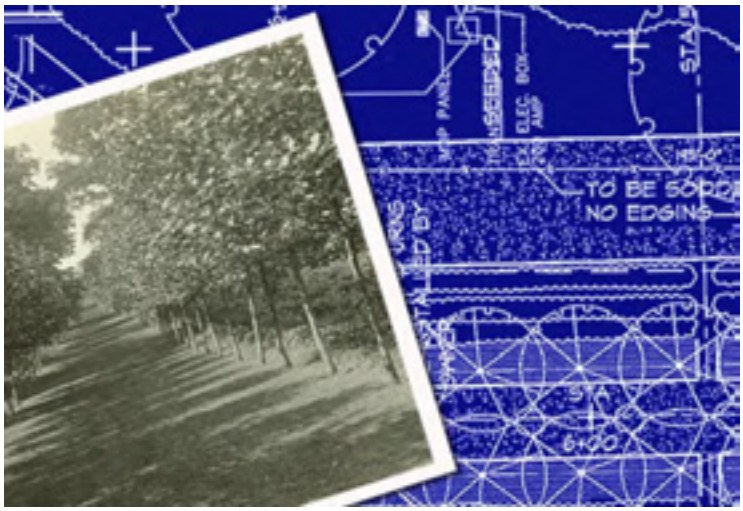
Stan Hywet HALL & GARDENS

Preserving the Past



NITROGEN LAB

Updated 4/12/17

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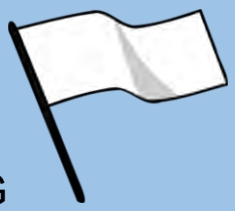
Nitrogen Expert: _____

(First & Last Name)

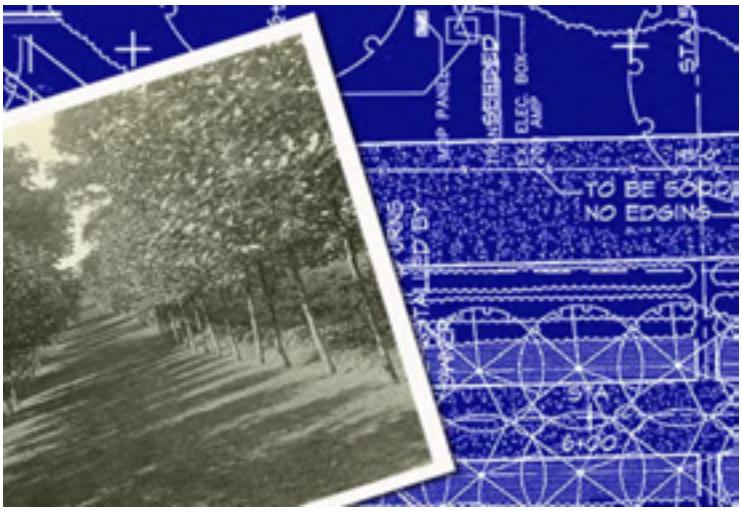
School: _____

7
N
Nitrogen
14.0067



FOLLOW THE WHITE FLAG

Preserving the Past



pH LAB

Updated 4/12/17

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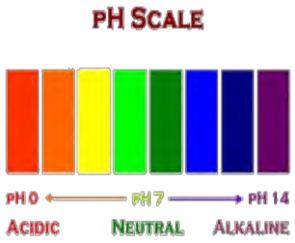
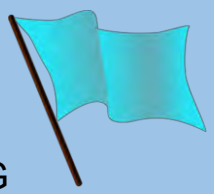
(First & Last Name)

School: _____



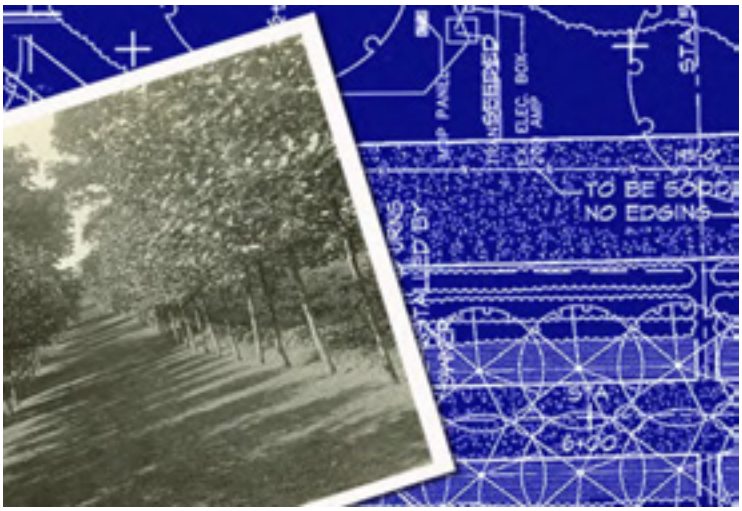
FOLLOW THE BLUE FLAG



Preserving the Past

PHOSPHORUS LAB

Updated 4/12/17



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Phosphorus Expert: _____

(First & Last Name)

School: _____

15
P
Phosphorus
30.97376

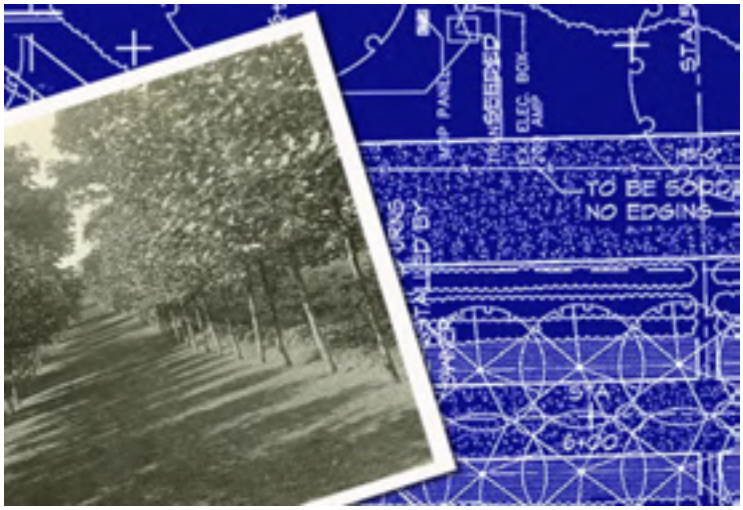
FOLLOW THE ORANGE FLAG

Stan Hywet HALL & GARDENS

Preserving the Past

POTASSIUM LAB

Updated 4/12/17



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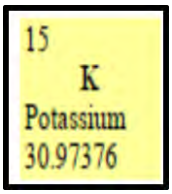
POTASSIUM Expert: _____

(First & Last Name)

School: _____

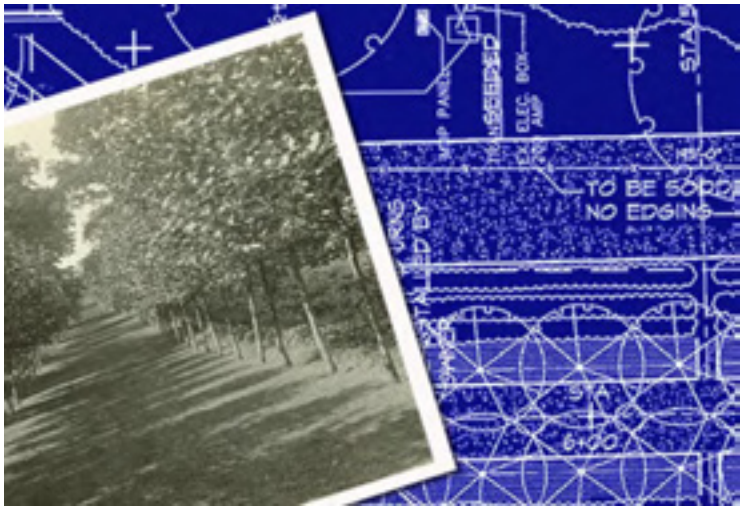


FOLLOW THE YELLOW FLAG

Preserving the Past

WORM LAB

Updated 4/12/17



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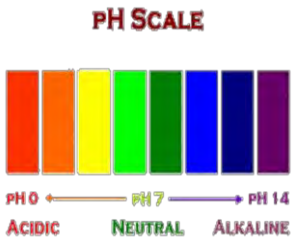
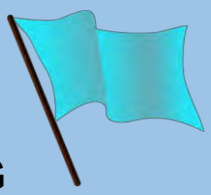
pH Expert: _____

(First & Last Name)

School: _____



FOLLOW THE BLUE FLAG



Dear Students,

Science is everywhere. Many problems in our world that can be solved today by using technology and science. Speaking of problems, we have one and need your help! We have heard that you are great problem solvers and may be able to help us. One of Stan Hywet's missions is to preserve the original design of the **garden**s and we need the plants in the **London Plane Tree Allée** and the **Dell**, both on the south side of the Manor House, to thrive.

Native and non-native plants were planted 100 years ago when Stan Hywet was built. Sixty four London Plane trees, rhododendron, azalea bushes, hostas and vinca minor plants form an **allée**; a natural hallway leading from the Manor House's South Terrace to Garmon Road. Unfortunately, over time the 64 original London Plane trees did not survive and the whole area had to be restored in 2007.

When the alleé was restored in 2007, we learned a few facts that may be helpful to you. First, much of this land on which the gardens were built was once a **stone quarry** and in some parts of the Dell, you can see the exposed sandstone **bedrock** (rock found under the soil). In many parts of the Dell and Plane Tree Allée, the soil is very shallow. Some areas in the alleé only have about 8 inches of soil! It is a good thing that when the area was restored, holes were drilled into the bedrock within which the new trees' roots will have room to grow.

Much of the native or original soil on the historic Stan Hywet **Estate** is composed of silt, loam and glacial till (which is easily compacted and allows for easy water run off). While the **Dell** (Zone D) contains mostly native soil, new soil was brought in from other areas to replace all of the original soil in the Plane Tree Allée back in 2007 (Zone B). In the years that followed, the soil was discovered to be inadequate-particularly for the rhododendrons which had an especially difficult time surviving a few harsh winters. So, in 2015, the soil was replaced *again* from the South Terrace to the land bridge (Zone A). At this time, new rhododendrons, hostas, azaleas, and vinca minor plants were planted in this area (the Plane Trees that were planted in 2007 stayed put).

As you know, healthy soil makes plants thrive. Are you able to come to Stan Hywet and conduct scientific tests of the soil and give us recommendations to help our plants thrive? We really need your help to preserve our gardens and make them especially beautiful for our guests. In your investigation, you will look into the original landscape plans and investigate how the Plane Tree Allée and Dell originally looked in 1916. You will also see how beautiful the Dell was when Virginia Seiberling (one of F.A.'s daughters) was married there in 1919. It is our hope to keep the Dell and Plane Tree Allée beautiful for another one hundred years!

We hope that you are willing to take this challenge. As a result of your investigation, you will be asked to provide us with scientific evidence on how to go about solving our problem. You may do this in a variety of ways— a written report, a power point, or even a video. The choice is yours! We are looking forward to your visit and are excited to hear back from you. Have fun!

Respectfully yours,

Toivo Motter, Dir. of Educatio

Table of Contents

“Change over time”

What does this mean?

Name and describe:

Two naturally occurring events that may change the earth’s surface.

Example: A volcano would change the land by adding new material and covering up older surface material on the earth’s surface.

One human-caused event that may change the earth’s surface.

Example: A farmer would change the land by tilling the soil in order to plant crops.

Natural Change #1: _____

Description of Change #1:_____

_____

_____

Natural Change #2: _____

Description of Change #2: _____

_____

_____

Human-Induced Change: _____

Description of Change: _____

_____

_____

Designing the Landscape

In the early 1900s, many American landscape designers looked at houses and their surrounding garden landscapes as indoor and outdoor rooms. They believed that the homes and the land surrounding them should work together and connected major rooms to outdoor gardens. They also began designing more informal (natural-looking) landscapes instead of forcing them into formal geometric patterns (squares, rectangles, triangles, or circles), which was the style in England at the time. Formal gardens are planned and planted with a specific design in mind, using a grid.

Before they chose someone to build a new home, the Seiberlings chose landscape designer Warren Manning to imagine how the land might look *around* their new home. After he walked around the Seiberling's property, which at one time was part of several old farms, Mr. Manning drew up a plan for the gardens.

In many of his designs, Mr. Manning worked to bring out the uniqueness of the land by using native plants. He also liked to include existing features on the land to create a more natural-looking design. One particular existing feature that Mr. Manning liked on the Seiberling property was the old, abandoned sandstone quarry. The Dell, the English Garden, the Japanese Garden and the Lagoon were all created from the old quarry pits. This was such an important part of Mr. Manning's design that the Seiberlings chose to name their entire estate "Stan Hywet", which means "stone quarry" in old English!

Identify and put a box around the "formal" features and circle the "informal" design features in the picture below:

Stan Hywet's Dell

Look at this photograph of the Dell as it looked in 1919. Describe what you see.

_____

_____

_____

_____

_____

_____

_____

Look at this photograph of the Dell as it appeared in2013. What differences do you notice (besides the fact that there are no people in the photograph).

