Meaningful Watershed Educational Experience (MWEE)

Wave of Plastic Jr: Macroplastics in the Chesapeake Bay

GRADE 5

St. Mary's County Public Schools

THINK. INSPIRE. GROW.

Charles County Public Schools

Working together to achieve excellence for every student.

NOAA CHESAPEAKE BAY

University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE
CHESAPEAKE BIOLOGICAL LABORATORY

Contents

Wave of Plastic Jr: Macroplastics in the Chesapeake Bay

- MWEE Framework
- The Next Generation Science Standards
- The Maryland Environmental Literacy Framework
- Alignment with NAAEE Community Engagement Guidelines
- Alignment with NOAA Education Goals & Chesapeake Bay Watershed Agreement
- MWEE Family Information Sheet (English)
- MWEE Hoja de información para la familia.
- Wave of Plastic Jr At-A-Glance
- Wave of Plastic Jr Lesson Overview
- Wave of Plastic Jr Lesson Pacing
- Introducing the Phenomenon
- Lesson One: Exploring the Properties of Macroplastics
- Lesson Two: Modeling the Path of Macroplastics
- Lesson Three: Macroplastics in the Bay Ecosystem
- Lesson Four: Taking Action: Macroplastics Awareness
- What's Next for Students?

Acknowledgments

Wave of Plastic, Jr. was created in large part by Jason Hayes, Elementary Science Supervisor for St. Mary's County Public Schools, with support from University of Maryland Center for Environmental Sciences - Chesapeake Biological Lab research staff, Dr. Carys Mitchelmore and Jessica McGlinsey, M.Ed., as well as Leigh Ann Anderson, Science Supervisor for Charles County Public Schools. This project was piloted and modified by science teachers in St. Mary's and Charles County: Kristi Goldsmith, Jordan Higgs, Rachel Boarman, Jackie Snyder, Emily Meny, and Dyanna Finamore. Funding provided by the NOAA B-Wet program.

MWEE Framework

A Meaningful Watershed Educational Experience (MWEE) is a "learner-centered experience that focuses on investigations into local environmental issues that lead to informed action and civic engagement." A MWEE has four key components:

Component 1: Issue Definition

- Students focus on a driving question that addresses a locally relevant environmental issue, problem, or phenomenon requiring background research and investigation.
- Students learn more about the issue through classroom instruction and by making observations, collecting data, conducting experiments, talking to experts, and reviewing credible publications.
- They also reflect on personal and public values and perspectives related to the issue.

Component 2: Outdoor Field Experiences

- Students participate in one or more outdoor field experiences sufficient to investigate the issue, problem, or phenomenon.
- Investigations may involve making observations, collecting data, and/or conducting other activities required for answering their questions and informing student actions.
- To the extent possible and within appropriate safety guidelines, students are actively involved in planning the inquiry that occurs during the outdoor field experience(s).
- These experiences can take place off-site and on the school grounds.

Component 3: Synthesis and Conclusions

- Students identify, synthesize, and apply evidence from their investigations to draw conclusions and make claims about the issue, problem, or phenomenon.
- Students communicate these conclusions and claim to internal and external audiences in venues that may range from the school classroom to the larger public community.

Component 4: Action Projects

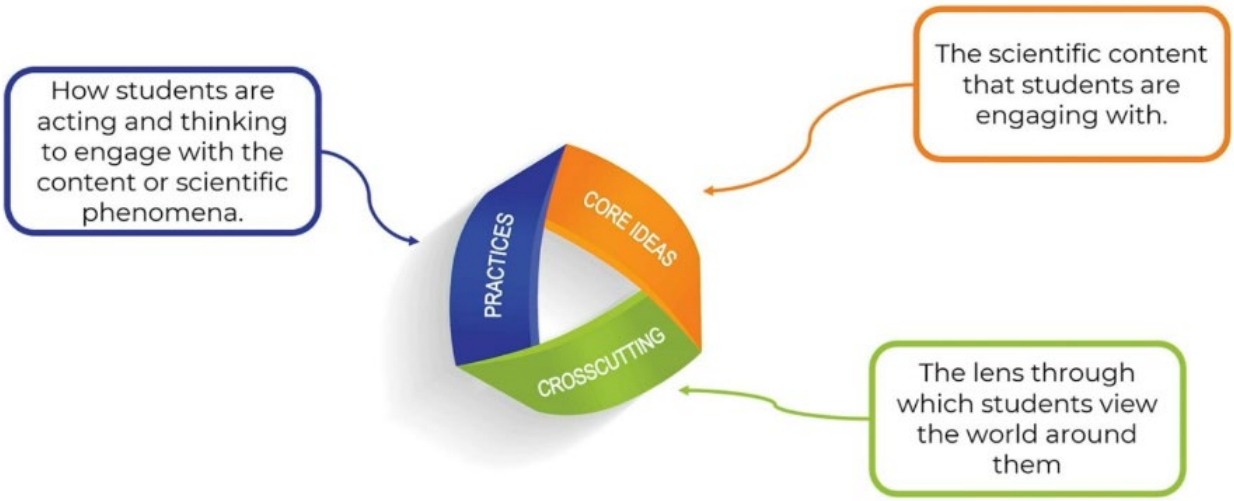
- Students identify, explore, and implement solutions for action.
- The solutions address conclusions and claims drawn through investigation.
- Students reflect on the action and determine the extent to which the action successfully addressed the problem, challenge, or phenomenon reflected in the claim.
- Students may also share proposals for sustaining or extending the action.

The Next Generation Science Standards

Teaching Science has shifted dramatically since the implementation of the Next Generation Science Standards (NGSS). Gone is the "Stand and Deliver" method, where teachers recited scientific facts, definitions, or information. With the NGSS, students are DOING the things scientists and engineers do by figuring out why natural phenomena occur and by solving problems.

Science instruction aligned to the NGSS is 3-dimensional, where students engage with Science & Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas together.

- Students DO Science by carrying out investigations, developing and using models, asking questions, constructing explanations, analyzing and interpreting data, engaging in argument, using mathematical thinking, or communicating information.
- Students THINK about Science by looking for patterns, identifying cause and effect relationships, measuring scale/proportion/quantity, examining systems, understanding how matter and energy flow, studying the structure of organisms and the function of those structures, and seeing how things change or remain stable.
- Students DO and THINK about Science as they LEARN about topics in Earth Science, Life Science, Physical Science, and Engineering.



The lessons in the Grade 5 MWEE enable students to engage in 3-dimensional learning based on a real-world phenomenon as they take on the role of environmental scientists.

The Maryland Environmental Literacy Framework

The Wave of Plastic Jr. MWEE: Macroplastics unit is designed to align with the Maryland Environmental Literacy Framework, ensuring that students engage in meaningful, inquiry-based learning experiences that promote environmental stewardship and scientific understanding.

Key Alignment Areas & Framework Connections:

1. Investigation of Environmental Issues

- Framework Reference: Environmental Issue Investigation & Action (Standard 1 & 7)
    - Students explore the issue of macroplastics in the Chesapeake Bay, examining their sources, movement, and ecological impact through data collection and analysis.
    - This aligns with the framework's emphasis on investigating environmental issues using evidence-based reasoning and developing solutions to real-world problems.

2. Systems Thinking & Interactions

- Framework Reference: Earth Systems & Human Impact (Standard 3 & 5)
    - Lessons explore how macroplastics move through Earth's spheres (geosphere, hydrosphere, biosphere, atmosphere), modeling their pathways and impact on ecosystems.
    - Students examine food chains, food webs, and matter cycling, emphasizing human-environment interactions in the Chesapeake Bay.

