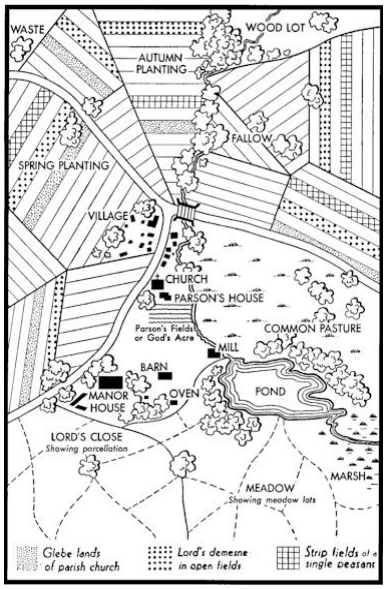
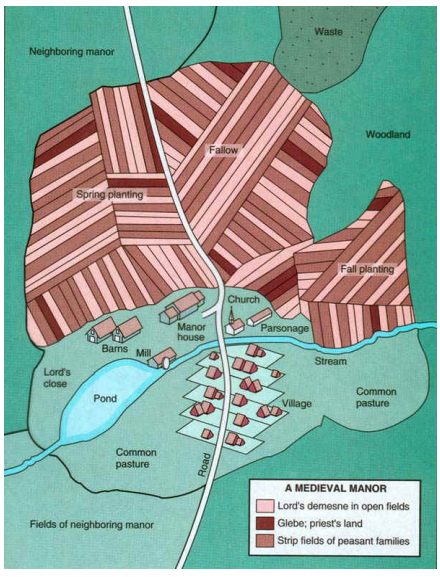
Teacher Notes and Background Information

- **Serfs** - A lord of the manor could not sell his serfs as a Roman might sell his slaves. On the other hand, if he chose to dispose of a piece of land, the serfs associated with that land went with it to serve their new lord, benefiting him from their knowledge of the land. Further, a serf could not abandon his land without permission, nor could he sell the land.
- **Serfs are peasants.** Serfs can be broken into different levels of peasant society.
- **A villein** (or *villain*) was the most common type of serf in the Middle Ages. Villeins had more rights and higher status than the lowest serf but were not freemen. Villeins generally rented small homes, with or without land. As part of the contract with the lord of the manor, they were expected to spend some of their time working on the lord's fields. This work was often only seasonal, for example the duty to help at harvest-time. The rest of their time was spent farming their own land for their own profit.
- **How people became serfs**: A freeman became a serf usually through force or necessity. Sometimes freemen were intimidated into dependency by the greater physical and legal force of an important person. Often a few years of crop failure or war might leave a person unable to make his own way. In such a case, a bargain was struck with a lord of a manor. In exchange for protection, the freeman would agree to become a lord's serf. These bargains were formalized in a ceremony known as "bondage" in which a serf placed his head in the lord's hands. These oaths bound the lord and his new serf in a feudal contract. To become a serf was a commitment that included all aspects of the serf's life. Serfdom was inherited at birth. By taking on the duties of serfdom, serfs bound not only themselves but all of their future children.
- On a manor, there was usually poorer quality land that could not be cultivated and be called the **waste land.** In the waste land, serfs could gather resources such as peat, firewood, materials for house repairs, animal waste, or fish.

Examples of manor maps





ARIZONA GEOGRAPHIC ALLIANCE

Teacher Notes on Wheat

Loamy soil--a mixture of sand, silt and clay--provides ideal nutrition for wheat, a grass that has become a staple in most diets around the world. The fertile, well-draining soil mixture of sand, silt and clay allows for rapid absorption of water and air by plant roots, which encourages growth.

Loamy soils are made up of about 40 percent sand, 40 percent silt and 20 percent clay. That combination holds enough water for the plant to take in nutrients but also drains well to allow air to reach plant roots, making the soil type ideal for most garden plants, according to Purdue University's Department of Horticulture and Landscape Architecture.

Soil needs protection against soil compaction. Soil compaction removes needed pockets of air and other soil gases and can affect water penetration.

The well-draining, loamy, black soils helps moisture penetrate down deep to root systems, reducing stress from dry conditions.

Five inches of rainfall are necessary per season to ensure that wheat crops will thrive.

To complete the Soil nvestigations you need the following:

1. Silt – topsoil like (garden center)

2. Sand – play sand (available at Walmart)

3. Dirt with high clay content (Phoenix dirt works well – to increase clay content add clay powder (available at Hi-Health)

4. Three buckets and a number (depends on the number of groups) of paper cups

For each sample: Use a large gallon bucket or tub. Combine your soil components in these approximate proportions. Label each bucket with A, B, or C. These will be used for the student investigations – mix up as much soil as you need based on the number of students.

Set up your soil samples as follows:
Soil Sample A: 40% silt, 40% sand and 20% clay dirt
Soil Sample B: 20% silt, 60% sand and 20% clay dirt
Soil Sample C: 20% silt, 10% sand and 60% clay dirt

40% silt, 40%, 20% clay dirt

Sample A will represent the crops with highest production.
Sample B and C will represent the areas with lower wheat production.

For one class, use the following measurements:
Sample A: 4-6 cups silt, 4 cups sand, and 2 cups clay dirt
Sample B: 1 cup silt, 6 cups sand, and 2 cups clay dirt
Sample C: 2 cups silt, 1 cup sand, and 6 cups clay dirt

Student Handout

Introduction:
Some of the earliest engineering innovations in history involved farming. Farming is one of the most important activities contributing to the advancement of civilization. During the Middle Ages, the difference between life and death depended on the ability to farm and produce food for the growing population in Europe. It also served as the basis on which the **feudal system** operated. The lord, his family, and the serfs were all supported by the income from the land.

Manors were different sizes depending on the wealth of the lord who owned all the land. The **manor** included the lord's house, villages, and land. The lord kept as much of the land as he wanted for his own use, and divided the rest among the peasants, also known as serfs, for their use. These serfs were required to work a certain number of days on the lord's land in exchange for the right to use of some of the lord's manor for their own farming. These serfs were considered part of the lord's property and had few rights. For example, they could not leave the village, marry, or sell oxen without the permission of the lord.

Not all the land on the manor was suitable for farming. To be sure that each person received both some good farming land, the land was divided in a pattern of long strips and each person might receive several of these long strips for what is known as **strip farming**. These strips of land were divided into acres. An **acre** was based on the amount of land a farmer could plow in one day. Because of the way the land was divided, farmers needed to work together cooperatively.

Let's look at the way the manor was organized. For this activity you will be working in a group of three to complete a series of tasks related to the operation of a manor. Your goal is to increase the production of wheat crops for your manor and earn enough "rewards" from your lords to enable you to return to the future. Each person in the manor has an important job to do to be sure that all living on the manor survive – and make it back to the present!

Task #1: Map of the Manor
Your first job will be to create a map of the manor. Read the description of your manor and create a map with realistic **proportions**. At least 50% of your manor is devoted to farming, 25% to common areas and housing (both the manor house and the village), and 25% to waste land and woods. Do a good job and the lord of the manor may reward you for your efforts.

Task 1: The Manor Map

Your manor must include:

1. 800 **acres** of land – you have an average sized manor. Just to give you an idea of the size of an acre - a football field in the United States is a little over an acre. Most manors were 750-1500 acres in size. Your manor supports 150 people. In addition to the lord's family, there are twelve farm families and other villagers with jobs to support the manor. These people are called villeins, a type of serf.

2. Your manor has about 400 acres of land for farming.

    a. These strips are scattered across the manor into three separate fields. Within your field you will find the land divided into three groups. Label your fields A, B, and C.

    b. Strips of land reserved for the lord – this land is called the **demesne**. Be sure to use a separate symbol in your legend for this land (50% for the lord).

    c. **A glebe –** strips of land that provide for the local church (10% of the farmland).

    d. Strips of land reserved for the peasant families (40% of the farmland).

    e. Remember: the farming land is divided into long strips.

3. **Manor House** – the home of the lord and lady is the largest structure on the manor. This house is either a large **fortified** house, or castle, with:

    a. a chapel

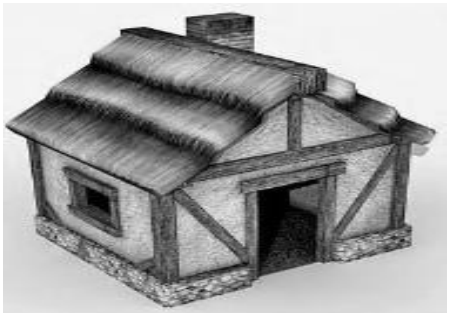
    b. kitchen,

    c. two farm buildings – barns for the cattle and a building to store crops

    d. a hall (a meeting place for conducting business)

    e. The manor house has **livestock**, a water source, and crops nearby in case of a **siege**.

