure:
Administer the PowerPoint creation activity.

Assessment:
Conduct the cleanup pretest prior to the first lesson.

Name _____ **Date** ____/____/____

Part I: Multiple Choice

Read each question carefully and circle the correct answer.

1) What are two environmental problems that make the local water body unsuitable habitat for many species?

a. Species abundance, biodiversity
b. Contaminated sediment, invasive species
c. Biodiversity, contaminated sediment
d. Invasive species, species abundance

2) Scientists make _____ using their senses (smell, sight, etc.) to understand and make hypotheses about the world.

a. observations
b. data
c. science
d. sampling

3) Which of the following is NOT a step that must precede the actual cleanup in a Great Lakes Legacy Act project?

a. Project design
b. Sampling
c. Application
d. Habitat restoration

4) The Great Lakes Legacy Act targets pollution from industrial discharges _____.

a. and cannot clearly be traced to a viable entity
b. and can clearly be traced to a viable entity

Part II: Statistics

Give the mean, median, mode, and any outliers for the data in column L-1 of Table 1.

5) Mean _____

6) Median _____

7) Mode _____

8) **Outlier(s) _____**

Table 1. Levels of contaminant "X" detected in water quality samples.

Date	L-1	L-2	L-3	L-10	RSL
1-Sep	1.2	0.65	0	0	0.31
30-Aug	0	0	0	0	0.31
10-Aug	.65	0	0	0.73	0.31
5-Aug	1.2	0.79	0.89	0	0.31
2-Aug	0.68	0	0	0	0.31
25-Jul	0.71	0.72	0.63	0	0.31
20-Jul	1	0	0		0.31
14-Jul	0.63	0	0		0.31
13-Jul	3.5	0	0		0.31
7-Jul	0.66	0.66	0.75	0.5	0.31
5-Jul	0.79	0.83	0.72		0.31

9) Table 1 displays results in a format that scientists use to communicate data with one another. This format is not good for communicating science to the public. In a couple sentences, describe two alternatives for communicating these data to the public. (Note: levels of contaminant "X" above 2.0 are dangerous.)

Part III: Fill in the Blank
Read each statement carefully and fill in the blank with the correct answer.

10) A(n) _____ species is supposed to live in the local ecosystem. It belongs there.

11) A(n) _____ species does not belong in the local ecosystem. It harms the species that belong in the ecosystem.

12) _____ is the wet, squishy mud found at the bottom of a river or lake.

Part IV: Short Answer
Read each question carefully and provide an answer using a complete sentence.

13) What are three environmental, social, or economic benefits that people derive from the Great Lakes?

14) Why is it important for scientists and engineers to work as a team to clean up the environment?

Our Area of Concern: Gettin' Cleaned Up

To learn more about your Area of Concern, you are going to do some internet research using Google and the GreatLakesMud.org site for basic information to create a class PowerPoint. Either individually or as small groups, have students "mine" for information on the site and create a slide on one or two points of information. Once each student/group has their PowerPoint slides created they should be imported into one presentation and each group will present their slides.

Slides needed for the presentation:

