SEDIMENT ANALYSIS 2015-2016 PROTOCOL

PURPOSE:

The purpose of the Sediment Study of Arcade Creek Project is to examine the health of the creek by assessing the size, type, and chemical composition of the sediment collected from the creek.

BACKGROUND:

The Sediment Analysis Study examines the changing geology of the creek bank and bed. Few realize that the sediments of the creek bed play a large role in determining the health of our Arcade Creek. The sediment that we will be analyzing is from disintegrated rocks transported by, suspended in, or deposited from water. Our samples may also include chemical and biochemical precipitates and decomposed organic material such as humus. Examination of sediment samples is essential for determining the health of the creek because soil composition can be used as a possible indicator of erosion rates, and as a way to predict the type of vegetation and animal life present. The size of the sediments themselves can very well be the limiting factor for macroinvertebrates and microinvertebrates living in the creek, as silt prevents the flow of oxygen to these organisms by clogging air passages (ex. fish in the creek). Our analysis will be used by the other studies, including biological assay and long mapping.

EXPLANATION OF METHODS:

Materials:

*The equipment you will be working with is dangerous. Always be mindful of the safety of yourself and others.

1. Tape Measure (to measure your distance from the bank)
2. Eckmann Dredge (apparatus to collect the sediment of your site)
3. Sediments Receptacle
4. Plastic (1 Gallon (3.8 L)) Ziploc Bags (with label space for your sample collection description— bring enough to double bag samples and extra just in case)
5. Sharpies (used to label each sample bag)
6. Waders (only necessary for those collecting the samples where water is present)

7. Cookie sheet/ baking pan (for drying the sediments)
8. Graduated Sieve (separating your sediment sample by size)
9. Electronic Balance (measuring the mass of each sample)
10. Paper Plates (used to transport your samples from sieve to balance)
11. Chemistry Test Set (used to test the chemical composition of each sample)
12. Trash Bag (we are all stewards of the creek, so all of us are responsible for maintaining a clean environment)

<u>At the Creek:</u>

*Even if the sediment bed is dry, still take samples following the normal procedure.

1. Each site should choose the same three transects (1-10) that are tested every semester for collecting samples so that there is consistent comparison. Locate your site's regular sediment transects.

Note: Sediment transects can be found by locating the colored flags pinned on trees by Long Mapping. Each colored flag contains the number and letter of that transect.

2. Once you find your transect, you must take note of several things. On your Ziploc Bag write down:

- The geological feature of the area where the sample is taken from (the types of geological features are listed in the vocabulary section)
- The distance from the imaginary line across the creek starting with the transect marker (measure using the tape measure—NOT by estimating!). Your collected samples must be from 2 to 3 meters from the bank and another from 5 to 6 meters from the bank.
- Make sure you also include the date and the transect number.

3. As stated before, each transect will require 2 samples--one from 2 to 3 meters from the bank, AND another from 5 to 6 meters from the bank. In the case where the creek is dry, or there is little water, take one of your samples on the edge of the creek (where the creek's water line would be when it is full) and one from where the middle of the creek bed would be.

Note: This is known as the Kia Clause, after the senior Kia Aliakbar, Class of 2015. :)

4. To use the Ekman Dredge:

1) Pull one of the two metal cables up to the top of the dredge where you will be able to place the loop of the cable over the button on the top.

2) Pull the second metal cable up to the top of the dredge where you will be able to place the loop of the cable over the button on the top. At this point, the bottom of the dredge should have an open jaw.

3) Place the dredge straight down into the desired area until the jaws are ⅓ of the way submerged in the soil. Do not push the dredge all the way down, or else the dredge will go beyond the benthic layer, which is what is supposed to be tested.

4) Hold the metal rope straight above and lightly thrown the weight down the rope so that the metal jaws of the dredge closes.

BE EXTREMELY CAREFUL BECAUSE THE ECKMANN DREDGE WILL SNAP YOUR FINGERS OFF IF YOU ARE NOT CAREFUL!!!

5) Slowly lift the dredge above an open Sediments Receptacle lifting at an angle so that the least amount of silt is lost.

6) Grabbing one of the metal cables, slowly pull the cable to the top so that the jaw can open. By doing this step, you will be able to successfully transfer your sediment from the dredge to the Sediments Receptacle. Transfer the sediment from the Sediments Receptacle to the Ziploc Bag for that sample.

7) Rinse out the Ekman dredge by dipping it in the available water and cleaning out the sediments stuck inside the dredge jaws. Clean all the sediments as much as possible.

8) Repeat this process for each of your samples. By the end, you should have six bags of sediments. Each bag should be filled about ⅓ of the way with sediment, so that the bag has around 750 g of sediment that can be tested.

9) Wash the dredge and any waders you used before checking them back into the creek room.

