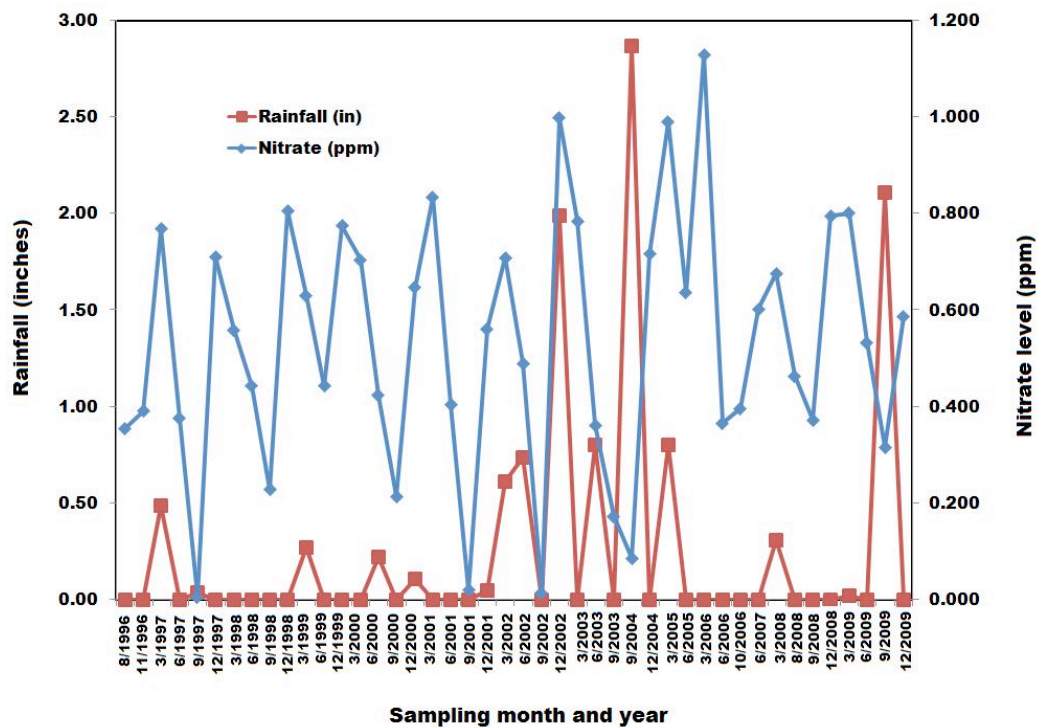


NAME:

BIOBUGS Urban Ecology: Watersheds and Aquatic Ecology
Extension Activity: Charles River Long-term Water Quality Data

Let's look at long-term nitrate data that was collected by the Charles River Watershed Association at the Massachusetts Avenue Bridge. That bridge is just downstream of where the Muddy River flows into the Charles River.



1. Is there a relationship between rainfall and nitrate levels? If yes, describe the pattern.
2. Is there a seasonal pattern to nitrate levels?
3. Based on this data, can you predict what the nitrate levels are this summer?
4. Is the data we collected today for the Muddy River similar to past summer nitrate levels in the Charles River?

***E. coli* in the Charles River**

Escherichia coli or *E. coli* lives in animal intestines and thus is also found in animal feces (including human). It is highly concentrated in raw sewage (point source) but may be especially present in cities due to domestic animals (non-point source). *Escherichia coli* and other fecal bacteria are often found in storm water runoff (from streets, parking lots, lawns) which then pollutes the local waterways. Coastal beaches are often closed immediately after rainfall because of the possibility of fecal bacteria contamination (and other pollution).

In this activity we are looking at data collected from the Charles River (at the Longfellow Bridge) on the abundance of *E. coli* over a 2 year time period. Water samples were collected monthly and analyzed for the concentration of *E. coli* (measured in number of bacteria per mL of water).

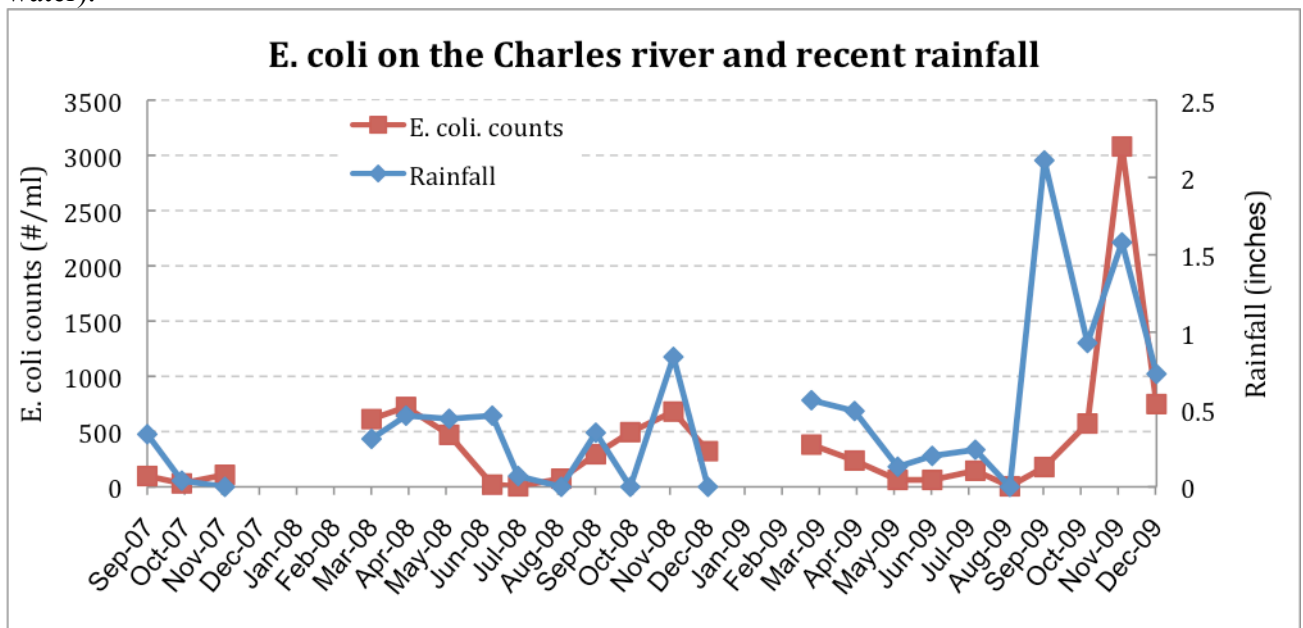
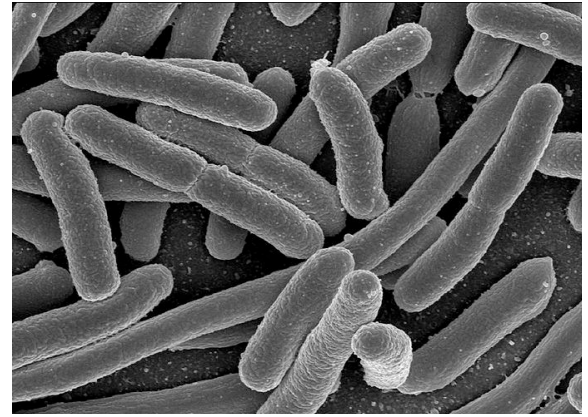


