

## Teacher Guide to Results

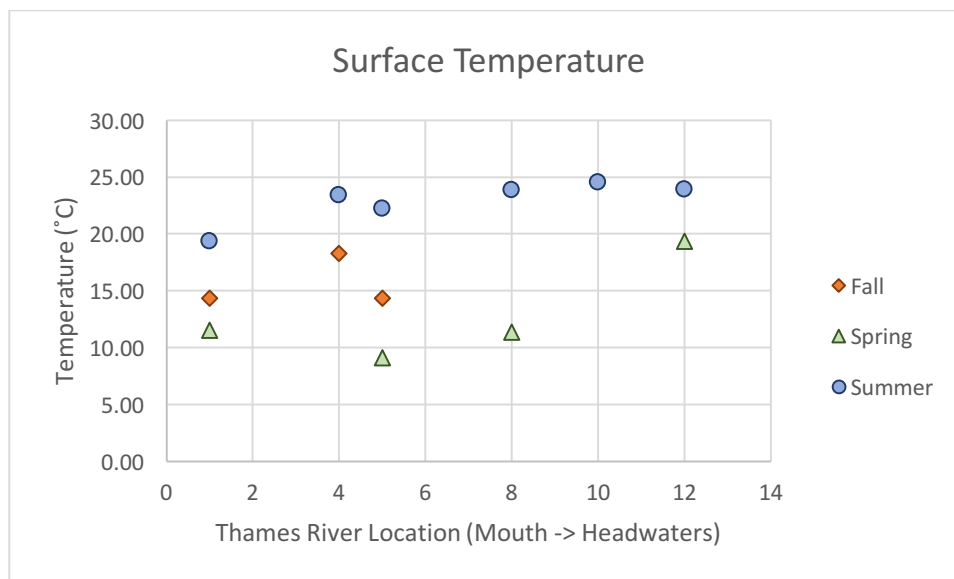
### Project Oceanology Sewage Plant Data Analysis Activity

These graphs and notes are intended to serve as an overview for teachers, so that they know what results their students may find during analysis of the Project Oceanology Sewage Plant Dataset. These are not intended as a rubric or key to graphs that students may create, although they may be used as examples. There are many good options for formatting graphs.

The graphs below all show location along the Thames on the x-axis. Station 1 is at the mouth, and station 12 is at the headwaters in Norwich. The different color markers indicate seasons, and are shown in the legend. Station 4 is the closest station to both the Groton and New London sewage treatment plants. Montville and Norwich also have sewage treatment plants that discharge into the Thames (see map).