5. Pick up any trash you see! We need to keep the creek as clean as possible!

<u>At Home:</u>

Once at home, you must remove any organic material and break up any clods within your sample. There are two methods to dry your samples:

1) Save any *Corbicula* clams in a separate container, labeled with transect information to count and record them in the lab.

Note: *Corbicula* is the invasive clam species which our study looks for. *Corbicula* is italicized and the first letter is capitalized in type, but it is underlined and capitalized in handwriting, like so: Corbicula.

2) Spread sample into a thin layer using a cookie sheet with edges.

3) Bake at 250 degrees or slightly more until dry.

4) Place the samples in a **new, dry**, bag. Do **not** return the newly dried samples to the original bag. Make sure to keep the same information on the new bag, including transect, date, etc. Wet samples will not be accepted for sieving or for chemical tests.

*For each bag of sediments dried, you can receive 30 minutes for your hours, but they will only be counted if the sediments are completely dry.

At the Lab:

**Remember to subtract the mass of the paper plate from your total mass FIRST in order to achieve accurate results.

1. Make sure the sieve levels are in the right order. Pour each sample separately into the top level of the multilevel sieve.
2. Place the top back on the sieve and shake the sieve in a circular motion for approximately two minutes. PLEASE DO NOT SHAKE THE SIEVE ON THE TABLE AND DON'T SHAKE UP AND DOWN.
3. Find the mass of the sample of each layer of the sieve by pouring each level of the sieve into a separate paper plate and weighing with a scale.
4. Make sure that all the sediment has been taken out of the sieves by using the available toothbrush. DO NOT hit the sieves with the toothbrushes--this damages the mesh.
5. Record the data onto the Master Data Sheet (this will be given to you).
6. Calculate the total mass of the entire sample by adding together the masses of the individual layers.
7. Find the percentage of the total mass that each layer of sediment gave using the following equation:

$$\frac{\text{Mass of Layer}}{\text{Mass of Sample}} \times 100 = \text{percentage}$$

8. And again, return these samples to the SAME bag.

9. Repeat this process, exchanging samples with a different site without telling them your findings (aka Quality Assurance, Quality Control—QAQC). Compare data. If there's a small discrepancy, take the average. If there's a large discrepancy, repeat the procedure together. Get as many opinions on your data as possible to ensure that it is as accurate as possible.

10. Repeat these steps for each of the samples.

Chemical Testing:

1. You will have to test every sample for their chemical compositions. You will be given a master sheet to record your data. Chemical Lab Kits will be given to you.

2. The entire procedure is written in the last several pages.

3. The four chemical aspects that you will test will be:

a. **pH**: The organisms of the creek each require a specific pH and thus explains the catastrophic consequences of life in the creek when the pH changes. Most fish in the creek live in pH around 6.5-8.0. At around the 5 mark, fish level will dramatically decrease because fish can not cope with such high acidity. Macroinvertabrates also survive poorly around the 5 mark. Sudden decrease or increase in pH levels must be notified to the managers and/or leaders of the Bio-Assessment Study, as this study closely examines the macroinvertebrates in the creek.

b. **Nitrogen:** Nitrogen-containing compounds act as nutrients in streams, rivers, and reservoirs. The major impact of nitrates/nitrites on fresh water bodies is that of over-fertilization called **eutrophication**. Nitrates stimulate the growth of algae and other plankton that then provide food for higher organisms such as macroinvertebrates and fish; however an excess of nitrogen can cause over-production of plankton. As plankton decompose they use up the oxygen which causes other oxygen-dependent organism to expire.

c. **Phosphorous**: In many cases, phosphorous share many similarities with that of Nitrogen. Phosphorous is essential for plant and animal growth with low levels being the ideal amount. However, sudden increase in the concentration can make the algae (AKA algae bloom) and plant population explode, and choke the waterways out of their oxygen. When algae and plants die and start decomposing they also use of the oxygen, which is hazardous for the other life in the creek.

d. **Potassium**: Again, we have a chemical that is essential for plant growth yet can be dangerous at the wrong levels. Potassium ions are an essential component of plant nutrition; however excess of these potassium ions can serve as a limiting factor for

plant growth. Potassium should generally stay at low levels to ensure the health of the creek.

4. Wash all test tubes and other equipment used.

5. NOTE: Old Sediment bags are dumped in the Nature Center 1.5 years after it has been tested. For example, the sediments from Fall 2014 will be dumped out in Spring of 2015.

So what does this mean?

These indicators are not dangerous to the creek but beneficial at the right amount. All of them are essential to the growth of life within the creek. However, sudden increase or decrease in levels of any of these can present a danger to all life within the creek. In most cases, our chemical lab results are important to other study groups. Bio Assessment searches for various types of macroinvertabrates in the same places we take samples. If you happened to notice a sudden increase or decrease in nitrogen levels of your tested samples, it is suggested that you contact Bio Assessment which may help them explain certain phenomenon within the creek.

