Port of Baltimore

Environmental Education

Environmental Stewardship
at
Maryland's Dredged Material Placement Sites

Sponsored by the Maryland Port Administration
Presented by Maryland Environmental Service

Questions or comments?
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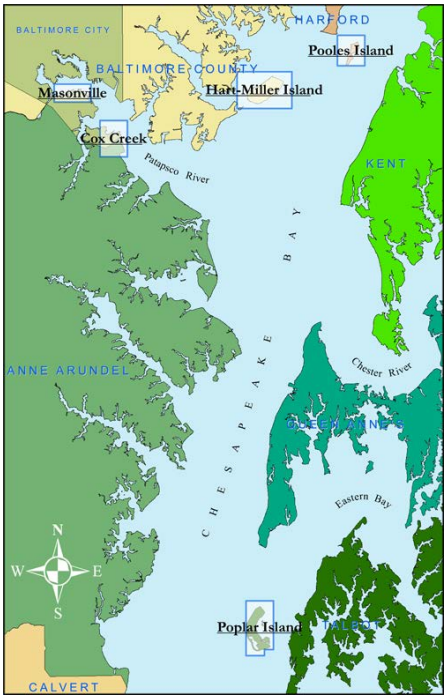
Dear Educator,

Thank you for using “Port of Baltimore Environmental Education” as a resource in your classroom! In this Teacher’s Guide you will find hands-on field experiences plus pre- and post-trip classroom lessons. We hope that these activities provide a valuable learning experience for your students.

Both maritime commerce and the ecology of the Chesapeake Bay are vitally important to Maryland. Each year, more than 2,000 cargo vessels and cruise ships call on the Port of Baltimore, moving approximately 38 million tons of cargo and generating $1.7 billion in revenue. As they travel, these ships pass through the Chesapeake Bay, Maryland's natural treasure and the nation's largest estuary.

As a result, the Maryland Port Administration has dual responsibilities. One is to ensure that vessels traveling to and from Baltimore have safe and navigable channels. The second is to support regional goals for clean water and healthy wildlife habitat in the Chesapeake Bay.

The Maryland Port Administration is committed to beneficially reusing material dredged from shipping channels and doing required mitigation projects. This has created unique opportunities to showcase how the commercial industry can help restore valuable habitat in the Bay. Because public education is important to MPA and its partners, we offer free educational field experiences at Maryland’s Dredged Material Containment Facilities:



- Hart-Miller Island
- Swan Creek Wetland at Cox Creek
- Masonville

This Teachers’ Guide includes the on-site activities your students will be completing on their field trip to Hart-Miller Island, Cox Creek, or Masonville. Maryland Environmental Service staff will be on-site to direct these activities. Also included are pre- and post-trip lesson plans for you to use in your classroom to prepare students for their trip and to review and reinforce concepts after they’ve visited one of our sites.

Each pre- and post-trip lesson plan contains:

- Summary
- Appropriate grade levels
- Time required
- Objectives
- Materials needed
- Activity procedure
- Extensions/related activities
- Background information
- Vocabulary
- Other student copy sheets

Most Background Information readings are written for an upper middle school audience. You may either print this to distribute to your students, or review the information through a class discussion.

Although each lesson can stand alone, the lessons outlined in this guide were designed to build on one another. All activities and lessons are aligned to Maryland State Curriculum and the Maryland Environmental Literacy Standards (see Lesson Alignment chart).

Our Dredged Material Containment Facilities are active construction sites and therefore, strict safety protocol must be followed while touring these locations. We welcome visitors of all ages to tour Hart-Miller Island, Cox Creek, and Masonville. However, due to safety restrictions, students below 3rd grade may not participate in hands-on activities while on-site. Accordingly, most lessons and activities included in this Guide are best suited for students in grades 3 through 12. Extensions for younger and older students are included when applicable.

We welcome your feedback and encourage you to share your experiences with us so that we may improve our program. Enclosed at the end of this Teachers' Guide is a Participant Survey. Thank you for your participation!

We look forward to seeing you on-site! We hope the enclosed lessons are a valuable resource for your students' learning experience.

This curriculum was compiled by the following staff at Maryland Environmental Service:
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Port of Baltimore Environmental Education

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Grades 3-12

Pre-Trip Lesson #1: Sedimentation and the Watershed

SUMMARY: STUDENTS WILL LEARN HOW SEDIMENT TRANSPORT OCCURS IN THE CHESAPEAKE BAY WATERSHED

GRADE LEVELS: 3-12

READING/ENGLISH LANGUAGE ARTS	SOCIAL STUDIES	SCIENCE	MATHEMATICS	TECHNOLOGY	ENVIRONMENTAL LITERACY
1.0 General Reading Processes Gr.3-8 D.3. Understand, acquire, and use new vocabulary. **2.0 Comprehension of Informational Text** Gr.3-8 A.1.a. Read, use, and identify the characteristics of nonfiction material. To gain information or content knowledge. Gr.9-12 1.1.3. The student will use after-reading strategies appropriate to both the text and purpose for reading by summarizing, comparing, contrasting, synthesizing, drawing conclusions, and validating the purpose for reading.	**3.0 Geography** Gr.4 D.1.b. Describe ways and reasons people in Maryland and the United States modify the natural environment and the consequences of modifications. Gr.7-8 D.1.b Explain the consequences of modifying the natural environment.	**1.0 Skills and Processes** Gr.6-8 A.1.b. Develop the ability to clarify questions and direct them toward objects and phenomena that can be described, explained, or predicted by scientific investigations. Gr.3-5 B.1.a. Develop explanations using knowledge possessed and evidence from observations, reliable print sources, and investigations. D.3.Examine and modify models and discuss their limitations. Gr.6-8 D.3. Analyze the value and the limitations of different types of models in explaining real things and processes. **2.0 Earth/Space Science** Gr.4 A.2. Recognize and explain how physical weathering and erosion cause changes to Earth's surface. Gr. 5 A.2.c. Cite examples that demonstrate how the natural agents of wind, water, and ice produce slow changes on the	None	None	**Standard 1 Environmental Issues** Topic A.1. Identify an environmental issue Topic B.2. Communicate, evaluate and justify personal views on environmental issue and alternate ways to address them. **Standard 5 Humans and Natural Resources** Topic A.1. Analyze the effects of human activities on earth's natural processes. Topic A.2. Analyze the effects of human activities that deliberately or inadvertently alter the equilibrium of natural processes. **Standard 7 Environment & Society** Topic 1.A. Investigate factors that influence environmental quality.

	Earth's surface. Gr. 6 A.2. Cite evidence to demonstrate and explain that physical weathering and chemical weathering cause changes to Earth materials. **6.0 Environmental Science** Gr.6 A.1.c. Identify and describe problems associated with obtaining, using, and distributing natural resources. Gr.4-8 B. Environmental Issues (all). Gr.9-12 1.2 The student will pose scientific questions and suggest investigative approaches to provide answers to questions. 2.1.2. The student will describe the purpose and advantage of current tools, delivery systems and techniques used to study the atmosphere, land and water on Earth. 2.4.2. The student will explain how the transfer of energy drives the rock cycle. 6.3.2. The student will evaluate the interrelationship between humans and water quality and quantity. 6.3.3. The student will evaluate the interrelationship between humans and land resources.	

Pre-Trip Lesson #2: Dredging up the Future

SUMMARY: STUDENTS WILL LEARN ABOUT CONTAINER SHIPS, WHY DREDGING IS NECESSARY, HOW IT IS DONE, AND WHAT CAN BE DONE WITH DREDGED MATERIAL. THEY WILL ALSO BE GIVEN AN INTRODUCTION TO THE SITE THEY WILL BE VISITING: MASONVILLE, HART-MILLER ISLAND, COX CREEK/SWAN CREEK.

GRADE LEVELS: 3-12

READING/ENGLISH LANGUAGE ARTS	SOCIAL STUDIES	SCIENCE	MATHEMATICS	TECHNOLOGY	ENVIRONMENTAL LITERACY
1.0 General Reading Processes Gr.3-8 D.3. Understand, acquire, and use new vocabulary. **2.0 Comprehension of Informational Text** Gr.3-8 A.1.a. Read, use, and identify the characteristics of nonfiction materials. To gain information or content knowledge. Gr.9-12 1.1.3. The student will use after-reading strategies appropriate to both the text and purpose for reading by summarizing, comparing, contrasting, synthesizing, drawing conclusions, and validating the purpose for reading.	**3.0 Geography** Gr.6 B.1.c. Explain how human perceptions of and interactions with the environment changed over time due to technologies. Gr.7 B.1 Analyze interrelationships among physical and human characteristics that shape the identity of places and regions around the world Gr.4 C.1d. Describe the transportation and communication networks for the movement of people, goods, and ideas to, from, and within Maryland, such as Bay Bridge, National Road, B&O Railroad, the Port of Baltimore, and C&O Canal. Gr.3-8 D. (all) Modifying and Adapting to the Environment.	**6.0 Environmental Science** Gr.5 B.2.a. Explain how human activities may have positive consequences on the natural environment. Gr.9-12 1.2 The student will pose scientific questions and suggest investigative approaches to provide answers to questions. (when Experiments with Buoyancy extension is completed) 1.3 The student will carry out scientific investigations effectively and employ the instruments, systems of measurement, and materials of science appropriately. (when Experiments with Buoyancy extension is completed) 1.6 The student will use mathematical processes. (when Experiments with Buoyancy extension is completed) 1.7 The student will show that connections exist both within the various fields of science and among science and other disciplines including mathematic, social studies, language arts, fine arts, and technology. 5.1.4. The student will analyze	Gr.9-12 (only when Experiments with Buoyancy extension is completed) Algebra/Data Analysis 1.2 The student will model and interpret real-world situations using the language of mathematics and appropriate technology. **Geometry** 2.3.2 The student will use techniques of measurement and will estimate, calculate, and/or compare perimeter, circumference, area, volume, and/or surface area of two- and three-dimensional figures and their parts.	**2.0 Digital Citizenship** Gr. 4-8 A.1.b. Identify examples of technology's impact on the environment.	**Standard 1 Environmental Issues** Topic A.1. Identify an environmental issue. **Standard 5 Humans and Natural Resources** Topic B.1. Analyze from local to global levels, the relationship between human activities and the earth's resources

	the behavior of forces. (when Experiments with Buoyancy extension is completed) 6.3.3. The student will evaluate the interrelationship between humans and land resources.	

Pre-Trip Lesson #3: Coastal Erosion

SUMMARY: THROUGH HANDS-ON INVESTIGATIONS AND ANALYSIS OF HISTORICAL MAPS, STUDENTS WILL INVESTIGATE THE EROSIONAL EFFECTS OF WIND AND WATER ON CHESAPEAKE BAY ISLANDS AND SHORELINE.

GRADE LEVELS: 3-12

READING/ENGLISH LANGUAGE ARTS	SOCIAL STUDIES	SCIENCE	MATHEMATICS	TECHNOLOGY	ENVIRONMENTAL LITERACY
1.0 General Reading Processes Gr.3-8 D.3. Understand, acquire, and use new vocabulary. **2.0 Comprehension of Informational Text** Gr.3-8 A.1.a. Read, use, and identify the characteristics of nonfiction materials. To gain information or content knowledge. Gr. 9-12 1.1.3 The student will use after-reading strategies appropriate to both the text and purpose for reading by summarizing, comparing, contrasting, synthesizing, drawing conclusions, and validating the purpose for reading.	**3.0 Geography** Gr. 3 B.1.d. Describe how geographic characteristics of places and regions change over time and influence the way people live and work. Gr. 4 B.1.c. Describe how geographic characteristics of a place or region change over time and affect the way people live and work. D.1.b. Describe ways and reasons people in Maryland and the United States modify the natural environment and the consequences of modifications. Gr. 7-8 D.1.b. Explain the consequences of modifying the natural environment. **6.0 Social Studies Skills and Processes** Gr. 3-8 F.1.a. Interpret information in maps, charts and graphs. F.2.a. Compare information from a variety of sources. F.3.a. Recognize relationships in and among ideas or events, such as cause and effect, sequential order, main idea, and details. G.2.a. Use historically accurate resources to answer questions, make predictions, and support ideas.	**1.0 Skills and Processes** Gr. 6-8 A.1.b. Develop the ability to clarify questions and direct them toward objects and phenomena that can be described, explained, or predicted by scientific investigations. Gr. 3-5 B.1.a. Develop explanations using knowledge possessed and evidence from observations, reliable print sources, and investigations. D.3.Examine and modify models and discuss their limitations. Gr.6-8 D.3. Analyze the value and the limitations of different types of models in explaining real things and processes. **2.0 Earth/Space Science** Gr. 5 A.1.c. Cite examples that demonstrate how the natural agents of wind, water and ice produce slow changes on the Earth's surface. Gr. 6 A.2.a. Identify examples of physical weathering, such as the effect of wind, ice, etc. and describe the changes caused in each. Gr.4 A.2. Recognize and explain how physical weathering and erosion cause changes to Earth's surface.	**3.0 Knowledge of Measurement** Gr. 3 A.1.a. Estimate and determine length. B.1.a. Measure length of objects using a ruler, a tape measure, a yardstick, or a meter stick. Gr. 4 A.1.a. Read customary and metric measurement units. Gr. 5 B.1. Measure in customary and metric units. Gr. 6 B.1. Measure in customary and metric units.	None	**Standard 1 Environmental Issues** Topic A.1. Identify an environmental issue Topic B.2. Communicate, evaluate and justify personal views on environmental issue and alternate ways to address them. **Standard 5 Humans and Natural Resources** Topic A.1. Analyze the effects of human activities on earth's natural processes. Topic A.2. Analyze the effects of human activities that deliberately or inadvertently alter the equilibrium of natural processes. **Standard 7 Environment & Society** Topic B.1. Examine the influence of individual and group actions on the environment and explain how groups and individuals can work to promote and balance interests.

	Gr. 9-12 1.2. The student will pose scientific questions and suggest investigative approaches to provide answers to questions. 2.4.2. The student will explain how the transfer of energy drives the rock cycle.	

Pre-Trip Lesson #4: What's the Limit?

SUMMARY: STUDENTS WILL LEARN WHY WATER QUALITY IS IMPORTANT AND HOW IT RELATES TO DREDGED MATERIAL PLACEMENT SITES.

GRADE LEVELS: 2-12

READING/ENGLISH LANGUAGE ARTS	SOCIAL STUDIES	SCIENCE	MATHEMATICS	TECHNOLOGY	ENVIRONMENTAL LITERACY
1.0 General Reading Processes Gr.3-8 D.3. Understand, acquire, and use new vocabulary. **2.0 Comprehension of Informational Text** Gr.3-8 A.1.a. Read, use, and identify the characteristics of nonfiction materials. To gain information or content knowledge. Gr. 9-12 1.1.3 The student will use after-reading strategies appropriate to both the text and purpose for reading by summarizing, comparing, contrasting, synthesizing, drawing conclusions, and validating the purpose for reading.	**3.0 Geography** Gr. 3 D.1.b. Describe why and how people make decisions about protecting the environment. Gr. 7-8 D.1.b. Explain the consequences of modifying the natural environment. Gr. 7 D.1.d. Explain how land use and environmental issues are addressed by government policy.	**1.0 Skills and Processes** Gr. 3-5 B.1.a. Develop explanations using knowledge possessed and evidence from observations, reliable print sources, and investigations. **4.0 Chemistry** Gr.8 D.2.b. Use information gathered from investigations using indicators and the pH scale to classify materials as acidic, basic, or neutral. **6.0 Environmental Science** Gr. 6 B.1.c. Identify and describe that ecosystems can be impacted by human activities. Gr. 9-12 1.3.2. The student will recognize safe laboratory procedures. 1.4.2. The student will analyze data to make predictions, decisions, or draw conclusions. 1.6.4. The students will manipulate quantities and/or numerical values in algebraic equations. 4.2.4. The student will differentiate among acids, bases, and salts based on their properties. 6.3.2. The student will evaluate the relationship between humans and water quality and quantity.	**1.0 Knowledge of algebra, patterns, and functions** Gr. 6-8 B.1.a. Write an algebraic expression to represent unknown quantities. Gr. 9-12 1.1.3 The Student will apply addition, subtraction, multiplication, and/or division of algebraic expressions to mathematical and real-world problems. 3.1 The student will collect, organize, analyze, and present data.	**3.0 Technology for Learning and Collaboration** Gr.3 C.1.e. Use various electronic information retrieval sources to obtain information in a topic. **5.0 Technology for Information Use and Management** Gr. 3 A.1.f. Collect data using technology. Gr. 4-8 A.1.a. Select relevant information from appropriate technology resources. **6.0 Technology for Problem-Solving and Decision-Making** Gr. 9-12 Select and use tools and equipment correctly and safely.	**Standard 1 Environmental Issues** Topic A.1. Identify an environmental issue **Standard 5 Humans and Natural Resources** Topic A.2. Analyze the effects of human activities that deliberately or inadvertently alter the equilibrium of natural processes. **Standard 6 Environment and Health** Topic A.1. Identify and describe natural changes in the environment that may affect the health of human populations and individuals. **Standard 7 Environment & Society** Topic 1.A. Investigate factors that influence environmental quality Topic B.1. Examine the influence of individual and group actions on the environment and explain how groups and individuals can work to promote and balance interests.

Pre-Trip Lesson #5: Pre-Trip Video and Brochure

SUMMARY: STUDENTS WILL CONCLUDE PRE-TRIP CLASSROOM ACTIVITES BY VIEWING AN INFORMATIONAL VIDEO AND READING A BROCHURE ABOUT HART-MILLER ISLAND, COX CREEK OR MASONVILLE.

GRADE LEVELS: 3-12

READING/ENGLISH LANGUAGE ARTS	SOCIAL STUDIES	SCIENCE	MATHEMATICS	TECHNOLOGY	ENVIRONMENTAL LITERACY
2.0 Comprehension of Informational Text Gr.3-8 A.1.a. Read, use, and identify the characteristics of nonfiction materials. To gain information or content knowledge. **3.0 Listening** Gr.3-5 A.2. Comprehend and analyze what is heard. Gr. 6-7 A.2. Apply comprehension and literary analysis strategies and skills. Gr. 9-12 1.1. The student will use effective strategies before, during, and after reading, viewing, and listening to assigned materials.	**3.0 Geography** Gr.4 C.1.d. Describe the transportation and communication networks for the movement of people, goods, and ideas to, from and within Maryland, such as the Port of Baltimore. Gr.3-8 D.1. Explain/describe/analyze why and how people modify their environment and the impact of those modifications.	None	None	None	**Standard 1 Environmental Issues** Topic A.1. Identify an environmental issue. **Standard 5 Humans and Natural Resources** Topic A.2. Analyze the effects of human activities that deliberately or inadvertently alter the equilibrium of natural processes. **Standard 7 Environment & Society** Topic 1.A. Investigate factors that influence environmental. quality Topic B.1. Examine the influence of individual and group actions on the environment and explain how groups and individuals can work to promote and balance interests. Topic E.1. Analyze and explain global economic and environmental connections.

Post-Trip Lesson #1: Design-an-Island

SUMMARY: STUDENTS WILL RESEARCH EXISTING CHESAPEAKE BAY ISLANDS AND COASTAL AREAS THAT COULD BE POTENTIAL DREDGED MATERIAL PLACEMENT SITES. GRADE LEVELS: 3-12

READING/ENGLISH LANGUAGE ARTS	SOCIAL STUDIES	SCIENCE	MATHEMATICS	TECHNOLOGY	ENVIRONMENTAL LITERACY
7.0 Speaking Gr. 3-5 A.2. Make oral presentations. Gr. 6-7 A.1. Demonstrate appropriate organizational strategies and delivery techniques to plan for a variety of oral presentation purposes. Gr. 8 A.1.b. Use a combination of organizational structures such as narrative, cause and effect, chronological/sequential, main idea with supporting details, problem/solution, question/answer, comparison and contrast, making appropriate transitions within a presentation. Gr. 9-12 2.1. The students will compose oral, written, and visual presentations that inform, persuade, and express personal ideas. 2.3. The student will locate, retrieve, and use information from various sources to accomplish a purpose.	**3.0 Geography** Gr. 3 B.1.d. Describe how geographic characteristics of places and regions change over time and influence the way people live and work. Gr. 4 B.1.c. Describe how geographic characteristics of a place or region change over time and affect the way people live and work. D.1.b. Describe ways and reasons people in Maryland and the United States modify the natural environment and the consequences of modifications. Gr.7 B.1 Analyze interrelationships among physical and human characteristics that shape the identity of places and regions around the world Gr. 7-8 D.1.b. Explain the consequences of modifying the natural environment. **6.0 Social Studies Skills and Processes** Gr. 3-8 F.1.a. Interpret information in maps, charts and graphs. F.2.a. Compare information from a variety of sources. G.2.a. Use historically accurate resources to answer questions, make predictions, and support ideas.	**1.0 Skills and Processes** Gr. 3-5 B.1.a. Develop explanations using knowledge possessed and evidence from observations, reliable print sources, and investigations. **2.0 Earth/Space Science** Gr. 5 A.1.c. Cite examples that demonstrate how the natural agents of wind, water and ice produce slow changes on the Earth's surface. Gr. 6 A.1.a. Identify examples of physical weathering, such as the effect of wind, ice, etc. and describe the changes caused in each. **6.0 Environmental Science** Gr.5 B.2.a. Explain how human activities may have positive consequences on the natural environment. Gr. 6 B.1.c. Identify and describe that ecosystems can be impacted by human activities. Gr. 9-12 1.5.2. The student will explain scientific concepts and processes through drawing, writing, and/or oral communication. 3.5.3. The student will investigate how natural and man-made changes in environmental conditions will affect individual organisms	None	**2.0 Digital Citizenship** Gr. 5-8 B.2.b. Use electronic resources appropriately. **3.0Technology for Learning and Collaboration** Gr. 3 C.1.e. Use various electronic information retrieval sources to obtain information on a topic. Gr. 4-8 C.1.f. Use various electronic information retrieval sources to obtain information on a topic. **4.0 Technology for Communication and Expression** Gr. 3 A.1.c. Present information, independently or with assistance, to various audiences including schools and community. Gr. 4-8 C.1.b. Present information independently to various audiences. **5.0 Technology for Information Use and Management** Gr. 3 A.1.a. Select relevant information from appropriate technology resources. A.1.e. Understand search strategies for age-appropriate Web search engines/directories. Gr. 4-8 A.1.a. Select relevant information from appropriate technology resources.	

	and the dynamics of populations.	A.1.e. Understand/refine search strategies for Web search engines/directories. **6.0 Technology for Problem-Solving and Decision-Making** Gr. 9-12 Develop abilities to apply and analyze the design process.

Post-Trip Lesson #2: Species Information Sheet

SUMMARY: STUDENTS WILL CREATE A SPECIES INFORMATION SHEET AND/OR POSTERS TO DISPLAY INFORMATION ABOUT A WILDLIFE SPECIES FOUND ON MARYLAND'S DREDGED MATERIAL PLACEMENT SITES.

GRADE LEVELS: 3-12

READING/ENGLISH LANGUAGE ARTS	SOCIAL STUDIES	SCIENCE	MATHEMATICS	TECHNOLOGY	ENVIRONMENTAL LITERACY
4.0 Writing Gr. 5-8 A.1.b. Select, organize, and develop ideas appropriate to topic, audience, and purpose. Gr. 3-8 A.7. Locate, retrieve, and use information from various sources to accomplish a purpose. Gr. 9-12 2.1.1. The student will compose to inform by using appropriate types of prose. 2.3.1. The student will identify sources of information on a self-selected and/or given topic and assess their appropriateness to accomplish a purpose.	**6.0 Social Studies Skills and Processes** Gr. 3-8 F.2.a. Compare information from a variety of sources. G.2.a. Use historically accurate resources to answer questions, make predictions, and support ideas.	**3.0 Life Science** Gr. 4 F.1. Explain ways that individuals and groups of organisms interact with each other and their environment.	None	**2.0 Digital Citizenship** Gr. 5-8 B.2.b. Use electronic resources appropriately. **3.0 Technology for Learning and Collaboration** Gr. 3 C.1.e. Use various electronic information retrieval sources to obtain information on a topic. Gr. 4-8 C.1.f. Use various electronic information retrieval sources to obtain information on a topic. **5.0 Technology for Information Use and Management** Gr. 3 A.1.a. Select relevant information from appropriate technology resources. A.1.e. Understand search strategies for age-appropriate Web search engines/directories. Gr. 4-8 A.1.a. Select relevant information from appropriate technology resources. A.1.e. Understand/refine search strategies for Web search engines/directories.	**Standard 1 Environmental Issues** Topic A.1. Identify an environmental issue Topic A.2. Develop and write research questions related to an environmental issue. Topic A.3. Given a specific issue, communicate the issue, the stakeholders involved and the stakeholders' beliefs and values. Topic A.4. Design and conduct the research. Topic A.5. Use data and references to interpret findings to form conclusions.

Post-Trip Lesson #3: Hot Commodities

SUMMARY: STUDENTS WILL RESEARCH ONE OF THE PORT OF BALTIMORE'S CHIEF IMPORTED COMMODITIES.

GRADE LEVELS: 3-12

READING/ENGLISH LANGUAGE ARTS	SOCIAL STUDIES	SCIENCE	MATHEMATICS	TECHNOLOGY	ENVIRONMENTAL LITERACY
4.0 Writing Gr. 5-8 A.1.b. Select, organize, and develop ideas appropriate to topic, audience, and purpose. Gr. 3-8 A.7. Locate, retrieve, and use information from various sources to accomplish a purpose. **7.0 Speaking** Gr. 3-5 A.2. Make oral presentations Gr. 6-7 A.1. Demonstrate appropriate organizational strategies and delivery techniques to plan for a variety of oral presentation purposes. Gr. 8 A.1.b. Use a combination of organizational structures such as narrative, cause and effect, chronological/sequential, main idea with supporting details, problem/solution, question/answer, comparison and contrast, making appropriate transitions within a presentation. Gr. 9-12 2.1. The students will compose oral, written, and visual presentations that inform, persuade, and express	**3.0 Geography** Gr. 3 A.1.c. Identify and describe the location of communities, major cities in Maryland, United States and the world using a globe, maps, and atlases. C.1.a. Explain how transportation and communication networks link places through the movement of people, goods, and ideas. Gr. 7 A.1.a. Use maps to compare geographic locations of places and regions. **4.0 Economics** Gr. 3 A.2. Examine the production process. B.1.b. Describe how countries around the world trade in the global market. Gr.7 A.2.a. Describe how goals of countries affect the use of resources in the pursuit of economic growth and sustainable development. **6.0 Social Studies Skills and Processes** Gr. 3-5 D.1.a. Gather and read appropriate print sources, such as textbooks, government documents, timelines, trade books, and web sites. Gr. 6-8 D.1.a. Gather and read	None	None	**2.0 Digital Citizenship** Gr. 5-8 B.2.b. Use electronic resources appropriately. **3.0 Technology for Learning and Collaboration** Gr. 3 C.1.e. Use various electronic information retrieval sources to obtain information on a topic. Gr. 4-8 C.1.f. Use various electronic information retrieval sources to obtain information on a topic. **5.0 Technology for Information Use and Management** Gr. 3 A.1.a. Select relevant information from appropriate technology resources. A.1.e. Understand search strategies for age-appropriate Web search engines/directories. Gr. 4-8 A.1.a. Select relevant information from appropriate technology resources. A.1.e. Understand/refine search strategies for Web search engines/directories.	**Standard 7 Environment & Society** Topic A.1. Investigate factors that influence environmental quality. Topic D.1. Understand how different political systems account for, manage, and affect natural resources and environmental quality. Topic E.1. Analyze and explain global economic and environmental connections.

personal ideas. 2.3. The student will locate, retrieve, and use information from various sources to accomplish a purpose.	appropriate print sources, such as journals, periodicals, government documents, timelines, databases, reference works, and web sites. D.1.d. Access and process information that is factual and reliable from readings, investigations, and/or oral communications. Gr. 3-8 E.2. Organize information from print sources. Gr. 3-8 F.3.a. Recognize relationships in and among ideas or events, such as cause and effect, sequential order, main idea, and details. Gr. 9-12 4.1. The student will evaluate how governments affect the answers of what to produce, how to produce, and for whom to produce.	

Post-Trip Lesson #4: Jeopardy!

SUMMARY: STUDENTS WILL REVIEW MATERIAL LEARNED THROUGH A POWERPOINT JEOPARDY! GAME.

GRADE LEVELS: 3-12

READING/ENGLISH LANGUAGE ARTS	SOCIAL STUDIES	SCIENCE	MATHEMATICS	TECHNOLOGY	ENVIRONMENTAL LITERACY
3.0 Listening Gr.3-5 A.2. Comprehend and analyze what is heard. Gr. 6-7 A.2. Apply comprehension and literary analysis strategies and skills. Gr. 9-12 1.1. The student will use effective strategies before, during, and after reading, viewing, and listening to assigned materials.	None	None	None	None	None

Post-Trip Lesson #5: Take Action!

SUMMARY: STUDENTS WILL CULMINATE THEIR EXPERIENCE WITH AN ACTION PROJECT THAT ADDRESSES ENVIRONMENTAL RESTORATION.

GRADE LEVELS: 3-12

READING/ENGLISH LANGUAGE ARTS	SOCIAL STUDIES	SCIENCE	MATHEMATICS	TECHNOLOGY	ENVIRONMENTAL LITERACY
None	**6.0 Social Studies Skills and Processes** Gr. 3-8 G.3.c. Identify and formulate a position on a course of action or an issue.	Gr. 9-12 6.4.5. Analyze the effectiveness of the action project in terms of achieving the desired outcomes.	None	None	**Standard 1 Environmental Issues** Topic B.1. Use recommendations to develop and implement an environmental action plan. Topic B.2. Communicate, evaluate, and justify personal views on environmental issue and alternate ways to address them. Topic B.3. Analyze the effectiveness of the action plan in terms of achieving the desired outcomes.

Port of Baltimore Environmental Education
Participant Survey

Your feedback is important to us and will help shape the future of this program. Please take a moment to evaluate "Port of Baltimore Environmental Education". You may attach a separate sheet of paper for additional comments. Thank you!

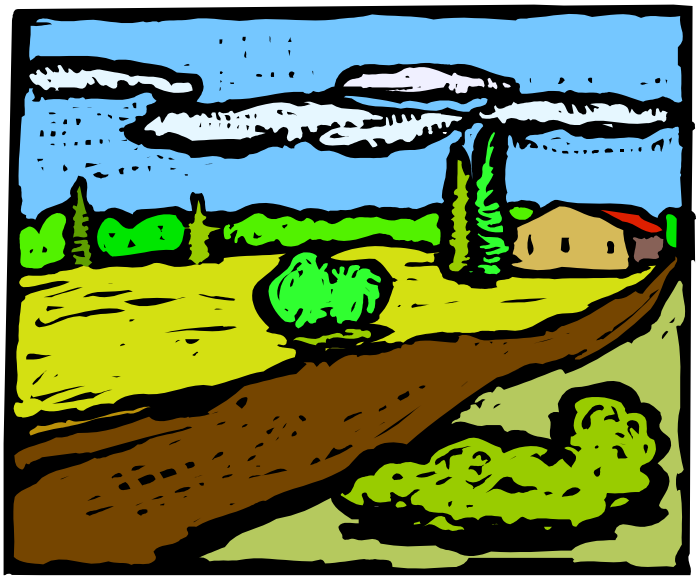
1. *School Year: 20_____ - 20_____*
2. *Which site did you visit with your class?*
3. *The lesson plans in the Teachers' Guide were useful*

   Strongly disagree disagree neutral agree strongly agree
4. *Which lesson plans did you use?*
5. *Why did you choose not to use other lesson plans?*
6. *Did you adapt any lesson plans? How did you adapt them to meet your needs?*
7. *Would you be willing to share these adaptations or new lesson plans if you were given credit?*
8. *I would recommend this program to other educators.*

   Strongly disagree disagree neutral agree strongly agree
9. *What did you like best about the program?*
10. *How would you improve the program?*

Please return this form to:
Outreach and Education Coordinator
Maryland Environmental Service
259 Najoles Road
Millersville, MD 21108

Pre-Trip Lesson #1: Sedimentation and the Watershed



Summary: Students will learn how sediment transport occurs in the Chesapeake Bay watershed.

Grade(s): 3-12

Time Required: 1 to 2 class periods

Objectives: After completing this lesson, students will be able to:

- Define watershed, sediment transport, and sedimentation and how they relate to the Chesapeake Bay.
- Describe the relationship between land use (impervious surfaces, in particular) and sedimentation.
- Investigate ways to reduce sedimentation in the Chesapeake Bay.

Materials Needed:

- Student copies: Sedimentation and the Watershed Background Information
- Modeling clay
- 1 aluminum paint pan (for class demonstration)
- Additional aluminum paint pans (enough for each group to have one)
- Sponges, scraps of indoor/outdoor carpet, leaves/twigs/branches
- Hot glue gun(s)
- Cups of soil
- Water

Activity:

1. Explain the concept of a watershed. Write the definition on the board (included in *Vocabulary* section of this lesson plan).

2. Have students read through the *Background Information*, or go over this information in a class discussion. Make sure students understand the concept of a watershed and how sediment transport occurs. As you share this information, you may want to review the six states and one city in the Chesapeake Bay watershed (Maryland, Virginia, Delaware, West Virginia, Pennsylvania, New York, and Washington, DC).

3. Explain to students that they are going to observe a model of the Chesapeake Bay watershed and how sediment transport happens within the watershed. (See *How to Build a Watershed Model* at the end of this lesson.) The paint pan represents the Bay watershed; in this particular model, there are large areas of impervious surface. Explain that you will pour water over the top of the model to represent precipitation. Ask students to hypothesize: Where will the water go? What will happen to the soil? Where will it end up? How did land use (concrete, roads, parking lots, other impervious surfaces) affect sediment transport in this model? (Impervious surfaces prevent water from being absorved into the ground. Therefore, when it rained, the soil that was sitting on top of the impervious surface, or clay, was transported straight to the Bay.)

4. Ask students to brainstorm ways to reduce sediment transport in this model. Allow them to build their own watershed; provide sponges, carpet, leaves/twigs/branches, etc. to create a way to reduce the amount of sediment that ends up on the bottom of the Bay after rainfall occurs.

5. Discuss results with students. What effect did the buffer have on the amount of sediment that ended up in the Chesapeake Bay? Compare the buffer area to a filter. What does a filter do (It allows water to pass through, but removes any particles that may be in the water.)? What other kind of filters can you think of (filters in fish/terrapin tanks, coffee filters, air filters.)? Buffers act like filters; the plants that grow in the buffer area will trap sediment and other pollution as runoff flows through. This will prevent sediment from ending up in the Bay and at the bottom of shipping channels.

6. Take your students outside to observe real-life examples of erosion on their school grounds. Ask students: What signs of erosion should we look for? (water paths, lack of plants, walking trails, stream bank erosion, field erosion, water flowing off impermeable surfaces, etc.) Lead the group to an area where you suspect there may be erosion (this will probably be an area that drains from a paved surface). Challenge students to find signs of erosion. They can record the location where erosion is occurring, sketch the area, describe the signs that indicate erosion is occurring, and brainstorm ways erosion could be decreased in these areas.

7. Discuss additional ways to reduce erosion and sediment transport in the Chesapeake (planting trees/native plants, creating/preserving wetlands, reducing the amount of impervious surfaces, planting and preserving SAV and marsh grasses, reducing rip rap/bulkheads, seawalls/breakwaters, reducing wave action close to shore, and creating living shorelines). More information about these Best Management Practices can be found at the Chesapeake Bay Program website: http://www.chesapeakebay.net

8. After your students have a better understanding of sedimentation in the Chesapeake Bay, they will be able to understand the connection between sediment transport and the need to dredge the Bay's shipping channels. This is explored in the next lesson: Dredging up the Future.

Extensions/Related Activities:

K-2:

- For younger students, you can run this experiment as a demonstration, with two models used to display impervious surface versus buffer zones.
- *Follow the Water from Brook to Ocean* by Arthur Dorros is a great introduction to watersheds for younger students. You can read the story together and discuss how water flows from a smaller body to a larger body. As you read, define water terms such as brook, stream, river, and ocean.
- *Water Dance* by Thomas Locker illustrates the stages of the water cycle through watercolor paintings.
- *Rainy-Day Hike*, a Project WET activity, introduces students to the concept of watersheds by investigating sites of flowing water on the school grounds.

3-12:

- Show students a map of Maryland's watersheds (available at http://mddnr.chesapeakebay.net/wsprofiles/surf/prof/prof.html).
- Point out major geologic features (mountains of Western Maryland, Chesapeake Bay, Atlantic Ocean and coastal bays, etc.) of the state.
- Find the watershed your school is in and the river closest to your school. Trace the course of your watershed, from its headwaters to where it empties (most likely the Chesapeake Bay).
- Students can label a blank map of Maryland watersheds and outline the watershed they live in.

- High schoolers can research watershed health, water quality, and other environmental information about their watershed at EPA's Surf Your Watershed website: http://cfpub.epa.gov/surf/state.cfm?statepostal=MD

9-12:

- Use stream tables to investigate more complex processes of weathering, erosion, and deposition and how water can change the shape of the earth over time.
- Further investigate the above Best Management Practices (BMPs) to reduce the amount of sediment flowing into the Chesapeake Bay. Students can create a research project about one particular BMP.

References:

"Chesapeake Bay Foundation | Bay Area Facts." *Chesapeake Bay Foundation | Save the Bay*. Web. June 2010. <http://www.cbf.org/Page.aspx?pid=433>.

Chesapeake Bay Program - A Watershed Partnership. Web. June 2010. <http://www.chesapeakebay.net>.

Dorros, Arthur. *Follow the Water from Brook to Ocean*. New York, NY: HarperCollins, 1991. Print.

"Gateways to Conservation." *Audubon Maryland-DC*. Web. June 2010. <http://mddc.audubon.org/birds-science-education/education/gateways-conservation>.

Kesselheim, Alan S., Britt Eckhardt. Slattery, Susan Higgins, and Mark R. Schilling. *WOW!: the Wonders of Wetlands*. St. Michael's, MD: Environmental Concern, 1995. Print.

Locker, Thomas. *Water Dance*. San Diego, Calif.: Harcourt Brace & Company, 1997. Print.

Project WET: Curriculum & Activity Guide. Bozeman, Mont.: Watercourse, 1995. Print.

Sedimentation and the Watershed
Background Information

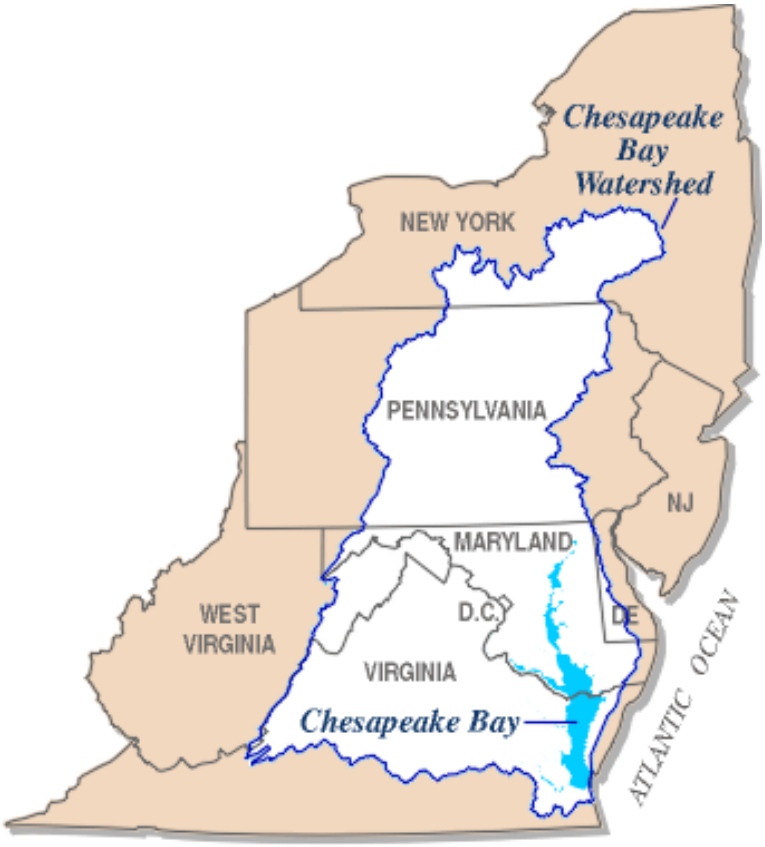


Figure 1. *Chesapeake Bay watershed and surrounding area.*

http://md.water.usgs.gov/publications/fs-150-99/html/figure1_big.gif

The Chesapeake Bay is the largest **estuary** in the United States and the third largest in the world. Its mix of salt and fresh water makes it a very complex ecosystem and it includes a wide variety of habitats and food webs. The Bay itself is about 200 miles long, but its waters begin over 300 miles north, all the way in Cooperstown, New York, home of the Baseball Hall of Fame. This is the northernmost point in the Chesapeake Bay **watershed**.

When it rains or snows within the Bay's watershed, the water will hit the land, run downhill, and form a small creek or stream. That creek or stream will flow downhill and join with other creeks and streams to form rivers. Those rivers will flow downhill and eventually into the Bay.

Therefore, how the land is used will affect the **water quality** of the Bay. Imagine that it's raining over a farm field near Cooperstown. A farmer there has just fertilized his fields, but he used a bit too much fertilizer. The rain will fall onto the farm field, wash away the extra fertilizer, and as the water flows through the field, it carries the fertilizer downhill to a nearby forest. Here the water joins more water to form a small stream. That stream flows out of the forest and into a housing development. After a while, that stream joins other streams to form a large river that will eventually empty its water into the Chesapeake Bay. That excess fertilizer is still dissolved in the water, and will eventually end up in the Chesapeake, where it

can cause environmental problems.

The same thing happens if homeowners use pesticides on their lawns; the excess pesticides could flow downstream, through the watershed, and end up in Bay waters. Likewise, if someone dumps motor oil down a storm drain, that oil may make its way into the Bay.

The entire Bay watershed is 64,000 square miles. This is a very large area of land for a relatively small body of water. As of April 2010, there are 16.8 million people living in the Bay watershed. All those people each have an impact on the water quality of the Chesapeake Bay, and that is why the Bay faces so many environmental challenges.

Take a look at the following satellite images of the Chesapeake Bay:

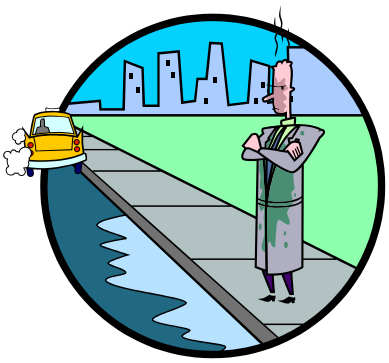
http://ces.iisc.ernet.in/hpg/envis/Remote/section443.htm

Landsat satellites captured these images. They are used to study land use patterns from space. Water is dark blue/black. Agricultural lands on the Eastern shore are a bright yellow or white tone. Baltimore and Washington DC contain large areas of **impervious surface** and appear light grey.

http://lh4.ggpht.com/__Kzb6VboLYU/SfCx0EZfugI/AAAAAAAAAlc/KSzblc_Ioeo/s512/chesapeake-satellite.gif.jpg

These Landsat images show great examples of **sediment transport**. Soil is a type of **sediment**. When water washes over and through the Chesapeake Bay watershed, it can carry sediment with it and into the Bay. This is known as **erosion**.

These pictures were taken shortly after a rain storm. Notice how the parts of the Susquehanna (left) and the Potomac, Rappahannock, and James Rivers (right) are brown.

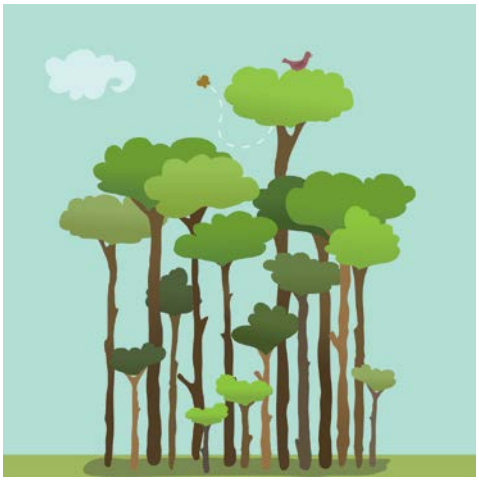


These rivers flow out of areas with large amounts of impervious surface, such as sidewalks, parking lots, and roads. When the rain from the previous day's storm hit these surfaces, there was nothing to prevent the sediment from traveling straight to the river. The rain fell over the land, moved downstream, and carried with it any sediment it washed over along the way. This sediment will eventually flow out of the rivers and end up on the bottom of the Bay.

Where does this sediment go after the rivers carry it into the Bay? Some sediment may be washed out into the ocean, but because the water slows once it reaches the Bay, the sediment actually settles to the bottom of the Chesapeake. Imagine that you add dirt to a water bottle. You shake the bottle to mix the dirt with the water, and then let the mixture sit for a few minutes. Where will the dirt eventually go? It'll go to the bottom, just like sediment does in the Chesapeake Bay. When the sediment settles on the bottom of the Bay, we call this **sedimentation**.

Because of all the excess sediment sitting at its bottom, the average depth of the Chesapeake Bay is about 21 feet. A person who is 6 feet tall could wade through over 700,000 acres of the Bay and never get his/her hat wet.

Sedimentation and the Watershed
Vocabulary



Buffer: an area bordering a body of water that is planted with trees, shrubs, and grasses. Buffers help filter runoff pollution and provide shade, food, and homes for wildlife.

Erosion: the gradual wearing away of rock and soil caused by water, wind, or ice through processes such as: physical breakdown, chemical solution, and transport of material.

Estuary: a body of water where fresh and salt water mix

Impervious surface: a surface that water can't penetrate, such as concrete.

Water Quality: a measurement of the properties of water. This helps us determine the health of the Chesapeake Bay.

Watershed: an area of land that drains rainwater or snow into one body of water (in this case, the Chesapeake Bay). A watershed is like a bathtub and the walls of the tub form the top of the watershed. When it rains (or you turn on the shower), all that is within the basin (or tub) washes down to the drain (or down to the stream, lake, river and to the Chesapeake Bay).

Sediment: small pieces of rock, shell, and plant/animal matter that is moved and deposited by water, wind, or ice.

Sedimentation: the act or process of forming or depositing sediment.

Sediment transport: when water transports soil into the Chesapeake Bay.

Sedimentation and the Watershed
How to Build a Watershed Model

Materials:
Modeling clay
1 aluminum paint pan (for class demonstration)
Additional aluminum paint pans (enough for each group to have one)
Paper cups
Sponges, scraps of indoor/outdoor carpet, leaves/twigs/branches
Hot glue gun(s)
Cups of soil
Water

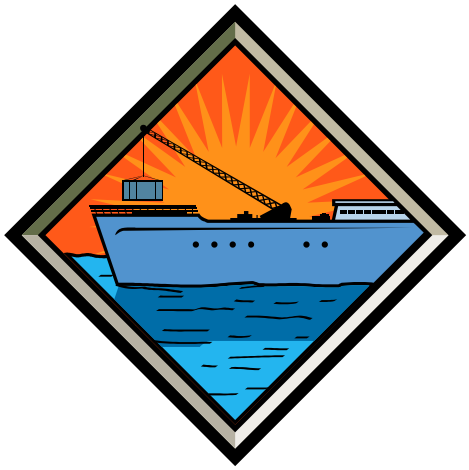
Procedure:
Part 1: Class demonstration:

1. Spread a layer of modeling clay in the top half of the paint pan to represent land/impervious surface. The bottom half will be empty to represent the Chesapeake Bay.
2. The clay should be shaped so that it slopes down to the water. Press the clay into the side of the pans to seal the edges; you may need to use hot glue around the edge of the clay. These models won't work well if there are large spaces between the clay and sides of the pans.
3. This model will represent a watershed with large amounts of impervious surface (the clay).
4. Spread a thin layer of soil over the model.
5. Poke holes in the bottom of one cup and slowly pour water from the other cup through this "sprinkler" over the top of the watershed model. Observe what happens to the soil as the water makes its way down into the deeper part of the pan, which represents the Chesapeake Bay.

Part 2: Individual groups:

6. Distribute a paint pan and paper cups to each group. Allow students to build their own watershed. This time they will use the sponges, carpet, leaves/twigs/branches, etc. to create a way to reduce the amount of sediment that ends up on the bottom of the Bay after rainfall occurs. Be sure sponges are hot glued to the clay.
7. Spread a thin layer of soil over the model.
8. Observe how much soil ends up at the bottom of the watershed that has large amounts of impervious surface compared to a watershed with buffer areas.

Pre-Trip Lesson #2: Dredging up the Future



Summary: Students will learn about container ships, why dredging is necessary, how it is done, and what can be done with dredged material. They will also be given an introduction to the site they will be visiting: Hart-Miller Island, Cox Creek/Swan Creek, or Masonville.

Grade(s): 3-12

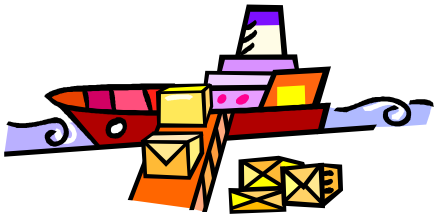
Time Required: 2 to 3 class periods
If time is limited, students should at least complete Part 2: "What is Dredging?" where they will learn essential background information about Dredged Material Placement Facilities.
If time allows, Part 1: "What dredging requirements might be in the future for the Port of Baltimore?" and the extension, "Experiments With Buoyancy" provide additional information about international commerce, shipping channels, and the need for dredging.

Objectives: After completing this lesson, students will be able to:

- Examine dredging requirements and the future of the Port of Baltimore
- Define dredging and types of dredges
- Address what to do with dredged material

Extension:

- Experiment with buoyancy and use mathematical calculations to model buoyancy.



Activity:

1. Review with students the concepts learned in the first lesson, Sedimentation and the Watershed: the Chesapeake Bay is a shallow body of water and is continually filling with more sediment due to erosion and sediment transport. They should know that the average depth of the Chesapeake Bay is only about 21 feet.

2. Ask students to look at the tag from an article of their clothing. Find out where that piece of clothing was made. How did it get from that foreign country to the shopping mall where you bought it (Foreign goods are transported to the US via container ships.)?

3. Students will complete "Dredging up the Future," a lesson from PORT: A Transportation System, a Port of Baltimore curriculum produced by Maryland Public Television: http://port.thinkport.org/docs/dredginglesson.pdf. They will learn that in order to access the Port of Baltimore, ocean-going ships require a 50-foot channel. However, sedimentation is occurring year-round in the Bay, and this sediment fills up shipping channels, requiring the need to dredge to maintain their depth. This lesson has 2 parts:

- Part 1: What dredging requirements might be in the future for the Port of Baltimore?
    - Students will complete "Container Ship Types" handout questions using this resource: http://www.globalsecurity.org/military/systems/ship/container-types.htm.
    - "Container Ship Types Class Discussion" can also be used in conunction with classroom discussion as an extending reading assignment to provide further background information.

- Part 2: What is Dredging?
    - An optional reading assignment, “What is Dredging?” is provided as a quick explanation of dredging and how it is accomplished.
    - Students will answer questions from “What Happens to the Material Dredged from the Bottom of the 'Harbor?” using the Safe Passage website: http://www.mpasafepassage.org. They will also research the Dredged Material Containment Facility they will be visiting using Backgrounders linked to the Safe Passage website.

Note: This lesson may be more effective, especially with older students, if students engage in the buoyancy activity first (see extension below).

Extensions/Related Activities:
K-2
Lower elementary students can explore the basic concepts of sinking and floating. Have students explore with a large tub of water and different objects; allow students to predict of each object will sink or float, then test their predictions. Discuss similarities and differences between objects that sank and objects that floated; emphasize that weight isn’t the only factor that determines whether objects sink.

3-5

Upper elementary students can experiment with buoyancy by observing a “Cartesian Diver” out of an emtpy soda bottle and an eye dropper (search the web for complete instructions). Have students try to figure out why the Cartesian Diver floats and sinks. Conclude activitiy with a boat-building competition; small groups will compete to see who can build a small aluminum foil boat that will support the most weight.

9-12
“Experiments with Buoyancy” (from PORT lesson plan *Dredging up the Future*)
High school students can investigate the Archimedes Principle of Buoyancy in order to understand how fully loaded cargo ships ride deeply in the water; thus presenting the need to dredge deep channels. This extension ends with a Floating Golf Balls Challenge, where students can mathematically model buoyancy using aluminum foil to form vessesls to carry a maximum amount of golf balls.

Materials/Vocabulary/References: See “Dredging up the Future” lesson plan.

Pre-Trip Lesson #3: Coastal Erosion

Summary: Through hands-on investigations and analysis of historical maps, students will investigate the erosional effects of wind and water on Chesapeake Bay islands and shoreline.

Grade(s): 3-12

Time Required: 2 to 3 class periods; 3 months of weekly observations if completing #1

Objectives: After completing this lesson, students will be able to:

- Identify and explain how and why erosion occurs.
- Observe erosion patterns in both real-life models and historical maps and photos.
- Explain how island and coastal restoration can benefit Chesapeake Bay habitat.

Materials Needed:

- (If completing #1) 50 cm pile of soil in undisturbed location on school grounds.
- For How to Build a Coastal Erosion Model (for each student group).
    - Aluminum paint pan
    - Sand
    - Water
    - Ruler
- Student copies: *Coastal Erosion Background Information* (Chesapeake Bay Maps can be displayed on overhead or PowerPoint).
- Set of Poplar Island (#1-10) and/or Hart-Miller Island (#1-5) historical maps (1 set per group).

Activity:

1. If time allows, create a "mountain" of soil 50 cm high in an undisturbed location on your school grounds. Have students observe this mountain once a week for three months. Students can measure its height, width, and note any changes in its surface. After three months of observations, ask students to suggest what forces may have caused changes in their mountain. (Students should recall what they learned about erosion in the first lesson: *Sedimentation and the Watershed*.) Have them predict how long the mountain would remain if you left it there; test their hypotheses if you have enough time.

2. Compare this "mountain" to an island in the middle of the Chesapeake Bay. Ask students: Are these two structures similar? Do the same forces that changed the mountain of soil (erosion) affect Chesapeake Bay islands and coastline? (Yes; precipitation washed over the mountain of soil, carrying particles away with it when it drained. Over time, enough particles were removed to change the size of the mountain. Rain water can erode islands/shoreline in the Bay, but so can wave action. We'll investigate the effects of wave action on a sand structure in Step 3.)

3. Have students create a model, similar to the watershed models from the first lesson *Sedimentation and the Watershed*. (See *How to Build a Coastal Erosion Model* at the end of this lesson.) They will be using paint pans again, but this time sand will represent an island/coastline, rather than clay representing the watershed. Students will observe how wave action can erode a sand structure.

4. Have students read through the *Background Information*, or go over this information in a class discussion. Be sure to point out the three historical Chesapeake Bay maps and ask students how the Bay has changed over the last 300 years (students should see how islands have gotten smaller and Eastern Shore coastline has retreated).

5. Distribute copies of Poplar Island or Hart-Miller Island historical charts/maps/photographs (labeled Poplar 1-10 or Hart-Miller 1-5). Explain that erosion can be mapped, based on the land pattern shown on historic charts, maps, and photographs. Students may work in small groups to examine each figure and put them in order, from oldest to most recent. Advise students that the earliest chart was made in 1736 (Poplar) or 1877 (Hart-Miller); the most recent photograph was taken in 2008 (Poplar) or 1976 (Hart-Miller).

6. Review each chart/map/photograph as a class and assign the correct dates. You can explain to students that surveying technologies became advanced in the 1840s; that's why there are few maps of the area prior to that date.

   Correct answers:
   Poplar #5: 1736
   Poplar #2: 1846
   Poplar #6: 1861
   Poplar #10: 1896
   Poplar #1: 1909
   Poplar #9: 1914
   Poplar #7: 1969
   Poplar #4: 1994
   Poplar #3: 2003
   Poplar #8: 2008

   Hart-Miller #3: 1877
   Hart-Miller #2: 1952
   Hart-Miller #5: 1969
   Hart-Miller #1: 1971
   Hart-Miller #4: 1976

7. Distribute an aerial photo of Poplar Island and the Dredged Material Containment Facility you will be visiting. Discuss the definition of restoration (included in *Vocabulary*), how restoration can preserve or enhance the remnants of an original island, and how restoration can benefit habitat (see *Background Information*).

Extensions:

Students can learn more about early Chesapeake Bay exploration and Captain John Smith at the National Park Service's Captain John Smith Chesapeake National Historic Trail. A selection of curricula, lesson plans, and educational resources are available at http://www.smithtrail.net/about-us/for-educators.aspx.