4. **Village** – has 12 houses and buildings where villeins (village people) or serfs live. They should be located together.



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5. **Lake or pond** provide water.

6. **Woods –**some of the woods are set aside for use only by the lord.

7. **Common pasture** – is for grazing cattle

8. **Roads/Paths** – are ways to travel around the manor.

9. **Waste Land –** is poor quality land not good for farming but are commonly used to gather other essential resources such as peat, firewood, materials for house repairs, animal waste, or fish.

Names_____

Manor Map Scoring Guide

Map	Points Possible	Points Earned	Comments
Contents Required:			
Manor House and manor buildings	**5**		
Village – adequate number of houses	**5**		
Common pasture	**5**		
Woods	**5**		
Pond/lake	**5**		
Waste lands	**5**		
Roads	**5**		
Farmland	**5**		
Located in a logical locations	**5**		
Proportion:			
The land use is clearly divided as required in the task instructions	**10**		
Map Elements:			
Map contains appropriate title and authors	**5**		
Map has a legend with easy to use symbols	**5**		
Map has an orientation and date	**5**		
Map is easy to read (writing is neat and appropriate use of color).	**5**		
Total	**75**		

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Name: _____

Manor Map Gallery Walk

Now you will look at the manor maps for the other manors in the kingdom. Answer the following questions using the **manor name** to identify the map.

1. Which map did you find best met the map requirements? _____

   Why did you select this map?

2. Which map contained the best legend and symbols for the map? _____

   What made this an easy to use legend?

3. Which map did find best met the land use proportions? _____

4. Do you feel any maps did not meet the land use proportions? If so, which one

   _____

5. Which map do you feel had the best use of color? _____

   What did you like about it?

6. Were there any maps that you had questions about placement of items – A map that made you go . .. I wonder why they did that?

7. After looking at all the maps, what is one thing you would do to improve your map?

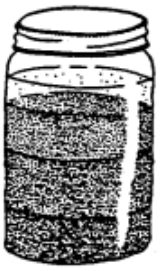
Teacher Demonstration to Engage – Session I

1. DO THIS PART OF THE DEMONSTRATION IN FRONT OF THE STUDENTS AND TELL THEM TO WATCH WHAT HAPPENS OVER THE NEXT COUPLE DAYS. DO NOT ANSWER ANY QUESTIONS OR GIVE ANY OTHER INFORMATION.

You will need three jars with three different types of soil that you label A, B, and C. These jars represent the three different soil samples from the manor that you have already mixed according to the proportions provided in the Teachers Notes on Wheat.

Soil Texture by Sedimentation

Another way to determine soil texture is by dividing the soil into its component parts using water to separate the particles.



Directions:

1. Fill a large (quart size) jar two-thirds full with water. Add soil until the water level is nearly to the top of the jar.

2. Cover and shake vigorously. Set the jar on a level surface and allow time for the particles to settle. The smallest particles may take overnight or even several days to settle.

2. THIS PART YOU WILL DO AFTER THE STUDENTS COMPLETE THE INVESTIGATION INTO SOIL TEXTURE AND WATER INFILTRATION. THIS WILL GIVE THEM ONE MORE PIECE OF INFORMATION IN FORMING THE SOLUTION TO THEIR PROBLEM.

3. Hold a piece of white poster board against the jar and mark the different layers on the board. Label these layers, from coarsest to finest (bottom to top), as sand, silt, and clay. Mark the top of the water level as well.

4. By measuring each layer of soil and the overall height of the water, you can calculate the percentage of each component and compare your results to the soil.

Task 2: Comparing Soil Samples (Properties)

Background Information:
Soils are precious natural resources that affect every part of the ecosystem. Soils hold water and nutrients for plants. All the food we eat and the natural materials we use, such as paper, wood and clothing; depend on soils. The physical properties of soils affect the type and amount of vegetation that can grow in a given location. For example, the amount of water a soil can hold, also known as **absorption** (water holding capacity) is a factor affecting the plants that can survive. Certain plants grow in sandy, well-drained, desert soils while others grow in heavy, clay, wetland soils.

