Green Eggs & Sand	Alignment with Maryland Voluntary State Curriculum – High School[1]

Module One – The Horseshoe Crab

The Horseshoe Crab module is the foundation of this project, the subject of which the subsequent modules build upon. The module lessons guide students to learn the biology and natural history of this wonderful creature.

REACH THE BEACH – MIDDLE & HIGH SCHOOL

Students play a board game to learn factors that scientists believe influence horseshoe crab spawning. These factors include water temperature, tides, wind, wave action, pheromones, sediment particle size, and beach slope.

Government	Science
None	**Goal 1 Skills & Processes** **Goal 3 Biology: 3.5 Ecology**: **3.5.1** (relationships between biotic & abiotic factors)- *more depth needed addressing <u>how</u> different abiotic factors limit populations.* **Goal 6 Environmental Science: 6.12.2** Use physical, chemical, biological, and ecological concepts to analyze and explain the interdependence of organisms within the environment: Explain why interrelationships & interdependencies of organisms contribute to the dynamics of ecosystems (CLG 6.2.2); The student will conclude that populations grow or decline due to a variety of factors (CLG 6.2.3); **[Potential exists to meet –Goal 3 Life Science***:* **3.5.3** (natural & man-made changes in environ. conditions affect individuals & population dynamics; **Goal 6 Environmental Science: Environmental Issues: 6.3.5** Explain that using the environment to meet one's wants and needs has consequences (i.e., pollution, extinction); **6.5.3** Identify the survival needs and interactions between organisms and the environment; **6.5.5** Explain that decisions influencing the environment may have benefits, drawbacks, and unexpected consequences no matter how carefully the decisions are made; **6.8.5** Analyze how human activities can accelerate or magnify many naturally occurring changes (i.e., erosion, air and water quality, populations) (MLO 6.2) *– more depth needed about how human activities can limit populations (e.g., altering the beach environment*).]

RAISING HORSESHOE CRABS IN THE CLASSROOM & EXPERIMENTS - MIDDLE (CAN BE USED FOR HS EXPERIMENTS)

Students learn all about horseshoe crabs - their physical needs and interactions with abiotic factors and how they behave by raising HSC in the classroom.

Government	Science
None	**Goal 1.0 Skills & Processes** **Goal 3 Biology 3.5 Ecology**: **Interdependence of diverse living organisms & their interactions with the biosphere. 3.5.1** (relationships between biotic & abiotic factors). **3.5.3** (natural & man-made changes in environment-al conditions affect individuals & population dynamics.

[1] Activities meet core learning goals as noted.

Module Two – Shorebird Connections

This module is a critical curricular link between horseshoe crabs and humans, just as the Delaware Bay provides a critical link in shorebird migration between South America and the Arctic. The module activities enable students to explore and broaden their understanding of shorebirds, with lessons on shorebird identification, feeding behaviors, adaptations and energentics. These lessons reveal the interdependence of species, and add complexity to the subject as students move on to study "Human Connections" (Module 3) and later, "Managing a Resource (Module 4).

BE SHORE ABOUT YOUR BIRDS – MIDDLE & HIGH SCHOOL

Students learn how scientists use dichotomous keys to identify organisms: students work through a hypothetical "sample key" to student faces. They use a DE Bay Shorebird brochure and apply keying skills to identify 10 species of shorebirds known to use Delaware, Maryland, and New Jersey as a pit stop on their migration to the Arctic breeding grounds. Students view live footage of shorebirds and key them as scientists do in the field. Finally, individuals or groups of students are assigned one of the shorebird species for follow up research using a "biological profile" form provided.

Government	Science
None	**Goal 1.0 Skills & Processes** **[Potential to meet: Goal 3: 3.3 Genetics**: How traits are inherited & passed on from one generation to another; **3.4.1 Evolution:** Mechanism of evolutionary change; New traits result (natural selection; environmental pressures; adaptations; variation in reproductive success).]

AVIAN OLYMPICS – MIDDLE & HIGH SCHOOL

By competing in various physical and academic challenges, students learn about the Red Knot's incredible physical abilities and adaptations for long-distance migration. Students also learn about ecological connections between migratory shorebirds, the Delaware Bay, and horseshoe crabs. **Potential exists** to address Human Health topics (caloric needs; burning calories; types of food best for endurance (e.g., competing in a marathon).

Government	Science
None	**Goal 1.0 Skills & Processes** **Goal 3 Biology: 3.3 Genetics**: How traits are inherited & passed on from one generation to another; **3.4.1 Evolution:** Mechanism of evolutionary change; New traits result (natural selection; environmental pressures; adaptations; variation in reproductive success).]

RESEARCH TOPICS – MIDDLE SCHOOL & HIGH SCHOOL

Alignment depends on topic selected. Based on the research topics outlined in the lessons, potential exists to meet the listed indicators. We suggest that the teacher review the listed indicators and assign students to address specific elements in their research. For example,

- What role (if any) does federal or state government play in migratory bird management?
- What regulations exist to protect migratory birds (or other natural resources related to your research topic)?
- How might current and/or projected coastal population trends impact horseshoe crab or migratory bird survival?
- What economic benefits are associated with migratory bird or horseshoe crab populations in Maryland?
- What food webs would be disrupted if either the horseshoe crab or Red Knots (or one of the other 3 migratory birds described) populations were disrupted?
- What are the main limiting factors associated with Red Knot survival? What threats exist (if any) that would impact the quality of these limiting factors (e.g., beach habitat: coastal population development)?

