Thermal Expansion and Sea Level Rise:

Half of all sea level rise is caused by the melting of glaciers on land. The other half is unknown to most people- you can see glaciers melting over time. Unfortunately, you cannot see water expanding as easily. The process is known as thermal expansion, and we can explore it through a simple experiment- heating water and measuring its rise!

Thermal expansion is based on a very simple property of water- as water molecules warm, they become "excited" meaning they begin moving more rapidly. This increases the space between each water molecule, causing water level to rise in a given container. As our climate warms, the water in our ocean basins is following this principle. As a low lying island, Nantucket is especially susceptible to sea level rise, and we've already seen it rise several inches over the last century due to a warming climate.

Materials:

- Water bottle, full
- Food coloring
- Clay
- Straw
- Sharpie
- Ruler
- One or more heat sources: examples include a regular incandescent lamp, reptile heating pads, greenhouse light, even a brightly lit windowsill

Instructions:

1. **Start by adding 1-2 drops of any food coloring to your full water bottle. This will make any changes to water level more obvious later on.**

2. **Now, insert the straw into the bottle of water. Be sure that when the straw is in the bottle, the water level in the straw is above the top of the bottle just slightly. Take a small ball of clay, and secure the straw in place being sure there are no gaps. Use more clay if needed to create a complete seal around the straw at the top of the bottle.**
3. **Mark the starting water level on the straw with the sharpie. There should be enough water in the straw to see it, but enough space in the straw that the water has room to move upwards.**
4. **Apply your heat source to the water bottle. This will look a little different for everyone depending on the materials you have at home. A simple incandescent lamp will work, though you may have to wait longer for results. You can speed up the process using a heating pad or heat lamp, like those for reptile tanks or a greenhouse lamp that would be available at most hardware stores. On a hot summer day, you can leave the bottle in direct sunlight to achieve the same results.**
5. **Check the water level in your straw after leaving your heat source on for at least 15 minutes.**

What to look for:

Have you noticed any changes?

The water should begin to creep upward into the straw, in proportion to how much heat is absorbed by the water in the bottle and how "excited" your water molecules are becoming.

Is there a limit to how much the water will rise in the straw? What do you think the limiting factor may be? Explore using different types of containers and heat sources- does the concept hold up in different versions of the experiment?

Thermal Expansion experiment setup: