Fluvial Systems Lab
Environmental Geology Lab
Dr. Johnson

*Introductory sections of this lab were adapted from Pidwirny, M. (2006). "Streamflow and Fluvial Processes". *Fundamentals of Physical Geography, 2nd Edition*. http://www.physicalgeography.net/fundamentals/10y.html

Streams move water and sediment through the landscape, eroding features to create channels or canyons, and depositing sediment within lakes and ocean basins. Water enters stream systems through precipitation, runoff and groundwater flow, and can exit the system through evaporation, seepage or flooding. Streamflow stops when the water reaches a receiving basin, such as a lake or ocean, while sediment is lost through deposition.

The long profile (grade) of an average stream is concave-upward, steep at the headwaters, decreasing in angle of the grade as the stream approaches sea level, and nearly flat at the mouth of the stream. The grade of a stream evolves over thousands of years and is influenced by erosion and deposition.

The figure below shows the general relationship between several factors that influence how streams behave. On the left side of the “equation” are sediment size (coarseness increasing to the outside of the sliding bar) and sediment load (on the weighing tray below the sediment bar). On the right side of the equation are stream slope (steepness increasing to the outside of the sliding bar) and discharge (on the weighing tray below the slope bar).

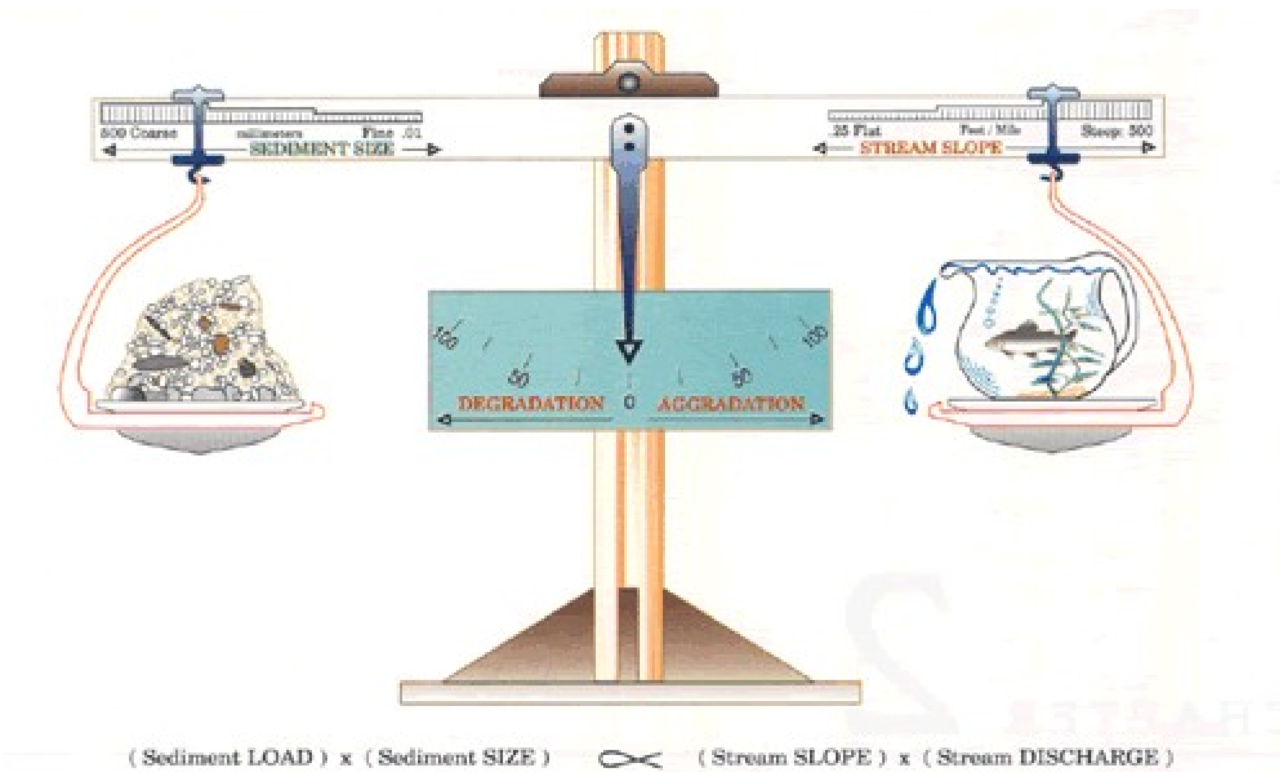

Image source http://www.fgmorph.com/fg_4_9.php

At the stream's headwaters, gradient and topography is steep and velocity is at a maximum, so a narrow and deep channel is created with minimal floodplain. Stream load is high due to the relief, and extensive erosion occurs, producing a V-shaped river valley. As we move further down the profile to a more sloping terrain, the stream's velocity decreases and the coarse stream load is deposited onto the floodplain. The stream may also take on a braided channel form. Finally, near the mouth of the channel the flat floodplain is composed of flooding deposits or point bar deposits from channel meandering, which is a sinuous shaped stream channel.