Government	Science
[**Potential to meet the following, depending on research focus: Government: 1.0 Political Science -**	**Goal 1.0 Skills & Processes** **Goal 3 Biology 3.4.1 Evolution:** Mechanism of evolutionary change; New traits result (natural selection;

A. The Foundations & Functions of Government: 3. Govt roles & policies re: public issues. a. (EPA) (1.1.3). b. (environ issues); e. (environ policy); **B. Economic Systems/Role of Government in Econ.** 3. Regulatory agencies & their social, economic, & political impacts (e.g. EPA) (4.1.3); **C. Protecting Rights/Maintaining Order: 3**. Impact of government decisions & actions (1.2.3). e. (EPA environ. standards; Md Dept. of Envir. regulations); **3.0 Geography: B. Geog Characteristics of Places/Regions.** 1. Roles & relationships of regions on formation & implementation of gov. policy (3.1.3) (population growth & impacts on environ; how natural resources & population define a region). c. how regional natural resources/environ issues influence gov. policies; **C. Movement of People, Goods & Ideas**. 1. How demographics relate to political participants, public policy & gov. policies (3.1.1). d. population trends & projections & how they affect environ**; D. Modifying the Environment 1.** Role of govt in addressing land use & other environ issues (3.1.2). a – e (leg. decisions on land use/environ. issues); **4.0 Economics: A. Scarcity & Econ Decision-making. 1.** Econ costs/benefits & opportunity costs (4.1.2). d. (public policy issues: env. concerns); **B. Economic Systems/Role of Govt in Economy.** 3. Regulatory agencies & their social, econ, & political impacts (4.1.3). (e.g., EPA); **U.S. World History 3.0 Geography:** 3.1 Evaluate interactions of environ factors & location/distribution of human activity (land use patterns before/after agricultural mechanize-tion) (3.1.2) Analyze impacts of human settlement patterns on environ (greenhouse effect); **U.S. History: 5.2 Political Science** (legislative attempts to address pollution; Clean Water Act; EPA regulations); impact of regulatory agencies (EPA).

environmental pressures; adaptations; variation in reproductive success);**3.5 Ecology**: **Interdependence of diverse living organisms & their interactions with the biosphere. 3.5.1** (relationships between biotic & abiotic factors). **3.5.2.** (interrelationships & interdependencies among different organisms = stability); **3.5.3** (natural & man-made changes in environmental conditions affect individuals & population dynamics; human activity & technology influences food webs); **3.5.4** All organism are part of & depend on 2 major global food webs that are influenced by human activity & technology (ocean; terrestrial); **3.6 Investigate a biological issue** (consequences & trade-offs between technology & environment; defend their position on biodiversity, population growth, global sustainability, etc.); **Goal 6 Environmental Science: Environmental Issues 6.5.3** Identify the survival needs and interactions between organisms and the environment (e.g., insects depend on plant and animal material for food); **6.3.5** Explain that using the environment to meet one's wants and needs has consequences (i.e., pollution, extinction); **6.5.5** Explain that decisions influencing the environment may have benefits, drawbacks, and unexpected consequences no matter how carefully the decisions are made; **6.8.5** Analyze how human activities can accelerate or magnify many naturally occurring changes (i.e., erosion, air and water quality, populations) (MLO 6.2); **Interdependence of Organisms 6.12.2** Use physical, chemical, biological, and ecological concepts to analyze and explain the interdependence of organisms within the environment; **Natural Resources and Human Needs 6.12.4** Use concepts from chemistry, physics, biology, and ecology to analyze and interpret the impact both positive (recycling) and negative (toxic wastes) of human activities on the earth's resources (land, water, air, energy, biological); **6.12.5** Investigate and analyze environmental issues from local to global perspectives (e.g., world population, food production and distribution, pollution and epidemics, biodiversity) to develop an action project that protects, sustains, or enhances the natural environment.

AP Environmental Science

II. The Living World: A. Ecosystem Structure (biological populations & communities; interactions among species); B. **Energy Flow (**food webs & trophic levels; ecological pyramids); **C. Ecosystem Diversity** (biodiversity; natural selection; evolution; ecosystem systems); **D. Natural Ecosystem Change** (climate shifts; species movement; ecological succession); **E. Natural Biochemical Cycles** (carbon; nitrogen; phosphorus; sulfur; water; conservation of matter).
IV. Land & Water Use: F. Fishing (fishing techniques; over-fishing; aquaculture; relevant laws & treaties).
VII. Global Change: C. Loss of Biodiversity 1. Habitat loss; overuse; pollution; introduced, endangered & extinct species; 2. Maintenance through conservation; 3. Relevant laws & treaties.

Module Three –Human Connections

This module provides an effective bridge between the Shorebird Connections module, and the Managing a Resource module. The Human Connections module focuses on introducing students to the many uses of crabs, the ways those uses and values have changed over time, and the unique and valuable biomedical applications. These activities use a combination of outdoor-interactive, indoor-laboratory, and internet exploration.

TIME TRACKING: A CRABS, BIRDS & HUMANS TIMELINE EXERCISE – MIDDLE & HIGH SCHOOL

Students work together laying out a spatial-linear timeline representation of the horseshoe crab's history from its origins 350 million years ago to the present day. Next, students are provided with a series of key dates in the horseshoe crabs, humans and shorebirds story, to position along the line. Because key events bunched on the timeline, students create an exploded "recent-time" version of the line (representing the last 200-500 years).

Events are added over the new line. Upon completion of each timeline piece, students work individually or in teams to answer a series of questions relating to the timeline events. As a culminating exercise, students are asked to forecast the next 50 years of HSC/Humans timeline events.

Government	Science
To effectively address the following LOs, more depth & context is needed than what is available on event cards. **Govt: 1.0 Political Science -A. The Foundations & Functions of Govt: 3.** Govt. role/policies re: public issues. a. (EPA) (1.1.3). b. (env. issues); e. (env. policy); **B. Econ Systems/Role of Govt in Econ.** 3. Regulatory agencies: social, econ, & political impacts (e.g. EPA) (4.1.3); **C. Protecting Rights/Maintaining Order: 3**. Impact of govt decisions/actions (1.2.3). e. (EPA env. standards; Md Dept. of Env. regs); **3.0 Geog: B. Geo Characteristics of Places/Regions.** 1. Roles/relationships of regions on formation/implementation of gov. policy (3.1.3) (pop. growth/impacts on env; resources & pops define regions). c. regional resources & environ. issues influence gov. policies; **3.0 Geog: B. Geog Characteristics of Places/Regions** 1. Roles/relationships of regions on formation & implementation of gov. policy (3.1.3). (pop growth/impacts on environ; resources/pop define a region). c. regional resources/environ. issues influence gov. policies; **D. Modifying Environ 1.** Govt. role addressing land use/other environ. issues (3.1.2); **4.0 Econ: A. Scarcity & Econ Decision-making. 1.** Econ costs/benefits/opportunity costs (4.1.2). d. (public policy issues, e.g., environ. concerns); **B. Econ Systems & Role of Govt in Econ.** 3. Regulatory agencies & their social, econ, & political impacts (4.1.3). (e.g., EPA).	**Goal 1 Skills & Processes** **Goal 3 Biology - 3.4.1 Evolution:** Mechanism of evolutionary change; New traits result (natural selection; environmental pressures; adaptations; variation in reproductive success); **3.5 Ecology**: **Interdependence of diverse living organisms & their interactions with the biosphere. 3.5.1** (relationships between biotic & abiotic factors). **3.5.2.** (interrelationships & interdependencies among different organisms = stability); **3.5.3** (natural & man-made changes in environmental conditions affect individuals & population dynamics; human activity & technology influences food webs); **3.5.4** All organism are part of & depend on 2 major global food webs that are influenced by human activity & technology (ocean; terrestrial). **Goal 6 Environmental Science: Environmental Issues** **6.5.3** Identify the survival needs and interactions between organisms and the environment (e.g., insects depend on plant and animal material for food); **6.3.5** Explain that using the environment to meet one's wants and needs has consequences (i.e., pollution, extinction); **6.5.5** Explain that decisions influencing the environment may have benefits, drawbacks, and unexpected consequences no matter how carefully the decisions are made; **6.8.5** Analyze how human activities can accelerate or magnify many naturally occurring changes (i.e., erosion, air and water quality, populations) (MLO 6.2).

LAL LAB: TESTING FOR ENDOTOXINS – HIGH SCHOOL (MIDDLE SCHOOL W/GUIDANCE)

This combination video/PowerPoint/lab activity is designed to deepen student understanding of the use of HSC blood in biomedical testing. The video introduces students to this process, including: how HSC are collected & bled; how the blood is centrifuged to collect the amoebocytes used to make the LAL media; how the end product is used to test all vaccines & other injectable materials put into the human body. The PPT provides greater depth: how the clotting properties of HSC blood were discovered; the nature of crab's immune system compared to humans; what endotoxins are; why we need to detect them; introduction to basics on how the gel-clot tests are carried out, leading to a culminating lab activity/demo, where students test and compare water samples for the presence of endotoxins, using the same LAL media used by the pharmaceutical industry.

Government	Science
None	**Goal 1 Skills & Processes** **Goal 3 Biology: 3.1 Biochemistry:** Explain the correlation between the structure & function of biologically important molecules & their relationship to cell process. **Goal 4 Chemistry 4.5** Chemistry's impact on society; **4.5.2** (limited resources need to be conserved); **4.6** Connections

	between science and other disciplines. **Goal 6 Environ Science: Environ Issues 6.3.5** Using the environ. to meet one's wants & needs has consequences; **6.5.5** Decisions influencing the environ. may have benefits, draw-backs, & unexpected consequences no matter how carefully made; **6.8.5** Human activities can accelerate/magnify many naturally occurring changes (MLO 6.2); **6.12.5** Investigate & analyze environ. issues from local to global perspectives to develop an action project that protects, sustains, or enhances the natural environ; Id environ. issue & formulate related research questions (CLG 6.4.1); design & conduct the research (CLG 6.4.2); interpret findings to form conclusions, make recommendations to help resolve the issue (CLG 6.4.3); apply conclusions to develop & implement an action project (CLG 6.4.4); analyze effectiveness of the action project in terms of achieving desired outcomes (CLG 6.4.5); **Natural Resources & Human Needs 6.12.4** Analyze & interpret the impact both positive and negative of human activities on the earth's resources (land, water, air, energy, biological): evaluate the interrelationships between humans and biological resources (CLG 6.3.4).

Module Four Managing a Resource

This module focuses on the complexities of managing a multi-use natural resource: (1) the different points of view of multiple stake-holders, (2) the challenges faced by natural resource managers seeking to balance the needs of these user groups, (3) the importance of gathering rigorous scientific data upon which to base management decisions, & (4) the importance of sequentially telling the harvesting controversy (1997-2002) story. Students apply critical thinking skills to discover how science, media, and politics can be used and misused in the natural resource regulatory process.

2. TRAGEDY OF COMMONS – MIDDLE & HIGH SCHOOL

Students play a game that simulates different demands placed upon a "commons" resource. Students are assigned different stakeholder positions that help them gain an understanding of the value a commons resources has on different segments of society, and experience how easily common resources can become depleted. Students gain an appreciation for the need to find management strategies that allow for sustainble use.

Government	Science
Government: 1.0 Political Science - A. The Foundations/Functions of Govt: 3. Govt roles/policies re: public issues. b. (environ. issues); e. (environ. policy); **B. Econ Systems & Role of Govt in Economy.** 3. Regulatory agencies & their social, econ, & political impacts (4.1.3); **C. Protecting Rights/Maintaining Order: 3**. Impact of govt decisions & actions (1.2.3). e. (Md Dept. of Envir. regulations); **3.0 Geog: B. Geog. Characteristics- Places/Regions** 1. Roles/ relationships of regions on formation/implementation of gov. policy (3.1.3) (population growth & impacts on environ; how resources/population define a region); c. how regional resources/environ. issues influence gov. policies; **C. Movement of People, Goods & Ideas**. 1. How demographics relate to political participants, public policy & gov. policies (3.1.1); d. population trends & projections: how they affect environ**; D. Modifying the Environ 1.** Role of govt addressing land use. other env. issues (3.1.2); a (leg. decisions on land use. env. issues); **4.0 Economics:- A. Scarcity & Econ. Decision-**	**Goal 1 Skills & Processes** **Goal 3 Biology 3.5 Ecology**: **Interdependence of diverse living organisms & their interactions with the biosphere. 3.5.3** (natural & man-made changes in environmental conditions affect individuals & population dynamics; human activity & technology influences food webs); **3.5.4** All organism are part of & depend on 2 major global food webs that are influenced by human activity & technology; **3.6 Investigate a biological issue** (consequences & trade-offs between technology & environment; defend their position on biodiversity, population growth, global sustainability, etc.). **Goal 6 Environmental Science: Interdependence of Organisms 6.12.2** Use physical, chemical, biological, & ecological concepts to analyze & explain the interdependence of organisms within the environ: conclude that populations grow or decline due to a variety of factors (CLG 6.2.3); **Natural Resources & Human Needs 6.12.4** Use concepts from chemistry, physics, biology, & ecology to analyze & interpret the impact both positive & negative of human activities on the earth's resources: evaluate the interrelationships between humans & biological resources (CLG 6.3.4); **Environmental Issues: 6.3.5** Using the environ. to meet one's wants & needs has consequences; **6.5.5** Decisions influencing the environ. may have benefits, drawbacks, & un-expected consequences no matter how carefully made; **6.8.5** Human activities can accelerate/magnify many naturally occurring changes (MLO 6.2).

