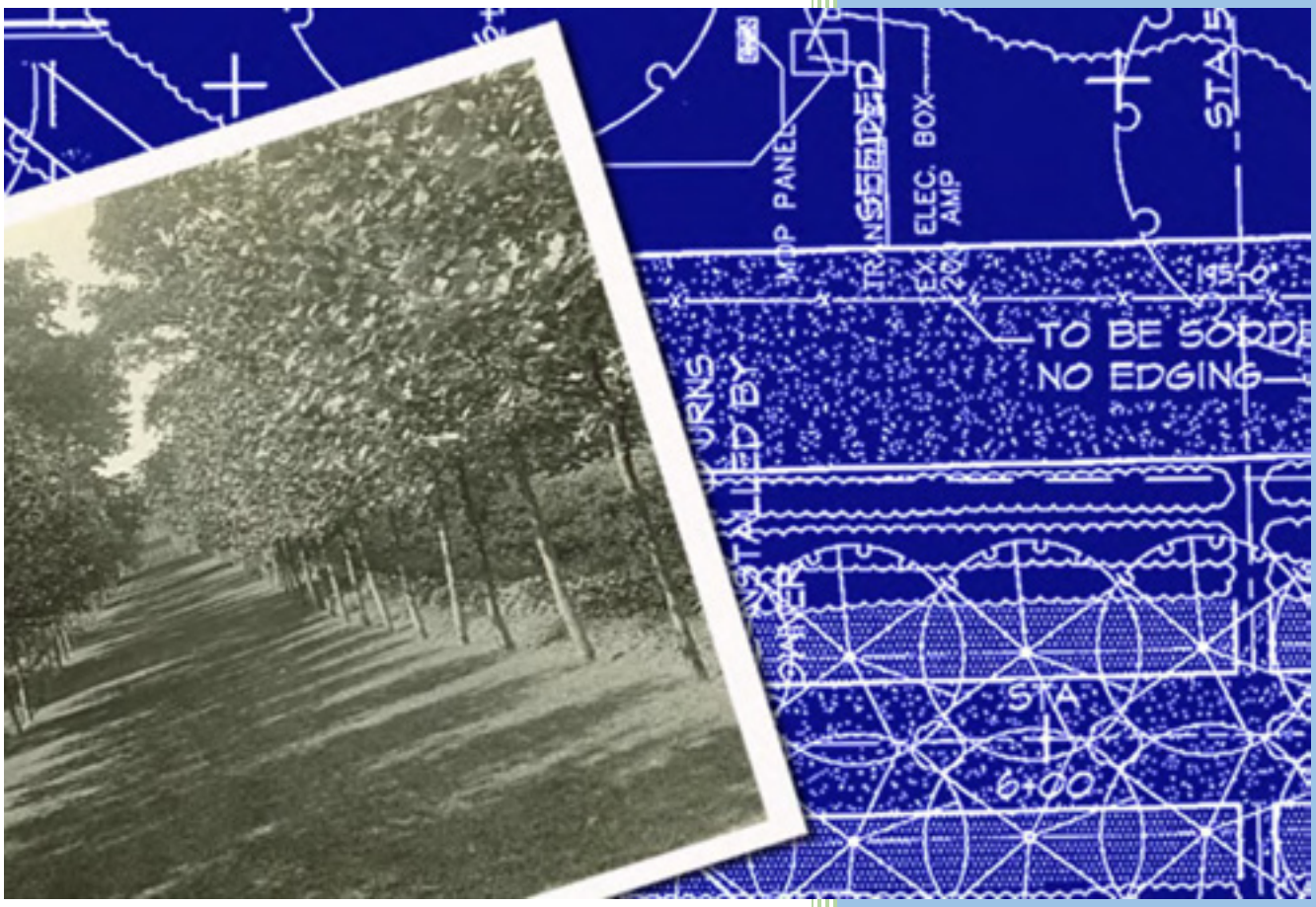
Preserving the Past

Teacher Edition

Updated 4/10/17



F.A. Seiberling co-founded the Goodyear Tire & Rubber Company in Akron, Ohio in 1898. In the early 1900s, F.A. began purchasing land in West Akron on which to build a home called Stan Hywet Hall. From 1915-1955, Stan Hywet Hall was the home of the Seiberling family and in 1957 it was opened to the public to become Stan Hywet Hall & Gardens, a non-profit organization.

Guided by its mission "*to preserve and share our historic Estate and serve as a resource for educational, cultural and recreational enrichment*," Stan Hywet is considered today to be a leader in historic restoration and preservation as well as a prominent educational resource for the community.

Stan Hywet has worked in close collaboration with the Akron Public Schools to develop "Preserving the Past," an experiential learning curriculum in which students are asked to solve a real-life problem: the historic preservation of Stan Hywet's 100-year-old landscape design.

Teacher: _____

School: _____

Visual Overview and Checklist

Before Visit Notes:
Teachers should try to complete the pre-visit activities & instruction in order to prepare students with the necessary background knowledge for the on-site experience.
Consider your role as an active participant at SHHG. Determine how you can enhance the experience for your students by including purposeful engaging questions as they test & on the tour by challenging them to think beyond the basics and by speaking enthusiastically about the process.
Review weather contingency, safety procedures & SHHG rules for behavior. Remind students about proper attire for weather.

Before Visit

- ☐ Answer teacher & students pre-visit surveys if provided
- ☐ Review teacher manual & plan for integration of curriculum
- ☐ Arrange for & equip chaperones
- ☐ Read introductory "Letter to Students" & show the problem statement
- ☐ Practice experiment techniques & processes shown on videos
- ☐ Discuss the final project & review the rubric for expectations
- ☐ Assign students to testing groups & have students work together to decide specific roles
- ☐ Analyze data from pre-visit activities & experiments to formulate hypotheses &

Day of Visit Notes:
Teacher brings: Stan Hywet Photo Release Permission Forms.

Have students bring:
- Student workbooks
- Lunches

Day of Visit

- ☐ Turn in Stan Hywet permission and photo release forms
- ☐ Group Activity
- ☐ Tour the Manor House
- ☐ Lunch
- ☐ Debrief on-site

After Visit Notes:
Review hypotheses with students to draw conclusion based on their data. Complete post & final projects.

After Visit

- ☐ Conduct post-visit activities in the manual including plant experiment
- ☐ Complete final project
- ☐ Complete post-evaluation if provided

Preserving the Past Pre-visit Introduction

Time	3 days
Standards	**Band Theme 5-8: Science Inquiry and Application:** ● Identify questions that can be answered through scientific investigations; ● Design and conduct a scientific investigation; ● Use appropriate mathematics, tools and techniques to gather data and information; ● Analyze and interpret data; ● Develop descriptions, models, explanations and predictions; ● Think critically and logically to connect evidence and explanations; ● Recognize and analyze alternative explanations and predictions; and ● Communicate scientific procedures and explanations. **Content Statement 6.ESS.4** Soil is unconsolidated material that contains nutrient matter and weathered rock. **Content Statement 6.LS.4** Living systems at all levels of organization demonstrate the complementary nature of structure and function. **CCSS.ELA-Literacy.RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts **CCSS.ELA-Literacy.RST.6-8.3** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. **CCSS.ELA-Literacy.RH.6-8.9** Analyze the relationship between a primary and secondary source on the same topic.
	● Use primary and secondary sources to investigate the composition of Stan Hywet's Plane Tree Allèe and Dell to determine how each has changed over time. ● Students will apply the scientific method to an inquiry-based problem. ● Students will analyze primary and secondary sources to conduct background research, formulate a valid scientific question, and develop a hypothesis relevant to the initial question. ● Students will be introduced to and apply specific vocabulary terms applicable to the problem design. ● Students will work with their teacher and with a team of their peers in achieving a shared goal. ● Students will read through a specific procedure to test soil characteristics.
Materials	Video https://www.youtube.com/watch?v=vZwgAdzp14Y&list=PLFEpVCsdEtd3CfAqXdG8OkyHG-mWpBQuZ&index=7 Letter
Anticipatory set (10 min)	**DAY 1** Stan Hywet's expert staff has set up a problem introduced via a letter (in the Teacher's Manual), and a pre-recorded video with instructions which are located on the science HUB for APS (6th Grade Essentials) and on the Stan Hywet Hall & Gardens YouTube channel - https://www.youtube.com/channel/UCmHVwN1HEQ5qgTdOZnjbMzg .

	Main Question to be answered: Is the soil at Stan Hywet Hall and Gardens meeting the needs of its plants so that they may thrive? ** Introduce the project with enthusiasm – Have the lettered "delivered" to you classroom & read it as an *invitation* to help with the problem.**
Materials	• Student Manual • Ruler
Intro 10-15 minutes 7 minutes 10 minutes 3 minutes 10-15 minutes 10-15 minutes 20-25 minutes	**DAY 2** 1. Have the students do the Pre-Survey. 2. Review the Scientific Method. a. Observation, Ask question, Hypothesis, Observation/Experiment, Evaluation of Data, Conclusion b. How may the scientific method apply to our challenge? c. What step are we on in the beginning? d. What do we need to do to follow the scientific method from here? 3. Next, do the "Change over Time" at the beginning of the Student Workbook. Allow students to brainstorm or think-pair-share to the prompt: *Describe changes that you know happen on earth both naturally and because of human activity.* 4. Review the vocabulary provided in the back of the manual. Introduce the students to the different words and how they might be used in the days to come. Remind the students to refer to the vocabulary list when they come to a word they do not know. **DAY 3** 5. Work through "Designing the Landscape" which defines & explains what formal and informal features are. 6. Direct students to the "**Dell and Plane Tree Allée"** in the student workbook. Instruct students to compare and contrast the historic and contemporary photos and think about and discuss the following: a. What natural changes have occurred? b. What changes have occurred as a result of human activity? c. Has anything stayed the same over time? Why or why not? 7. Direct students to "Analyzing Blue Prints" and the page which follows and includes photographs from 1914, 1916, 1999, 2007. Ask them examine the drawings & answer the questions.
Lesson reflection	Have students share some of their findings from the day ● What did they learn about landscaping? ● Can they describe the changes viewed in the photographs? ● Can they hypothesize why there are changes over time? ● How do they believe they might help provide information or assistance to Stan Hywet Hall and Gardens?

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 **gardens** 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 Education

“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.

Teacher Notes: *Informal means "natural looking" like the dell and the lagoon. Formal gardens modelled after European landscape design include the great garden, the English garden, the Japanese garden, and both the Plane Tree Allée and the Birch Tree Allée.*

Stan Hywet's Dell

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

There is a wedding taking place and the area seems very clear. The Dell was once a quarry which was designed as a more natural-looking area. As a part of this design, Warren Manning planned some walking paths to the west. Warren Manning's strategy for natural landscapes was to overplant a variety of plants and visit the site years later to see what plants did best in a particular environment.

