

Soil Solutions: A Medieval Soil Mystery

Author Diane Godfrey
Grade Level 6
Duration 5 class periods

National Standards

GEOGRAPHY

Element One:

The World in Spatial Terms

1. How to use maps and other geographic representations, geospatial technologies, and spatial thinking to understand and communicate information
3. How to analyze the spatial organization of people, places, and environments on Earth's surface.

Element 6: The Uses of Geography

17. How to apply geography to interpret the past
18. How to apply geography to interpret the present and plan for the future

NEXT GENERATION OF SCIENCE STANDARDS

MS. Structure and Properties of Matter

MS-PS1-b. Design a solution that solves a practical problem by using characteristic chemical and physical properties of pure substances.

MS Engineering Design

MS-PS1-b. Design a solution that solves a practical problem by using characteristic chemical and physical properties of pure substances
MS-LS2-g. Make an oral or written argument from evidence to support or refute the merits and constraints of different plans to solve a real-world problem to restore a disrupted ecosystem.

AZ Standards

ELA

Reading

Integration of Knowledge and Ideas

6.RI.7 Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

Writing

Production and Distribution of Writing

6.W.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

MATHEMATICS

Ratios of Proportional Relationships

6.RP.A.3.

Use ratio and rate reasoning to solve mathematical problems and problems in real-world context (e.g., by reasoning about data collected from measurements, tables of equivalent ratios, tape diagrams, double number line diagrams, or equations).

c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity). Solve percent problems with the unknown in all positions of the equation.

Arizona Social Science Standards

GEOGRAPHY

The use of geographic representations and tools helps individuals understand their world.

6.G1.1 Use and construct maps, graphs, and other representations to explain relationships between locations of places and regions.

Human-environment interactions are essential aspects of human life in all societies.

6.G2.1 Compare diverse ways people or groups of people have impacted, modified, or adapted to the environment of the Eastern Hemisphere.

HISTORY

The development of civilizations, societies, cultures, and innovations have influenced history and continue to impact the modern world.

6.H1.1 Compare the development and characteristics of historical cultures and civilizations from different global regions within designated time periods.

6.H1.2 Explain the causes and effects of interactions between cultures and civilizations.

Patterns of social and political interactions have shaped people, places, and events throughout history and continue to shape the modern world.

6.H4.1 Describe how different group identities such as racial, ethnic, class, gender, regional, and immigrant/migration status emerged and contributed to societal and regional development, characteristics, and interactions over time.



SIOP Elements		
Preparation Adapting content Linking to background Linking to past learning Strategies used	Scaffolding Modeling Guided practice Independent practice Comprehensible input	Grouping Option Whole class Small groups Partners Independent
Integrating Processes Reading Writing Speaking Listening	Application Hands on Meaningful Linked to objectives Promotes engagement	Assessment Individual Group Written Oral

Arizona English Language Proficiency Standards

Grade 6

Basic

Listening and Reading

Standard 1 By the end of each language proficiency level, an English learner can construct meaning from oral presentations and literary and informational text through grade appropriate listening, reading, and viewing.

B-1: determine the central idea or theme and explain how they are supported by using some text evidence.

B-2: recount specific details and information in a variety of texts.

Speaking and Writing

Standard 3 By the end of each language proficiency level, an English learner can speak and write about grade appropriate complex literary and informational texts and topics.

B-5: use examples of precise language and domain-specific vocabulary within informative texts.

Standard 5 By the end of each language proficiency level, an English learner can adapt language choices to purpose, task, and audience when speaking and writing.

B-1 demonstrate awareness of the need to adapt language choices according to purpose, task, and audience.

B-2: use general academic and content specific words, phrases, and phrases to express ideas.

Listening, Speaking, Reading, and Writing

Standard 6 By the end of each language proficiency level, an English learner can participate in grade-appropriate oral and written exchanges of information, ideas, and analyses, responding to peer, audience, or reader comments and questions.

B-1: participate in discussions about familiar topics and texts.

B-2: participate in written exchanges about familiar topics and texts.

B-5: contribute relevant information and evidence to collaborative oral and written discussions.

Standard 7 By the end of each language proficiency level, an English learner can conduct research and evaluate and communicate findings to answer questions or solve problems.

B-2: paraphrase observations/information notes with labeled illustrations, diagrams, or other graphics, as appropriate.

Overview

From the earliest beginning of civilization, agriculture has played a critical role in the advancement of societies. Without a stable food supply, countries were unable to sustain the people living there.

Today, it is the role of the agricultural engineer to continually look for ways to improve farming and land use in order to feed the 7 billion people living on our planet.

Purpose



Soil Solutions: A Medieval Soil Mystery

In this lesson, students will be transported back in time to the year 1100 AD to become serfs sent to solve the problem of poor wheat production on a feudal manor. In order to propose a solution, students will carry out investigations of the soil in the manor's fields then report back to the lord of the manor. Students will follow the engineering design model for their investigations while also learning about European feudal society.

Key Vocabulary

peasant, serf, or villein: member of the lowest feudal class and required to work for the lord

properties: characteristics of the soil

loam: a mixture of silt, sand, and clay

cultivate: to work on the soil in order to grow crops

fallow: a land area that is not used for growing crops

infiltration: the process by which water on the ground enters the soil

absorption: the ability to hold water

acre: a measurement of land area about 1.3 times the size of a football field

Materials

- Teacher Notes and Background Information
- Teacher Notes on Wheat
- Student Handout
- Task 1: The Manor Map
- Manor Map Scoring Guide
- Manor Map Gallery Walk
- 12" x 18" or larger drawing paper for map
- Art supplies for the map
- Teacher Demonstration to Engage--Session I
- Soil components (See Teacher Notes on Wheat for recommended stores)
- Task 2: Comparing Soil Samples (Properties)
- Water Infiltration
- Soil Texture by Feel Analysis of Soil
- Soil Investigation Worksheet and Answer Key
- Cultivation and Production Improvement Report and Answer Key
- Lord's Interview Questions
- Cultivation and Production Improvement Report Scoring Guide
- Power Point and Answer Key: Agriculture-Technology and Engineering: From the Middle Ages to Now
- Vocabulary Cards
- Vocabulary Test and Answer Key

Objectives

The student will be able to:

1. Create a map of a medieval manor based on written description of a manor.
2. Analyze a map for spatial organization of a manor.
3. Identify differences in soil properties between three different samples of soil.
4. Conduct an investigation into soil properties.
5. Report the results of soil property investigations.
6. Analyze production statistics.
7. Compute ownership and production using percentages.
8. Propose solution to improve crop production based on investigations.
9. Speculate on other factors that affect crop production
10. Identify ways that agricultural technology and engineering improves the lives of people—past and present.

Procedures

Prerequisite knowledge: Students should have been introduced to the European feudal system. Students should know how to calculate percentages.

SESSIONS ONE AND TWO

Engage:

a. Inform students they have been transported back into time. It is the year 1100 AD and they have become serfs (peasants) living on a manor in the heart of Europe. (For ELLs-be sure the students understand the imaginary idea of time travel.).

(Preparation: Adapting content, Linking to Background) Tell them they will need to successfully complete a series of tasks in order to return to the present. To earn this return, they must work to come up with a solution to the problem of poor wheat crop production in some areas of the manor and earn the lord's favor.

Optional: You may want to set up a "reward" system for cooperative tasks and the final report.

b. Let them know they are not alone; they have been transported in groups of three to the manor.

Divide students into groups of three (**Grouping Option: Small groups**)

c. Explain that you are now the **reeve**. (A reeve was employed by the lord to ensure that peasants worked well and did not steal from a lord.)

Explore:



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a. Distribute a sheet of paper to each group. Give each group time to generate ideas on what they think life was like for the peasants/serfs at this time? Ask them to sketch what they think should be on a manor. Review that a manor is a **self-sufficient** unit of land owned by a lord and worked on by the serfs.

(Preparation: Linking to Past Learning)

b. Before sharing ideas with the large group, have students share within their small groups so that ELLs have an opportunity to rehearse their answers.

