ESC 100 – Survey of Earth Science
GeoScience Investigation: Aurora Mastodont

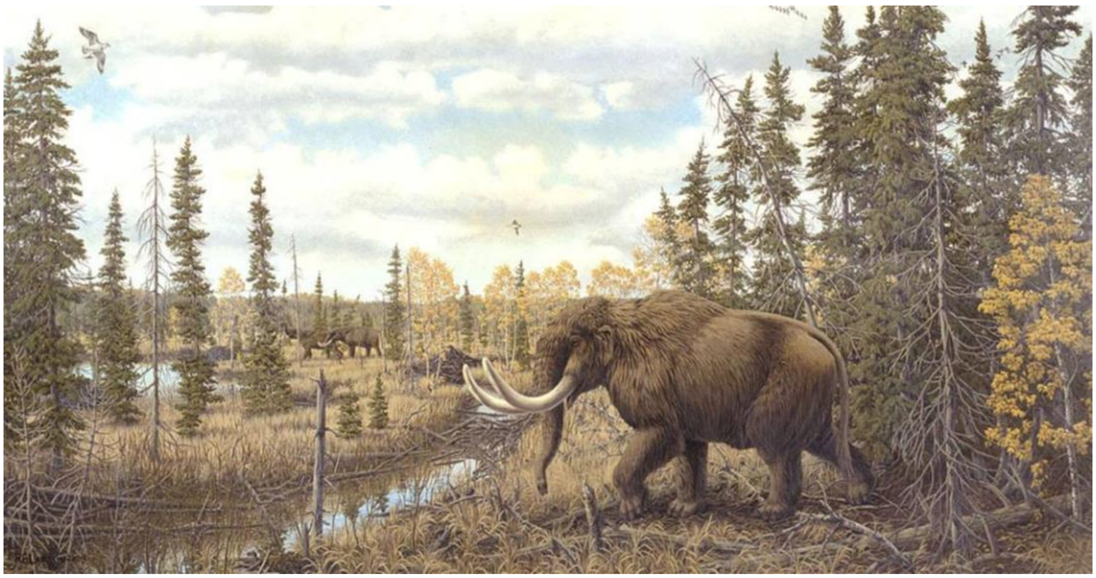
Name: ______________________________

Purpose

To collect authentic scientific data. To observe and analyze that data and make interpretations of past environments.

Introductory Information

In this exercise, you will take part in the Aurora Mastodont Project-Matrix Analysis Project. The data you collect and the samples you sort will be sent to the Illinois State Museum and become part of their permanent collection.



Above is an artist's drawing of a mastodont (*Mammut americanum*) in a recently de-glaciated environment, such as Northern Illinois 12,000 years ago. During this lab, you will be testing the hypothesis that this sketch of the environment is accurate.

1. In order to determine if the artist drew the environment correctly, provide two examples or types of data you would collect. Think about how we determine past environments.

The American Mastodont is an extinct member of the elephant family, including Asian elephants, African elephants, and extinct mammoths. Major differences between mastodonts and mammoths are that mastodonts have a broad, flat skull, simple "straight" tusks, and conical molar teeth. Mastodont teeth indicate that they ate twigs and leaves, as opposed to mammoths, who ate grasses.

2. Based on what they ate, in what environment would you expect mastodonts to have lived?
   forest　　grassland　　lake/wetlands/swamp　　glacial ice

Modified from Prof. Karen Kortz, Community College of Rhode Island

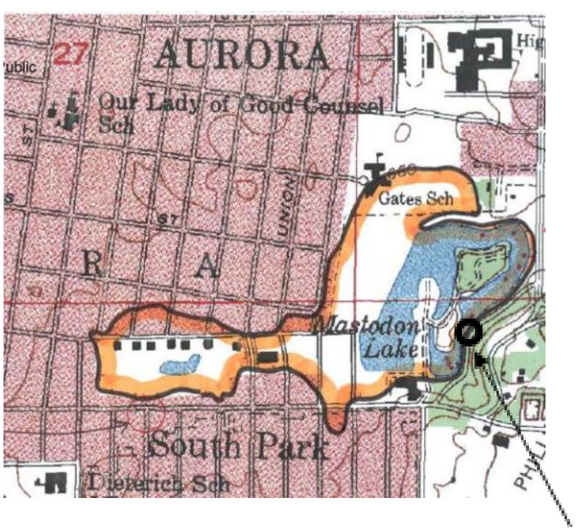
3. How much plant material and snails would you expect to find for each of the environments listed below? Put an X in the column indicating your prediction for each material.