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).

The garden looks relatively the same with a few areas that have been allowed to slightly overgrow. A few evergreens can be seen that were planted at a later date. Many of the trees in the background look about the same age as the ones pictured in the 1919 photograph indicating that these may be second or third generations.

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.

This photograph was taken shortly after the area was planted in 1916.

This photograph was taken in 1999 after quite a few years had passed when most of the trees had matured and most had died.

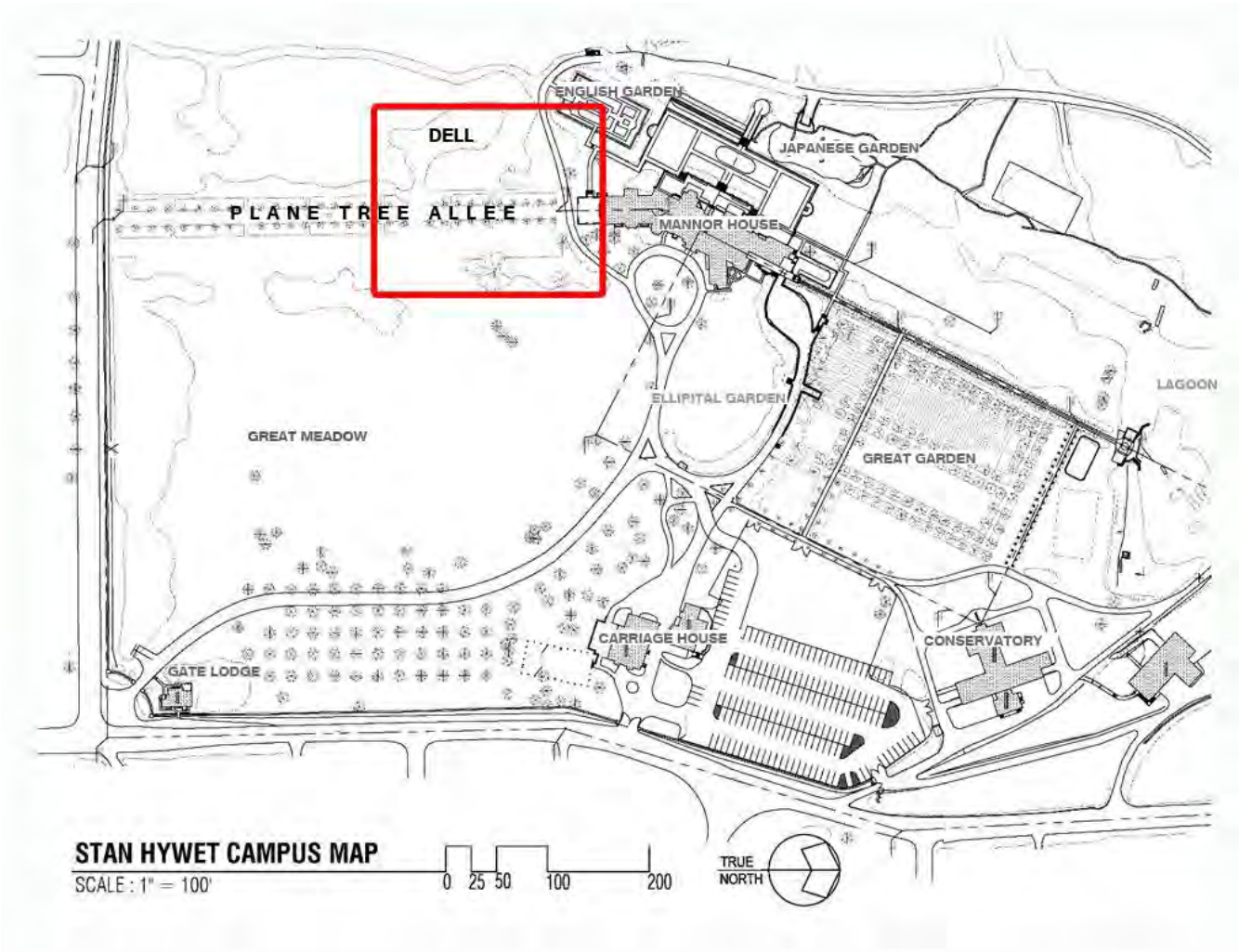
The third photo was taken in 2007 and shows that some effort was taken to cut down the remainder of the trees and dig out the old soil with heavy machinery.

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. *Almost 2.5 inches = ~250 feet*

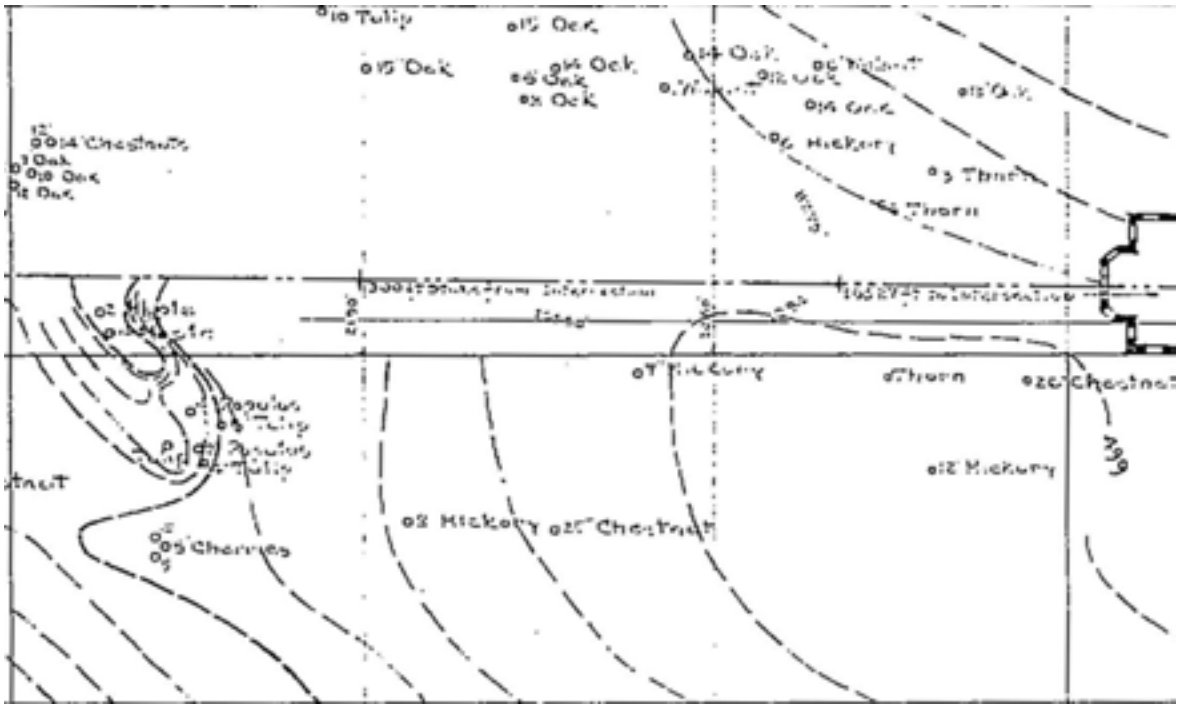
Next, calculate the area (length x width) within the box. This is the area we will be studying in the following pages. *1" x 1 ¼" = 1" x 1.25" = 100ft x 125ft = 12,500 ft²*

Analyzing Existing Condition Surveys and Landscape Blueprints

(Teacher Notes) Plane Tree Allée (1914-2007)*: The 1914 drawing shows the existing conditions of the land as it appeared before the plan for the estate was conceived. The 1916 drawing shows the gardens as originally designed by Warren Manning. The 1999 drawing shows the gardens as they appeared 80 years later. Much of the original plant material had died or was overgrown. The 2007 drawing shows the plan for the restoration of the original garden as it was in 1916.*

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:

The small circles with words next to them are trees. There are oak, chestnut, hickory, and tulip trees on the property.

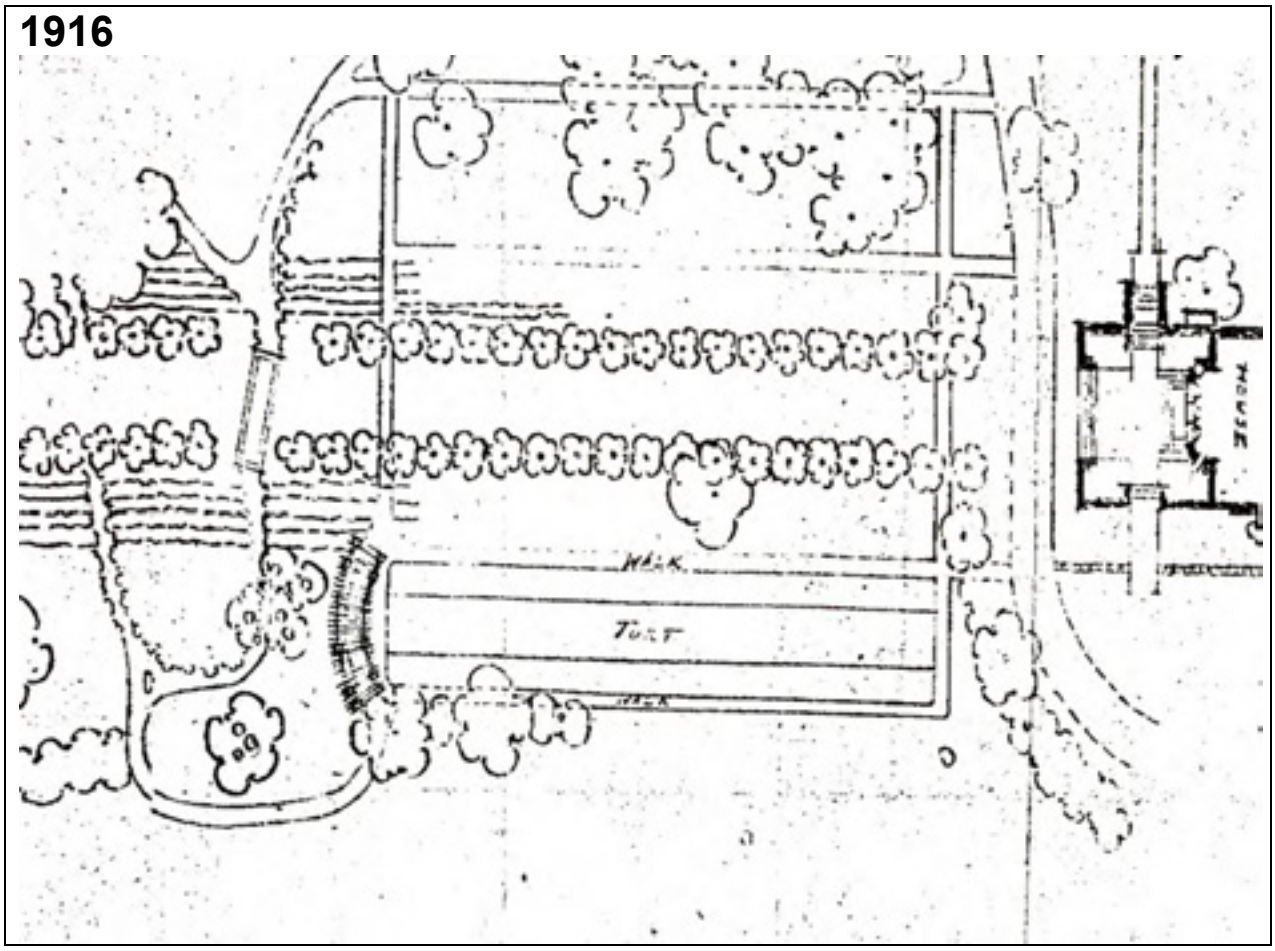
Observation #2:

There are curved and straight lines. The curved lines show where the land slopes and the angle of the slope. The closer topography lines are the steeper the slope. The straight lines represent the plan for the Plane Tree Allee.