_____

_____

_____

_____

_____

Stan Hywet's Plane Tree Allée

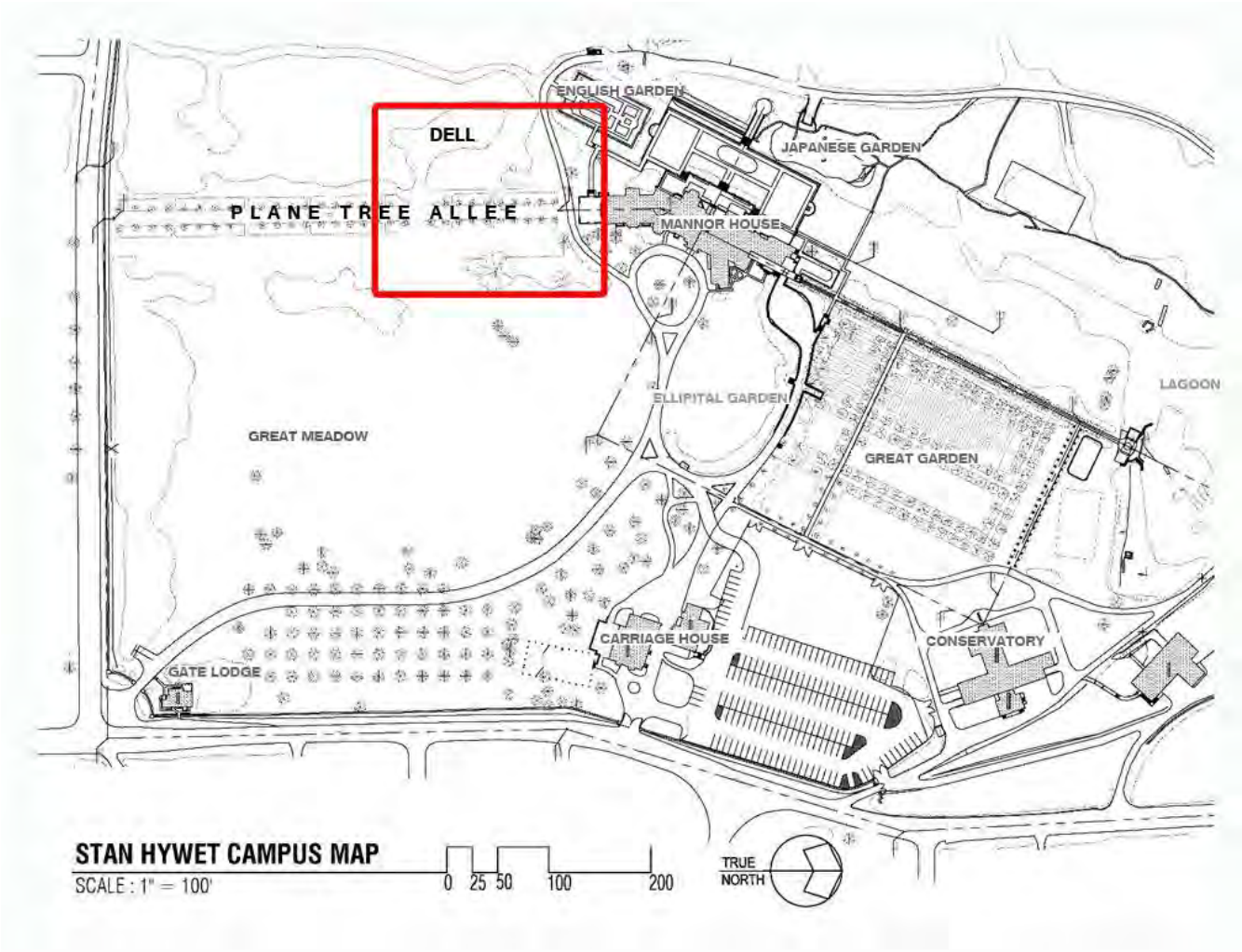
Look at these three photographs of the Plane Tree Allée and write a story about what you think happened over time.

ANALYZING BLUEPRINTS

Blueprints are often used to plan and build structures and are also used when planning and designing outdoor areas (landscapes). The images below are landscape blueprints.

After analyzing this blueprint and the one on the next page, write one or two key observations you notice. Keep in mind that each new image is of the same area, just from different years when they were drawn up.

You will be analyzing the soil on this part of the landscape at Stan Hywet Hall & Gardens!



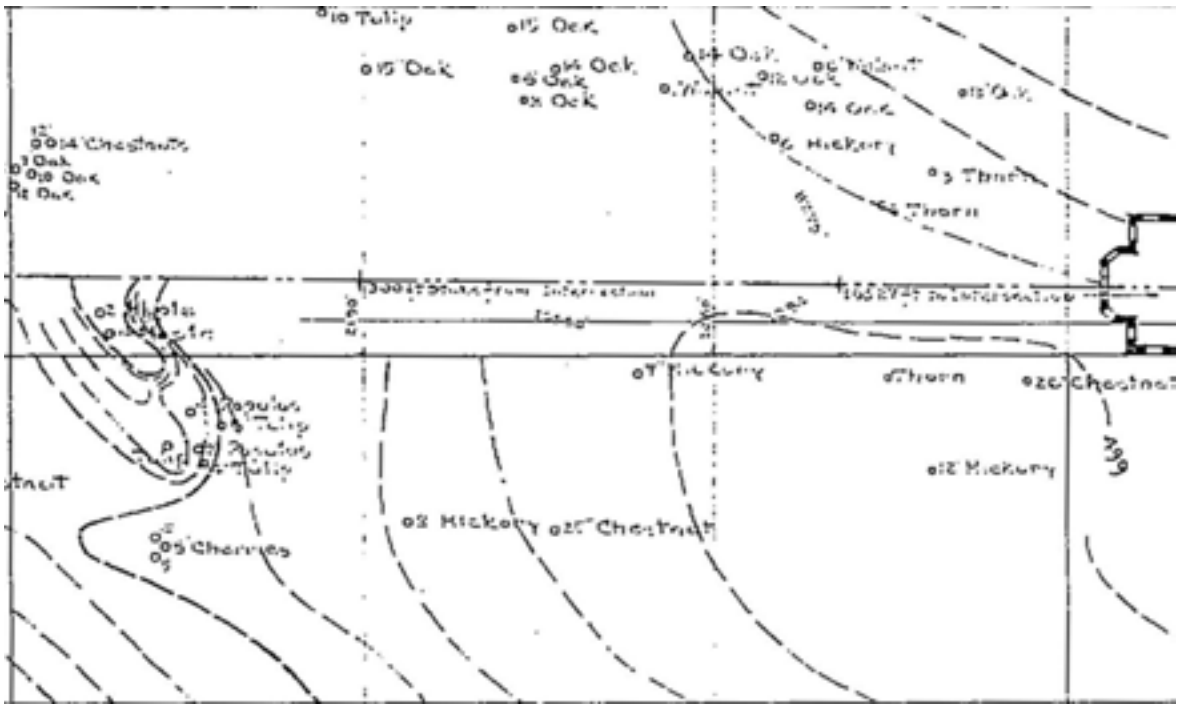
Using the scale indicated on the key at the bottom of the diagram (1 inch = 100 feet), calculate the full length of the Plane Tree Allée.

Next, calculate the area (length x width) within the box. This is the area we will be studying in the following pages.

Analyzing Existing Condition Surveys and Landscape Blueprints

Before a landscape designer creates a design, he/she must first observe, measure, and record the "existing conditions" of the area to be designed. The diagram below represents the area that would later become the Dell and Plane Tree Allée. Record any specific observations you notice about this area as it appeared in 1914.

1914



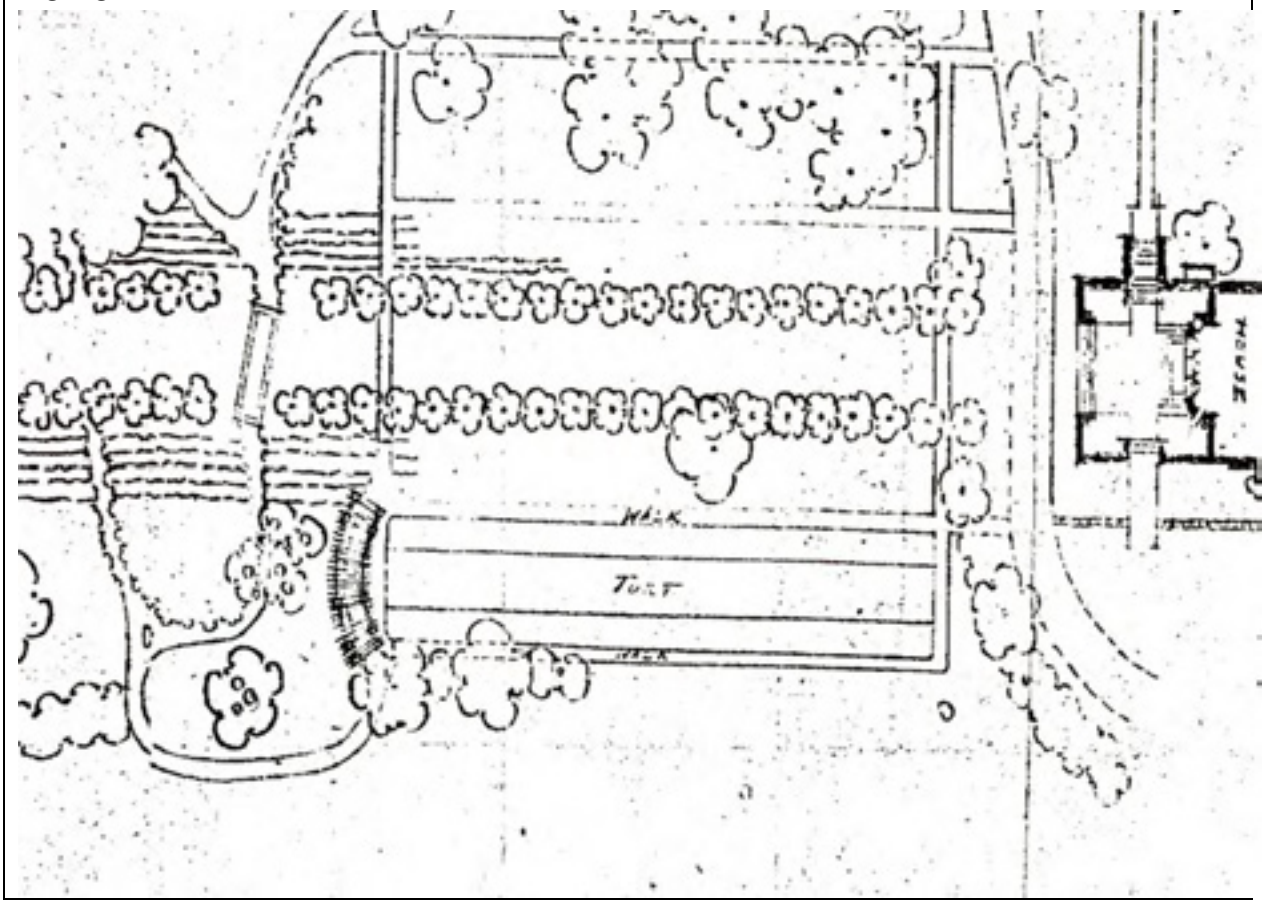
Observation #1:

Observation #2:

What do you think the object on the far right is?

Once an existing conditions study is complete, the landscape designer draws up a formal blueprint. Compare the landscape blueprint below to the existing conditions drawing from 1914. Make 2 observations about the features in the blue print.

1916



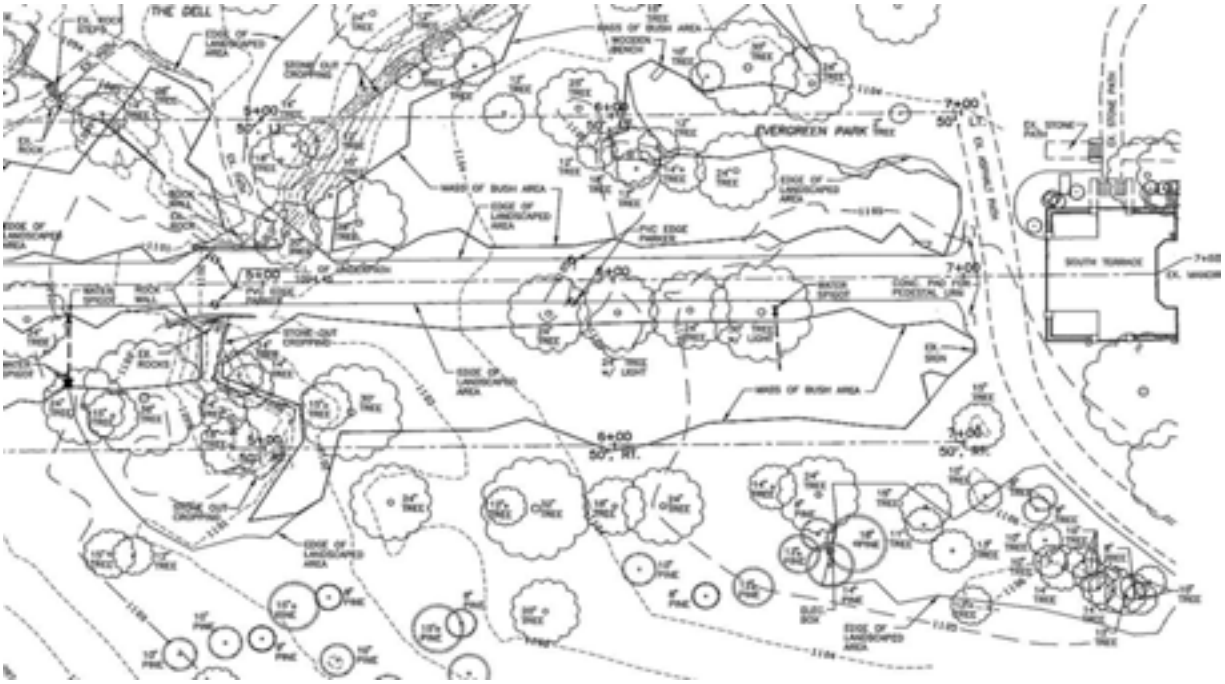
Observation #1:

Observation #2:

Would you consider this a formal or informal part of the landscape?