References:

"For Educators – Captain John Smith Chesapeake National Historic Trail - National Park Service." *Captain John Smith Chesapeake National Historic Trail - National Park Service*. Web. June 2010. <http://www.smithtrail.net/about-us/for-educators.aspx>.

Living Waters of the Chesapeake. Baltimore, Md.: National Aquarium in Baltimore, 2002. CD/DVD.

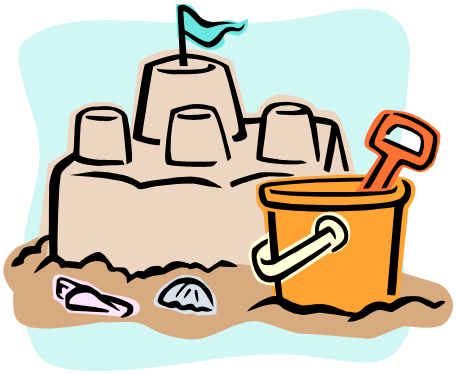
Coastal Erosion
Background Information

Water, the most common substance found on earth, is also one of the most powerful. As you learned in *Sedimentation and the Watershed*, water can erode the land as it flows downhill, drastically changing the landscape.

What are some signs of water erosion? How would a site look if erosion has affected that area of land?

On the next page few pages you will see three maps of the Chesapeake Bay: one from 1719; one from 1812-1824; and another that shows what the Bay presently looks like.

How has the Bay changed since 1719? Look specifically at the Eastern Shore coastline and nearby islands. Are there still as many islands in the Bay? Has the coastline changed? What would make these islands and shoreline smaller?



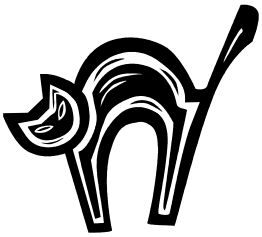
Think about the last time you built a sand castle at the beach. Imagine your sand castle was built very close to the water's edge. A large wave washes over the sand castle, taking a small amount of sand away with it. If enough waves wash over your castle, it may eventually disappear.

The wind and the waves from the Chesapeake Bay have washed over these islands and along the shoreline, taking away small amounts of land a little at a time. Now these lands are quickly disappearing. In the Bay watershed, 10,500 acres of land have been lost to erosion in the last 150 years.

As you learned in *Dredging up the Future*, the Maryland Port Administration and the US Army Corps of Engineers are using **dredged material** to rebuild an island in the Chesapeake Bay. This practice, known as "beneficial use," is how Maryland's Dredged Material Management Plan prefers to manage dredged material. By using dredged material to create wetlands, improve wildlife habitat, and restore eroding islands, the dredged material is put in a safe place that is great for the environment.

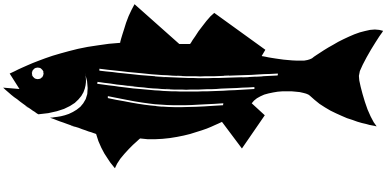
The Paul S. Sarbanes Ecosystem **Restoration** Project at Poplar Island is famous around the world for the good work that happens at this site.

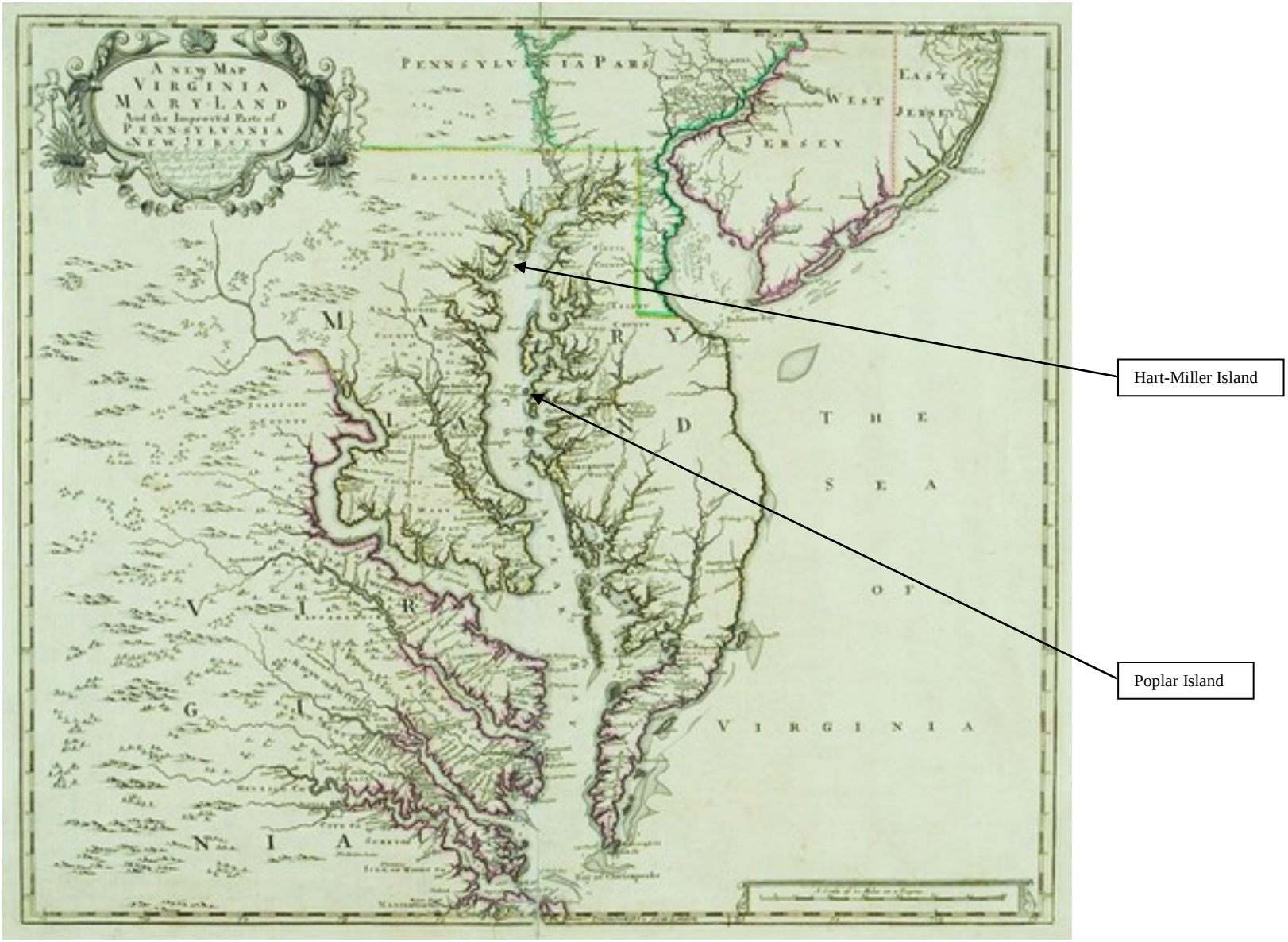
For almost 200 years, Poplar Island was home to many families who owned, lived on, and settled the land. They had farms, a church, a school house; everything they needed for a community. There was even a black cat farm on Poplar in the 1840s!



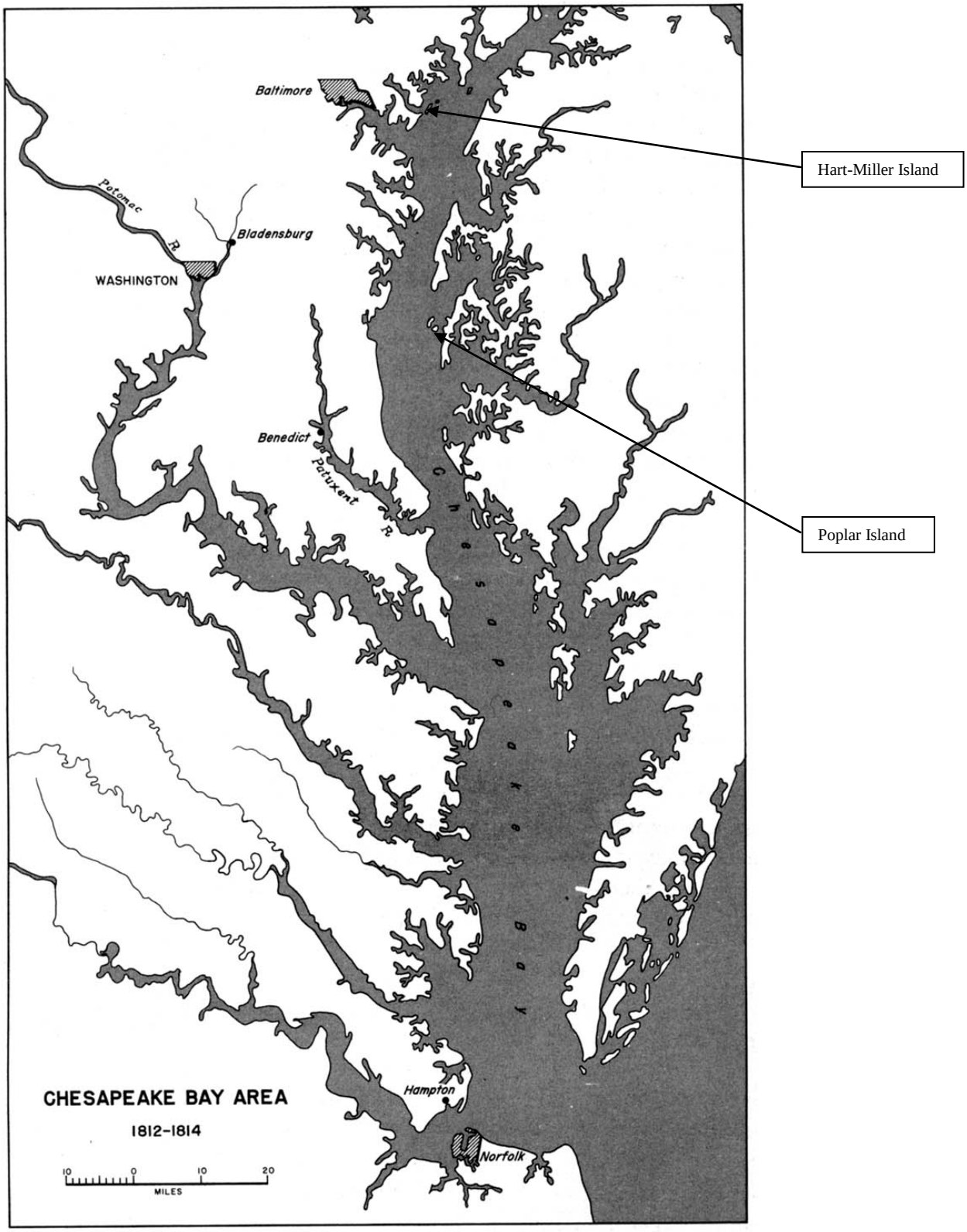
In 1847, a survey was done on Poplar Island that showed it was about 1,140 acres big. (An acre is about the size of a football field!) In 1992 and 1993, the US Army Corps of Engineers surveyed Poplar Island again and found that the island had eroded down to 4 tiny remnant islands. These 4 islands put together were less than 5 acres! Not only was Poplar home to people, but it provided habitat to many different Chesapeake Bay animals.

Many different organizations, like the Maryland Port Administration and the US Army Corps of Engineers, put their heads together and decided they wanted to restore Poplar to the size it was in 1847: about 1,140 acres. They used dredged material collected from shipping channels to rebuild wetland and upland habitat areas. Construction is still happening on Poplar, but already it has functional habitat that is a key part of the Chesapeake Bay **ecosystem**!

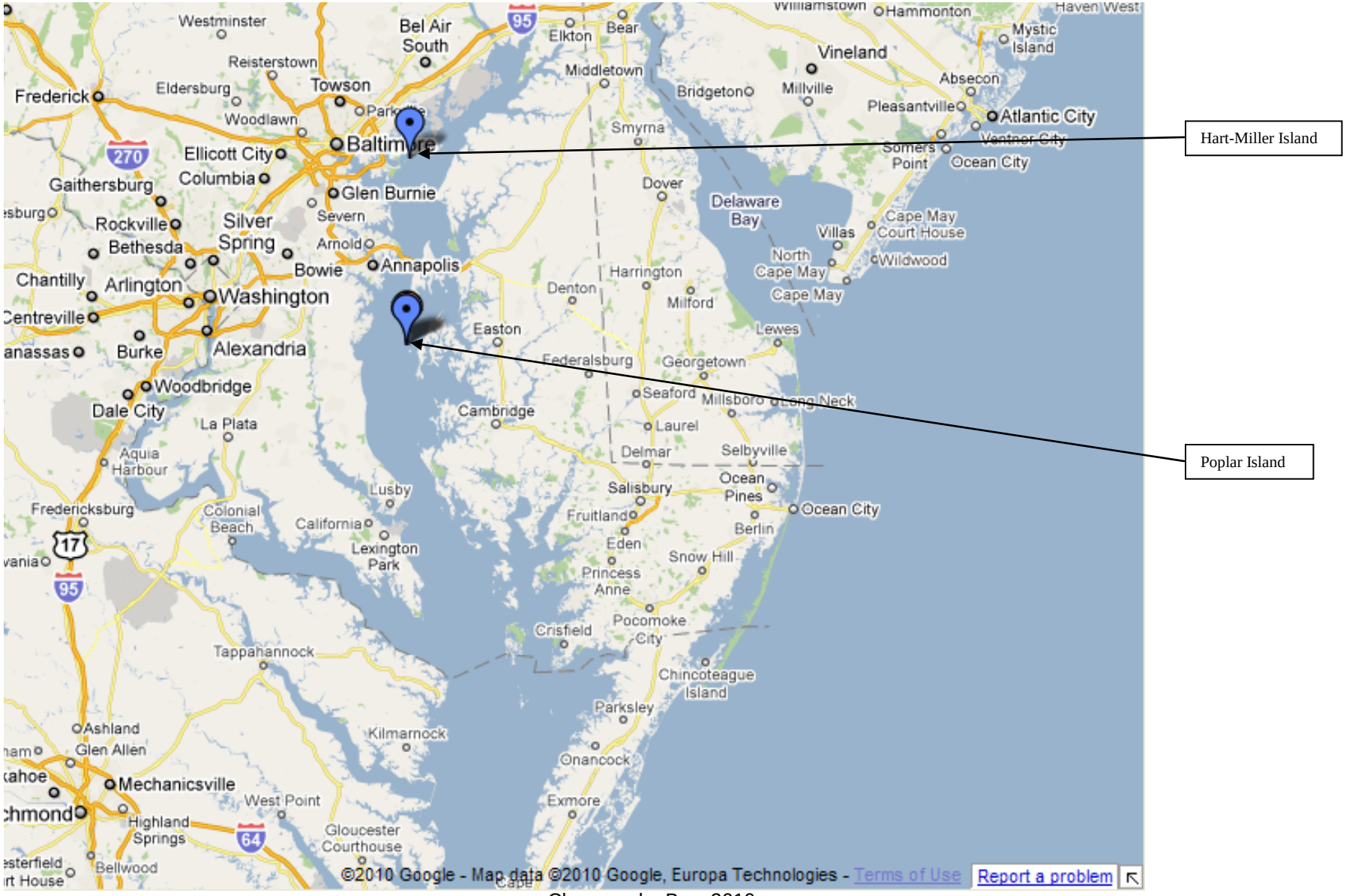




Chesapeake Bay, 1719
Courtesy: http://www.vos.noaa.gov/MWL/apr_08/exploration.shtml



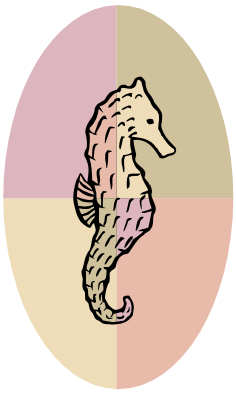
Chesapeake Bay, 1812-1814
Courtesy: http://www.lib.utexas.edu/maps/historical/chesapeake_1812-1814.jpg



Chesapeake Bay, 2010
Courtesy: maps.google.com

Coastal Erosion
Vocabulary

Dredged Material: soil or sediment that is taken from the bottom of a river or stream.



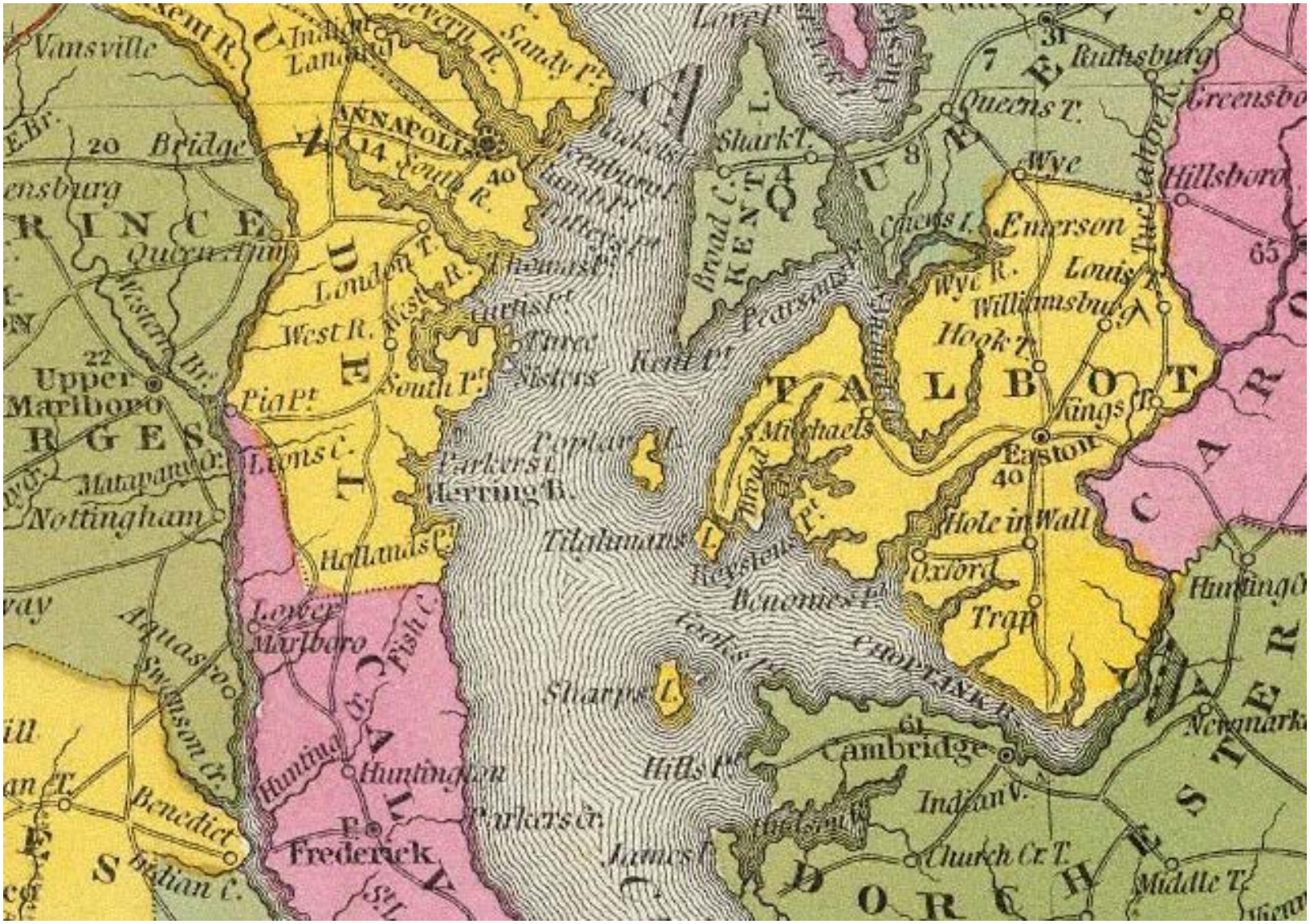
Ecosystem: a community of plants and animals, like a neighborhood.

Habitat: the place in which a plant or animal normally lives. It is where the basic elements needed by all living creatures to survive (food water, shelter, and space) are provided.

Restoration: the process of using scientific principles and experience to bring an area back to its former or original condition.


Talbot
County
Coursy Cr
Coursys Lords Gift
Newark
Love P.
Arundelton
South R.
Roac R.
West R.
Coppahan
Kent P.
Poplar P.
Loyos Cr.
St. Michaels R.
Tukkoh
Branch
N. E. Bra
Oxford
Swans Cr.
Hamet
Portland M.
Hering
Sharps I.
Chaptanck R.
Horne B.
Indi
Trips B.
Sharps Cr.
Fishing Cr.
Tobaccostocks Cr.
Dorches
Abington M.
Aquasquit
Patuxent M.
Bay of Ches

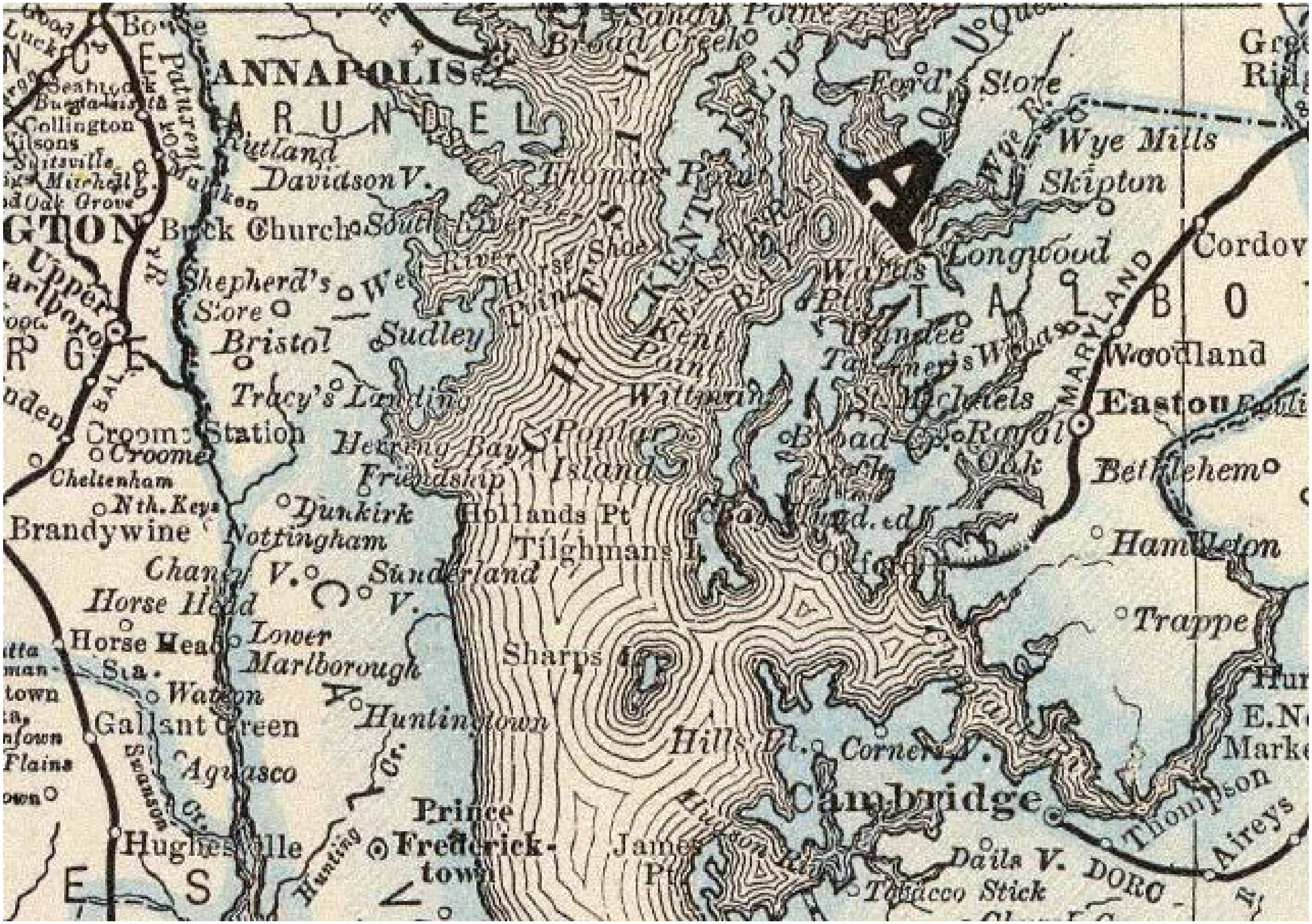
Poplar #5


Vansville
Bridge
ANNAPOLIS
South R.
Sandy Pt.
Shark I.
Queens T.
Wye
Hillsboro
Greensboro
Emerson
Louis
Williamsburg
Hook Pt.
Kent Pt.
Pearsons
Broad C.
KENT
QUEEN
ANNE'S
TALBOT
Upper Marlboro
Pig Pt.
South Pt.
Parkers I.
Merring B.
Poplar I.
St Michaels
Broad Pt.
Easton
Hole in Wall
Oxford
Trap
Tilghmans I.
Reynolds Pt.
Benoms Pt.
Hollands Pt.
Nottingham
Lower Marlboro
Fish C.
Sharps I.
Cambridge
Indian C.
Church Cr T.
Middle T.
Huntingtown
Frederick
Benedict
Hills Pt.
James I.
DORCHESTER
CAROLINE

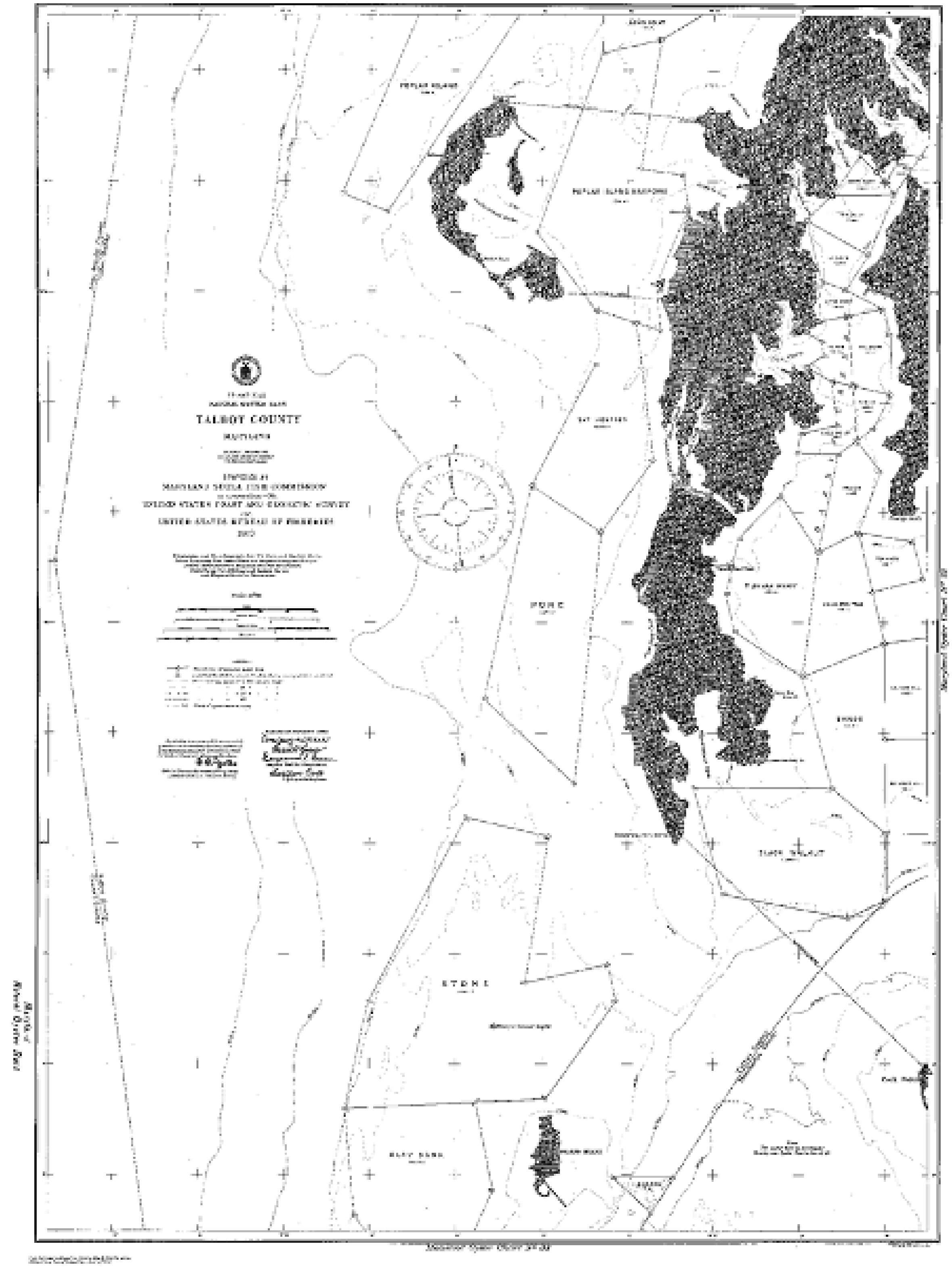
Poplar #2


EASTERN BAY
HERRING BAY
CHOPTANK RIVER
CAMBRIDGE
Kingstown
Louis T.
Queen Anne
Friendship
L. Marlboro
Hole in the Wall