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

The southern wing of the Manor House.

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



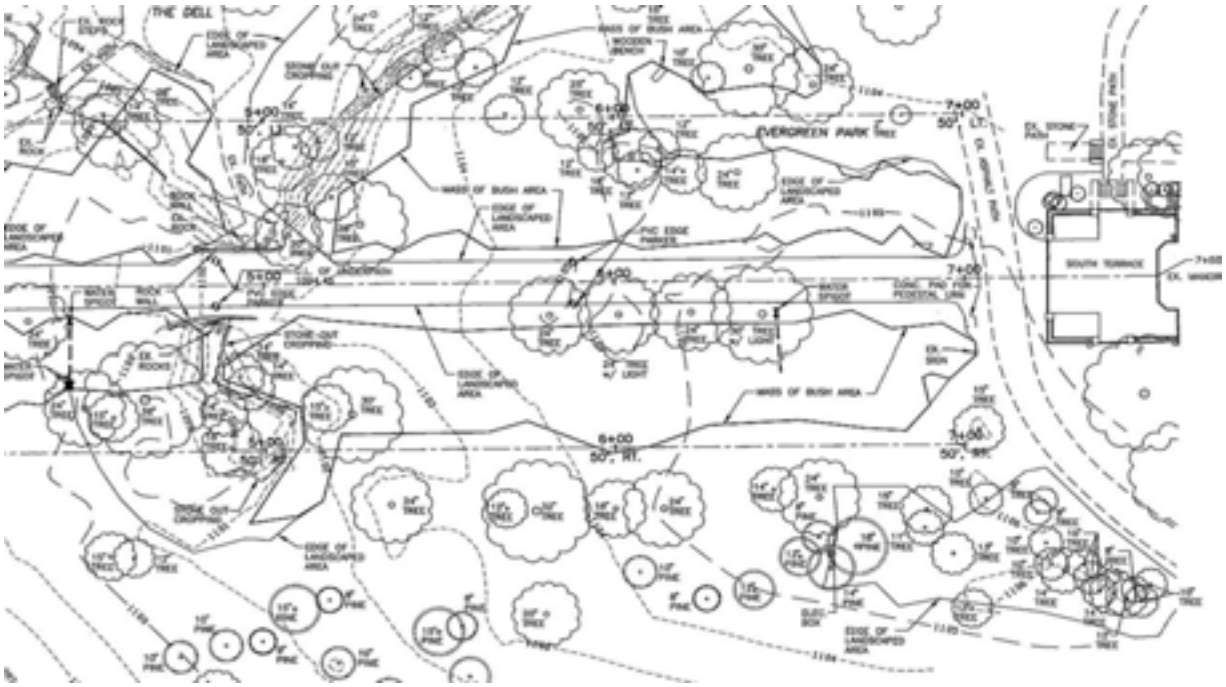
Observation #1:
The shapes that appear as cotton balls are planned locations for trees on the landscape blueprint. The 2 rows of plane trees making the outdoor "hallway" (or allee) extending from the south terrace of the South Terrace of the Manor House. The land slopes down towards Garman Road to the south (left side of the drawing), so when you are standing at the south terrace, an optical illusion will make it seem like the "hallway" continues on indefinitely.

Observation #2:
There seems to be another garden planned to the east of the allée. There are also walkways and a formal terrace (porch) with stairs planned to jut out from the southern wing of the Manor House.

Would you consider this a formal or informal part of the landscape? *Formal, but not as formal as an English-designed garden which contains 90 degree angles. Warren Manning did not like extremely formal gardens.*

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:

Many of the trees in the allée have died (Teacher note – there were originally 64 trees that made up the allée)

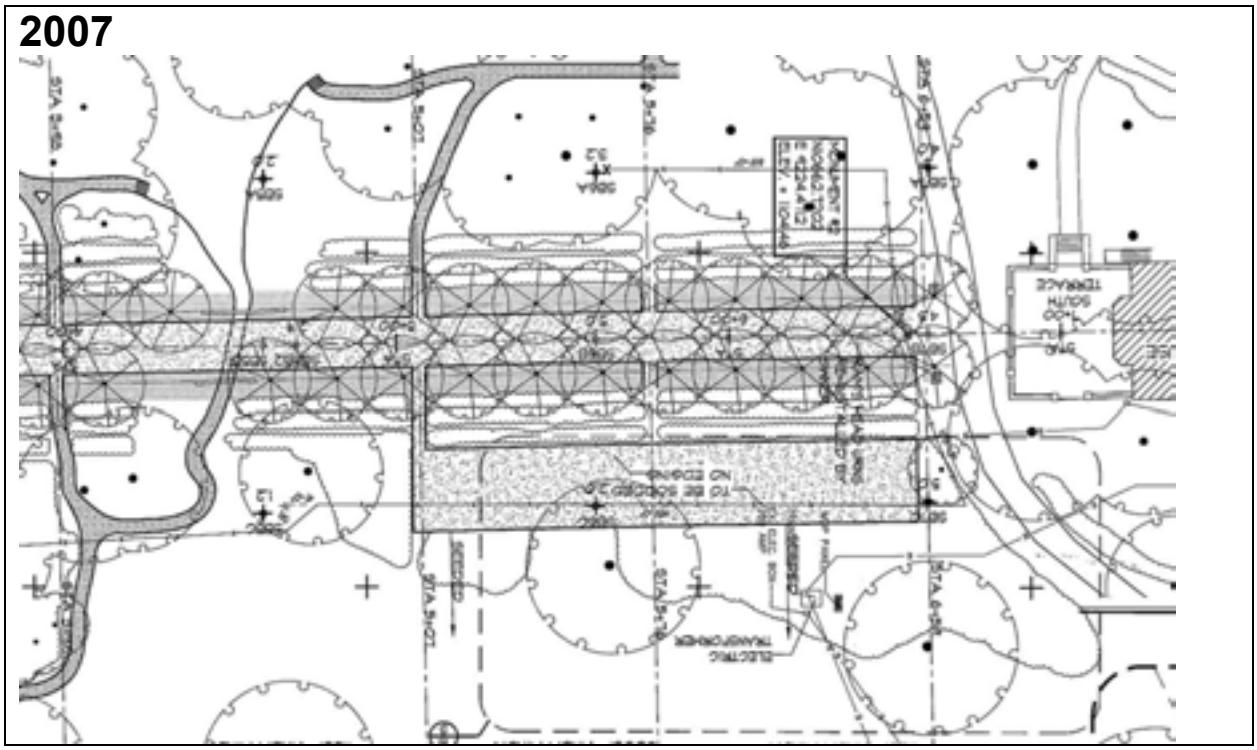
Observation #2:

The allée appears to be overgrown and unorganized.

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

The allée was not properly maintained over the years. Many of the original Plane Trees had developed cankers and died.

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



Observation #1:
This is a very organized plan for the restoration of the allée. Circles with dots in the middle show the tree locations in accordance to the original 1916 plan.

Observation #2:
Looks very similar to the 1916 blueprint.

What needed to be done in order to restore the Plane Tree Allée and Dell to Manning's original design from 1916?
They had to replace the soil to make sure the soil supported the trees and plants originally part of the landscape design. They had to plant new trees and take out older, overgrown trees that may have been diseased.

Pre-Visit Activities/Experiments – Soil and Types of Testing

<u>Standards</u>	**Band Theme 5-8: Science Inquiry and Application:** ● Identify questions that can be answered through scientific investigations; ● Design and conduct a scientific investigation; ● Use appropriate mathematics, tools and techniques to gather data and information; ● Analyze and interpret data; ● Develop descriptions, models, explanations and predictions; ● Think critically and logically to connect evidence and explanations; ● Recognize and analyze alternative explanations and predictions; and ● Communicate scientific procedures and explanations. **Content Statement 6.ESS.4** Soil is unconsolidated material that contains nutrient matter and weathered rock. **CCSS.ELA-Literacy.RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts **CCSS.ELA-Literacy.RST.6-8.3** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. **CCSS.ELA-Literacy.RH.6-8.9** Analyze the relationship between a primary and secondary source on the same topic.
Objectives	● Students will research a soil system to discover how its properties influence its use by nature and by human beings. ● Students will follow a multistep procedure to determine if the soil within a historic landscape will continue to promote optimal health and survival of its plants. ● Students will demonstrate working knowledge and understanding that soil has many properties that are necessary for plants to survive and thrive. ● Students will understand soil is unconsolidated material that contains nutrient matter and weathered rock. ● Students will use appropriate mathematics, tools and techniques to gather data and information. ● Students will analyze and interpret data. ● Students will develop descriptions, models, explanations and predictions. ● Students will think critically and logically to connect evidence and explanations. ● Students will communicate scientific procedures and explanations to their peers and their larger audience.
Garden History (30min)	To be done around activity 10 Lab aids
Materials	● Student Manual ● Computer