1. Title slide with an aerial or site picture of the Area of Concern with a catchy title.
2. A slide showing the audience what benefits we receive from the Great Lakes. (i.e. drinking water, recreation, etc.)
3. A slide with a picture of polluted sediment. Examples can be found on the GreatLakesMud.org pollution page. The students can ask the class if they know what sediment is (mud at the bottom of a lake or river). Any facts about the specific sediment pollutants of your Area of Concern would be valuable as well.
4. A slide of an aquatic food web. Examples of food webs can be found on the GreatLakesMud.org Education Introduction page for food web examples. Keep in mind that not all organisms on these food webs will necessarily be in your waterbody. Consult with Illinois-Indiana Sea Grant on organisms that are native to the area.
5. A slide that relates polluted sediment with the effects of the food chain.
6. A slide that circles back to how polluted sediment affects the benefits of the Great Lakes (slide 2).
7. Several slides for the Great Lakes Legacy Act including:
    a. Who is involved?
    b. What the partners' role?
    c. What progress has been made so far? Pounds /cubic yards of contaminated sediment removed? Make the numbers relatable (i.e. 5 million pounds = 750 adult male elephants).
        i. Volume of sediment. Again make it relatable to your audience.
        ii. Cost. Once again, how is millions of dollars relatable to your audience?
    d. What is the process start to finish for a restoration project?
        i. Helpful resources for research
            1. GreatLakesMud.org Legacy Act tab
               http://www.greatlakesmud.org/legacy-act.html
            2. U.S. Environmental Protection Agency
               http://www.epa.gov/great-lakes-legacy-act
            3. Presentation by Marc Tuchman – GLNPO
               http://tinyurl.com/jbzqwrw
8. A slide on what's going on in my Area of Concern? Use GreatLakesMud.org for information.
    a. How much is getting cleaned up?
        i. Volume (make relatable)
        ii. Acreage
        iii. Cost (relatable)
9. 7-10 slides with pictures of the site cleanup. Some will be found on GreatLakesMud.org. Check with Illinois-Indiana Sea Grant for other reliable sources for photographs.
10. Final slide for questions remaining about the project that the class can ask Illinois-Indiana Sea Grant or project managers when available.

Lesson 2:

Get the Lowdown on Your Local Water Quality

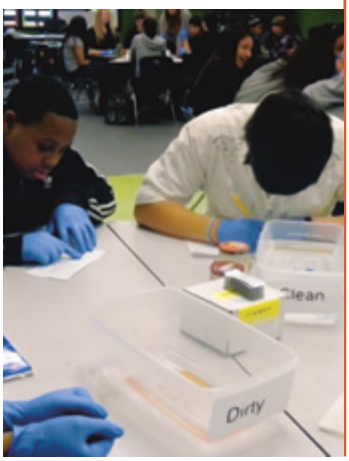
Grade Level: 9-12

Time: 180 minutes (*90 Minutes Field, 90 Minutes Lab*)

Vocabulary:
Sampling, observations, data, data collection, parameter, contaminant.

Great Lakes Literacy Principles:

Principle 6
Concepts E, F



Summary:
Students go on a field trip to a remediated or clean portion of their local water body and take water samples. They then perform a lab test with water test kits to determine water quality.

Objectives:
Students will learn how to perform water sampling and data collection, adequately representing a section of the water body.

Materials:
Lab notes, lab sheets, latex gloves, tape, Sharpies, water test kits (the AM-12 TesTab Water Investigation Kit, LaMotte, was used in the pilot), baby food jars, and two one-quart food storage containers (one empty labeled "dirty" and one full of clean water labeled "clean").

Procedure:

1. Field activity: Walk along the water and point out interesting ecological characteristics of the site. Ask students to make observations in their lab notes. While students are making notes, identify two locations where students will sample. Locations should provide easy access to the water with stable footing for the students. Separate students into teams of four each. Take half the teams to one location and half the teams to the other. Hand out gloves and a baby food jar to each team. Have students label their jar with their team name and location using tape and a Sharpie. Demonstrate how to take a water sample. Ask students to make observations about their water sample in their lab notes. Switch teams to opposite locations and repeat to obtain the second sample. Again, have students label their jar with their team name and location.

2. Classroom lab: Choose six parameters from the kit to test for. Prepare the lab with one test parameter from the water test kit at each table. Place two 1-quart food storage containers (one empty labeled "dirty" and one full of clean water labeled "clean") at each table. Ask students to divide into their field teams and sit at the

tables in teams. Go over each of the parameters with the students and explain why each is an important indicator of water quality. Remind students to take notes as this information will help them fill out their lab sheets.

Following the water test kit instructions, demonstrate how to perform a parameter test to the students. Show the students how to empty the test into the "dirty" storage container. Use water from the "clean" storage container to rinse the test tube, and dump contents into the "dirty" storage container so that the tube is clean for the next test. Tell the students they will perform one test for each sample at each table (two tests per table). Walk around and help students fill out their lab sheets as they do their tests.

