SIGINIFICANT FIGURES

1. WHY DOES IT MATTER?

In science, the number of digits to which you report data is important because it indicates explicitly the precision with which the data were gathered. If you report that the discharge of a stream is 20.50896 CFS you mean that it was measured to the nearest 1/100,000th of a CFS, and that this discharge is significantly and truly different than a neighboring stream with a discharge of, say, 20.50893 CFS.

2. WHAT'S THE BIG DEAL?

Commonly data reported are the product of two measured variables. For example, in calculating discharge, you have to multiply velocity by cross sectional area. For example, velocity may be measured to the nearest 0.1 ft sec^{-1} (say, 1.7 ft sec^{-1}) and cross sectional area may be measured to the nearest 0.1 ft^2 (say, 25.87 ft^2). What is the product of these two numbers? My excel program reports the answer as 43.979 ft^3 sec^{-1}. Is this correct? Is it ok to say that this discharge is really different than another discharge of, say 43.980 ft^3 sec^{-1}, and to then make a big deal about the difference?

No. A velocity measured to 1.7 ft sec^{-1} has 2 significant figures, and an area reported as 25.87 ft^2 has 4 significant figures, so the answer can only be reported to 2 significant figures. That is 44 ft^3 sec^{-1} and not 43.979 ft^3 sec^{-1}.

More importantly, now when reported to the correct number of significant figures there is no difference in the 2 dishcarge measurements (reported above as 43.979 ft^3 sec^{-1} and 43.980 ft^3 sec^{-1}), and there is no reason to explain this difference in a report because IT IS NOT REAL!

So, in a nut shell, the big deal is that TO REPORT RESULTS TO A GREATER NUMBER OF SIGNIFICANT FIGURES THAN JUSTIFIED IS ACADEMICALLY, INTELLECTUALLY, AND OTHERWISE DISHONEST.

3. SIMPLE RULES TO LIVE BY:

- **For multiplication and division**, *the product cannot have more significant figures than the least precise number that went into the multiplication or division*. Scientific notation is very useful for numbers less than 1. For example, the number 0.0000032 has two significant figures and should be reported as 3.2 * 10^{-6}, and the number 0.000003 has 1 significant figure and should be reported as 3.*10^{-6}. In EXCEL, you can formulate your cells to give you the proper number of significant figures, and this is best accomplished by using scientific notation.
- **For adding and subtracting**, the decimal point is your guide. *You may have no more digits to the right of the decimal point than the least precise of your numbers.*

  e.g., 9.74+0.5= 10.2 (not 10.24)
- **when counting numbers of items**, the result is considered to have an infinite number of significant figures. For example, say you have counted 250 pollen grains in a mud sample. The number 25 is considered to be known with infinite precision (assuming that you can count), so it does not limit the significan t figures of any product or sum that is derived from this number.
- **Rounding off.** Obviously, you will need to round off to comply with rules of significant figures. Rule is, if last significant number is odd and is followed by a 5 (e.g., 3.75) you round up to 3.8; if even (e.g., 3.65), just toss the 5, and you have 3.6.