3. Inquiry-Based Learning & STEM Integration

- Framework Reference: Environmental Literacy & Scientific Inquiry (Standard 2)
    - Students develop models, conduct investigations, analyze data, and construct explanations, aligning with the Next Generation Science Standards (NGSS).
    - The MWEE integrates STEM practices by emphasizing engineering solutions to environmental problems, such as investigating plastic pollution mitigation strategies.

4. Action & Civic Engagement

- Framework Reference: Civic Engagement & Environmental Decision-Making (Standard 7 & 8)
    - In Lesson Four: Taking Action, students design and implement an action plan to reduce macroplastic pollution, aligning with the framework's goal of empowering students to apply knowledge toward environmental solutions.
    - The MWEE fosters community involvement, encouraging students to consider how advocacy, and individual actions contribute to conservation efforts.

5. Accessibility for All Learners

- Framework Reference: Environmental Literacy for All Learners (Standard 9)
    - Lessons incorporate Universal Design for Learning (UDL) principles, ensuring that all students have meaningful access to learning through multiple means of engagement, representation, and expression.
    - Collaborative learning strategies (e.g., group discussions, hands-on activities, and multimodal assessments) are designed so that every learner, including English learners and students with disabilities, can fully participate and succeed.

6. Conservation & Sustainability Practices

- Framework Reference: Sustainability & Stewardship (Standard 6)
    - Students investigate how communities use science and technology to manage natural resources, aligning with the framework's emphasis on sustainability and responsible environmental management.
    - Lessons reinforce the importance of reducing plastic waste, making informed consumer choices, and implementing conservation practices at local and global scales.

Alignment with NAAEE Community Engagement Guidelines

The Wave of Plastic Jr. MWEE: Macroplastics unit aligns with the North American Association for Environmental Education (NAAEE) Community Engagement Guidelines for Excellence by emphasizing collaborative, action-oriented learning experiences that connect students to real-world environmental challenges. This unit fosters community-centered learning, inclusivity, civic action, and long-term environmental stewardship.

1. Community-Centered

- **Guideline:** Environmental education should be rooted in local issues, community needs, and shared responsibilities.
- Unit Connection:
    - The MWEE focuses on macroplastic pollution in the Chesapeake Bay, a local and regional issue affecting both the environment and surrounding communities.
    - Students investigate how plastic waste impacts their own communities, emphasizing place-based learning.
    - The unit encourages local action, such as the schoolyard action plan.

2. Based on Sound EE Principles

- **Guideline:** Programs should be scientifically accurate, developmentally appropriate, and inquiry-driven.
- Unit Connection:
    - The unit aligns with Next Generation Science Standards (NGSS) and Maryland Environmental Literacy Standards, ensuring accurate and evidence-based learning.
    - Lessons follow an inquiry-based approach, allowing students to ask questions, analyze data, and develop solutions.
    - Systems thinking is embedded in the curriculum, helping students understand how macroplastics move through environmental systems.

3. Collaborative and Inclusive

- **Guideline:** Environmental education should involve diverse perspectives, encourage partnerships, and ensure accessibility for all learners.
- Unit Connection:
    - The MWEE incorporates Universal Design for Learning (UDL) principles, making content accessible to students of all abilities.
    - Collaborative learning strategies (e.g., group discussions, peer investigations, community outreach) are integrated throughout the lessons.
    - The unit encourages student voice and participation, allowing them to develop their own action plans based on their unique community's needs.

4. Oriented Toward Capacity Building and Civic Action

- **Guideline:** Programs should empower learners to take action and develop the skills needed for long-term environmental engagement.
- Unit Connection:
    - Lesson 4: Taking Action engages students in civic action by developing a plan to reduce macroplastic pollution.
    - Students explore conservation efforts, and individual behaviors that contribute to sustainability.
    - The MWEE emphasizes student-led initiatives, such as conducting research, organizing awareness campaigns, or engaging with school decision-makers.
    - The unit helps students develop leadership skills, preparing them to be environmentally responsible citizens.

5. Long-Term Investment in Change

- **Guideline:** Effective environmental education fosters lasting change through sustained engagement, reflection, and community partnerships.
- Unit Connection:
    - The MWEE encourages ongoing student involvement in environmental stewardship beyond the classroom.
    - Reflection activities help students track their learning progress and consider how they can continue their environmental efforts.
    - The unit promotes interdisciplinary learning, connecting science, social studies, and civic responsibility to encourage lifelong environmental engagement.
    - By empowering students with knowledge and skills, the MWEE supports long-term behavioral change related to waste management and conservation.

The MWEE connects students to the people and places of their own watershed. Featuring local community members of all ages who work to protect the Bay gives students relatable role models close to home and shows them that environmental action is something they can take part in now.

Alignment with NOAA Education Goals & Chesapeake Bay Watershed Agreement

The Wave of Plastic Jr. MWEE: Macroplastics unit aligns with NOAA's Education Goals and the Chesapeake Bay Watershed Agreement's Environmental Literacy Goal by fostering science-based decision-making, conservation awareness, and hands-on environmental learning.

How This Unit Supports NOAA's Education Goals:

A Science-Informed Society

- Students investigate plastic pollution through hands-on experiments, data collection, and system modeling to understand its impact on the Chesapeake Bay.
- The unit integrates real-world scientific principles, encouraging students to apply evidence-based reasoning to environmental challenges.
- NOAA Resources to Support Learning:
    - NOAA Marine Debris Program (https://marinedebris.noaa.gov) – Provides interactive maps, data sets, and lesson plans on marine plastic pollution.

Conservation & Stewardship

- Lessons explore how plastics move through the watershed, emphasizing their impact on ecosystems, food webs, and water quality.
- Students engage in problem-solving activities to identify ways individuals and communities can help reduce plastic waste and protect natural resources.
- NOAA Resources to Support Learning:
    - NOAA's Ocean Guardian School Program (https://sanctuaries.noaa.gov/education/ocean_guardian/) – Supports student-led projects focused on ocean and watershed conservation.
    - NOAA Planet Stewards Education Program (https://oceanservice.noaa.gov/education/planet-stewards/) – Provides environmental education resources, funding opportunities, and action project ideas.

How This Unit Supports the Chesapeake Bay Watershed Agreement's Environmental Literacy Goal

Hands-On Watershed Learning

- Students model how macroplastics travel through the environment, reinforcing an understanding of the Chesapeake Bay ecosystem.
- The unit follows the Meaningful Watershed Educational Experience (MWEE) framework, ensuring that students explore, analyze, and take action on a local environmental issue.
- NOAA Resources to Support Learning:
    - Chesapeake Bay Watershed Education & Training (B-WET) Program (https://www.noaa.gov/office-education/bwet) – Grants and resources for MWEE-based learning experiences.

- NOAA's Chesapeake Bay Office Education Resources (https://www.fisheries.noaa.gov/topic/chesapeake-bay) – Offers virtual field trips, data tools, and lesson plans focused on Bay health.

Promoting Conservation Awareness

- Lessons focus on scientific solutions for reducing plastic waste impacts, helping students understand how individuals and communities can contribute to a healthier Chesapeake Bay.
- Activities emphasize data interpretation and critical thinking, strengthening students' ability to make informed environmental decisions.

MWEE Family Information Sheet (English)

WHAT IS MY FIFTH-GRADE STUDENT LEARNING IN THE MEANINGFUL WATERSHED EDUCATIONAL EXPERIENCE?

- What plastic is, and how it is produced.
- Types of plastic.
- Properties of plastic.
- Ways plastic gets into the environment.
- Ways plastic gets into the Chesapeake Bay ecosystem.
- How we can slow down or stop plastic getting into the environment.

OUR CLASS WILL INVESTIGATE THE DRIVING QUESTION

- How do the actions of humans (positive or negative) affect the Chesapeake Bay?

