

Pre-Beach/Pre-Presentation Lesson Plan I

Grade Level 7th-12th

Length of lesson ~45-90minutes

Content Standards: (Standards listed at end of Lesson Plan)

Learner Background: Students have not had any education on horseshoe crabs. This lesson is meant for a pre-lesson to a beach outreach or classroom lecture. Students do have prior knowledge of basic biology and of creating experiments. Students have prior knowledge of scientific method and how it is used.

Student Learning Objective(s): Students will be able to explain basic biological knowledge of horseshoe crabs, be able to explain what makes them unique and important to humans and to the ecosystem. Students will also be able to create a scientific experiment for testing a variable having to do with horseshoe crab blood.

Assessment: The experiment students create to test horseshoe crab blood and quality of the horseshoe crab research paper.

Materials/Resources: Computers, worksheets, paper, pencils.

Learning Activities: Whole class for initiation, individual for worksheet, and groups for experiment creation.

Initiation: Ask the class what they know about horseshoe crabs. Anything and everything and if anybody knows what makes them unique, make a list on the board and have all students copy it down.

Lesson Development: Students will go through the research worksheet (provided) and finish that. Once they are done, they will get into groups and come up with a scientific experiment (using scientific method) that would test the blood of a horseshoe crab. (This is a hypothetical lab, teacher's discrepancy as to set boundaries of experiment).

Closure: Students will share their experiments with the class. Students will give both comments and critique the experiments to help students align with the scientific method.

Pre-Beach/Pre-Presentation Lesson Plan II

Grade Level 7th-12th

Length of lesson ~ 45-90 minutes

Content Standards: (Standards listed at end of Lesson Plan)

Learner Background: Students have not had a beach visit or lecture from horseshoe crab researchers. Students have a basic background in biology from earlier grades. This lesson is before lecture or beach visit with researchers.

Student Learning Objective(s): Students will be able to answer general questions about horseshoe crabs history and structure/function (worksheet). Students will also be able to construct a persuasive argument for saving and protecting the horseshoe crabs.

Assessment: Persuasive paper

Materials/Resources: Computers, worksheet, pencils

Learning Activities: Whole class for initiation and then individual for research and paper creation.

Initiation: Have students write down for 5 minutes what they know about horseshoe crabs, anything and everything.

Lesson Development: Students will be given the research worksheet and will be given time to finish the research and finish the worksheets. Students will then (class time permitting) will write a persuasive paper in class or at home on protecting and saving the horseshoe crab.

Closure: Students will write down 3 questions each they have for the beach visit or for the classroom lecture from horseshoe crab researchers.



Post-Beach/Post-Presentation Lesson Plan

Grade Level 7th-12th

Length of lesson 2 or 3 periods of ~45min

Content Standards: (Standards listed at end of Lesson Plan)

Learner Background: Students have had either a beach visit with Project *Limulus* or have had a lecture by Project *Limulus*. Students should have background knowledge of horseshoe crabs (including anatomy, behavior and physiology) and an understanding the research that Project *Limulus* is doing and why it is being done.

Student Learning Objective(s): Students will be able to create a pamphlet/poster with information about horseshoe crabs. Students will be able to construct a persuasive argument as to why the horseshoe crabs should be helped & saved and ways to help. Students will be able to create graphs and tables to show the data that they recorded. Students will be able to create additional scientific research investigations.

Assessment: The pamphlet/poster that the students create.

Materials/Resources: Poster, paper, pencils, computers (optional for graphs/posters), rulers

Learning Activities: Whole class for activity instructions (~5-10min) then groups for poster/pamphlet creation.

Initiation: 3-2 (3 things learned, 2 questions you still have) from lecture/beach visit. (5min)

Lesson Development: Teacher will have examples of posters/pamphlets and pass them around or show them to the students. The students will then get into groups and analyze data they have from beach/lecture and create graphs/tables. Students will then create a pamphlet or poster that is putting out awareness of horseshoe crabs and the advantages of helping/saving them.

This should be a persuasive argument of trying to help the populations of horseshoe crabs living within Long Island Sound

Closure: Have students briefly go over their posters/pamphlets and what information they chose to put onto the pamphlet and why.

Exit Slip- Two questions they wish to investigate if this research was to continue. (If higher level class, have them create hypothesis to questions.)