	Woody plant material		Freshwater snail shells	
	A lot	A little	A lot	A little
Forest				
Grassland				
Lake / swamp				
Glacial ice				

The Pleistocene Ice Age extended from 1.6 million years ago to today. However, temperatures and ice cover were not uniform during the Ice Age, but instead there were many separate pulses of glacier advance and retreat. We are currently living in a time when glaciers are small (an interglacial period). The last glacial period when glaciers covered much of northern North America began approximately 30,000 years ago, and the glaciers mostly retreated by 10,000 years ago. Aurora, IL was covered by the last ice sheet, the Laurentide Ice Sheet, until about 16,600 years ago, when the Minooka Moraine was formed to the east of Phillips Park. During the retreat of the Laurentide Ice Sheet, a large block of ice was left behind, and formed the Phillips Park kettle. The kettle then became a bog or swampy area.

In the 1930s, bones of American Mastodonts were found during an excavation of a marsh that was part of a glacial kettle in Phillips Park, south of Aurora, Illinois. The map below shows the outline of the Phillips Park kettle (black line) and the location of the mastodont finds from the 1930's (red dots). The mastodont fossils are from a layer of sediment called marl that has been dated to be ~11,000 years old. Marl is a silty calcium carbonate rich sediment formed in lakes or swamps that commonly have snails.

4. What radiometric dating technique (hint: which element) do you think was used to determine this absolute age of the marl, and what are two examples of things that might have been dated?



Map showing kettle, current lake, and 2004 dig site

Damming the lake to prepare the 2004 dig site

5. How do you think we know that the kettle was a swampy area in the past?

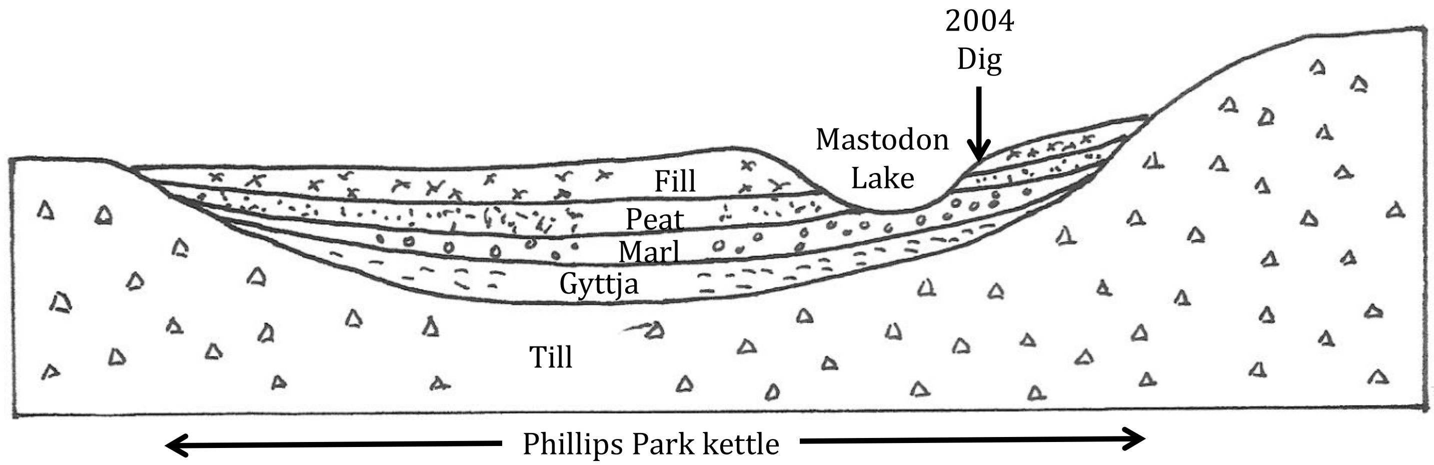
In 2004, scientists and students excavated an area where the mastodont fossils were found in the 1930's (the small circle on the map on the previous page). They carefully documented what they saw as they dug deeper into the ground, and they saved what they dug through. They found a consistent sequence of sediments as they dug in many places. That sequence of sediments, or stratigraphy, is as follows (note: a 'depth' of 100m is the current ground surface)