OUR CLASS WILL BE ABLE TO DO

- Research and communicate information about plastic.
- Investigate the properties of plastics by carrying out experiments.
- Develop and use models of plastic movement in the environment.
- Investigate ways plastic can move on our school grounds.
- Develop and use models showing how plastic moves throughout the Chesapeake Bay ecosystem.
- Create and implement an action plan slowing or preventing the movement of plastic on our school grounds.
- Communicate the plan to our school community.

OUR ESSENTIAL TERMS

- Plastic
- Macroplastic
- Plastic Trap
- Plastic Highway
- Ecosystem
- Food Web
- Action Plan

MWEE Hoja de información para la familia.

¿QUÉ ESTÁ APRENDIENDO MI ALUMNO DE QUINTO GRADO EN LA EXPERIENCIA EDUCATIVA MEANINGFUL WATERSHED?

- ¿Qué es el plástico y cómo se produce?
- Tipos de plástico.
- Propiedades del plástico.
- Formas en que el plástico ingresa al medio ambiente.
- Formas en que el plástico ingresa al ecosistema de la bahía de Chesapeake. (Chesapeake Bay)
- ¿Cómo podemos reducir o detener la entrada de plástico al medio ambiente?

NUESTRA CLASE INVESTIGARÁ LA PREGUNTA PRINCIPAL

- ¿Cómo afectan las acciones de los humanos (positivas o negativas) a la bahía de Chesapeake?

NUESTRA CLASE PODRÁ

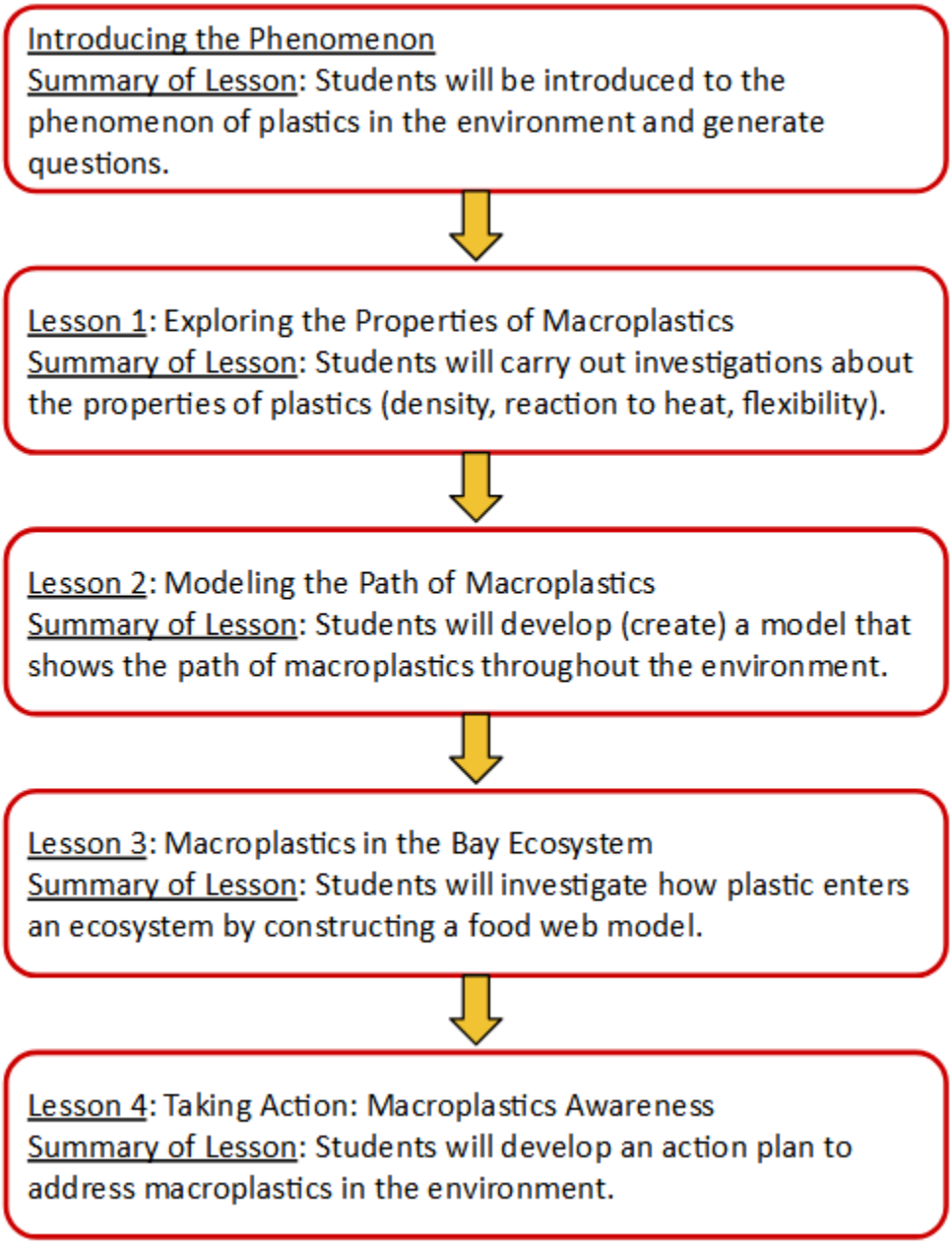
- Investigar y comunicar información sobre el plástico.
- Investigar las propiedades de los plásticos mediante la realización de experimentos.
- Desarrollar y utilizar modelos del movimiento del plástico en el medio ambiente.
- Investigar las formas en que el plástico puede moverse en los terrenos de nuestra escuela.
- Desarrollar y utilizar modelos que muestren cómo se mueve el plástico en todo el ecosistema de la bahía de Chesapeake.
- Crear e implementar un plan de acción para reducir o prevenir el movimiento de plástico en las instalaciones de nuestra escuela.
- Comunicar el plan a nuestra comunidad escolar.

NUESTROS TÉRMINOS ESENCIALES

- Plástico
- Macroplástico
- Trampa de plástico
- Autopista del plástico
- Ecosistema
- Red alimentaria
- Plan de acción

Wave of Plastic Jr At-A-Glance

Below is a summary of the lessons contained in Wave of Plastic Jr:



Wave of Plastic Jr Lesson Overview

Lesson	Key Lesson Components
Introducing the Phenomenon	Review of open and closed-ended questions
	Observe the phenomenon
	Generate open-ended questions about the phenomenon
Lesson 1: Exploring the Properties of Macroplastics	Research types of plastic
	Examine plastic objects and identify the types of plastic based on their symbols
	Properties of plastics investigation (density, flexibility, reaction to heat)
	Claim-Evidence-Reasoning (CER)
Lesson 2: Modeling the Path of Macroplastics	Review of Earth's spheres and modeling, including sorting activity
	Develop a model of Earth's spheres containing plastic and test it
	Identify and mark plastic traps and highways on school grounds
	Creative writing prompt
Lesson 3: Macroplastics in the Bay Ecosystem	Review of food chains and food webs
	Identify organisms in the Chesapeake Bay ecosystem as producers, consumers,
	Develop a food web of the Chesapeake Bay ecosystem and introduce plastic into
	Claim-Evidence-Reasoning (CER), using the developed food web
Lesson 4: Taking Action: Macroplastics Awareness	Research and present types of green infrastructure
	Revisit plastic trap and highway sites on school grounds
	Develop a plan/method to prevent plastics from getting into storm drains
	Communicate/implement the plan
	Claim-Evidence-Reasoning (CER)
	Revisit the phenomenon and students' open-ended questions

Wave of Plastic Jr Lesson Pacing

Recommended Timeline Guide - Grade 5 Meaningful Watershed Educational Experience (MWEE)

Overview

This unit was originally designed around a 50-minute science class period. The guide below can be used to adjust pacing based on your schedule and the needs of your students.