We going to use this figure to try and determine what is likely to happen in a handful of case studies on stream behavior. For each case study, you will have the opportunity to discuss expected outcomes with a group of your peers and then we will run the experiment on the stream table to see what actually happens. Then you will have the opportunity to record what happened during the stream table experiment. Keep in the mind that in the scientific world, running an experiment one time would not be sufficient to prove repeatability. Therefore, you will also have the opportunity to discuss what might vary if the experiment was run repeatedly.

First, let's talk about the stream table itself. The table sits on saw horses which give it a permanent 6% slope. However, the exit drain pipe can be raised or lowered to increase or decrease the slope of the water surface, respectively, which is more important. The sediment used in the stream table is the size of sand but is less dense. This allows the river on the table to act like a real river and not like a trickle of water on the beach. This helps solve what would otherwise be a scaling problem. Water is recirculated through the system and can be controlled by altering power to the pump.

PART 1 – Stream Table Experiments

EXPERIMENT # 1

Base level drops significantly along a meandering river with moderate discharge.

Which part of the stream equation does this scenario affect and in what way is it affected (more/less, up/down, higher lower)?

After discussing it with your group, what do you think will happen in the experiment? First, describe what you think will happen and then draw a series of figures that show your hypothesis.

What actually happened? Describe and draw figures for what happened on the stream table. Also discuss how this was different or similar to what you predicted.

How might the experiment vary if we were to run it 15 times? Make sure that you are specific about the variability and the cause of the variability.

EXPERIMENT #2

Discharge along a river with a moderate gradient increases significantly and then returns to its original flow.

Which part of the stream equation does this scenario affect and in what way is it affected (more/ less, up/down, higher lower)?

After discussing it with your group, what do you think will happen in the experiment? First, describe what you think will happen and then draw a series of figures that show your hypothesis.

What actually happened? Describe and draw figures for what happened on the stream table. Also discuss how this was different or similar to what you predicted.

How might the experiment vary if we were to run it 15 times? Make sure that you are specific about the variability and the cause of the variability.

EXPERIMENT #3

Base level is high due to the construction of a dam. A stream with moderate discharge flows into the reservoir.

Which part of the stream equation does this scenario affect and in what way is it affected (more/less, up/down, higher lower)?

After discussing it with your group, what do you think will happen in the experiment? First, describe what you think will happen and then draw a series of figures that show your hypothesis.

…and then discharge increases…

Describe what you think will happen and then draw a series of figures that show your hypothesis.

What actually happened? Describe and draw figures for what happened on the stream table. Also discuss how this was different or similar to what you predicted.

How do you think this is similar or different compared with how a similar situation would happen in nature with a dam? How about in areas where a larger river reaches the ocean?

EXPERIMENT #4

A small creek with low discharge suddenly switches to a "flashy" discharge régime. In other words, discharge fluctuates rapidly between high discharge and low discharge.

After discussing it with your group, what do you think will happen in the experiment. First, describe what you think will happen and then draw a series of figures that show your hypothesis.

What actually happened? Describe and draw figures for what happened on the stream table. Also discuss how this was different or similar to what you predicted.

Steams in the Charlotte area tend to have a flashy discharge. Why do you think this is? How do streams in the Charlotte area respond to a flashy discharge? How is this different or similar to the natural discharge of streams?

Come up with a new experiment for the stream table with your group. You will then pitch the idea to the class and then vote. Whichever is the most popular will be run on the stream table.

Stream Lab Part 2

In addition to typing up your answers to the first (stream table related) part of the lab. I also want you to examine natural streams during our break from lab. We've talked about a lot of types of stream features that are common almost everywhere. For this part of the lab you will find a local stream (there are plenty in the area: behind the physical plant, along the Greenway on Concord Rd, south on Main, etc), take pictures of features that we've talked about, and then create a finished lab product that includes your answers for the first part of the lab and the new (2^{nd}) half with annotated pictures. Below are the features that you'll want to find and discuss. Remember, you should have an annotated picture for each part. I assume that most of you have a digital camera or a cell phone camera. If not, you can check one out from IT in the basement of Chambers.

You may share initial pictures IF you were out in the field (well, stream) together. However, you pictures must be annotated separately. It is likely that you will find it useful to get into the creek, sandals and shorts are ideal for this in the Davidson area. Please let me know if you have any questions.

1. Find a section of a stream with a cut bank. Take pictures of the cut bank and annotate the pictures to make it easier to discuss. Then describe the processes that occurred to form the cut bank. Where was the majority of water flowing? Where was flow the fastest?

2. Find a section of the stream with a point bar. This point bar may be associated with the about cut bank (or not). Describe the processes that occurred to form the cut bank? What is the energy of water along the point bar compared with the energy along the outside of the turn? How about the grain size?

3. Find a wide, straight section of the stream and examine how sediment differs across the cross section. Is sediment more fine or coarse where water is flowing the fastest? Is water deep or shallow where it is flowing the fastest?

4. Find a series of ripples and describe how they migrate. Do your best to take pictures of the ripples. Spend a few minutes looking at them. How does grain size change along the ripples? Where on the ripple is the coarsest sediment?