Name _____ Section _____

Partner(s) _____ Date _____

SAMPLING VARIATION

Object

The object of this activity is to determine the variation and causes of variation that are introduced during sampling from a large mixture.

Pre-Lab Queries

In the previous lab you investigated variations in repetitive measurements of discrete objects. Often, scientists are required to sample from mixtures where the sampling might impact the results. To start an investigation of sampling variation, answer the following questions.

Do you always get the same number of raisins in a scoop of Raisin Bran® cereal or the same number of pretzels in a handful of party mix? Explain.

Is obtaining a representative sample from a heterogeneous mixture different from or the same as obtaining a similar sample from a homogeneous mixture? Explain.

Procedure

You will work in pairs or individually for this activity.

In the previous activity, *Measurement Variation*, you learned how to examine variation by determining deviations, standard deviation (σ), and percent coefficient of variation (%CV). We can apply the same statistics to determine how the actual sample and sampling technique contribute to variation. Using the statistics, we can also consider means of minimizing sample variation.

Sand and gravel are the state of Maryland's most valuable mineral resources. These materials involve big money for Prince George's County and other regions of southern Maryland. Gravel is defined as any sedimentary material with a particle size greater than 2 mm. The category of

sand encompasses particles from 0.63 to 2 mm. Examine the sand and gravel mixture available in the laboratory but do not disturb the mixture.

Your task in this activity is to determine the % by mass of sand in the sand and gravel mixture.

$$\% \text{ sand} = \frac{\text{mass of sand}}{\text{mass of sample}} \times 100$$

Considering the laboratory mixture, is sampling the mixture going to present difficulties? Explain.

What problems do you anticipate in obtaining accurate data to complete your task?

By the way, your task requires you to make this analysis with great precision. Will you rely on a single sample? Explain.

1. Using the small scoop, obtain a sample of the sand/gravel mixture. Be sure you do not stir or significantly disturb the total mixture. Determine the mass of the mixture and record the data in the table provided. Use the balances in the lab (mass to nearest 0.01 g), not the analytical balances.

2. Separate the mixture using a sieve and mass the sand, recording the value.

3. Calculate the % sand in the mixture.

4. Repeat the sampling and separating with 4 additional samples.

5. Repeat steps 1-4 using the large scoop rather than the small scoop.

6. When you have completed all analyses, calculate the following statistics for your five percentages using the small scoop and the 5 using the large scoop. Record in the appropriate table.
   a. average (mean)
   b. standard deviation (σ)
   c. % CV

Using your TI-83 graphing calculator, enter your % sand results into L_1 (small scoop) and L_2 (large scoop). Use [STAT] and 1-Var Stats to get the mean and sample standard deviation, S_x.

7. Enter the % sand results for your group in the Excel spreadsheet. Give your group a code name or use your initials to identify your group. Proofread the values entered!

8. Once the entire class has entered the percentages, the instructor will post the Excel file with the class data at a web address that will be written on the board. Write the address on the line below before leaving class.

_____

You will find that the posted file has the mean, standard deviation, and % CV calculated for each group and for the class as a whole. Use this information to answer the questions that follow. Check your group results!

Variation Analysis

For the Group Results (n=5)

1. In getting a scoop of sample, the mass of the sample collected varied. Does this influence the results?

   Would making sure that the scoop contents were level influence the results? Explain

2. Is there variation in the % CV among the different groups in the class using the small scoop? Explain.

   What does this tell you about the sampling techniques for each group?

   Do you find the same variation in the group results for the large scoop? Explain.

3. Which group had the largest % CV and which had the smallest % CV?

Did the same groups have the largest and smallest values for the large scoop? What does this imply about the sampling technique of the group members?

For the Pooled Results of the Class

4. What is the number of trials of this pool? n = _____

5. How does the class % CV for the small scoop compare to the % CV for the large scoop?

Is this what you would have anticipated for the % CV values? Explain why or why not.

6. Discuss the factors that might lead to large group % CV values.

7. Does increasing the number of trials influence the precision of the analysis? Explain.

8. Suggest ways in which the precision of the results could be reduced for: a) each group; and, (b) for the class.

9. What is the cause(s) of the variation in this activity? Explain.

Small Scoop Data and Results

Trial	Mass of container	Mass of container and mixture	Mass of container	Mass of container and sand	% sand
1					
2					
3					
4					
5					

Mean	
Standard deviation	
% CV	

Large Scoop Data and Results

Trial	Mass of container	Mass of container and mixture	Mass of container	Mass of container and sand	% sand
1					
2					
3					
4					
5					

Mean	
Standard deviation	
% CV	