In 1999, a new existing conditions study was conducted and the drawing below was created. Record some observations below that compare this landscape with the blueprint that was created in 1916.

1999

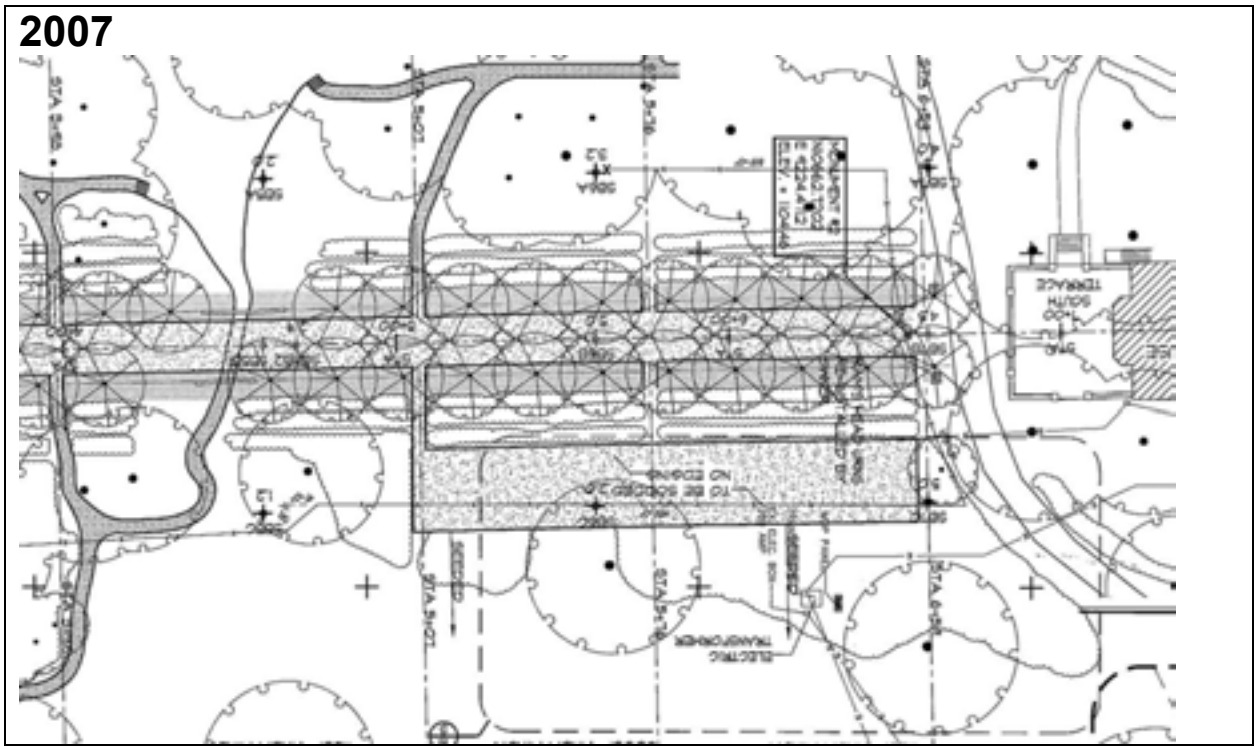


Observation #1:

Observation #2:

What do you think might have happened to this location over time?

In 2007, this blueprint was drawn up by a landscape architect for the complete restoration of the allee.



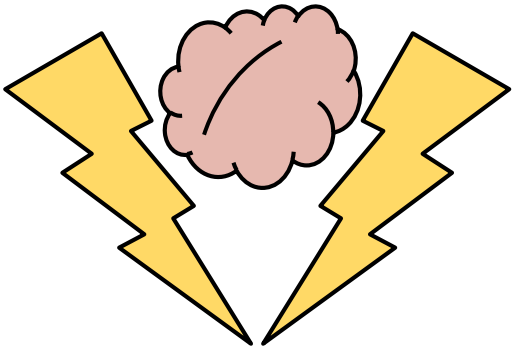
Observation #1:

Observation #2:

What needed to be done in order to restore the Plane Tree Allée and Dell to Manning's original design from 1916?

Let's talk about soil more on the next page!

SOIL BRAINSTORM!!!!!



What do you know about soil?

Write down everything that comes to mind about soil!!

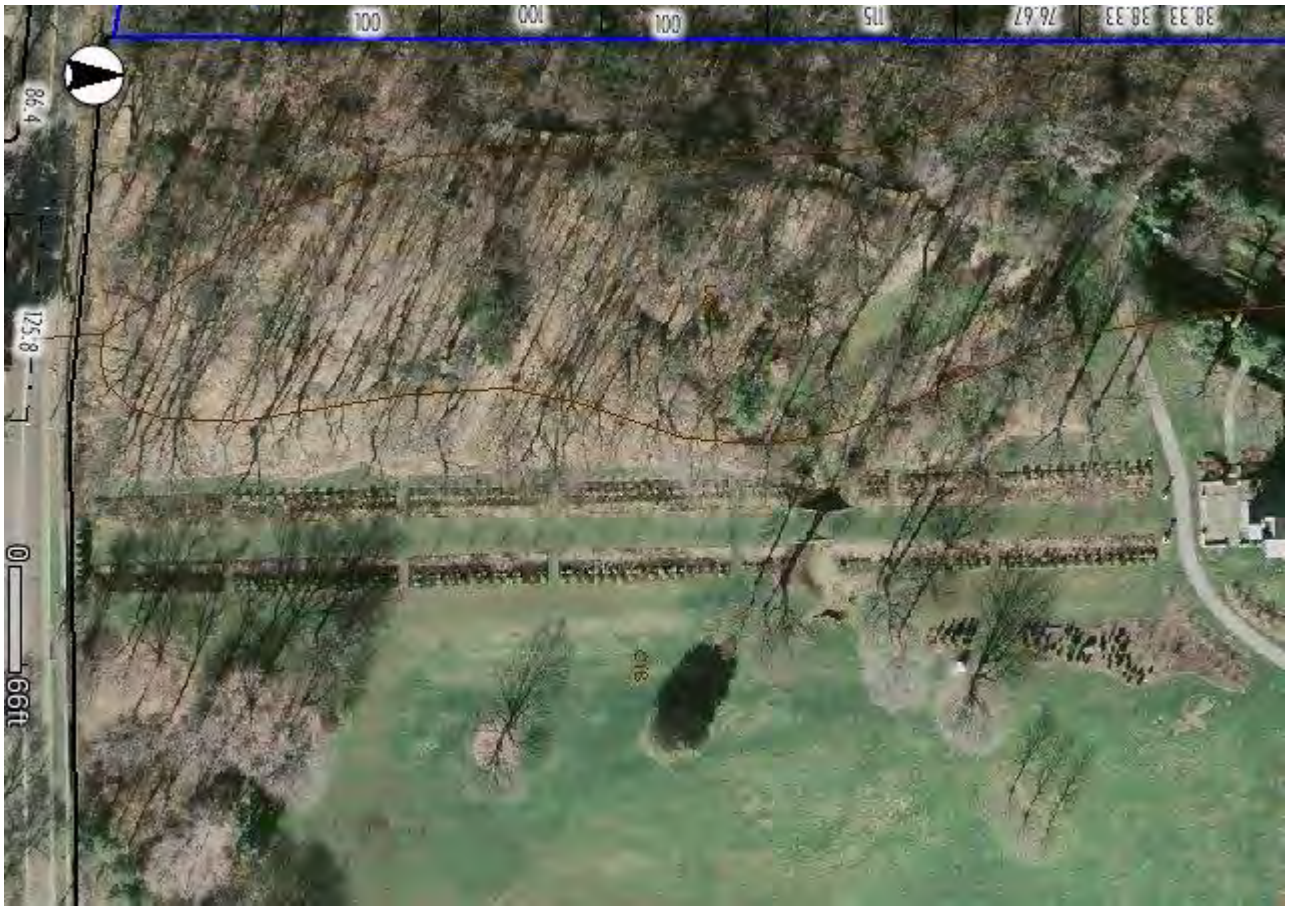
Native Soil

The native soil on the property is Northeast Ohio topsoil. When the Plane Tree Allée was landscaped, the plants used for the design did not thrive, partly due to the slope of the land as well as other characteristics of the soil. In 2007, when Stan Hywet attempted to restore the original landscape design, they removed the original soil at the Allée down to the bedrock and replaced it with new soil. Unfortunately, this new soil was of poor quality and they had to replace the soil again in 2015.

Soil Drainage Considerations -

While the original architects understood that the drainage of water was important, they did not understand the properties of the soil on the site. The primary soil the buildings of Stan Hywet share is Canfield (CfB) soil which has a slow permeability. This silt loam glacial till is made of fine material and becomes highly compacted very easily, forming what is called a fragipan. When these soils are saturated, water tends to flow laterally on top of the fragipan. **Excerpt from *Storm Water Management Program***

This is an aerial photo taken during a soil survey of the property in 2007, after the replanting of the Plane Tree Allée.



Circle the part of the manor house included in this photograph.

Put two rectangles around the parts of the property we will be studying (The Dell & the Plane Tree Allee).

Background Information on Plants and Soil Requirements

Plants, like people, need adequate nutrition. When plants are not given proper nutrients, they don't grow well and are more likely to become sick or diseased. Just like humans require certain nutrients that are taken in from the food they eat, plants take in through their roots **nitrogen**, **phosphorous** and **potassium**, and smaller amounts of other **nutrients** including calcium, magnesium and iron contained in the soil.

Because plants remove nutrients from the soil, the soil must be regularly replenished. Humans usually add nutrients back to the soil by using chemical **fertilizers** or biological materials including compost and manure. Chemical fertilizers are mixtures of purified chemicals. They are sold as soluble, short-acting forms (powders or liquids) or as long-acting, slow-release pellets. Compost is a term used for a mixture of partially decomposed plant material. Besides adding nutrients back to the soil, compost also changes the physical and chemical properties of soil to help plant roots grow and take up nutrients. When the soil is too dense or sandy, the plant roots can't absorb fertilizers as easily, and the nutrients can wash out of the soil.

Overuse of fertilizers and fertilizer run-off are serious environmental problems. Too much fertilizer can damage plants, and can contaminate other soils and contribute to water pollution problems.

Quick Questions

1. **What are two ways nutrients may be added back into soil?**

   _____

   _____

   _____

2. **What nutrients do plants need and how do they obtain them?**

   _____

   _____

   _____

3. **What can happen if the soil is too dense or too sandy?**

   _____

   _____

   _____

4. **What might happen if too many nutrients are added to the soil by humans?**

   _____

   _____

   _____

100 Years Later: Focusing in on the Plane Tree Allée Soil

Directions: Answer the following questions about what we will be doing at Stan Hywet Hall & Gardens

What will we be testing at Stan Hywet? _____

What is your group's experimental test? _____

_____

**** Now go to a computer and go to the science HUB for APS (6th Grade Essentials) for information that will help you answer the questions below.**

Why is your test important to soil and plant development? _____

_____

_____

What effect does your test item (nitrogen, phosphorous, worms, etc.) have on the soil? _____

_____

_____

What can cause the soil levels of your test item to change? _____

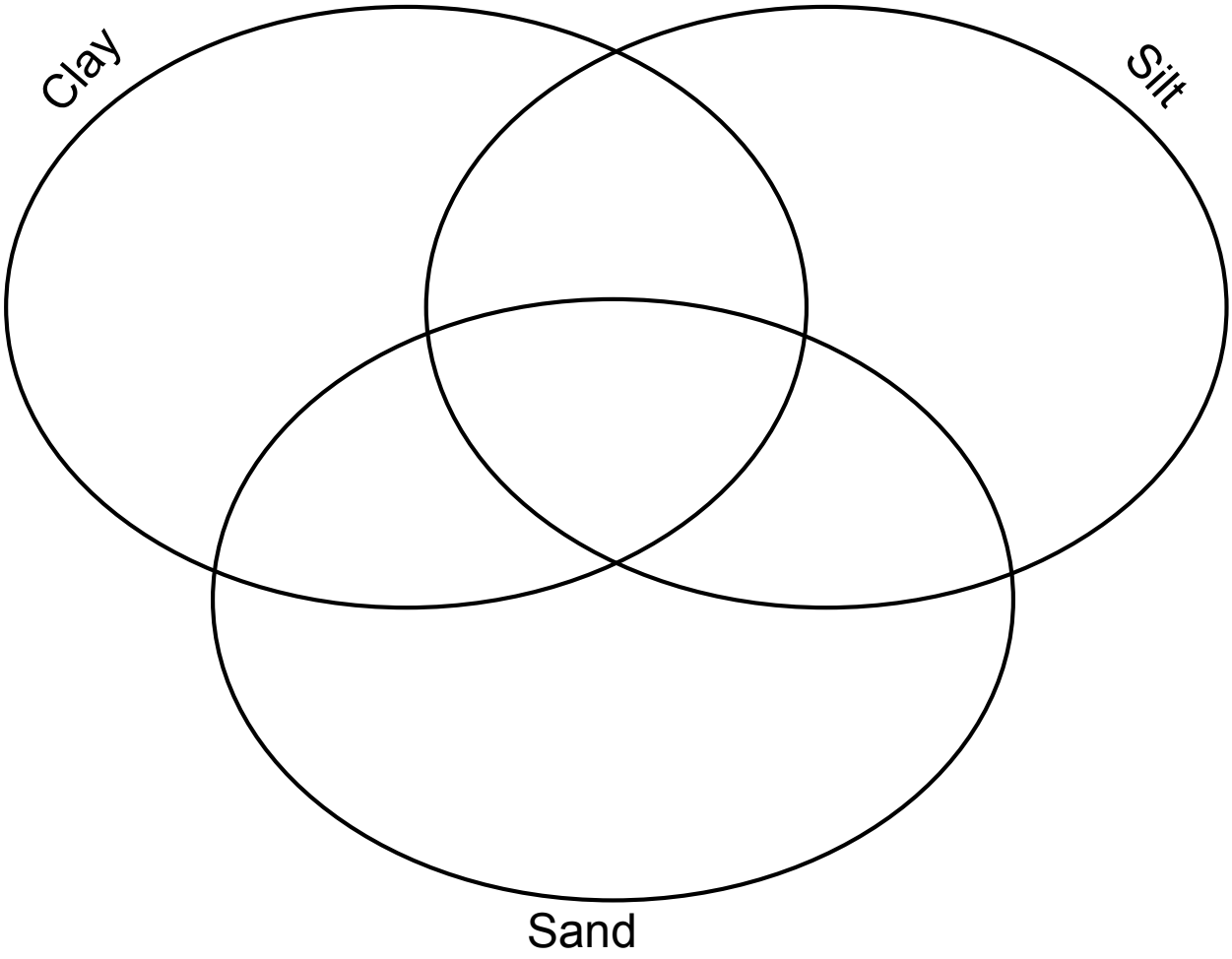
_____

_____

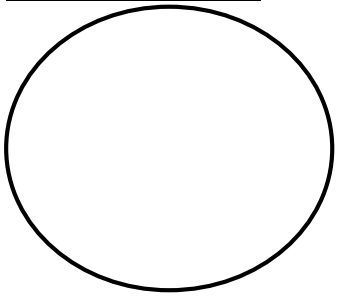
Instructions for observations:

1. What is the overall appearance of the soil?
2. Using your magnifying glass describe the soil particles.
3. After wetting the tip of your finger, move the soil between your thumb and forefinger. Describe the texture.
4. Record your observations on the next page.