Soil **texture** is the way a soil feels, and refers to the amount of sand, silt and clay particles that are present in a soil. Sand, silt, and clay particles are all different sizes. The largest soil particle is sand and feels gritty to the touch. The next smaller particle size is silt and feels smooth to the touch. The smallest particle size is clay and feels sticky and is hard to squeeze in your hand. Most soils have a mixture of sand, silt, and clay.

Tasks – Your job is to investigate the different soil samples from the manor to see if understanding the texture of the soil may help you devise a plan for improving crop production**.** There are three different tests we will conduct to examine the make-up of the soils.
One way to determine the **soil texture** is by moistening a soil sample and trying to form a ribbon with the sample.

Another way to examine texture is to test how the soil is affected by water. You will perform a water **infiltration** test. Infiltration rate is a measure of how fast water enters the soil. Based on what you observe about its behavior, you can get a rough idea of the soil texture.

And the last, is to observe how the soil **sedimentation** can help us determine what particles are in the soil. Sedimentation will separate the particles in the soil by type-- sand, silt, and clay.

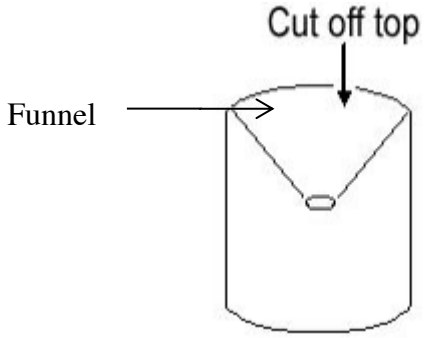
Water Infiltration

Names_____

Another way to examine texture is to test how the soil is affected by water. You will perform a water infiltration test. Infiltration rate is a measure of how fast water enters the soil. Based on what you observe about its behavior, you can get a rough idea of the soil texture. The amount of water that can infiltrate into the soil is influenced by precipitation (ice, snow, rain) factors and the nature of the soil. The precipitation factors are kind of precipitation and amount of precipitation that fall on the area.

Materials:

- Soil samples
- Three 2-liter plastic bottles with top cut off -
- Paper coffee filters
- Water
- Measuring cup or graduated cylinder



Procedures

1. Set up three bottles as shown.
2. Place coffee filter in the funnel.
3. Fill coffee filter with 1 cup of soil sample.
4. Make sure soil sample is spread evenly.
5. Pour 2 cups of water slowly over soil; do not let overflow.
6. Record time it takes for water to be absorbed into soil and begin to drain into bottle.
7. Use measuring cup to determine amount of water that drained through soil and record.
8. Record amount of water retained in soil.
9. Repeat with each of the three soil samples taken from the manor.

After observing what happens, be ready to answer this question: **How do you think water absorption might affect the crops?**

