Designed by: NERRS (National Estuarine Research Reserve System) as modified by Ed Tivnan

MA State Standards addressed by the lesson (Include minimum of two state frameworks goals for this subject and grade level that this lesson aligns to):

1. **Ecology 6.4 Grades 9-12**

2. **The Chemistry of Life 1.1 Grades 9-12**

<u>Education for Sustainability Frameworks</u>:

EfS Standard 1 – Students understand and are able to apply the basic concepts and principles of sustainability (i.e.: meeting present needs without compromising the ability of future generations to meet their needs).

EfS Standard 2 – Students recognize the concept of sustainability as a dynamic condition characterized by the interdependency among ecological, economic, and social systems and how these interconnected systems affect individual and societal well-being. They develop an understanding of the human connection to and interdependence with the natural world.

Brief Summary of Unit (including curricular content and unit goals):

Students model estuaries, artificially enriching both fresh and salt water samples with different amounts of nutrients and observing the growth of algae over several weeks.

The lesson plan goals are:

Students will understand how water quality and nutrient parameters in an estuary can indicate disruptions to ecological processes in estuaries. Students will be able to relate their lab experiences to the factors that cause algae blooms and eutrophication in an estuary. Students will be able to explain how nutrients cycle in an estuary and how natural processes and human impacts affect this cycle. Students will be able to identify sources of nitrogen inputs to estuaries and identify sustainable ways to limit them.

Stage 1 – Identify desired results

Enduring understandings (what understandings are desired?):

Students will understand that: An overload of nutrients can be harmful to estuaries.

Essential questions (what essential questions will be considered?): Is more better?

If Nitrogen is an essential element for life, what is a sustainable level to have a healthy estuary?

Outcomes (what key knowledge and skills will students acquire as a result of this lesson/unit?)

Students will know…Eutrophication, HAB (Harmful algal blooms) Nitrogen Cycle,

Students will be able to… Interpret water quality samples and data to explain the effects of over-enrichment on water quality and living things in estuary.

Stage 2 – Determine acceptable evidence

Performance tasks (what evidence will show that students understand?): Over several weeks students will observe water quality samples that have been artificially enriched and explain what is happening and interpret the impact on estuaries.

Other evidence (quizzes, tests, prompts, observations, dialogues, work samples): Quiz assements on Eutrophication, HAB (Harmful algal blooms), Nitrogen Cycle.

Write a short letter to the town council of school district outlining your recommendations about steps to take to reduce the amount of nutrients that flow into the local estuary or wetlands.

Adapted from *"The Big Ideas of UbD"* by Grant Wiggins and Jay McTighe, 2004.

Stage 3 – Learning plan

Learning activities (what will students do and what will you, the teacher do, to prepare the students to achieve the desired outcomes? :

The teacher will provide:
Water source from an estuary with algae
worksheets by teams.
Liquid plant fertilizer.
Sea salt.
ecosystems?
Measuring teaspoons
(5) 600 ml beakers to each student.
support high
Safety eyewear for each student.
(1) Digital camera.
nutrients?
Student Worksheets titled Nutrients in an Estuary

weeks.

load

The students will:
Prepare (5) 600 ml beakers per student

Brainstorm the following 3 questions:
Why are estuaries the most productive

in the world?
What types of nutrients estuaries need to

Productivity?
What are the ways that estuaries receive

Do Prediction portion of student worksheet.
Students do biweekly observations of beakers for 3

Students take a digital picture of each beaker and

into a data file for comparison later. Complete their

observations, display their images and discuss by

teams.

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