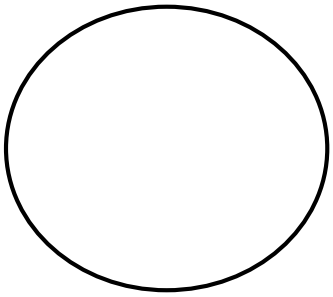
Soil Observations - How does the soil look and feel?



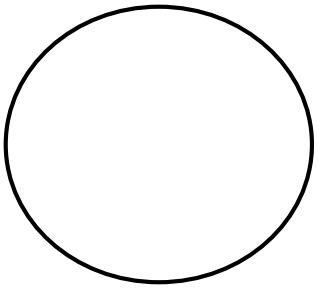
Draw the Particles



SAND



SILT



CLAY

Existing Dell and Plane Tree Allée Plants

<u>Directions:</u> Your teacher will assign you a plant or tree. Use the links on the science HUB for APS (6th Grade Essentials) to help find out information about your plant and tree. Use the research questions to guide your investigation. Be prepared to share you information with the class.

	Trees	**Dell**	**Plane Tree Allée**	**Native**	**Non-native**	**<u>Research Question:</u> What does this tree needs to stay healthy?** **How much water does the plant need?** **How much sun/shade is best for the health of the plant?** **In what kind of soil does the plant thrive?** **What nutrient levels in the soil are best for this plant?**
1	**Tulip Tree** *Liriodendron* 	x				
2	**Black Oak** *Quercus velutina* 	x				
3	**Eastern Redbud** *Cercis canadensis* 	x				

	Trees	**Dell**	**Plane Tree Allée**	**Native**	**Non-native**	**<u>Research Question:</u> What does this tree needs to stay healthy?** **How much water does the plant need?** **How much sun/shade is best for the health of the plant?** **In what kind of soil does the plant thrive?** **What nutrient levels in the soil are best for this plant?**
4	**Black Cherry** *Prunus serotina* 	x				
5	**London Plane Tree** *Platanus × acerifolia* 		x			

	<u>Wild Flowers/ Plants</u>	**Dell**	**Plane Tree Allée**	**Native**	**Non-native**	**<u>Research Question:</u> What does this tree needs to stay healthy?** **How much water does the plant need?** **How much sun/shade is best for the health of the plant?** **In what kind of soil does the plant thrive?** **What nutrient levels in the soil are best for this plant?**
1	**Squirrel Corn** *Dicentra canadensis* 	X				

	Wild Flowers/ Plants	**Dell**	**Plane Tree Allée**	**Native**	**Non-native**	**Research Question: What does this tree needs to stay healthy?** **How much water does the plant need?** **How much sun/shade is best for the health of the plant?** **In what kind of soil does the plant thrive?** **What nutrient levels in the soil are best for this plant?**
2	**Dutchman's Breeches** *Dicentra cucullaria* 	X				
3	**Wild Chives** *Allium schoenoprasum* 	X				
4	**Daylily** *Hemerocallis fulva* 	X				
5	**Mountain Laurel** *Kalmia latifolia* 	X				

	Wild Flowers/ Plants	**Dell**	**Plane Tree Allée**	**Native**	**Non-native**	**Research Question: What does this tree needs to stay healthy?** **How much water does the plant need?** **How much sun/shade is best for the health of the plant?** **In what kind of soil does the plant thrive?** **What nutrient levels in the soil are best for this plant?**
6	**Canadian Wild Ginger** *Asarum canadense* 	X				
7	**Azalea** *Rhododendron* 'Red-Red' 		X			
8	**Hosta** 		X			
9	***Common Periwinkle*** *Vinca minor* 		X			

	Wild Flowers/ Plants	**Dell**	**Plane Tree Allée**	**Native**	**Non-native**	**Research Question: What does this tree needs to stay healthy?** **How much water does the plant need?** **How much sun/shade is best for the health of the plant?** **In what kind of soil does the plant thrive?** **What nutrient levels in the soil are best for this plant?**
10	***Rhododendron*** *maximum* 'Roseum' 		X			
11	***Rhododendron*** *catawbiense* 'Album'  (white)		X			
12	***Rhododendron*** *Catawbiense* 'Nova Zembla'  (pink)		X			
13	***Lily of the Valley*** *Convallaria majalis* 					

Soil Permeability Lab Exercise

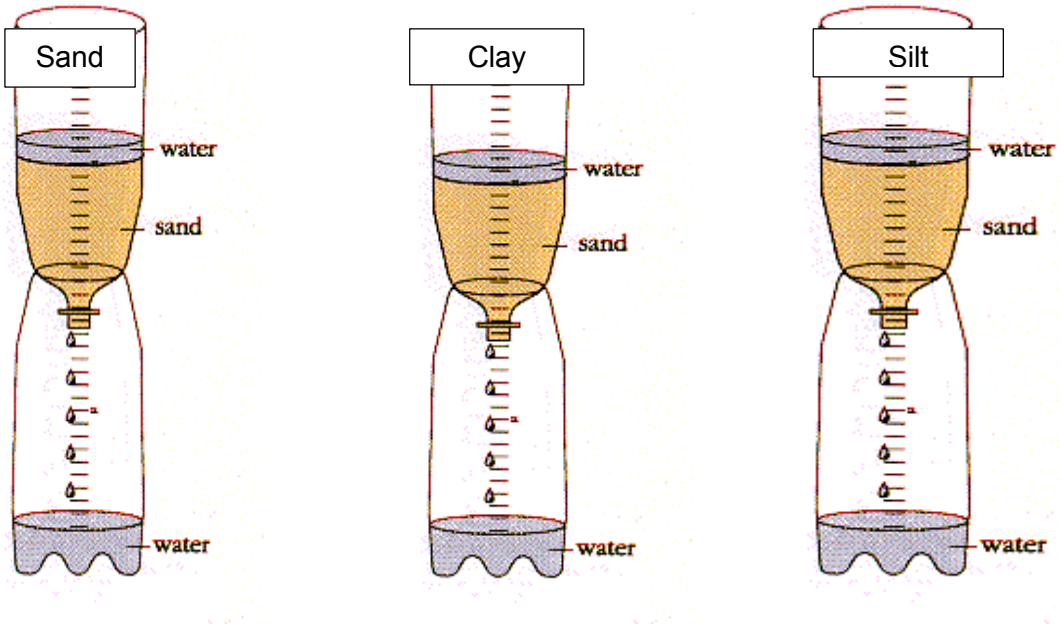
BATTLE OF THE SOIL TYPES

Predict (Rank in order from most to least amount of water collected):

1._____

2._____

3._____



Pre-Experiment Instructions:

1. Set up three 2-liter bottles (3 rings stands if available) and insert one cutoff 2 L bottle with the spout end down on top.

2. Insert a small plastic mesh in the bottom of the inverted bottle and insure that the cap is on securely, but not too tight.

3. Fill each soda bottle 1/3 full of soil; one soil type for each bottle. Be sure the levels are equal.

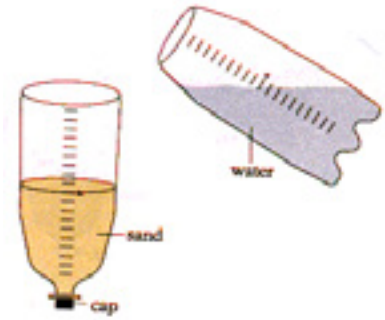
4. Place a 400 mL beaker under each bottle.

   Or use a 400 mL beaker

5. BEFORE adding the water, the Containment Specialist should practice taking the bottle cap on and off. It is important to try and recap the bottle as quickly as possible.

6. Group positions:

   - Time keeper:_____
     - (Responsibility: Operates stopwatch)
   - Water manager:_____
     - (Responsibility: Get and pour water)
   - Containment Specialist:_____
     - (Responsibility: Cap removal & Replacement)
   - Recorder: _____
     - (Responsibility: Records outcomes)



Hypothesis :

_____

_____

_____

Predict (Rank in order from most to least amount of water collected):

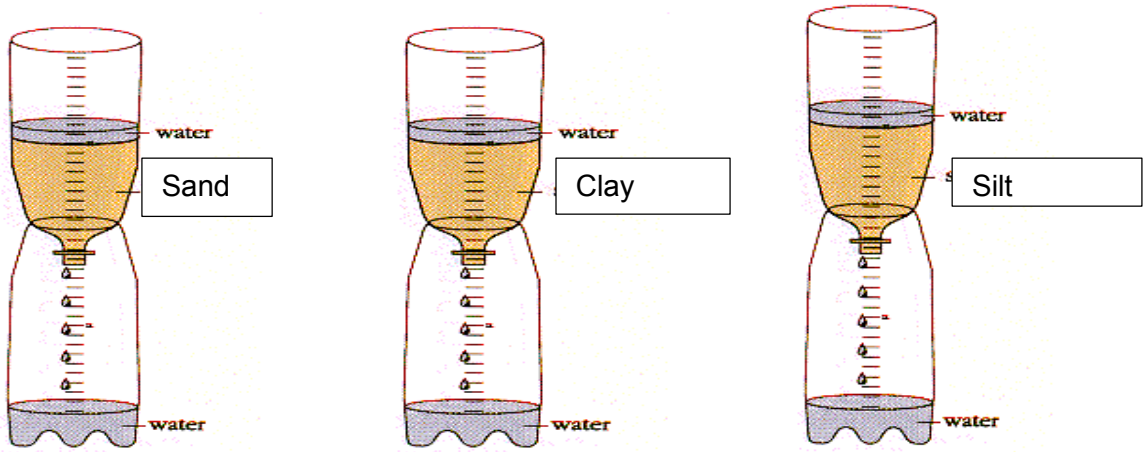
1._____

2._____

3._____

Experiment Instructions

1. The stopwatch should be ready, as well as someone who is going to record the amount of water level every 30 seconds. The person who is going to remove and put the cap on the bottle should also be ready.
2. Remove the bottle cap, and gently pour the 250 mL of water. The stopwatch should start as soon as water begins to be poured into the three soil columns.
3. Stopwatch person announces time intervals every 30 seconds so the "recorder" can write down the volume of water every time for 30s, 1m, 1m 30s, and 2m.
4. The cap is to be put on when the 2 minute mark is announced..
5. Measure the volume of water in each beaker by pouring the water into the graduated cylinder. This should be done for each beaker and emptied in a designated area before measuring the next beaker.



Report the volumes of water obtained from each soil type and record on the table below.

Report the volumes of water obtained from each soil type and record on the classroom board. Once all the numbers are collected for each group in each box, the numbers can be totaled and divided by the number of entries. In the data table below, record the class averages. These numbers will be recorded on a graph to determine which soil had the fastest rate of permeability.

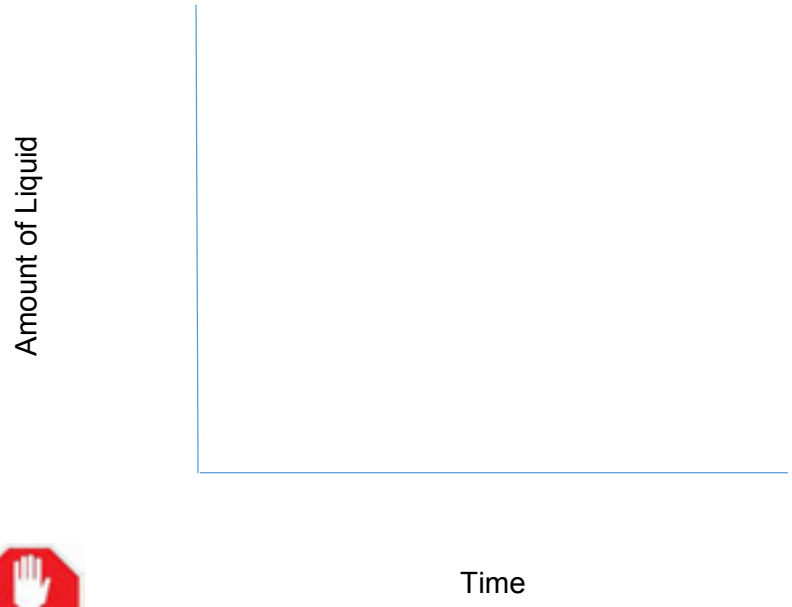
Type of Soil	mL 30s	mL 1min	mL 1m 30s	mL 2min	#1-3 for Clarity (1=most clear)
Sand					
Silt					
Clay					

Work out the math here:

Data Table of Class Averages for each box.

