BACKGROUND MATERIAL:
The Elizabeth River is located in an urban area passing through several cities: Norfolk, Portsmouth, and Chesapeake. Certain gasses in the Earth’s atmosphere such as carbon dioxide and water vapor known as the greenhouse gasses trap energy from the sun. The greenhouse effect is necessary to keep the Earth warm enough for life. However, when levels of carbon dioxide increase it leads to global warming. Industry, boating and automobile use in these urban areas increase the Greenhouse gasses in the atmosphere of the Elizabeth River area.

Global warming will likely cause a sea level rise of 9-88 cm (3.5-34.6 in.) within the next 100 years as a result of thermal expansion of water. The Elizabeth River is tidal and connected to the waters of the Atlantic Ocean experiencing the influence of its waters with each incoming tide.

How will global warming and sea level rise impact the Elizabeth River watershed?

MATERIALS:
- Erlenmeyer Flask
- Glass tube
- Rubber Stopper with hole to fit in Erlenmeyer Flask
- Cold water
- Warm water or Heat Lamp
- China marker
- Laminated USGS Quadrangle topographic maps, scale 1:24,000 of Elizabeth River Shoreline
- Laminated topographic maps, scale 1”+100’ of Elizabeth River Shoreline
- Large poster size map legend
- Wet/Dry Markers

ACTIVITY: “Thermal Expansion and Sea Level Rise”
Teacher Notes:
1. Demonstrate thermal expansion of ocean and Elizabeth River water with the following procedure:
   - Fill Erlenmeyer Flask with cold water
   - Insert glass tube in rubber stopper so that it extends from the top and bottom
   - Seal Erlenmeyer Flask with stopper
   - Mark water level in the tube with China Marker (see diagram)
   - Place flask in warm water or under a heat lamp
   - Note location of water in glass tube after approximately 5 minutes
2. Using the USGS map, review the colors on the maps and their significance: green-vegetation, blue-water, black-buildings, red or gray-densely built up areas.
3. Post the map legend and ask students to locate: primary and secondary roads, a major building school, church, homes, marsh, piers.
4. Have students locate contour lines and determine changes in elevation.
Student Pages:

- Now examine the topographic map of the Elizabeth River shoreline. Notice the contour lines have a different elevation interval. What is the new elevation interval?
- You will examine the impact a rising sea level will have on the areas along the Elizabeth River.

1. Choose an area of your local map and identify the natural areas and manmade structures.

2. Looking at your map, find the current shoreline, as determined by the mean high water mark. Trace an area of the current coastline with the blue marker.

3. Now trace the new coastline if sea level was to rise 2 feet. Trace the new shoreline in red.

4. Look at the features of the map that are now inundated (covered with Elizabeth River water). Discuss the implications of the shoreline change:
   
   - Is the entire shoreline affected in the same manner?
   - What natural and man-made features will be affected?
   - How much land will be lost?
   - Will buildings, houses, marshes be inundated?
   - What animals and plants will be affected?
   - Will there be economic costs due to the shoreline changes?
   - Will the impact be short term or permanent?

5. What if the sea level was to rise 3 feet? Trace this new shoreline in green. Discuss the same questions.