

Aqueducts and Aquaduckies

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Grade Level 6
Duration 4 class periods

National Standards

GEOGRAPHY

Element 5: Environment and Society

- 14. How human actions modify the physical environment
- 15. How physical systems affect human systems
- 16. The changes that occur in the meaning, use, distribution, and importance of resources

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-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

AZ Standards

ELA

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.

Language

Vocabulary

Acquisition and Use

- 6.L.6 Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.

SCIENCE

Life Science

- 6.L2U1.14 Construct a model that shows the cycling of matter and flow of energy in ecosystems.

Arizona Social Science Standards

GEOGRAPHY

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.

Examining human population and movement helps individuals understand past, present, and future conditions on Earth's surface.

- 6.G3.1 Analyze how cultural and environmental characteristics affect the distribution and movement of people, goods, and ideas.

- 6.G3.2 Analyze the influence of location, use of natural resources, catastrophic environmental events, and technological developments on human settlement and migration.

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.



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 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-3 compose informational text that includes details to develop a topic while using appropriate conventions. B-5: use examples of precise language and domain-specific vocabulary within informative texts. 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.

Overview

The ancient Romans constructed many aqueducts to route water to cities and other sites. These aqueducts are considered to be one of the greatest engineering feats of the ancient world. Many of the ancient aqueducts are still in use today. Aqueducts served several functions including providing potable water and supplying water to baths and fountains. Water was then routed into the sewers, where they helped remove waste matter from the cities.

Purpose

In this lesson students solve a problem: How to get water to flow through use of an aqueduct. They will see how gravity plays a large role in the flow of this water while they will also practice the skills of an engineer.

Key Vocabulary

- trench:** a long cut in the ground, a ditch
- tunnel:** an underground passage
- pressurized pipe:** tube used to conduct liquid
- wall:** a structure of stonework, cement, or other materials built to retain a flow of water
- arcade:** a series of arches supported by columns
- gravity:** force by which bodies fall to the earth

Materials

- 4 Styrofoam or plastic cups per group of students
- Yard stick
- Poster Board
- Scissors
- 1 or more rubber ducks (aquaducks)
- Tape
- Tinfoil
- Aqueduct (Aquaducky) Engineering handout
- Rubric for Aqueduct (Aquaducky) Engineering
- Group Work Score Sheet for Aquaducky
- Aqueduct Essay Scoring Guide
- Vocabulary handout and Power Point
- Civil Engineering Power Point

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- Aqueduct Photos Power Point
- Vocabulary Test and Answer Key
- Engineering Design Process Model assessment
- Water source (faucet, 2-liter bottles or pitchers to pour the water)

Objectives

The student will be able to:

1. Explain how aqueducts worked to transport water.
2. Describe the job of a civil engineer.
3. Analyze how the advancement of technology changed a civilization and how geography played a role in the advancement.

Procedures

Prerequisite Knowledge: The students have read about aqueducts in one of their textbooks and are familiar with their uses and importance.

SESSION ONE

Engage:

1. Show the students the rubber duck. Explain the play on words (Aqueduct, Aquaduck).
(Scaffolding: Comprehensible input)
2. Then explain the problem: The herdsman who discovered Romulus and Remus has a problem. Remus is sad. His rubber duck was left behind in Rome. The fastest way to get the duck would be to float it through the Roman aqueducts to Remus. Can you help?
3. Have students share what they know about aqueducts since they will be using this invention to solve the problem. Record their comments on the whiteboard. **(Preparation: Linking to past learning)**
4. Show the Aqueduct Photos PowerPoint **slides 1-3 only**. Have students contribute more comments to the whiteboard after viewing the 3 slides. **(Preparation: Linking to past learning)**

Explore:

5. Return to the problem of getting the duck to Remus. Divide students into groups of 4 and have them design an aqueduct using the following list of materials: poster board, cups, tape, scissors, and tinfoil. Have 1 member of the group create a drawing of the proposed aqueduct. Have another member create a detailed materials list. **(Application: Promotes engagement; Grouping Option: Small groups)**
6. Have groups share their ideas.
7. Explain that in the next session, they will become civil engineers. To understand what civil