Name of sediment	"Typical" depth (m)	Typical thickness (m)	Description	Age
Modern fill	100 to 98	Variable to 1	Debris found in 1940's to 1980's used to stabilize bank of Mastodon Lake from erosion	<60 (+/-)
Paleosol 1*	99	0.5 to 0.9	Black clay loam soil formed in loess, with occasional vertebrates	<10,000(?)
Sandy silt*	98	0.1 to 0.9	Dark grey sandy silt with tan sandy silt lens	<10,000 (?)
Paleosol 2*	98	0.2 m	Black clay loam soil formed in loess with organic rich lens at base	<10,000 (?)
Marl	98	0.3 to 0.7	Gray calcareous silt with abundant freshwater snails, remains of mastodont, fish & turtle	Top is 11,520 (+/- 90), Mastodont molars: 10,980 (+/- 60 RCYBP) and 10,430 (+/- 40 RCYBP)
Gyttja	97	1 (?)	Dark grey silty clay, with plant remains	Middle: 13,710 (+/- 70 RCYBP); Base:14,130 (+/- 70 RCYBP)
Lake mud	Unknown	7	Blue-green clay, laminated, no fossils	> 15,000
Till+	Unknown		Glacial drift from last ice advance forming Minooka Moraine	17,500 to 16,600 yr BP

* This would be (stratigraphically) equivalent to the peat found by the CWA workers in the 1930's

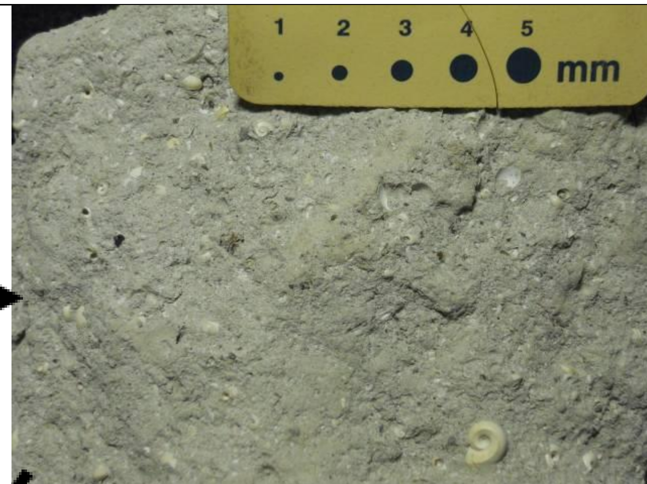
\+ This was not found in the 2004 dig, and is known from regional studies

A schematic east-west cross section through the Phillips Park kettle is below, showing the simplified stratigraphy and the location of the 2004 dig



In order to make sure that all the fossils were recovered, the paleosols, sandy silt, and marl were washed through a screen, and the large pieces were saved. In this lab, you will be examining this screen wash from the various layers beneath the ground surface. Snail shells, plants, and other material in the screen wash allow us to determine what the environment was like during the Ice Age, when mastodonts roamed the area.

The excavation site



Marl that was dug out of a particular layer

Wet screen washing the marl

Screenwash

6. How is the screenwash different than what was excavated from the ground? Why was this done?

Your part in this research is to sort the sceenwash into piles of different materials. Pictures of the common components of the screenwash are shown below. Examples of these are on display in the lab.

Snails

Plants

Rocks

Historical Debris

Analyze the Matrix

7. Remember that we will send your results and sorted samples back to the Illinois State Museum, so please do a good job with your sorting and measuring! Record all of the results from your group on the "Aurora Mastodont Project-Matrix Analysis Data Recording Form".

Step 1. Record the sample data from your vial on the "Aurora Mastodont Project-Matrix Analysis Data Recording Form".

Step 2. Pour the sample onto a clean sheet of white paper. Spread gently into a thin layer by hand.

Step 3. Sort items into the following categories. Use your fingers, tweezers, magnets (for pulling out metal and slag), etc.

- Plant Material
- Snails (be gentle, they are fragile!)
- Rocks and Pebbles
- Historic Debris (slag, metal, glass, plastic, etc.)
- Bones (if present)
- Insect parts (be gentle, they are fragile!)
- Unknown or other.

Step 4. Weigh the objects in each category. Record this number (in grams) on your data form in the Results section. Place each object category into its own envelope and label it with the appropriate information. Do NOT combine your sorted piles together and put them back into the vial!

