Questions
What is measurement bias, and how can we detect it?
What useful information can we get from biased measurements?

Objectives
In this activity you will see that measurement systems are often subject to measurement bias. Your awareness of potential bias in data that you analyze should be heightened as you think about possible sources of bias. Bias is a property of the measurement system; you cannot reduce it simply by taking more measurements. The only way to measure bias is to compare the measurements with an independent source of "truth" outside the measurement system you are using. **However *comparisons* between two sets of measurements may be little affected if the bias is the same in each.**

Activity
1. Collect the data.
Look carefully at the first string, labeled A. Without using any measurement instruments (except your eyes), estimate the length of the string to the nearest whole inch.

Write your estimate here (Length of string A = _____) and enter into the computer.

Repeat the process for the second piece of string, B. (Length of string B = _____)

2. Describe the data graphically.
String A
 a) Make a dot plot and a box plot of the data. Also plot the mean and ±1 standard deviation.
 b) Describe the plots of the data (center, variation, shape, skew, symmetry, gaps, outliers)
 c) To you, which measure seems to provide the best measure of center: mean or median? Why?
 d) To you, which measure seems to provide the best description of variability: IQR or s.d.? Why?

String B
Same as above. For the second graph use the same scale as you did on the first, though not the same graph. This will allow you to make direct comparisons.

3. Making comparisons
Using the two data sets, not your estimate, decide which is the longer string and by how much. Explain how you did this.

4. Determining the bias
 a) Ask the teacher for the correct lengths for each string. Plot these correct values on your graphs. What do you see?

> *It is likely that the true value is not at the center of the distribution. This discrepancy between the center of the measurements and the true value is called bias. Bias is a property of the measurement system, not of an individual person making the estimate.*

 b) Does our system of estimating the lengths of string appear biased? What factors might be causing the bias?
 c) What was the effect of the bias on the answer to step 4? That is, is the estimate of which string is longer and by how much inaccurate because of the bias? Why is this the case?