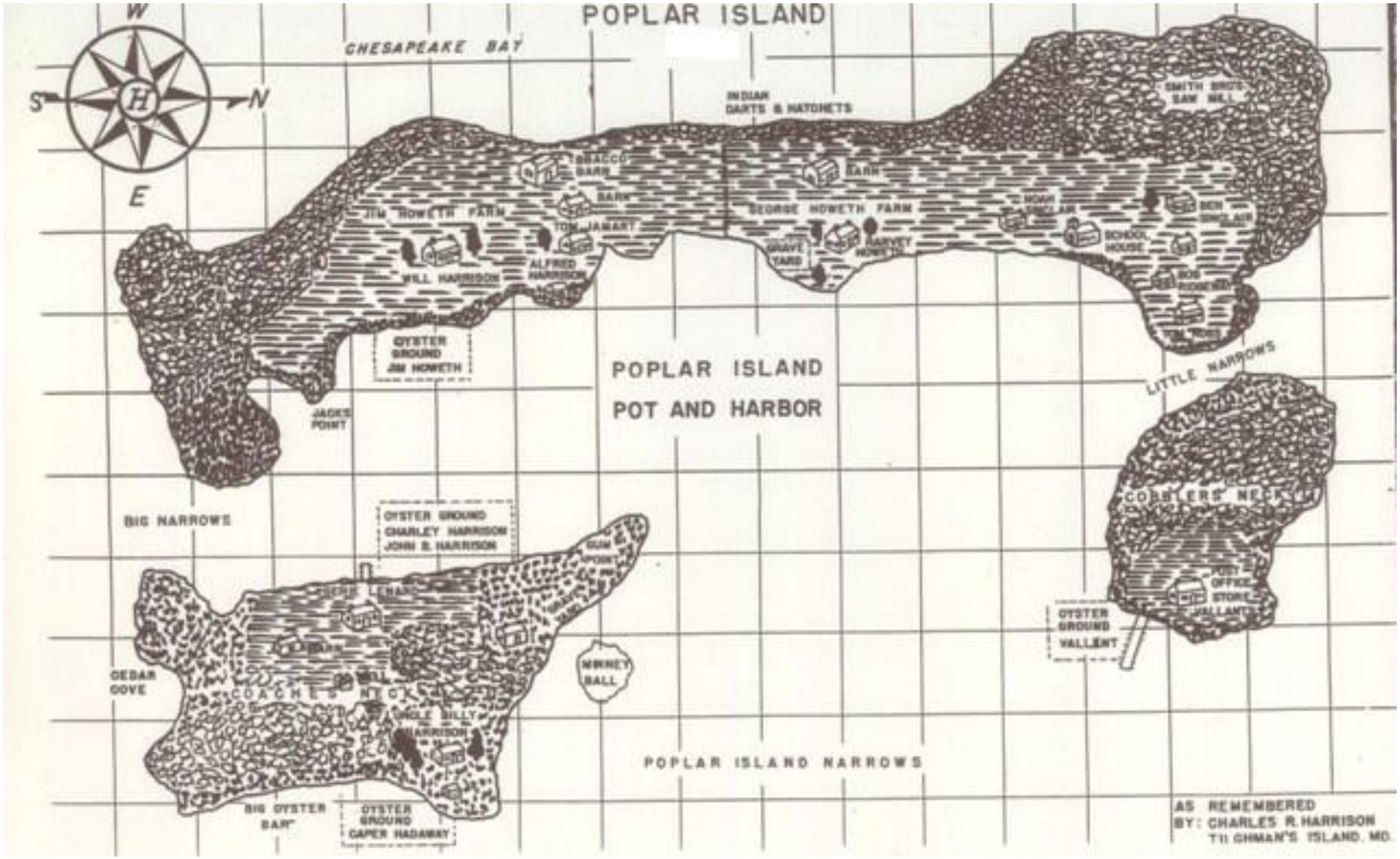
Poplar #6


ANNAPOLIS
ARUNDEL
Broad Creek
Ford's Store
Wye Mills
Skipton
Rutland
Davidson V.
Collington
Oak Grove
Brick Church
South River
Shepherd's Store
Upper Marlboro
Longwood
Cordova
Bristol
Sudley
Kent Point
MARYLAND
TALBOT
Woodland
Tracy's Landing
St. Michaels
Easton
Croom Station
Croome
Herring Bay
Poplar Island
Royal Oak
Bethlehem
Friendship
Cheltenham
Nth. Keys
Brandywine
Dunkirk
Hollands Pt
Nottingham
Tilghmans I.
Hamilton
Sunderland
Horse Head
Trappe
Lower Marlborough
Sharps I.
Huntingtown
Gallant Green
Hills Pt.
Aquasco
Cambridge
Prince Frederick-town
Thompson
Aireys
Hughesville
Dails V.
Tobacco Stick

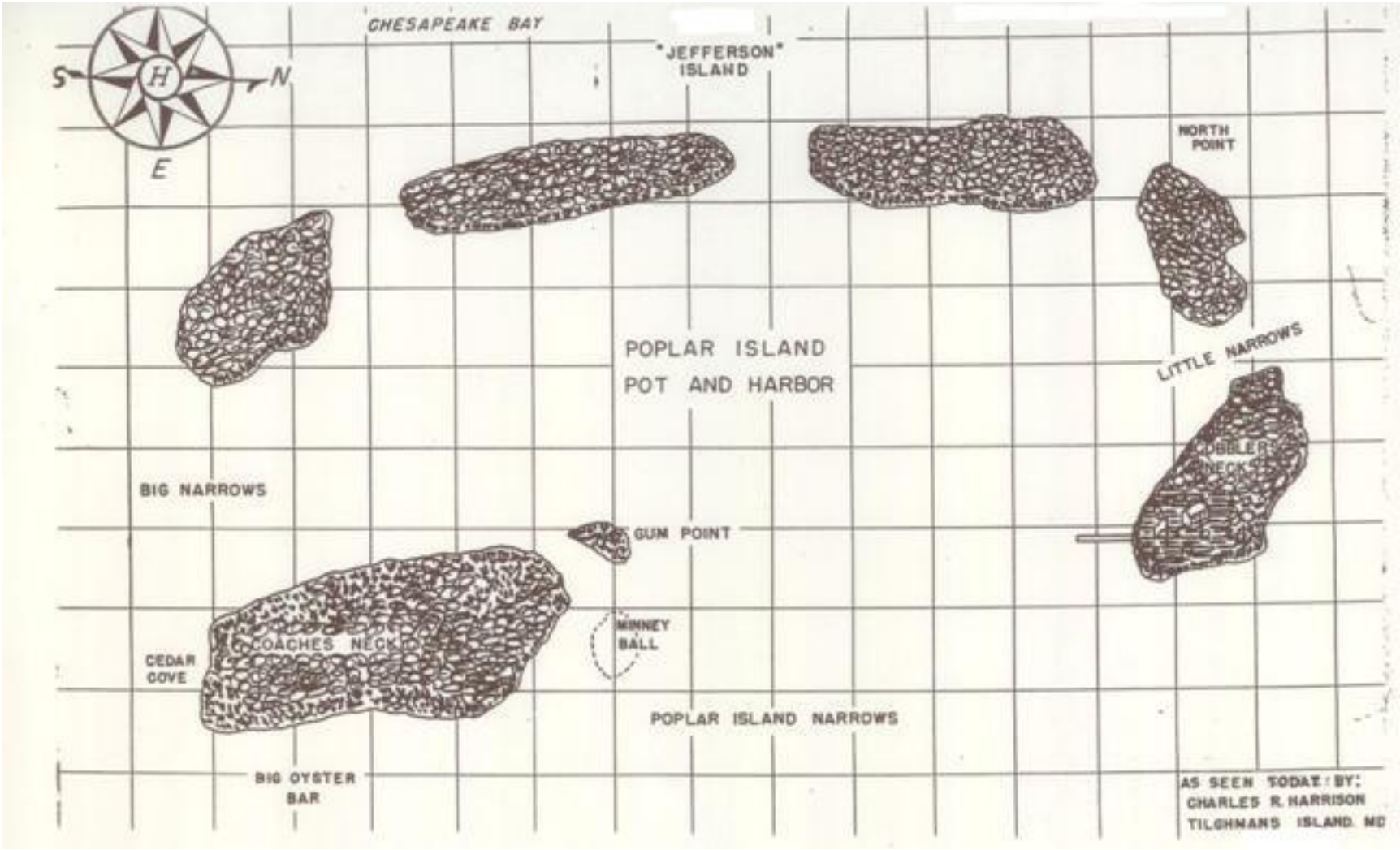
Poplar #10



Poplar #1


POPLAR ISLAND
CHESAPEAKE BAY
W
S
N
E
H
INDIAN DARTS & HATCHETS
SMITH BROS. SAW MILL
TOBACCO BARN
BARN
JIM HOWETH FARM
TOM JAMART
GEORGE HOWETH FARM
NOAH SINCLAIR
BEN SINCLAIR
GRAVE YARD
HARVEY HOWETH
SCHOOL HOUSE
BOB SINCLAIR
WILL HARRISON
ALFRED HARRISON
OYSTER GROUND JIM HOWETH
POPLAR ISLAND
POT AND HARBOR
LITTLE NARROWS
JACK'S POINT
BIG NARROWS
OYSTER GROUND CHARLEY HARRISON JOHN S. HARRISON
GUM SPOON
POST OFFICE STORE
VALLIANT
OYSTER GROUND VALLIANT
CEDAR COVE
COACHES NECK
NORNEY BALL
POPLAR ISLAND NARROWS
BIG OYSTER BAR
OYSTER GROUND CAPER HADAWAY
AS REMEMBERED BY: CHARLES R. HARRISON
TILGHMAN'S ISLAND, MD.

Poplar #9

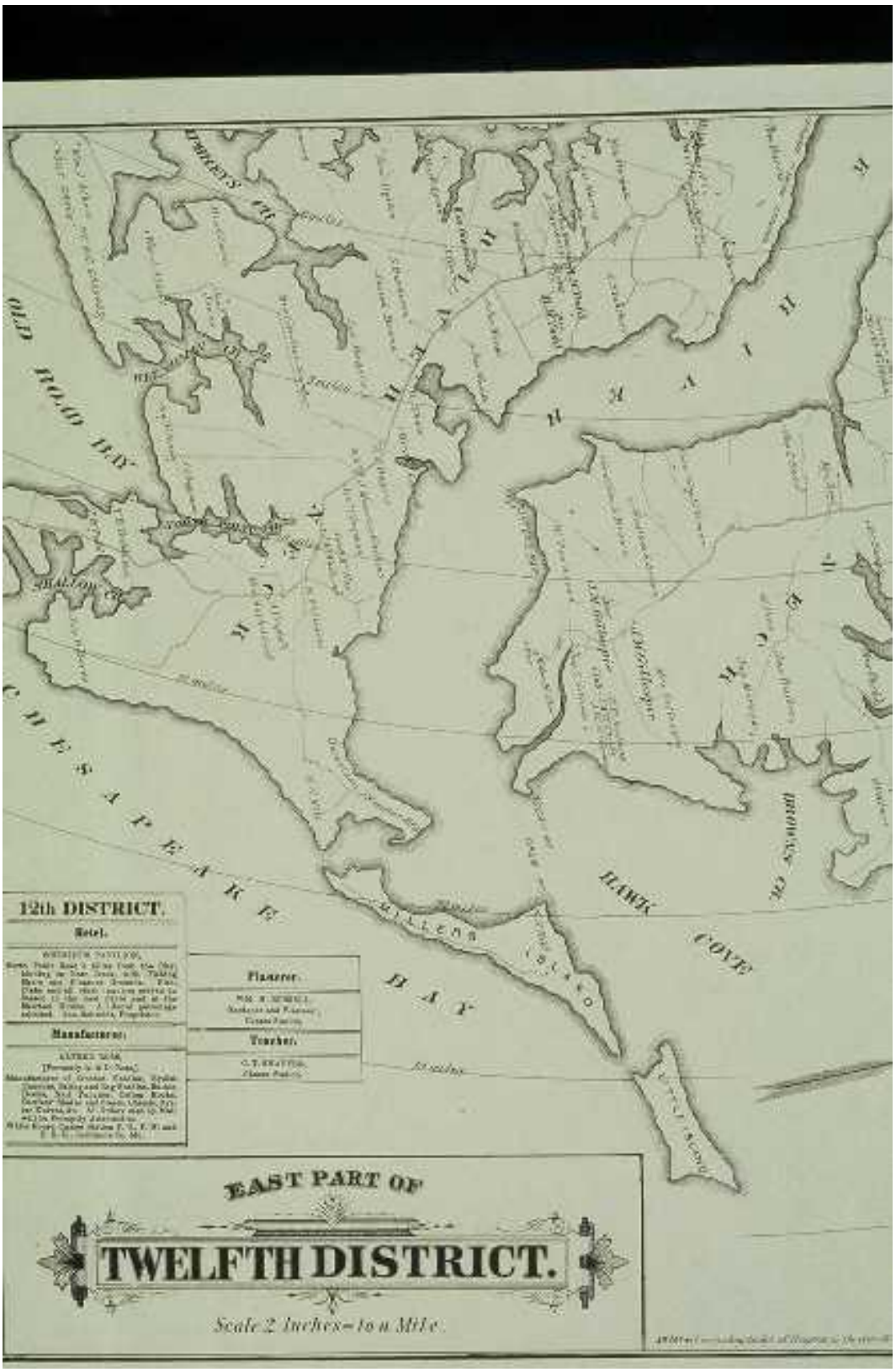

CHESAPEAKE BAY
"JEFFERSON" ISLAND
NORTH POINT
POPLAR ISLAND
POT AND HARBOR
LITTLE NARROWS
COBBLER NECK
BIG NARROWS
GUM POINT
MINNEY BALL
COACHES NECK
CEDAR COVE
POPLAR ISLAND NARROWS
BIG OYSTER BAR
AS SEEN TODAY BY:
CHARLES R. HARRISON
TILGHMANS ISLAND, MD

Poplar #7

Poplar #4

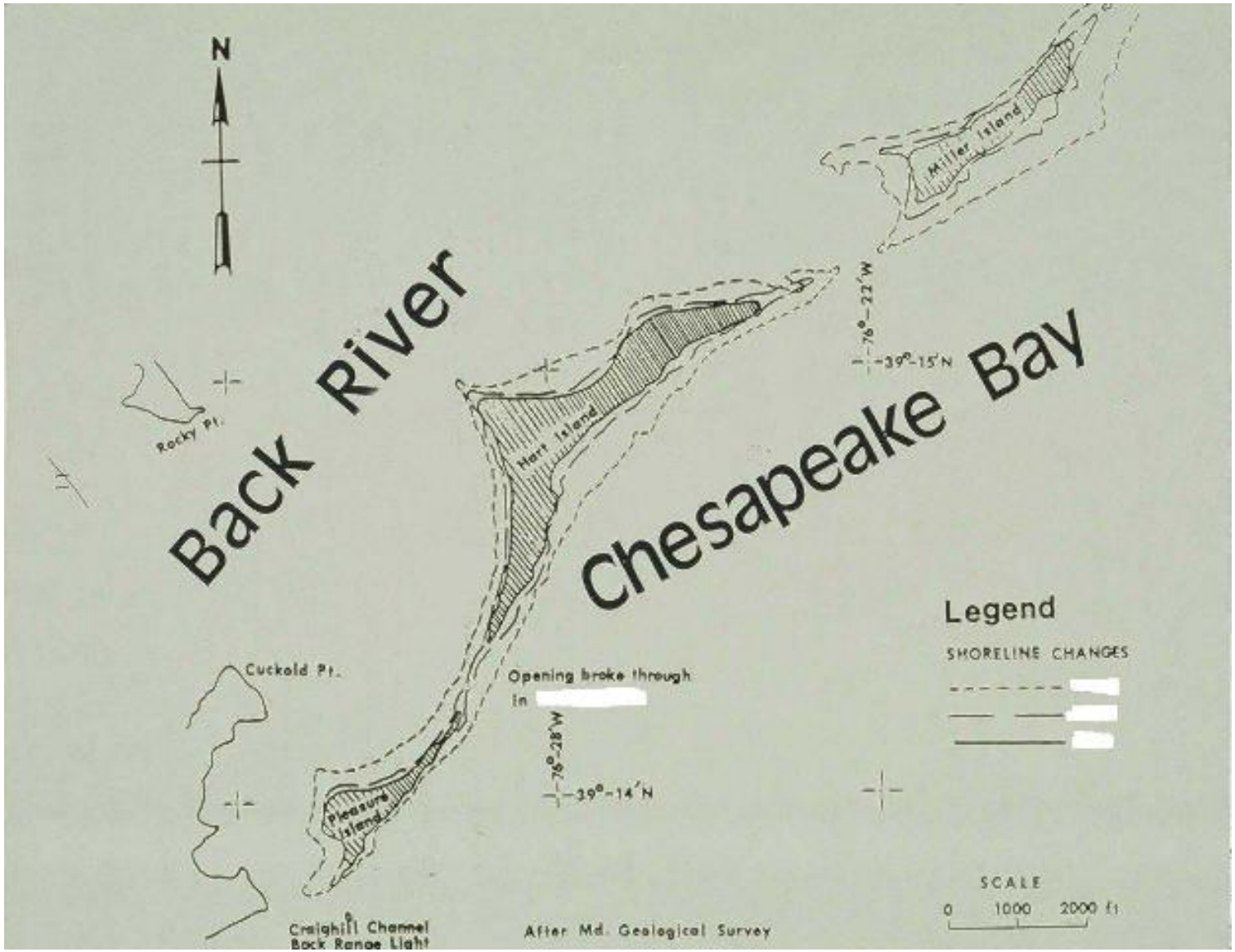
Poplar #3

Poplar #8



Hart-Miller #3

Hart-Miller #2



Hart-Miller #5

Hart-Miller #1

Hart-Miller #4

Dredged Material Placement Facilities, Present-Day

Cox Creek

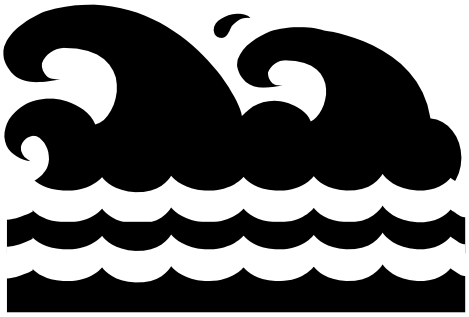
Masonville

Poplar Island

Hart-Miller Island

Coastal Erosion
How to Build a Coastal Erosion Model

Materials:
For each group:
Aluminum paint pan
Sand
Water
Ruler



Procedure:

1. Slope a generous amount of sand against the deep end of the paint pan.
2. Add enough water to cover about half the sand.
3. Use the side of a ruler to generate steady, even waves in the tray. This will simulate wave action in the Chesapeake Bay.
4. Observe the action of the waves on the "shoreline."
5. Experiment with different types of waves: long, slow waves versus very small, rapid waves. Record how these waves affect the shape of the shoreline.

Results:

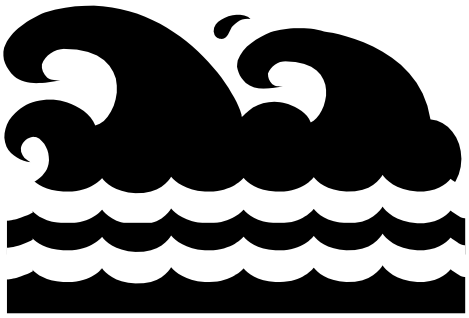
1. Describe the action of the waves on the "shoreline."

2. Where is the sand moving?

3. Repeat this experiment with different types of waves: long, slow waves versus very small, rapid waves. Record how these waves affect the shape of the shoreline.

4. Summarize how wind and water affect islands and shoreline.

Coastal Erosion
ANSWER KEY
How to Build a Coastal Erosion Model



Materials:
For each group:
Aluminum paint pan
Sand
Water
Ruler

Procedure:

1. Slope a generous amount of sand against the deep end of the paint pan.
2. Add enough water to cover about half the sand.
3. Use the side of a ruler to generate steady, even waves in the tray. This will simulate wave action in the Chesapeake Bay.
4. Observe the action of the waves on the "shoreline."
5. Experiment with different types of waves: long, slow waves versus very small, rapid waves. Record how these waves affect the shape of the shoreline.

Results:

1. Describe the action of the waves on the "shoreline."

The water removes sand from the upper part of the "beach."

2. Where is the sand moving?

The water deposits the sand below the water line.

3. Repeat this experiment with different types of waves: long, slow waves versus very small, rapid waves. Record how these waves affect the shape of the shoreline.

Answers will vary.

4. Summarize how wind and water affect islands and shoreline.

Over time, erosional forces from wind and water can remove land, making islands and shoreline smaller.

Pre-Trip Lesson #4: What's the Limit?

Summary: Students will learn why water quality is important and how it relates to Dredged Material Containment Facilities (DMCF).

Grade(s): 2-12

Time Required: 2 to 3 class periods

Objectives: After completing this lesson, students will be able to:

Part 1 (Grades 2-5)

- Measure different water quality parameters (pH, temperature, dissolved oxygen) among household substances.
- Explain how these parameters can affect the Chesapeake Bay ecosystem.

Part 2

- Explain how dredging and water quality are related.
- Define several water quality parameters.

Part 3 (Grades 6-12)

- Use real-time water quality data to predict water quality values around the Dredged Material Containment Facility they will be visiting.

Part 4

- Calculate Total Suspended Solids (TSS) using a given formula.
- Determine whether given TSS and pH values are within specific permit limits.
- Explain why it is important to monitor spillways at a DMCF.

Materials Needed:

Part 1

- Five clear glasses, each containing a sample of one of the following: tap water, bottled water, water with rubbing alcohol, and wetland water (if easily available on your school grounds). Plus a marker to label each A, B, C, or D.
- pH sample liquids (lemon juice, vinegar, rainwater, cola, Windex, bottled water, Miracle-Gro, baking soda/chalk/aspirin/antacid pills dissolved in water, etc.)
- Small paper cups
- pH papers (Carolina Biological Supply 1-800-334-5551) or an acid rain test kit (Delta Education 1-800-442-5444)
- Small jars or cups
- Several jars with water of different temperatures (hot, warm, cold, ice-cold)
- Thermometers
- Light source (unshaded light bulb)
- Paper to shade one jar of water
- Dissolved oxygen test kit
- Student copies: *Student Worksheet, Part 1: Water Testing Stations*

Part 2

- Student copies: *Part 2: Background Information*
- Overhead transparency or student copies: *What's the Limit? Vocabulary*

Part 3

- Student computer access
- Student copies: *Student Worksheet, Part 3: Eyes on the Bay: Real-Time Water Quality Data*

Part 4

- Calculators
- Student copies: *Student Worksheet, Part 4: Become an Environmental Inspector*
- Overhead transparencies: TSS Analysis Diagram and "Permit Limits" reference page

Activity:

Part 1: Grades 2-5: Water Testing Stations

1. Engage students by showing them 4 different samples that all appear to be clean water. Review the definition of pollution. Ask students if it is easy to tell whether or not water is polluted. Pass the samples around; ask students to use their senses of smell and sight to observe the water. Ask students to explain why they believe each sample is polluted or not, then review correct answers:
    - A: Tap water: This water is impure because tap water contains chlorine. Although people need chlorine in tape water to kill bacteria that may harm us, chlorine is toxic to fish and other life in the water.
    - B: Bottled water: This water is probably not polluted. It has most likely been filtered and has not been treated with chemicals.
    - C: Water with rubbing alcohol: This water looks clean but our sense of smell tells us it is polluted. Remind students that our sense of smell is important in determining whether water is polluted (water may look clean but smell like sewage or other pollutants).
    - D: Wetland water: This water may look dirty, but that doesn't necessarily mean it's polluted. We must test the water to determine if pollution is present.

2. Set up several water testing stations:
   pH: set up some jars with some common liquids (listed in *Materials*). Have small cups available and pH papers to perform testing.
   Temperature: Set up several jars with hot, warm, cold, and ice-cold water. Have a thermometer available. If possible, set up two jars of water at the same temperature under a light builb. Shade one jar; leave the other exposed to the light source.
   Dissolved oxygen: Set up a variety of liquid samples to be tested. You may choose samples from pH station or samples with dirt, soap, etc. Follow instructions on test kit.

3. Distribute copies of *Student Worksheet, Part I: Water Testing Stations.* Explain the water quality parameter that students will be measuring at each station. Divide students into small groups.

4. Have groups rotate between the 3 stations and follow the directions at each to measure water quality parameters.

5. Distribute copies of *Vocabulary* (if necessary for student understanding).

6. Discuss results (these questions are included on *Student Worksheet*):
    - What human activities could impact pH levels?
    - Why does water with a very high or very low pH level kill fish?
    - What is the relationship between dissolved oxygen and temperature?
    - Why does the shaken water sample contain more dissolved oxygen?
    - What natural events could increase water temperatures?
    - What human activities could increase water temperatures?
    - Is there a relationship between water temperature and water depth?
    - What conditions would increase or decrease dissolved oxygen?

Part 2*: Background Information* and *Vocabulary*

1. Have students read through the Background Information, or go over this information in a class discussion. Make sure students understand the vocabulary words and the different parameters that are used to measure water quality.

Part 3: Grades 6-12: *Eyes on the Bay: Real-Time Water Quality Data*

1. Distribute *Student Worksheet, Part 3: Eyes on the Bay: Real-Time Water Quality Data.*
2. Students will follow instructions to access MD DNR's Eyes on the Bay website.
3. Students will use website to find definitions and measurement units for 5 water quality parameters: dissolved oxygen, water temperature, salinity, pH, and water clarity/turbidity. They will enter this in the appropriate columns of their Data Chart.
4. Students will find the real-time monitoring station that is closest to the Dredged Material Containment Facility your class will visit. They will analyze data from this station to predict the range for each water quality parameter around the DMCF. This will be recorded on the Data Chart.

Part 4: *Become an Environmental Inspector*

1. Distribute *Student Worksheet, Part 4: Become an Environmental Inspector*. The TSS Analysis diagram and "Permit Limits" reference page can be displayed on an overhead; individual student copies are not necessary.
2. Students will follow instructions to calculate the TSS level of a water sample.
3. Students will take on the role of an Environmental Inspector. They must compare water quality data to permit limits to decide if the data meets permit requirements.

Extensions/Related Activities:

K-2:

- For younger students, the WOW! Wonders of Wetlands activity *Nutrients: Nutrition or Nuisance?* provides a hands-on game to teach about water quality in a marsh.
- *A-maze-ing Water* from Project WET teaches students how actions in the home and yard affect water quality.

***Note:**

pH is an important water quality parameter for students to understand and it is investigated thoroughly during this classroom lesson. However, due to permit requirements, students will not be able to test pH from our containment areas while on-site at one of our Dredged Material Containment Facilities. They will be able to test other water quality parameters. If you feel this will cause confusion amongst your students, please explain this before your fieldtrip.

References:

Eyes on the Bay. Maryland Department of Natural Resources. Web. June 2010. <http://www.eyesonthebay.net>.

Kesselheim, Alan S., Britt Eckhardt. Slattery, Susan Higgins, and Mark R. Schilling. *WOW!: the Wonders of Wetlands*. St. Michael's, MD: Environmental Concern, 1995. Print.

Project WET: Curriculum & Activity Guide. Bozeman, Mont.: Watercourse, 1995. Print.

Project WILD Aquatic: K-12 Curriculum & Activity Guide. Houston, TX: Project WILD, 2008. Print.

"What's Up With Our Nation's Waters?" *US Environmental Protection Agency*. Web. 25 June 2010. <http://www.epa.gov/owow/monitoring/nationswaters/>.

What's the Limit?
Student Worksheet
Part 1: Water Testing Stations

Station 1: pH*

pH determines whether the water is acidic or basic.

Directions: Pour a small amount of each sample liquid into separate cups. Take one strip of pH paper and dip the end into the sample. Hold paper in sample liquid for 5 seconds. Compare color to color chart to find pH value.