On each envelope, please write the following

- Sample number from vial
- Grid number (i.e. D12)
- Your sample depth (i.e. 98.42)
- Your layer description (i.e. paleosol or marl or gyttja)
- Today's date
- Your name(s)

Step 5. Enter your data into the Aurora Mastodont website using the computers provided in the lab.

Making Sense of the Data

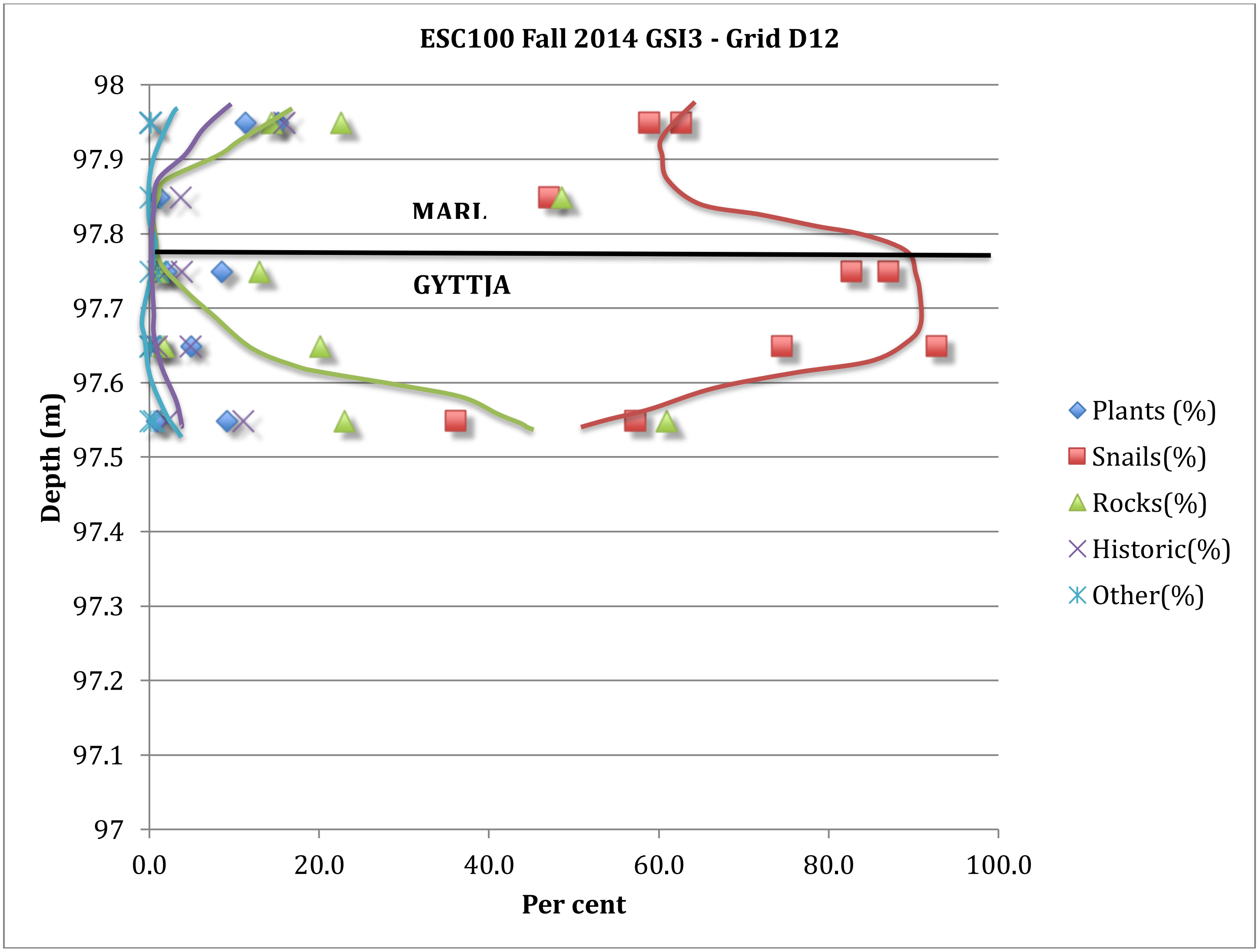
8. In the table below, record the results of your analyses by recording the weights of the components you analyzed, and the elevation of your group's sample. Record the results from other groups in the table below also.

Elevation (m)	Plants (g)	Snails (g)	Rocks (g)	Historic (g)	Other (g)	Total (g)

9. Calculate the percent of the total sample all of the results from above. Also add the sediment type from the sample bag or given to you by your instructor.