The unit follows a four-part core structure, preceded by an introductory phenomenon:

- Introduction to Phenomena
- Lesson 1: Properties of Macroplastics
- Lesson 2: Modeling Plastic Movement
- Lesson 3: Plastic in the Bay Ecosystem
- Lesson 4: Taking Action

Recommended Schedule

The table below shows three pacing options for each lesson: a recommended planned pace, a compact minimum pace, and an expanded in-depth pace. All times are based on 50-minute class periods.

Component	Lesson	Planned Time (Recommended)	Minimum Time (Compact)	Expanded Time (In-Depth)
Issue Investigation Begins	Introduction to Phenomena	1 day (50 min)	40 min	2 days (100 min)
Issue Investigation	Lesson 1: Exploring the Properties of Macroplastics	4 days (200 min)	2 days (100 min)	5–6 days (250–300 min)
Outdoor Investigation	Lesson 2: Modeling the Path of Macroplastics	3 days (150 min)	2 days (100 min)	4–5 days (200–250 min)
Synthesis & Conclusions	Lesson 3: Macroplastics in the Bay Ecosystem	3 days (150 min)	2 days (100 min)	4 days (200 min)
Informed Action	Lesson 4: Taking Action: Macroplastics Awareness	4 days (200 min)	2–3 days (100–150 min)	5–7 days (250–350 min)
Total Unit		15 days (~12.5 hours)	9–10 days (~7.5–8.5 hours)	20+ days (16.5+ hours)

Adjusting the Unit's Length

If You Need to Shorten the Unit

Best areas to trim:

- Reduce CER (Claim-Evidence-Reasoning) writing to a single lesson
- Complete plastic type research as homework
- Use teacher-provided examples instead of student-built models
- Conduct one density test rather than all three liquid-density investigations
- Use a virtual campus walkthrough instead of a full outdoor plastic-trap survey
- Turn action plan presentations into gallery walks

Possible compressed schedule: 9–10 class periods.

If You Have More Time

Recommended extensions:

- Schoolyard litter audit
- Campus plastic trap mapping project
- Chesapeake Bay food web research
- Engineering challenge: build a better plastic trap
- Green infrastructure design challenge
- Community awareness campaign
- Data collection before and after the student action project
- Stewardship day or cleanup event

Possible expanded schedule: 20–25 class periods.

Suggested Time by MWEE Component

The unit's four lessons map onto the four components of a Meaningful Watershed Educational Experience (MWEE), summarized below.

MWEE Component	Corresponds To	Time	Key Activities
Issue Investigation	Introduction + Lesson 1	5 days	Investigate what plastics are; explore plastic properties; identify sources of macroplastics; develop driving questions
Outdoor Investigation	Lesson 2	3–5 days	Model Earth systems; explore school grounds; identify plastic highways and traps
Synthesis & Conclusions	Lesson 3	3–4 days	Build Chesapeake Bay food webs; analyze ecosystem impacts; complete CER (Claim-Evidence-Reasoning) explanations
Informed Action	Lesson 4	4–7 days	Research green infrastructure; design solutions; communicate and implement action plans

Flexible Scheduling Notes

- 50-Minute Classes: Follow the suggested timeline as written.
- 90-Minute Block Schedule: Combine most lesson days into half the calendar time.
- Elementary Self-Contained Classrooms: Break investigations into shorter 20–30 minute segments.
- Informal Education / Homeschool Programs: Convert each lesson into a half-day workshop or weekly session.

Estimated Unit Length

- Fast Track: 9–10 days
- Recommended Implementation (Full MWEE): 15 days (12.5 hours)
- Expanded MWEE Experience: 20–25 days (16.5+ hours)

All times are based on 50-minute class periods. Adjust pacing to fit your students, schedule, and available time.

WAVE OF PLASTIC Jr.™

Grade 5 Meaningful Watershed Educational Experience (MWEE)

RECOMMENDED TIMELINE GUIDE

ORIGINAL DESIGN:
1 CLASS PERIOD = 50 MINUTES

This unit was designed around a 50-minute science class period.
Use this guide to adjust the time based on your schedule and the needs of your students.

CORE UNIT STRUCTURE

- Introduction to Phenomenon
- 1 Lesson 1: Properties of Macroplastics
- 2 Lesson 2: Modeling Plastic Movement
- 3 Lesson 3: Plastic in the Bay Ecosystem
- 4 Lesson 4: Taking Action

RECOMMENDED SCHEDULE

COMPONENT	LESSON	PLANNED TIME (RECOMMENDED)	MINIMUM TIME (COMPACT)	EXPANDED TIME (IN-DEPTH)
Issue Investigation Begins	Introduction to Phenomenon	1 day (50 min)	40 min	2 days (100 min)
1 Issue Investigation	Lesson 1: Exploring the Properties of Macroplastics	4 days (200 min)	2 days (100 min)	5–6 days (250–300 min)
2 Outdoor Investigation	Lesson 2: Modeling the Path of Macroplastics	3 days (150 min)	2 days (100 min)	4–5 days (200–250 min)
3 Synthesis & Conclusions	Lesson 3: Macroplastics in the Bay Ecosystem	3 days (150 min)	2 days (100 min)	4 days (200 min)
4 Informed Action	Lesson 4: Taking Action: Macroplastics Awareness	4 days (200 min)	2–3 days (100–150 min)	5–7 days (250–350 min)
TOTAL UNIT		15 days (~12.5 hours)	9–10 days (~7.5–8.5 hours)	20+ days (16.5+ hours)

The recommended timeline is for a full MWEE experience.
The expanded time allows for further exploration and in-depth inquiry and action projects.

IF YOU NEED TO SHORTEN THE UNIT

Best areas to trim:

- Reduce CER writing to a single lesson
- Complete plastic type research as homework
- Use teacher-provided examples instead of student-built models
- Conduct one density test rather than all three liquid-density investigations
- Use a virtual campus walkthrough instead of a full outdoor plastic-trap survey
- Turn action plan presentations into gallery walks

POSSIBLE COMPRESSED SCHEDULE: 9–10 CLASS PERIODS

IF YOU HAVE MORE TIME

Recommended extensions:

- Schoolyard litter audit
- Campus plastic trap mapping project
- Chesapeake Bay food web research
- Engineering challenge: Build a better plastic trap
- Green infrastructure design challenge
- Community awareness campaign
- Data collection before and after student action project
- Stewardship day or cleanup event

POSSIBLE EXPANDED SCHEDULE: 20–25 CLASS PERIODS

SUGGESTED TIME BY MWEE COMPONENT

ISSUE INVESTIGATION
Introduction + Lesson 1
5 DAYS
- Investigate what plastics are
- Plastic properties
- Sources of macroplastics
- Driving questions

OUTDOOR INVESTIGATION
Lesson 2
3–5 DAYS
- Model Earth systems
- Explore school grounds
- Identify plastic highways and traps

SYNTHESIS & CONCLUSIONS
Lesson 3
3–4 DAYS
- Build Chesapeake Bay food webs
- Analyze ecosystem impacts
- Complete CER explanations

INFORMED ACTION
Lesson 4
4–7 DAYS
- Research green infrastructure
- Design solutions
- Communicate and implement action plans

FLEXIBLE SCHEDULING NOTES

50-MINUTE CLASSES
Follow suggested timeline as written.

90-MINUTE BLOCK SCHEDULE
Combine most lesson days in half the calendar time.

ELEMENTARY SELF-CONTAINED CLASSROOMS
Break investigations into shorter 20–30 minute segments.

INFORMAL EDUCATION / HOMESCHOOL PROGRAMS
Convert each lesson into a half-day workshop or weekly session.