For More Information go to:

Projectlimulus.org or contact us info@projectlimulus.org

Supplemental information

<http://www.ceoe.udel.edu/horseshoecrab/>

Good website provided by NOAA and Sea grant

<http://www.marine.usf.edu/pjocean/packets/f01/f01u5p3.pdf>

What is a Horseshoe crab by Project Oceanography

<http://www.fws.gov/northeast/pdf/horseshoe.fs.pdf>

Introductory information on horseshoe crabs provide by the U.S. Fish and Wildlife Service

<http://www.dnr.state.md.us/education/horseshoecrab/>

Information on horseshoe crabs provided by the Maryland Department of Natural Resources

<http://www.pbs.org/wnet/nature/episodes/crash-a-tale-of-two-species/introduction/592/>

Video explaining the connections of horseshoe crabs and the migratory shore bird the Red Knot in DE Bay, provided by NATURE and PBS, includes full video, teacher guide, etc.

<http://www.exploringnature.org/db/detail.php?dbID=45&detID=2671>

Blank and labeled horseshoe crab picture



Name _____

Date _____

Horseshoe Crab Research Worksheet

- 1.) What is the scientific (Latin) name for the American horseshoe crab?
 - a. *Limulus polyphemus*
 - b. What does the name mean?
Limulus=askew and polyphemus = giant from Greek mythology with one eye
- 2.) Where are horseshoe crabs found around the world?
 - a. *Asia and East Coast of North America from Main to the Gulf of Mexico*
- 3.) What color is horseshoe crab blood and why?
 - a. *Blue, because they use copper instead of iron for oxygen transport*
- 4.) What are the 3 main body segments of a horseshoe crab?
 - a. *Prosoma, opisthosoma, and telson*
- 5.) What land animal are horseshoe crabs closely related to?
 - a. *Spiders and Scorpions*
- 6.) Why are horseshoe crabs being tagged and researched? (Explain)
 - a. *Should mention, importance to Red Knots, blood uses, economic importance.*
- 7.) What is their blood being used for?
 - a. *Medical testing, testing vaccines etc. for bacterial contaminations.*
- 8.) What kind of eyes to horseshoe crabs have?
 - a. *2 large Compound eyes and photoreceptors*
- 9.) What do horseshoe crabs use their telson for?
 - a. *Flipping themselves over when upside down*
- 10.) How old are horseshoe crabs?
 - a. *~200 million years for the modern horseshoe crab, ~400 million years for their oldest ancestor.*

2004 Connecticut Department of Education: Core Science Curriculum Framework Standards:

Grades 6-8 Core Scientific Inquiry, Literacy and Numeracy

- C INQ.1** Identify questions that can be answered through scientific investigation.
- C INQ.2** Read, interpret and examine the credibility of scientific claims in different sources of information.
- C INQ.3** Design and conduct appropriate types of scientific investigations to answer different questions.
- C INQ.4** Identify independent and dependent variables, and those variables that are kept constant, when designing an experiment.
- C INQ.5** Use appropriate tools and techniques to make observations and gather data.
- C INQ.6** Use mathematical operations to analyze and interpret data.
- C INQ.7** Identify and present relationships between variables in appropriate graphs.
- C INQ.8** Draw conclusions and identify sources of error.
- C INQ.9** Provide explanations to investigated problems or questions.
- C INQ.10** Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic.

Grades 9-10 Core Scientific Inquiry, Literacy and Numeracy

- D INQ.1** Identify questions that can be answered through scientific investigation.
- D INQ.2** Read, interpret and examine the credibility and validity of scientific claims in different sources of information.
- D INQ.3** Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.
- D INQ.4** Design and conduct appropriate types of scientific investigations to answer different questions.
- D INQ.5** Identify independent and dependent variables, including those that are kept constant and those used as controls.
- D INQ.6** Use appropriate tools and techniques to make observations and gather data.
- D INQ.7** Assess the reliability of the data that was generated in the investigation.
- D INQ.8** Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms.
- D INQ.9** Articulate conclusions and explanations based on research data, and assess results based on the design of the investigation.
- D INQ.10** Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic

Adapted from “Green Eggs and Sand” Maryland Department of Natural Resources 580 Taylor Avenue Annapolis, MD 21401

D INQ.11 Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic.

10.5 – Evolution and biodiversity are the result of genetic changes that occur over time in constantly changing environments.

D 42. Describe how structural and behavioral adaptations increase the chances for organisms to survive in their environments.

10.6 – Living organisms have the capability of producing populations of unlimited size, but the environment can support only a limited number of individuals from each species.

D 43. Describe the factors that affect carrying capacity of the environment.

D 44. Explain how change in population density is affected by emigration, immigration, birth rate and death rate, and relate these factors to the exponential growth of human populations.

Enrichment

Ecology:

- Fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigration, emigration and death.
- Changes in an ecosystem can result from changes in climate, human activity, introduction of nonnative species, or changes in population size.
- Biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats.

Physiology:

- Organisms have a variety of mechanisms to combat disease.