Guilford College Geology 121 Lab
Field Study of a Stream System: Horsepen Creek Fall 2008

This week we will collect data at four stations along Horsepen Creek, northwest of the campus. The Monday lab group will collect data from two stations; the Thursday lab group will collect data from the remaining two stations. At each station, we'll collect the following physical and chemical data:

-water temperature	-bed load sediment size and distribution
-electrical conductivity	-stream velocity
-pH	-stream discharge
-dissolved oxygen	-nutrient concentrations (nitrogen, phosphorous)

We will break up into groups today to collect and record the data in the field. At the next lab meeting, we'll show you how to analyze the data, and explain how to go about writing the formal lab report.

This lab will be due in three weeks: you will have one week to collect the data as a group, one week to analyze and graph the data (we will help you learn to use the spreadsheets in lab), and the final week will be used to complete the individual lab report (the Saturday field trip is that weekend, Oct. 28th). The lab report will be ***due on*** Nov. 7th or Nov 9th**,** in your respective lab session. While late labs are still accepted for one week after the due date (max), I will deduct points as per the syllabus.

How does one go about conducting a scientific project, and writing a scientific report?

1. Select a topic. This we have already done, but you will also be choosing your own hypothesis to test.

2. Perform the experiments. We will do this by gathering our data in the field.

3. Analyze the data: Perform the necessary calculations, plots, and graphs, to make some sense out of all that raw data. What does it mean? What did you expect to find? Does it differ from what you actually found? Why?

4. Search the literature: find appropriate references to help you interpret this data. For your report, these references will include (but are certainly not limited to) personal communications from me (and others, perhaps), your textbook, other books and papers, and authoritative websites.

5. Discuss the results: What does it mean? Are the results as you expected (be sure to support this, and explain why it is expected!), or do they differ from what you actually found? Do you have any reasonable explanations for these differences (you should be able to come up with some after discussing with your instructor or the TA).

6. Mechanics: Write up your report using the format given in the detailed handout. We expect college-level writing with references cited. In the scientific literature, authors don't footnote, but cite references as they go.

Geology 121 Lab **Guilford College** **Spring 2008**

Field Study of a Stream System: Horsepen Creek

This week we will analyze the data we collected at four stations along Horsepen Creek. The Tuesday lab group collected data from two stations (#1 and # 3); the Thursday lab group collected data from the remaining two stations.

The results of the field work will be used by each student individually as the basis for a **formal, professional lab report** on the physical and chemical parameters of the stream system. The report should follow the outline given below. Tables, graphs, maps, and cross-sections must be appended to the written report, as noted.

This lab will be due in three weeks: the first week we collected the data, this week we analyze the data (again in groups), and the third week you'll work on your individual lab report. It is worth three times the points of a regular lab exercise. The lab report will be ***due on*** **Nov 7 or Nov 9*,*** in your respective lab. Labs turned in late will have points deducted as per the syllabus.

Typically, writers of scientific papers and reports use the categories listed in the outline below as subheadings in the text, which makes it a lot easier for the reader to follow. Remember any data gathered on the field trip <u>must</u> be <u>tabulated</u> and, in most cases, <u>graphed</u>, and included in the paper. Also, have mercy on us! Be concise and direct, don't use overly inflated language. You do not have to use the third person passive voice, although you can if you prefer. If you *mean* "we checked the water temperature with a thermometer", just say so! *PLEASE* don't say "the thermal characteristics of the rivulet were ascertained by careful insertion of a thermal probe at the depth of precisely 5 centimeters below the aqueous surface for a time period of …". Keep it concise!

<u>Lab report outline</u>:

I. <u>Introduction</u>: This is a *brief* statement about the nature of our investigation and its purpose, including dates and location. ***Your hypothesis goes here with supporting information from the literature.*** This section should be about two or three paragraphs long.