(20 minutes)	**<u>DAY 4</u>** Have students complete the page titled “Soil Brainstorm” and then follow-up with “Native Soil” and “Background Information on Plants and Soil Requirements” worksheet. Break students up into 5 groups (pH, K, N, P, and worms). Have each experiment group read/research their experimental test. (What should be normal levels for their tests in healthy NE Ohio Topsoil?) ● What are they testing for? ● Why is this nutrient factor important to soil? ● What can cause the nutrient level to change? ● What are the consequences of too much vs. too little of certain nutrients? ● How might this factor influence the garden plants? ● In your opinion, is this test something that the staff at Stan Hywet in the early 1900’s could have done? Why or why not?
(20 minutes)	Complete the following study: ***100 Years Later*** If computer access is not readily available, this section may need to be moved to accommodate computer availability. **Necessary information and links are located on the science HUB for APS (6th Grade Essentials).** Create a hypothesis for your group’s test. What do you expect to discover at Stan Hywet? Why do you think this? ** Ask students to begin thinking about their post-visit project. They can begin their introduction by using this background information they have just learned. ***Teacher note:*** *If computer access is limited, the class can be split in half for history reading and plant research.* *If the students have trouble with any of the terms used in the background reading sections, have them highlight unfamiliar words and look them up in the vocabulary section. Work as a class or in groups to find meaning.* *<u>Note for the Plant Discovery Section:</u> Please advise the students that information they may find on each plant will vary. The information fields may not be filled for each plant. There is still much information about the world that science has not yet studied. They are now on the leading edge of science!* **Procedure** 1. Read through a brief history of the gardens/grounds one section at a time. Lead discussions with the class based on the questions provided in the packet. 2. Have each of the students select a plant from the workbook list and research online using provided links to find information about it. The goal is to become an

	expert on that plant and can share the information with the class. Some research questions to consider include: a. Is the plant native to Ohio? b. What is its habitat and georgraphic distribution? c. What are its needs? What kind of soil does the plant prefer? How much water and sunlight is required for the plant? ***Teacher note:*** *To find plant information make sure that spelling and spacing is accurate. On the USDA site, access online in-depth information for the plants that have a "Characteristics" link. Note also that the map on the first plant page is a current range map, not a native range map. The native range can be found by clicking the "View Native Status" link under the map, and referencing the "Native Status" section of the General Characteristics.* 3. Based on what you have learned so far, compare and contrast the two specific gardens we are studying, the Dell and the London Plane Tree Allee. **Class Discussion Questions** ● What might happen to the gardens if maintenance stopped? Short term? Long term? ● Why would Manning plant non-native plants in the gardens?
Soil Permeability (30min)	**Aligns with Activity 5 Lab aids**
	Materials (per group preferably) ● 3 - 2L bottles with bottoms cut off ● Screen mesh (cut into 3x3 inch squares) ● Magnifying glasses - 1 for each participant or set of partners. ● Soil samples of sand, silt, and clay. Note: "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 ● Soil sample from backyard or other source (optional) ● 100 mL graduated cylinder ● 400 mL beakers ● 3 - 2 liter bottles or Ring stands & Ring clamps ● Stopwatch ● Water ● Paper towels ***Teacher note:*** *This experiment can be conducted as a classroom demonstration by groups with assigned parts or each group can conduct the entire experiment.*

	Procedure
	● Have the students brainstorm and write down what they know, or think they know, about soil.
	● Prepare small containers with each of the soil components: sand, silt, and clay.
	● Have students observe, magnify, and feel the soil.
	● Record student observations in a Venn diagram and have students draw examples of the particles.
	● Transition to the large experiment by setting up the components and deciding who will perform the tasks in their groups.
	● Make sure the students record their hypothesis and predictions for the experiment they are about to perform.
	● After conducting the experiment, have students record their individual results on the board, then find the class average.
	● Have students answer questions first on their own then review as a class.
	Class Discussion Questions
	● Did your predictions match the results?
	● How might soil change over time? From sand to clay?
	  ○ Weathering, Erosion, addition or depletion of organic matter and nutrients.
	● What factors could change how permeable soil is?
	  ○ Amount of water, compaction, surface angle, space created by plant roots.

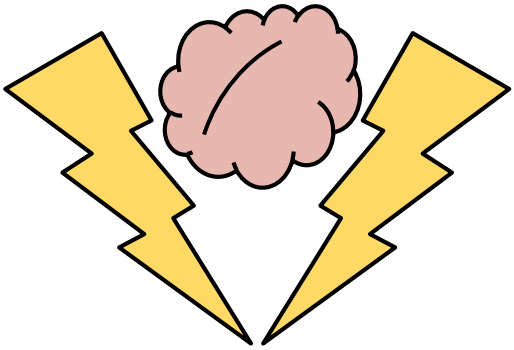
Soil Texture (30 min)	**Aligns with Activity 4&5 Lab aids**

	These simples exercises are quick and easy ways to classify a soil.
	Materials
	● Results from Activity 4&5 Lab aids, or see teacher note
	
	Teacher Note: *For teachers without "lab aids," provided is an experiment that should be conducted prior to this experiment.*
	
	Procedures
	1. First, reflect on the experiment you conducted in class during which you separated the soil into its different particle sizes. Use the percentages obtained from that experiment on the soil triangle and it will give you an approximation of the soil types you have.
	
	2. The second method is a hands-on approach whereby following the flowchart provided, the soil type can be determined by feeling texture.
	  a. Try this process with each soil type.
	  b. Can be done with the soil at the school as well.
	Class Discussion Questions
	● What are the three main different types of soils?
	● How can you tell soils apart?
	● How do the three types of soil interact with water?

	• Do you need tools to classify soil? Why or why not?

Reference	Plant Nutrients: http://www.ncagr.gov/cyber/kidswrld/plant/nutrient.htm (NC Agriculture Plant Nutrients)
	
	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 Extension Hostas)
	
	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”
	• 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)

SOIL BRAINSTORM!!!!!



What do you know about soil?

Write down everything that comes to mind about soil!!

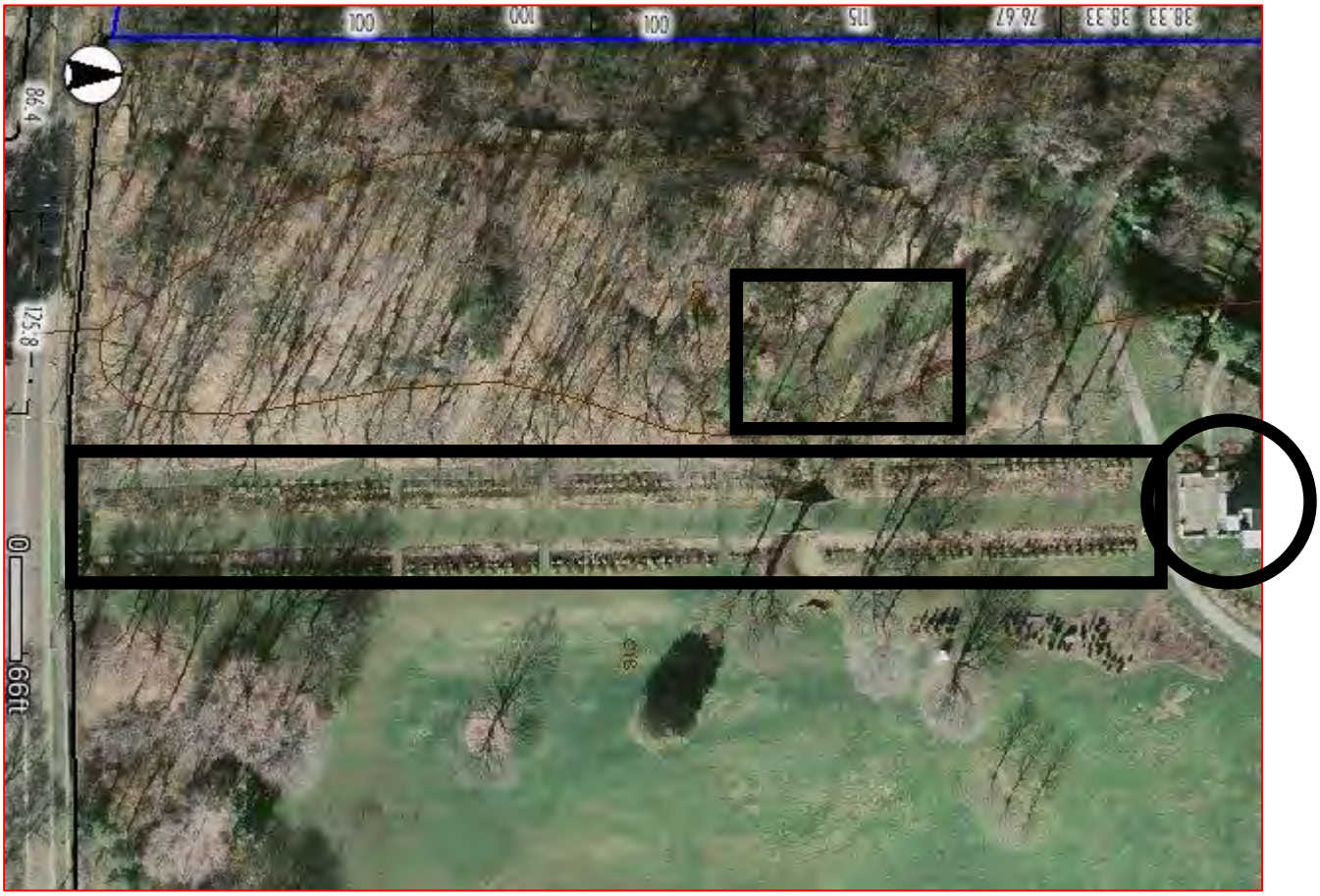
Native Soil

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 and 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?**
   By adding Chemical fertilizers or biological materials such as compost and manure. Chemical fertilizers are mixtures of purified chemicals. Compost is a term used for a mixture of partially decomposed plant material. Nature can also put nutrients back into the soil when animals or plants die, when leaves fall into the soil and decompose, or when earthworms consume the soil and excrete waste products into the soil. Also, bacteria and other microorganisms can help provide nutrients to the soil. Certain plants that grow can also provide Nitrogen back to the soil through Nitrogen-fixing through their root nodules.

2. **What nutrients do plants need and how do they obtain them?**
   Plants require nitrogen, phosphorous, potassium, and other trace minerals from soil in order to survive. Plants obtain the carbon they need from carbon dioxide gas during photosynthesis. Plants obtain oxygen and hydrogen in the form of water through their roots. Because plants remove nutrients from the soil through their roots, the soil must be regularly replenished.

3. **What can happen if the soil is too dense or too sandy?**
   When the soil is too dense the water stands in the soil diluting the minerals, or the water runs off of the land and takes the nutrients with it. When the soil is too sandy, water flows too fast through the soil and the plant roots can't absorb the water or nutrient fertilizers as easily. Also, the nutrients can wash out of the soil.

4. **What might happen if too many nutrients are added to the soil by humans?**
   Water pollution may occur by the over use of chemical fertilizers.