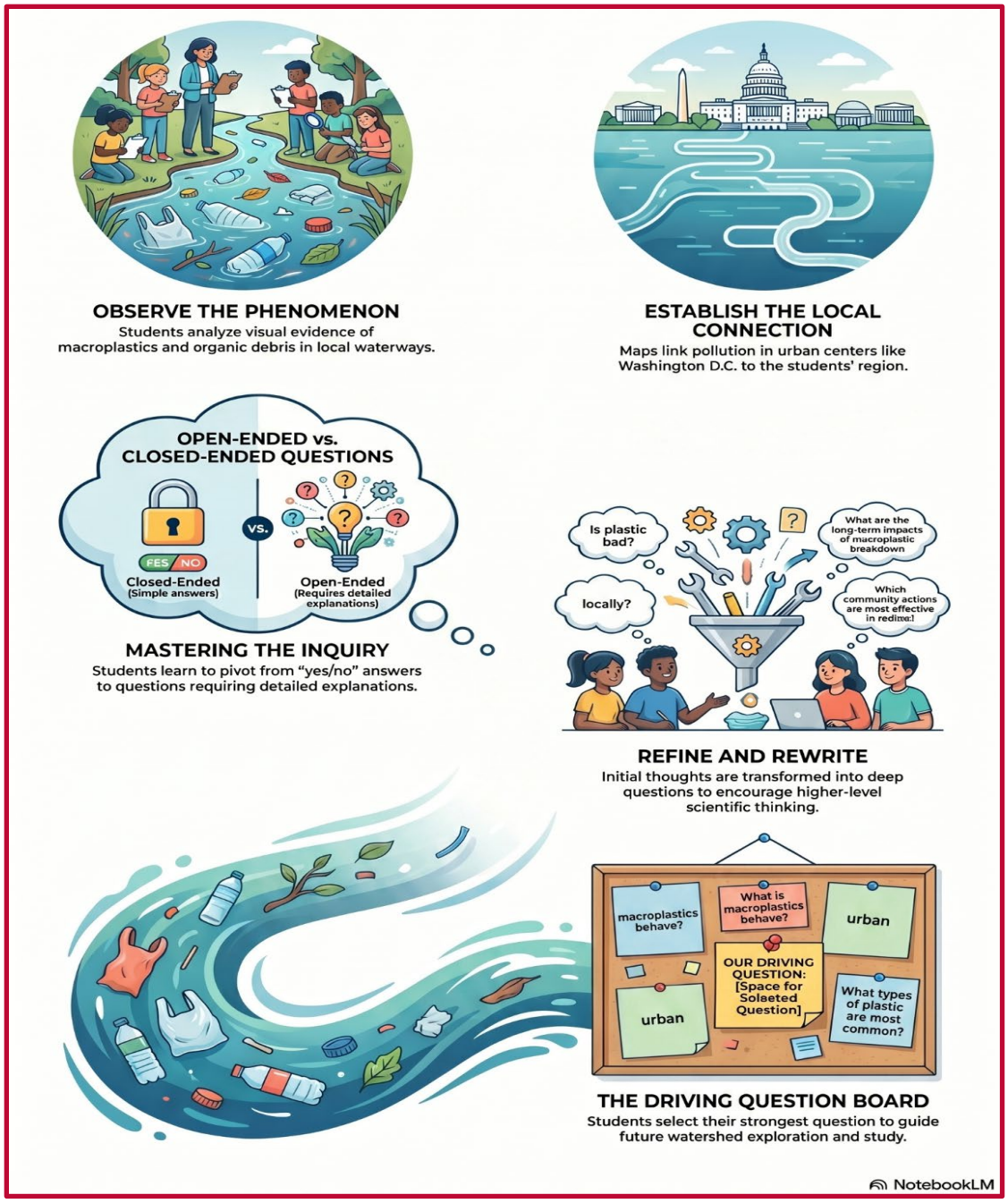
ESTIMATED UNIT LENGTH

FAST TRACK 9–10 days (7.5–8.5 hours)
RECOMMENDED (FULL MWEE) 20–25 days (16.5+ hours)
EXPANDED MWEE 20–25 days (16.5+ hours)

All times are based on 50-minute class periods.
Adjust pacing to fit your students, schedule, and available time.

Together, we can keep the Chesapeake Bay clean and healthy!

Introducing the Phenomenon



Lesson Overview

In this lesson, students will be introduced to the real-world phenomenon of macroplastics in the environment.

Lesson Materials

- Google slide deck
- Student Booklet, page 1
- Chart paper for Driving Question Board (Optional)
- Post-its for students

Before You Teach…

Educator Reflection: Environmental issues like plastic pollution are not experienced equally by all communities. Before teaching these MWEE lessons, take a few minutes to reflect:

- "What assumptions do I hold about who causes pollution and who is responsible for solving it?"
- "Which communities near the Chesapeake Bay are most affected by plastic pollution and water-quality issues, and whose voices are often left out of that conversation?"
- "How might my own background shape the examples I choose, the students I call on, and how I interpret their ideas?"
- "How can I make sure every student, regardless of language, background, or prior experience, sees themselves as capable of investigating and acting on this issue?"

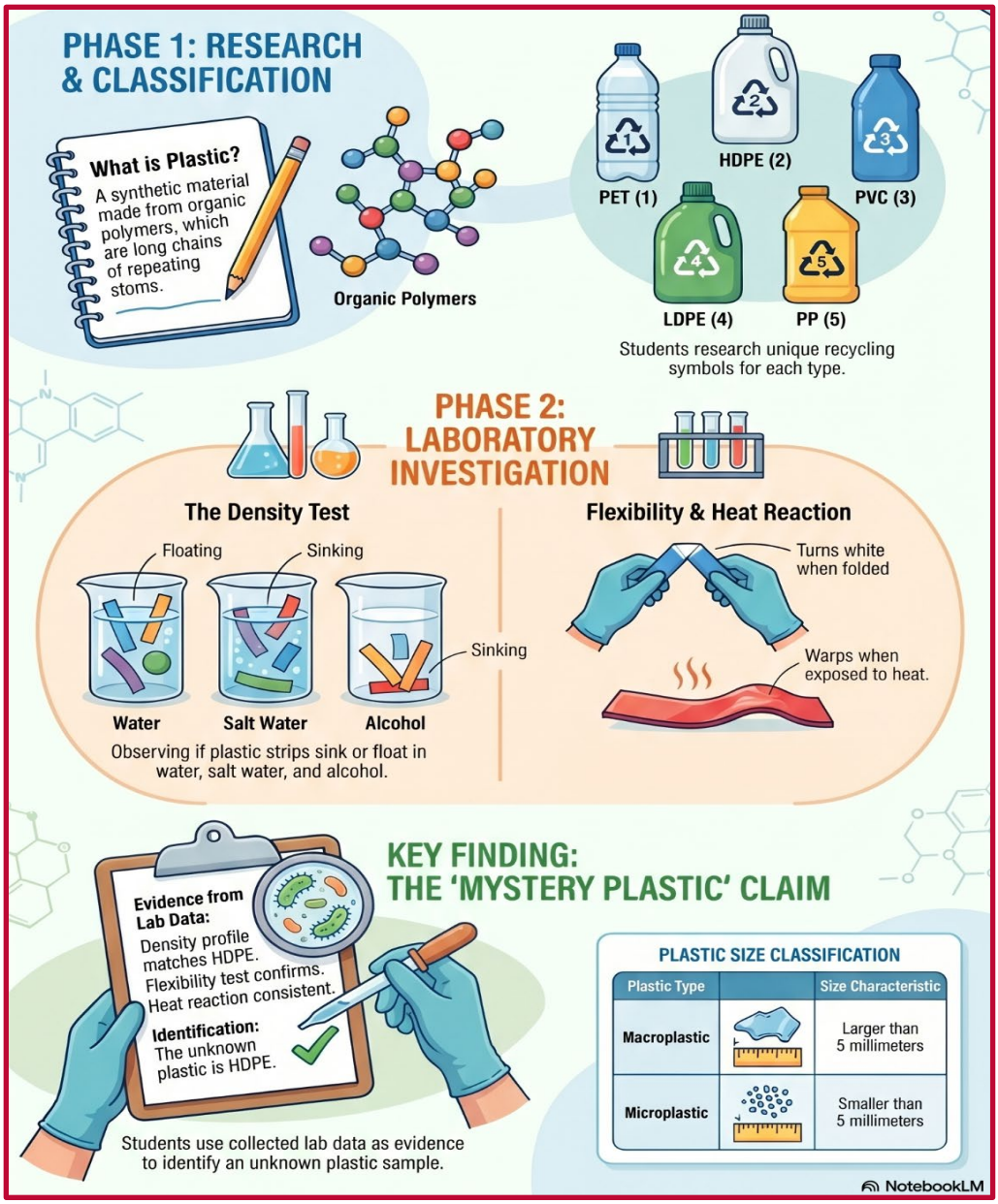
There are no single right answers here; the goal is to teach with awareness of the perspectives we each bring into the classroom.

