Build a Buoy Lesson Plan

I. What is the state of the Chesapeake Bay?
   a. Different criteria – water quality, fisheries
   b. Bay near CBEC gets a grade of C-/D

II. How do we know?
   a. What organizations research and work on issues concerning the CB?
      i. DNR (department of natural resources), NOAA (national oceanic and atmospheric administration)
   b. Human-operated monitoring equipment – can we have people operating scientific equipment in every tributary and in enough locations around the Bay as often as would be necessary to get a good picture of the health of the Bay? And remember that conditions change throughout the seasons, and even throughout the day.
   c. Buoy data- over 1,000 operational NOAA buoys around the world.
      i. Chesapeake Bay Integrated Buoy System (CBIBS) – Chesapeake network of buoys.
      ii. 10 operational buoys in the Bay from headwaters in Havre de Grace, MD to Norfolk, VA. Closest one is near Annapolis.
      iii. Collect data every 10 minutes and relay data to a land-based server via solar powered wireless transmitter (Verizon Wireless network). Data posted instantly to website.
      iv. http://buoybay.noaa.gov/. Smart phone apps (Smart Buoys for iPhone). Call in 877-BUOY-BAY.
   d. What are buoys used for?
      i. Navigational markers (boundaries of underwater roads, identify hazards for boats and swimmers)
      ii. Observation – weather and water quality

III. What criteria do scientists look at to determine water quality with buoys? Pass out dry erase board and have groups brainstorm different criteria. Then each group shares 1-2 of their ideas.
   a. Temperature – air and water
      i. Warmer water = more stressful for animals, less oxygen in the water (think opening a warm bottle of soda) = more dead zones
      ii. Stratification→ warmer water trapped on top of cold water, especially in summer. Due to differences in density.
         1. Where do nutrients from dead things go? Sink to the bottom - and when there is no circulation between bottom cold and upper warm water, all the nutrients stay on the bottom
   b. Clarity
      i. Underwater plants (SAV) need sunlight on bottom for photosynthesis
      ii. Without SAV photosynthesizing, what problems are created?
         1. Less oxygen in the water
         2. Not taking up nutrients= algae growth
   c. Dissolved Oxygen
      i. Lots of things affect the oxygen level. Low DO = stressful
   d. Salinity

i. Signal flood events
ii. Changes in salinity stressful to animals and plants.

e. pH – can signal some types of pollution, pH is higher during an algal bloom
f. Water depth
    i. Safe for boats or too shallow?
    ii. Signal flood events
g. Chlorophyll a
    i. Algal abundance determined by levels of chlorophyll a (important component of photosynthesis in algae and plants)

IV. What do we do with the data?
a. Locate sources of pollution – regulate point-source pollution and minimize non-point sources
b. Try to figure out what triggers algae blooms
c. Health of water for humans, fisheries

V. Build-a-Buoy (40 min)
a. Criteria that buoy must meet (3)
    i. Float
    ii. Visible – must be 3D, so boats will avoid buoy.
    iii. Securely hold weight – needs to hold weight of scientific equipment without falling off (this is a constraint of this model, since we use golf balls).
b. Build. Calculate budget.
c. Test (20 min)
    i. Each group presents their buoy – name and how much the model costs.
    ii. Group places the buoy in the water. They may quickly adjust the model.
    iii. Teacher or chaperone carefully adds golf balls to the model. Count while adding.
    iv. Record number of golf balls and cost of model.
d. Evaluate most cost-effective model
    i. Evaluate all buoys that meet the basic 3 criteria. If a buoy does not meet all 3 criteria, the model is disqualified.
    ii. Divide cost of model by the number of golf balls it held. Announce winning model.

VI. Discuss challenges and advantages of working as a team to build the model. This is a great team-building activity.
a. Challenges – lots of different ideas to discuss, everyone wanting to take charge, no one wanting to take on a leadership role, difficult to compromise, …
b. Pros – lots of ideas, seeing things from different perspectives, everyone has diverse skills and knowledge to contribute, troubleshooting, …

VII. Discuss limitations of this model compared to actual buoys
a. Materials – shapes of PVC joints, length of zip ties, etc.
b. Equipment secured to buoy – although using golf balls helps demonstrate that the payload (weight) affects the center of gravity and should be kept as low as possible