Scenario A: *The Floodgates Have Opened*
Scientific and Historical Background Information for the Teacher

Scientists estimate that 75% of the pollutants that reach the Chesapeake Bay from its watershed are carried there by stormwater that runs off the land and into tributary streams and rivers. Stormwater can contain high levels of sediments, nutrients (nitrates and phosphates), toxins and/ or excess freshwater which can disrupt normal habitats and life cycles of the organisms in the Bay and its tributaries. Waters polluted beyond certain levels may lead to restricted recreational use of the Bay by boaters, swimmers and fishermen.

Water quality is monitored by the Maryland Department of Natural Resources at fixed stations on tributaries and throughout the Bay, and by satellites carrying equipment that detect levels of turbidity, temperature, and chlorophyll. The satellites also record images called "true color images" that show sediments in the Bay waters. [1]

Turbidity is a measure of the cloudiness of water due to suspended sediments that scatter light in the water. The particles are usually silt washed into the waterway by rain or melting snow, but they may also be bits of plant and animal materials or algae. The higher the turbidity level or value, the cloudier the water appears.

The satellite that takes images of the Chesapeake Bay watershed every day is equipped with a camera that measures levels of turbidity in the Bay. When data about water quality is collected in the field, scientists usually use a Secchi Disk to record turbidity, noting the depth at which they can no longer see the black and white quadrants on the round disk. In the Chesapeake Bay highest turbidity levels are found in the northern part of the Bay near the mouth of the Susquehanna River, which contributes 44% of its total fresh water.

High turbidity poses a problem for aquatic life. Particles in the water block the sunlight that is necessary for photosynthesis in submerged aquatic grasses. With photosynthesis rates compromised a chain reaction may occur, beginning with the reduction of overall amounts of aquatic grasses. Loss of these grasses means there is less oxygen given off by the plants during the photosynthesis process resulting in a reduced level of dissolved oxygen (DO) in the water to be used by the animals in the ecosystem, loss of food for some aquatic species, and loss of shelter for young fish and invertebrates. In addition, silt particles transported from the watershed make breathing difficult for young fish and can coat the bottom, smothering young, bottom-dwelling invertebrates such as oysters and clams. [1]

Stormwater that carries silt particles may also carry dissolved nitrates and phosphates from animal wastes and excess fertilizer applied to farm fields, suburban yards and golf courses. Heavy loads of these nutrients produce algal blooms, contributing to the dead zones caused by anoxia (lack of oxygen) that are found in the depths of the Bay and some of its tributaries in mid to late summer. Algae are short-lived, and when they die they

sink to the bottom, where they are broken down by aerobic bacteria, which consume the dissolved oxygen needed by bottom dwelling invertebrates and finfish. In addition, warm summer water holds less dissolved oxygen and mixes less with oxygenated surface waters than occurs in the cooler months. [2]

The population of the Chesapeake Bay watershed is presently about 17 million people, a number that increases by approximately 100,000 a year. [3] Studies of sediment core samples from five sites on the Bay tell us about the history of land use and sediment load carried by water in the thousands of freshwater tributaries that eventually empty into the Chesapeake. The presence and relative abundance of pollen grains of species such as rag weed, a successional herb, and oak, a dominant tree in the region's climax forests, are indicators of the extent of cleared land for agriculture and urban use from settlement by pre-European Native Americans to present day. The story is one of a ten-fold plus increase in ragweed (and, therefore, cleared forest) from the arrival of European settlers in the1650's through the 20th century. The core samples also reflect a significant variation in sediment loads from year to year and location to location on the Bay. The highest levels are in the northern end, near the mouth of the Susquehanna River. There are notable average yearly increases after the 1650's, with significant spikes in sediment deposits occurring in the same years as serious tropical storms and hurricanes, but not before the mid-1700's. [4]

Bibliography:

[1]Maryland Department of Natural Resources, (2014). *Eyes on the bay*. Retrieved from website: www.mddnr.chesapeakebay.net/eyesonthebay/

[2] Maryland Department of Natural Resources, (2014). *Eyes on the bay*. Retrieved from website: www.mddnr.chesapeakebay.net/eyesonthebay/whatsitmean.cfm

[3] Jeffery, D. (2005). C. Barry (Ed.), *Exploring the Chesapeake, 400 Years Ago and Today*. National Geographic Maps.

[4] U.S. Department of Commerce, NOAA. (1998). *Pollution history of the Chesapeake Bay* (NOS ORCA 121). Retrieved from website: http://ccma.nos.noaa.gov/publicatios/TechMemo121.pdf

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