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?_____*SOIL*_____

What is your group's experimental test? *On cover of your student manual*_____

**** 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? *answers will vary*

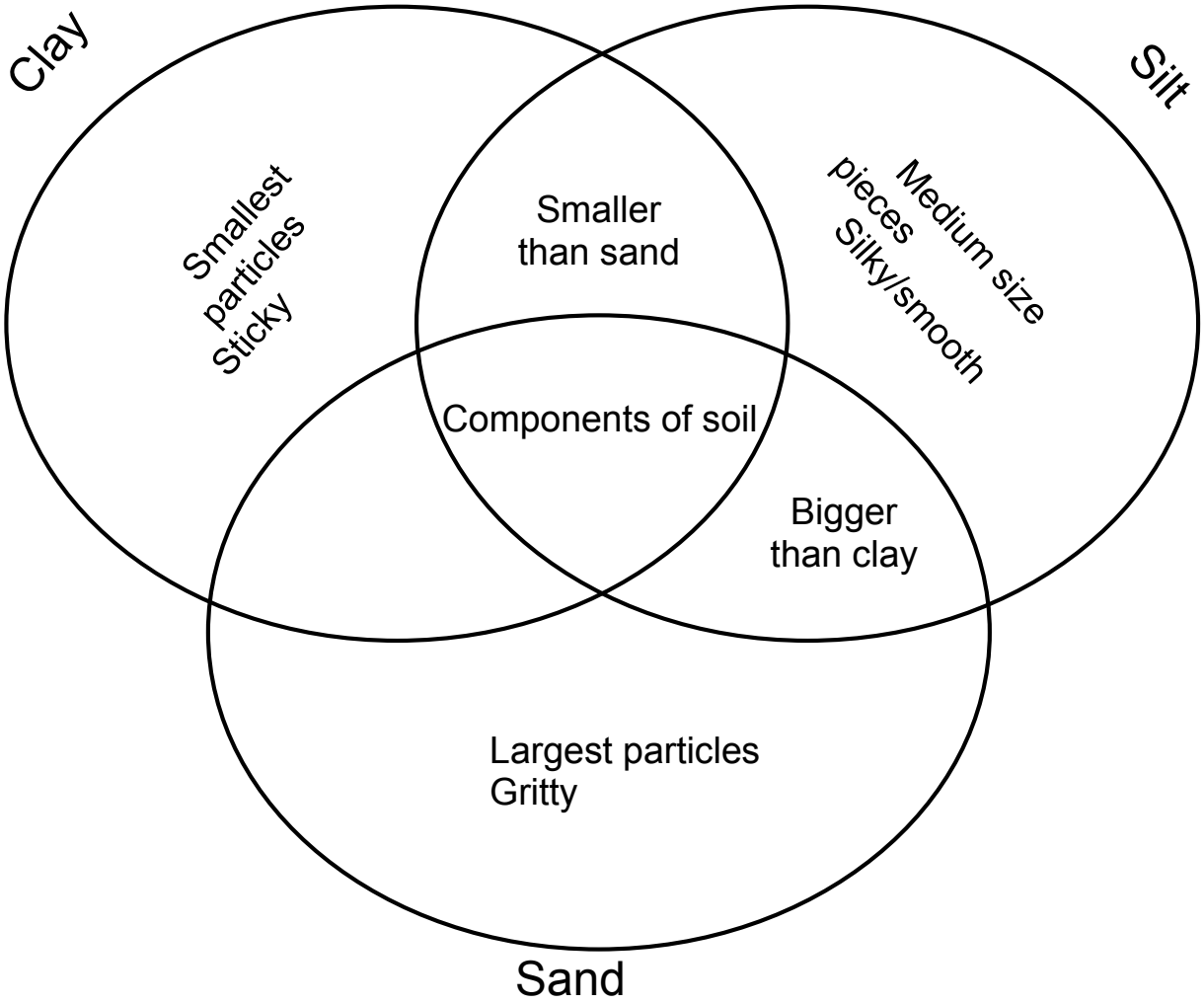
What effect does your test item (nitrogen, phosphorous, worms, etc.) have on the soil? *answers will vary*

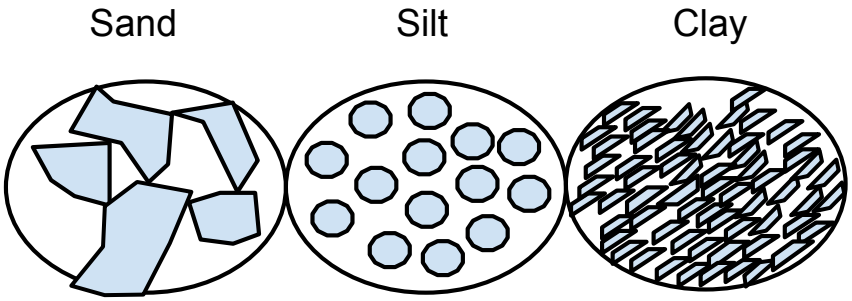
What can cause the soil levels of your test item to change? _answers will vary

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

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 your 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			

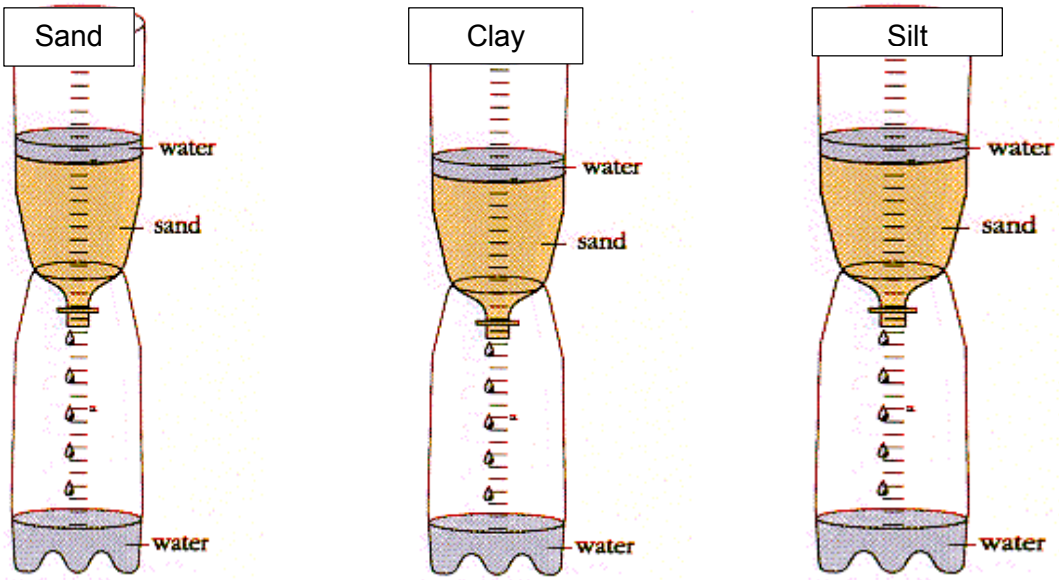
	Wild Flowers/ Plants	**Dell**	**Plane Tree Allée**	**Native**	**Non-native**	**Research Question: What does this tree needs to stay healthy?** **How much water does the plant need?** **How much sun/shade is best for the health of the plant?** **In what kind of soil does the plant thrive?** **What nutrient 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			

Soil Permeability Lab Exercise

BATTLE OF THE SOIL TYPES

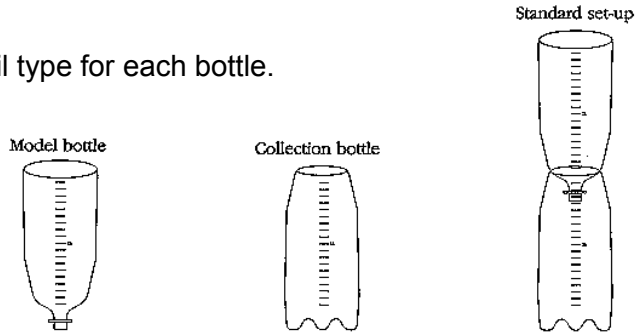
Predict (Rank in order from most to least amount of water collected):

1. ***Sand***
2. ***Silt***
3. ***Clay***



Pre-Exper ns:

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.



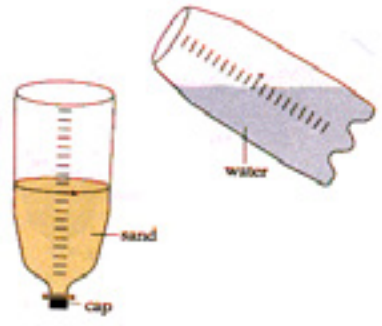
4. Place a 400 mL beaker under each bottle.

   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: Name: _____
     - (Responsibility: Operates stopwatch)
   - Water manager: Name: _____
     - (Responsibility: Get and pour water)
   - Containment Specialist: Name: _____
     - (Responsibility: Cap removal & Replacement – You will may)
   - Recorder: Name: __ _____
     - (Responsibility: Records outcomes)



Hypothesis:

If water is added to the soil then the soil with the largest particles will let the most water through.

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

1.____Sand_____

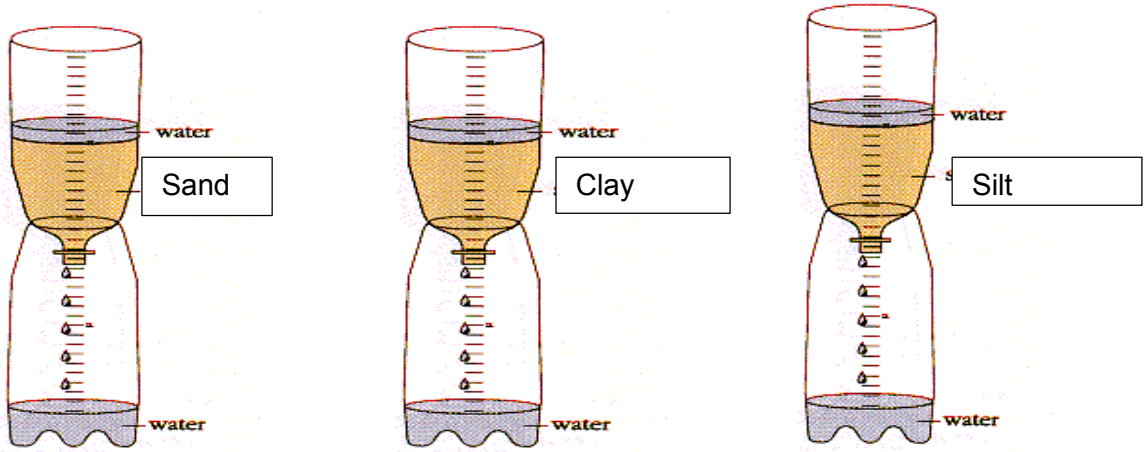
2.____Silt_____

3.____Clay_____

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.