Each student should come up with a hypothesis that can be tested by the data we have gathered. Possible topic ideas for your hypothesis:

- Explore the relationship between current velocity and grain size (See Figure 18.15 in your text, page 439. A larger version is posted on Moodle)
- Explore the relationship between current velocity and depth at the four sites
- Analyze the relationship between current flow and number of tributaries
- Compare sediment sizes from pool vs. riffle environments at all sites
- Explore the trend in water flow versus rainfall over the past four years
- Explore the trend in grain size at a given site over the past four years
- Explore relationships between land use and the water quality at the sites.
- Analyze the grain size relationships between pool and riffle environments
- Examine the relationship between stream temperature and dissolved oxygen

II. <u>Description of the area and of the creek</u>:

A. Location (where were we?)

B. Climate of the region (look it up! What is our average rainfall? Are we high or low this year? A good place to start is http://www.nc-climate.ncsu.edu/climate/ncclimate.html, and you will want to make sure that you focus on the Piedmont region of North Carolina)

C. Drainage basin characteristics: include a map on which the drainage basin (watershed) has been outlined. Use the copy in this lab handout, and refer to the map in your discussion. You will need to look at the actual USGS 7½ minute topo maps (available in lab) to really be able to see where to outline the drainage basin. Remember the drainage basin will be the ridges surrounding our creek system. Inside the drainage basin, all surface runoff will end up in Horsepen Creek. Outside the drainage basin, the runoff ends up in a different creek system.

D. General stream characteristics: From the topographic map or Google Earth, estimate the length of the stream. Find the elevation of the stream at its source, at sites 1, 2, 3, and 4, and at its mouth (where it empties into Lake Brandt).

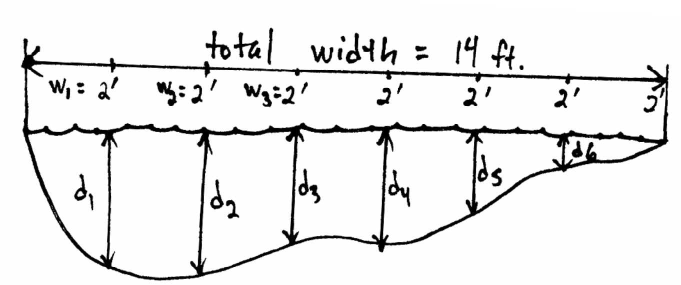
III. <u>Methods and Materials</u>: This section describes how each part of the study was done (experimental method); and what special equipment was used. A very short description of the method used to obtain each type of data, in the form of a list with an indented statement for each, will be sufficient. *During lab next week, each group will describe their experimental method—so take good notes!*

IV. <u>Results, Data Analysis</u>: what we found out about each part of the study. This includes 'just the facts', that is, you present the data here, in the form of tables and graphs **as well as a brief narrative**. The main discussion of the results (i.e. what they mean) will take place in a later section.

A. Discharge and velocity: variations along the length of the stream. We will collect data on depth of stream (at 2 foot intervals), width of stream, and time it takes a fishing float to go 10 feet downstream using a stopwatch. From this we can calculate discharge (Q):

$$Q = \text{cross-sectional area} \times \text{velocity}$$

Since the velocity varies a great deal across the width of the stream, we will separate the stream into certain width intervals or segments. At each interval, we measure depth and stream velocity. Then we will calculate a discharge for each segment, and add them all up at the end to get total discharge for each site. For instance:



total discharge $Q = Q_1 + Q_2 + Q_3 \cdots$

Q_1 (ft^3/sec) = A_1 (ft^2) x V_1 (ft/sec)

A_1 (ft^2) = width$_1$ (ft) x depth$_1$ (ft)

***Note: you must keep units the same! We are working in feet and tenths of feet.

To calculate the velocity, you will need the data on how long it took the float to go 10 feet downstream (Length = 10 ft)

V_1 (ft/sec) = distance / time = $Length_1$/ # of seconds at $depth_1$

At the end, you must have a table for your report with at least four numbers: the total discharge (Q) for each of the four sites we visited. You should also include a graph of discharge from the U.S.G.S. that shows 7 days of flow, including the days of our sampling period (be sure to cite this properly!). If you intend to discuss anything related to current velocity, you should also keep track of your velocities at each site. For this type of study (grain size relative to stream velocity), would you want to use the average velocity across all the channels, or the maximum velocity you found? Think about how we sampled the sediments, and decide how you want to proceed.