Content Delivery

1. Show Slides 1-3. Use Slide 3 to review closed-ended and open-ended questions. Slide 3 is in Skip Mode. If you want to use it, right click on the slide and select Unskip Mode.
2. Pass out a QFT Question Sheet to each student.
3. Go over the directions on Slide 4.
4. Show the video found on Slide 5. Show it as many times as you need to. Follow up with the map on Slide 6. Emphasize the location of where the video was shot and where we live.
    a. NOTE: Adjust the circle on Slide 6 to better reflect where your county is located.
5. Go over the directions on Slide 7.
6. Set up a Driving Question Board somewhere in your classroom. You can use a piece of chart paper, a part of your board, or a part of your wall.
7. Pass out one post-it per student. Go over the directions on Slide 8.

Click here to view a video tutorial that goes over Introducing the Phenomenon.
Click here for more information about the Question Formulation Technique (QFT).

<u>Lesson One</u>: Exploring the Properties of Macroplastics



Lesson 1 Overview

In this lesson, students will build their background knowledge by researching types of plastics and carrying out investigations about the properties of plastics (density, reaction to heat, flexibility, folding).

Lesson 1 Standards

Science Content Standard(s)

- 5-PS1-3: Make observations and measurements to identify materials based on their properties.

Disciplinary Literacy (DL) Standard(s)

- RI.5.3 Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.
- W.5.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information.
- W.5.7 Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.

Lesson 1 Clarity and Expectations

Driving Question: How do the actions of humans (positive or negative) affect the Chesapeake Bay?

Supporting Questions:

- What is plastic?
- What are the physical properties of plastic?
- What are the chemical properties of plastic?
- How does plastic affect the environment?

Learning Target(s): In this lesson we will…

- Learn how plastic is made.
- Research and learn about the different types of plastic.
- Investigate the properties of plastic.
- Look for patterns in the properties of different plastics, like density, flexibility, and how they react to heat.

Lesson 1 Vocabulary

- Plastic
- Synthetic
- Organic
- Polymer

- Polypropylene (PP)
- Polyvinyl Chloride (PVC)
- High Density Polyethylene (HDPE)
- Low Density Polyethylene (LDPE)
- Polyethylene Terephthalate (PET)
- Flexibility
- Density
- Microplastic
- Macroplastic

Click here to access the Lesson 1 Vocabulary Slide Deck

Lesson 1 Materials

- Lesson Plan
- Slide Deck
- Page 3 of Student Booklet: Research Sheet (for Explanation)
- Student Booklet, Pages 4-6 (for Exploration)
- Investigation Materials (Part 1):
    - Bag of common plastic household objects (e.g. bottles, cups, trays, cutlery, boxes, bags)
- Investigation Materials (Part 2):
    - One set of six plastic strips (options for plastics are shown in the vocabulary deck – suggest that students bring in clean plastics from home to promote reuse and recycle), consisting of a strip of polypropylene (PP), a strip of polyvinyl chloride (PVC), a strip of high density polyethylene (HDPE), a strip of low density polyethylene (LDPE), a strip of polyethylene Terephthalate (PET), and a strip of mystery plastic (each marked with their name using a permanent marker)
    - Hairdryer & Tongs (to hold the ends of the plastic strips while blow drying)
    - 1 l of diluted rubbing alcohol (40% rubbing alcohol by volume)
    - Three plastic bowls
    - One spoon
    - Tap water
    - Salt

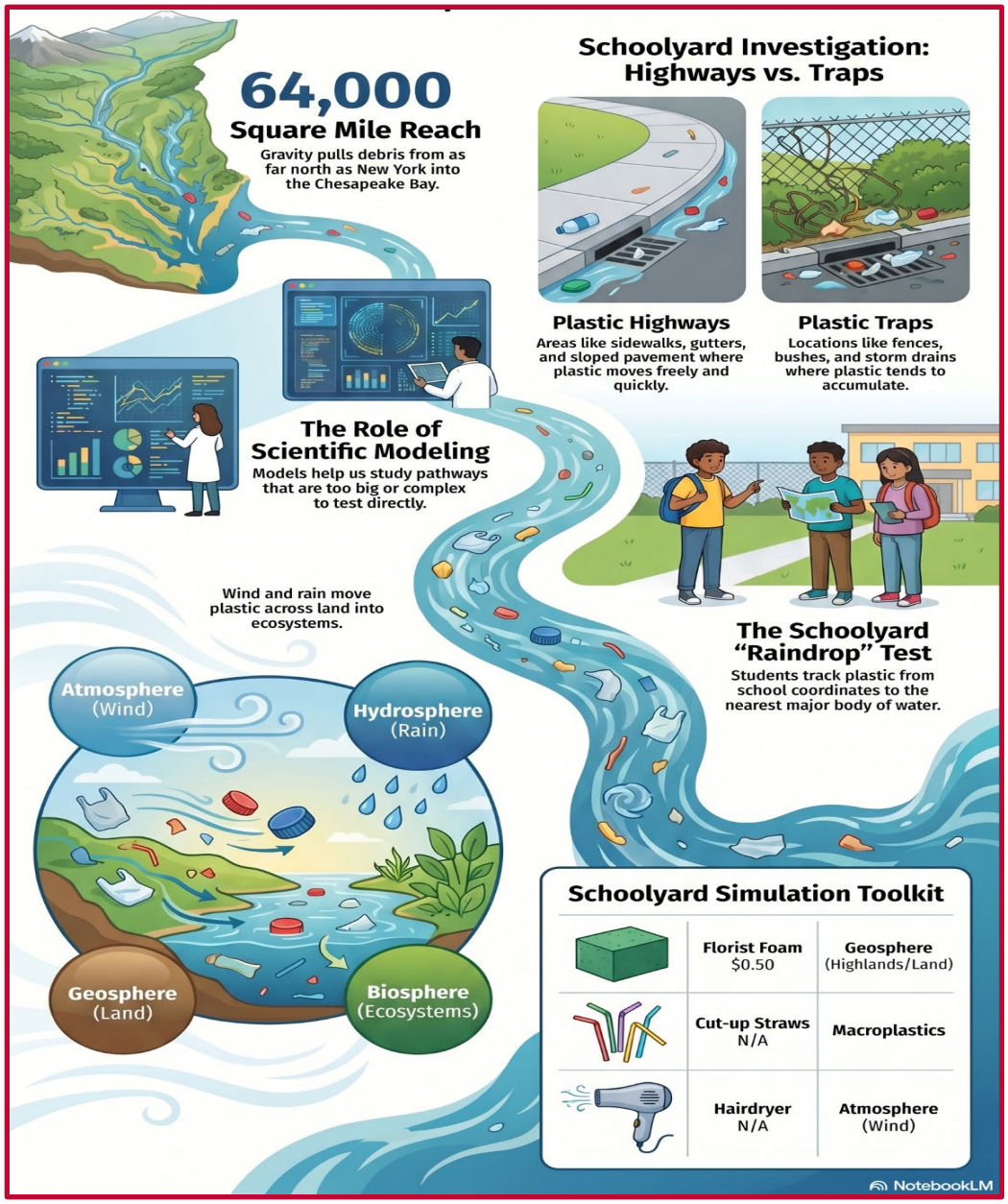
Lesson 1 Video Tutorials

Video tutorials are available for Lesson 1. Click the links below.