<u>Data Analysis (Analysis for Every Transect Done)</u>

A. Sieved Samples

a. *Corbicula* (Invasive Clam Species) Count

EX: How does the amount of *Corbicula* found in your samples imply the current state of the creek at your transect?

b. The Different Types of Sediment Found in Your Samples (coarse, silt, etc)

EX: How do the levels of silt affect the diversity of life at your transect?

c. Margin of Error/Possible Sources of Error

EX: Sieved samples incorrectly, silt lost during sample collection, etc

B. Chemical Tested Samples (Analysis of Your Findings During the Chemical Tests)

a. pH Levels

EX: What do low levels of pH mean? Does this explain the lack of macro invertebrates existing at your transect?

b. Nitrogen Levels

EX: What do the high levels of Nitrogen levels imply? Does this explain the amount of algae and plankton growth at the transect?

c. Phosphorus Levels

EX: See Nitrogen Levels

d. Potassium Levels

EX: See Nitrogen Levels

C. Both Sieved and Chemical Tested Samples

a. Comparison of last year's data (trends, differences, possible explanations)

b. Processed data tables for data collected during sieving parties and chemical tests. Please label all data tables with the season and year in the title.

c. Visual representations of your data (graphs, charts, etc). At least 1 visual representation for sieved samples and chemical tested samples per transect.

Essential Information:

This chart will help you interpret your findings after you have sieved your samples.

<u>Size of Particles</u>

(Source: USAG)

2 mm	gravel
1.0-2.0 mm	very coarse sand
0.5-1.0 mm	coarse sand
0.25 - 0.5 mm	medium sand
0.125 - 0.25 mm	fine sand
0.05 - 0.125 mm	very fine sand
0.02 - 0.05 mm	coarse silt
0.002 - 0.02 mm	medium-fine silt
< 0.002 mm	clay

DEFINITIONS:

Algal Bloom: "An algal bloom is a rapid increase in the density of algae in an aquatic system. Algal blooms sometimes are natural phenomena, but their frequency, duration and intensity are increased by nutrient pollution. Algae can multiply quickly in waterways with an overabundance of nitrogen and phosphorus, particularly when the water is warm and the weather is calm. This proliferation causes blooms of algae that turn the water noticeably green, although other colors can occur."

(Cited from: http://floridaswater.com/algae/)

Benthic Layer: The sediment from the bottom of the creek. Usually it is 5-6 cm of the top of the sediments layer, which is picked up with the Ekman dredge. It is one of the main indicators of the health of the creek.

Note: The benthic layer shifts around with large rains, so keep that in mind when writing your final analysis.

Eutrophication: "The process by which a body of water acquires a high concentration of nutrients, especially phosphates and nitrates. These typically promote excessive growth of algae. As the algae die and decompose, high levels of organic matter and the

decomposing organisms deplete the water of available oxygen, causing the death of other organisms, such as fish. Eutrophication is a natural, slow-aging process for a water body, but human activity greatly speeds up the process."

(Cited from website: http://toxics.usgs.gov/definitions/eutrophication.html)

- *Cultural Eutrophication:* Occurs when human activity introduces increased amounts of the key factors in cultural eutrophication, which are **nitrates** and **phosphates**. The main sources of these nutrients are treated sewage and runoff from farms and urban areas.

  (Cited from website: http://www.encyclopedia.com/topic/eutrophication.aspx)

Run: A relatively shallow part of a stream with moderate velocity and little or no surface turbulence.

Riffle: A shallow part of the stream where water flows swiftly over completely or partially submerged obstructions to produce surface agitation.

- This churning water is important because it mixes oxygen into the creek.
- Riffles are not caused by fish but rather partially submerged objects within the creek such as rocks.

Pool: A small part of the reach with little velocity, commonly with water deeper than surrounding areas.

Pointbar: Accumulations of sediment on the insider of meander bends.

Cross section: A line of known horizontal and vertical elevation across a stream perpendicular to the flow. Measurements are taken along this line so that geomorphologic characteristics of the section are measured with known elevation from bank to bank.

Transect: A line across a stream perpendicular to the flow and along which measurements are taken, so that morphological and flow characteristics along the line are described from bank to bank.

Riparian Corridor: "…the interface between land and a flowing surface water body. Plant communities along the river margins are called riparian vegetation"

- Basically all the greenery around the creek makes up this corridor

MASTER DATA SHEET

SIEVING DATA

Year:

Site:

Season:

	4 mm		**1 mm**		**500 micrometers**		**120 micrometers**		**Silt**	
Sample #	Mass (g)	% of total	Mass (g)	% of total	Mass (g)	% of total	Mass (g)	% of total	Mass (g)	% of total
1										
2										
3										
4										
5										
6										

	Transect	Dist. From N Bank (m)	Corbicula	Feature	Potassium	pH	Nitrogen	Phosphorus
1								
2								
3								
4								
5								
6								

CHEMICAL LAB PROCEDURES

Proper Handling of Chemical Test Equipment

1. Carefully follow all instructions.
2. Do not handle tablets; dispense from cap to test tube.
3. Carefully wash and rinse all apparatus used.
4. Tighten reagent caps immediately after use. Do not interchange caps.
5. Avoid prolonged exposure to direct sunlight.
6. Avoid temperature extremes.

