Critical Work Function: Perform mathematical manipulations	
Key Activities	Perform data analysis Perform calculations relating to work function

Title: Statistical analysis of laboratory data

Assessment:

Students should be comfortable performing statistical analyses that pertain to data sets commonly encountered within bioscience laboratories. In particular, students should be able to calculate accuracy (i.e. absolute error and % error) and precision (i.e. standard deviation). Any time students repeat a measurement, accuracy and precision can be calculated. Students should also observe the correct number of significant figures.

Example

You are verifying the performance of a balance in your lab. You weigh the same 10g standard four times and obtain the weights below. Calculate the accuracy and precision of the balance. (*Note: While this example uses four measurements, this exercise is best done using ten or more measurements.)*

10.001g	9.999g
9.998g	10.005g

Answer

Accuracy can be calculated using the following equation:

$$\%\ error = \frac{calculated\ mean - expected\ value}{expected\ value} \times 100\%$$

To solve this equation, the student must first calculate the data set's mean ($\bar{x}$).

$$mean = \bar{x} = \frac{sum\ of\ data\ points}{total\ number\ of\ data\ points} = \frac{40.003}{4} = 10.001$$

$$\%\ error = \frac{10.001 - 10.000}{10.000} \times 100\% = \mathbf{0.01}\%$$

Precision is calculated using the following formula, which also requires a calculation of the mean (i.e. $\bar{x}$):

$$Standard\ Deviation\ (SD) = \sqrt{\frac{\Sigma(x - \bar{x})^2}{n - 1}}$$

$$SD = \sqrt{\frac{\Sigma(10.001 - 10.001)^2 + (9.999 - 10.001)^2 + (9.998 - 10.001)^2 + (10.005 - 10.001)^2}{4 - 1}} = \mathbf{0.003}$$

where n is the number of measurements.

Note that both the answer for accuracy and precision contain the correct number of significant figures. Because the Standard Deviation is a small number, students could be asked to express this value in scientific notation:

$$SD = 0.003 = 3 \times 10^{-3}$$

Resources for teaching:

- Seidman, L.A., and C.J. Moore. 2009. Basic Laboratory Methods for Biotechnology Pearson Education, Inc., San Francisco, CA.
- Seidman, L.A., M.E. Kraus, D.L. Brandner, J. Mowery. 2011. Laboratory Manual for Biotechnology and Laboratory Science Pearson Education, Inc., San Francisco, CA.

c3bc
Community College Consortium for Bioscience Credentials
#TC-23761-12-60-A-37

This product was funded by a grant awarded by the U.S. Department of Labor's Employment and Training Administration. The product was created by the grantee and does not necessarily reflect the official position of the U.S. Department of Labor. The Department of Labor makes no guarantees, warranties, or assurances of any kind, expressed or implied, with respect to such information, including any information on linked sites and including, but not limited to, accuracy of the information or its completeness, timeliness, usefulness, adequacy, continued availability, or ownership.