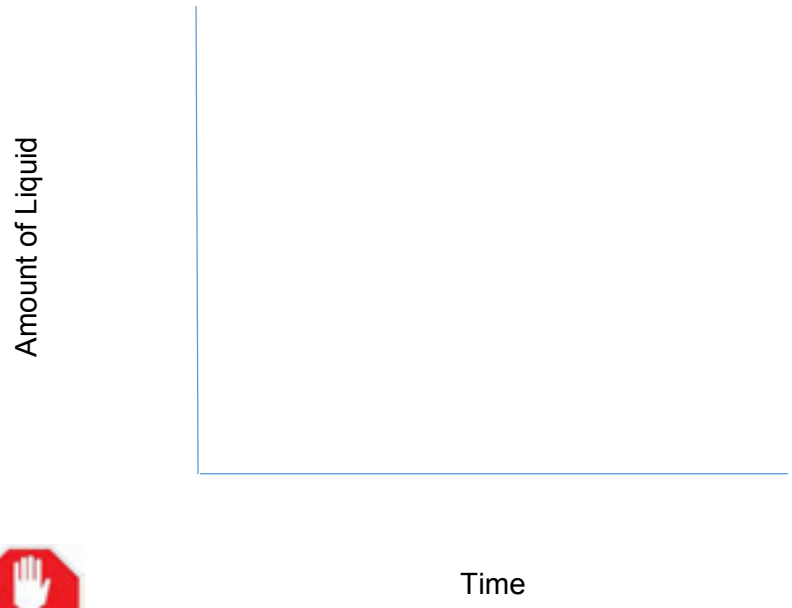
Type of Soil	mL 30s	mL 1min	mL 1m 30s	mL 2min	#1-3 for Clarity (1=most clear)
Sand					
Silt					
Clay					

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?**
   Clay

2. **What might be a reason for the differences in permeability (rate at which the water flows through the soil) for the various soil types?**
   The size of the soil particles determines the rate at which the water can flow through the soil. The smaller the particle size, the less space there is for water to pass through, the slower the water will travel. Larger particles, like sand, leave more space between particles allowing the water to pass through them more quickly.

3. **Different plants need different types of soil to grow. If you had a plant that required a lot of water that was growing in sandy soil, what could you do to the soil to increase its ability to hold water?**
   Mix the sand with some silt or clay so that the spaces between the sand particles would be smaller. This would require a little experimenting to determine how much silt or clay to use.

On-Site Lesson Plan

Time	4 hrs
<u>Standards</u>	**Band Theme 5-8: Science Inquiry and Application:** • Identify questions that can be answered through scientific investigations; • Design and conduct a scientific investigation; • Use appropriate mathematics, tools and techniques to gather data and information; • Analyze and interpret data; • Develop descriptions, models, explanations and predictions; • Think critically and logically to connect evidence and explanations; • Recognize and analyze alternative explanations and predictions; and • Communicate scientific procedures and explanations. **Content Statement 6.ESS.4** Soil is unconsolidated material that contains nutrient matter and weathered rock. CCSS.ELA-Literacy.RST.6-8.3 • Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
Objectives	• Follow a multistep procedure to determine if the soil within an historic landscape will continue to promote optimal health and survival of its plants over time. • Use appropriate mathematics, tools and techniques to gather data and information. • Develop descriptions, models, explanations and predictions.
Materials	• Student Manual • Test kits • Safety goggles and glovesClipboard and Stopwatch • Pencil
Anticipatory set	• Students arrive and are reintroduced to the problem and a brief history of the Plane Tree Allee and Dell areas. • Break the students into their experimental groups. • As the students look at the Plan Tree Allee and Dell discuss if the area looks healthy. Based on what they observe, do they think the soil and plants look healthy? • Have the students revisit their hypothesis. Do they wish to change or keep it based on what they have seen?

Procedures	• Take the students to their color assigned sampling zone.
	• Record a prediction of what their results may be based on their observations.
	• Check that all safety precautions are being met and that materials are laid out.
	• Make sure to accurately record all findings:
	  ○ Date and time
	  ○ Group
	  ○ Zone

	○ Test performed ○ Test results ○ Nearby plants ***Teacher Note:*** *During down time or while waiting for their tests to dissolve and develop, students can:* ● *Draw a quick sketch of their surroundings.* ● *Perform the soil texture classifications by hand test, just like in class.*
Reflection (Can be done onsite or back at school)	● Did your visual assessment match your test result? ● What was it like performing the test in the field "in person"? ● How might we use all the data we collected today? What might you guess about other test results conducted at Stan Hywet?

Reference	Plant Nutrients: http://www.ncagr.gov/cyber/kidswrld/plant/nutrient.htm (NC Agriculture 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:
	  • the kinds of materials in soil
	  • the arrangement of soil materials
	  • the 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)

Weather Contingency Plan

In the event of inclement weather which would prohibit soil testing on site at the Plane Tree Allee and Dell, testing will be moved indoors and a substitute test (water) will take the place of the worm test. Testing will be done in either the Reinberger Classroom or the Carriage House Auditorium depending on the size of the student group for the day.

The Part 2 *Change Over Time in the Birch Tree Allee with first floor Manor House investigation* which requires students to be outside as well as inside, will be adapted as an all-inside expanded tour with notation of key horticulture and landscape highlighted as students look outside from within the manor.

Students will remain in their pre-assigned testing groups. Students will also remain in their pre-assigned large groups for testing and touring.

Procedure will be as follows:

Organization and Preparation -

- Once students are physically split into their two main groups, weather permitting, one group will do a “walk through” of the Plane Tree Allee and Dell to make observations prior to the testing.
- The other group will go to the Birch Tree Allee/Manor House for Part 2.

Program Implementation -

- Group A will receive some basic instruction at the South Terrace of the Manor House and then will walk through Sites A, C, and D to note observations and comparisons about the soil, plant/tree life, etc.
- Following the walk-through, students will go indoors (classroom or auditorium).
- Tables will be pre-set with testing kits.
- A soil sample from one of the test sites (A or C from the Allee, D from the Dell) will be provided.
- With assistance from the teacher, chaperone, and/or volunteers, students will put on safety gear and complete their assigned test.
- Certain chemicals/tablets used for the tests will be distributed to the adult to ensure safety.
- After completion of the test, result data will be entered online through use of the iPads/computer.
- Under the supervison of the adult, each student group will be responsible for cleaning items used from their test kit (rinse out test tubes, pipets, measuring spoon), returning those items to the kit which will be checked by the adult and then closed up in preparation for the next group. Clean-up will be done at the sink in the classroom or in the sink in the kitchen connected to the Carriage House Auditorium.
- Students will remain seated until all groups have completed testing and further instructions provided.
- Both student groups will return to the Carriage House Auditorium for lunch.
- After lunch the groups will switch testing and tour roles.
- At the conclusion of session 2, everyone will return to the Auditorium for a debrief session and closure prior to boarding the bus for return to the school.

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 Allee 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'

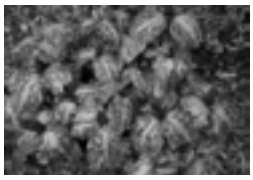
Wild Chives
Allium schoenoprasum

Mountain Laurel
Kalmia latifolia

Common Perwinkle
Vinca Minor

Rhodendron maximum
'Roseum'

Dutchman's Breeches
Dicentra cucullaria



Toadshade
Trillium sessile

Hosta

Azalea
Rhodedendron 'Red Rose'

Squirrel Corn
Dicentra Canadensis

Rhododendron catawbiense
'Nova Zembia'

Daylily
Hemerocallis fulva

Canadian Wild Ginger
Asarum canadense

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: _____

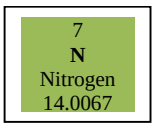
Materials manager- Position responsibilities: Gather solution, pour solution, clean up area, return supplies.

Name: _____

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

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

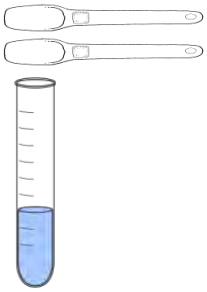
***Please read all the steps before performing and refer to nitrogen Expert:*



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

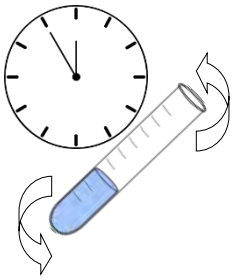
Record Observations:

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



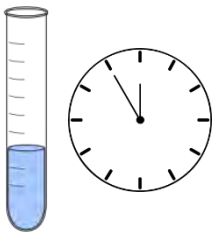
Record Observations:

Step 3 Cap and mix gently for one minute



Record Observations:

Step 4 Remove cap and allow soil to settle.



Record Observations:

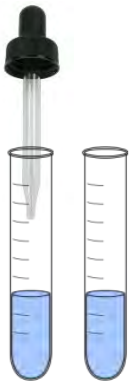
Step 5

-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.

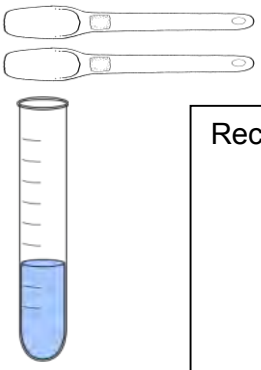


Record Observations:

Step 6

-Add the*Nitrogen Indicator Powder to soil extract in second tube.

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

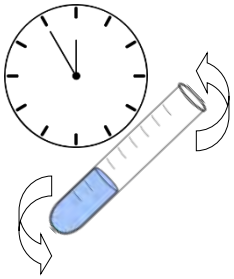


Record Observations:

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:

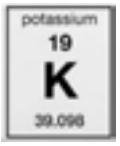
List the group members responsible for each job:
Expert: The expert will lead the test. He/she will assign these jobs within the groups for the phosphorus test. They will talk and explain each step. They will also assign jobs and clean up. The expert will record the results of the phosphorus test.
Name: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

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: _____

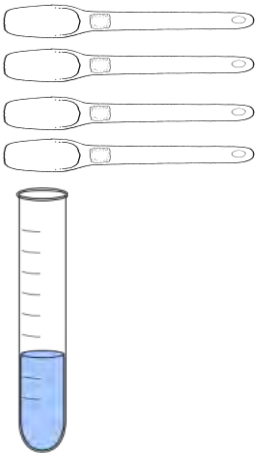
***Please read all the steps before performing and refer to potassium expert:*



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

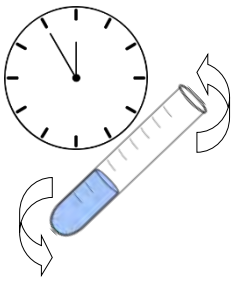
Record Observations:

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.

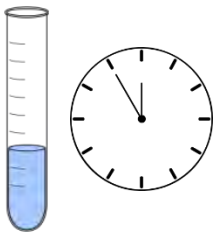


Record Observations:

Step 4

-Remove cap.

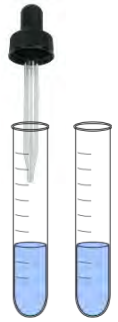
-Allow to stand and soil to settle until liquid above soil is clear.