making. 1. Econ. costs & benefits & opportunity costs (4.1.2). d. (public policy issues, such as environ. concerns); **B. Economic Systems & the Role of Govt in the Econ.** 3. Regulatory agencies & their social, economic, & political impacts (4.1.3).	

3A. BELIEFS & VALUES & 3B. IDENTIFYING THE STAKEHOLDERS – UPPER MIDDLE – HIGH SCHOOL

This activity engages students in exploring the how's and why's of the beliefs and values that underpin the perspectives that different people bring to environmental issues. The activity begins with a discussion of values and identifying personal values, followed by a discussion relating to how people's beliefs and values shape their views. After watching a video clip, students identify the values and beliefs of different stakeholders in the horseshoe crab fishery. Through this process, students come to understand how different people can come to see the same issue in different ways.

Government	Science
Government: 4.0 Economics:- A. Scarcity & Economic Decision-making. 1. Economic costs & benefits & opportunity costs (4.1.2). d. (public policy issues, such as environmental concerns).	**Goal 3 Biology: 3.5 Ecology**: **Interdependence of diverse living organisms & their interactions w/ biosphere. 3.5.3** (natural & man-made changes in environ. conditions affect individuals & population dynamics; human activity & tech. influences food webs); **3.5.4** All organism are part of & depend on 2 major global food webs influenced by human activity & technology; **3.6 Investigate a biological issue** (consequences & trade-offs between tech. & environ; defend their position on biodiversity, population growth, global sustainability, etc.). **Goal 6: Natural Resources & Human Needs 6.12.4** Analyze & interpret positive & negative impacts of human activities on earth's resources: evaluate interrelationships between humans & biological resources (CLG 6.3.4); **Environ Issues 6.3.5** Using the environ to meet one's wants & needs has consequences; **6.5.5** Decisions influencing the environment may have benefits, drawbacks, & unexpected consequences no matter how carefully made; **6.8.5** Human activities can accelerate or magnify many naturally occurring (MLO 6.2). **AP Environmental Science** **IV. Land & Water Use: F. Fishing** (fishing techniques; over-fishing; aquaculture; relevant laws & treaties).

4. HOW BEHAVIOR CONTRIBUTES TO NATURAL RESOURCES CHALLENGES - HIGH SCHOOL

In order to gain an understanding of waterman values toward horseshoe crab population issues, students are presented similar scenarios to examine and analyze their own behaviors in everyday life situations. By putting their selves in another's "shoes," students gain an understanding about what motivates people (resource uses) to do what they do. The scenarios are effective as "seeds" for fueling class discussions about waterman issues.

Government	Science
Government: 4.0 Economics:- A. Scarcity & Economic Decision-making. 1. Economic costs & benefits & opportunity costs (4.1.2). d. (public policy issues, such as environmental concerns).	**Goal 1 Skills & Processes** **Goal 3 Biology: 3.5 Ecology**: **Interdependence of diverse living organisms & their interactions / biosphere. 3.6 Investigate a biological issue** (consequences & trade-offs between tech. & environ; defend their position on biodiversity, population growth, global sustainability, etc.); **Goal 6: Natural Resources & Human Needs 6.3.5** Using enviro to meet one's wants/needs has consequences; **6.5.5** Decisions re: environ have benefits/drawbacks/unexpected consequences no matter how carefully made.

5. THE ART OF ARGUMENT – UPPER ELEMENTARY, MIDDLE & HIGH SCHOOL

Students explore the art of argument through a series of 12 lessons. Students read & write about the horseshoe crab & shorebird controversy in Delaware, Maryland, and New Jersey. Students learn the concepts of "point of view, bias, and tone" as well to discriminate facts from opinions as they read current and past articles on HSCs. Students complete journal activities, develop article reports on primary sources and write a five paragraph persuasive essay.

English	Science
Goal 1 Demonstrate the ability to respond to text by	**Goal 1 Skills & Processes**

employing personal experiences and critical analysis. **Goal 2**. Compose oral, written or visual presentations that inform, persuade and express personal ideas. **Goal 4** Demonstrate the ability to evaluate the content, organization and language use of text.

Government

1.0 Political Science - A. The Foundations & Functions of Government: 3. Governmental roles & policies regarding public issues. a. (EPA) (1.1.3). b. (environmental issues); e. (environmental policy); **B. Economic Systems & Role of Government in Economy.** 3. Regulatory agencies & their social, economic, & political impacts (e.g. EPA) (4.1.3); **C. Protecting Rights & Maintaining Order: 3**. Impact of government decisions & actions (1.2.3). e. (EPA environ standards; Md Dept. of Envir. regulations).
3.0 Geography: B. Geographic Characteristics of Places & Regions. 1. Roles & relationships of regions on formation & implementation of gov. policy (3.1.3). (population growth & impacts on environment; how natural resources & population define a region). c. how regional natural resources & environmental issues influence gov. policies;
4.0 Economics:- A. Scarcity & Economic Decision-making. 1. Economic costs & benefits & opportunity costs (4.1.2). d. (public policy issues, such as environmental concerns); **B. Economic Systems & the Role of Government in the Economy.** 3. Regulatory agencies & their social, economic, & political impacts (4.1.3). (e.g., EPA).