Sample description	pH value	Acid or Base?

*A buffer is something that neutralizes acids and bases in solution. Chalk, baking soda, and antacids act as buffers. Mix them with lemon juice or vinegar and test the solution again.

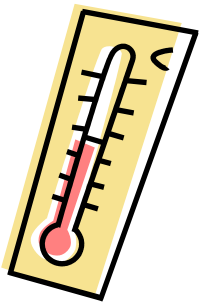
Questions:

1. What human activities could impact pH levels?

2. Why does water with a very high or very low pH level kill fish?

Station 2: Temperature

Temperature is a measurement of hot or cold the water is.



Directions: Practice using thermometers to get accurate readings. Compare results with your classmates to assess accuracy.

Sample	Temperature
Hot water	
Warm water	
Cold water	
Ice water	
Water exposed to light source	
Water shaded from light source	

Questions:

1. What natural events could increase water temperatures?

2. What human activities could increase water temperatures?

3. What is the relationship between water temperature and water depth?

Station 3: Dissolved oxygen

Dissolved oxygen tells us how much oxygen the water contains.

Directions: Follow the directions in your dissolved oxygen test kit carefully under adult supervision. Test the dissolved oxygen levels of water at different temperatures. Samples can be shaken vigorously and re-tested to compare differences in oxygen levels.

Sample	Dissolved oxygen
Hot water (before shaking)	
Hot water (after shaking)	
Warm water (before shaking)	
Warm water (after shaking)	
Cold water (before shaking)	
Cold water (after shaking)	
Ice water (before shaking)	
Ice water (after shaking)	

Questions:

1. What conditions would increase or decrease dissolved oxygen?

2. What is the relationship between dissolved oxygen and temperature?

3. Why does the shaken water sample contain more dissolved oxygen?

What's the Limit?
Part 2: Background Information

Every living thing on Earth uses water, including all the organisms found in the Chesapeake Bay and its rivers. The **water quality** of the Chesapeake Bay is closely linked to how the land is used within the Bay's watershed. Human uses, such as agriculture, urban and industrial use, and recreation can cause pollution on land. Water drains from the land into streams and rivers and can carry with it these pollutants that might change the quality of the water in the Chesapeake Bay.

Just like doctors use tools to make sure you are healthy, scientists use different instruments to find out how healthy the water is. Your doctor might use a thermometer or a stethoscope; water scientists use probes, gauges, and meters to determine water quality. These tools measure a variety of **parameters** to judge water quality:

- Physical: **water elevation, temperature, clarity/turbidity, salinity, total suspended solids**
- Chemical: **pH*, dissolved oxygen,** metals, oil
- Aesthetic: odors, color, floating matter

To ensure that the water where plants and animals call home is a healthy habitat, state and federal agencies determine water quality standards. These standards set the maximum level for different water quality parameters. The parameters must be below the set maximum level in order for natural environment to be healthy.

In the *Dredging up the Future* lesson, you learned why the Baltimore Harbor and Chesapeake Bay shipping channels need to be dredged and what happens to the dredged material. You learned what a confined disposal facility is and how Maryland beneficially reuses dredged material to rebuild island and wetland habitats. You learned there are four Dredged Material Containment Facilities around the Bay: Poplar Island, Hart-Miller Island, Cox Creek, and Masonville.

How are dredging and water quality related? After dredged material is placed within each site, it slowly dries and consolidates. This **dewatering** process allows the excess water to drain from the land into **spillways**

and then return to the Bay. Any water that leaves the site is carefully monitored to make sure the water returning to the Bay meets the limits outlined in our **permits**. Environmental Inspectors collect water samples, test the water, and if the parameters meet our permit limits, the water can be released from the site through a spillway.

These water samples can be collected two different ways. Grab samples are individual samples collected from a spillway in less than 15 minutes. Inspectors measure pH with a grab sample. Composite samples are a combination of individual samples that are collected over an 8-hour period. A certain amount of water is collected every 20 minutes. After 8 hours, all those samples are combined, and one composite sample is taken from that combination. Inspectors measure total suspended solids with a composite sample.

What's the Limit?
Vocabulary

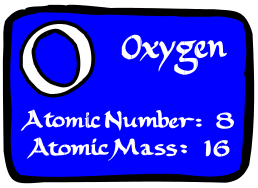
Water quality: the chemical, physical, and biological characteristics of water with respect to its suitability for a particular use.

Dewater: the process of removing water from dredged material so that it may dry out and consolidate.

Permit: a document that gives permission to do something (like discharge water from a Dredged Material Containment Facility).

Spillway: a structure used to release water when open, or hold water when closed.

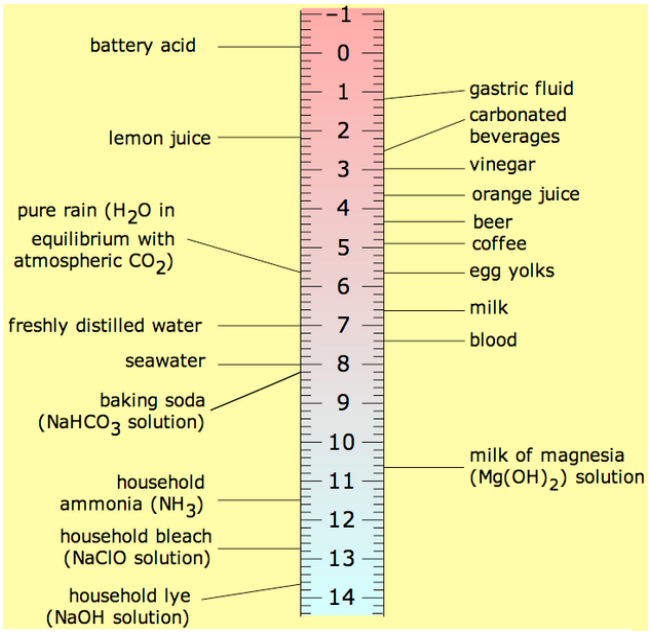
Water Quality Parameter: one part of a set of properties that determine the characteristics of something (like water quality). Below are different water quality parameters:



Dissolved oxygen (DO): Just like humans, aquatic organisms need oxygen in order to breathe. This indicator tells scientists how much oxygen is available in the water. Many different factors affect the DO level: temperature, how fast the water is flowing, and how many plants are growing in the water.

Clarity: clearness of a water sample; the ability to see through the water

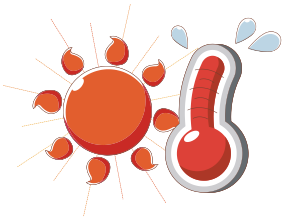
pH*: pH stands for "potential hydrogen," which determines whether the water is acidic or basic. The pH scale ranges from 1 to 14; values less than 7 are considered acidic; 7 is considered neutral, and a pH greater than 7 is considered basic. Rainwater is slightly acidic with a pH of around 6.5. The pH of a body of water is extremely important to



http://commons.wikimedia.org/wiki/File:PH_scale.png

aquatic life. If pH becomes too high or too low, some species of fish may not survive. An extremely low pH can allow harmful metals in the soil to seep into a body of water, poisoning aquatic life.

Salinity: a measurement of the total amount of salt dissolved in the water. In the Bay, salinity is the result of the mixing of freshwater from streams and rivers with ocean water.



Temperature: Water temperature is very important. If the water gets too hot or too cold, organisms may die. Temperature also affects the chemistry of the water. Fish and other aquatic animals require oxygen in the water in order to breathe; warm water holds less dissolved oxygen than cold water.

Total suspended solids: a measurement of the amount of small particles of solid pollutants that float on the surface of or are suspended in a water sample. TSS is measured by filtering the water sample through filter paper and weighing the filter. The increase in weight of the filter paper is used to calculate TSS:
TSS (mg/L) = ([A-B]*1000)/C
Where A = End weight of the filter; B = Initial weight of the filter; C = Volume of water filtered

Turbidity: a measurement of the ability for light to pass through a sample of water; the more particles that are suspended in the sample, the more turbid it will be. Events that stir up sediment or cause runoff, such as rain and storms, will increase the turbidity of the water. Algae blooms will also cause high turbidity. If turbidity gets too high, light will be blocked and bay grasses won't be able to grow.

Water elevation: the height of the water, relative to mean low tide

What's the Limit?
Student Worksheet
Part 3: Eyes on the Bay: Real-Time Water Quality Data

Soon your class will be visiting a Dredged Material Containment Facility (DMCF): Hart-Miller Island, Cox Creek, or Masonville. Before you go, predict what the water quality will be around the site. In this activity, you will analyze real-time water quality data from the Eyes on the Bay website from the Maryland Department of Natural Resources.

Instructions:

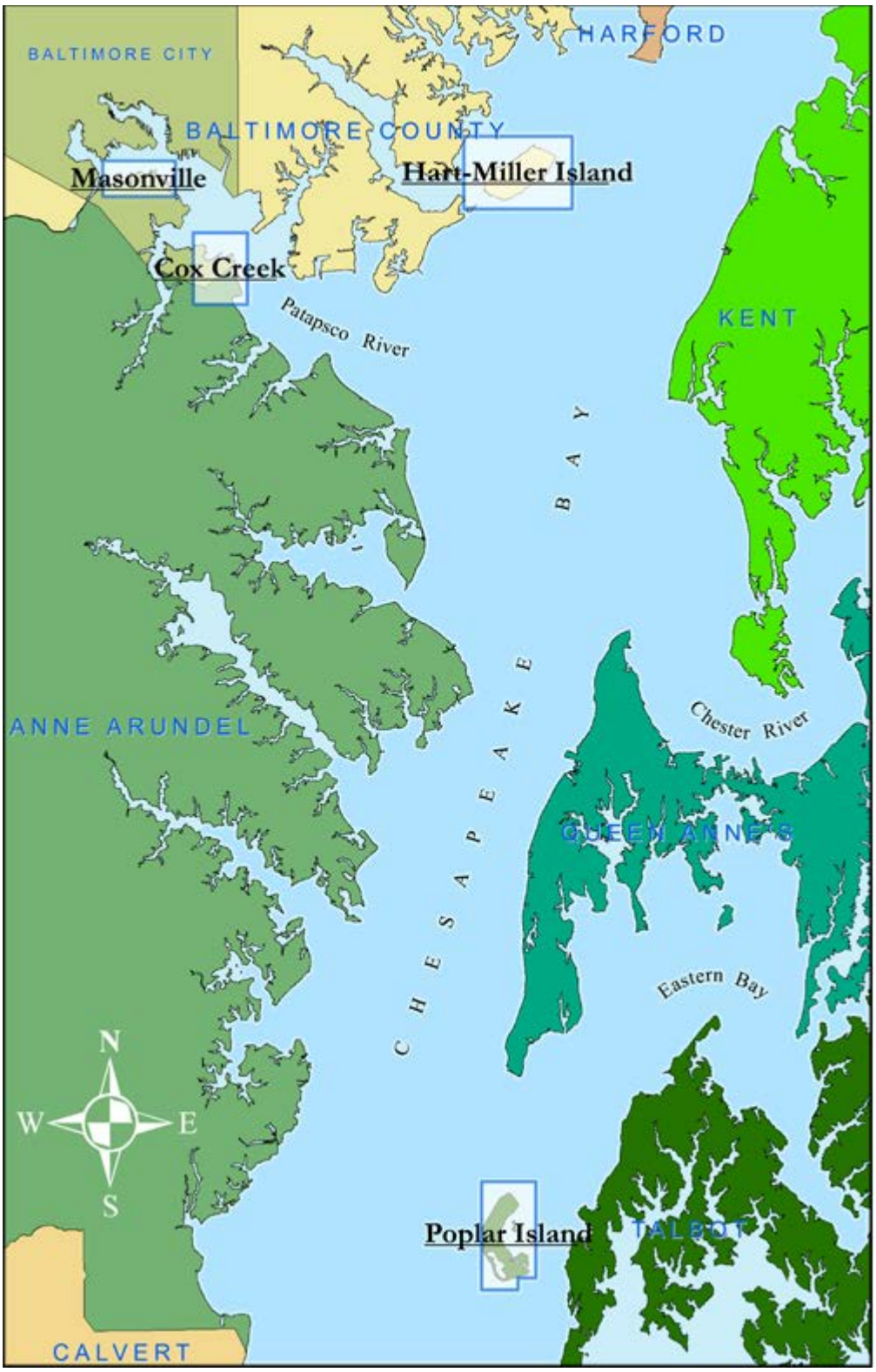
1. Go to the Eyes on the Bay website: www.eyesonthebay.net. You will see a map of Maryland with several red squares, blue stars, green and orange circles, and yellow plus signs. These represent monitoring stations, where machines in the water measure water quality. We can access these machines through the Eyes on the Bay website to see what the water quality of that site is like, sometimes at that exact moment in time.

2. You will predict the water quality around the DMCF you will visit. You will do so by analyzing data from the closest monitoring station.

3. Before you can look up this data, you must find the definition of and measurement units for each water quality term (dissolved oxygen, water temperature, salinity, pH, and water clarity/turbidity).
    - From the Eyes on the Bay main page, click on "What Does It Mean? A brief explanation available data" from the column on the left. Using the information from this page, fill in the columns of your Data Chart labeled "Definition" and "Measurement Units."

4. Return to the Eyes on the Bay main page. Compare the Eyes on the Bay map to the map on the following page that shows Maryland's Dredged Material Containment Facilities. Find the monitoring station that is closest to the DMCF you will be visiting. Ask your teacher for help if you are unsure which station is closest to your site.
    - What Dredged Material Containment Facility will you be visiting? What is the name of the monitoring station that is closest to this DMCF?

    Answers: _____ and _____



Maryland's Dredged Material Placement Sites
http://www.mpasafepassage.org/mapping.html

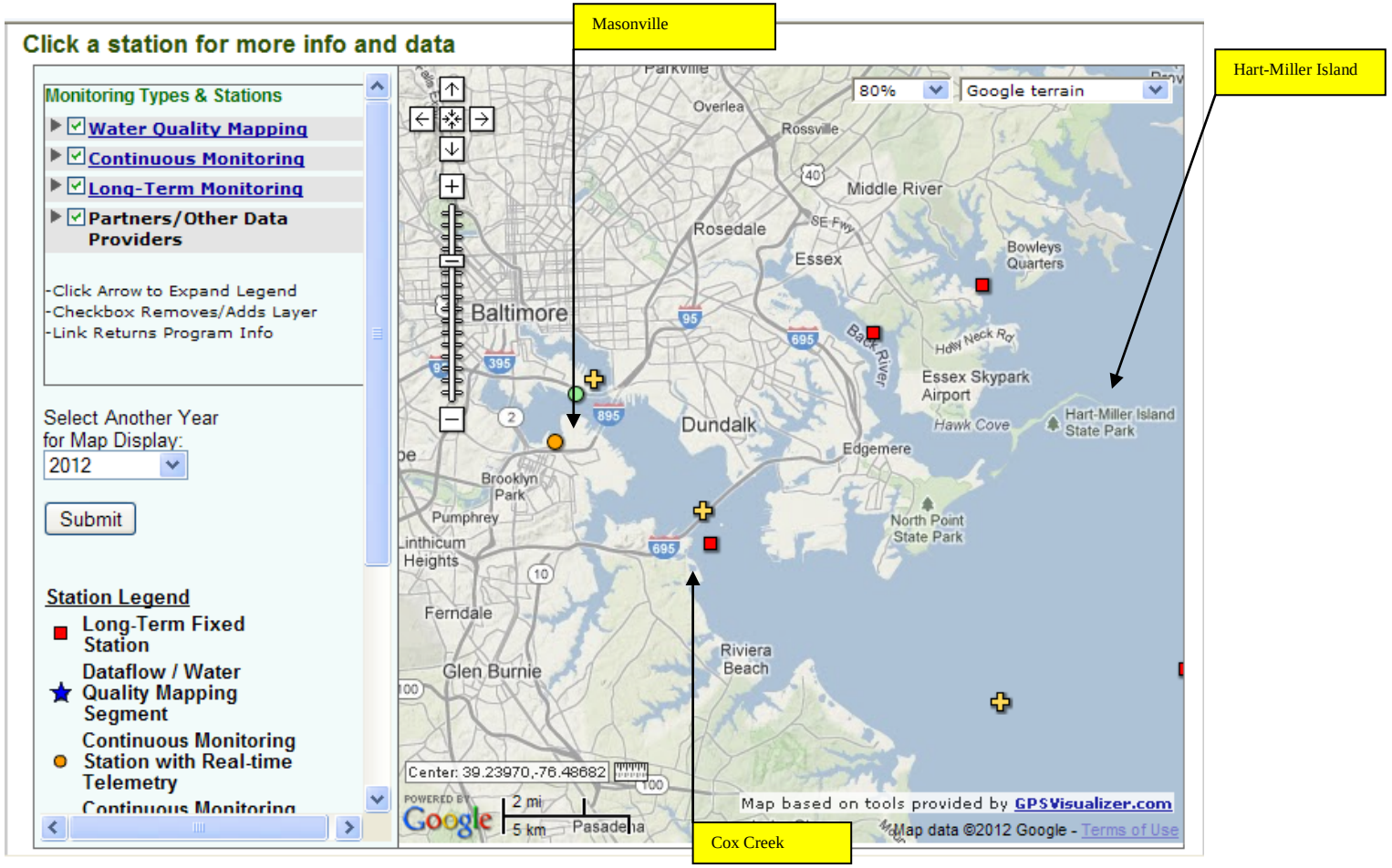
5. Click on the icon for this station. You will see more information about the station (the location of the station, the coordinates, a description, and/or depth, etc.).
    - Below that you will see graphs showing ranges of values for different water quality parameters.
    - Use the graphs to estimate the highest and lowest values of each parameter (dissolved oxygen, water temperature, salinity, pH, water clarity/turbidity). Record these in the last column of the Data Chart. You may have to click on a link to switch to a graph of a different parameter.

Data Chart:

Water Quality Term	Definition	Measurement units	Parameter range around site, based on closest monitoring station
Dissolved Oxygen			Masonville:
			Hart-Miller Island:
			Cox Creek:
Water Temperature			Masonville:
			Hart-Miller Island:
			Cox Creek:
Salinity			Masonville:
			Hart-Miller Island:

			Cox Creek:
pH*			Masonville:
			Hart-Miller Island:
			Cox Creek:
Water clarity/turbidity			Masonville:
			Hart-Miller Island:
			Cox Creek:

What's the Limit?
ANSWER KEY
Part 2: Eyes on the Bay: Real-Time Water Quality Data



ANSWER KEY (continued)

Site	Closest Monitoring Station
Hart-Miller Island	WT4.1 – Back River
Cox Creek	WT5.1 – Baltimore Harbor
Masonville	Patapsco River – Masonville Cove

Data Chart:

Water Quality Term	Definition	Measurement units
Dissolved Oxygen	"The amount of oxygen dissolved in Bay waters is probably the single most important measure of habitat quality; without oxygen, all of the living resources familiar to us perish. Dissolved oxygen (DO) is measured as a concentration (mg/l – milligrams per liter). When DO concentrations drop below 5 mg/l, the Bays' more sensitive organisms, such as fish, become stressed, especially if exposed to these conditions for prolonged periods. Bottom-dwelling organisms such as worms are usually more tolerant, and some species can survive at levels down to 1 mg/l in some cases. Most of the Bays' more visible living resources will not survive exposure to waters of less than 1 mg/l for more than a few hours."	Mg/l (milligrams per liter)
Water Temperature	"Temperature undergoes wide variations seasonally, although it is much less variable and much more predictable than any other habitat measurement. This can be seen by looking at the historical range for the long-term stations for any given month. This relative stability is due to the heat retaining properties of water, which make it much more resistant to temperature changes than our atmosphere."	Degrees Fehrenheit
Salinity	"The concentration of salt, or salinity, is a function of the mixing of freshwater from the Bay's tributaries with ocean waters, which contain approximately 32 ppt (parts per thousand) salinity. In any given location, salinity can vary greatly depending upon river flow, being low during high flows and high during droughts. Most of the Bay's living resources are adapted to these large swings in salinity, but extreme floods or droughts can lead to stressful conditions. For example, prolonged extreme low salinity can lead to mortality of clams and other benthic organisms. Conversely, extended periods of high salinity brought on during	Parts per thousand

	periods of drought can lead to mass oyster mortality, by increasing the distribution and virulence of oyster parasites. Extended periods of high salinity can also force fish that prefer lower salinities, such as yellow perch, out of river mainstems and up into headwater creeks. These areas often have large algae blooms and low DO conditions, which can be stressful or even lethal to fish. Freshwater species of bay grasses, such as wild celery, cannot move and may be stressed or killed by the rising salinities brought on by a drought."	
pH	"pH, in simple terms, is a chemical measure of whether or not something is an acid or a base. It is measured on a log scale of 0 to 14, with each unit representing a ten-fold change. A pH of 7 is considered neutral and a range of 5.5 to 8.5 is usually tolerated by most aquatic organisms. Lower pHs are sometimes seen in fresher waters due to acid precipitation or even naturally-occurring organic acids, which can be found in areas with extensive marshes. High pHs can occur during algae blooms due to chemical processes associated with photosynthesis. Moderate to higher salinities usually "buffer" pH in the 7 to 8 range, so most of the more extreme values will be found in low salinity situations."	No units
Water clarity/turbidity	"Secchi depth is a measure of the clarity, or turbidity of the water. Secchi depth is measured using a circular plate, called a Secchi disk, which is divided into quarters painted alternately black and white. The Secchi disk is lowered into the water until it is no longer visible, and that depth is measured. Secchi depth values that are high indicate clearer water, and low Secchi depths indicate high turbidity. Turbid waters typically appear cloudy and have high concentrations of total suspended solids (TSS), thereby allowing less light to penetrate through the water. As described above, increased turbidity is often due to excessive algal growth. However, turbidity can also increase due to land run-off and shore-line erosion, pollution, resuspension of bottom sediments, dredging operations, or during high periods of fresh-water input from rivers and streams. Turbidity is typically high in areas known as turbidity maximum zones, which occur at the edge of salt wedges where freshwater and saltwater mixing occurs. Highly turbid waters, or waters with low secchi depth, tend to prevent the growth of bay grasses, which provide DO to the water column and critical habitat for many fish and invertebrate species. Water clarity can also be measured more accurately using a transmissometer, which records turbidity values in Nephelometric Turbidity Units (NTUs). Turbidity values over a threshold of 15 NTUs are normally considered to be detrimental to bay grass growth. Increased turbidity can also lead to decreased fish health by increasing susceptibility to infectious diseases through increased stress, and reducing the ability of fish's gills to extract DO from the water. High areas of turbidity can also cause the silting over of benthic organisms, the equivalent to being buried alive."	Secchi depth is measured in meters; Transmissometers measure turbidity in Nephelometric Turbidity Units (NTUs)

What's the Limit?
Student Worksheet
Part 4: Become an Environmental Inspector

After dredged material is placed at Hart-Miller Island, Cox Creek, or Masonville, it will dry and consolidate. To help with consolidation, the extra water is drained off the dredged material and back into the Chesapeake Bay or Patapsco River. We call this dewatering. The water that leaves the site exits through structures called spillways.

As an Environmental Inspector, it is your job to make sure this water returning to the Bay is not polluted. One of the water quality parameters you must measure is Total Suspended Solids (TSS), or the amount of particles (solids) that are floating, or suspended in the water.

TSS is measured by filtering the water sample through filter paper and weighing the filter (see diagram). The increase in weight of the filter paper is used to calculate TSS:

$$TSS\ (mg/L) = ([A-B]*1000)/C$$

A = End weight of the filter (mg)
B = Initial weight of the filter (mg)
C = Volume of water filtered (mL)

Analyze:

1. How does TSS affect water quality?

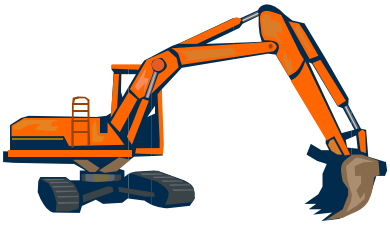
2. Which is better: high TSS or low TSS?

3. You filter a water sample to measure TSS. Before the test, the filter weighs 114.3 mg. You filter 50 mL of sample water through the filter. After the filter has dried, it weighs 121.3 mg. What is the TSS level of the sample?

The Industrial Discharge Permit sets limits on the amount of Total Suspended Solids in the water being discharged, or released, from Hart-Miller Island, Cox Creek, and Masonville. pH is also limited by these permits.

If TSS, pH, or other water quality parameters are above or below permit limits, you are not allowed to open the spillway to discharge water into the Chesapeake Bay or Patapsco River. Once a spillway is open, the water must be tested every hour.

Other parameters regulated by permits can include metals (arsenic, cadmium, chromium, copper, lead, silver, zinc, barium, hexavalent chromium, cyanide, iron, mercury, nickel, and selenium), ammonia, oil & grease, biological oxygen demand, chemical oxygen demand, total organic carbon, and priority pollutant organics.



If the water contains persistant floating solids or foam, it cannot be discharged. State and federal laws also prohibit discharges of oil or other products causing a visible oil sheen on the water. If a visible sheen appears on the water at the point of discharge, you must close the spillway immediately.

Prepare for work!
You are an Environmental Inspector working on the site your class will be visiting. You are monitoring different spillways onsite to make sure the water you are discharging is within the permit limits. You take water samples and test the required water quality parameters. Compare your results (shown below) to the permit limits (shown on a separate page) and decide what you should do with the spillway.

1. First thing in the morning, you approach Spillway 6 and find it closed. Prior to opening the spillway, you find:
   TSS = 855 mg/L
   pH = 10.4
   Dissolved Oxygen (DO) = 2.43 mg/L
   Salinity = 7.4 ppt
   Water temperature = 26 °C
   Water elevation = 1.4 feet

   What do you do? Why?

2. At 10:00 am, you approach Spillway 4. The spillway is closed and you notice a slick-looking coating on the surface of the water. You find:
   TSS = 89 mg/L
   pH = 8.2
   Dissolved Oxygen (DO) = 3.63 mg/L
   Salinity = 7.2 ppt
   Water temperature = 24 °C
   Water elevation = 0.2 feet

   What do you do? Why?

3. In mid-afternoon, you approach Spillway 7 for scheduled monitoring. It has been opened and discharging water for 6 hours. You find:
   TSS = 967 mg/L
   pH = 8.7
   Dissolved Oxygen (DO) = 2.43 mg/L
   Salinity = 7.4 ppt
   Water temperature = 22 °C
   Water elevation = 0.2 feet

   What do you do? Why?

4. It is the end of the workday and you approach Spillway 3 to monitor before leaving for the day. You find:
   TSS = 141 mg/L
   pH = 7.9
   Dissolved Oxygen (DO) = 2.43 mg/L
   Salinity = 7.4 ppt
   Water temperature = 24 °C
   Water elevation = 0.9 feet

   What do you do? Why?

Summarize:
Why is it important to monitor spillways?

What's the Limit?
ANSWER KEY
Part 4: Become an Environmental Inspector

Analyze:

1. How does TSS affect water quality?
   If there are particles suspended in the water, less light will penetrate. Which can prevent the growth of underwater plants. Particles in the water can also clog the gills of fish and cover fish eggs and other animals on the bottom.
2. Which is better: high TSS or low TSS?
   The lower the TSS value, the more clear the water.
3. You filter a water sample to measure TSS. Before the test, the filter weighs 114.3 mg. You filter 50 mL of sample water through the filter. After the filter has dried, it weighs 121.3 mg. What is the TSS level of the sample?
   TSS = ([121.3 – 114.3]*1000)/50 = 140 mg/L

Prepare for work!

1. First thing in the morning, you approach Spillway 6 and find it closed. Prior to opening the spillway, you find:
   TSS = 855 mg/L
   pH = 10.4
   Dissolved Oxygen (DO) = 2.43 mg/L
   Salinity = 7.4 ppt
   Water temperature = 26 °C
   Water elevation = 1.4 feet

   What do you do? Why?
   The spillway should remain closed. TSS and pH are too high.

2. At 10:00 am, you approach Spillway 4. The spillway is closed and you notice a slick-looking coating on the surface of the water. You find:
   TSS = 89 mg/L
   pH = 8.2
   Dissolved Oxygen (DO) = 3.63 mg/L
   Salinity = 7.2 ppt
   Water temperature = 24 °C
   Water elevation = 0.2 feet

   What do you do? Why?
   The spillway should remain closed. If a visible sheen appears on the water, it may not be discharged.