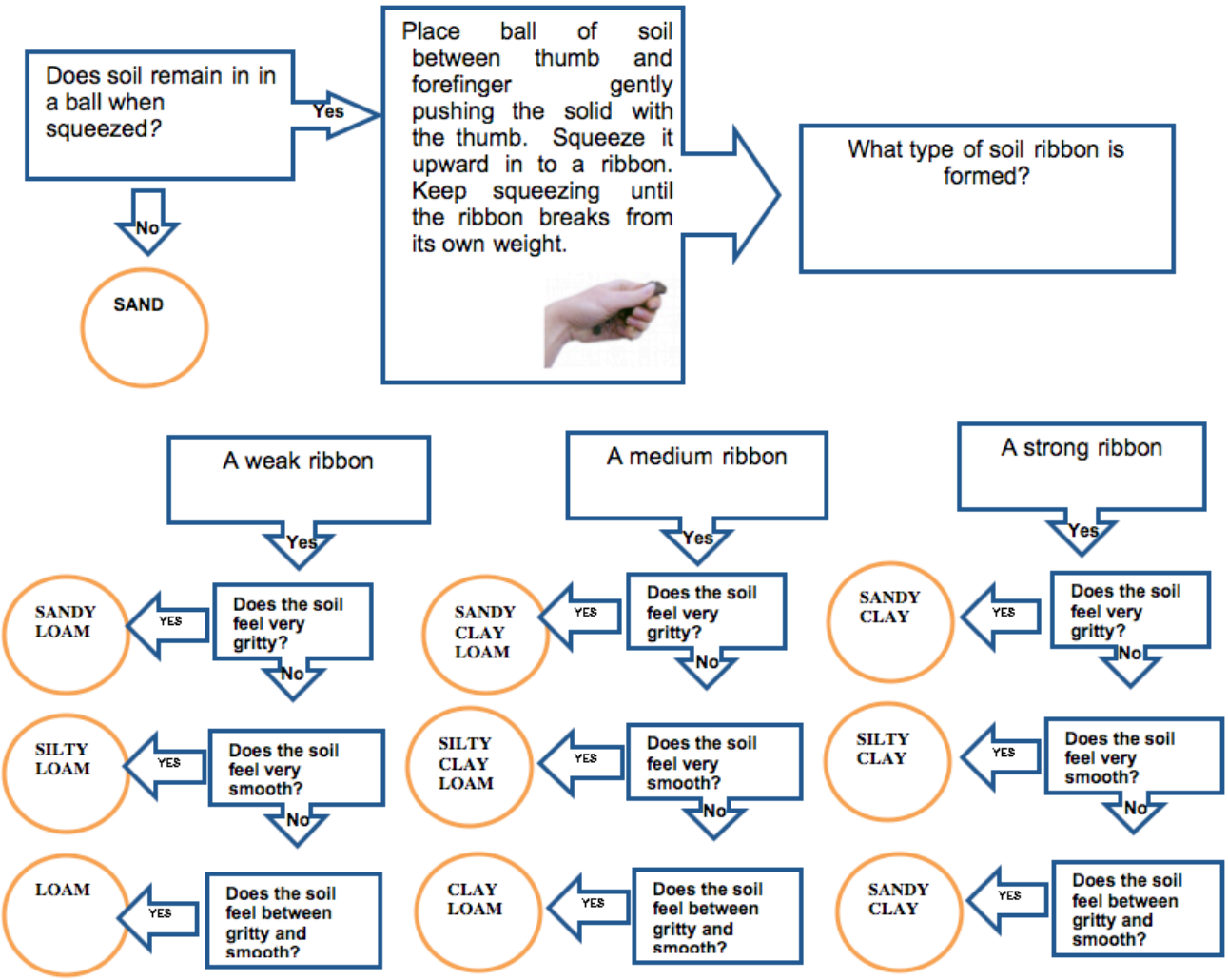
Soil Type	Absorption Rate (time to discharge water)	Discharge Amount (amount traveling through the soil)	Water Absorbed (amount held in the soil)
Sample A			
Sample B			
Sample C			

Texture-by-Feel Analysis of Soil Student Instructions

Step 1: Take a small handful of soil that will fit comfortably in the palm of your hand.

Step 2: Add enough water to make a ball. Knead the ball for 1 – 2 minutes, adding more water until it just stops sticking to your fingers.

Step 3: Now you are ready to analyze the soil. Follow the arrows (yes or no answers) until you determine the type of soil. Test each soil sample. Be sure to record your results before going to the next sample.



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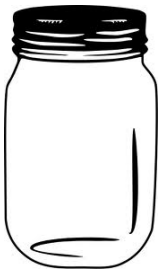
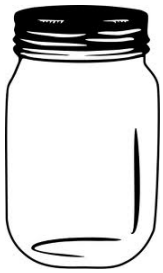
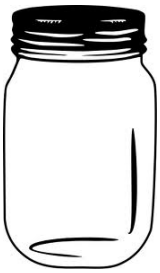
Names_____

Task 2: Soil Investigation Worksheet

Describe what you discovered about the soil textures of soil from different parts of the manor.

Sedimentation Test: Draw what you observed:

A  **B**  **C** 

What is the proportion of silt, sand, and clay in each field?