Extension:

Compile the data from each group into the master dataset (template provided in the lesson) for locations one and two. On a separate day, talk to the students about data analysis. Discuss the definitions of mean, median, mode, and outlier statistics with the students. Hand out the master dataset to the students and complete statistic examples on the board. Demonstrate how to solve mean, median, and mode for the first two parameters with the students. Have students perform the data analysis activity. Send the data analysis results to Illinois-Indiana Sea Grant.

Assessment:

Lab sheets and data analysis activity with grading sheets are provided in the lesson.

Name _____ **Date** ____/____/____ **Team** _____

Field Sampling: Location One

Part I: Environment Observations
Make eight observations about the location one environment using your senses (sight, hearing, touch, and smell). Some example observations include: speed of water flow, color of the water, air and water temperature, presence of wildlife, and presence of plants in/near/far from the water.

1)

2)

3)

4)

5)

6)

7)

8)

Part II: Water Sample Observations
Make two observations about the location one water sample.

1)

2)

Name _____ **Date** ____/____/____ **Team** _____

Field Sampling: Location Two

Part I: Environment Observations
Make eight observations about the location two environment using your senses (sight, hearing, touch, and smell). Some example observations include: speed of water flow, color of the water, air and water temperature, presence of wildlife, and presence of plants in/near/far from the water.

1)

2)

3)

4)

5)

6)

7)

8)

Part II: Water Sample Observations
Make two observations about the location two water sample.

1)

2)

Name _____ **Date** ____/____/____ **Team** _____

Data Collection

List each parameter that you are testing the location one water sample for in the Test Name column. Define the parameter, perform any necessary calculations, and list your test result. Describe what this result tells you about the water and implications for the ecosystem.

LOCATION 1

Test Name/Parameter	Parameter Definition	Calculations	Test Result	What does the result tell us?

Name _____ **Date** ____/____/____ **Team** _____

Data Collection

List each parameter that you are testing the location one water sample for in the Test Name column. Define the parameter, perform any necessary calculations, and list your test result. Describe what this result tells you about the water and implications for the ecosystem.

LOCATION 2

Test Name/Parameter	Parameter Definition	Calculations	Test Result	What does the result tell us?

Name _____ **Date** ____/____/____ **Team** _____

LOCATION 1

Test Name	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8

Name _____ **Date** ____/____/____ **Team** _____

LOCATION 2

Test Name	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8

Name _____ **Date** ____/____/____

Part I: Short Answer
Read each question carefully and provide an answer using a complete sentence.

How do we solve for a mean value?

How do we solve for a median value?

How do we solve for a mode value?

What is an outlier? Give two reasons why they occur.

Name _____ **Date** ____/____/____

Part II: Data Tables

Fill in the tables below using the master dataset.

LOCATION 1

Test Name	Outliers	Mean	Median	Mode

LOCATION 2

Test Name	Outliers	Mean	Median	Mode

Lesson 3:

Making Environmental Decisions Through Data Analysis

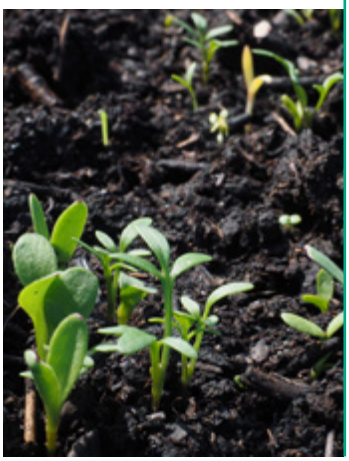
Grade Level: 9-12

Time: 55 Minutes

Vocabulary:
Data management, data analysis, data reporting, mean, median, mode.

Great Lakes Literacy Principles:

Principle 7
Concepts D, E, F



Summary:
Discuss the site water quality based on results from the data analysis activity. Students make conclusions about their data. Students learn how scientists use various communication strategies to communicate data to different groups and use data to make project-level decisions.