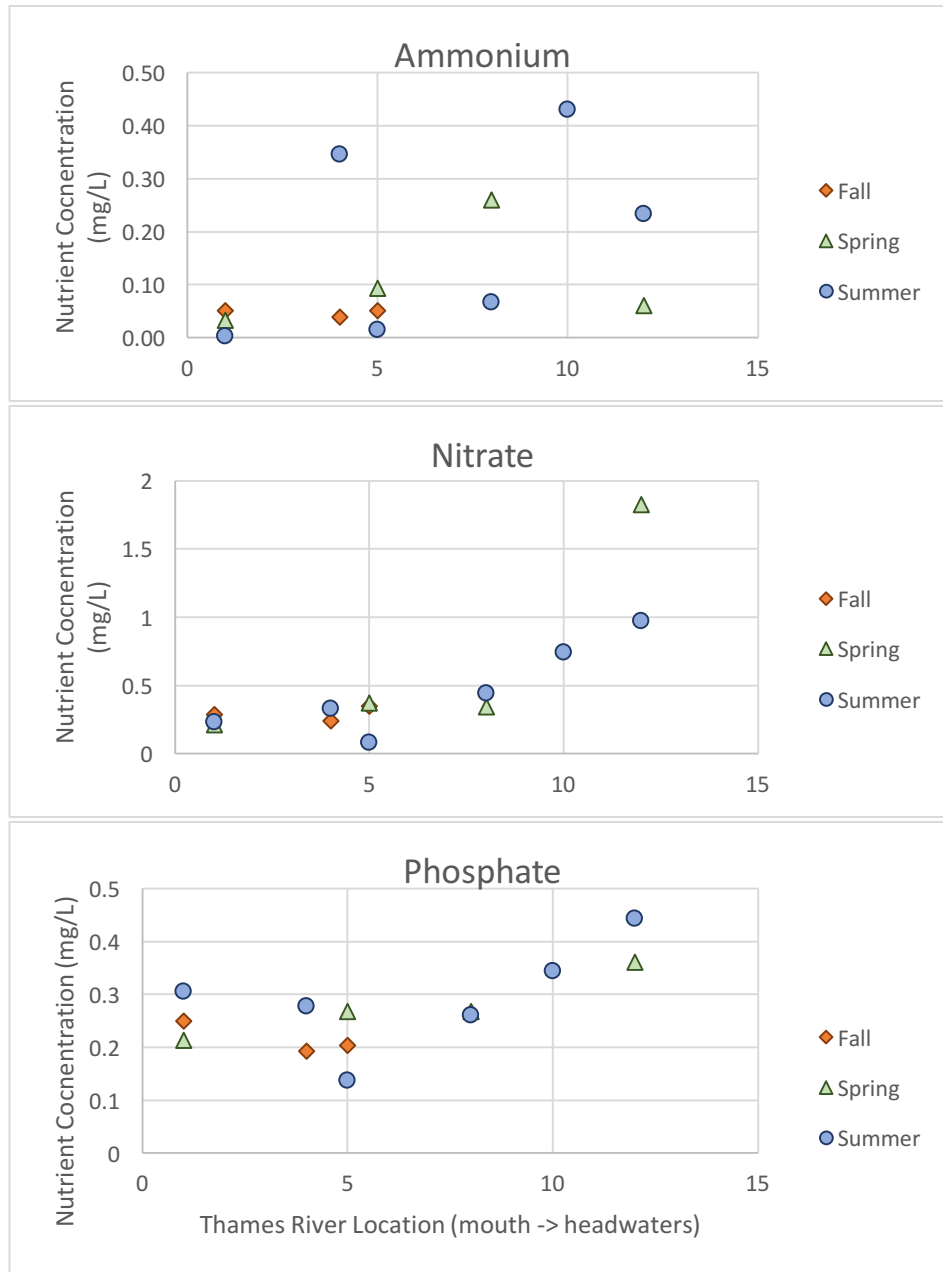
Students (and teachers) may notice that there are gaps in the dataset. For example, we do not have fall data from stations 8, 10, and 12. This is the result of uneven sampling – for various reasons, school groups in the fall are less likely to go all the way up the river. These gaps do not render the dataset invalid, but they may provide useful jumping off points for discussion as students generate hypotheses about what the trips would show.

#### Variation in Temperature as a Function of Location and Season



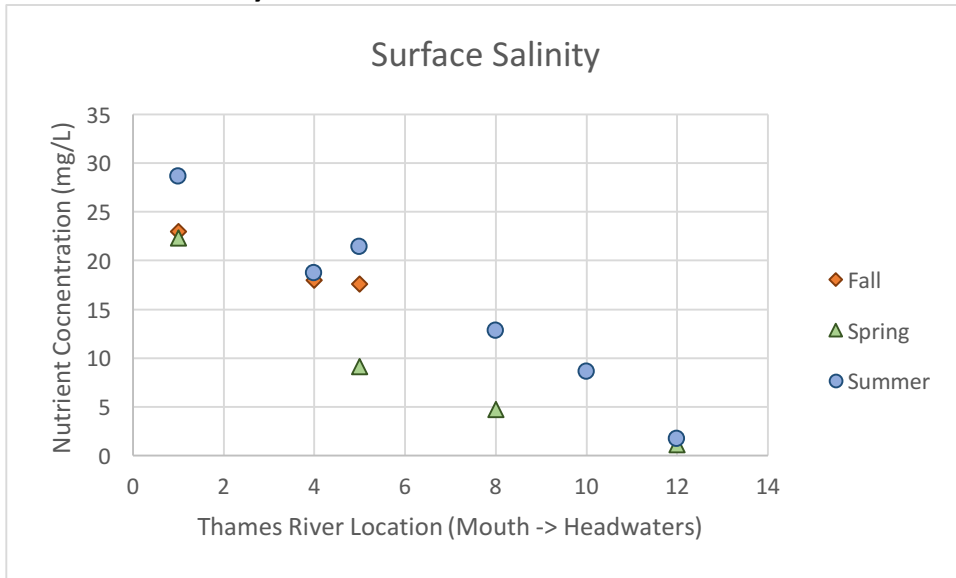
*Temperature shows a strong seasonal pattern, as you would expect: summer is the warmest, followed by fall, and then spring. The headwaters appear to be slightly warmer than the mouth. Bottom and average temperatures show a similar pattern (not shown).*