Type of Soil	mL 30s	mL 1min	mL 1m 30s	mL 2min	#1-3 for Clarity (1=most clear)
Sand					
Silt					
Clay					

Rate of Permeability of Different Types of Soil



Sand – solid line
Silt – dashed line
Clay – use different color for line

and Think

1. **Which soil sample produced the lowest volume of water in two minutes?**

2. **What might be a reason for the differences in permeability (the rate at which the water flows through the soil) for the various soil types?**

3. **Different plants need different types of soil to grow. If you had a plant that required a lot of water and you had a very sandy soil, what could you do to the soil to increase its ability to hold water?**

Let's Make Some Observations!

Some things to remember:

Plants are alive although their "life" is different from that of animals and humans. There are many aspects of "life" - a few droopy or brown leaves do not mean that a plant is "dead." It may simply be unhealthy.

The different parts of a plant have different responsibilities: Plants take in air through their leaves. Chloroplasts in the plant absorb the sun's energy for use in photosynthesis. Water and nutrients from the soil are taken in through the roots.

Key Questions to Answer:

⇒ What **kinds of trees/plants** do you see? (check back of this sheet)

⇒ Would you say the plant life is generally **healthy**? Why or why not?

Observe: Look for patterns in the <u>entire zone</u> & surrounding areas.

* **leaf color** (green, brown, brown spots)
* **leaf firmness** or **droopiness**
* **fullness** of plant
* **height** of bush or tree

⇒ Touch and feel the soil. What **type of soil** is it? (sand, silt, clay). Refer to your student workbook.

⇒ Find the sun's position in the sky. Do you think the plants are getting enough or too much **sunlight**?

⇒ Is there any evidence of **animal life** near the plants or in the area?

SKETCH

Select one of the trees, plants, or flowers you see in your observation. Draw it below. Try to capture those aspects that will help you to identify what you have drawn.

In which *soil zone* was your tree, plant, or flower? _____

Do some investigating. What kind of tree, plant, or flower is it? _____

_____

The Plane Tree Allée and Dell host a number of trees and plants. See how many you can identify.

TREES are best identified by their leaves, bark, and fruit.

London Plane Tree: *Platanus × acerifolia*

Leaf **Bark** **Fruit**

Black Cherry: *Prunus serotina*

Leaf **Bark** **Fruit** **Flower**

Black Oak: *Quercus velutina*

Leaf **Bark** **Fruit**

Eastern Redbud: *Cercis canadensis*

Leaf **Bark** **Fruit** **Flower**

Sugar Maple: *Acer saccharum*

Leaf **Bark** **Fruit**

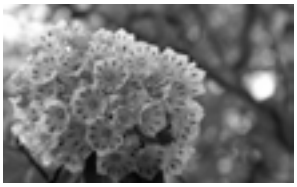
Tulip Tree: *Liriodendron*

Leaf **Bark** **Fruit** **Flower**

Plants/Flowers

Rhododentron catawbiese
'Album'

Wild Chives
Allium schoenoprasum

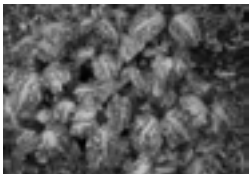


Mountain Laurel
Kalmia latifolia

Common Perwinkle
Vinca Minor

Rhodendron maximum
'Roseum'

Dutchman's Breeches
Dicentra cucullaria



Toadshade
Trillium sessile

Hosta

Nitrogen Lab Test (Zone: ____)

Before beginning the test, take a few minutes to note some things about your testing zone: What plants & animals do you observe? What do you notice about the soil? Is your spot sunny or shady? Why do you think things look as they do? Predict a possible outcome for the test you will conduct.

Record Observations:

Expert: The expert will lead the test. He/she will assign these jobs within the groups for the phosphorus test. They will talk and explain each step. They will also assign jobs and clean up. The expert will record the results of the phosphorus test.

Name: _____

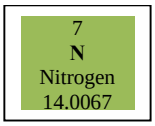
Materials manager- Position responsibilities: Gather solution, pour solution, clean up area, return supplies.

Name: _____

Timer manager- Position responsibilities: Work the timer.
Name: _____

Recorder- Position responsibilities: Record all data, fill in lab sheet, and illustrate all diagrams.
Name: _____

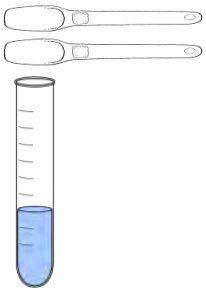
***Please read all the steps before performing and refer to nitrogen Expert:*



Step 1 Fill test tube to line 7 with * Nitrogen Extracting Solution.

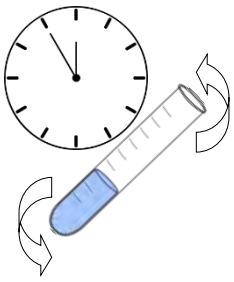
Record Observations:

Step 2 Use 0.5g spoon to add two measures of soil sample.



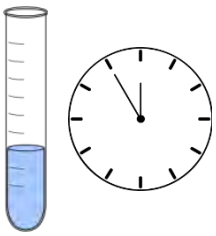
Record Observations:

Step 3 Cap and mix gently for one minute



Record Observations:

Step 4 Remove cap and allow soil to settle.



Record Observations:

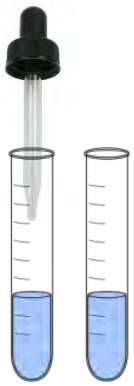
Step 5

-Use a clean pipet 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 (note: *do not pull up any soil*).

-Fill second tube to line 3 with liquid.

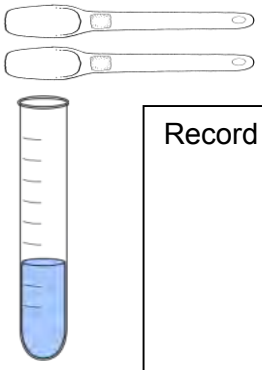


Record Observations:

Step 6

-Add the*Nitrogen Indicator Powder to soil extract in second tube by breaking open the capsule.

-The adult working with your group will measure the powder to be added for this step
(1 spoonful = 0.5 g).

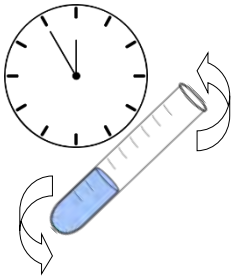


Record Observations:

Step 7

-Cap and gently mix

-Wait 5 minutes for pink color to develop above the powder.



Record Observations:

Step 8

- Take out the card and match color reaction with Nitrogen Color Chart.
- Record result Nitrogen: **Circle the Color Below <u>and</u>**

Record the amount: _____

Potassium Lab Test (Zone: ____)

Before beginning the test, take a few minutes to note some things about your testing zone: What plants & animals do you observe? What do you notice about the soil? Is your spot sunny or shady? Why do you think things look as they do? Predict a possible outcome for the test you will conduct.

Record Observations:

List the group members responsible for each job:

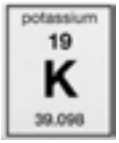
Expert: The expert will lead the test. He/she will assign these jobs within the groups for the phosphorus test. They will talk and explain each step. They will also assign jobs and clean up. The expert will record the results of the phosphorus test.
Name: _____

Materials Manager - Position responsibilties: Gather solution, pour solution, clean up area, return supplies.
Name: _____

Timer Manager – Position responsibilities: Work the timer.
Name: _____

Recorder – Position responsibilities: Record all data, fill in lab sheet, and illustrate all diagrams.
Name: _____

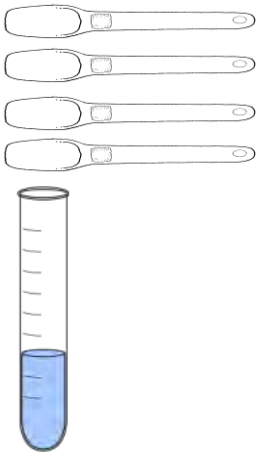
***Please read all the steps before performing and refer to potassium Expert:*



Step 1 Fill test tube to line 7 with *Potassium Extracting Solution.

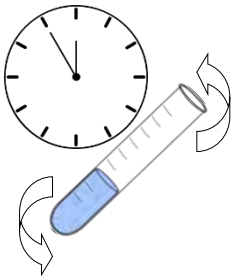
Record Observations:

Step 2 Use 0.5g sppon to add four (4) measures of soil sample.



Record Observations:

Step 3 Cap and mix gently for one minute.

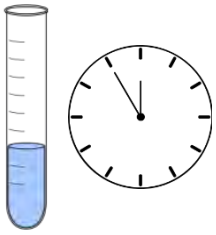


Record Observations:

Step 4

-Remove cap.

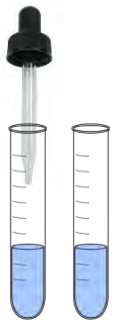
-Allow to stand and soil to settle until liquid above soil is clear.



Record Observations:

Step 5

-Use a pipet to transfer the clear liquid to second clean test tube.
To avoid agitation of soil, squeeze bulb of black lid pipet before inserting tip into liquid.
-Release bulb slowly to draw clear liquid into pipet (*Note: Do not pull up any soil*).
-Fill second tube to line 5.



Record Observations:

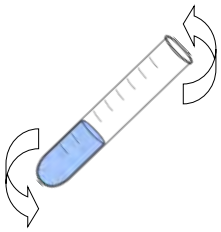
Step 6

Add one Potassium Indicator Tablet to soil extract in second tube.

Record Observations:

Step 7

Cap and Mix until tablet dissolves. A purplish color will appear.



Record Observations:

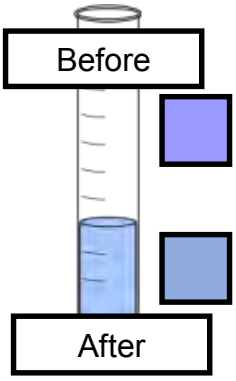
Step 8

-Add Potassium Test Solution 2 drops at a time while keeping count.
-Mix contents after each addition.
-Stop adding drops when the color changes from PURPLE to BLUE.

Record Observations:

Step 9

Record result of Potassium: **Circle the number drops below <u>and</u>**
Record the level: _____



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

pH Lab Test (Zone:_____)

Before beginning the test, take a few minutes to note some things about your testing zone: What plants & animals do you observe? What do you notice about the soil? Is your spot sunny or shady? Why do you think things look as they do? Predict a possible outcome for the test you will conduct.

Record Observations:

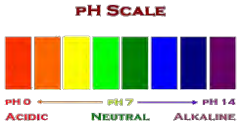
List the group member responsible for each job:

Expert: The expert will lead the test. He/she will assign these jobs within the groups for the pH test. They will talk and explain each step to the other 3. They will also assign jobs and clean up. The expert will record the results of the pH test.
Name: _____

Timer: This person will be in charge of using the stopwatch and timing 1 minute (1:00) in step 3- And 10 minutes (10:00) in step 4.
Name: _____

Measurement: This person will be in charge of putting the pH Indicator in the tube and measuring out the dirt.
Name: _____

Holder: This person holds the test tube and shakes the test tube for 1 minute (1:00).
Name: _____



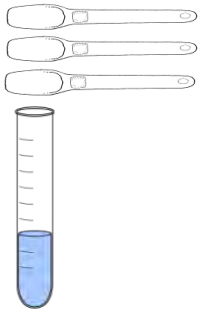
***Please read all the steps before performing the test and refer to pH Expert:*

Step 1

-Pick up test tube.
-Fill test tube to line 4 with pH Indicator (purple).
-Squeeze bottle gently to control amount dispensed.

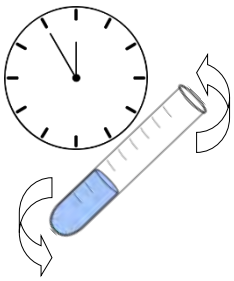
Record Observations:

Step 2 Use 0.5g spoon to add three (3) measures of soil sample.



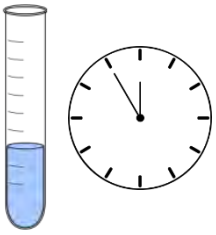
Record Observations:

Step 3 Cap and mix gently for one minute.



Record Observations:

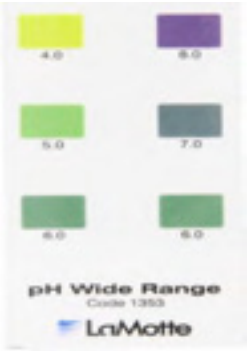
Step 4 Allow tube to stand for 10 minutes to let soil settle.



Record Observations:

Step 5

- Take out the card and match color reaction with pH Color Chart.
- Record result as pH: Circle the **Color Below <u>and</u> Record the number**: _____



Phosphorus Lab Test (Zone: ____)

Before beginning the test, take a few minutes to note some things about your testing zone: What plants & animals do you observe? What do you notice about the soil? Is your spot sunny or shady? Why do you think things look as they do? Predict a possible outcome for the test you will conduct.