Elevation (m)	Plants (%)	Snails (%)	Rocks (%)	Historic (%)	Other (%)	Type

10. Plot these data on the graph on the next page. Use the figure below as an example, which are data from a previous analyses of 13 samples. Label the appropriate samples "oldest" and "youngest" on the plot (i.e. depths).

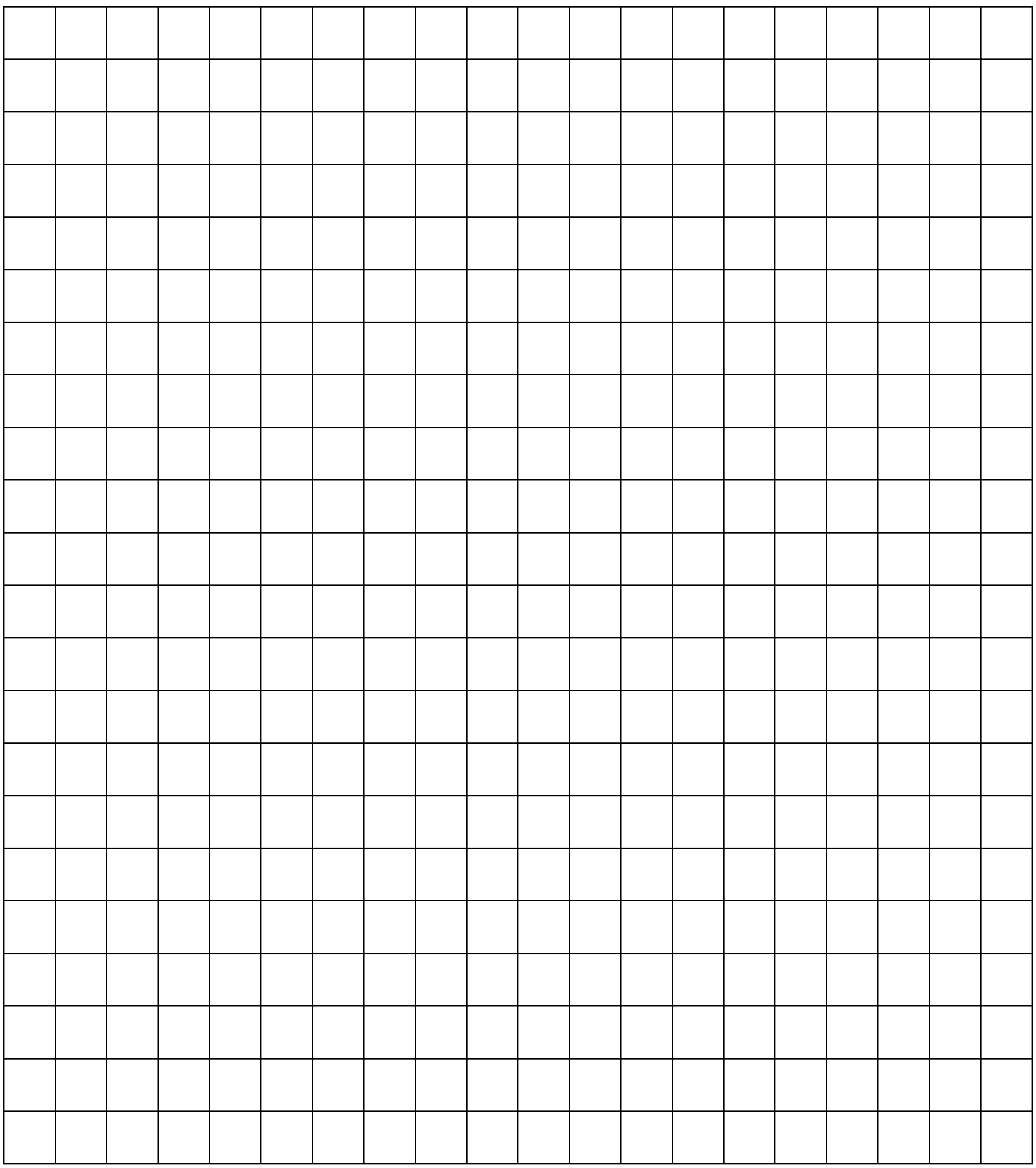


11. Over what vertical range were the samples analyzed by the class collected? Approximately the height of a (circle one) coffee cup table doorway

12. Why do the percentages vary vertically, up and down your graph?

13. Using the results in question 9 and/or the plot on the next page, complete the table below by placing an X in the column with the component with the maximum percentage for each of the layers that you have samples from. Your class may not have samples from all 5 stratum types, so please answer just for the layers that have been analyzed. **Each layer (row) will have a single "X"**, but any component (column) may be the most common in multiple layers (perhaps more than one 'X's' in a column). There is no column for rocks, because they are common to all layers.