Sample A ____% silt ____% sand ____% clay

Sample B ____% silt ____% sand ____% clay

Sample C ____% silt ____% sand ____% clay

Water Infiltration Test- Observations

Soil Type	Absorption Rate (time for water to travel through soil)	Discharge Amount (amount which traveled through the soil)	Water Absorbed (amount of water remaining in the soil)
Sample A	☐ slowest ☐ medium ☐ fastest	☐ almost all ☐ very little ☐ in between	☐ the most ☐ the least ☐ in between
Sample B	☐ slowest ☐ medium ☐ fastest	☐ almost all ☐ very little ☐ in between	☐ the most ☐ the least ☐ in between
Sample C	☐ slowest ☐ medium ☐ fastest	☐ almost all ☐ very little ☐ in between	☐ the most ☐ the least ☐ in between

Texture-by-Feel Analysis of Soil

Sample A is: _____

Sample B is:_____

Sample C is: _____

Discussion Questions:

1. Describe which soil texture would be best for gardens and growing healthy plants.

2. How do you think water absorption might affect the crops?

3. Why is it important to think about these properties of the soil?

Soil Investigation Worksheet **Answer Key**

Soil by Feel and Infiltration Test investigation results VARY by observation and what is recorded.
Separation Demonstration (one done by teacher) investigation results VARY by observation and discussion.

Discussion Questions

1. Soils that are best for gardens and growing plants are loams. These soils are found in areas with good summer rains and cold winters. This makes for a variety of grain sizes. There are a variety of loams (i.e. sandy, silty, clayey, etc.); however a loam has less clay than sand or silts. Loams also tend to have higher organic material percentages.

2. Answers will vary. Infiltration is an indicator of the soil's ability to allow water movement into and through the soil profile. Soil temporarily stores water, making it available for root uptake, plant growth and habitat for soil organisms. If it runs off, plants don't get enough water. If it drains too quickly, water doesn't stay long enough for plants to use the water.

3. The texture of a soil affects the water infiltration rates and the movement of water through the soil. The soil texture can also affect the aeration of the soil and the ease with which a soil can be tilled. A soil's texture is a factor that can control if the soil may be used for agriculture or gardening.

Name(s): _____

Cultivation and Production Improvement Report

Total Acreage of the Manor set aside for cultivation (farming) - use your manor map for this information: _____ acres (50% of the manor land).

One-fourth of the land for cultivation is fallow (not being used in order to nourish the soil): _____ acres

Current acres being farmed: _____

Chart of Land in Cultivation

	Lord's Acreage 50%	**Peasant Acreage 40%**	**Parish (Church Acreage) 10%**
Field A			
Field B			
Field C			
Total			

Wheat Harvest Report

Field A production is 9 bushels of wheat per acre.
Field B production is 5 bushels of wheat per acre.
Field C production is 7 bushels of wheat per acre.

	Lord (50%)	**Peasant (40%)**	**Parish (10%)**
Field A			
Field B			
Field C			

ASK: Observations based on this data about the wheat yield (amount produced) of the three fields:

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IMAGINE and PLAN: What does the lord of the manor want you to do? What was your plan to discover a possible reason for the yield differences?

PLAN: What did you discover about the properties of the three fields (summary of results)?

CREATE: What is your suggestion for improving production?

IMPROVE: What are some other areas of possible investigation into the different yields? Pick **one** and describe how you might design a way to investigate this possibility?

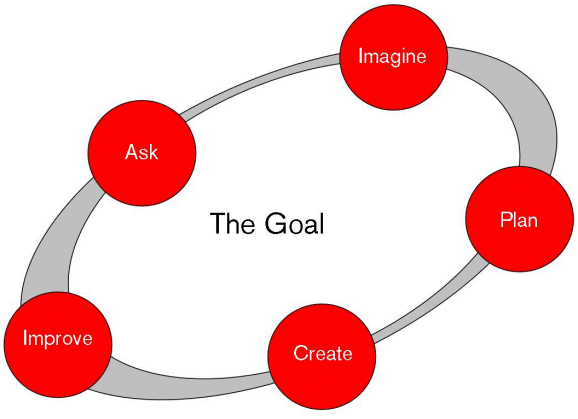
Plants Water and Nutrition	**Weather**
Land- topography (shape of the land)	**Other Ideas**

Engineering Design Model: How do you rate your teams understanding of this process? Circle one:

A. Excellent - We could design our own investigation.

B. Good – We could design our own investigation but might need some help.

C. Not Yet – We would probably need a lot of help designing an investigation.



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Answer Key: Cultivation and Production Improvement Report

Name(s): _____

Total Acreage of the Manor set aside for cultivation: __400____ acres (50% of the manor land). Manor land is 800 acres

One fourth of the cultivated land is fallow (not being used in order to nourish the soil): ___100_____ acres (1/4 of the total cultivated land)

Current acres being farmed: _____300_____ (400 cultivate acres – 100 non-cultivated acres)

Chart of Land in Cultivation

	Lord's Acreage 50%	Peasant Acreage 40%	Parish (Church Acreage) 10%
Field A	50	40	10
Field B	50	40	10
Field C	50	40	10
Total	150	120	30

Wheat Harvest Report

Field A production is 9 bushels of wheat per acre.
Field B production is 5 bushels of wheat per acre.
Field C production is 7 bushels of wheat per acre.

