## A DROP IN THE BUCKET – Ancient Egyptian Irrigation

**Author**  
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**Grade Level**  
6

**Duration**  
3 class periods

### National Standards

**GEOGRAPHY STANDARDS**

**Element Five:** Environment and Society  
14. How Human Actions Modify the Physical Environment

### Common Core Standards

**ELA COMMON CORE**  
Reading Standards for 6-8 for Literacy in History/Social Studies  
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.

**Mathematics Common Core Standards**  
Ratios of Proportional Relationships  
6.RP.1. Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. For example, “The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak.” “For every vote candidate A received, candidate C received nearly three votes.”

### Other Arizona Standards

**SOCIAL STUDIES STANDARDS**  
Strand 2 World History  
Concept 2: Early Civilizations  
PO 3. Describe the importance of the following river valleys in the development of ancient civilizations: Nile – Egypt

**Strand 4 Geography Environment and Society**  
PO 2. Describe the intended and unintended consequences of human modification (e.g., irrigation, aqueducts, canals) on the environment.

**PO 3.** Explain how changes in the natural environment (e.g., flooding of the Nile) can increase or diminish its capacity to support human activities.

**SCIENCE STANDARDS**  
Strand 2: History and Nature of Science  
Concept 1: History of Science as a Human Endeavor  
PO 1. Identify how diverse and/or cultures, past and present, have made important contributions to scientific...
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PO2 Describe how a major milestone in science or technology has revolutionized the thinking of the time.

Strand 3 Science in personal and social perspectives

Concept 1 Changes in Environments

PO 2. Describe how people plan for, and respond to, the following natural disasters: flooding.

Concept 2: Science and Technology in Society

PO 3. Design and construct a solution to an identified need or problem using simple classroom materials.

PO 4. Describe a technological discovery that influences science.

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**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.
A4. Create charts to organize information.
A5. Create visuals to present information.
EFC-B. Use math skills to calculate and measure.
B3. Calculate conversions for different situations.
EFC-C. Compose in a variety of forms.
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C1. Use Math, Social Studies, and Science target vocabulary.

EFC-D. Communicate clearly using math, science, and social studies target vocabulary.
D2. Participate in small and large groups.
EFC-E. Comprehend reading materials.
E3. Use new English vocabulary.

Arizona English Language Proficiency Standards

ELL 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:
B-21: applying understanding of content area vocabulary within math, science and social studies texts.
B-22: following a set of written multi-step instructions to perform routine procedures and answer questions.

ELL Stage IV
Basic
Writing
Standard 1: The student will express his or her thinking and ideas in a variety of writing genres. The student will express his or her thinking and ideas by using a variety of writing genres, as demonstrated by:
B-3: taking notes using a teacher selected and student created graphic organizer or cloze notes.

Standard 4: The student will integrate elements of effective writing to develop engaging and focused text. The student will integrate elements of effective writing to develop engaging and focused text as demonstrated by:
B-1: writing text that incorporates details.

Overview

Engineering and math concepts were utilized in ancient civilizations. Man learned to harness and to begin directing the forces of nature. Man also created inventions to facilitate the use of available resources for agricultural needs, sustenance, and the growth of culture.

Purpose

In this lesson, students will learn that human ingenuity enabled the ancient Egyptian culture to survive and to achieve wealth and power. The use of irrigation and the use of the lever in the invention of the shadoof (shaduf) were integral to managing the annual flooding of the Nile River. Students will connect this knowledge with the principles of engineering. This lesson is modified for English Language Learners (ELLs).

Key Vocabulary

irrigation: man-made way to water land to grow crops
shadoof: a machine used to lift water for irrigation purposes
lever: a bar used to raise an object by pushing down on the other end
fulcrum: a support about which a lever turns
counterweight: a weight that balances another weight
load: weight supported by the lever