The following website gives real-time discharge, precipitation, etc for our Site 4. It will be useful, so check it out NOW (link is also available on Moodle)!

http://nc.waterdata.usgs.gov/nwis/uv?dd_cd=02&format=gif&period=14&site_no=0209399200

B. Chemical characteristics (if included) (pH, dissolved oxygen, conductivity, turbidity, and water temperature): variations along the length of the stream. You should display these data as a graphs, one graph for each separate parameter that we measure; for example you will have a graph that shows the pH values at all four of our sampling locations. You also must include a brief narrative describing the variations (what was the range of pH values you saw, did it vary widely or were they all about the same?)

C. Size distribution of the bedload sediments: variations along the length of the stream. These data must be plotted exactly as described below. We used graduated sieves to screen the sediment samples into 8 different size fractions (5.6 mm, 4 mm, 2 mm, 1 mm, 0.5 mm, 0.25 mm, 0.125 mm, 0.063 mm).

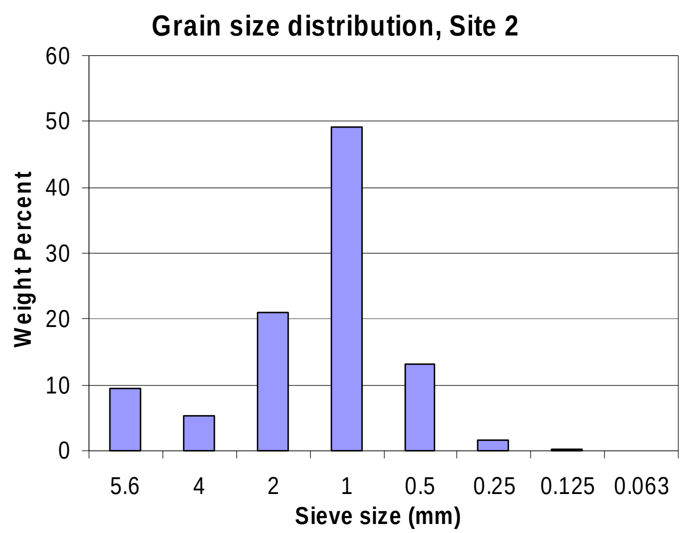
-first, calculate (for each grain size) the percentage of total weight:
% = weight of the one grain size/ total weight of all of the sediments
(so you will have each grain size in terms of %, not in grams, since the sample sizes are different at each of the four sites.)