### Variation in Nutrient Availability as a Function of Location and Season:



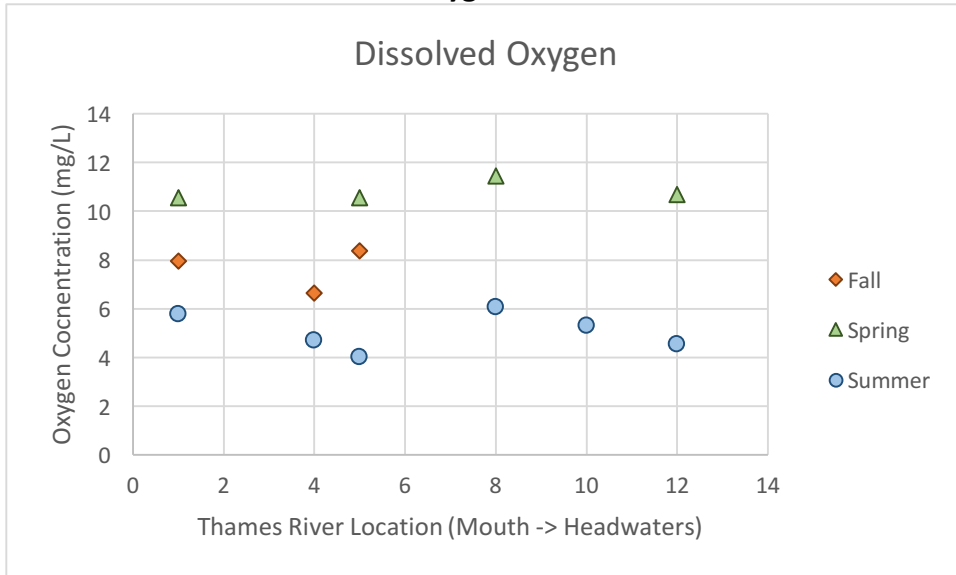
All three nutrients are found at higher levels farther up the Thames. Nitrate and Phosphate are found at relatively low levels in the lower Thames (stations 1-4), and the area near the Groton sewage treatment plant (station 4) is not noticeably different from the areas immediately upstream and downstream (stations 1 and 5). Ammonia is a bit more variable but also consistent with this pattern. In general, we find that the Groton and New London sewage treatment plants do a good job, but the Norwich plant has more problems. The upper part of the river has elevated levels of nutrients in both the spring and summer. The data do not show evidence of a seasonal pattern, although the lack of fall data higher up the river makes it difficult to compare.