- Day 1
- Day 2
- Day 3

    - Density (Tap Water)
    - Density (Salt Water)
    - Density (Rubbing Alcohol)
    - Flexibility/Fold Color
    - Action of Heat
- Day 4

<u>Lesson Two</u>: Modeling the Path of Macroplastics



Lesson 2 Overview

In this lesson, students will develop and use models to show how macroplastics move throughout Earth's spheres. Students will also examine their school grounds to identify places where plastic can move freely and where plastic gets trapped.

Lesson 2 Standards

Science Content Standard(s)

- 5-ESS2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

Disciplinary Literacy (DL) Standard(s)

- W.5.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information.
- 5.NOS.B.6 Apply and extend previous understanding of addition and subtraction of whole numbers to add and subtract decimals to hundredths.
    a. Apply estimation strategies to estimate sums and differences of decimals.
    b. Use concrete models, drawings, strategies based on place value (e.g., partial sums), properties of operations and/or the inverse relationship between addition and subtraction to add and subtract decimals.
    c. Use an algorithm to add and subtract decimals. d. Determine and explain when a strategy or algorithm is or is not needed.
- 5.NOS.B.7 Apply and extend previous understanding of multiplication and division of whole numbers to multiply and divide decimals to hundredths in context.
    a. Apply estimation strategies to estimate products and quotients.
    b. Use concrete models, drawings, and arrays to multiply and divide.
    c. Use strategies based on place value (e.g., partial products, partial quotients) to multiply and divide.
    d. Use properties of operations and/or the inverse relationship between multiplication and division to multiply and divide.
    e. Represent and explain the computation by connecting concrete models, drawings, and/or equations to the meaning of multiplication and division.

Environmental Literacy Standards

Standard 2: Human Dependence on Earth Systems and Natural Resources

Environmentally literate students construct and apply understanding of how Earth's systems and natural resources support human existence.

Enduring Understanding: Local environments are made up of unique natural systems and resources that change over time and include resources that help humans survive, conduct required and recreational activities, and express multiple and varied cultures.

Objective Statements: By the end of grade 5, students will:

A. Investigate the natural systems and natural resources of Maryland's environment.
B. Analyze how Maryland's natural systems and natural resources help Marylanders survive.

C. Identify how the local environment influences human activity and local culture.
D. Investigate how dependence on natural systems and natural resources in Maryland has changed over time and across various populations.

Standard 3: Environmental Impact of Human Activity
Environmentally literate students construct and apply understanding of the environmental impact of human activities on Earth's systems and resources.
Enduring Understanding: Human activities impact the environment in many varied ways with different levels of environmental impact, and humans can make choices that are better for the environment.
Objective Statements: By the end of grade 5, students will:

A. Evaluate the level of environmental impact from local human activities.
B. Identify ways of meeting human needs with respect to their environmental impacts.
C. Identify choices that have a positive impact on the environment.

Lesson 2 Clarity and Expectations

Driving Question: How do the actions of humans (positive or negative) affect the Chesapeake Bay?

Supporting Questions:

- What are Earth's spheres, and how do they interact?
- How can we model the movement of plastic among Earth's spheres?
- How do wind and water affect the movement of plastic in the environment?
- What prevents plastic from moving in the environment?

Learning Target(s): In this lesson we will…

- Review how Earth's spheres interact with each other.
- Develop a model of Earth's spheres.
- Use the model to show how macroplastics move among Earth's spheres.
- Determine areas of our school grounds where plastics will accumulate and move freely.

Lesson 2 Vocabulary

- Atmosphere/Biosphere/Geosphere/Hydrosphere
- Model
- Plastic Trap/Plastic Highway

Click here to access the Lesson 2 Vocabulary Slide Deck

Lesson 2 Materials

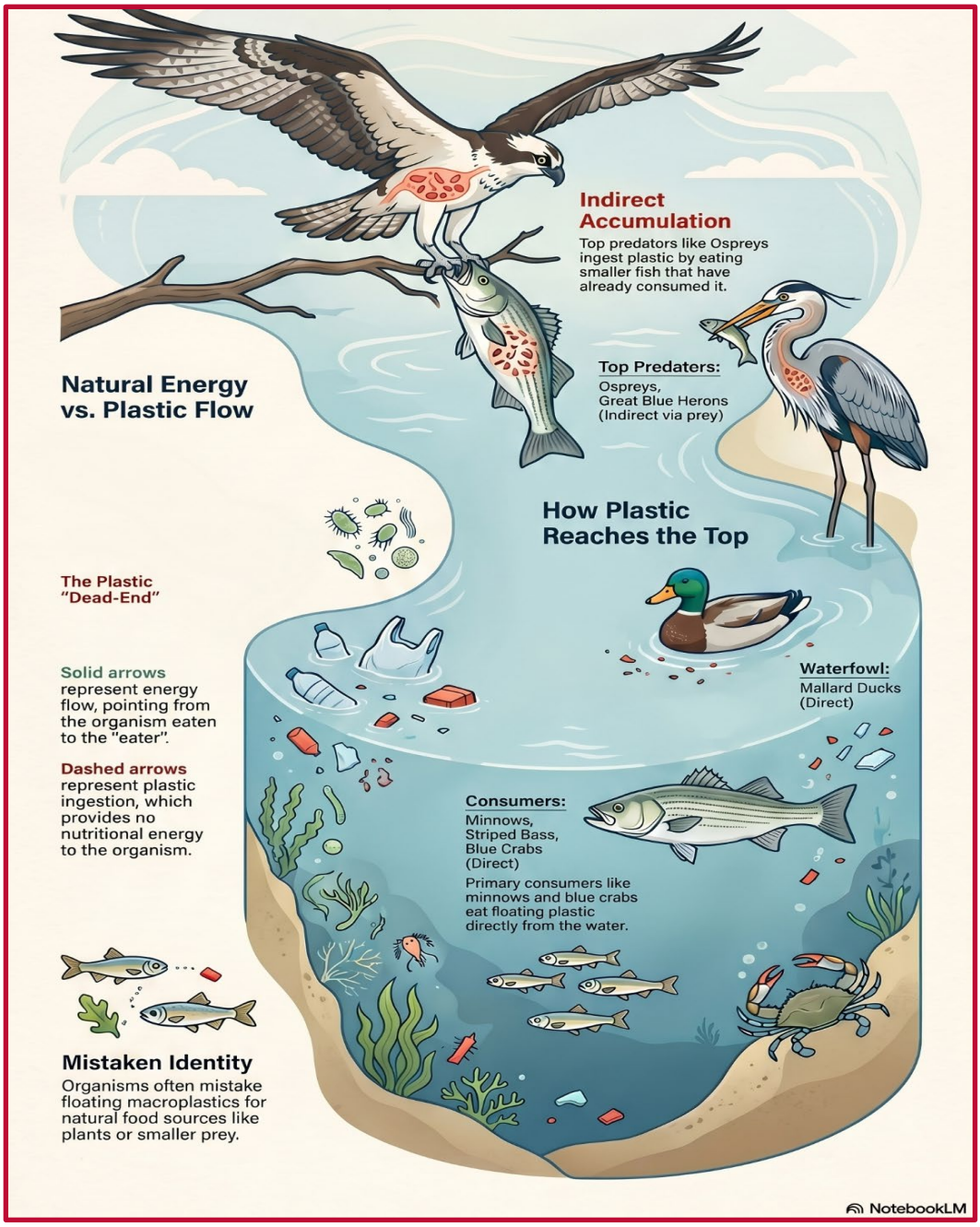
- Lesson Plan
- Slide Deck
- Model Matching Cards (for Explanation)
- Student Booklet, pages 11-12 (for Exploration)
- Materials for making the model (Exploration):
    - Natural materials, like pine cones, rocks, branches, sticks
    - 1 aluminum pan per group
    - 1 piece of aluminum foil per group (the same size as the pan)
    - Paper or plastic cups
    - Piece of paper or cardboard
    - Tiny model houses
    - Small cut up pieces of straws (which represent “plastic”)
    - Red and blue flags (for Extension)
    - Clipboards (for Extension)