Goal 3 Biology: 3.1 Biochemistry: Explain correlation between structure & function of biologically important molecules & their relationship to cell process; **3.4.1 Evolution:** Mechanism of evolutionary change; New traits result (natural selection; environmental pressures; adaptations; variation in reproductive success); 3**.5 Ecology**: **Interdependence of diverse living organisms & interactions w/biosphere. 3.5.1** (relationships between biotic & abiotic factors). **3.5.2.** (interrelationships & interdependencies among different organisms = stability); **3.5.3** (natural & man-made changes in environ conditions affect individuals & population dynamics; human activity & technology influences food webs); **3.5.4** All organism are part of & depend on 2 global food webs influenced by human activity & technology; **3.6 Investigate a biological issue** (consequence/trade-offs between tech & environ; defend their position on biodiversity, population growth, global sustainability); **3.5.3** (natural/man-made changes in environ affect individuals & population dynamics; human activity & tech influences food webs); **3.5.4** All organism are part of & depend on 2 major food webs influenced by human activity & tech; **3.6 Investigate a biological issue** (consequences & trade-offs betw tech & environ; defend their position on biodiversity, population growth, global sustainability, etc.).
Goal 4 Chemistry 4.5 Chemistry's impact on society; **4.5.2** (limited resources need to be conserved); **4.6** Connections between science and other disciplines.
Goal 6 Environmental Science: Interdependence of Organisms 6.12.2 Use physical, chemical, biological, & ecological concepts to analyze & explain the interdependence of organisms within the environ: conclude that populations grow/decline due to a variety of factors (CLG 6.2.3); **Natural Resources & Human Needs 6.12.4** Use concepts from chemistry, physics, biology, & ecology to analyze & interpret the impact both positive & negative of human activities on the earth's resources: evaluate the interrelationships between humans & biological resources (CLG 6.3.4); **Environmental Issues: 6.3.5** Using the environ. to meet one's wants & needs has consequences; **6.5.5** Decisions influencing the environ. may have benefits, drawbacks, & un-expected consequences no matter how carefully made; **6.8.5** Human activities can accelerate/magnify many naturally occurring changes (MLO 6.2).
AP Environmental Science
II. The Living World: A. Ecosystem Structure (biological populations & communities; interactions among species); B. **Energy Flow (**food webs & trophic levels; ecological pyramids); **C. Ecosystem Diversity** (biodiversity; natural selection; evolution; ecosystem systems); **D. Natural Ecosystem Change** (climate shifts; species movement; ecological succession); **E. Natural Biochemical Cycles** (carbon; nitrogen; phosphorus; sulfur; water; conservation of matter).
IV. Land & Water Use: F. Fishing (fishing techniques; over-fishing; aquaculture; relevant laws & treaties).
VII. Global Change: C. Loss of Biodiversity 1. Habitat loss; overuse; pollution; introduced, endangered & extinct species; 2. Maintenance through conservation; 3. Relevant laws & treaties.

6. WebQuest: The Horseshoe Crab Harvesting Controversy – Middle & High School

This activity engages students in exploring the how's and why's of multiple points of view. It identifies the major stakeholders in the horseshoe crab story, involves students in WebQuest-based research on the varying views of these stakeholders, and culminates with students presenting and defending a position on how the resource should be managed.

Government

Govt: 1.0 Political Science - A. Foundations/ & Functions of Govt: 3. Govt roles/policies re: public issues. b. (environ issues); e. (environ policy); **B. Econ Systems & Role of Govt in Economy.** 3. Regulatory agencies: their social, econ, & political impacts (4.1.3); **C. Protecting Rights/Maintaining Order: 3**. Impact of govt decisions & actions (1.2.3). e. (Md Dept. of Envir.

Science

Goal 1 Skills & Processes
Goal 3 Biology:
3.1 Biochemistry: Correlation between structure/function of biologically important molecules & their relationship to cell process; **3.4.1 Evolution:** Mechanism of evolutionary change; New traits result (natural selection; env. pressures; adaptations; variation in reproductive success); **3.5 Ecology**: **Interdependence of diverse living organisms & their interactions with biosphere. 3.5.1** (relationships between biotic & abiotic factors). **3.5.2.** (interrelationships & interdependencies among different organisms = stability); **3.5.3** (natural/ & man-made changes in environ. conditions affect

regs); **3.0 Geog: B. Geog Characteristics of Places & Regions.** 1. (pop growth/impacts on environ.; natural resources & population define a region). c. regional resources & environ issues influence gov. policies; **C. Movement of People, Goods & Ideas**. 1. d. population trends & projections & how they affect the environ**; D. Modifying Environ 1.** Role of govt: addressing land use & other environ. issues (3.1.2). a (leg. decisions on land use & environ. issues); c. State executive branch addresses land use (pollution, water resources, critical areas); d. role of state/local govt: addressing land use; e. evaluate how fed. State & local govt. develop policy to address land use & environ. **4.0 Econ:- A. Scarcity & Econ Decision-making. 1.** Econ costs/benefits/ opportunity costs (4.1.2). d. (env concerns); **B. Econ Systems & Role of Govt in Economy.** 3. Regulatory agencies: their social, economic, & political impacts (4.1.3).	individuals & population dynamics; human activity & tech. influences food webs); **3.5.4** All organism are part of & depend on 2 major global food webs influenced by human activity & tech; **3.6 Investigate a biological issue** (consequences /trade-offs between tech. & environ.; defend position on biodiversity, pop growth, global sustainability, etc.). **Goal 4 Chemistry:** 4.5 Chemistry's impact on society. **4.5.2** (limited resources need to be conserved); **4.6** Connections between science and other disciplines. **Goal 6 Environ Science Interdependence of Organisms 6.12.2** Analyze/explain interdependence of organisms w/in environ.: organisms are linked by transfer & transformation of matter & energy at ecosystem level (CLG 6.2.1); interrelationships & interdependencies of organisms contribute to dynamics of ecosystems (CLG 6.2.2); conclude that populations grow/decline due to a variety of factors (CLG 6.2.3); provide examples showing natural selection leads to organisms well suited for survival in particular environ. (CLG 6.2.4); **6.5.3** ID survival needs & interactions between organisms & the environ. **Natural Resources & Human Needs 6.12.4** Analyze & interpret positive/negative impacts of human activities on earth's resources: evaluate the interrelationships between humans & biological resources (CLG 6.3.4); **Environmental Issues 6.3.5** Using the environ. to meet one's wants & needs has consequences; **6.5.5** Decisions influencing the environ. have benefits, drawbacks, & unexpected consequences no matter how carefully made; **6.8.5** Human activities can accelerate/magnify many naturally occurring changes (MLO 6.2); **6.12.5** Investigate & analyze environ. issues from local to global perspectives.