	Lord (50%)	Peasant (40%)	Parish (10%)
Field A	350	280	70
Field B	250	250	50
Field C	450	360	90
Total	1050	890	210

Lord's Interview Questions:

1. What solution do you have to increasing my wheat production in Field A?
2. What solution do you have to increasing my wheat production in Field B?
3. What difference does it make if my fields have too much sand?
4. Tell me how you went about testing my soil?
5. How can I tell if my soil is sandy?
6. How can I tell if I have too much clay?
7. How can I tell if I need more clay?
8. Do you think there could be too much silt in the soil?
9. What else could be the problem with the wheat production in my manor?
10. How do you plan to test other possibilities?
11. What is in loam?
12. What would be the best proportion of loam for my crops to grow best?
13. Do you think that because field A is on a hill this could affect the production?
14. How does the amount of water the soil holds affect the way wheat grows?
15. How can you tell how much water soil is able to hold?
16. How does the amount of clay in the soil affect the plants?
17. How does the size of the soil particles affect the way plants grow?
18. If I decided to grow some other type of crop in Field A or B, might I have more success?

Production and Cultivation Improvement Report Scoring Guide

	Points Possible	Team	Reeve or Lord	Comment(s)
Completed Soil Investigation Worksheet to compile findings of investigations	**10**			
Acreage Calculations: correctly computed	**10**			
Process: fully explained each step in the investigation	**10**			
Suggestion to lord: based on the investigation and supported with data	**10**			
Further investigations considered: team worked together to brainstorm other possible investigations	**5**			
Presentation-each member of the team has a part in the presentation prepared.	**5**			
Total	**50**			

Team Reflections:

What were two things your team did well?

1.

2.

In what two areas could your team improve its performance?

1.

2.

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Answer Key for PowerPoint - Agriculture – Engineering and Technology: From the Middle Ages to Now

Review:

What is technology? **Technology is almost anything created to solve a problem or meet a need. It can be a thing, system or process.**

What is engineering? **Engineering is the use of creativity to design something to solve a problem**

What is agriculture? **The term agriculture is generally used to describe the science or the practice of cultivating plants, animals and other life forms for the utilization of food and other products by humans to sustain life.**

What do you think an agricultural engineer does? **Answers will vary but should combine elements of technology, engineering, and agriculture in answer.**

The Middle Ages

Improvements in agricultural technology were among the most important things that happened in the Middle Ages. Let's look at some of the farming and agricultural technologies that were developed during this time:

1. Crop rotation was done in ancient times. The improvement was to go from a two-field system to a three-field system, increasing the amount of agricultural land in use by 37% from what it had been in ancient times. **Could grow more crops and feed more people**

2. The invention of the horse collar made it possible for horses to pull harder and longer. **Farmers could plow more land.**

3. Horse equipment also made it possible for the horse to pull newly invented heavier plows. **Made plowing easier, could plow deeper, plow more fields**

4. The peasants also developed ***tandem harnessing***, which allowed as many horses as one had to be hitched to the same vehicle. **Could plow more fields in less time**

5. Horseshoes were invented. **Protected horses from damaging hooves on stones, or hoof damage from standing in wet fields, prevented horse injuries**

6. The European wheelbarrow was an improvement on the earlier one used in ancient Rome that required two men to use it. **Less manpower needed--farmers could do other things**

7. Wine presses were a medieval invention. **More production--more trade**

8. Vertical windmills and mills powered by tidal action were invented. **Could make more grains for more food**

9. Grinding wheels for sharpening tools were invented in the Middle Ages. **Better tools--faster production**

10. New spinning wheels and looms increased demand for linen fiber. **More jobs and better and cheaper cloth.**

Pick three improvements and/or inventions? For each of your choices, tell how the new technology affected or improved life in the Middle Ages. Answers will vary but should be supported with correct evidence.

Now the big question - - - what do you think was the result of all of these improvements? The increased agricultural production could sustain more people which in turn increased the number of towns.