Lesson 2 Video Tutorials

Video tutorials are available for Lesson 2. Click the links below.

- Day 1
- Day 2
- Day 3

<u>Lesson Three</u>: Macroplastics in the Bay Ecosystem



Lesson 3 Overview

In this lesson, students will investigate the movement of energy and matter within the Chesapeake Bay ecosystem and the effects of introducing macroplastics.

Lesson 3 Standards

Science Content Standard(s)

- 5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

Disciplinary Literacy (DL) Standard(s)

- W.5.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information.

Environmental Literacy Standards

Standard 3: Environmental Impact of Human Activity

Environmentally literate students construct and apply understanding of the environmental impact of human activities on Earth's systems and resources.

Enduring Understanding: Human activities impact the environment in many varied ways with different levels of environmental impact, and humans can make choices that are better for the environment.

Objective Statements: By the end of grade 5, students will:

- Evaluate the level of environmental impact from local human activities.
- Identify ways of meeting human needs with respect to their environmental impacts.
- Identify choices that have a positive impact on the environment.

Lesson 3 Clarity and Expectations

Driving Question: How do the actions of humans (positive or negative) affect the Chesapeake Bay?

Supporting Questions:

- What is an ecosystem? What are the parts of an ecosystem?
- What is the difference between food chains and food webs?
- How does matter and energy move throughout a food web?
- How does plastic get into an ecosystem, and what effects does it have on the ecosystem?

Learning Target(s): In this lesson we will…

- Examine living and nonliving parts of the Chesapeake Bay ecosystem.
- Review food chains and food webs.
- Construct a Chesapeake Bay food web.
- Use the Chesapeake Bay food web to describe the movement of matter, particularly macroplastics.

Lesson 3 Vocabulary

- Ecosystem
- Producer
- Consumer
- Decomposer
- Food Chain
- Food Web
- Carnivore
- Herbivore
- Omnivore
- Bacteria
- Carrion

Click here to access the Lesson 3 Vocabulary Slide Deck

Lesson 3 Materials

- Lesson Plan
- Slide Deck
- Food Web Cards (for Exploration)
- Chart paper (for Exploration)
- Crayons or markers (for Exploration)
- Glue or glue sticks (for Exploration)
- My Group's Food Web Sheet (See lesson plan for three different versions of the worksheet)

Lesson 3 Video Tutorials

Video tutorials are available for Lesson 3. Click the links below.

- Day 1
- Day 2
- Day 3

<u>Lesson Four</u>: Taking Action: Macroplastics Awareness

Lesson 4 Overview

In this lesson, students will develop an action plan to address macroplastics in the environment.

Lesson 4 Standards

Science Content Standard(s)

- 5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Disciplinary Literacy (DL) Standard(s)

- RI.5.3 Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.
- W.5.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information.
- W.5.7 Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.
- SL.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes.

Social Studies Standard(s)

- Standard 6.0: Skills and Processes- Students will inquire about civics, geography, economics, history, and people and nations of the world using disciplinary literacy skills and processes to critically evaluate content through a variety of source materials across disciplines and use reading, writing, and other forms of communication to develop, defend, and critique arguments in order to take informed action.

Environmental Literacy Standard(s)

Standard 1: Environmental Issue Investigation & Action

Environmentally literate students investigate environmental issues in order to develop and implement local actions that protect, sustain, or restore the natural environment.

Enduring Understanding: Everyone can positively impact the environment by thinking creatively, utilizing evidence for solving problems, and critically evaluating possible environmental impacts.

Objective Statements: By the end of grade 5, students will:

A. Identify a local environmental issue through observation and/or research.
A. Use evidence to construct explanations and generate possible solutions to the environmental issue.
B. Develop an action plan to protect, sustain, or restore the natural environment.
C. Implement the environmental action plan and reflect on the impact and effectiveness of the plan.

Standard 4: Consequences of Environmental Change on Human Health and Well-Being

Environmentally literate students construct and apply understanding of the consequences of human-induced environmental change on individual and collective health and well-being.

Enduring Understanding: Human health and well-being are impacted by environmental changes that can cause inequities in human health and resource distribution.
Objective Statements: By the end of grade 5, students will:

- Identify the consequences of human-caused environmental issues on human health.
- Determine how human-caused environmental change can affect people's mental and physical well-being.
- Investigate inequities in human health and resource distribution caused by human-caused environmental changes.

Lesson 4 Clarity and Expectations

Driving Question: How do the actions of humans (positive or negative) affect the Chesapeake Bay?

Supporting Questions:

- How can plastic be slowed down or stopped in the environment?
- How can people be made aware of the effects of plastic in the environment?

Learning Target(s): In this lesson we will…

- Identify and enhance plastic traps and highways using natural materials.
- Design and implement nature-based solutions that change how macroplastics move through the environment.
- Explain how their solutions keep the Bay ecosystem stable.
- Monitor and analyze the effectiveness of their interventions.

Unit 4 Vocabulary

- Green Infrastructure
- Rain Garden
- Constructed Wetland
- Living Shoreline
- Bioswale
- Permeable Pavement
- Action Plan

Click here to access the Lesson 4 Vocabulary Slide Deck

Lesson 4 Materials

- Lesson Plan
- Slide Deck
- Student Booklet, Page 24: Research Sheet (for Engagement)

- Student Booklet, Pages 25-27 (for Exploration, Explanation, and Extension)
- Chart paper (for Engagement and Exploration)
- Colored pencils or markers (for Engagement and Exploration)
- Collected natural materials (logs, leaves, mulch, soil, stones) (for Explanation)
- Various materials for communicating plans (for Extension)

Unit 4 Video Tutorials

Video tutorials are available for Lesson 4. Click the links below.

- Day 1
- Day 2
- Day 3
- Day 4

What's Next for Students?

In middle school, students will continue to learn more about the impacts of plastics in the Chesapeake Bay ecosystem by shifting the focus from **macro**plastics to **micro**plastics.

Wave of Plastic (Middle School) is a curricular unit helping middle school students make sense of the core ideas related to issues of plastic pollution (particularly those relevant to the Chesapeake Bay watershed). Created in 2019, in partnership with the University of Maryland Chesapeake Biological Lab, Calvert County Public Schools, and St. Mary's County Public Schools, students will engage in authentic interdisciplinary practice culminating in comprehensive, student-driven, informed action projects across five lessons.