Geography Grows a Stem:  
Engineering that Made a Difference

Author  
Patricia Touchette Hutchinson

Grade Level  
6th

Duration  
1-2 class periods

National Standards

NATIONAL GEOGRAPHY STANDARDS

Essential Element I: The World in Spatial Terms
1. How to use maps and other geographic representations, tools, and technologies to acquire, process and report information.

Essential Element IV. Human Systems
12. The process, patterns and functions of human development.

NEXT GENERATION of SCIENCE STANDARDS

MS Engineering Design

MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

Common Core Standards

ELA COMMON CORE

Reading Standards for 6-8 for Literacy in History/Social Studies

Key Ideas and Details

6-8.RH.1 Cite specific textual evidence to support analysis of primary and secondary sources.

Integration of Knowledge and Ideas

6-8.RH.7 Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.

Arizona Standards

SOCIAL STUDIES STANDARD

Grade 6
Strand 2: World History Concept 2: Early Civilizations

PO 2. Determine how the following factors influenced groups of people to develop into civilizations

Strand 4: Geography Concept 1: The World in Spatial Terms

PO 4. Locate physical and human features (e.g., significant waterways, mountain ranges, cities,

Concept 5: Environment and Society

PO 2. Describe the intended and unintended consequences of human modification (e.g., irrigation, aqueducts, canals) on the environment.

SCIENCE STANDARD Concept 2: Science and Technology in Society

PO1 Propose viable methods of responding to an identified need or problem.

PO2. Compare possible solutions to best address an identified need or
Geography Grows a STEM problem.

<table>
<thead>
<tr>
<th>SIOP Elements</th>
<th>Preparation</th>
<th>Scaffolding</th>
<th>Grouping Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adapting content</td>
<td>Modeling</td>
<td>Whole class</td>
<td></td>
</tr>
<tr>
<td>Linking to background</td>
<td>Guided practice</td>
<td>Small groups</td>
<td></td>
</tr>
<tr>
<td>Linking to past learning</td>
<td>Independent practice</td>
<td>Partners</td>
<td></td>
</tr>
<tr>
<td>Strategies used</td>
<td>Comprehensible input</td>
<td>Independent</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Integrating Processes</th>
<th>Application</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td>Hands on</td>
<td>Individual</td>
</tr>
<tr>
<td>Writing</td>
<td>Meaningful</td>
<td>Group</td>
</tr>
<tr>
<td>Speaking</td>
<td>Linked to objectives</td>
<td>Written</td>
</tr>
<tr>
<td>Listening</td>
<td>Promotes engagement</td>
<td>Oral</td>
</tr>
</tbody>
</table>

TESOL Standard(s)

ESL: English for Content
Through The Use Of ESL Methodologies, The Student Will:
EFC-A. Create, read, and interpret visual information relating to science, social studies, and math.
A1. Draw and label maps.

Arizona English Language Proficiency Standards

Stage IV
Basic
Reading
Standard 4: The student will analyze text for expression, enjoyment, and response to other related content areas.
The student will demonstrate knowledge of reading comprehension by:
Stage IV Reading Standard 4: The student will analyze text for expression, enjoyment, and response to other related content areas. The student will demonstrate knowledge of reading comprehension by:
B-4: answering who, what, where, when, why, which and how questions about text..HI-8: summarizing the main idea and supporting details from text using academic vocabulary.

Writing
Standard 2: The student will identify and apply conventions of standard English in his or her communications.
The student will identify and apply conventions of standard English in his or her written communications by:
B-3: writing words and sentences using appropriate capitalization (e.g., proper nouns, pronoun “I”, titles, abbreviations, words used as names).
B-4: writing sentences using appropriate punctuation (e.g., ending punctuation; period: abbreviations; colons: time; commas: items in a series, introductory words, friendly letters; apostrophes: contractions).

Overview

Man has the ability to solve problems. While engineers are often seen as the problem solvers, they also deal with geographic challenges in many of their worksites. So how does geography and engineering tie together?
Purpose

In this lesson, students will connect geographic themes and locations with engineering advances, using six different locations. This lesson can be considered a beginning lesson to show how geography ties with STEM subjects. It is modified for English Language Learners (ELLs).

Key Vocabulary

geography: the study of the Earth

technology: use of science to solve problems

engineering: using science to solve problems

Materials

- World Map- Atlantic Centered
- Computer, projection device, and Internet
- Atlases (if available)
- 5 Themes video (See Sources section)
- Engineering Design Process image
- Short Youtube videoes of each engineering project (6 of these about 2 min. each) (See Sources section)
- Video Analysis Sheet
- Engineering that Made a Difference readings (6)
- Reading Analysis Sheet and Answer Key
- Highlighters
- Google Earth (Extension idea)
- Vocabulary cards

Objectives

Students will be able to:
1. accurately locate the different sites on a map of the world
2. connect the engineering design process to their own construction projects
3. articulate the result of the engineering process that is associated with each site.

Procedures

Prerequisite Knowledge: Students know the 5 Themes of Geography.