8. THE REST OF THE STORY – HIGH SCHOOL (MIDDLE SCHOOL W/GUIDANCE)

Students use graphs of real data collected from various sources that show a decline in HSC population over recent years. After forming conclusions from these data based on face value, students are presented with more information that relates some inconsistencies & other flaws in each data set. Students learn that for valid decisions to be made about management of a resource like this, the need for more solid, targeted scientific data is critical.

Government	Science
Government: 1.0 Political Science - A. The Foundation/Functions of Govt: 3. Govt roles/policies re: public issues. b. (enviro issues); e. (enviro policy); **B. Econ Systems/Role of Govt in Economy.** 3. Regulatory agencies & their social, economic, & political impacts (4.1.3); **C. Protecting Rights/Maintaining Order: 3**. Impact of govt decisions & actions (1.2.3). e. (Md Dept. of Envir. regulations); **4.0 Econ:- B. Economic Systems & Role of Govt in Economy.** 3. Regula-tory agencies & their social, economic, & political impacts (4.1.3).	**Goal 1 Skills & Processes** **3.5 Ecology**: **Interdependence of diverse organisms & interactions w/biosphere. 3.6 Investigate a bio issue** (consequence/trade-offs between tech/environ; defend position on biodiversity, pop growth, global sustainability). **Goal 6 Environ Science: Natural Resources/Human Needs 6.12.4 Analyze/interpret** positive/negative impacts of human activities on resources: Evaluate interrelationships between humans & biological resources (CLG 6.3.4); **[Potential to meet:** (lesson lacks action project or designing authentic research) **6.12.5** Investigate & analyze env. issues from local to global perspectives (e.g., biodiversity); id env issue, formulate related research questions (CLG 6.4.1); interpret findings, form conclusions, make recommendations to resolve issue (CLG 6.4.3).] **AP Environmental Science** **IV. Land & Water Use: F. Fishing** (techniques; overfishing; aquaculture; relevant laws & treaties). **VII. Global Change: C. Loss of Biodiversity** 1. Habitat loss; overuse; pollution; 2. Conservation; 3. Laws & treaties.

9. OTHER VIEWS OF RESEARCH – HIGH SCHOOL

Students watch a video clip featuring four people expressing various concerns relating to the collection, use and interpretation of data upon which management decisions about horseshoe crabs are based. As they listen to the video, students summarize the important points each of the featured people (stakeholders) is trying to make.

Government	Science
[Potential exists to meet – with further discussion & depth in the following: Government: 1.0 Political Science - A. The Foundations & Functions of Government: 3. Govt. roles & policies regarding public	**Goal 1 Skills & Processes** **Goal 6 Environmental Science: Environmental Issues 6.3.5** Using the environ. to meet one's wants & needs has consequences; **6.5.5** Decisions influencing the environ. have benefits, drawbacks, & unexpected consequences no matter how carefully made; **6.12.5** Investigate & analyze environ. issues from local to global perspectives.

issues. e. (environmental policy); **B. Economic Systems & the Role of Government in the Economy.** 3. Regulatory agencies & their social, economic, & political impacts (4.1.3); **C. Protecting Rights & Maintaining Order: 3**. Impact of govt decisions & actions (1.2.3). e. (environ. standards; Md Dept. of Envir. regulations); **3.0 Geography: B. Geographic Characteristics of Places & Regions.** 1. Roles & relationships of regions on formation & implementation of govt. policy (3.1.3) (how natural resources & population define a region). c. how regional natural resources & environ. issues influence govt. policies; **D. Modifying the Environment 1.** Role of government in addressing land use & other environmental issues (3.1.2). a (leg. decisions on environ. issues); **4.0 Economics:-B. Economic Systems & the Role of Government in the Economy.** 3. Regulatory agencies & their social, economic, & political impacts (4.1.3).]	

10. ISSUES ANALYSIS – USING SECONDARY DATA – HIGH SCHOOL – MIDDLE W/GUIDANCE

This activity is designed to follow the video clip showing people concerned about the management of horseshoe crabs and their views. Students will learn that many sources of secondary data have inherent biases based upon the view of the author, and sources of information gathered: working in groups, students analyze different newspaper articles and compare their analyses among groups, to see that, despite all the articles covering the same topic, not all the journalists presented it in the same manner.

Government	Science
None	**Goal 1 Skills & Processes** **Goal 3 Biology: 3.5 Ecology**: **Interdependence of diverse living organisms & their interactions with the biosphere: 3.6 Investigate a biological issue** (consequences & trade-offs between technology & environment; defend their position on biodiversity, population growth, global sustainability, etc.). **[Potential exists to meet:** (lesson does not address action plan) **Goal 6 Environmental Science: Environmental Issues 6.12.5** Investigate & analyze environmental issues from local to global perspectives to develop an action project that protects, sustains, or enhances the natural environment" ID an environmental issue & formulate related research questions (CLG 6.4.1); design & conduct research (CLG 6.4.2); interpret findings to form conclusions & make recommendations to help resolve the issue (CLG 6.4.3).

13B. SPAWNING CRAB SURVEY – MIDDLE & HIGH SCHOOL

Students will learn the concepts of relative abundance, statistical sampling, and how to interpret data from sampling data. Students will simulate the sampling technique developed by the Atlantic States Marine Fisheries Commission (ASMFC) designed to determine the relative abundance of spawning horseshoe crabs.