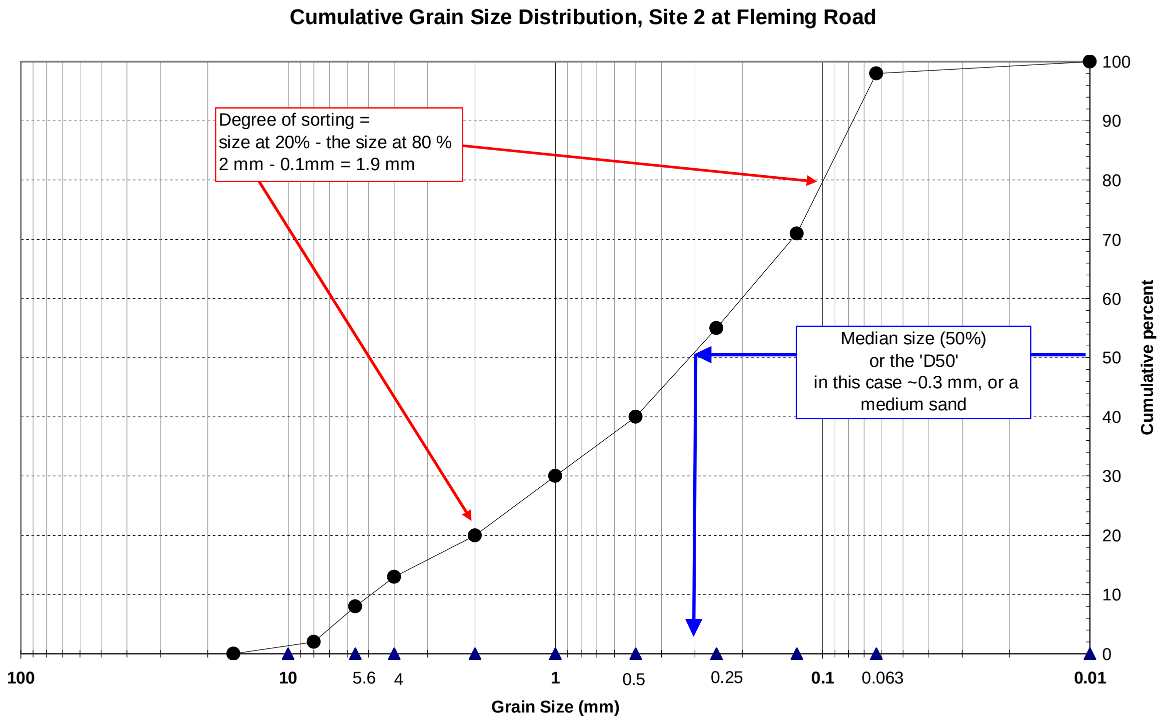
-next, calculate "cumulative %", in which you add each new weight % to the previous sum. Here is an example from a previous year:

Site 2 HPC, Fleming Rd

Size	**wt (gm)**	**%**	**cum %**
5.6mm	7.2	9.4	9.4
4mm	4.1	5.4	14.8
2mm	16	21.0	35.7
1mm	37.5	49.1	84.9
.5 mm	10	13.1	98.0
.25 mm	1.3	1.7	99.7
.125 mm	0.2	0.3	100.0
.063 mm	0	0.0	100.0
Total:	**76.3**		

Once you have the weight percent calculations made for each site, plot weight % vs. grain size in Excel as a histogram, as shown below. We will help you do this in lab, and you can also check with a TA if you would like additional assistance.





Now we need to plot a cumulative weight % vs. grain size on semi-log paper, as shown at left and demonstrated in class. Then, from the graph, you can determine the following two parameters.

-Median grain size = size at 50 cumulative weight % (We call this the D50)

-Degree of sorting = size at 20 cumulative % minus size at 80 cumulative %. A large number means the sample is poorly sorted, a small number means it is well-sorted.

Summary of required data for the results section:

-Table or graph showing the total discharge (Q) calculated for the four sites (1 table or graph)

-Graph showing the rainfall and discharge on Horsepen Creek from the U.S.G.S. gauging station over a 7 day period that includes our sample date. You can copy the graph since they give permission for that, but be sure to cite these data appropriately!

-Graphs presenting the chemistry data at all four sites, one for each parameter we measured (temperature, EC, D.O., pH, turbidity)

-A histogram of grain size distribution for riffle samples at every site (four graphs).

-A graph of the cumulative weight distribution for the sediments collected in the riffles for each of the sites (four graphs). You must also indicate the D50 and the degree of sorting for each site, on a separate table (1 table).

- Any additional graphs or tables which you will use to test or examine your hypothesis, properly labeled. You should have a minimum of one graph or table, most students will have several.

V. <u>Discussion and Conclusions</u>: This is the heart of the report! If you do all the calculations and graphs, no matter how pretty, but skimp on this part you won't get a good score on the report.