SESSION ONE

Engage:

a. Begin the lesson with a 53 second video on the “5 Themes of Geography” for a review. Take time to write the 5 themes on a whiteboard and have students give examples of each. (Preparation: Linking to Past Learning)

Explain:

a. Tell the students that the 5 themes will be used throughout this lesson. They will also be using certain map skills to locate the following:
   - Hama, Syria
   - Avignon, France
   - Isthmus of Panama
   - Mohenjo-Daro, Pakistan
   - Chand Baori Jaipur, India
   - Chunnel English channel at Dover
b. Model finding one of these locations on a map of the world. (Scaffolding: Modeling) Distribute the world maps and atlases and have the students locate the countries. They will estimate the location and write the city/physical feature and country name on the map and mark it with a star. (Scaffolding: Comprehensible Input)
c. The class will brainstorm what they may know about the environment of each of these geographic locations; vegetation, water, climate, physical environment etc. (Preparation: Linking to Past Learning) Write this information on the whiteboard or a flip pad.
d. At this point write “human-environmental interaction” on the board. This is the geographic theme that is most important to this lesson., Ask the students for some examples of human-environmental interaction (HEI). Examples may range from mining, to road building, to creating and enjoying a park, etc. Accept all ideas. (Scaffolding: Comprehensible Input)
e. Introduce the following definitions:
   - geography: the study of the Earth’s
   - technology: use of science to solve problems
   - engineering: using science to solve problems

Have students suggest images that could illustrate each of the words. Give vocabulary cards to ELLs.
f. Now that students understand a definition of engineering, introduce the Engineering Design Process. Display the image that explains the process. (Scaffolding: Comprehensible Input)
g. Ask if any students have ever tried to build a fort or another project. Did it work the first time? If not, what did they have to do to make it work? Students should take an example from their own lives and practice the engineering design process in a think/pair/share. For example: give a problem you solved such as: Too much trash was being left in desks. Be sure to model the design process on how you solved the problem. Then let them do the
SESSION TWO:
Explore:

a. Pass out Video Analysis Sheets to each student. Students will respond individually to the following questions for each video: "What difference did this engineering project make?" "What problem did it solve." (Group Option: Independent or Partners) (Application: Promotes Engagement)

b. Students will now view six short videos (each about 2 min.). Students will hold on to the Video Analysis Sheets for the next part of the lesson.

Elaborate:

a. After viewing the videos, students will break into groups. (Group Option: Small Groups) Each group will now receive a short reading about one of the videos. As a group, students will read orally read through the selection and highlight important geographic facts that relate to HEI (geography) and engineering.

b. Before students begin the group work, explain that each complete response is worth 5 points. Students are to observe correct capitalization and end punctuation. Students are encouraged to collaborate but they will each individually fill out a Reading Analysis Sheet.

c. Ask groups to share their ideas with the rest of the class. Students should then fill in their Reading Analysis Sheets for the other 5 readings. (Integrating Process: Listening) (Assessment: Written)

d. As closure, go back to the whiteboard or flip pad and have class add to or delete parts of their original information about the environment of the six geographic locations now that they know more about each location. (Preparation: Linking to Past Learning)

Assessment

Evaluate:
Reading Analysis Sheet can be graded for reading/geography/science using the point system given on the worksheets: (150 pt. total) Mastery would be 120 points (80%) or higher for a reading grade.

Mapwork can be graded for a geography grade. Mastery would be 90% or higher on locating the 6 locations.

The Video Analysis Sheet can be graded for science (engineering) concepts of problems and solutions. Mastery would be considered completing 80% of the questions with reasonable answers.

Extensions:

1. Create a Google Earth tour to link the different geographic locations. Use the coordinates listed at the top of the reading selections and insert a virtual tack at each location.
2. Show da Vinci Self-Supporting Bridge images. Have students build Leonardo’s Self-Supporting Bridge. You will need parts of equal size. Wood (craft sticks) works better than plastic, for example because there will be less friction. This self-supporting bridge was supposedly designed to help move war brigades over water.

Sources

Youtube Videos:
5 Theme of Geography (edited through iMovie).
http://www.youtube.com/watch?v=ty32cUqxa5g

Big,Bigger,Biggest: Building the Panama Canal
http://www.youtube.com/watch?v=3cboULUZeB0

Mohenjo Dara and Harappa
http://www.youtube.com/watch?feature=endscreen&NR=1&v=RAlK2AXTAeA

Pont du Gard: Roman Aqueduct
http://www.youtube.com/watch?v=zQtiwLq9gW

Chand Baori Well- Jaipur, India
http://www.youtube.com/watch?v=9aWj0aqCPi0

Hama Water Wheels
http://youtu.be/-8Ys-EzwqWE

English Channel Underground Tunnel
http://www.youtube.com/watch?v=vGBnjM72WSsA

Tunnel Boring Machine as seen in Kuala Lumpur
http://www.youtube.com/watch?v=Q41vzLjwZgM&feature=player_detailpage

Leonard daVinci: The Engineer.
Geography Grows a STEM

http://illumin.usc.edu/printer/150/leonardo-da-vinci-
da Vinci bridge illustration.