Government	Science
None	**1.0 Skills & Processes: A. Constructing Knowledge; B. Applying Evidence and Reasoning; C. Communicate Scientific Information; D. Technology.**

14A. WORKING ON SOLUTIONS –MIDDLE & HIGH SCHOOL

Students learn about what was being done, as of the summer of 2002, to help protect horseshoe crabs, and determine a way to share that information with others.

Government	Science
Government: 1.0 Political Science - A. The Foundations & Functions of Government: 3. Governmental roles & policies regarding public issues. b. (environmental issues); e. (environmental policy); **B. Economic Systems & the Role of Government in the Economy.** 3. Regulatory agencies & their social, economic, & political impacts (4.1.3); **C. Protecting Rights & Maintaining Order: 3**. Impact of government decisions & actions (1.2.3). e. (Md Dept. of Envir. regulations); **3.0 Geography: B. Geographic Characteristics of Places & Regions.** 1. Roles & relationships of regions on formation & implementation of gov. policy (3.1.3). (how natural resources & population define a region). c. how regional natural resources & environmental issues influence gov. policies; **D. Modifying the Environment 1.** Role of government in addressing land use & other environmental issues (3.1.2). a (leg. decisions on land use & environ. issues); **4.0 Economics: A. Scarcity & Economic Decision-making. 1.** Economic costs & benefits & opportunity costs (4.1.2). d. (public policy issues, such as environmental concerns); **B. Economic Systems & the Role of Government in the Economy.** 3. Regulatory agencies & their social, economic, & political impacts (4.1.3).	**Goal 1 Skills & Processes** The following learning outcomes may be met, depending on the focus of students' outreach presentation: **Goal 3 3.5 Ecology**: **Interdependence of living organisms & their interactions w/ biosphere. 3.5.1** (relationships between biotic & abiotic factors). **3.5.2.** (interrelationships/interdependencies among different organisms = stability); **3.5.3** (natural/manmade changes in env conditions affect individuals & population dynamics; human activity & tech influences food webs); **3.5.4** All organism are part of/depend on 2 global food webs influenced by human activity & technology; **3.6 Investigate a biological issue** (consequences & trade-offs between tech. & environ; defend position on biodiversity, population growth, global sustainability, etc.). **Goal 4 Chemistry: 4.5** Chemistry's impact on society. **4.5.1** (synthetics); **4.5.2** (limited resources need to be conserved); **4.6** Connections between science and other disciplines. **Goal 6 Env Science: Interdependence of Organisms 6.12.2** Analyze/explain interdependence of organisms w/in env; explain how organisms are linked by transfer/transformation of matter & energy at ecosystem level (CLG 6.2.1); explain why interrelationship/interdependencies of organisms contribute to dynamics of ecosystems (CLG 6.2.2); conclude that populations grow/decline due to variety of factors (CLG 6.2.3); provide examples showing natural selection leads to organisms well suited for survival in particular env.(CLG 6.2.4); **6.5.3** Id survival needs & interact-tions between organisms & env. **Natural Resources/Human Needs 6.12.4** Analyze/interpret positive/negative impacts of human activities on resources: evaluate interrelationships between humans & biological resources (CLG 6.3.4). **Goal 6 Environ Science: Environ Issues 6.3.5** Using environ. to meet one's wants & needs has consequences; **6.5.5** Decisions influencing environ. have benefits, drawbacks, unexpected consequences no matter how carefully made; **6.8.5** Human activities can accelerate/magnify naturally occurring changes (erosion, air/water quality, populations) (MLO 6.2); **6.12.5** Investigate & analyze environ. issues from local-global perspectives to develop an action project that protects, sustains, or enhances the environment: id an environ. issue & formulate related research questions (CLG 6.4.1); design & conduct the research (CLG 6.4.2); interpret findings to form conclusions & make recommendations to help resolve the issue (CLG 6.4.3); apply the conclusions to develop & implement an action project (CLG 6.4.4); analyze the effectiveness of the action project in terms of achieving the desired outcomes (CLG 6.4.5). **AP Environmental Science** **II. The Living World: A. Ecosystem Structure** (biological populations & communities; interactions among species); B. **Energy Flow (**food webs & trophic levels; ecological pyramids); **C. Ecosystem Diversity** (biodiversity; natural selection; evolution; ecosystem systems); **IV. Land & Water Use: F. Fishing** (techniques; over-fishing; aquaculture; relevant laws/treaties); **VII. Global Change: C. Loss of Biodiversity** 1. Habitat loss; overuse; pollution; introduced, endangered & extinct species; 2. Maintenance through conservation; 3. Relevant laws & treaties.

14B. PROBLEM SOLVING WITH THUMPER – HIGH SCHOOL (MIDDLE W/GUIDANCE)

Through watching interview snippets with a Delaware waterman, and answering a series of questions relating to it, students discover practical use of the scientific method in real-world problem-solving - in this case, investigating the viability of an alternative bait strategy (using the waste product of horseshoe crab bleeding for biomedical use) that could greatly reduce or eliminate the need for harvesting horseshoe crabs for use as conch bait.

Government	Science
None	**Goal 1 Skills & Processes** **Goal 3 Biology 3.5 Ecology**: **Interdependence of diverse living organisms & their interactions with the biosphere. 3.5.1** (relationships between biotic & abiotic factors). **3.5.2.** (interrelationships & interdependencies