Figure 1: *E. coli* counts in the Charles River (measured in number per mL), and the amount of rainfall over the 3 days before sample collection. Water quality data is provided by the Charles River Watershed Association (www.CWRA.org), rainfall is measured at and provided by Logan International Airport.

1a. Why does the *E. coli* concentration in the river change so much? Where does the *E. coli* come from?

1b. What is the relationship between *E. coli* concentration in the Charles River and rainfall?

1c. For much of the graph (Figure 1) there appears to be a correlation between *E. coli* and rainfall (i.e. when rainfall is heavy, *E. coli* counts are high). However, in September of 2009 there is a very large amount of rain but very little *E. coli*. What are some reasons that the relationship might not hold here?

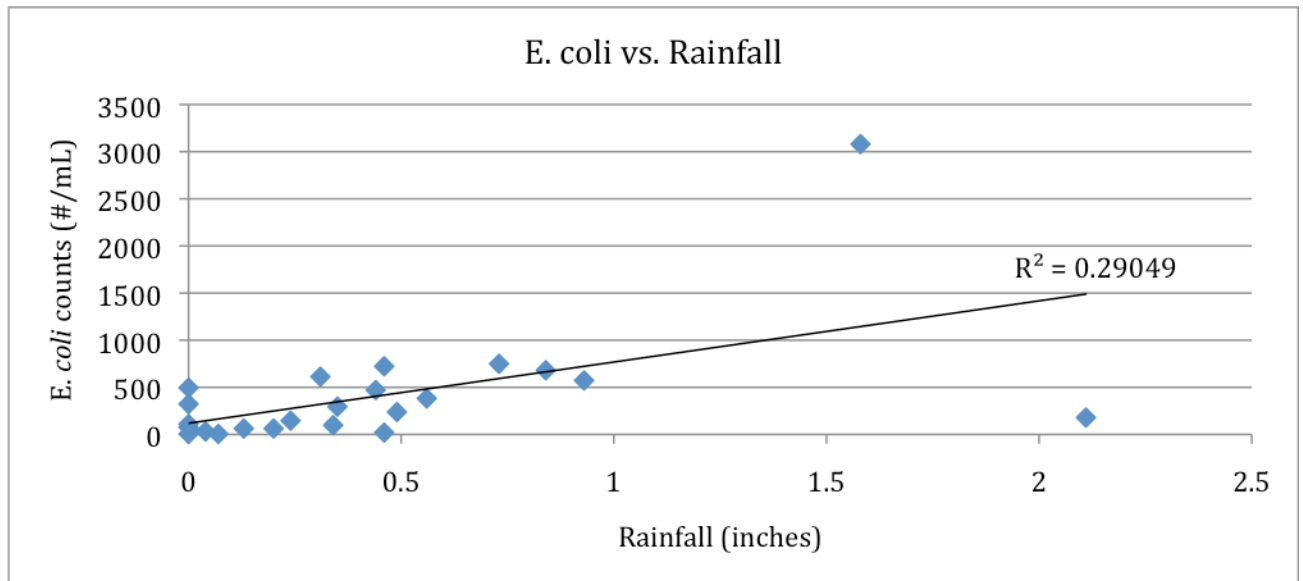


Figure 2: Scatterplot of all the data points shown in Figure 1. Least squares regression was used to show a line of best fit. If *E. coli* counts increased in an amount directly proportional to the amount of rainfall we would expect the points to lie very close to the line of best fit. The R^2 value is a statistical method to quantify how closely related rainfall and *E. coli* are. A value of 1 means that the two values are completely dependent, while a value of 0 means they are completely independent. Above the value of 0.29 means that *E. coli* concentration is only slightly dependent on the amount of rainfall, thus there must be other important factors.

2a. What does this graph, and the R^2 value, tell us about the relationship between *E. coli* and rainfall?

2b. If *E. coli* is not completely dependent on rainfall what are some other factors that might influence the concentration of the bacteria in the Charles?