Watershed Warriors Dead Zones Lesson Plan

Stage One: Desired Results
1. Essential Question(s): ● What are nitrates and phosphates and where do they come from? ● How can human activities cause eutrophication? ● What are the impacts of this eutrophication on the marine life? ● Why is it important that you take actions to prevent dead zones? 2. Mastery Objective(s): 1) 5.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which d) hypotheses are formed from testable questions; i) inferences are made and conclusions are drawn; j) models are constructed to clarify explanations, demonstrate relationships, and solve needs; and k) current applications are used to reinforce science concepts. 2) 5.7 The student will investigate and understand how Earth's surface is constantly changing. Key concepts include g) human impact. 3) 4.9 The student will investigate and understand important Virginia natural resources. Key concepts include a) watersheds and water resources; b) animals and plants; 4) 4.5 The student will investigate and understand how plants and animals, including humans, in an ecosystem interact with one another and with the nonliving components in the ecosystem. Key concepts include f) influences of human activity on ecosystems.
Stage Two: Assessment Evidence
1. Summative Assessment: ● Group assessment: The solutions that the students come up with to combat eutrophication and the students' abilities to answer the essential questions by using critical thinking and their knowledge of eutrophication and dead zones.
Stage Three: Learning Plan
● Materials o Felt board environment (see image in the materials document) o Cards with images of eutrophication sources (can be laminated; see image in the materials document) o Velcro tape (to attach images to felt board) o Wooden dowel (to hang the felt board) o Colored file folders or cardstock (to make the flaps for the final solutions)

- Warm up/Discussion:
  - Watch Eutrophication animation (FuseSchool - Global Education) https://www.youtube.com/watch?v=6LAT1gLMPu4
- Dead Zone Simulation
  - Distribute laminated cards with the images of the eutrophication sources and organisms to the students.

  - Part 1: Before eutrophication - Have students with the aquatic plants and fish cards velcro them in the lower half of the felt environment (the river cross section).

  - Part 2: Eutrophication sources - Identify the eutrophication sources and have students place their card on the felt environment using velcro. As each source is added to the environment, explain what it is and how it contributes nitrates and phosphates to the environment. The simulation works best if done in the following order: the farm, the city, the sewage system, the road and cars, the factory, and the rainclouds. (See the materials document for the images).

  - Part 3: Effects - Have students with algae cards (the green masses that resemble clouds and stars) velcro the algae to the "water" in the felt environment, simulating an algae bloom. Discuss the effects of the algae, including the blocked sunlight, the toxic chemicals produced by some algae types, and the consumption of dissolved oxygen when the algae dies and decays. Explain how this causes dead zones and add the "no oxygen" card to the water. Discuss how each of these factors impact the organisms added in Part 1, such as the grasses and fish, and remove them from the felt board to simulate death due to lack of sunlight and anoxic conditions.

  - Part 4: Solutions - Show the students the (5-6) cardstock or file folder flaps with current solutions for the sources of nutrients described in the simulation (but do not reveal the actual solutions). Have students turn to their group at their table and brainstorm solutions that might be under the flaps (3-5 minutes). Cycle through the room and have mini discussions with the groups to give hints and encourage critical thinking. It is okay to encourage them to brainstorm new solutions that are not in the flaps.

- Conclusion Summary Discussion -
  - After the allotted time is up, have each group share their best solution. If a solution under a flap is guessed, open the flap and explain the solution. If a solution is mentioned that is not on one of the flaps, write it one the board. After all groups have shared, explain any solutions under the flaps that were not guessed. As a class, go over the essential questions and review the main lesson points.