Materials

• Computer to show PowerPoint and YouTube video
• Vocabulary cards
• Vocabulary Test and Answer Key
• Log Sheet
• Social Studies Assessment and Answer Key
• Timer
• PowerPoint Presentation
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- Any items available to demonstrate classes of lever:
  - Class 1 – balance scale, crowbar, scissors
  - Class 2 – wheelbarrow, metal nutcracker, bottle opener, door hinge
  - Class 3 – golf club, tennis racket, baseball bat, broom
- Plan Sheet for a Shadoof
- Shadoof and Ratio Problems and Answer Key
- Shadoof Math Assessment and Answer Key
- Answer Key for Captions and Visuals in the PowerPoint
- PowerPoint Presentation Assessment Checklist
- Picture of a Shadoof Labeled
- Science and Engineering Rubric
- For each group, a Shadoof Building Materials Bag containing:
  - Tubular cardboard clothes hanger attachments-- (Most dry cleaners will donate.)
  - Four bathroom-sized paper cups
  - Paper clips
  - Metal brads
  - Roll of pennies
  - Four 12" pieces of string
  - Sandwich bag that zips up
- Each group will also need:
  - Scotch tape
  - Markers
  - Scissors
  - Ruler

**Objectives**

The student will be able to:

1. identify how the ancient Egyptians used irrigation.
2. describe how a lever (shadoof) was used to take advantage of the flooding of the Nile to develop irrigation systems.
3. determine a central idea of an image and text.
4. integrate information from a PowerPoint on the history of irrigation to demonstrate understanding of irrigation in ancient Egypt.
5. collaborate within a group.
6. solve ratio problems.
7. use engineering principles to create a shadoof.

**Procedures**

*Teacher Background Information can be found at:*
http://en.wikipedia.org/wiki/Shadoof
http://www.answers.com/topic/lever
http://en.wikipedia.org/wiki/Ancient_Egyptian_agriculture
http://enchantedlearning.com/physics/machines/Shadoof

**SESSION ONE**

1. **Engage:** Ask the students if they know how a bucket changed the culture of Ancient Egypt. Discuss possible answers. *(Preparation: Linking to past learning)*
2. **Explore:** Show students the first 10 slides in PowerPoint presentation on irrigation in Egypt. Don't discuss any of the concepts of the two presentations.
3. **Explain:** Pass out packet of log sheets to the students. Tell students they will see the PowerPoint presentation again on technology and engineering in ancient Egypt. *(Application: Linked to objectives)* When the slide comes on, students will copy the number and title of the slide on their log sheet. Students will have 2 minutes to study each image and caption from PowerPoint.
4. **Elaborate:** Students will draw a quick depiction and write a sentence about each slide. *(Integrating Processes: Writing)* Do Number 1 as a sample together. Get feedback on what they can reasonably draw and write in two minutes.
5. **Scaffold:** Students will complete unfinished log sheets. *(Preparation: Strategies used)*

5. The next five slides will be done in conjunction with the teacher demonstration on the three kinds of levers. It is important that teacher is conversant with Teacher Background and Notes above. On three separate 4 x 6 cards, print “FULCRUM,” “LOAD,” and “EFFORT.” Students should complete log sheet after each of the following slides.

- Show slide 11 on how a lever works. Show the students that the effort is 'you.'
- Show slide 12 on class one lever. Have students come up and identify the fulcrum, the load (resistance), and the effort (you) on a pair of scissors or a crowbar. Have 3 students hold a card by the proper part of your examples. Do this for each class of lever.
- Show slide 13 on class 2 lever – Do the same procedure as the above slide with wheelbarrow, metal nutcracker, bottle opener, or door hinge.
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- Show slide 14 on class 3 lever – Same procedure as above with broom, baseball bat, tweezers, golf club, or tennis racket.
- Have students remember “FLE123” to remember the class of lever, and draw it on the board.

F (fulcrum) in the middle – class 1 lever
L (load) in the middle – class 2 lever
E (Effort) in the middle – class 3 lever
- Show slide 15 on the shadoof and discuss with class.
- Show slide 16 and discuss: work = force x distance

6. Evaluate: Give students 5 minutes to study and review their Log Sheets with a partner to clarify what they do not understand. (Grouping Option: Partners) Give students the Social Studies Assessment. Collect assessment and Log Sheets. Grade Log Sheets with the PowerPoint Presentation Assessment Checklist. There are 32 total checkmarks possible for each student. A checkmark is given if they understand the image portrayed (not for artistic skills.) A checkmark is given if they write a sentence explaining the main idea or topic of the caption. Figure the percentage based on number of checks. Grade the Social Studies Assessment with the provided answer key. (Assessment: Written)
7. Show YouTube video: Shadoof 123.