Record Observations:

List the group member responsible for each job:

Expert: The expert will lead the test. He/she will assign these jobs within the groups for the phosphorus test. They will talk and explain each step. They will also assign jobs and clean up. The expert will record the results of the phosphorus test.

Name: _____

Materials manager- Position responsibilities: Gather solution, pour solution, clean up area, and return supplies.

Name: _____

Timer manager- Position responsibilities: Work the timer.
Name: _____

Recorder- Position responsibilities: Record all data, fill in lab sheet, and illustrate all diagrams.
Name: _____

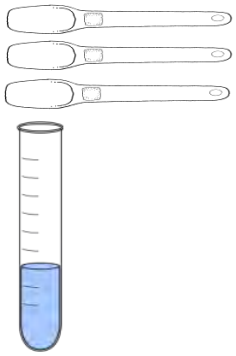
15
P
Phosphorus
30.97376

Please read all the steps before performing the test and refer to phosphorus Expert:

Step 1 Fill test tube to line 6 with *Phosphorus Extracting Solution.

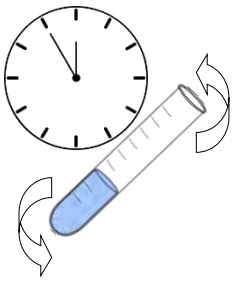
Record Observations:

Step 2 Use 0.5g spoon to add three (3) measures of soil sample.



Record Observations:

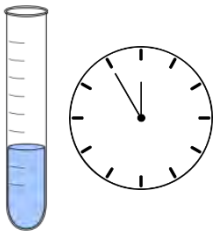
Step 3 Cap and mix gently for one minute.



Record Observations:

Step 4

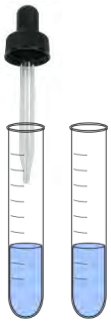
-Remove cap.
-Allow to stand, and soil to settle, until liquid above soil is clear.



Record Observations:

Step 5

-Use a pipet to transfer the clear liquid to a second clean test tube.
-To avoid agitation of soil, squeeze the bulb of the pipet before inserting tip into liquid.
-Release bulb slowly to draw clear liquid into pipet (*Note: Do not pull up any soil*).
-Fill second tube to line 3.



Record Observations:

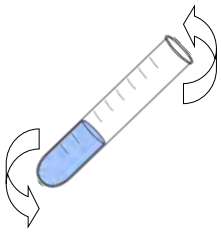
Step 6

Add six (6) drops of *Phosphorus indicator reagent to soil extract in second tube.

Record Observations:

Step 7

Cap and Mix.



Record Observations:

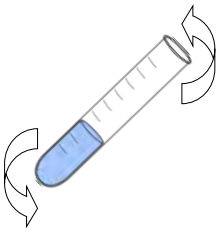
Step 8

- Locate the tablet in the lid of container wrapped in foil.
- Add one *Phosphorus Test Tablet.

Record Observations:

Step 9

- Cap and mix until tablet dissolves.
- A blue color will develop.



Record Observations:

Step 10

- Take out the card and match color reaction with Phosphorus Color Chart.
- Record result of Phosphorus: **Circle the Color Below <u>and</u> Record the level: _____**

Worm Lab Test (Zone: ____)

Before beginning the test, take a few minutes to note some things about your testing zone: What plants & animals do you observe? What do you notice about the soil? Is your spot sunny or shady? Why do you think things look as they do? Predict a possible outcome for the test you will conduct.

Record Observations:

List the group member responsible for each job:

Task manager Position responsibilities: Time manager, keeping group on task, measuring worms, managing the calculator, make sure everyone is working on their own job, and assist with worm sorting.
Name: _____

Materials manager Position responsibilities: Gather solution, pour solution, clean up area, return supplies, and assist with worm counting.
Name: _____

Organism manager Position responsibilities: Collect all worms from ground, sort them by dwelling location into 3 containers, count worms.
Name: _____

Recorder Position responsibilities: Record all data, fill in lab sheet, and illustrate all diagrams.
Name: _____

***Please read all the steps before performing the test and refer to Worm Expert*:

1. Observe the duff of an area that is one square foot. Place tile that is one square foot and create a groove with a stick.
2. Measure and record the depth of the center of the leaf litter (duff). _____ cm
3. Place sticks or rocks in the grooves to create a barrier.
4. Remove the leaf litter (duff).
5. Add one tablespoon of mustard powder to one gallon of water. Mix well. (See the adult leader to help).
6. Pour 1/2 of the gallon container **SLOWLY** (allowing it to absorb) into your lab area and the wait 5 minutes for your result.

a. *How long did it take the first worm to reach the surface after applying the solution? (Record answer in minutes and seconds): _____*
b. *Start collecting the worms and clean them with a water bottle and place them all in the aluminum foil pan after you dump the leaf litter.*
c. *Record on the chart below.*

Time (Minutes)	***How many did you find?***	***How many are in each range of measurement?***	
0-5		***0-7 cm (epigeic)***	
		8-13 cm (endogeic)	
		14+ cm (anecic)	

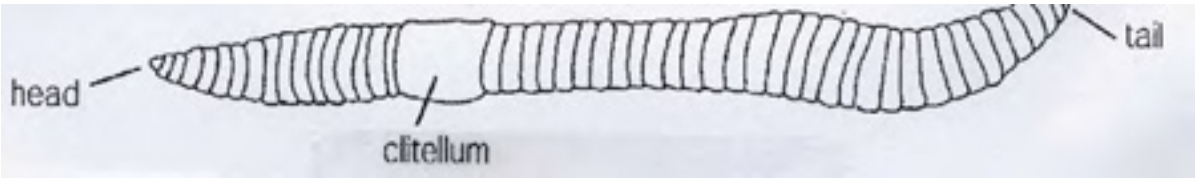
Pour the other ½ of the container into your lab area and after 5 minutes record your results.

a. Start collecting the worms and clean them with a water bottle and place them all in the aluminum foil pan after you dump the leaf litter.
b. Record below.

Time (Minutes)	***How many did you find?***	***How many are in each range of measurement?***	
5-10		***0-7 cm (epigeic)***	
		8-13 cm (endogeic)	
		14+ cm (anecic)	

How many TOTAL worms did you find?

How many are in each range of measurement?	
0-7 cm (epigeic)	
8-13 cm (endogeic)	
14+ cm (anecic)	



Ecological Type	Description	Habitat	Meaning of Name	Examples
Epigeic – litter dwelling species	0-7 cm Small; dark red or reddish brown ; move quickly	Live above the mineral soil; feed on organic matter	Epi = on Gaia = earth	Red wigglers
Endogeic – soil-dwelling species	8-13 cm Small to medium; light gray or no pigment; slower to moving	Live in the upper layers of the soil; feed on buried organic matter, mineral soil, and decaying roots	Endo = within Gaia = earth	Aporreclodea
Anecic – deep-burrowing species	14+ cm Large and muscles; reddish brown with wedge-shape tail; more color on front end, less on tail end	Live deeply in the soil; feed on surface litter by pulling organic matter into burrow; can rapidly change soil ecology	Unknown	Night Crawlers

Change Over Time…in the Birch Tree Allee

Restoration

Select one of the **ground cover** plants (those under and around the trees) you see in your observation. Draw it below. Try to capture those aspects that will help you to identify what you have drawn.

Compare your sketch to the plant identifying sheets included in this workbook.

What plant did you identify?

Common Name: _____

Scientific Name _____

We have learned that in the Plane Tree Allee most of the original plants and trees did not survive over time because of problems with the soil. Stan Hywet did restoration work in 2007 and 2015 to help improve the soil. Your soil testing analysis results will help maintain the balance of nutrients needed to keep the plants healthy.

In the Birch Tree Allee, there is a different situation.

Restoration occured in this allee, but there was no complete removal of soil or plants & trees. But work needed to be done to keep the trees healthy. The trees that exist in the Birch Tree Allee today are grafts (pieces of the living tree, shoots or stems) from the original root stock of the trees planted when the Seiberlings lived here!

Examine the pictures below of the Birch Tree Allee over time. Note some of the changes you see. How does the Allee look the same? How is it different? Write a story about what you think happened over time.

1921

1930

1940

Today

- What do you notice about the trees?
- Do they look healthy?
- Describe the allee. Has the look of it changed over time?
- What do you think may have been the cause for some of these changes over time?
- How might some of these changes have occurred?

_____

_____

_____

_____

_____

_____

_____

The undergrowth or **ground cover** helps the trees. Birch trees are native to locations that have longer lasting and colder temperatures than we have in this region of Ohio.

Think about...

How might this ground cover help the trees to stay healthy?

<u>Hypothesis:</u> Why might this plant be a good choice for the ground cover under the birch trees? How do these plants contribute to the health of the birch trees?
**HINT: Birch trees are most often found in the northern most parts of our country which includes places like Alaska, Washington, Oregon, Minnesota, Vermont, New Hampshire, and northern New York.

_____

_____

Let's investigate! Using the provided temperature probes, take a temperature reading in BOTH the Birch Tree Allee and the Bowling Lawn/North Meadow.

Soil temperature in the **Birch Tree Allee**: _____ °C

Soil temperature in the **Bowling Lawn/North Meadow**: _____ °C

Compare the two temperatures readings.

- Why is there a difference between the two temperature readings?
- What might cause the difference?
- Do you think that the kinds of plants/trees that were planted in each location would affect the temperature readings? Why or why not?

Revisit your hypothesis from the beginning of this section. Why might the plants used as ground cover under the birch trees in the allee be a good choice? Does the temperature of the soil give you any ideas to support or "prove" your hypothesis? Is there something else that may have been done or not done over time to help the trees survive & thrive?