3. In mid-afternoon, you approach Spillway 7 for scheduled monitoring. It has been opened and discharging water for 6 hours. You find:
   TSS = 967 mg/L
   pH = 8.7
   Dissolved Oxygen (DO) = 2.43 mg/L
   Salinity = 7.4 ppt
   Water temperature = 22 °C
   Water elevation = 0.2 feet

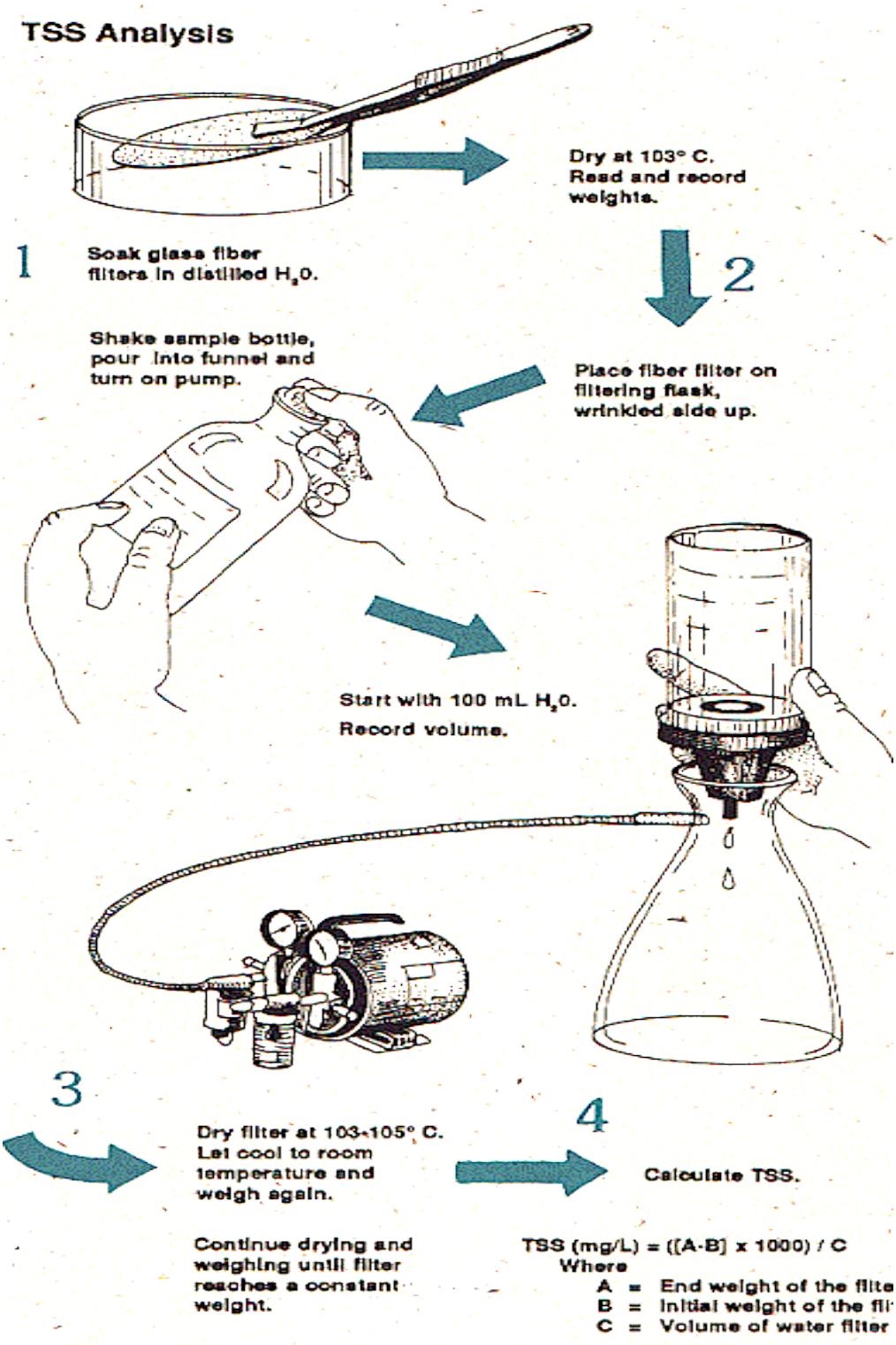
   What do you do? Why?
   The spillway should be immediately closed. Since it was opened 6 hours ago, the water has been stirred up and TSS have become too high.

4. It is the end of the workday and you approach Spillway 3 to monitor before leaving for the day. The spillway is closed. You find:
   TSS = 141 mg/L
   pH = 7.9
   Dissolved Oxygen (DO) = 2.43 mg/L
   Salinity = 7.4 ppt
   Water temperature = 24 °C
   Water elevation = 0.9 feet

   What do you do? Why?
   The spillway should remain closed. If it were opened someone would need to be onsite to monitor the water, but you are about to leave for the day.

Summarize:
Why is it important to monitor spillways?
Any water that is released through a spillway into the Chesapeake Bay or the Patapsco River will make its way into the Bay/River ecosystem. We want to make sure that this water will not harm that ecosystem. High TSS and/or an extremely high or low pH can have negative effects on the ecosystem.

If Environmental Inspectors discharge water that does not meet our permit limits, we will be in violation of our permits and could possibly lose those permits. Then we would not be able to discharge any water, and all construction activities would stop.



http://www.ecy.wa.gov/programs/wq/plants/management/joysmanual/4tss.html

Permit Limits Reference Page

Industrial Discharge Permit

TO DISCHARGE FROM
Hart-Miller Island Dredged Material Containment Facility
TO
the Chesapeake Bay

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

	Quarterly Average	Daily Maximum	Measurement Frequency
TSS	400 mg/l	800 mg/l	1/Day

The pH shall not be less than 6.0 or greater than 10.0 and shall be monitored once per day by grab sample.

State Discharge Permit

TO DISCHARGE FROM
Cox Creek Dredged Material Containment Facility
TO
the Patapsco River

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

	Monthly Average	Daily Maximum	Measurement Frequency
TSS	75 mg/l	150 mg/l	1/Day

The pH shall not be less than 6.0 or greater than 9.0 and shall be monitored once per day by grab sample.

State Discharge Permit

TO DISCHARGE FROM
Masonville Dredged Material Containment Facility
TO
the Patapsco River

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

	Quarterly Average	Daily Maximum	Measurement Frequency
TSS	75 mg/l	150 mg/l	1/Day

The pH shall not be less than 6.0 or greater than 9.0 and shall be monitored once per day by grab sample.

Pre-Trip Lesson #5: Pre-Trip Video

Summary: Students will conclude pre-trip classroom activities by viewing an informational video.

Grade(s): 3-12

Time Required: 1 class period

Objectives: After completing this lesson, students will be able to:

- Summarize the importance of the Port of Baltimore, the need for dredging, and how dredged material is being used as a beneficial product.

Materials Needed:

- Video: "The Port of Baltimore: A Living Classroom"
- Student copies: *Questions to Answer as You Watch*

Activity:

1. Distribute *Questions to Answer as you Watch*.
2. Students will answer questions as they view the video.

Note: the video lists Chrissy Albanese as the point of contact for more information and tour scheduling; this contact information is outdated. For Poplar Island tours, contact Laura Baldwin, Poplar Island Tour Coordinator at 410-770-6503 or poplartours@earthlink.net. For Hart-Miller Island, Cox Creek, or Masonville Tours, for more general information, call Laura Baker, Outreach and Education Coordinator, Maryland Environmental Service at 410-729-8649 or LBAKE@menv.com.

"The Port of Baltimore: A Living Classroom"
Pre-Trip Video and Brochure
Questions to Answer as you Watch or Read

1. Why is the Port of Baltimore considered Maryland's gateway to the world and the center of numerous activities?

2. What are channels and why are they important to the Port of Baltimore?

3. What is dredging?

4. Why must dredging occur?

5. How is dredged material being used as a beneficial product?

6. What three Dredged Material Placement Sites are mentioned in this video and where are they located?

7. What is the definition of an *organism*?

8. What is the definition of *aquatic*?

9. What is the definition of *erosion*?

10. Why are these sites important to the Port of Baltimore and the State of Maryland?

"The Port of Baltimore: A Living Classroom"
Pre-Trip Video
Questions to Answer as you Watch
ANSWER KEY

1. Why is the Port of Baltimore considered Maryland's gateway to the world and the center of numerous activities?

The Port of Baltimore has grown to become one of the largest ports on the East Coast of the US. It contains a rich selection of maritime services that makes the Port and the State strong. It is 300 miles closer than any other North Atlantic port, making it the shortest and quickest route to the interior of the country. This allows shippers to serve 1/3 of the nation's population through the Port of Baltimore.

2. What are channels and why are they important to the Port of Baltimore?

Channels are underwater highways used by ships to travel in and out of the Port. Due to erosion, the Patapsco River would be about 16 feet deep, but because the shipping channels are dredged to a depth of 50 feet, large container and cargo ships can safely enter and exit the Port.

3. What is dredging?

Dredging is the process by which sediments are gathered from the bottom of shipping channels using heavy equipment.

4. Why must dredging occur?

Dredging must occur in order to keep the channels at least 50 feet deep to allow large container and cargo ships to safely enter/exit the Port of Baltimore. The Port of Baltimore is Maryland's largest revenue generator based on the number and size of ships coming in.

5. How is dredged material being used as a beneficial product?

The material dredged from the shipping channels is being used as a beneficial product to restore habitats and create land masses.

6. What three Dredged Material Placement Sites are mentioned in this video and where are they located?

Cox Creek (about a half mile south of the Francis Scott Key Bridge on the western shore of the Patapsco River)
Hart-Miller Island (just off the mouth of Back River, where it empties into the Chesapeake Bay)
Poplar Island (just off the Chesapeake Bay coastline, about 34 miles south of Baltimore near Talbot County) *this answer is from the brochure

7. What is the definition of an *organism*?

A living thing, plant or animal

8. What is the definition of *aquatic*?

Something that lives in the water

9. What is the definition of erosion?

Land worn away by action of water and wind

10. Why are these sites important to the Port of Baltimore and the State of Maryland?

These sites help the Port of Baltimore by containing dredged material. As the shipping channels are dredged annually, the Port places dredged material at these sites. In the future, they will also become tourist attractions, wildlife sanctuaries, recreation areas, and scientific learning centers.

On-Site Activity #1: Site Introduction through Magnet Fun!

Summary: Students will learn about the need for dredging for the Port of Baltimore as well as the placement of dredged material at the site they are visiting.

Grade: K-12

Time required: 20 minutes; can be adjusted easily

Objectives: After completing this lesson, students will be able to:

- Describe why the Port of Baltimore (PoB) needs to be dredged
- Explain what is being constructed at the site they are visiting
- Name one benefit to the environment from the site they are visiting

Materials (To be provided by MES):

- Magnet board for dredging
- Magnet board for Cox Creek Wetland
- Wetland Grab bag (optional)
- Plant ID cards and orange flagging (optional)

Environmental Literacy Standards met:

Standard 1 Environmental Issues

Topic A.1. Identify and environmental issue.

Topic B.2. Communicate, evaluate, and justify personal views on environmental issue and alternate ways to address them. Hold up the dredging magnet board, lean it, or have a volunteer hold it for you.

Standard 5 Humans and Natural Resources

Topic B.1. Analyze, from local to global levels, the relationship between human activities and the earth's resources

Standard 7 Environment and Society

Topic A.1 Investigate factors that influence environmental quality

Topic E.1. Analyze and explain global economic and environmental connections

Activity:

The Port of Baltimore Magnet Board

1. Hold up the dredging magnet board, lean it, or have a volunteer hold it for you. Tell students that today is an exciting day! They all have their driver's license and they get to buy this awesome green car!

2. Ask where the car might be made. Accept any answer from Asia, usually Japan or China. Place the car magnet on the shore of Asia.

3. Point out to students that they live in Maryland and point to it on the board. Something separates you from your car. The Pacific Ocean. How do you get your car across the Pacific Ocean? Planes are expensive, guide students to cargo ship. Place the ship on the board and the car on the ship. "Sail" the ship across the Pacific Ocean, mentioning that it will go through the Panama Canal.

4. As the ship approaches the POB ask the students what the problem is. The water is too shallow and the ship will run aground and get stuck. Ask students what could be done to allow the ship to get into the POB. Guide them to the answer of digging up the extra sediment. Define that

process as dredging. Have a student come up and remove the dredged material magnet from the board and hold onto it. "Sail" the cargo ship into the POB and unload the car. Tell the students they can now drive to a dealership and pick up their new car!

5. Why is the Bay so much more shallow than the ocean? Explain sedimentation. When it rains, loose soil is washing down through the watershed and into the Chesapeake Bay. Average depth is 15-21 ft, cargo ships need 50 ft to float. What if we didn't dredge the Bay? Cargo ships couldn't enter the POB. Goods would not be delivered. Thousands of people would lose their jobs. Millions of dollars would be lost to the state of MD.

6. Go back to student holding dredged material magnet and tell them to hold on a few more minutes because they are going to have an important role.

The Cox Creek Magnet Board

1. Hold up the magnet board, lean it, or have a volunteer hold it for you. The Swan Creek wetland at Cox Creek was created to offset the habitat lost by creating the dredge material containment facility next door.

2. Ask students to recall what they learned about the Port of Baltimore and dredging from the introduction (dredged material is taken out of the shipping channels).

3. Explain that Swan Creek wetland used to be very polluted. Show trash magnets in wetland. It was very hard for the plants and animals in these shallows water areas to survive because they did not have a healthy habitat. Further offshore in the Patapsco River was habitat for larger fish.

4. POB purchased Cox Creek and was given permission to make a DMCF. Place large dredged material magnet on board. This pushed the little fish that were trying to survive in shallow waters further into deeper water where they were eaten by the larger fish. Cover little fish magnets with big fish magnets.

5. Swan Creek wetland was a "mitigation" to offset shallow water habitat loss in the area of the DMCF. Wetland was cleaned up.
    a. Remove trash magnets
    b. Plants were planted
    c. Place cattail magnets
    d. Animals returned to the healthy habitat
    e. Place heron, eagle, butterfly, etc. magnets

Wrap up:

- What was Swan Creek wetland like before it was purchased by the POB?
- Why did we have to clean it up?
- What happened after it was cleaned up and replanted?

Hart Miller Island Magnet Board

1. Hold up the magnet board, lean it, or have a volunteer hold it for you. In the 1700's this is what this area looked like. Point out where landbase was located and note the area was a peninsula and attached to the main land. Point out the land that will eventually be Hart, Miller and Pleasure Islands. We could have walked to this location in the 1700's. Many plants and animals called this area their home because it was excellent habitat (Food, water, shelter, and space)
2. It was very common for towns to be built near water because waterways were like highways in that time period. People cut down trees to use as building supplies and clear land for farming. What did that do to the animals? (Lost habitat, animals had to leave or die off).
3. When trees are removed, the roots that hold soil in place are also removed. What happens when wind and waves hit all this loose soil? (Erosion, a natural process but it can be sped up by removing vegetation.) The peninsula began to erode.
4. In the 1850's Hart Island and Miller Island split. Remove the magnet around Miller Island.

5. Then in 1965 Pleasure Island and Hart Island split. Remove the magnet around Hart Island. The area that was left at Hart and Miller islands equaled about 100 acres.
6. Does this look like good habitat for animals in this area? (No, missing space component.) If we wanted to build this area back up to give the animals more space, what would we need? (Dirt). Where can we get a bunch of dirt that isn't being used for something else all ready? (Bottom of the Chesapeake Bay, dredged material).
7. Have the student holding the dredged material magnet from the POB board place the dredged material over Hart and Miller Islands. First the sandy beach at the state park was created; it connected Hart and Miller Islands. Then, just like a jigsaw puzzle we built the outside first. The edge of the island is made of large rocks called armor stone and they make up the dikes that hold the dredged material inside. Does this look like good habitat though? (No, needs vegetation). Place green HMI magnet on top. We planted native species of grasses and trees on the island. What will that attract? (Wildlife.) We didn't bring any wildlife to the island. Anything the students see on the island swam, flew or floated there.
8. Wrap up:
    a. Describe why the POB needs to be dredged.
    b. Explain what is being constructed at HMI.
    c. Name one benefit to the environment from rebuilding HMI.

Extensions:

At Cox Creek Cobble Riffle

- In place so that trucks and equipment still have access to site beyond the wetland area
- Allows fish (i.e. carp) to still cross into the wetland to spawn.

Any site: Wetland Grab Bag

- Items in blue bag represent a characteristic of the wetland.
- Have students select an item from the bag and guess what it represents in the wetland.
    - Bird: important migratory and nesting habitat
    - Sponge: absorbs excess water during storms and eases flooding
    - Soap: Cleans the water by trapping and neutralizing pollutants
    - Strainer: catches nutrients, organisms
    - Baby picture: nursery, baby animals protected here
    - Noodles: Marsh is excellent food source for animals and humans

Plant ID

- Pass out pictures of plants with facts and information about the plant on the back.
- Have students walk up and down the road near the station to find their plant.
    - Pre-mark each plant with orange flagging
- Once everyone has found their plant have the students teach the rest of the group about their plant by showing them the actual plant and reading the facts on the card.

On-Site Activity #2: Birding Station

Summary: Habitat restoration projects at Dredged Material Containment Facilities provide very important habitat to birds.

Grades: All grades

Time Required: 20-30 mins; can be adjusted easily

Objectives: After completing this lesson, students will be able to:

- List 3 reasons why this area is important habitat to birds.
- Name 3 different species of birds they saw.
- Speculate what would happen to the birds they saw today if this habitat wasn't available.

Materials needed (to be provided by MES):

- Dry erase magnet board or large sticky note pad
- Identiflyer electronic bird call device
- Laminated bird pictures
- Markers
- Easel

Environmental Literacy Standards met:
Standard 1 Environmental Issues
Topic A.1. Identify an environmental issue.
Topic B.2. Communicate, evaluate, and justify personal views on environmental issue and alternate ways to address them.
Standard 5 Humans and Natural Resources
Topic B.1. Analyze, from local to global levels, the relationship between human activities and the earth's resources.

Activity (for MES Staff purposes):

1. Walk group to observation area.

2. Explain that the site provides very important habitat to birds:
   - Resting spot for migratory birds
   - Protected nesting area
   - Prime habitat in otherwise urban setting (For MV and CC trips)
   - Prime Island habitat (For HMI)

3. Explain that today they are going to see how many different species of birds they can identify.
   - Create a chart that shows how many birds each group observed.
   - Optional: divide group into smaller teams. To assign team names, have team identify an adverb and a type of bird. For example, "the pilaging penguins." Write each team name on poster paper. Keep a tally of total number of species observed by each team.

4. Look and listen for birds in the wetland.
   - Point out birds that you see and give whatever facts or interesting information you can.
     - See facts on back of bird pictures
   - Play call on Identiflyer.

5. Osprey information
   - Osprey brought to the brink of extinction in 1970's due to DDT use.
   - DDT was a chemical pesticide that weakened the shells of birds like Eagles and Osprey.
   - When DDT was banned the populations of these birds bounced back.

- Migrate from as far south as the Amazon river basin in South America
- Return to the same next each year
- 2-3 chicks per year
- Male provides ~6lbs of fish a day to the nest
- Piscivores: 99% of diet is fish
- Have special barbs on pads of feet that grip fish as they fly
- Have amazing eyesight, can hover over water and see fish swimming under the surface

6. Wrap-up conclusion: This site provides very important habitat to birds.
    - Have participants list 3 reasons why this area is important habitat to birds.
    - Name 3 different species of birds they saw.
    - Speculate what would happen to the birds they saw today if this habitat wasn't available.

On-Site Activity #3: Terrapin Travels: A Life-Sized Life Cycle Game

Summary: Students will play a life-sized board game to understand the challenges that diamonback terrapins face during their life cycle.

Grades: All grades

Time Required: 20-30 mins; can be adjusted easily

Objectives: After completing this lesson, students will be able to:

- List 3 things that helped them survive the game.
- List 3 things that hindered their survival.
- What is something the student can do to help the diamondback terrapin's survival.

Materials needed (to be provided by MES):

- 24 game pieces with attached game cards
- 3 sets of dice: placed at cards 1, 8, 9, 13, and 15.
- Flagging: placed at card 6

Environmental Literacy Standards met:
Standard 1 Environmental Issues
Topic A.1. Identify an environmental issue.
Topic B.2. Communicate, evaluate, and justify personal views on environmental issue and alternate ways to address them.
Standard 4 Populations, Communities, and Ecosystems
Topic B.1. Analyze the growth or decline of populations and identify a variety of responsible factors.
Standard 5 Humans and Natural Resources
Topic B.1. Analyze, from local to global levels, the relationship between human activities and the earth's resources.
Standard 7 Environment & Society
Topic B.1. Examine the influence of individual and group actions on the environment and explain how groups and individuals can work to promote and balance interest through.

Activity:

1. Discuss the lifecycle of the diamondback terrapin
    - Used to be numerous in Chesapeake Bay
    - Over harvesting
    - Habitat loss
    - Predators: Fox, raccoon, birds, humans, crab pots, pets, vehicles
    - Takes 7 years to sexually mature

2. Explain that participants will play a board game where they are a diamondback terrapin attempting to nest.

3. Instructions:
    - Roll the die and follow the instructions on the cards.
    - Make sure to follow the directions to a "T"! (Jump up and down, duck and cover, etc.)
    - Allow students to work their way through the game at their own pace.
    - Once they have "survived" by completing the game board and reaching maturity, give them the option to play again.

4. Wrap Up: Count how many students nested and how many died in the process
    - What were 3 things that helped them survive?
    - What were 3 things that hindered their survival?
    - What can students do to help the terrapin population?

On-site Activity #4: Water Quality

Option 1: Macroinvertebrate Mayhem

Summary: By studying the population of macroinvertebrates in a body of water, we can tell if it is healthy or unhealthy.

Grade: 4th-9th

Time Required: 20-40 mins, can be adjusted easily

Objectives: After completing this lesson, students will be able to:

- Explain what will happen to biodiversity in a polluted stream over time.
- Name 3 different species of macroinvertebrates we talked about.
- Identify one tolerant and one intolerant species.

Materials needed (to be provided by MES):

- Macro kit, including:
    - Vials of macroinvertebrate specimens
    - Name tags
    - Photo cards of macros

Environmental Literacy Standards met:

Standard 1 Environmental Issues

Topic A.1. Identify an environmental issue.

Topic B.2. Communicate, evaluate, and justify personal views on environmental issue and alternate ways to address them.

Standard 5 Humans and Natural Resources

TopicA.1. Analyze the effects of human activities on earth's natural processes.

Topic B.1. Analyze, from local to global levels, the relationship between human activities and the earth's resources.

Standard 7 Environment & Society

Topic A.1 Investigate factors that influence environmental quality.

Activity:

1. Explain to the students that this is the water quality station. Ask them what things we might test to find if a sample of water is healthy or unhealthy.
    - Temperature
    - Salinity
    - Dissolved oxygen
    - pH
    - Turbidity

2. We don't have any of the equipment today to test those things. What else could we look for?
    - Animals
    - Macroinvertebrates
        - "Macro-" means big enough to see with the naked eye
        - "Invertebrate" means no internal skeleton

3. Many of the bugs that we know and we see flying around on land start their lives in the water.
    - Show pictures of macros in nymph and adult phases.
    - Explain whether each species is tolerant or intolerant of water pollution.

4. Take out the name tags and pass them out to the students. Tell them they are going to play a game where they pretend to be the macroinvertebrate shown on their card. They have to move in special ways to represent their macro.
    - Dragonfly: tolerant, no restrictions on movement
    - Mayfly: Intolerant, arms out to the sides spinning in circles
    - Stonefly: Intolerant, hops on one foot
    - Caddisfly: Intolerant, hops with both feet together

5. Give students a minute to practice moving like their macro. Tell them the game is like tag where they have to survive in a stream by travelling from the starting line to the finish line without being tagged.
    - Designate one area to be the starting line and another to be the finish.
    - Assign one student to be an environmental stressor (sewage, sedimentation, or fertilizer).
    - Macros move from start to finish in their special ways.
    - NO RUNNING.

6. After one round, have the students that were tagged turn their card over to the pink side. This signifies an intolerant/pollution sensitive species being killed and replaced by a tolerant/pollution insensitive species. These macros have no restrictions on their movement.
    - After a few rounds, assess/explain what happened:
        - Tolerant species are more difficult to tag by the "stressor"/are less affected by the "stressor" because they have no restrictions on their movement. Eventually a polluted stream will have nothing but tolerant species and will lack biodiversity.
    - Explain why a lack of biodiversity can be detrimental to an ecosystem.

7. Wrap up:
    - Show students preserved macroinvertebrate samples.
    - Have students explain what happens to biodiversity in a polluted stream over time.
    - Name 3 species that were discussed.
    - Name one tolerant and one intolerant macroinvertebrate species.

Option 2: TSS Demonstration (Hart-Miller Island only)

Summary: Total Suspended Solids (TSS) is a way to measure the amount of particles in water. This is one way to measure the health of a body of water.

Grade: 3rd-12th

Time Required: 20-40 minutes; can be adjusted easily

Objectives: After completing this lesson, students will be able to:
- Demonstrate how to perform the steps involved in a TSS test.
- Explain why different water samples show different TSS levels and how TSS levels are related to water quality.
- Identify why it is necessary to measure TSS at a Dredged Material Containment Facility.

Materials needed (to be provided by MES):
- TSS analysis equipment, including pre-weighed filter paper, flask, pump, deionized water.
- Water samples from various locations around the island.

Activity:
1. MES educator will walk a student volunteer through the steps of a TSS test:
    - Using forceps, place a new filter pad on the filter holder, which is connected to a vacuum flask. Place glass filter on filter holder.
    - Measure 50 ml of water with graduated cylinder and pour sample into filter.

- Turn on vacuum pump to draw sample through filter. Triple rinse with deionized water.
- Remove filter pad from filter.

2. Explain that in an actual TSS test, the filter pad would need to be dried and weighed to achieve a numerical value for the TSS level of the sample. Students can visually compare filter pads between different water samples collected from various areas of the site. Ask students:
    - Which sample has lower TSS? Why? (Increased vegetation can filter the water, etc.)
    - What do you notice about the color difference between samples? What is the reason for the difference in color? (Absense/presence of algae, types of sediment within water column, etc.)
    - Ask students why it is important to measure TSS from a spillway. Explain how spillways operate and how MES determines whether to open each spillway.

On-Site Activity #5: Fishing Station

Summary: There is a wide diversity of fish that thrive in both the wetlands and beach areas of Dredged Material Containment Facilities.

Grade: All grades

Time Required: 20-40 minutes; can be adjusted easily

Objectives: After completing this lesson, students will be able to:

- List 3 reasons why this area is important habitat to fish.
- Name 3 different species of fish they saw.
- Speculate what would happen to the fish they saw today if this habitat wasn't available.

Materials needed (to be provided by MES):

- Seine net
- Hand net
- Kiddie pool
- Waders
- Fish ID guide

Environmental Literacy Standards met:

Standard 1 Environmental Issues

Topic A.1. Identify an environmental issue.

Topic B.2. Communicate, evaluate, and justify personal views on environmental issue and alternate ways to address them.

Standard 4 Populations, Communities, and Ecosystems

Topic A.1. Explain how organisms are linked by the transfer and transformation of matter and energy at the ecosystem level.

Topic C.1. Explain how the interrelationships and interdependencies of organisms and populations contribute to the dynamics of communities and ecosystems.

Standard 5 Humans and Natural Resources

Topic B.1. Analyze, from local to global levels, the relationship between human activities and the earth's resources.

Activity:

1. Before students arrive, set up station and haul the seine net a couple times to collect a sample of fish.

2. When students arrive at beach, instruct them:
   - Do not pick up items off the beach (MV and CC).
   - Do not enter the water.

3. Explain that there is a diversity of fish that use this area as habitat. Today we are going to use this seine net to collect some of those fish.

4. Instruct students that when the net is brought back onto shore, they can help collect fish from the net. *Students must wet their hands before touching any fish.* Place the fish immediately in a bucket of water and transfer to the pool.

5. Seine as many times as possible during station time, leaving about 5-10 minutes to discuss what was caught.

6. Wrap up: Bring students together around the pool and show them the different species of fish that were caught. Depending on what is caught, discuss:
    - Food web
    - Adaptations for survival
    - Importance to humans
    - What if this site wasn't restored? Would we see these fish?
    - Why are these fish important to this ecosystem?
    - Recall the names of three fish that were caught

On-Site Activity #6: Scavenger Hunt

Summary: This is a wrap-up activity to be used at the end of a rotating station field trip. It can be done as a scavenger hunt or a geocaching activity based on age level. Recommended grade 5 and up for using GPS units.