Reading the Color Charts

When matching a test color to a color chart, stand with the light source behind the observer and hold the test tube approximately one-half inch away from the color chart. If the color of a test reaction falls between two standard colors on a color chart, the mid-point between the two standard values is taken as the test result. For example, a pH test color reaction falling between the standard colors for pH 4.0 and pH 5.0 represents a test result of pH 4.5. In the other tests color reactions may either match, fall between, or fall beyond the three standard colors representing "Low," Medium," and "High." Therefore seven different test results are possible: Very Low, Low, Medium Low, Medium, Medium High, High, and Very High.

pH TEST

1. Fill test tube (0755) to line 4 with pH Indicator (5701). Squeeze bottle gently to control amount dispensed.

2. Use 0.5g spoon (0698) to add **three** measures of soil sample.
3. Cap and mix gently for one minute.
4. Allow tube to stand for 10 minutes to let soil settle
5. Match color reaction with pH Color Chart (13533). Record results as pH.

PHOSPHORUS TEST

1. Fill test tube (0755) to line 6 with *Phosphorus Extracting Solution (5704).
2. Use 0.5g spoon (0698) to add **three (3)** measures of soil sample.
3. Cap and mix gently for one minute.
4. Remove cap. Allow to stand, and soil to settle, until liquid above soil is clear.
5. Use one pipet (0364) to transfer the clear liquid to a second clean test tube. To avoid agitation of soil, squeeze bulb of pipet before inserting tip into liquid. Release bulb slowly to draw clear liquid into pipet. Do not pull up any soil. Fill second tube to line 3.
6. Add six (6) drops of *Phosphorus Indicator Reagent (5705) to soil extract in second tube.
7. Cap and mix.
8. Add one Phosphorus Test Tablet (5706).
9. Cap and mix until tablet dissolves. A **blue** color will develop.
10. Match color reaction with Phosphorus Color Chart (1372). Record result as Phosphorus.

    Low 0-50 lb/acre

    Medium 50-100 lb/acre

    High +100 lb/acre

NITROGEN TEST

1. Fill test tube (0755) to line 7 with *Nitrogen Extracting Solution (5702).
2. Use 0.5g spoon (0698) to add **two** measures of soil sample.
3. Cap and mix gently for one minute.
4. Remove cap and allow soil to settle.
5. Use a clean pipet (0364) to transfer the clear liquid to a second test tube. To avoid agitation of soil, squeeze bulb of pipet before inserting tip into liquid. Release bulb slowly to draw clear liquid into pipet. Do not pull up any soil. Fill second tube to line 3 with liquid.
6. Use 0.25g spoon (0695) to add two measures of *Nitrogen Indicator Powder (5703) to soil extract in second tube.
7. Cap and gently mix. Wait 5 minutes for **pink** color to develop above the powder.
8. Match test color with Nitrogen Color Chart (1371). Record as Nitrogen.

Low 0-30 lb/acre

Medium 30-60 lb/acre

High +60 lb/acre

POTASSIUM (POTASH) TEST

1. Fill test tube (0755) to line 7 with Potassium Extracting Solution (5707).
2. Use 0.5g spoon (0698) to add four (4) measures of soil sample to test tube.
3. Cap and shake vigorously for one minute.

4. Remove cap and allow soil to settle.
5. Use a clean pipet (0364) to transfer the clear liquid to a second clean test tube. Be careful not to pull up any soil into pipet. Fill second tube to line 5 with liquid.

   NOTE: If additional extract is needed to fill the tube to line 5, repeat steps 1 through 4.

6. Add one Potassium Indicator Tablet (5708) to soil extract in second tube.
7. Cap and mix until tablet dissolves. A **purplish** color will appear.
8. Add Potassium Test Solution (5709), two drops at a time, keeping count. Mix contents after each addition. Stop adding drops when the color changes from purplish to **blue.**
9. Use Potassium End Point Color Chart (1352) as a guide in reading this color change. Keep an accurate count of the number of drops added. Read test result from table*.

***TABLE**

Number of Drops (Added Potassium Level)
0-8 (Very High)
10 (High)
12 (Medium High)
14 (Medium)
16 (Medium Low)
18 (Low)
20 or more (Very Low)

Low (0-120 lbs/Acre)

Medium (120-200 lbs/ Acre)

High (+200 lbs/Acre)