	Snails	Historic	Plants	Bones or insects	Other
Fill					
Sandy silt					
Paleosol					
Marl					
Gyttja					



Percent (%)

14. (EXTRA CREDIT if you have snails in your sample) Using the gastropod identification chart in the lab, identify the gastropod species that are in your sample as best as you can. If you have a lot of gastropods, note that you only need to count a maximum of 12. Circle the appropriate column after you have counted them.

Valvata tricarinata	none	1 to 3	4 to 12	more than 12
Amnicola limosus	none	1 to 3	4 to 12	more than 12
Pyrgulopsis lustrica	none	1 to 3	4 to 12	more than 12
Physella cf. gyrina	none	1 to 3	4 to 12	more than 12
Gyraulus cf. parva	none	1 to 3	4 to 12	more than 12
Helisoma anceps	none	1 to 3	4 to 12	more than 12
Other				
____________________	none	1 to 3	4 to 12	more than 12
____________________	none	1 to 3	4 to 12	more than 12

15. (EXTRA CREDIT if you have snails in your sample) Based on the environments in which the snails live, circle the one phrase on each line that best describes the environment recorded in the excavated material.

shallow water	deep water
fast-moving stream	still water
muddy to silty bottom	sandy to silty bottom
aquatic plants	no aquatic plants
rotting plants on the lake bottom	no rotting plants on the lake bottom
mineral-rich water	mineral-poor water

16. Study the Gastropod identification chart on your table. Notice the environments that the snails typically live in. A paleontologist studied the gastropods from several samples in 2004, and determined that *Valvata tricarinata, Amnicola limosus* and *Pyrgulopsis lustrica* are the most common species present. Using these as a guide, describe the <u>environment of the kettle</u> while the gastropods were living.

17. What is your overall interpretation of the environment of the Phillips Park, and the kettle that Mastodon Lake was dug into, as recorded in the excavated (screenwash) material from the 2004 dig? Use your responses to Question 3, 10, 13 and 16 to help you answer this question. Compare results from the different elevations and determine if the environment changed over the time recorded by the samples or if it was fairly constant. If it changed, how did it change? Explain your answer.

18. Based on your environmental interpretation in the previous question, do you think mastodonts commonly roamed where their bones were found in the 1930's? Explain your answer. It is not unusual for bodies or bones to be transported after an animal dies before it is buried. Consult the cross section of the Phillips Park kettle, and maps and the photos on display in the lab.

19. Thinking about the environment recorded by the excavated material from Mastodon Lake and the topography of Phillips Park, hypothesize as to why the mastodont bones were found where they were found. Check the maps and the photos on display in the lab.

20. How does the environment for the kettle differ from that around the kettle? Think about the age of the marl and what was happening in Aurora, IL at that time (and what HAD happened).

21. Examine the artist's sketch from the beginning of the lab once again. Did the artist draw the environment correctly? Use specific data you collected to support your answer.

22. Please submit your data to the Aurora Mastodont Project – Matrix Analyses Project website. By doing this, you will let other students and schools see your results, and you can see how your results compare to theirs. Please submit your data to http://www.livebinders.com/play/play/627554 and hit submit after you are finished entering data.

Aurora Mastodont Project-Matrix Analysis Project
Data Recording Form

Student/Volunteer name(s):____________________________________

Sponsoring Institution:____

Today's Date:__________________

Sample information

Original Sample #: _______________

Unit: ________________________

Elevation (m):_______________

Stratum: _____________________

Original Volume of sample: _______mL (total of the vial volume)

Results

1) Plant Pieces (g):________________

2) Bones and bone fragments (g):_________________

3) Snails (g):________________

4) Insects and insect parts (g):________________

5) Rocks and Pebbles (g):_______________

6) Historic Debris (slag, metal, glass, plastic, etc.)(g):_____________

7) Unknown or other (g):___________________

Describe:____

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Comments

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Did you submit your data to the AMP-MAP website (http://www.livebinders.com/play/play/627554)

YES NO