Grade: All grades

Time Required: 30 mins, can be adjusted easily

Objectives: After completing this lesson, students will be able to:

- Summarize the theme of their field trip

Materials needed (to be provided by MES):

- Strips of paper with theme statements
- Containers
- GPS units (if applicable)
- Clues to container locations

Environmental Literacy Standards met:
n/a

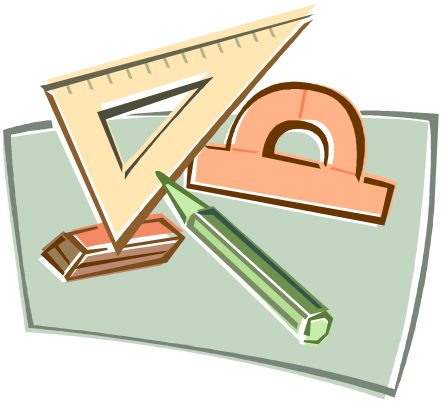
Preparation: To be done before students arrive on-site:

- Print out papers with theme statements.
- Place one each (or more for multiple groups based on time) in a camouflaged container.
- Hide containers just off the road near the stations.
- Place station signs with clues in front of the container location.

Activity:

1. Tell the students that they are going to read clues (or use GPS Units) to find containers hidden around the site. Explain the rules:
    - Each container holds a strip of paper with part of a statement typed on it.
    - Go to each stop and collect ONE paper from each container.
    - After ONE paper is removed REHIDE the container.
    - Rotate students through the locations like they were stations.
    - Everyone will meet up at a set location and go to the final stop together.
    - Put all the papers together in order at the end to read a theme or concluding phrase to summarize the field trip.

Post-Trip Lesson #1: Design-an-Island



Summary: Students will research existing Chesapeake Bay islands and coastal areas that could be potential Dredged Material Containment Facilities.

Grade(s): 3-12

Time Required: 1-2 class periods for research, 1 class period for preparation, 1 class period for presentations

Objectives: After completing this lesson, students will be able to:

- Name an island/coastal area in the Chesapeake Bay that has been exposed to severe erosion in recent years.
- Research the geographical, historical, and environmental implications of this island/coastal area.
- Design a future Dredged Material Containment Facility at this area.

Materials Needed:

- Computer with internet access; other research materials
- Student copies: Design-an-Island

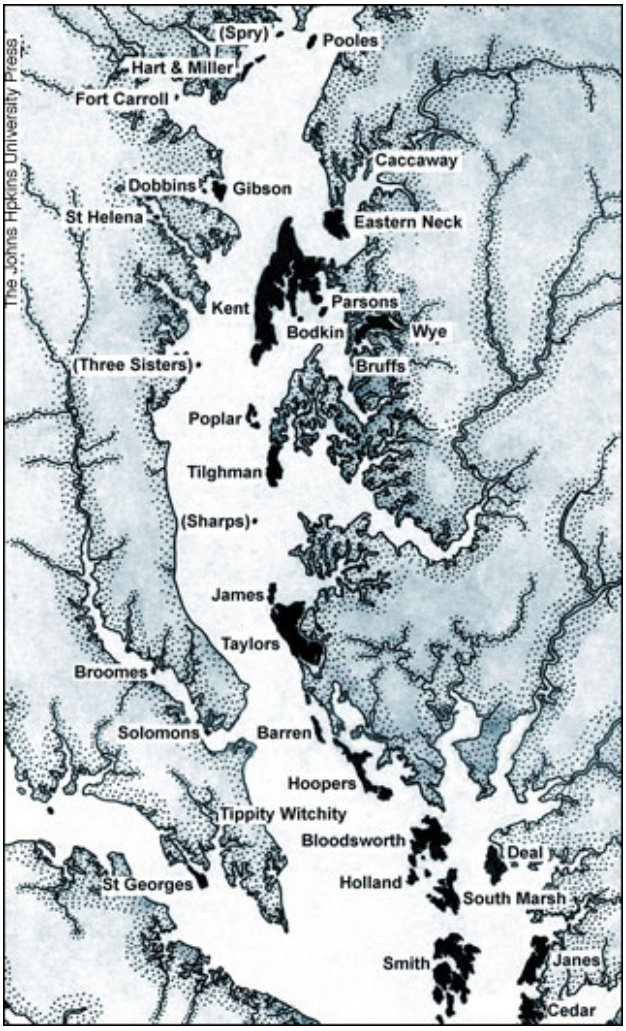
Activity:

1. Students may work individually or in small groups to complete "Design-an-Island" Student Worksheet. They will need internet access to research Chesapeake Bay islands and shoreline.
2. Students will create an oral presentation to give to the class that summarizes their findings. Be sure to point out guidelines included in Student Worksheet.

Design-an-Island
Student Worksheet

By now you have learned how sediment transport occurs in the Chesapeake Bay watershed. You also know the importance of the Port of Baltimore to the shipping industry. Therefore, you know why we need to dredge the Chesapeake Bay shipping channels. You have learned about Maryland's Dredged Material Containment Facilities where the material taken from these channels has been stockpiled: Poplar Island, Hart-Miller Island, Cox Creek, and Masonville. You have even visited one of these sites and learned about what goes on at these sites and the different kinds of plants and animals that make homes there.

Eventually these sites will reach capacity and won't be able to hold any more dredged material. We will have to find new sites to place dredged material. Your job today is to research an existing Chesapeake Bay island or coastal area that could potentially be our next Dredged Material Containment Facility. Select your site from the map below:



Source: *The Disappearing Islands of the Chesapeake* by William B. Cronin

Other possible sites include Hills Point, Thomas Point, Hambleton, Roystin, Cows, Punch, Herring, Powell, Swan, and Turtle Egg. Items to include in your report:

- Location
- Distance from the shipping channels
- Historical/cultural land use
- Current status/ownership
- Size

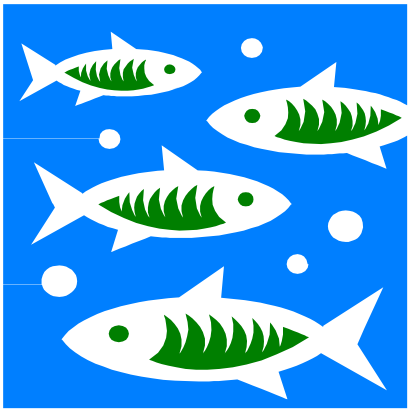
After you have researched your location, design the new Dredged Material Containment Facility. You want to be able to store as much dredged material as possible, while restoring the right kinds of habitat. Things to remember while designing your Placement Site:

- What side of the island/shoreline is the windward side? This is the side that will be hit most directly by wind and waves. How will this affect your design (in terms of things like armor stone, etc.)?
- What different kinds of habitat will you include (upland, wetland, shallow water areas, mudflats, nesting islands, rocky shorelines, etc.)? What percentage of each and why?
- What outcomes do you predict from constructing these habitats?

Be prepared to present your findings to your class.

Try using these resources:
http://www.mdsg.umd.edu/MarineNotes/Apr90/index.php
http://www.mdsg.umd.edu/MarineNotes/Dec92/index.html
http://www.chesapeakebay.net/blog/post/bay_islands_wildlife_habitat_succumbing_to_sea_level_rise
http://www.msa.md.gov/msa/mdmanual/01glance/html/islands.html
http://www.easternshoreheritage.com/bay_islands/bay_islands.php
The Disappearing Islands of the Chesapeake by William B. Cronin.

Post-Trip Lesson #2: Species Information Sheet



Summary: Students will create a Species Information Sheet and/or poster series to display information about a wildlife species found on Maryland's Dredged Material Containment Facilities.

Grade(s): 3-12

Time Required: 1 class period for research; 1 class period for presentations

Objectives: After completing this lesson, students will be able to:

- Demonstrate in-depth knowledge of one species found in restored habitat areas of Maryland's Dredged Material Containment Facilities.

Materials Needed:

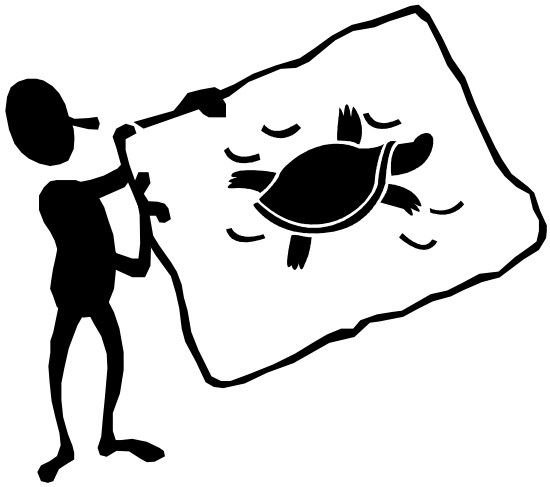
- Computer with internet access; other research materials
- Student copies: Species Information Sheet

Activity:

1. Students may work individually or in small groups to complete a species information sheet, as outlined in the attached Student Worksheet.
2. Species lists for Hart-Miller Island Cox Creek/Swan Creek, and Masonville are attached. Students will need internet access to research the wildlife species they choose from these lists.

Extensions/Related Activities:

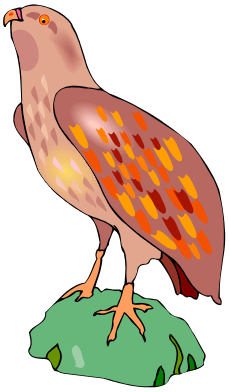
- Create a poster series dislaying the vital information in the species information sheet. Present the posters and display them throughout the classroom or school.



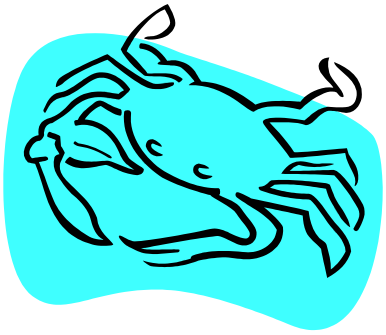
Species Information Sheet
Student Worksheet

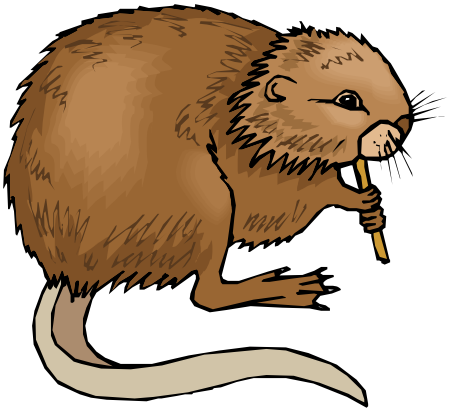
One of the benefits of restoring habitats in the Chesapeake Bay and Patapsco River is that we get to see many different kinds of wildlife at our Dredged Material Containment Facilities. You saw some of these animals up-close-and-personal during your fieldtrip.

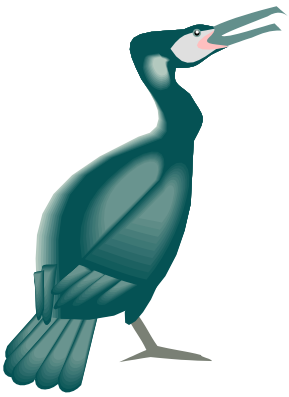
Research a species found on Hart-Miller Island, Cox Creek/Swan Creek, or Masonville. Write up a two-page Species Information Sheet. It should include:



- Species life cycle
- Habitat requirements
- Breeding requirements
- Population status
- Historical/cultural trends and issues
- How the species relates to the site







NON-AVIAN and NON-INSECTIVAL FAUNA OF HART-MILLER ISLAND

The following is a listing of animal species, other than birds and insects, which have occurred on Hart-Miller Island. In the future as more survey work is conducted, this list will undoubtedly expand resulting in a more complete picture of the Island's animal life.

MOLLUSKS (Aquatic)
Rangia cuneata – Brackish Water Clam
Mytilopsis leucophaeata – Dark False Mussel

MOLLUSKS (Terrestrial)
Bradybaena similaris – Asian Tramp Snail

HORSESHOE CRABS
Limulus polyphemus – Atlantic Horseshoe Crab

CRUSTACEANS
Balanus improvisus – Bay Barnacle

TICKS
Amblyomma americanum – Lone Star Tick
Dermacentor variabilis – American Dog Tick

FISH
Anguilla rostrata – American Eel
Brevoortia tyrannus – Atlantic Menhaden
Ameiurus nebulosus – Brown Bullhead
Fundulus diaphanus – Banded Killifish
Fundulus heteroclitus – Mummichog
Gambusia holbrooki – Eastern Mosquitofish
Menidia menidia – Atlantic Silverside
Morone americana – White Perch
Lepomis gibbosus – Pumpkinseed
Lepomis macrochirus – Bluegill
Perca flavescens – Yellow Perch

AMPHIBIANS
Anaxyrus fowleri – Fowler's Toad
Pseudacris crucifer – Northern Spring Peeper
Lithobates sphenocephalus utricularius – Southern Leopard Frog
Lithobates clamitans melanota – Northern Green Frog
Lithobates catesbeiana – American Bullfrog

REPTILES
Kinosternon subrubrum subrubrum – Eastern Mud Turtle
Terrapene carolina carolina – Eastern Box Turtle
Clemmys guttata – Spotted Turtle
Chrysemys picta picta – Eastern Painted Turtle
Chelydra serpentina serpentina – Eastern Snapping Turtle
Caretta caretta – Loggerhead Sea Turtle
Nerodia sipedon sipedon – Northern Watersnake
Thamnophis sirtalis sirtalis – Eastern Gartersnake
Pantherophis alleghaniensis – Eastern Ratsnake

MAMMALS
Didelphis virginiana – Virginia Opossum
Blarina brevicauda – Northern Short-tailed Shrew
Myotis lucifugus – Little Brown Myotis
Peromyscus leucopus – White-footed Mouse
Microtus pennsylvanicus – Meadow Vole
Ondatra zibethicus – Muskrat
Mus musculus – House Mouse
Canis latrans – Coyote
Vulpes vulpes – Red Fox
Procyon lotor – Common Raccoon
Lutra canadensis – Northern River Otter
Odocoileus virginianus – White-tailed Deer

This list was compiled by Gene Scarpulla, Maryland Ornithological Society and Maryland Entomological Society Representative on the Hart-Miller Island South Cell Environmental Restoration Project Working Group and North Cell Habitat Development Working Group. *(01/29/10)*

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BIRDS OF HART-MILLER ISLAND

Since 1977, 286 species of birds have been observed on or around Hart-Miller Island. This monitoring effort was undertaken by members of the Maryland Ornithological Society and was made possible through the cooperation of the Maryland Port Administration, the Maryland Environmental Service, and the Maryland Department of Natural Resources.

Species followed by (B) are "confirmed" breeders on the island; species followed by (b) are "probable" breeders on the island. Breeding status is based on criteria set forth in the Atlas of the Breeding Birds of Maryland and the District of Columbia (Robbins and Blom 1996). Taxonomy is based on the Check-list of North American Birds, 7th edition (AOU 1998) through the 50th Supplement to the Check-list (AOU 2009).

Snow Goose
Brant
Cackling Goose
Canada Goose (B)
Mute Swan (B)
Tundra Swan
Wood Duck (B)
Gadwall
Eurasian Wigeon
American Wigeon
American Black Duck (B)
Mallard (B)
Blue-winged Teal
Northern Shoveler
Northern Pintail
Green-winged Teal
Canvasback
Redhead
Ring-necked Duck
Greater Scaup
Lesser Scaup
Surf Scoter
White-winged Scoter
Black Scoter
Long-tailed Duck
Bufflehead
Common Goldeneye
Hooded Merganser
Common Merganser
Red-breasted Merganser
Ruddy Duck (B)
Red-throated Loon
Common Loon
Pied-billed Grebe (B)
Horned Grebe
Red-necked Grebe
Eared Grebe
American White Pelican
Brown Pelican
Double-crested Cormorant
Great Cormorant
American Bittern
Least Bittern (B)
Great Blue Heron
Great Egret
Snowy Egret
Little Blue Heron
Tricolored Heron
Cattle Egret
Green Heron (b)
Black-crowned Night-Heron
Glossy Ibis
Black Vulture
Turkey Vulture
Osprey (B)
Mississippi Kite
Bald Eagle (B)
Northern Harrier
Sharp-shinned Hawk
Cooper's Hawk
Northern Goshawk
Red-shouldered Hawk
Broad-winged Hawk
Red-tailed Hawk
Rough-legged Hawk
Golden Eagle
American Kestrel
Merlin
Peregrine Falcon (B)
King Rail
Virginia Rail (b)
Sora (b)
Common Moorhen (B)
American Coot (B)
Black-bellied Plover
American Golden-Plover
Semipalmated Plover
Piping Plover
Killdeer (B)
American Oystercatcher
Black-necked Stilt (B)
American Avocet
Spotted Sandpiper (B)
Solitary Sandpiper
Greater Yellowlegs
Willet
Lesser Yellowlegs
Upland Sandpiper
Whimbrel
Hudsonian Godwit
Marbled Godwit
Ruddy Turnstone
Red Knot
Sanderling
Semipalmated Sandpiper
Western Sandpiper
Little Stint
Least Sandpiper
White-rumped Sandpiper
Baird's Sandpiper
Pectoral Sandpiper
Purple Sandpiper
Dunlin
Curlew Sandpiper
Stilt Sandpiper
Buff-breasted Sandpiper
Ruff
Short-billed Dowitcher
Long-billed Dowitcher
Wilson's Snipe
American Woodcock (b)
Wilson's Phalarope
Red-necked Phalarope
Red Phalarope
Black-legged Kittiwake
Bonaparte's Gull
Black-headed Gull
Little Gull
Laughing Gull
Franklin's Gull
Ring-billed Gull
California Gull
Herring Gull (B)
Thayer's Gull
Iceland Gull
Lesser Black-backed Gull
Glaucous Gull
Great Black-backed Gull (B)
Least Tern (B)

Gull-billed Tern
Caspian Tern
Black Tern
Roseate Tern
Common Tern (B)
Arctic Tern
Forster's Tern
Royal Tern
Sandwich Tern
Black Skimmer
Rock Pigeon
Mourning Dove (b)
Monk Parakeet
Yellow-billed Cuckoo (B)
Black-billed Cuckoo (B)
Eastern Screech-Owl
Great Horned Owl (B)
Snowy Owl
Short-eared Owl
Common Nighthawk
Chimney Swift
Ruby-throated Hummingbird (b)
Belted Kingfisher
Red-bellied Woodpecker
Yellow-bellied Sapsucker
Downy Woodpecker (b)
Hairy Woodpecker
Northern Flicker (b)
Olive-sided Flycatcher
Eastern Wood-Pewee (b)
Acadian Flycatcher
Alder Flycatcher
Willow Flycatcher (B)
Least Flycatcher
Eastern Phoebe
Great Crested Flycatcher (B)
Eastern Kingbird (B)
Scissor-tailed Flycatcher
White-eyed Vireo
Yellow-throated Vireo
Blue-headed Vireo
Warbling Vireo
Red-eyed Vireo
Blue Jay
American Crow
Fish Crow (B)
Horned Lark
Purple Martin (B)
Tree Swallow (B)
N. Rough-winged Swallow (b)
Bank Swallow (B)
Cliff Swallow
Cave Swallow
Barn Swallow (B)
Carolina Chickadee (b)
Tufted Titmouse (b)
Red-breasted Nuthatch
White-breasted Nuthatch
Brown Creeper
Carolina Wren (b)
House Wren (B)
Winter Wren
Sedge Wren
Marsh Wren (b)
Golden-crowned Kinglet
Ruby-crowned Kinglet
Blue-gray Gnatcatcher
Eastern Bluebird
Veery
Gray-cheeked Thrush
Bicknell's Thrush
Swainson's Thrush
Hermit Thrush
Wood Thrush (b)
American Robin (b)
Gray Catbird (B)
Northern Mockingbird
Brown Thrasher (B)
European Starling (B)
American Pipit
Cedar Waxwing (B)
Blue-winged Warbler
Tennessee Warbler
Orange-crowned Warbler
Nashville Warbler
Northern Parula
Yellow Warbler (B)
Chestnut-sided Warbler
Magnolia Warbler
Cape May Warbler
Black-throated Blue Warbler
Yellow-rumped Warbler
Black-throated Green Warbler
Blackburnian Warbler
Pine Warbler
Prairie Warbler
Palm Warbler
Bay-breasted Warbler
Blackpoll Warbler
Black-and-white Warbler
American Redstart
Ovenbird
Northern Waterthrush
Louisiana Waterthrush
Kentucky Warbler
Connecticut Warbler
Mourning Warbler
Common Yellowthroat (B)
Hooded Warbler
Wilson's Warbler
Canada Warbler
Yellow-breasted Chat
Eastern Towhee (b)
American Tree Sparrow
Chipping Sparrow
Clay-colored Sparrow
Field Sparrow
Vesper Sparrow
Lark Sparrow
Savannah Sparrow
Grasshopper Sparrow
Nelson's Sparrow
Saltmarsh Sparrow
Seaside Sparrow (B)
Fox Sparrow
Song Sparrow (B)
Lincoln's Sparrow
Swamp Sparrow (B)
White-throated Sparrow
White-crowned Sparrow
Dark-eyed Junco
Lapland Longspur
Snow Bunting
Scarlet Tanager
Northern Cardinal (b)
Rose-breasted Grosbeak
Blue Grosbeak (B)
Indigo Bunting
Dickcissel
Bobolink
Red-winged Blackbird (B)
Eastern Meadowlark
Yellow-headed Blackbird
Rusty Blackbird
Brewer's Blackbird
Common Grackle (B)
Brown-headed Cowbird (B)
Orchard Oriole (b)
Baltimore Oriole
Purple Finch
House Finch (B)
Common Redpoll
Hoary Redpoll
Pine Siskin
American Goldfinch (B)
Evening Grosbeak
House Sparrow

This list was compiled by Gene Scarpulla, Maryland Ornithological Society Representative on the Hart-Miller Island South Cell Environmental Restoration Project Working Group and the North Cell Habitat

Development Working Group.
(01/29/10)

Eugene J. Scarpulla
9015 Millers Island Boulevard
Millers Island, MD 21219-1645
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Swan Creek Wetland Species List:

Birds:

Acadian Flycatcher (*Empidonax virescens*)
American Avocet (*Recurvirostra americana*)
American Black Duck (*Anas rubripes*)
American Coot (*Fulica americana*)
American Crow (*Corvus brachyrhynchos*)
American Golden Plover (*Pluvialis dominica*)
American Goldfinch *(Carduelis tristis)**
American Kestrel *(Falco sparverius)**
American Redstart (*Setophaga ruticilla)*
American Robin *(Turdus migratorius)**
American Tree Sparrow (*Spizella arborea*)
American Wigeon (*Anas americana)*
Bald Eagle (*Haliaeetus leucocephalus*)
Baltimore Oriole (*Icterus galbula)**
Barn Swallow *(Hirundo rustica)**
Barred Owl (*Strix varia)*
Belted Kingfisher (*Ceryle alcyon*)*
Black Vulture *(Coragyps atratus)*
Black-and-white Warbler (*Mniotilta varia*)
Black-bellied Plover *(Pluvialis squatarola)*
Black-crowned Night-Heron (*Nycticorax nycticorax)*
Blackpoll Warbler *(Dendroica striata)*
Blue Grosbeak (*Guiraca caerulea)*
Blue Jay *(Cyanocitta cristata)*
Blue-gray Gnatcatcher (*Polioptila caerulea)*
Blue-headed Vireo (*Vireo solitarius*)
Blue-winged Teal (*Anas discors)*
Bonaparte's Gull *(Larus philadelphia)*
Broad-winged Hawk (*Buteo platypterus)*
Brown Thrasher (*Toxostoma rufum)*
Brown-headed Cowbird *(Molothrus ater)*
Bufflehead (*Bucephala albeola*)
Canada Goose (*Branta canadensis)**
Canvasback (*Aythya valisineria)*
Carolina Chickadee *(Poecile carolinensis)*
Carolina Wren *(Thryothorus ludovicianus)*
Caspian Tern (*Hydroprogne caspia*)
Cattle Egret (*Bubulcus ibis*)
Cedar Waxwing *(Bombycilla cedrorum)*
Chimney Swift *(Chaetura pelagica)**
Chipping Sparrow (*Spizella passerina)*
Clay-colored Sparrow (Spizella pallida)
Common Goldeneye (*Bucephala clangula)*
Common Grackle *(Quiscalus quiscula)*
Common Loon (*Gavia immer)*
Common Yellowthroat *(Geothlypis trichas)*
Cooper's Hawk (*Accipiter cooperii)*
Dark-eyed Junco (*Junco hyemalis)*
Double-crested Cormorant (*Phalacrocorax auritus)*
Downy Woodpecker *(Picoides pubescens)**
Dunlin (*Calidris alpina*)
Eastern Bluebird (*Sialia sialis)*
Eastern Kingbird (*Tyrannus tyrannus)*
Eastern Phoebe (*Sayornis phoebe*)
Eastern Screech-Owl (*Megascops asio*)
Eastern Towhee *(Pipilo erythrophthalmus)*
Eastern Wood-Pewee (*Contopus virens*)
European Starling (*Sturnus vulgaris*)
Field Sparrow (*Spizella pusilla*)*
Fish Crow (*Corvus ossifragus)*
Forster's Tern (*Sterna forsteri*)
Fox Sparrow *(Passerella iliaca)*
Gadwall (*Anas strepera)*
Glossy Ibis (*Plegadis falcinellus*)
Golden-crowned Kinglet (*Regulus satrapa*)
Gray Catbird *(Dumetella carolinensis)*
Great Black-backed Gull (*Larus marinus)*
Great Blue Heron (*Ardea herodias)*
Great Crested Flycatcher *(Myiarchus crinitus)*
Great Egret *(Ardea alba)*
Great Horned Owl (*Bubo virginianus)*
Greater Scaup (*Aythya marila)*
Greater Yellowlegs (*Tringa melanoleuca)*
Green Heron (*Butorides virescens)*
Green-winged Teal (*Anas crecca)*
Hairy Woodpecker (*Picoides villosus)*
Hermit Thrush *(Catharus guttatus)*
Herring Gull (*Larus argentatus)*
House Sparrow (*Passer domesticus)*
House Wren *(Troglodytes aedon)*
Indigo Bunting *(Passerina cyanea)*
Killdeer (*Charadruis vociferous*)*
Laughing Gull *(Larus atricilla)*
Least Bittern (*Ixobrychus exilis)*
Least Sandpiper *(Calidris minutilla)*
Least Tern (*Sterna antillarum)*
Lesser Scaup (*Aythya affinis)*
Lesser Yellowlegs (*Tringa flavipes)*
Lincoln's Sparrow (*Melospiza lincolnii*)
Little Blue Heron (*Egretta caerulea)*
Long-tailed Duck (Clangula hyemalis)
Magnolia Warbler (*Dendroica magnolia*)
Mallard (*Anas platyrhynchos*)*
Marsh Wren *(Cistothorus palustris)*
Merlin (*Falco columbarius*)
Mourning Dove (*Zenaida macroura*)
Mute Swan (*Cygnus olor*)*
Northern Bobwhite (*Colinus virginianus*)
Northern Cardinal *(Cardinalis cardinalis)* *
Northern Flicker *(Colaptes auratus)*
Northern Harrier (*Circus cyaneus)*
Northern Mockingbird *(Mimus polyglottos)* *