### Variation in Salinity as a Function of Location and Season:



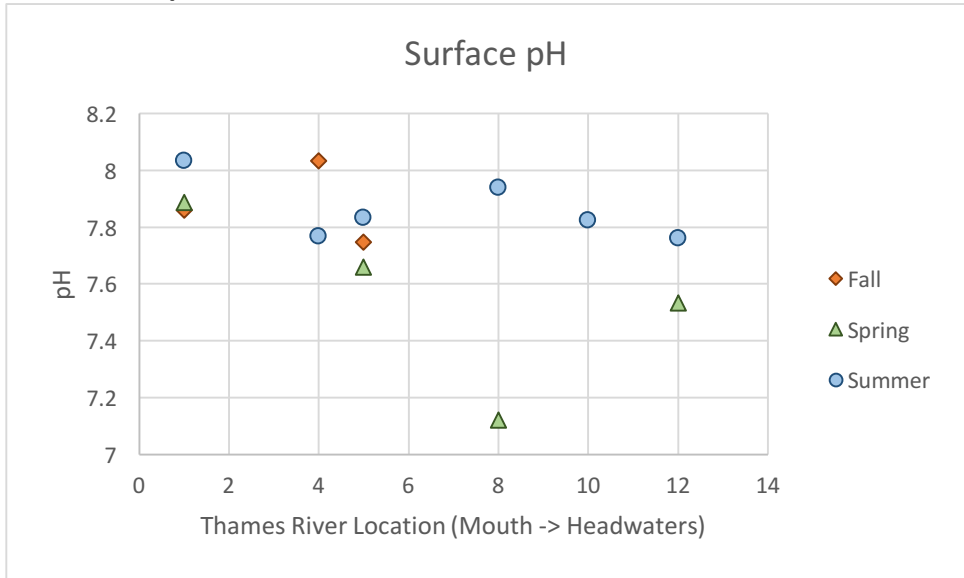
Salinity decreases steadily up the river from the mouth to the headwaters, as we expect. The seasonal pattern is not as strong, but summer appears to be slightly more saline than spring and fall across all locations. This is expected, because evaporation rates are higher during warm weather.

### Variation in Bottom Dissolved Oxygen as a Function of Location and Season:



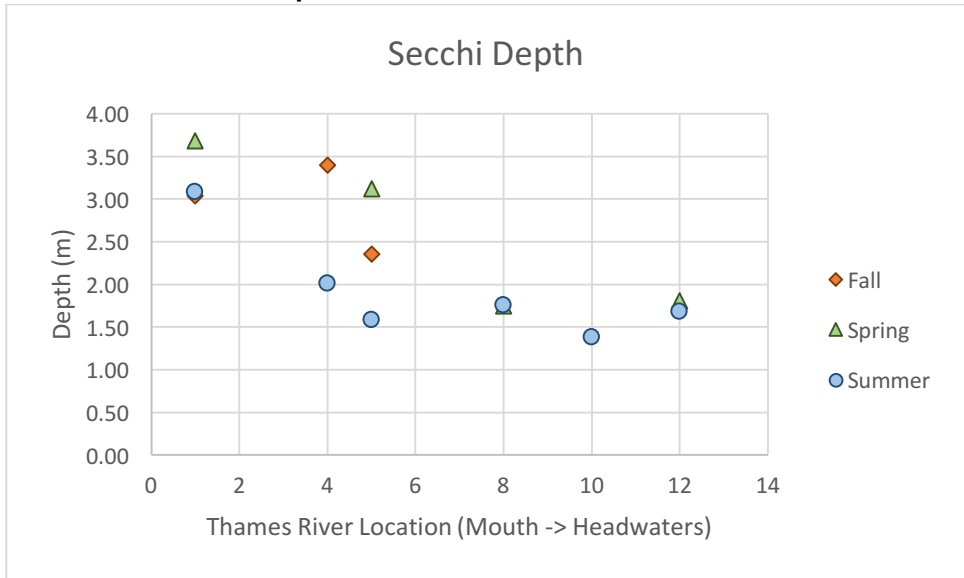
Dissolved oxygen levels are highest in the spring, when the water temperature is low. The solubility of oxygen in seawater is inversely proportional to temperature. This also coincides with the spring phytoplankton bloom. Dissolved oxygen is lowest in summer, when water temperatures are highest. Oxygen concentrations below 5 mg/L can be stressful to marine organisms, and these conditions do sometimes occur in the summer. Oxygen levels are relatively consistent along the Thames, from the mouth to the headwaters.

### Variation in pH as a function of Location and Season



Surface pH is highest near the mouth of the Thames, where conditions are most influenced by the ocean, and lowest upriver near the headwaters. This is expected because the pH of ocean water in general is slightly basic, around 8, while the pH of freshwater is around 7. There is no consistent pattern with respect to season. Bottom pH (not shown) displays a similar pattern. All of these values are normal and healthy for estuaries.

### Variation in Secchi Depth as a function of Location and Season



Secchi depth (visibility) is highest at the mouth, and declines as you move upriver. This could be the result of suspended sediment and organic matter in the freshwater lens at the top of the water column. There's no consistent pattern with respect to season.