(Integrating Processes: Speaking)

c. Ask groups to share out their ideas. **(Integrating Processes: Listening)**

d. Let students know that over the next couple days they will be investigating and gathering information in order to solve the problem of poor crop production on the manor. If they do not solve the problem, they will not be returning to present day.

e. Then explain that to help solve the problem they will need to learn about soil.

f. Conduct Teacher Demonstration Engage— Session 1 on Sedimentation **(Scaffolding: Comprehensible Input)**

Explain:

a. Distribute the Student Handout. Read the introduction together.

b. Have students identify words or concepts that need more clarification. You may need to begin this process by asking students some questions to get them started: Can you tell me in your own words what is a manor? Does anyone know how big an acre is? Has anyone been on a farm? Did the farm use strip farming? **(Scaffolding: Comprehensible input)**

c. Read together the instructions for creating a map of their manor. Go over the concept of proportion and clarify they understand this percentage for land use is based on the whole (the manor land). Check for understanding - call on a student to explain another way of saying 50%, 25% (half and a quarter). Have the student draw a rectangle on the board and demonstrate and label percentages of a whole. **(Scaffolding: Modeling)**

Elaborate:

a. Distribute to each group a piece of paper and Task 1: The Manor Map and the Manor Map Scoring Guide.

b. Explain the assignment and how they will be evaluated on their map.

c. If you want, you can briefly display examples of manor maps but don't give them too many ideas.

d. Hold them all accountable by explaining that you will observe how the group works together and

report back to the lord of the manor. Explain that the lord of the manor may give "rewards" to the groups that share responsibilities for the task.

a. Provide students time to complete their maps.

(Application: Hands-on)

e. Collect all the maps after the students have attached the Manor Map Scoring Guide to the back of their map.

f. Wrap up the session by having students write down on a slip of paper what they did to help the group complete the task and collect it at the door.

g. **(Integrating Processes: Writing)**

h. Groups may need additional time to finish the map in Session II or complete as homework.

Evaluate:

a. To evaluate the maps, post all the maps on a wall or desktops. Be sure to leave plenty of spacing for students to move around for about 5 minutes and look at the maps. Let students share ideas within their groups.

b. Distribute the Manor Map Gallery Walk and explain key vocabulary terms (best legend, best symbols, etc.) on the worksheet. **(Scaffolding: Comprehensible input)**

c. Give students additional time to examine the maps again but this time focusing on the questions on the worksheet. Students will complete their own worksheet. **(Grouping: Independent)**

d. End class by having students share a few comments about the maps.

e. Collect the Manor Map Gallery Walk.

f. Let students know the lord of the manor will be reviewing the maps and rewards may follow.

SESSION THREE AND FOUR

Engage:

1. Repeat the problem that needs to be solved: The lord of the manor has an issue with some of the serfs on his manor not producing enough crops on the lord's land. It will be the job of the serfs to come up with a way to get more crops from the lord's fields.

2. To solve the problem, they need to learn more about farming, especially soil, to make a plan that they can present to the lord.

Explore:

a. Explain to students there are some acres on the farm that produce crops better than other places.

b. Distribute the Production and Cultivation Improvement Report. Tell students they will fill out this report as they carry out this investigation.



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- c. Have the students complete the first page to prepare the data on land under cultivation and the yields for the three fields. **(Grouping: Small groups or Independent)**
- d. Give students a few minutes to come up with ideas on what might contribute to one area of the manor producing better crops than others.
- e. Share out a few of the responses and let students know that the peasants will just begin by focusing on soil, but to keep these other ideas in mind for later. **(Integrating Processes: Listening)**

Explain:

- b. Tell students you have collected some soil samples from different parts of the manor. The soil samples from the manor fields have been divided into A, B, and C buckets.
- c. Explain that students by the end of the class they will be able to answer the question: What are some **properties** of different soils?
- d. Give each group a plastic cup with soil from the three different fields/buckets. Use a permanent marker to mark the cups A, B, and C.
- e. Tell students that one of the important parts of engineering **(ASK)** is to be able to communicate the **properties** of the material they are working with.
- f. Ask students to inspect the soils using their eyes, noses, and hands. **(Application: Hands-on)**
- g. In their groups, discuss what they see, feel, and smell in the samples. On the board, record what students share out about the samples. **(Integrating Processes: Listening)** Be sure students understand that the soil properties are different in each sample.
- g. Distribute the Task 2: Comparing Soil Samples (Properties) and Task 2: Student Soil Investigation Worksheet. Read the Background Information together and discuss any vocabulary or concepts that might not be known. **(Integrating Processes: Listening; Scaffolding: Comprehensible input; Grouping: Whole class)**

Option 1:

- h. Divide the class into half. One half will complete the Texture by Feel Analysis of Soil Investigation using the soil from the three cups. The other half of the class will participate in the Water Infiltration investigation. Groups will switch activities.