Northern Parula (*Parula americana*)
Northern Pintail (*Anas acuta)*
Northern Rough-winged Swallow *(Stelgidopteryx serripennis)*
Northern Shoveler (*Anas clypeata)*
Orchard Oriole *(Icterus spurius)**
Hooded Merganser (*Lophodytes cucullatus)**
Horned Grebe (*Podiceps auritus*)
House Finch (Carpodacus mexicanus)
Osprey (*Pandion haliaetus*)*
Ovenbird (*Seiurus aurocapillus)*
Palm Warbler *(Dendroica palmarum)*
Pectoral Sandpiper *(Calidris melanotos)*
Peregrine Falcon (*Falco peregrinus*)
Pied-billed Grebe *(Podilymbus podiceps)*
Pine Siskin (*Carduelis pinus*)
Pine Warbler *(Dendroica pinus)*
Prairie Warbler *(Dendroica discolor)*
Prothonotary Warbler (*Protonotaria citrea)*
Purple Martin (*Progne subis*)
Red-bellied Woodpecker *(Melanerpes carolinus)**
Red-breasted Merganser (*Mergus serrator)*
Red-eyed Vireo (*Vireo olivaceus)*
Redhead (*Aythya americana)*
Red-shouldered Hawk (*Buteo lineatus)*
Red-tailed Hawk (*Buteo jamaicensis)**
Red-winged Blackbird *(Agelaius phoeniceus)**
Ring-billed Gull (*Larus delawarensis)*
Ring-necked Duck (*Aythya collaris)*
Rock Pigeon (*Columba livia)*
Ruby-crowned Kinglet *(Regulus calendula)*
Ruby-throated Hummingbird *(Archilochus colubris)*
Ruddy Duck (*Oxyura jamaicensis)*
Rusty Blackbird (*Euphagus carolinus)*
Savannah Sparrow *(Passerculus sandwichensis)*
Scarlet Tanager *(Piranga olivacea)*
Sedge Wren (*Cistothorus platensis*)
Semipalmated Plover (*Charadrius semipalmatus*)
Semipalmated Sandpiper (*Calidris pusilla)*
Sharp-shinned Hawk (*Accipiter striatus)*
Short-billed Dowitcher (*Limnodromus griseus*)
Snowy Egret (*Egretta thula*)
Solitary Sandpiper (*Tringa solitaria)*
Song Sparrow *(Melospiza melodia)*
Sora (*Porzana carolina*)
Spotted Sandpiper *(Actitis macularia)*
Swamp Sparrow *(Melospiza georgiana)*
Tree Swallow *(Tachycineta bicolor)**
Tri-colored Heron (*Egretta tricolor)*
Tufted Titmouse *(Baleolophus bicolor)*
Tundra Swan (*Cygnus columbianus*)
Turkey Vulture (*Cathartes aura)*
Veery (*Catharus fuscescens*)
Western Sandpiper (*Calidris mauri*)
White-breasted Nuthatch (*Sitta carolinensis)*
White-crowned Sparrow (*Zonotrichia leucophrys*)
White-eyed Vireo *(Vireo griseus)*
White-throated Sparrow (*Zonotrichia albicollis)*
Wilson's Snipe *(Gallinago delicata)*
Winter Wren (*Troglodytes troglodytes*)
Wood Duck (*Aix sponsa*)
Wood Thrush (*Hylocichla mustelina)*
Yellow Warbler *(Dendroica petechia)*
Yellow-bellied Flycatcher (*Empidonax flaviventris*)
Yellow-bellied Sapsucker *(Sphyrapicus varius)*
Yellow-billed Cuckoo *(Coccyzus americanus)**
Yellow-breasted Chat (*Icteria virens)*
Yellow-crowned Night-Heron (*Nyctanassa violacea)*
Yellow-rumped Warbler *(Dendroica coronata)*

Mammals:

American Beaver (*Castor canadensis)*
Eastern Chipmunk (*Tamias striatus)*
Eastern Cottontail (*Sylvilagus floridanus)*
Eastern Gray Squirrel (*Sciurus carolinensis)*
Common Gray Fox (*Urocyon cinereoargenteus)*
Common Raccoon (*Procyon lotor)*
Ground Groundhog (*Marmota monax)*
Muskrat (*Ondatra zibethicus)*
River Otter (*Lutra canadenis*)
Red Fox (*Vulpes vulpes*)
Virginia opossum (*Didelphis virginiana)*
White-tailed Deer (*Odocoileus virginiana)*

Reptiles and Amphibians:

American Bull Frog (*Rana catesbeiana*)
Black Rat Snake (*Elaphe obsolete)*
Common Five-lined Skink (*Eumeces fasciatus)*
Common Snapping Turtle (*Chelydra serpentine*)
Copperhead Snake (*Agkistrodon contortix)*
Diamondback Terrapin (*Malaclemys terrapin)*
Eastern Box Turtle (*Terrapene Carolina)*
Eastern Hog-nosed Snake (*Heterodon platirhinos)*
Eastern Kingsnake (*Lampropeltis getula)*
Eastern Mud Turtle (*Kinosternon subrubrum)*
Eastern Red-bellied Turtle (*Chrysemys rubriventris)*
Eastern Six-lined Racerunner (*Cnemidophorus sexliniatus)*
Eastern Snapping Turtle (*Chelydra serpentina serpentina*)
Fowler's Toad (*Bufo woodhousii fowleri)*

Northern Black Racer (*Coluber contrictor)*
Northern Fence Lizard (*Sceloporus undulates hyacinthinus)*
Northern Red-bellied Turtle (*Pseudemys rubiventris)*
Northern Spring Peeper (*Pseudacris crucifer)*
Northern Watersnake (*Nerodia sipedon)*
Painted Turtle (*Chrysemys picta*)
Pickerel Frog (*Rana palustris)*
Red-bellied Waternake (*Nerodia erythrogaster)*
Red-eared Slider (*Trachemys scripta elegans)*
Stinkpot (*Sternotherus odoratus)*
Southern Leopard Frog (*Rana sphenocephala utricularia)*

Fish & Crustaceans:

American Eel (*Anguilla rostrata*)
Amphipod spp.
Alewife (*Pomolobus pseudoharengus)*
Atlantic Croaker (*Micropogonias*)
Atlantic Silverside (*Menidia menidia*)
Banded Killifish (*Fundulus diaphanous)*
Bay Anchovy *(Anchoa mitchilli)*
Blue Crab (*Callinectes sapidus)*
Bluegill (*Lepomis macrochirus)*
Common Carp (*Cyprinus carpio)*
Comb Jellyfish *(Cnetofora*)
Grass Shrimp (*Palaemonetes pugio*)
Inland Silverside (*Menidia beryllina*)
Mud Crab (*Scylla serrata*)
Mummichog (*Fundulus heteroclitus*)
Northern Pipefish (*Syngnathus focus*)
Pumpkinseed (*Lepomis gibbosus)*
Rainwater Killifish (*Lucania parva*)
Sheepshead Minnow (*Cyprinodon variegates*)
Striped Bass *(Morone saxatilis)*
Striped Killifish *(Fundulus majalis)*
White Perch (*Morone americana*)

December 2008

Masonville Wildlife Survey

04/27/11 – 7am-1030am
Masonville Environmental Education Center, Frankfurst Ave., Fairfield section of Baltimore, MD
WEATHER: Overcast/MC, 66-72 degrees, SSE 6 mph- S 10 mph

BIRDS
Canada Goose - 12 (one pair w/ 4 goslings
Mallard – 8
Canvasback - 1 (hen)
Lesser Scaup - 1 (drake)
Ruddy Duck – 40
Horned Grebe – 1
Double-crested Cormorant – 13
Great Blue Heron – 3
Great Egret – 1
Little Blue Heron – 1
Turkey Vulture – 1
Caspian Tern – 5
Northern Cardinal – 8
Red-winged Blackbird – 19
Fish Crow – 5
N. Rough-winged Swallow – 2
Purple Martin – 1
Tree Swallow – 3
Barn Swallow – 1
Carolina Chickadee – 1
Carolina Wren – 2
House Wren – 1
Blue-gray Gnatcatcher – 1
American Robin – 11
Gray Catbird – 3
Northern Mockingbird – 3
Mourning Dove – 1
Chimney Swift – 1
Red-bellied Woodpecker – 2
Eastern Kingbird – 3
Warbling Vireo – 5
Blue Jay – 22
Brown Thrasher – 1
European Starling – 3
Yellow Warbler – 8
Song Sparrow – 1
Swamp Sparrow – 2
White-throated Sparrow – 3
Lesser Yellowlegs – 3
Wilson's Snipe – 4
Ring-billed Gull – 16
Herring Gull – 2
Great Black-backed Gull – 2
Red-shouldered Hawk – 2
Spotted Sandpiper – 1
Osprey – 1
Green Heron – 1
Common Grackle – 14
Brown-headed Cowbird – 3
Orchard Oriole – 10
Baltimore Oriole – 6
American Goldfinch – 20
SPECIES: 52
INDIVIDUALS: 285

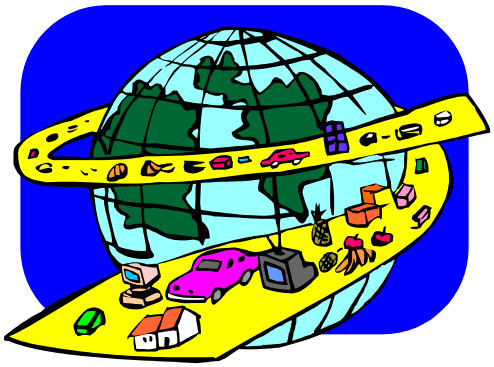
MAMMALS
Red Fox - 1
White-tailed Deer - 5

REPTILES
Eastern Painted Turtle - 1

BUTTERFLIES
Eastern Tiger Swallowtail - 1
Black Swallowtail - 5
Spichbush Swallowtail - 1
Cabbage White - 13
Orange Sulphur - 5
Clouded Sulphur - 1
Monarch - 1
Pearl Crescent - 6
Eastern Tailed Blue - 3
Wild Indigo Duskywing - 1

DRAGONFLIES
Common Green Darner - 2

Post-Trip Lesson #3: Hot Commodities



Summary: Students will research one of the Port of Baltimore's chief imported commodities.

Grade(s): 3-12

Time Required: 1 class period for research, 1 class period for preparation, 1 class period for presentations

Objectives: After completing this lesson, students will be able to:

- Identify a commodity that is imported through the Port of Baltimore.
- Trace the trade route this commodity followed en route to its final destination.
- Present their findings to the class.

Materials Needed:

- Computer with internet access; other research materials
- *Hot Commodities* Student Worksheet

Activity:

1. Have students research the Port of Baltimore's chief imports. A good place to start is the State Archive's Port of Baltimore website: http://www.msa.md.gov/msa/mdmanual/01glance/html/port.html. These commodities include automobiles and small trucks, iron ore, petroleum products, gypsum, sugar, cement, bauxite, salt, crude mineral substances, fertilizer and fertilizer materials, ferroalloys, wood pulp, and paper.
2. Students can work individually or in teams to choose one of these commodities to research. You can also assign a commodity to a student or team.
3. Students will take the role of someone who relies on this commodity: miner, farmer, manufacturer, business owner, etc. and will follow the instructions included in the Student Worksheet to research their commodity.
4. Students will outline the path of their commodity on the enclosed world atlas (courtesy National Geographic Xpeditions). If you have a plotter available, this atlas is also available to be printed on a larger scale: http://www.nationalgeographic.com/xpeditions/atlas/index.html?Parent=world&Mode=b&SubMode=w. You can have the class draw the routes of all the commodities researched; each commodity can be outlined in a different color.
5. Students will create a PowerPoint presentation to show what they have learned about the commodity.

Extensions/Related Activities:

- Older students can create a lesson to teach younger students about the commodity they researched.
- Students can learn more about foreign products available in the US through National Geographic's Xpeditions lesson "Products Across Borders": http://www.nationalgeographic.com/xpeditions/lessons/11/g68/products.html. This lesson includes an interactive short story that outlines the impact of globalization in our daily lives.
- A group activity can be played to demonstrate global interdependence. Split students into 5 groups. Assign each group a notecard with one of the following country information:
    - Country 1: United States
      Imports: cars, coffee

Exports: grain, computers

- Country 2: Japan
  Imports: metal, oil
  Exports: cars, rice
- Country 3: Columbia
  Imports: grain, textiles
  Exports: coffee, bananas
- Country 4: Saudi Arabia
  Imports: rice, airplanes
  Exports: oil, textiles
- Country 5: Great Britain
  Imports: computers, bananas
  Exports: metal, airplanes

As a group, students will study their country card and determine which countries they need goods from. Students will form a circle. A representative from one country will start with a ball of string (i.e. United States, which exports grain and computers). Another country that needs grain or computers (ie. Columbia imports grain) will ask for the string; the United States will toss the ball of string across the circle to someone from Columbia; this represents the exchange of grain. Repeat until a global 'economy' has been created. You can simulate different economic circumstances: tension between two countries (those representatives take steps back to create tension in the string); civil war within a country (cut the string of one country); a trade embargo (cut all the strings from a country); etc.

References:

"Atlas - Xpeditions @ Nationalgeographic.com." *National Geographic - Inspiring People to Care About the Planet Since 1888*. Web. June 2010. <http://www.nationalgeographic.com/xpeditions/atlas/index.html?Parent=world&Mode=b&SubMode=w>.

"Lesson Plans - Products Across Borders." *National Geographic - Inspiring People to Care About the Planet Since 1888*. Web. June 2010. <http://www.nationalgeographic.com/xpeditions/lessons/11/g68/products.html>.

"Mike's Lesson Plan String Trade." *Frontier Homepage Powered by Yahoo!* Web. June 2010. <http://www.frontiernet.net/~mikef/lessonplans/lesson1a.htm>.

Hot Commodities
Student Worksheet

In this activity you will be researching a commodity that is imported through the Port of Baltimore. You must find out:

- The name of the commodity
- What is it used for?
- Who is the end user?
- How is the commodity processed or produced?
- How does it get to the Port of Baltimore?
- What kind of ship is the commodity transported on?
- Where does it go after it leaves the Port?

On the following page you will find a world atlas. Trace the route your commodity followed as it travelled from its place of origin to its final destination. Label its stops along the way.

THE WORLD

NATIONAL GEOGRAPHIC marcopolo
XPEDITIONS
www.nationalgeographic.com/xpeditions

Post-Trip Lesson #4: Jeopardy!

Summary: Students will review material learned through a PowerPoint Jeopardy! game.

Grade(s): 3-12

Time Required: 1 class period

Objectives: After completing this lesson, students will be able to:

- Review what they have learned throughout this curriculum about the Chesapeake Bay watershed, the Port of Baltimore, habitat restoration, water quality, plants, and wildlife.

Materials Needed:

- PowerPoint Jeopardy file (enclosed CD contains this file)

Activity:

1. Run the PowerPoint as a slide show. On the first slide, you will find the game board with the 5 categories (Chesapeake Bay watershed, the Port of Baltimore, habitat restoration, water quality, and plants/wildlife).
2. Split class into teams or have students compete individually. It may be helpful to have one student be the scorekeeper. Designate a student or team to go first; they will make a seection from the game board.
3. To display the question (technically in Jeopardy! the answers are displayed), click on the appropriate point value on the game board. The slide displaying the question/answer will appear.
4. Students may raise their hands to answer the question; student or team with their hands raised first will get the chance to respond. If they answer correctly, they receive the corresponding points. If they answer incorrectly, they lose those points and other students/teams get the opportunity to answer.
5. The game ends when all questions have been answered. Student or team with the most points wins.

References:

"PowerPoint Jeopardy." *James Madison University - Home*. Web. June 2010. <http://www.jmu.edu/madison/teacher/jeopardy/jeopardy.htm>.

Game Board

Chesapeake Bay Watershed	**Port of Baltimore**	**Habitat Restoration**	**Water Quality**	**Plants and Wildlife**
The states and city within the Chesapeake Bay watershed.	The process of removing material from the bottom of a waterway.	Four components of a habitat.	Where rainwater goes after running into a storm drain.	This net is made of two perpendicular poles with a net stretched between them and is used to sample shallow water habitats.
This settles to the bottom of the Chesapeake Bay and fills shipping channels.	This channel depth is required by ocean-going ships.	Maryland's four Dredged Material Placement Sites.	These structures are used to release water from a Dredged Material Containment Facility.	This tool is used to make distanct objects look nearer, with separate eyepieces for each eye.
A surface that water cannot penetrate, such as concrete. This surface increases runoff that enters the Bay.	A commodity that is imported through the Port of Baltimore.	The size of Poplar Island in 1847.	This water quality parameter is directly related to the temperature of the water.	This investigation or inspection is done to document the plant species of a certain area.
An area bordering a body of water that is planted with trees, shrubs, and grasses.	The distance (in nautical miles) ships travel along shipping channels to get to the Port of Baltimore.	The process by which dredged material is dried and consolidated into solid ground.	This water quality parameter measures the amount of small particles in the water and is directly related to turbidity.	A measurement of the variety of life in a specific habitat.
One way to reduce sediment transport in the Bay watershed.	One way to use dredged material, where the dredge is applied to the bay environment to rebuild island and wetland habitats.	One type of habitat being restored at a Dredged Material Placement Site.	This document allows permission to discharge water from a Dredged Material Containment Facility.	This plant species can be found at a Dredged Material Containment Facility.

Answer Key

Chesapeake Bay Watershed	Port of Baltimore	Habitat Restoration	Water Quality	Plants and Wildlife
What are Maryland, Virginia, West Virginia, Delaware, Pennsylvania, New York, and Washington, DC?	What is dredging?	What are food, water, shelter, and space?	To the nearest creek or stream, then into a river, then into the Chesapeake Bay.	What is a seine net?
What is sediment?	What is 50 feet?	What are Poplar Island, Hart-Miller Island, Cox Creek, and Masonville Cove?	What are spillways?	What are binoculars?
What is an impervious surface?	What is/are automobiles/small trucks, iron ore, petroleum products, gypsum, sugar, cement, bauxite, salt, crude mineral substances, fertilizer and fertilizer materials, ferroalloys, wood pulp, or paper?	What is approximately 1,140 acres?	What is dissolved oxygen?	What is a survey?
What is a buffer?	What is 150?	What is dewatering?	What is TSS, or Total Suspended Solids?	What is biodiversity?
What is planting trees/native plants, creating/preserving wetlands, reducing impervious surface, planting/preserving SAV and marsh grasses, reducing rip rap, bulkheads, seawalls/breakwaters, reducing wave action close to shore, orcreating living shorelines?	What is beneficial use?	What is upland, wetland, mudflat, or open water area?	What is a permit?	What is Mile-a-Minute, panicgrass, milkweed, Phragmites, cottonwood, foxtail, groundsel tree, horseweed, pokeweed, cocklebur, salt marsh hay, cordgrass, redcedar, black cherry, sweetgum, sassafras, or cattail?

Post-Trip Lesson #5: Take Action!

Summary: Students will culminate their experience with an action project that addresses environmental restoration.

Grade(s): All

Activity:
In April 2008, Governor O'Malley issued a groundbreaking Executive Order establishing the Maryland Partnership for Children in Nature. This Partnership was charged with making sure all young Marylanders "have the opportunity to learn about their environment, connect with their natural world, and grow to become responsible stewards."

In April 2009, the Maryland Partnership for Children in Nature Report & Recommendations for Governor O'Malley was released. These recommendations include strengthening students' connection to nature during the school day by providing an annual meaningful outdoor environmental education experience for every student, every year, pre-K through grade 12. In 2011, Maryland became the first state to require students to be environmentally literate as a high school graduation requirement. Each local school system will design its own environmental education program that aligns with the Maryland Environmental Literacy Curriculum Standards.

We hope to accommodate local school systems through the Port of Baltimore environmental education initiatives and field experiences at Maryland's Dredged Material Containment Facilities.

To make this environmental education experience even stronger, we recommend that you conclude your trip and these lessons with an Action Project. Students can complete a service-learning project that addresses dredging and environmental restoration. This action may involve advocacy, restoration, or both (planting trees or wetland plants, installing reef balls, contacting local watershed groups, etc.). With an action component, this program can be considered a Meaningful Watershed Educational Experience (MWEE) by the Chesapeake Bay Program/Chesapeake 2000 Agreement (see enclosed CBP brochure and fact sheet).

More information about Action Projects can be found in Project WILD's *Taking Action: An Educator's Guide to Involving Students in Environmental Action Projects*, published by Western Regional Environmental Education Council, Inc., in cooperation with World Wildlife Fund. Intended for educators of grades 5-12, this guide describes how to plan, implement, and evaluate effective environmental action projects.

For more information about Meaningful Watershed Educational Experiences, please contact the Chesapeake Bay Program: http://www.chesapeakebay.net/education_mwee.aspx?menuitem=19535 or download the Chesapeake Bay Foundation's *Guide to Creating Meaningful Watershed Experiences*: http://www.cbf.org/Document.Doc?id=190.

If you would like assistance planning an Action Project with your students, please contact the Maryland Environmental Service Outreach and Education Coordinator at (410) 729-8649.

References:
"Chesapeake Bay Foundation | CBF Publications." *Chesapeake Bay Foundation* | *Save the Bay*. Web. June 2010. <http://www.cbf.org/Page.aspx?pid=548>.

"Children In Nature." *Maryland Department of Natural Resources*. Web. June 2010. <http://www.dnr.state.md.us/cin/>.

"Meaningful Watershed Educational Experience (MWEE) - Chesapeake Bay Program." *Chesapeake Bay Program - A Watershed Partnership*. Web. June 2010. <http://www.chesapeakebay.net/education_mwee.aspx?menuitem=19535>.

"Taking Action." *Project WILD*. Web. June 2010. <http://www.projectwild.org/TakingAction.htm>.

Meaningful Watershed Educational Experience (MWEE)

MWEEs serve as the foundation for a rich, lifelong relationship between students and their Bay.

Using the outdoors as a hands-on laboratory strengthens student connections to the natural environment, improves academic achievement, and increases student engagement.

MWEEs integrate field work in the Chesapeake Bay watershed with multi-disciplinary classroom activities and instruction. They can be a sustained, integral component of classroom instruction.

MWEEs are an effective tool for teaching many subjects—including science, math, history, reading and art.

"For in the end, we will conserve only what we love, we will love only what we understand, we will understand only what we are taught"

— Baba Dioum

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Eyes are Opened, Environmental Ethics are Formed

For More Information in Your Area

Maryland

Maryland State Department of Education Environmental Programs

http://www.marylandpublicschools.org/MSDE/programs/environment/

Pennsylvania

Pennsylvania Department of Education Ecology & Environment

http://www.pde.state.pa.us/env_eco

Virginia

Virginia Naturally: Curriculum resources, Classroom grants, & Student information

http://www.vanaturally.com

District of Columbia

DC Department of Health Watershed Protection Division

http://dchealth.dc.gov/services/administration_offices/environmental/watershed/enved.htm

Did you know?

Recognizing the value of hands-on environmental education, the governors of the Chesapeake Bay states and the Mayor of Washington, DC signed a commitment in 2000 to provide a meaningful watershed experience for every student in the Chesapeake Bay watershed before graduation from high school.

Meaningful Watershed Educational Experience

A Meaningful Watershed Educational Experience, or MWEE, enables students to participate in hands-on environmental learning about the Chesapeake Bay watershed. This experience will serve as the foundation for a rich, lifelong relationship between students and their Bay. Throughout the MWEE process, students develop a sense of environmental ethics and stewardship that are essential to the long-term sustainability of the Chesapeake Bay. In addition, studies have shown that hands-on environmental education increases the academic performance of students in a variety of subjects.

What Is a MWEE?

A MWEE integrates field work in the Chesapeake Bay watershed with multidisciplinary classroom activities and instruction. Students then share their discoveries with local schools and communities, both orally and in writing.

MWEEs Are Investigative or Project-Oriented.

Students investigate questions, problems, and issues related to the watershed. Activities include streambank or oyster restoration projects and planting underwater grasses; water quality monitoring; on-site studies of Bay plants and animals; or social studies that deepen a student's understanding of historical, cultural, or economic interests. Projects may also involve interaction with natural resource personnel.

MWEEs Are Integrated within the Instructional Program.

A MWEE is not a single field trip; rather, the experience reflects an integrated approach to learning. MWEEs align with jurisdictional learning standards and occur where and when they fit into the existing curriculum. They also are effective tools for teaching many subjects—including science, math, history, reading, and art.

MWEEs Involve Preparation, Action, and Reflection.

A MWEE is organized into three phases. First, students research and discuss a watershed issue or problem in preparation for the field component. Second, students take action by observing, measuring, or collecting data during their outdoor experience. Third, students return to the classroom, reflect upon and analyze their project, and reach conclusions.

MWEEs Reveal the Watershed as a System.

MWEEs have an intentional connection to the watershed as a whole. Experiences focus not only on the Bay, rivers, and streams, but also on terrestrial issues such as erosion control, buffer creation, groundwater protection, and pollution prevention.

Students and Teachers Sustain MWEEs throughout the School Year.

In-class preparation and reflection activities are vital to solidify the watershed concept. Thus, an outdoor experience, or extended outdoor project, should be expanded by classroom activities throughout the school year.

Did you know?

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NOAA B-WET

Bay Watershed Education and Training Program

The NOAA Chesapeake Bay B-WET Program provides hands-on watershed education to students and teachers to foster stewardship of the Chesapeake Bay. B-WET supports the commitment of the Chesapeake Bay Program—a partnership for watershed restoration—to provide every student in the watershed with a meaningful bay or stream outdoor experience before graduation from high school. To accomplish this, B-WET focuses on enabling experiences for students and teachers.

MWEEs for Students

MWEEs support bringing the outdoors into the classroom through a strong complement of field and classroom experiences. This provides an opportunity to teach science, math, reading, social studies, and even art in an interesting and thought-provoking manner.

Professional Development for Teachers

By providing teachers with the knowledge and confidence to weave together classroom and field activities to meet existing learning standards, student engagement and achievement is increased.

How to Apply

The B-WET program provides competitive grants and technical support facilitating MWEEs for students and related professional development for teachers. Typical grants range from $50,000 to $150,000. Eligible organizations include:

- Schools and school systems
- Colleges and universities
- Nonprofit organizations
- State and local government agencies

More information on the application process and other programs is available at http://chesapeakebay.noaa.gov.

ChART Your Way to Bay Education

www.chesapeakebay.net/chart/

Chesapeake Academic Resources for Teachers (ChART) is a web site designed to help educators provide MWEEs to their students. It is conveniently divided into three searchable sections: teaching resources, professional development, and field studies. This makes finding information you need fast and easy.

Teaching Resources

Use ChART to search a host of great teaching resources including books, data, web sites, and much more.

Professional Development

Prepare yourself to teach your students about the Chesapeake Bay and its watershed. Browse a large database of professional development training that can help you find the right program for you.

Field Study Programs

Search our library of field study programs and find opportunities that enable your students to experience the Bay's watershed hands-on.

ChART content has been approved by state departments of education, and wherever possible aligns with standards of learning and/or academic standards.

Port of Baltimore Jeopardy

Chesapeake Bay Watershed	Port of Baltimore	Habitat Restoration	Water Quality	Plants and Wildlife
10	10	10	10	10
20	20	20	20	20
30	30	30	30	30
40	40	40	40	40
50	50	50	50	50

The states and city within
the Chesapeake Bay watershed.

Chesapeake Bay Watershed – 10 points

This settles to the bottom of the Chesapeake Bay and fills shipping channels.

Chesapeake Bay Watershed – 20 points

A surface that water cannot penetrate, such as concrete. This surface increases runoff that enters the Bay.

Chesapeake Bay Watershed – 30 points

An area bordering a body of water that is planted with trees, shrubs, and grasses.

Chesapeake Bay Watershed – 40 points

One way to reduce sediment transport in the Bay watershed.

Chesapeake Bay Watershed – 50 points

The process of removing material from the bottom of a waterway.

Port of Baltimore – 10 points

This channel depth is required by ocean-going ships.

Port of Baltimore – 20 points

A commodity that is imported through the Port of Baltimore.

Port of Baltimore – 30 points

The distance (in nautical miles) ships travel along shipping channels to get to the Port of Baltimore.

Port of Baltimore – 40 points

One way to use dredged material, where the dredge is applied to the Bay environment to rebuild island and wetland habitats.

Port of Baltimore – 50 points

Four components of a habitat.

Habitat Restoration – 10 points

Maryland’s four Dredged Material Placement Sites.

Habitat Restoration – 20 points

The size of Poplar Island in 1847.

Habitat Restoration – 30 points

The process by which dredged material is dried and consolidated into solid ground.

Habitat Restoration – 40 points

One type of habitat being restored at a Dredged Material Placement Site.

Habitat Restoration – 50 points

Where rainwater goes after running into a storm drain.

Water Quality – 10 points

These structures are used to release water from a Dredged Material Containment Facility.

Water Quality – 20 points

This water quality parameter is directly related to the temperature of the water.

Water Quality – 30 points

This water quality parameter measures the amount of small particles in the water and is directly related to turbidity.

Water Quality – 40 points

This document allows permission to discharge water from a Dredged Material Containment Facility.

Water Quality – 50 points

This net is made of two perpendicular poles with a net stretched between them and is used to sample shallow water habitats.

Plants and Wildlife – 10 points

This tool is used to make distant objects look nearer, with separate eyepieces for each eye.

Plants and Wildlife – 20 points

This investigation or inspection is done to document the plant species of a certain area.

Plants and Wildlife – 30 points

A measurement of the variety of life in a specific habitat.

Plants and Wildlife – 40 points

This plant species can be found at a Dredged Material Containment Facility.

Plants and Wildlife – 50 points