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:

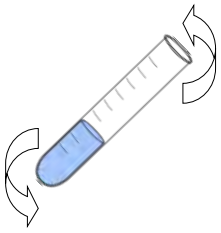
Step 6

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:

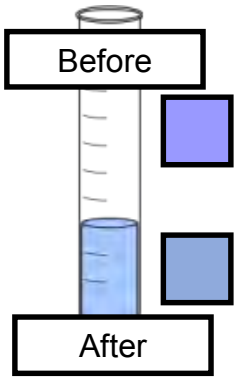
Step 8

-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:

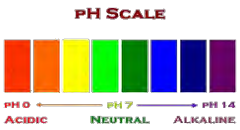
Expert: The expert will lead the test. He/she will assign these jobs within the groups for the pH test. They will talk and explain each step to the other 3. They will also assign jobs and clean up. The expert will record the results of the pH test.
Name: _____

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:*

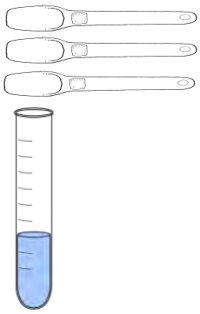


Step 1

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

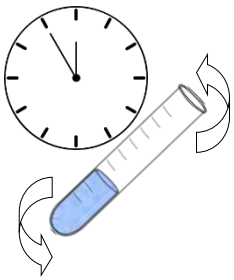
Record Observations:

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



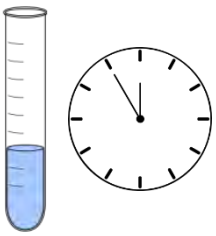
Record Observations:

Step 3 Cap and mix gently for one minute.



Record Observations:

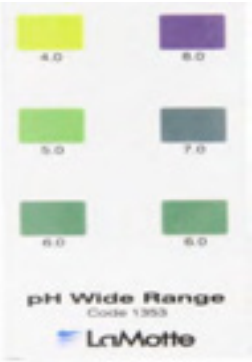
Step 4 Allow tube to stand for 10 minutes to let soil settle.



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: _____

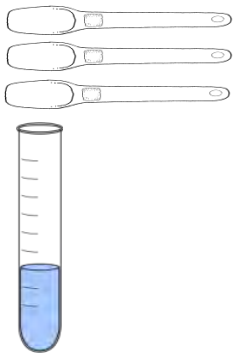
Please read all the steps before performing the test and refer to phosphorus Expert:

15
P
Phosphorus
30.97376

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

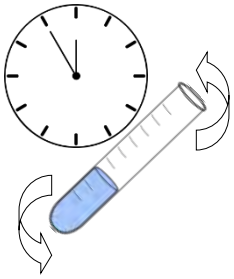
Record Observations:

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.

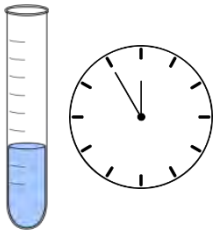


Record Observations:

Step 4

-Remove cap.

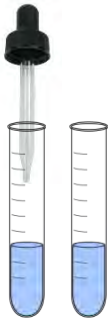
-Allow to stand, and soil to settle, until liquid above soil is clear.



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.

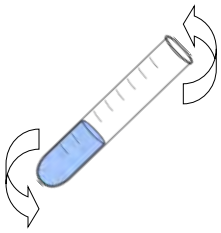


Record Observations:

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:

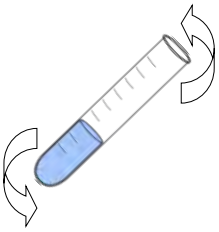
Step 8

- 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)	

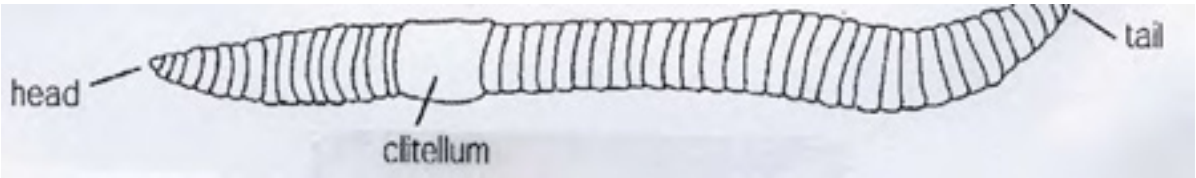
Pour the other ½ of the container into your lab area and after 5 minutes record your results.

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 <u>total</u> 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?

*There are a variety of answers that would be acceptable. Students should mention that there were times when the foliage was fuller and that there seems to have been more trees at different times. The trees were less healthy and more sparse in 1930. In 1940 and today there is more of an "archway" formed. ** It may be beneficial to note that this process is called "pleaching." Trees were woven or tied together to form a bend which resulted in a shaded path or an "extended hallway" from the manor house.*

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?

Hypothesis: 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

Answers may vary. *The ground cover acts as a type of insulation to keep the soil cooler. This is important for the health of these trees which naturally thrive in a cooler climate.*

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?

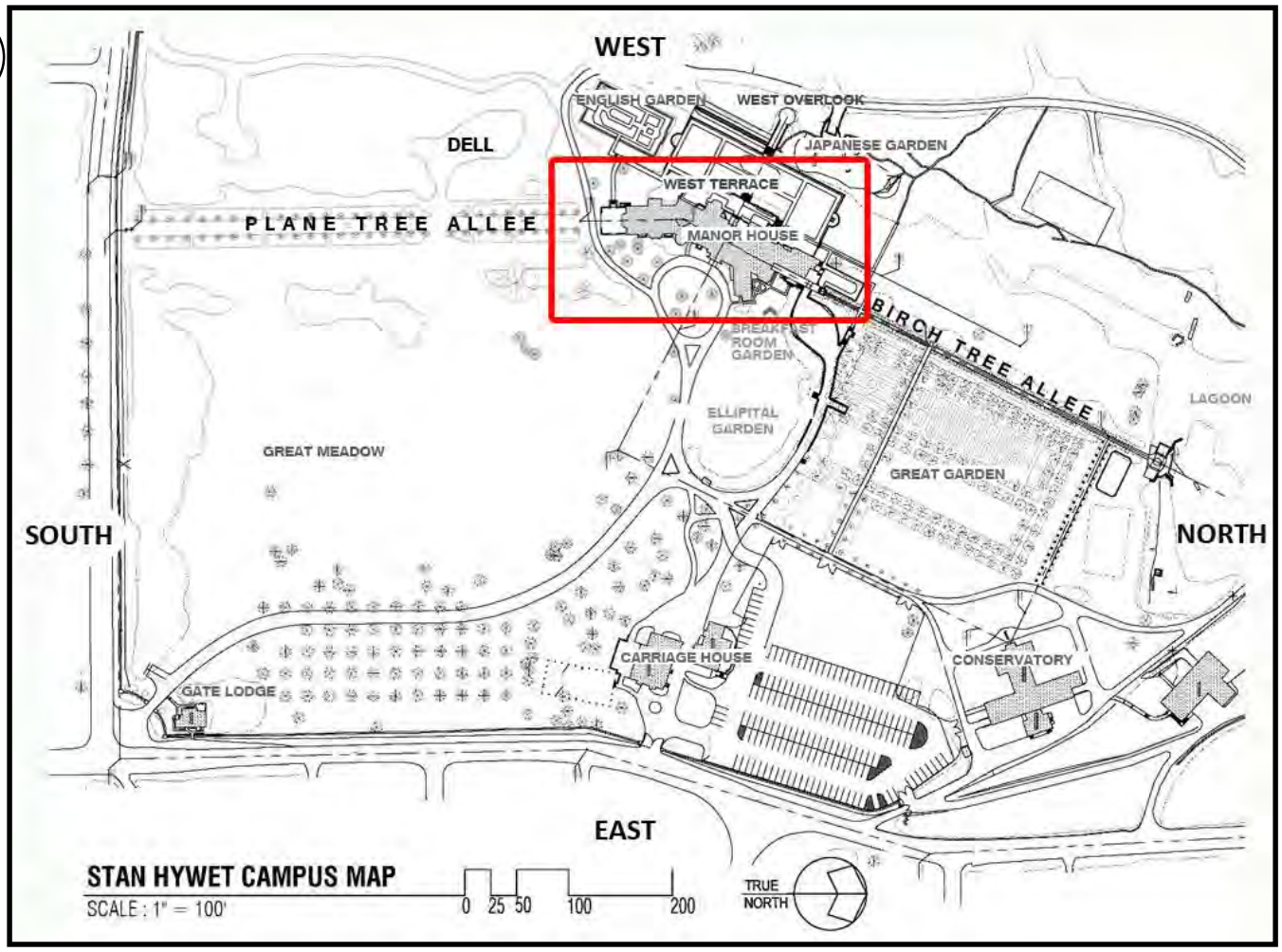
Revisit your hypothesis from the beginning of this section. Why might the plants used as ground cover under the birch trees in the allee be a good choice? Does the temperature of the soil give you any ideas to support or "prove" your hypothesis? Is there something else that may have been done or not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

The ground cover may keep the soil cooler. Also, the staff at Stan Hywet Hall & Gardens prune the trees to maintain the health and angle of the trees to form the "pleached" hallway look.