This is where you talk about what all those data really **mean**. Did you find what you expected to? Do the data match what the textbooks and lectures would lead you to predict? If not, why not? (And I have to warn you, most of the time the answer is not "we messed up". When or if we did mess up with data collection, I will tell you!) Go through this section by section (discharge, sediment data, each individual water chemistry parameter), and discuss each of them in turn. Be sure to reference back to the graphs and figures presented in the Results section, and you can also refer to the pictures and observation data posted on Moodle regarding the physical description and nature of the stream at each site.

Next, ***evaluate your hypothesis – is it supported by our data? Why or why not?*** Again, be sure to reference the graphs that you are using to support (or not support!) your original hypothesis. Your original hypothesis must have a sound basis, but if it is not supported by the data that is perfectly ok – just give some possible (must be reasonable) reasons that would explain why. Talk to the instructor about this, you will need to speculate but it must be kept within reason. What other experiments would you suggest to find out more about your hypothesis?

As a final wrap up to the report, provide a final paragraph or two that synthesizes the results of the study into a coherent picture of the changes in chemistry, flow, sediment transport, and landscape evolution along the stream, as it flows from upland to its sedimentary basin at local base level in Lake Brandt.

VI. <u>Data and calculations</u>: Append the data collected, along with your calculations of stream flow, stream velocity, and sediment size distribution to the end of the report. It is fine to just include a copy of your spreadsheets, as long as they are properly labeled.

VII. <u>References</u> You must use a minimum of three references in your formal report, including (but not limited to) your textbook and authoritative websites.

<u>Format for referencing in the text</u>: Don't use footnotes or endnotes, but cite references as you go. For example: say that you want to point out that ruby and emerald are both colored by chromium, and you got that information from a 1980 article in Scientific American by Kurt Nassau entitled "The causes of color." So you write:

> Both the red of ruby and the green of emerald are caused by trace amounts of chromium in their crystal structures (Nassau, 1980).

or...

> Nassau (1980) shows that both the red of ruby and the green of emerald are caused by trace amounts of chromium in their crystal structures.

You only put in a page number if it's a direct quote, and go easy on the direct quotes from secondary sources! A direct quote would be referenced as follows:

> "...the red of ruby and the green of emerald are both the result of trace amounts of chromium substituting for aluminum in the crystal structures" (Nassau, 1980, p 321).

VII. References (continued)

A longer quote would be indented and single-spaced.

In your list of references, any articles or books you reference are given in alphabetical order, by the author's last name and then by date with the most recent first.

For a journal article:

Nassau, K., 1980, The causes of color. Scientific American 243,124-156.

For a book:

Nassau, K., 1980, Gems Made by Man, Oxford University Press.

For a web site:

> Gardner, C.A., Scott, W.E., Major, J.J., and T.C. Pierson , 2000, Mount Hood—History and Hazards of Oregon's Most Recently Active Volcano. USGS web site: http://geopubs.wr.usgs.gov/fact-sheet/fs060-00/ Visited 10/2/2006.

If you have an example not included here, please contact the instructor and we'll help you!

A word on plagiarism and the honor code: Plagiarism is defined in the student codebook as "failure to give credit to sources of information or ideas on written work submitted for academic credit... Three or more consecutive words taken directly...must be placed in quotation marks with appropriate reference given. Paraphrasing of the statements or ideas of others must be clearly referenced. All sources used in the preparation of academic work must be included in a bibliography...whether or not direct quotes or paraphrasing are used."

Also, although the data collection is certainly a group activity, each student *must* write their own final report. You absolutely may NOT copy and paste sections of another person's paper into your own report; all of the writing must be yours and yours alone If unauthorized collaboration takes place, the report will receive a grade of a zero. . If you have any questions about what is ok to do and what is not, please contact the instructor or one of the TA's….we are here to help! ☺

That's all there is to it – just seven sections, and some of them almost write themselves! Please remember, we are more than happy to help you outside of lab time as you work on this project.

Map of Horsepen Creek Drainage area