- engineers do, show the Civil Engineering Power Point. **(Application: Meaningful)**
8. Then show **slides 4-15** of the Aqueduct Photos PowerPoint.
 9. Conclude class with students sharing with a classmate three things that they learned today about aqueducts or about civil engineering. **(Assessment: Group)**

SESSION TWO

Elaborate:

1. Distribute the Aqueduct (Aquaduck) Engineering handout. Explain that as Civil Engineers, this is the problem they must solve (Remus needs his duck), and these are the specifications for building the aqueduct as decided upon by supervisors of the project. It is their job, as a group of 4 to create a model of the proposed aqueduct using the plans provided. If this model is successful, the larger (actual) project would be started.
2. Divide students into groups of 4 and review the requirements of the project including the grading rubric at the end of the handout. **(Grouping options: Small groups; Scaffolding: Comprehensible input)**
3. Groups will gather materials and begin working on the prescribed design. **(Application: Hands on, Promotes engagement)**

SESSION THREE

Evaluate:

1. Have students complete their aqueducts. When they are ready for testing, give them water. Work with each group to assess their success: Did the aquaduck float from one end to the other of the aqueduct? Provide time for re-engineering. **(Application: Hands on, Promotes engagement)**
2. When all of the groups have re-engineered their projects, go from group to group and evaluate their aqueduct using the rubric. **(Assessment: Group)**

SESSION FOUR

1. Have students recall individually on a piece of paper some of the vocabulary words from Session Two and Three that they used in building the project. Distribute the Vocabulary handout and show the Vocabulary Power Point. **(Scaffolding: Comprehensible input; Integrated Processes: Reading, Listening,**



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Speaking) Give vocabulary test later in the week. **(Assessment: Individual)**

2. Share the Aqueduct Essay Scoring Guide with the students and explain your expectations.
3. Have students write an essay describing how Roman aqueducts were made, what they were used for, and how they worked. The essay should include a diagram of the aqueduct that the group created with the following labels: arch, column, water channel, and keystone. Extra credit points can be given for tunnels, shaft, and gravity. **(Assessment: Individual, Written; Integrated Processes: Reading, Writing)**
4. Have students return to their groups and identify the Engineering Design Process Model with steps from the aqueduct building activity. **(Assessment: Group)**

Assessment

ELA and Geography

Students will score a 4 or higher on the essay using the 6 Traits Writing Rubric in the area of Ideas/Content or on the Aqueduct Essay Scoring Guide.

ELA

Students will score 80% or higher on vocabulary test for language arts grade.

ELA and Science

Students will score a 4 or higher on the Engineering Design Process Model diagram using the 6 Traits Writing Rubric in the area of Ideas/Content for a language arts grade and science grade.

Science

Students will score a 3 or higher on the Rubric for Aqueduct (Aquaducky) Engineering for a science grade.

Extensions

1. Have the students connect their aqueducts to make a series, float a ducky for this longer distance, and demonstrate their understanding of gravity.
2. Play build an aqueduct at the following website: <http://www.pbs.org/wgbh/nova/lostempires/roman/aqueduct.html>

Sources

Vocabulary definitions

<http://www.pbs.org/wgbh/nova/lostempires/roman/manual.html>

Other sources:

Clip art provided copyright free from <http://office.microsoft.com/en-us/images/>

<http://science.howstuffworks.com/engineering/structural/10-roman-engineering-tricks.htm>

<http://www.brighthubeducation.com/history-homework-help/124006-easy-roman-architecture-projects-aqueduct-model-roads-columns/>

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<http://google-latlong.blogspot.com/2008/11/roman-history-comes-to-life-in-google.html>

http://www.ehow.com/list_7599352_uses-roman-aqueducts.html