Objectives:

- Analyze data using simple statistics.
- Make conclusions about the environment using data.
- Describe different strategies scientists use to communicate data to the public.
- Explain how scientists use data to make project-level decisions.

Materials:
Results from data analysis, Scientific Data PowerPoint. An editable PowerPoint (.ppt) file can be found on www.greatlakesmud.org/education.html.

Procedure:
Using results from the data analysis, engage students in a discussion on making conclusions about water quality at the site. Give the presentation on data reporting and decision making. Students do data conclusions worksheet. Contact Illinois-Indiana Sea Grant if interested in having a guest speaker, such as a project scientist, visit the class. An example plan of work for the guest speaker is provided.

Assessment:
Data conclusions activity with grading sheet.

Example Plan of Work for Guest Speaker

Purpose and Background:
The objective of this guest speaker visit is to teach students about data management, data analysis, reporting data (including communicating it to the public), and using data to make project-level decisions. Use real-life examples and stories to engage the students in these topics. They will benefit from listening to "real-world scientists" speak about the process of each of these steps, which will validate each step's importance. Twenty-five minutes of time is recommended for the guest speaker, but that can be modified based on the teacher's need.

Agenda:

1. Introduce guest speakers
    a) Name, role, why you came to speak to the class

2. Guest speaker stories
    a) Use engaging stories and examples to answer each of these questions. Use as many applicable stories from the current environmental cleanup project as possible.
        i) Where did you go to school? What jobs did you have before this one?
        ii) A lot of responsibility comes with this role (problem solving, budgeting, etc.).
        iii) Is this job what you thought it was going to be?
        iv) What do you like about this job?
    b) Questions from the students

3. Deliver Scientific Data PowerPoint

4. Teacher overview of data analysis activity
    a) Mean, median, mode, outliers

5. Making Conclusions Using Data Worksheet

Timeframe: 55 Minutes

Name _____ **Date** ____/____/____

Use your data analyses and lab note observations to provide answers in complete sentences.

Part I: Synthesizing Data

What parameters were of high concern at location one?

Why do you think those parameters were of high concern?

What parameters were of high concern at location two?

Why do you think those parameters were of high concern?

Did results from location one vary from location two? How so? Why or why not?

Using what we have learned about what these tests mean, state how healthy the water body is. (Make sure you use information from both locations to make a conclusion.)

How can we as a school help to ensure that the water body continues to thrive after the remediation is done?

Part II: Reporting Data

How do scientists present data so that the public can understand the data?

Lesson 4:

Dynamic Careers to Clean Up the Environment

Grade Level: 9-12

Time: 55 Minutes

Vocabulary:
Scientist, engineer.

Great Lakes Literacy Principles:

Principle 7
Concept F

Summary:
Students learn about different careers in the environment as well as the teamwork aspect of environmental cleanups. This lesson includes the option to have a project scientist or engineer visit as a guest speaker to discuss careers and their roles in the cleanup.

Objectives:

- Name important classes to take in high school and college in order to pursue an environmental career.
- Describe the variety of careers in environmental science and engineering.
- Describe the teamwork aspect of environmental cleanups.

Materials:
Career PowerPoint. An editable PowerPoint (.ppt) file can be found on www.greatlakesmud.org/education.html.

Procedure:
Prior to Lesson Plan 4, have students write one-minute speeches about the environmental cleanup. Choose five finalists to deliver their speeches to the class. Deliver the PowerPoint on environmental careers, and engage students in a Q&A session about environmental careers. Contact Illinois-Indiana Sea Grant if interested in having a guest speaker, such as a project scientist or engineer, visit the class. The guest speaker can provide personal experiences on careers in environmental science and engineering. An example plan of work for the guest speaker is provided.

Example Plan of Work for Guest Speaker

Purpose and Background:
The objective of this guest speaker visit is to teach students about careers in environmental science and engineering. They will benefit from listening to "real-world scientists" speak about their background and different career options. Twenty-five minutes of time is recommended for the guest speaker, but that can be modified based on the teacher's need.