Option 2:

- i. Have all students complete the Texture by Feel Analysis of Soil investigation. Then conduct the Water Infiltration investigation as a demonstration only. As you pour water into the funnels, students will record their observations on the Water Infiltration worksheet concerning soil from the 3 samples.

- j. Bring out the jars from Session 1 demonstration on Sedimentation. Complete the second part in front of the students.
- k. Review what is the goal (problem to be solved) and what would it look like if they were successful. **(Application: Linked to Objectives) (IMAGINE)**

Elaborate:

- a. Have groups complete the Task 2: Soil Investigation Worksheet together. **(Grouping: Small groups) (PLAN)**
- b. Check for understanding by asking discussion questions. **(Integrating Processes: Listening and Speaking; Grouping: Whole group)**
- c. Have students prepare their Cultivation and Production Report except for the CREATE portion and self-evaluate their group on the Cultivation and Production Scoring Guide. **(Grouping: Small group; Assessment: Individual)**

Evaluation:

- a. Now have students complete the CREATE portion of the Cultivation Production Report individually on a separate sheet of paper. Each group member will share his/her ideas for improving cultivation on the various fields. **(Grouping: Independent and Small group)**
- b. Use Lord's Interview Questions to check for understanding. Ask each group one or two questions. **(Assessment: Oral and Individual)**
- c. Use the Cultivation and Production Improvement Report Scoring Guide to evaluate student work. **(Assessment: Written and Individual)**
- d. Discuss ideas for other investigations that could relate to soil. **(IMPROVE)**

SESSION FIVE

- a. Show students the Power Point: Agriculture – Technology and Engineering: From the Middle Ages to Now.
- b. Discuss observations on modern farm technology and the role of agricultural engineers. **(Preparation: Linking to Past Learning)**
- c. Show the Power Point a second time and have students complete the activities. **(Scaffolding: Comprehensible input)**

Assessment

Social Sciences

The Manor Map can be graded using the Manor Map Scoring Guide. Mastery will be considered a score of 80% or higher.



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Science

The Soil Investigation Worksheet can be graded using the answer key. Mastery will be considered a score of 75% or higher.

Mathematics and ELA

The Cultivation and Production Improvement Report can be graded using the scoring guide. Mastery will be considered a score of 80% or higher.

Science and ELA

The questions for the PowerPoint (Agriculture-Technology and Engineering: From the Middle Ages to Now) can be scored using the answer key. Mastery will be considered a score of 80% or higher.

ELA

The Vocabulary Test can measure language acquisition. Mastery will be considered a score of 80% or higher.

Extensions

A compilation of other investigations for exploring and understanding soil by Utah Agriculture in the Classroom:
http://utah.agclassroom.org/files/uploads/estore/unit_dirt.pdf

Brain Pop videos on soil, nitrogen cycle or photosynthesis.

Research the pros and cons of genetically altered crops.

Investigate the role of soil and the Dust Bowl.

Sources

Examples of a Manor Maps:

http://www.angelfire.com/hi5/interactive_learning/Norman_Conquest/the_middle_ages.htm

http://go.hrw.com/hrw.nd/gohrw_rls1/pKeywordResults?ST9%20Medieval%20Manor

http://www.uncp.edu/home/rwb/lecture_mid_civ.htm

YouTube video explaining soil texture separation test

<https://www.youtube.com/watch?v=iZvgRMjYpVM>

Soil Texture Test Instructions

http://www.agric.wa.gov.au/objtwr/imported_assets/content/lwe/water/irr/fn_soil_texturing.pdf