	among different organisms = stability); **3.5.3** (natural & man-made changes in environ. conditions affect individuals & population dynamics; human activity & technology influences food webs); **3.5.4** All organism are part of & depend on 2 major global food webs that are influenced by human activity & technology (ocean; terrestrial); **3.6 Investigate a biological issue** (consequences & trade-offs between technology & environ.; defend their position on biodiversity, population growth, global sustainability, etc.). **Goal 4 Chemistry: 4.5** Chemistry's impact on society. **4.5.1** (synthetics); **4.5.2** (limited resources need to be conserved); **4.6** Connections between science and other disciplines. **Goal 6 Environmental Science: Environmental Issues 6.3.5** Explain that using the environ to meet one's wants & needs has consequences; **Interdependence of Organisms 6.5.3** Identify the survival needs & interactions between organisms & the environ; **6.5.5** Decisions influencing the environ. have benefits, drawbacks, & unexpected consequences no matter how carefully made; **6.8.5** Human activities can accelerate/magnify many naturally occurring changes (MLO 6.2); **6.12.2** Use physical, chemical, biological, & ecological concepts to analyze & explain the interdependence of organisms within the environ: explain how organisms are linked by the transfer & transformation of matter and energy at the ecosystem level (CLG 6.2.1); explain why interrelation-ships & interdependencies of organisms contribute to the dynamics of ecosystems (CLG 6.2.2); conclude that populations grow or decline due to a variety of factors (CLG 6.2.3); provide examples showing that natural selection leads to organisms that are well suited for survival in particular environ (CLG 6.2.4); **Natural Resources and Human Needs 6.12.4** Use concepts from chemistry, physics, biology, & ecology to analyze & interpret the impact both positive/negative of human activities on the earth's resources: evaluate the interrelationships between humans & biological resources (CLG 6.3.4). **AP Environmental Science** **IV. Land & Water Use: F. Fishing** (fishing techniques; over-fishing; aquaculture; relevant laws & treaties).

15. GETTING MORE INVOLVED – ALL GRADES

ACTION PROJECTS are activities designed so students can apply knowledge gained from participation in The Green Eggs and Sand curriculum to real-life issues. Students are encouraged to get involved in projects about horseshoe crabs and shorebirds, or they can explore and undertake the challenges of understanding other natural resource management issues of concern in their communities.

Government	Science
Government: 1.0 Political Science - A. The Foundations & Functions of Government: 3. Governmental roles & policies regarding public issues. b. (environmental issues); e. (environmental policy); **B. Economic Systems & the Role of Government in the Economy.** 3. Regulatory agencies & their social, economic, & political impacts (4.1.3); **C. Protecting Rights & Maintaining Order: 3**. Impact of government decisions & actions (1.2.3). e. (Md Dept. of Envir. regulations); **3.0 Geography: B. Geographic Characteristics of Places & Regions.** 1. Roles & relationships of regions on formation & implementation of gov. policy (3.1.3). (how natural resources & population define a region). c. how regional natural resources & environmental issues influence gov. policies; **D. Modifying the Environment 1.** Role of government in addressing land use & other	**Goal 1 Skills & Processes** The following indicators may be met, depending on the focus of students' outreach presentation: **Goal 3 3.5 Ecology**: **Interdependence of diverse living organisms & their interactions with the biosphere. 3.5.1** (relationships between biotic & abiotic factors). **3.5.2.** (interrelationships & interdependencies among different organisms = stability); **3.5.3** (natural & man-made changes in environmental conditions affect individuals & population dynamics; human activity & technology influences food webs); **3.5.4** All organism are part of & depend on 2 major global food webs that are influenced by human activity & technology (ocean; terrestrial); **3.6 Investigate a biological issue** (consequences & trade-offs between tech. & environ; defend their position on biodiversity, population growth, global sustainability, etc.). **Goal 4 Chemistry: 4.5** Chemistry's impact on society. **4.5.1** (synthetics); **4.5.2** (limited resources need to be conserved); **4.6** Connections between science and other disciplines. **Goal 6 Environmental Science: Goal 6 Environmental Science: Environmental Issues 6.3.5** Using the environ. to meet one's wants & needs has consequences; **6.5.3** Identify survival needs & interactions between organisms & the environ; **6.5.5** Decisions influencing the environ. have benefits, drawbacks, & unexpected consequences no matter how carefully the decisions are made; **6.8.5** Human activities can accelerate/magnify many naturally occurring

environmental issues (3.1.2). a (leg. decisions on land use & environ. issues); **4.0 Economics: A. Scarcity & Economic Decision-making. 1.** Economic costs & benefits & opportunity costs (4.1.2). d. (public policy issues, such as environmental concerns); **B. Economic Systems & the Role of Government in the Economy.** 3. Regulatory agencies & their social, economic, & political impacts (4.1.3).	changes (i.e., erosion, air and water quality, populations) (MLO 6.2);**Interdependence of Organisms 6.12.2** Use physical, chemical, biological, & ecological concepts to analyze & explain the interdependence of organisms within the environ; explain how organisms are linked by the transfer & transformation of matter & energy at the ecosystem level (CLG 6.2.1); explain why interrelation-ships & interdependencies of organisms contribute to the dynamics of ecosystems (CLG 6.2.2); conclude that populations grow or decline due to a variety of factors (CLG 6.2.3); provide examples showing that natural selection leads to organisms that are well suited for survival in particular environ.(CLG 6.2.4); **Natural Resources & Human Needs 6.12.4** Use concepts from chemistry, physics, biology, & ecology to analyze & interpret the impact both positive/negative of human activities on the earth's resources: evaluate the interrelationships between humans & biological resources (CLG 6.3.4); **6.12.5** Investigate & analyze environ. issues from local to global perspectives to develop an action project that protects, sustains, or enhances the natural environment: identify an environ. issue & formulate related research questions (CLG 6.4.1); design & conduct the research (CLG 6.4.2); interpret findings to form conclusions & make recommendations to help resolve the issue (CLG 6.4.3); apply the conclusions to develop & implement an action project (CLG 6.4.4); analyze the effectiveness of the action project in terms of achieving the desired outcomes (CLG 6.4.5). **AP Environmental Science** **II. The Living World: A. Ecosystem Structure** (biological populations & communities; interactions among species); B. **Energy Flow (**food webs & trophic levels; ecological pyramids); **C. Ecosystem Diversity** (biodiversity; natural selection; evolution; ecosystem systems); **IV. Land & Water Use: F. Fishing** (fishing techniques; over-fishing; aquaculture; relevant laws/treaties); **VII. Global Change: C. Loss of Biodiversity** 1. Habitat loss; overuse; pollution; introduced, endangered, extinct species; 2. Maintenance through conservation; 3. Relevant laws & treaties.