_____

_____

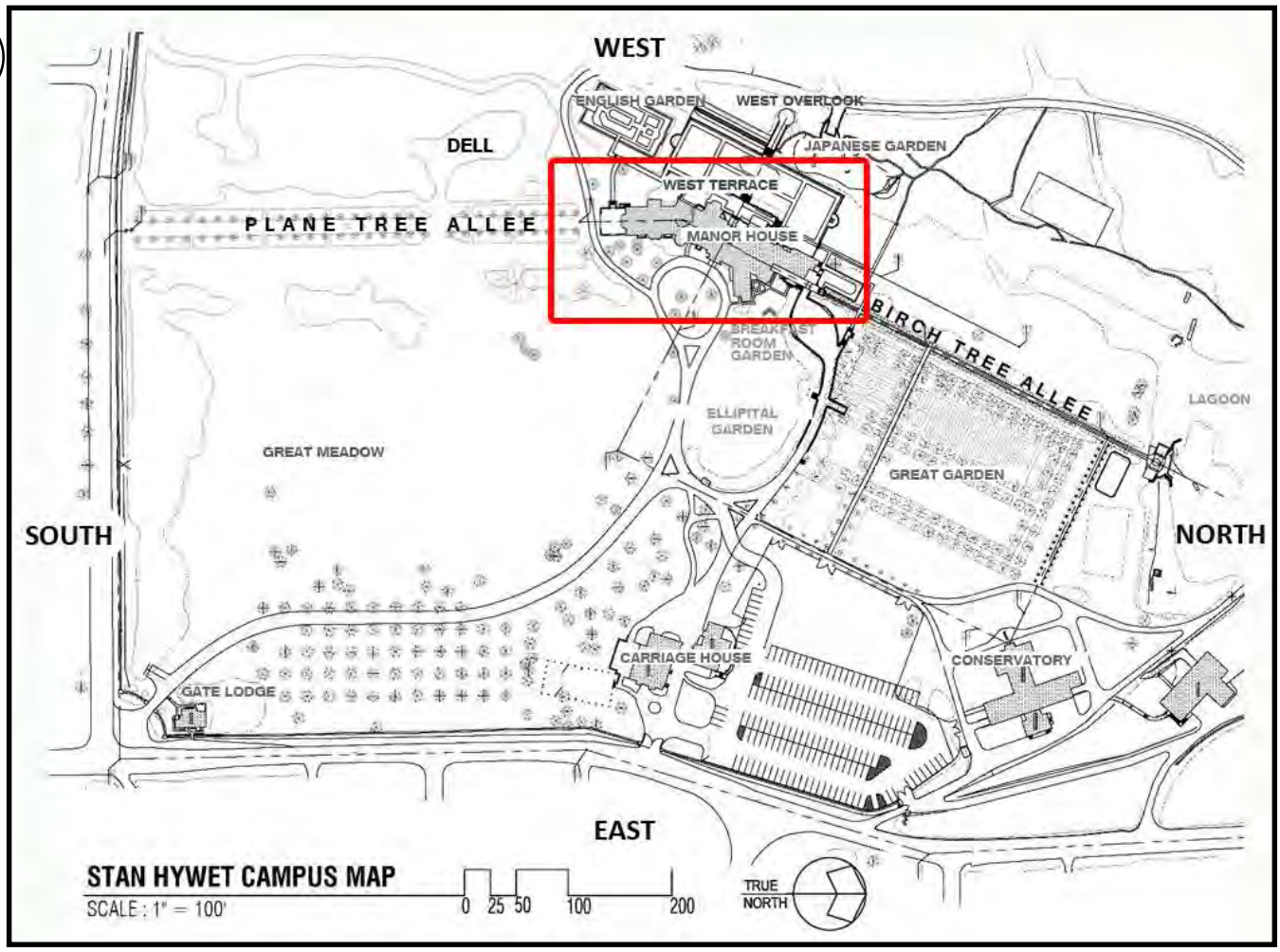
_____

_____

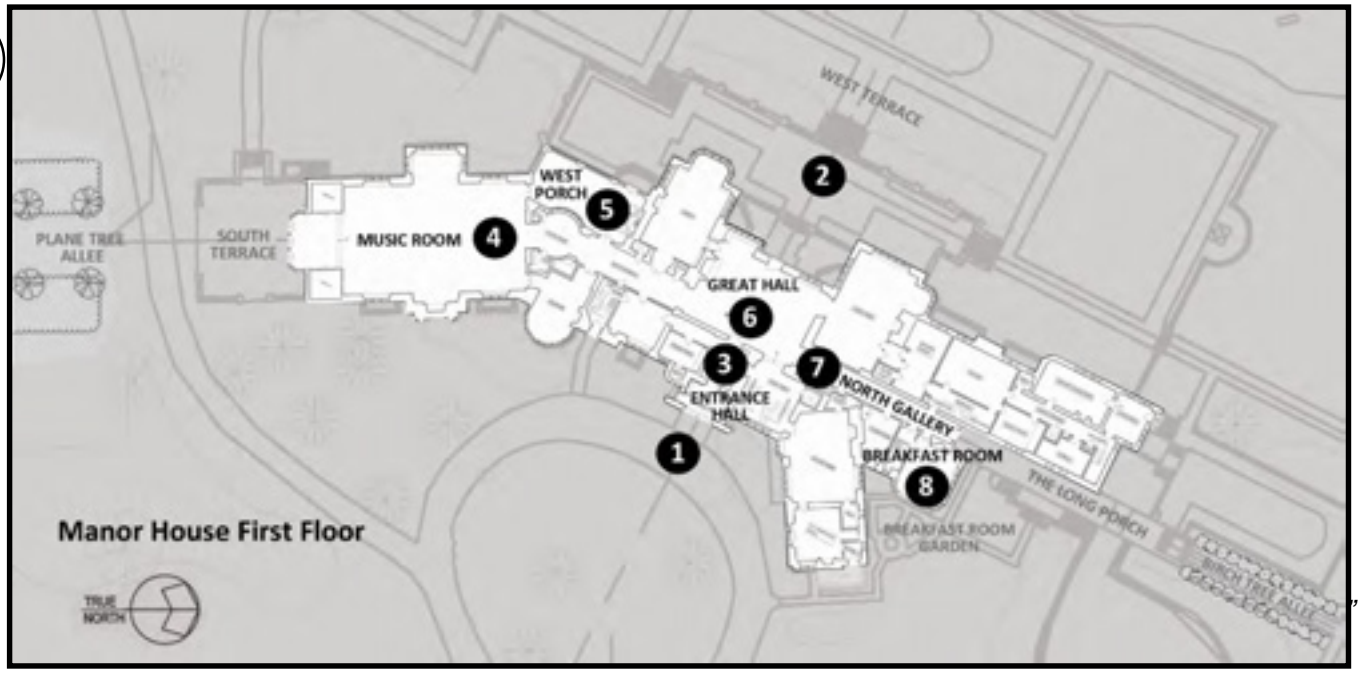
"Inside Out, Outside In"

The original design for the gardens and landscape of Stan Hywet included views inside the manor house that connected to outside gardens. Use these maps to help you find all the clues to these "connections" inside!

A



B



Inside the Manor House…

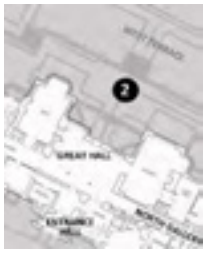
The Seiberlings had specific plans for the design of their home and property. Warren Manning, their landscape designer gave close attention to landscape physical features (hills, valleys, water, etc.) or **topography** because he thought the house and the land should work well and perfect the design of each other. The house was located on the property in a spot which provides several different overlooks or vistas. In some places the house design seems to continue to the outside. *Let's explore some of those areas!*

1: *Before you enter the manor house…*

Look at the front outside of the house. What do you notice about the roof? The chimneys? The windows? _____

_____

The Seiberlings designed the house in the **Tudor style**. That is shown by steeply pitched roofs (not flat), masonry chimneys (made from bricks or stones), decorated doorways, groups of windows, and decorative half-timbering, wood framework & bricks, stones and decorated plaster in between the wood pieces.



2: *Walk around to the back of the house.* Does it look similar to the front? What do the windows look like here? What do you think is the purpose of the orange awnings? _____

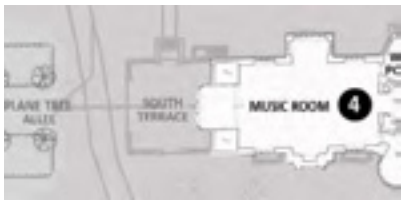
The back of the house has an **arts & crafts style** which was more modern for the time of the Seiberlings. This style included larger and more windows which provided brighter rooms inside of the manor.

As you walk into and throughout the house pay close attention to LIGHT. Are the rooms bright or dark? Is the amount and type of light different in the various areas of the house? Are there special features in the rooms that make it seem lighter or darker?

3: *Enter the front door of the manor house.*

As you enter the house – look at the Latin phrase above the doorway. The Seiberlings built their home to share with others – *Non Nobis Solum* (Not for Us Alone). YOU are a receiver of their gift!

The house is set on the land at a west/east point to capture where the sun rises & sets. Depending on the time of day for your visit, you may observe different things. What do you see? Is there anything that stands out to you? _____



4: *The Music Room*

How many windows do you see in this room? _____

Do you feel that the room is light or dark? _____
Does the furniture in the room add to that feeling? Why or why not? _____

_____

Look to the far end of the room and out the windowed doors off of the stage. What can you see outside? _____
Why do you think this view is important? _____

_____

** In this room **there is an illusion created where the room appears to continue in an extended hallway out into the Plane Tree Alley**. Do you think the design was successful in creating this illusion? Why/why not? _____

_____

5: *The West Porch & Terrace*

Where do you think a "porch" would normally be found?
Where is this porch? Is it at the **front** or **back** of the house? (Circle one). Remember that this room has "arts & crafts" design.
Do you recall what that means about the type of windows you should find there?
Describe the windows and light in this room. _____

_____

What kind of furniture and floor is in this room? How do these things help create an "outside" feel inside the house? _____

_____

What other special object is in this room that makes you think about the "outside"? What sound you hear? Do you like it? What is your favorite thing about it? _____

_____

Look out the window. Do you see anything similar outside?

_____

6: *The Great Hall*

This is a magnificent room that was often used to entertain the guests of the Seiberlings. Is the lighting in this room similar to the other rooms you've investigated? How is it the same or different from the music room and the west porch?

_____

_____

Look at the map at the beginning of this section & locate the **box**. What lies to the west of the west terrace in between the English & Japanese Gardens? _____

If you are standing inside the Great Hall and looking out the "back door,' you can see the overlook perfectly. Actually, the house was purposefully placed so that on the first day of summer – the summer **equinox** – the setting sun is perfectly visible in the line of sight from the overlook, into the back door, through the Great Hall, and out to the front door!

Look toward the "front door" Do you think it's the same size as the one in the back? The size of the Great Hall makes the back door appear larger but it is an illusion – both doors are the same size!

7: *The North Gallery*

From the music room, you saw the illusion of an extended "hallway" from inside the house out into the Plan Tree Allee.

While standing in the north gallery and looking out through the long porch, you will see a similar "hallway" of trees. What is this area called?

_____

The manor house was set on the property so that there were many beautiful views of their property and beyond. Besides this one, can you name 2 others you've seen?

_____ _____

Look at the map of the property again. Follow the Birch Tree Allee all the way to the end. It ends up out near the lagoon where the two Tea Houses are located. This spot is a favorite because of the vista to see the beautiful Sand Run Metropark!

8: *The Breakfast Room*

The design in this room focuses “sights” and “sounds” along with the connection of the inside to the outside.

** Enter the room and close your eyes. Stand quietly. What do you hear? _____

Generally this decoration appears outside as it does here. Where did you see this **inside** the manor house? _____

Remember that there was no mistake in where the house was built. This room is on the east side of the house and is called the breakfast room. What event every day can be observed in this room if you are someone who gets up from bed early? _____

What are two colors of décor do you observe in the room?

_____ _____

Look out the windows again. When the Seiberlings lived at Stan Hywet, the flowers planted outside in the Breakfast Room Garden had blooms that matched the colors of the inside decorations and furnishings!

Your visit to the Stan Hywet Manor House is complete! But what you can learn about the design of the home and grounds has really just begun. The connection of the inside to the outside was done on purpose. Although guests of the Seiberlings certainly enjoyed the inside of the house, they were invited to walk the gardens and view the vistas from around the property.

Post Visit Plant Experiment

1. Fill five pots with perlite, the provided soil that is nutrient free.

2. Prepare five different watering solutions:
    a. Pure water (label as “0”)
    b. ¼ strength fertilizer (label as “¼”)
    c. Regular strength fertilizer (“1”)
    d. Double-strength fertilizer (“2”)
    e. Quintuple-strength fertilizer (“5”)

3. Moisten the perlite in each pot with an equal volume of each watering solution. Plant 6 radish seeds (or other seeds) in each pot.

4. Water each pot twice a week with an equal volume of the appropriate watering solution.

Hypothesis:

_____

_____

Predict (Rank in order from best growth to least growth)

1. **___Pot B_____**
2. **___Pot D_____**
3. **___Pot C_____**
4. **___Pot E with the most fertilizer____**
5. **___Pot A with no fertilizer_____**

Observations:

- Each time you water, make careful notes about the appearance of the plants. Note when the seeds sprout, shoot height, number of leaves, leaf color and size, etc.

	Notes	**Drawing**
First Watering:		
Second Watering:		
Third Watering:		
Fourth Watering:		
Final:		

Present Your Findings – Optional Final Project

Projects and Presentations (Thinking ahead to next year's science fair) – Rubric developed for elements contained in each of the following (including the problem, hypothesis, results, at least one piece of background information, etc.):

- Written lab report
- Powerpoint/Prezi of Experiment (See guidelines below)
- Song/Rap
- Play
- Display Board (See guidelines below)
- Video (Template to be provided)
- Other

Project must include the following:

- **Intro -** A summary of the problem, background information, and why your test is important.

- **Materials & Methods -** How did you perform your test?

- **Results -** What were your findings?

- **Discussion -** What do your findings mean? Are the plant needs being met? If not, what can be done to modify the soil so that they will?

- **References -** Where did you get your information?

Final Project Rubric

	1	2	3
Intro	Missing or provides incorrect information for 2 or more aspects of the introduction.	Missing or provides incorrect information for one of the aspects of the introduction.	Provides correct background information including the problem statement and why the test is important.
Materials and Methods	Did not include what test was performed and how it was done.	Provides information on what was tested or how the area was tested, but includes incorrect information.	Provides correct information on what was tested and how the area was tested.
Results	Did not include test outcomes and had no observations from the zones.	Includes the information gathered from at least 1 test performed, as well as at least 1 observation made for each zone where the test was conducted.	Includes the information gathered from both tests performed, as well as 2 observations made for each zone where the test was conducted.
Discussion	Does not compare the findings to plant needs, or provides no recommendations if they were needed.	Provides an explanation of the findings and if they match the requirements of the plants growing there. If they did not match, then provides at least 1 recommendation to aid the soil.	Provides a clear explanation of the findings and if they match the requirements of the plants growing there. If they did not match, then provides at least 2 recommendations to aid the soil.
References	Includes no references.	Includes at least 1 reference.	Includes 2 or more references

Stan Hywet Newscast

Speaker One: Breaking news! Students from _____ (*Name of school*) have completed an investigation of soil at Stan Hywet Hall and Gardens in Akron, Ohio. Stand by for important information.

Speaker Two: Hello, my name is _____. We come to you today to report our testing at Stan Hywet Hall and Gardens. As you may know, Stan Hywet Hall was the home of _____ who co-founded the Goodyear Tire & Rubber Company. Stan Hywet Hall is surrounded by beautiful gardens and majestic trees. Our class enjoyed our trip there. _____ (*Name of Speaker 3*), are you ready to explain our purpose for visiting Stan Hywet Hall?

Speaker Three: Thanks, _____ (*Name of Speaker 2*). Since we are such good problem solvers, we were asked to help preserve the historic gardens at Stan Hywet Hall. Healthy soil is necessary for plants such as azaleas, hostas, and rhododendrons that live in the gardens of Stan Hywet to survive. Since many of the gardens were built on land that was once a stone quarry, the soil is very shallow. Stan Hywet has changed over time. Stan Hywet wants to preserve the historic gardens so that generations to come may enjoy them and the manor house. Therefore, Stan Hywet asked the Akron Public Schools sixth graders to collect evidence on the condition of the soil. _____ (*Name of Speaker 4*), are you there? Can you explain the procedures we used at Stan Hywet?

Speaker Four: Thanks, _____ (*Name of Speaker 3*). As citizen scientists, we observed our surroundings, thought critically, gathered evidence, recorded our findings and analyzed our data. We are using this broadcast to communicate our findings. We used soil from three different zones from the Plane Tree Allee and Dell at Stan Hywet. In each zone we studied nutrients Phosphorus, Potassium and Nitrogen, checked the pH, as well as, the worms. Safety precautions were taken such as using _____ and _____. Sending it back to you, _____. (*Name of Speaker 3*)

Speaker Three: Thanks for the update, _____ (*Name of Speaker 4*). Let's look at the information that we found starting with our worm findings. _____ (*Name of Speaker 5*) are you there? Can you tell us what you found and what it means?

Speaker Five: Sure, _____ (*Name of Speaker 3*). Our groups were testing the amount of worms located in all three zones.

In ZONE A: _____

In ZONE C: _____

In ZONE D: _____

Speaker Three: So what does this all mean?

Speaker Five: If the worm population is too high, _____

_____

_____

If the worm population level is too low, _____

_____

_____ As you can see worms are important for the soil in gardens for plant growth.

Speaker Three: What does this mean for Stan Hywet? What did you conclude?