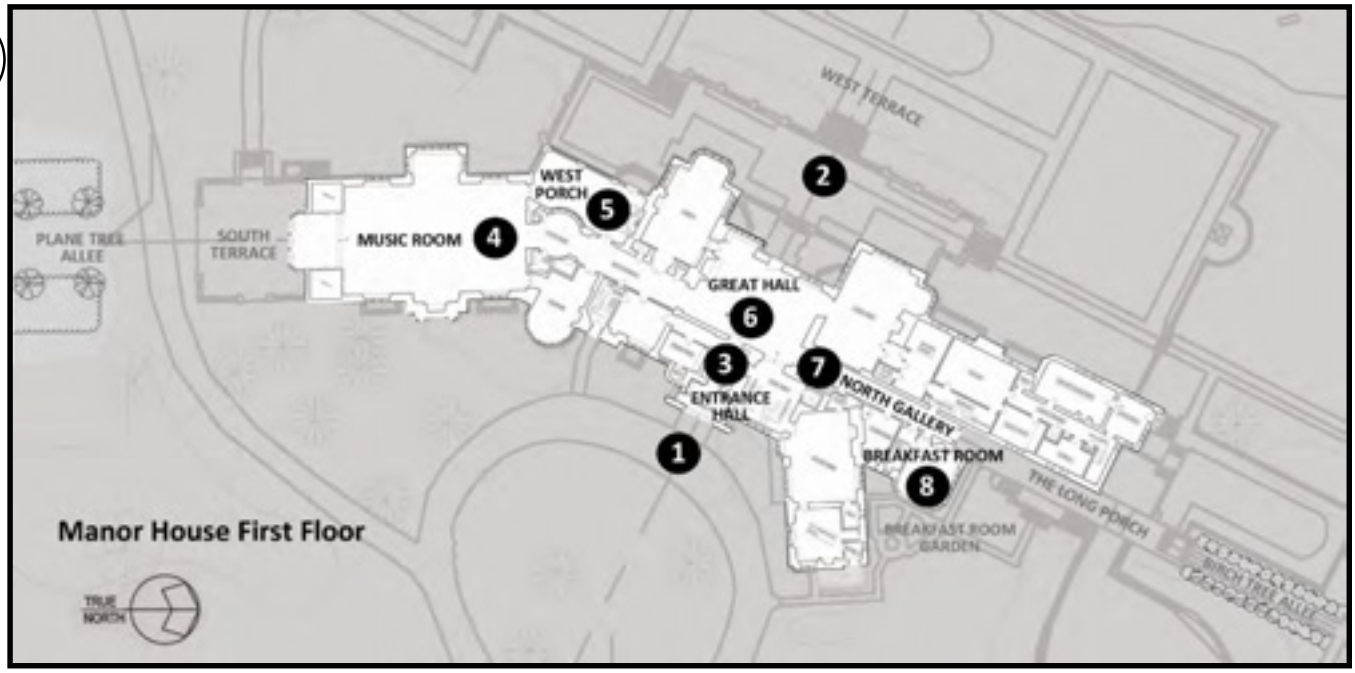
"Inside Out, Outside In"

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



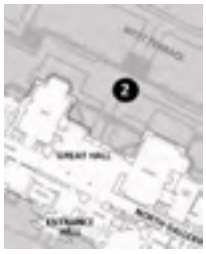
Inside the Manor House…

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 roof looks peaked (pointed). There are 12 chimneys with many stacks. There are decorated and stained-glass 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 is different – many more windows, not as decorated (ornate). The awnings change the light which passes through the windows.*

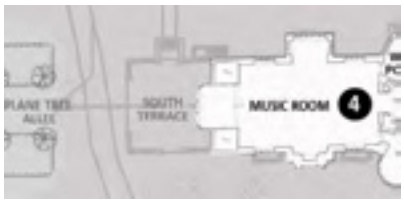
The back of the house has an **arts & crafts style** which was more modern for the time of the Seiberlings. This style included larger and more windows which provided brighter rooms inside of the manor.

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 angle 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? *There may be light streaming in the windows, shadows, warm lighting from the awnings, etc.*



4: *The Music Room*

How many windows do you see in this room? *Answers may vary. More at the section that is the back of the house.*

Do you feel that the room is light or dark? *light*

Does the furniture in the room add to that feeling? Why or why not? *The chandeliers contribute to the lighting of the room. The furniture isn't large wood & dark as in other sections of the house.*

Look to the far end of the room and out the windowed doors off of the stage. What can you see outside? *The Plane Tree Allee*

Why do you think this view is important? *Because the designers wanted to create the idea that the inside extends to the outside.*

** 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? *Answers will vary.*

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. *There are a lot of windows to the outside & also shared with the round room. The windows are decorated & have small panes of glass.*

What kind of furniture and floor is in this room? How do these things help create an "outside" feel inside the house? *The floor is tiled and the furniture is the type that might normally be found on an outside porch or deck.*

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? *Answers will vary. There is a fountain.*

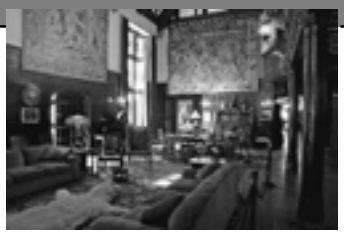
Look out the window. Do you see anything similar outside? *There is a fountain outside also, off the west terrace.*

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?
This room has fewer windows and is overall quite a bit darker than the other rooms. The furniture is bigger and definitely for indoors.

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

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 Birch Tree Allee

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? *The Plane Tree Allee from the Music Room*, *The view from the West Porch to the Terrace.*

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? *The fountain in the Breakfast Room Garden*
Generally this decoration appears outside as it does here. Where did you see this **inside** the manor house? *In the West Porch*

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? *Sunrise*

What are two colors of décor do you observe in the room?
yellow and *blue*
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!

This room is at the front of the house but has a design feature seen more in the back of the house – there are *a lot of windows* in order to bring in the beautiful morning sunshine.

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. If you have time, go with your group to one of the many gardens.

Post-Visit - Plant Study and Projects/Presentations

<u>Standards</u>	**Band Theme 5-8: Science Inquiry and Application:** ● **Identify questions that can be answered through scientific investigations;** ● **Design and conduct a scientific investigation;** ● **Use appropriate mathematics, tools and techniques to gather data and information;** ● **Analyze and interpret data;** ● **Develop descriptions, models, explanations and predictions;** ● **Think critically and logically to connect evidence and explanations;** ● **Recognize and analyze alternative explanations and predictions; and** ● **Communicate scientific procedures and explanations.** **Content Statement 6.ESS.4** ● 6.LS.4 Living systems at all levels of organization demonstrate the complementary nature of structure and function. **CCSS.ELA-Literacy.RST.6-8.1** ● **Cite specific textual evidence to support analysis of science and technical texts.** **CCSS.ELA-Literacy.RST.6-8.3** ● **Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.** **CCSS.ELA-Literacy.RH.6-8.9** ● **Analyze the relationship between a primary and secondary source on the same topic.**
Objectives	Students will apply the scientific method to an experiment using fertilizer as the independent variable, and health of plants during growth as the dependent variable.
Plant Study	(30min experimental set up with additional check-ins on progress for 2 weeks prior to visit**. Aligns with Activity 9 Lab aids**)
	Materials Per Group: ● 5 containers (milk cartons or 8-16oz bottles) for preparing fertilizer solutions ● Cups to measure liquid for watering ● 5 plant pots per team, or planting trays, or plastic or styrofoam cups with small holes in the bottom ● 30 radish seeds **For whole class use:** ● Liquid or powdered plant food (such as Miracle Gro or Schultz). ● Inert potting substrate such as Perlite or Vermiculite (Do not use potting soil). ○ Pre-rinse to remove dust by putting into a dishpan and

	covering with several inches of water, swish around a few times and pour off the water. ● Use drain trays to place under pots (aluminum baking trays or cafeteria trays work fine). ○ To avoid cross contamination, put all the pots watered with the same solution on a single tray. Don't put all the pots of each group on a tray or the fertilizer will move between them ● Growth area for plants - plant grow lights or a window sill. ***Teacher note:*** *This experiment can be conducted as a classroom demo, in individual groups with assigned parts, or the entire experiment can be conducted by each group.* **Procedure** ● Provide information about plant needs Instruct students to work through the questions independently and then with a partner (think-pair-share). ● Have the students gather their materials and assemble their plantings ● Have the solutions ready for students to apply to their plants. ● Have students make a hypothesis and predictions based on what they have learned. ● Place plants in bright sunlight by a window. ● Water each plant twice a week with their respective solutions. ● Each time the plants get watered have the students make observations on what they see. **Class Discussion Questions** ● After the experiment, compare the outcomes to their predictions. Were you correct? If not, work together to explain why. ● What do plants need to be healthy? ● How do plants interact with soil/their environment?
Reference:	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)

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:

If fertilizer helps plants grow larger and faster, then the greater the amount of fertilizer used, the larger and faster the plants will grow.

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:		

Teaching hints

1. Obtaining and preparing material: Radish seeds work particularly well in this experiment because they are small enough to use up their stored nutrients fairly quickly, and because they germinate quickly. Radish seeds will germinate in less than one week, and start producing leaves within two weeks. The effects of the different watering solutions should be apparent within three weeks of starting the experiment.

2. Optional Soil testing: Interested students can test nutrient availability in their experimental pots or in the soil near your school using a LaMotte soil test or Rapitest soil test kit.

Final Project/Presentation

Standards	**Band Theme 5-8: Science Inquiry and Application:** • Identify questions that can be answered through scientific investigations; • Design and conduct a scientific investigation; • Use appropriate mathematics, tools and techniques to gather data and information; • Analyze and interpret data; • Develop descriptions, models, explanations and predictions; • Think critically and logically to connect evidence and explanations; • Recognize and analyze alternative explanations and predictions; • Communicate scientific procedures and explanations. **Content Statement 6.ESS.4** Soil is unconsolidated material that contains nutrient matter and weathered rock. **6.LS.4** Living systems at all levels of organization demonstrate the complementary nature of structure and function. **CCSS.ELA-Literacy.RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts. **CCSS.ELA-Literacy.RST.6-8.3** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. **CCSS.ELA-Literacy.RH.6-8.9** Analyze the relationship between a primary and secondary source on the same topic. **CCSS.ELA-Literacy.SL.6.5** Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information.
Objectives	• Create a written report and a presentation to share findings and provide recommendations. • Analyze and interpret data. • Develop descriptions, models, explanations and predictions. • Think critically and logically to connect evidence and explanations. • Communicate scientific procedures and explanations.
Materials	• Computer/Internet access • Paper • Pencil • Poster Supplies
Anticipatory Set	• Introduce students to the Stan Hywet Soil Data page. • Inform them how to add their team's data. • The data from all schools will be released on June 1st.

Procedure	1. Have each team enter their data into the Soil Spreadsheet found on the APS Science webpage or Stan Hywet Ed resources page. 2. Then when all data is released, have students retrieve all data on their test from their school. 3. Plot data on a map (optional). 4. Interpret their results. a. Find the average of their test result for each zone. b. Trace=1, Very Low=2, Low=3, Medium Low=4, Medium=5, Medium High=6, High=7, Very High=8 c. Does the level of their test findings match the range of the plants in their respective gardens? d. If not, research ways to modify the soil so that it does. 5. Present their findings in a scientific format (either a paper or a presentation of some form). Working together in their experimental groups of 4, the students will write a group scientific report on about their test. Be sure to include the following parts: a. Intro i. A summary of the problem ii. Background information iii. Why their test is important b. Materials & Methods i. How and where did they perform their test c. Results i. What were their findings d. Discussion i. What do their findings mean ii. Are the plant needs being met iii. If not, are there ways to modify the soil e. Resources i. Where did they get their information from 6. After the students have done their individual reports, they can bring their ideas together as a class to look at the total soil picture. a. How healthy was the soil when looked at on a single test level? b. How healthy was the soil when all test levels were considered? c. If treatment was needed, what worked well for your test? d. If treatment was needed, were there any that corrected more than one test?

FINAL PROJECT: 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 _____

_____

_____

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

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 t issues, 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 Seiberling family.

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 Extension 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.

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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.

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