Agenda:

1. Speeches
    a) Top five speech finalists chosen by the teacher give their speeches to the guest.
    b) The teacher works with the guest speaker to determine the best speech.
    c) The teacher may be able to have his or her student speak at a press event for the environmental clean up. Contact Illinois-Indiana Sea Grant for more information.

2. Career education PowerPoint
    a) Types of jobs in environmental science with a focus on environmental research scientists (ERS) and environmental engineers (EE).
    b) Interests of ERS/EE
    c) Where do they work? (field, lab, etc.)
    d) What classes should I take in high school?
    e) College majors
    f) Summers matter!/internships

3. Introduce guest speakers
    a) Name, role, why you came to speak to the class

4. Life of a project scientist or engineer
    a) Role of a scientist or engineer in an environmental cleanup
        i) Where did you go to school? What jobs did you have before this one?
        ii) A lot of responsibility comes with this role (problem solving, budgeting, etc.).
        iii) Is this job what you thought it was going to be?
        iv) What do you like about this job?
        v.) Describe the many ways you are a leader.
        vi.) Walk us through a typical day/week.
        vii.) How does your job differ from people you work closely with?
    b) Questions

5. Discussion about water sampling data
    a) What did you learn about the water?
    b) Did results vary between locations?
    c) Are there any parameters we should be concerned about?

Timeframe: 55 minutes

Lesson 5:

The Real Deal—Cleanup in the Field

Grade Level: 9-12

Time: 90 Minutes

Vocabulary:
Banks, erosion control, water flow, hydrology.

Great Lakes Literacy Principles:

Principle 6
Concepts D, E, F

Summary:
Students go on a tour of the site and perform a litter cleanup.

Objectives:
- Become more connected to the site by performing stewardship activities.
- Develop understanding of the engineering and science behind the cleanup by seeing it firsthand.

Materials:
Gloves, trash bags, and hand sanitizer.

Procedure:
To perform only the litter cleanup portion of this lesson, contact Alliance for the Great Lakes for information on litter cleanup opportunities in your area. To perform the entire lesson, including a site tour, contact Illinois-Indiana Sea Grant. At least two teachers are required for the completion of this lesson. Split students into two groups. One group goes on a site tour for 45 minutes with the first teacher and a project manager. The project manager highlights interesting scientific and engineering features using engineering diagrams and before and after pictures. The second teacher leads the other group in a litter cleanup. For this portion, students are split into teams of two or three each. The teacher gives gloves to each of the students and a trash bag to each team. At the end of the litter cleanup activity, students are provided hand sanitizer. The groups, including teachers and chaperones, switch and perform the remaining activity for their group. Finally, the teacher administers the test on a later day.

Assessment:
Posttest and answer key are provided in Lesson Plan 1 and cover concepts learned throughout the educational program.

Lesson 6:
Press Event

Grade Level: 9-12

Time: 60 Minutes

Vocabulary:
Remediation, restoration, scientist, engineer, contaminant, sediment, native, invasive

Great Lakes Literacy Principles:

Principle 6
Concepts D, E, F

Summary:
Contact Illinois-Indiana Sea Grant for information on press events related to the cleanup and to learn how to participate. Students who attend the press event will need to sign a photo release form, which can be obtained from Illinois-Indiana Sea Grant. Logisitics and timing for the press event will be determined weeks in advance. Students can simply attend the event to listen to speakers. There are many options for involvement. A student representative may have the opportunity to give a speech about their involvement. If grade school children are attending the event with native plants to install, they could help the younger students. Another possibility is displaying a poster and answering questions about their water sampling project. Alternatively, a student could videotape the event and write a blog post or article for the school website.

Materials:
Dependent on participation (*e.g., student's speech or poster on water sampling project).*

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> *We will conserve only what we love. We will love only what we understand, and we will understand only what we are taught.*
>
> - Baba Dioum

FIND OUT MORE

GreatLakesMud.org
Visit our webiste for additional resources

cmccoy2@illinois.edu
Please send all questions and feedback to Environmental Social Scientist Caitie Nigrelli

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