Speaker Five: We thought that Stan Hywet _____

_____

_____

Speaker Three: Did you make any observations about the worms you would like to share?

Speaker Five: Yes! We found that _____

_____

_____

Speaker Three: Thank you, _____ (*Name of Speaker 5*). Interesting results. Let's look at another test that the students at _____ (Name of school) completed. _____ (*Name of Speaker 6*), can you share what you found out when your group completed the test?

Speaker Six: Yes, _____ (*Name of Speaker 3*). HOLD THE PRESS! We have some exciting new testing!!! We tested temperature of the soil in the new area called the Birch Tree Allee.

Speaker Three: What does this all mean?

Speaker Six: Soil temperature is important to Birch Trees because _____

_____

_____

If, if the temp is too low, _____

_____

If, if the temp is too high, _____

So, as you can see temp of the soil is impacts plant growth. We, concluded that _____

_____

Speaker Three: I see that _____ (*Name of Speaker 6*). Thanks for your hard work. Let's continue now with the soil testing results. _____ (Name of *Speaker 7*), can you talk about the soil testing in the Plane Tree Allee and Dell?

Speaker Seven: I'd be happy to _____ (*Name of Speaker 3*). However (*Pause*) …Wait a minute. We have some exciting news in regards to this year's visit to the Stan Hywet MANOR HOUSE. We actually connected it to the environment.

Speaker Three: WOW! What does this mean "connecting the house to environment"?

Speaker Seven: Well _____ (*Name of Speaker 3)*

We learned that the designer of the landscape and gardens and the architect that designed the house worked together on some areas of their plans. It was planned so that from inside the house you could see and enjoy some things outside.

Speaker Three: So what did you see in the house?

Speaker Seven: We visited the Music Room, the West Porch & Terrace, the Great Hall, the North Gallery and the Breakfast Room. _____ (*Name of room*) was my favorite because _____

_____

Speaker Three: What things in the rooms did you notice that were interesting?

Speaker Seven: We saw _____

_____

_____

Speaker Three: Thank you, _____ (*Name of Speaker 7*). This is very interesting information that _____ (*Name of* School) has found at Stan Hywet. It's time to move on to our soil testing. _____ (*Name of Speaker 8*), are you there?

Speaker Eight: Yes, good morning, _____ (*Name of Speaker 3*).

Speaker Three: Can you explain what the results of your tests mean? How does nitrogen, phosphorus Potassium and the pH affect plant life?

Speaker Eight: Well, _____ (*Name of Speaker 3*).

Nitrogen in the soil helps _____

_____

_____

Phosphorus in the soil _____

_____

_____

Potassium in the soil _____

_____

_____

The ph of the soil affects _____

_____

Speaker Eight: Our group worked in Zone A. We found that the soil in Zone A had a nitrogen level of _____, a phosphorus level of _____, a potassium level of _____and a pH level of _____.

Speaker Three: How would you describe Zone A?

Speaker Eight: Zone A was _____

_____

_____

Speaker Three: So what would recommendations would your team make to Stan Hywet?

Speaker Eight: We would make the following recommendations to Stan Hywet for ZONE A

_____

_____

_____

Speaker Three: Moving on to Zone C, _____. Can you share your results with the audience?

Speaker Nine: Nice to see you again, _____ (*Name of Speaker 3*). Our group worked in Zone C. We found that the soil in Zone B had a nitrogen level of _____, a phosphorus level of _____, a potassium level of _____ and a pH of _____.

Speaker Three: How would you describe Zone C?

Speaker Nine: Zone C was_____

_____

_____

Speaker Three: So what would recommendations would your team make to Stan Hywet as a result of your analysis?

Speaker Nine: We would make the following recommendations to Stan Hywet regarding Zone C.

_____

_____

_____

Speaker Three: Moving on to Zone D. _____, (*Name of Speaker 10*) Can you share your results with the audience?

Speaker Ten: Hello _____ (*Name of Speaker 3*). Our group worked in Zone Dell. We found that the soil in Zone D had a nitrogen level of _____, a phosphorus level of _____, a potassium level of _____ and a pH of _____.

Speaker Three: So what would recommendations would your team make to Stan Hywet as a result of your analysis?

Speaker Ten: We would make the following recommendations to Stan Hywet regarding Zone D. _____

_____

_____

Speaker Three: How would you describe Zone Dell?

Speaker Ten: Zone D was _____

_____

_____

Speaker Three: Wow! Looks like we are out of time! I would like to thank all who participated in this amazing work, the teachers, Stan Hywett, Science & Health Department and all the students. This is _____ (*Name of Speaker 3*) signing off from _____. Thank you and good day.

ONLY USE IF WE DO NOT TEST WORMS INSTEAD WATER

Speaker Three: We also studied the water from the lagoon, from the tap and rainfall. Safety precautions were taken such as using _____ and _____. _____. (*Name of Speaker 5*) Did you make any observations about the lagoon, rain or tap water that you would like to share?

Speaker Four: Yes! We found that _____

_____

_____

Speaker Three: Thanks for the update, _____ (*Name of Speaker 4*). Let's look at the information that we found starting with our water testing. The group tested rain water, lagoon water, and tap water. _____ (*Name of Speaker 5*) are you there? Can you tell us what you found and what it means?

Speaker Five: Sure, _____ (*Name of Speaker 3*). Our group completed the phosphorus tests. We found that the phosphorus in the rain water was _____ _____. In the lagoon water, the phosphorus was _____. In the TAP water, the phosphorus level was_____.

Speaker Three: So what does this all mean?

Speaker Five: If the phosphorus level is too high, _____

_____

_____

If the phosphorous level is too low, _____

_____

_____

So, as you can see, phosphorous is an important nutrient for plant growth.

Speaker Three: What does this mean for Stan Hywet? What did you conclude?

Speaker Five: We thought that Stan Hywet _____

_____

_____

Speaker Three: Did you make any observations about the lagoon, rain or tap water that you would like to share?

Speaker Five: Yes! We found that _____

_____

_____

Speaker Three: Thank you, _____ (*Name of Speaker 5*). Interesting results. Let's look at another test that the students at _____ completed. _____ (*Name of Speaker 6*) , can you share what you found out when your group completed the pH test?

Speaker Six: Yes, _____ (*Name of Speaker 3*). Our group completed the pH test. We found that the ph of the rain water was _____. The lagoon water pH was _____. The pH of TAP water was _____.

Speaker Three: So what does this all mean?

Speaker Six: If the pH of the water is too high, _____

_____

_____

But, if the pH is too low, _____

_____ So, as you can see pH of the soil impacts plant growth.So we, concluded that _____

_____

Speaker Three: I see that, _____ (*Name of Speaker 6*). Thanks for your hard work. Let's move onto the nitrogen testing. _____ (*Speaker 7*), can you talk about the nitrogen test?

Speaker Seven: I'd be happy to _____ (*Name of Speaker 3*). Our group completed the nitrogen tests. We found that the nitrogen in the rain water was _____ In the TAP water the nitrogen level was _____. In the LAGOON water the nitrogen level was_____.

Speaker Three: So can you explain what it means to plant growth at Stan Hywet?

_____

_____

Speaker Seven : If the nitrogen level is too high, _____

_____

_____

If the nitrogen level is too low, _____

_____

_____

Speaker Three: So what were the nitrogen levels at Stan Hywet?

Speaker Seven: We found that the nitrogen in the rain water was _____. In the lagoon water, the nitrogen was _____. In the TAP water, the nitrogen level was_____.

Speaker Three: What do these nitrogen levels mean for Stan Hywet? What are your recommendations?

Speaker Seven: We think that Stan Hywet _____

_____

_____

Vocabulary

1. **Allée** – a walk or passage created between two evenly planted rows of trees.

2. **Bedrock** – very bottom layer of soil.

3. **Blueprint** – a design plan or other technical drawing.

4. **Clay** - platy and thin particles of soil that stick close together.

5. **Dell** – a small, usually wooded valley. Stan Hywet's Dell was designed

6. **Estate** – large piece of property that contains a house and is maintained by great wealth.

7. **Fertilizer** – product containing chemicals that when added, increases the nutrients in the soil.

8. **Firm Soil Consistency** – can be broken apart with a lot of pressure between two fingers.

9. **Friable Soil Consistency** – can be broken apart with a small amount of pressure from one finger.

10. **Garden** - land set aside for growing plants that provide beauty, food, or other uses.

11. **Grainy Soil Texture** - made up of large sized pieces called sand that feels gritty.

12. **Landscape** - all the visible features of an area of countryside or land, often considered in terms of their aesthetic appeal.

13. **Landscape architect** - person who designs the outside spaces for a client.

14. **Loose Soil Consistency** - can be broken apart when simply held.

15. **Native plants** - plants that grow naturally in an ecosystem.

16. **Nitrogen (N)** - a colorless, odorless, gaseous element that constitutes about four-fifths of the volume of the atmosphere and is present in combined formin animal and vegetable tissu es, especially in proteins and DNA.

17. **Non-native (exotic) plants** - plants introduced into an ecosystem where they do not naturally grow.

18. **Nutrients** - from the Latin root *nutr,* which means "to feed." Nutrients can contain material from decomposing plant and animal material, chemicals from rocks and other decaying matter that "feed" the plant.

19. **pH** – The symbols used to express the acidity or alkalinity of a solution on a scale of 0-14, where less than 7 represents acidity, 7 neutrality, and more than 7 alkalinity.

20. **Phosphorous (P)** – a solid, nonmetallic element among other things is a necessary constituent of plant and animal life, helping to build molecules necessary for life like proteins and DNA.

21. **Potassium (K)** – a silvery, white metallic element that oxidizes rapidly in the air and whose

compounds are used as fertilizer.

22. **Sand** – small course-grained pieces of rock.

23. **Silky Soil Texture** - made up of medium sized pieces called silt that feels like powder.

24. **Silt** – soft and powdery particles of soil

25. **Soil Consistency** - description of how easily a soil breaks apart when pressed.

26. **Soil Permeability** - allowing liquids or gases to pass through

27. **Soil Texture** - the way the soil feels, based on the amount of sand, silt, and clay present in the soil.

28. **Stan Hywet** - means “stone quarry” in Old English. A stone quarry is where huge stones were taken from the ground.

29. **Sticky Soil Texture** - made up of small pieces called clay that feels gummy.

30. **Topsoil** – the fertile, upper part of the soil comprising of dead organic matter as well as inorganic materials.

31. **Warren Manning**: landscape architect hired by the

Links and Resources

"Play sand" can be purchased at a home improvement store in the garden section. Silt and clay can be purchased through a catalog company such as Ward's Natural Science www.wardsci.com

Plant Nutrients

- http://www.ncagr.gov/cyber/kidswrld/plant/nutrient.htm - NC Agriculture Plant Nutrients

Worms

- http://urbanext.illinois.edu/soil/SoilBiology/earthworms.htm - Soil Biology Earthworms

Soils

- http://earthsci.org/education/investigations/ies/Soils/Soil.htm - Throughout this module, students will use hands-on, inquiry-based explorations to investigate the following in 7 different modules:
    - Materials in soil
    - Arrangement of soil materials
    - Amount of water the soil can hold
    - How water flows through soil
- http://soilandwater.ohiodnr.gov/swcds/find-a-local-swcd - ODNR
    - Click on Soil Conservation in the left margin
- http://homeguides.sfgate.com/pine-bark-soil-conditioner-101383.html - Pine Fines help condition the soil.
- http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/edu/ - USDA - Soil Education

Garden History Plant Info

- http://plants.usda.gov/ - USDA Plant Database
- http://www.wildflower.org/plants/ - Wildflower and Plant Database
- http://ohioline.osu.edu/hyg-fact/1000/1239.html - OSU Extenstion Hostas

Post Visit Resources

- http://www.instruction.greenriver.edu/mcvay/b100/general_format_for_writing_a_sci.htm - General Format for Writing a Scientific Paper
- http://www.lamotte.com/images/pdf/instructions/36250.pdf - Garden Guide
- http://www.ext.colostate.edu/pubs/garden/07235.pdf - Colorado State University Extension - Soil Basics

Stan Hywet Hall & Gardens Videos

https://www.youtube.com/playlist?list=PLFEpVCsdEtd3CfAqXdG8OkyHG-mWpBQuZ
(On the Stan Hywet website. Go to the bottom of the home page. Click on the YouTube icon. Go to the Stan Hywet Education Playlist).

Credits & Acknowledgements

Stan Hywet's focused partnership with **Akron Public Schools** demonstrates our stewardship of an ongoing environment of learning that reaches beyond the classroom, draws connections with lessons and resources in the outside world and links students with learning resources within their community.

Akron Public Schools
David James, Superintendent
Tamiko Hatcher, Director of Specialty Program
Katrina Halasa, Learning Specialist, Health and Science K-12
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Support Staff: Edith Golson, Martha Goodward, Tricia Kelly, Suzanne Leyerle, Odeh Halaseh

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Lenna Black (2016-2017), Matt Drexler(2014-2015), Ben Bellamy (2013-2014) - Education Coordinators
Dianne Ketler, Grant Writer
Jill Burket, Researcher
Volunteers

University of Akron
Kristin L. K. Koskey, Ph.D., Assistant Professor, Educational Foundations & Leadership Assessment & Evaluation ProgramNaada Mikki Ph.D., Associate Professor, Curriculum and Instructional Studies - Science Education

This project was made possible in part by the Institute of Museum and Library Services, Martha Holden Jennings Foundation, and the **OMNOVA Foundation**.

Prior funding was provided by the **Dominion Foundation**, and the **Joseph G. and Sally A. Miller Family Fund**.