SESSION TWO
1. Engage: Ask, “What are the advantages of using a shadoof?” (Grouping Option: Whole class) Review the principles of the shadoof. Ask, “What class of lever is the shadoof?.” (class one) (Preparation: Linking to background) Draw a diagram of a shadoof on the board. (Refer to slide #11 from Session One.) Write the words fulcrum, lever, load, and counterweight. (Integrating Processes: Reading) Show the Picture of a Shadoof Labeled. Call on students to come up to the whiteboard and draw a shadoof and label the parts. (Grouping Option: Independent) Ask students to match the correct shadoof part to the correct vocabulary word. (Grouping Option: Independent) Tell them the advantage of using the shadoof. (Because of the lever and the counterweight, a person can lift more weight with a shadoof than without it.)

2. Explore: Explain, “Today, we’re going to meet an irrigation engineer. Listen carefully for how engineers do their work.” Show video of Dr. Ed Martin. Discuss what he says about basin irrigation, how irrigation has changed since ancient times, how productive the soil is in Arizona, and what does it take to be an engineer.

http://youtu.be/HxCTJuPls5U (Application: Meaningful)
3. Explain: In the YouTube video, Dr. Martin encouraged students to think like engineers. Now is their chance! Tell students they are going to design and build their own shadoofs in groups of four. (Application: Linked to objectives) They will design a shadoof to meet these specifications: (Application: Hands on)
Project the last slide of the PowerPoint on the screen so students can refer to it during construction:
- The shadoof must be free-standing.
- The long end of the lever needs to be at least twice as long as the short end.
- The lever must be stiff enough to pivot at the fulcrum.
- Use the same materials (pennies) for the counterweight and the load. Notice that the amounts will be different if the lever is balanced.
- They must label the parts of their creative model. (Integrating Processes: Reading)
- They must come together to discuss, create, listen, and ask questions.
- Each group will have a scribe.

Group students. (Grouping Option: Small groups)
4. Elaborate: Distribute group bags containing cardboard clothes hanger rods, paper cups, paper clips, metal brads, rolls of pennies, and four 12” pieces of string. Provide each group with scotch tape, markers, rulers, and scissors. Pass out Plan Sheet for Shadoof. Explain that before they build they must complete a plan sheet. (Preparation: Strategies used) On the plan sheet, the group must decide how they are going to build their shadoof. All group members should participate. The scribe should record the group responses to the questions on the plan sheet. (Application: Promotes engagement)
5. Evaluate: Students will go on a shadoof museum walk. Each group will look at every other group’s shadoof and observe the following factors: (Scaffolding: Guided Practice)
- Did the shadoof work?
- Did the shadoof balance the load and the counterweight?
- Was the shadoof properly labeled?
- Were materials used wisely?
- How would they improve their shadoof based on the museum walk?
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Students then return to their groups and discuss how they might change their design. (Integrating Processes: Speaking) Each group chooses a person to share proposed changes with the class. At end of session, collect Plan Sheet for a Shadoof. (Assessment: Group) Grade using the Science and Engineering Rubric. Have groups gather the pennies and put in sandwich bag. Scribe returns the pennies to the teacher.

SESSION THREE
1. Engage: Take a survey of your students. (Grouping Option: Whole class) Write the following quantities, and record them on the board.
   1. Number of students who rode the bus to school today, compared to those who did not
   2. Number of people wearing long sleeves to short sleeves
   3. Number of boys to girls
2. Explore: Show a picture of a dog (or any animal.) How many legs? How many ears? Eyes? Tails? (Preparation: Adapting content) Show a picture of another animal and ask similar questions.
3. Explain: Explain to students that a ratio is a relationship between 2 quantities. Look back at the survey information for a simple ratio. (15 boys and 15 girls would be 1:1) (20 long sleeves to 10 short sleeves would be 2:1) Write this information as a ratio. Then draw a T chart on the board. Label columns heads and tails. Tell students to think back to the animal pictures. In some cases the ratio of legs to tails is 4 to 1. It is expressed as 4:1 Draw another T chart and ask about 3 dogs. Would the ratio be the same? Explain that 12 legs would represent 3 tails, but the 4:1 ratio is the same.
4. Elaborate: Tell students that ratios are used daily by people during work and play. Show the NASA video on ratios. http://www.youtube.com/watch?v=GVte5q8jz7M (Preparation: Strategies used)
5. Evaluate: Do this problem on the board:
The well under the bucket of the shadoof can distribute 2 quarts of water per second. How much water can the well distribute in sixty seconds?
   \[
   \frac{2 \text{ quarts}}{1 \text{ second}} \times \frac{60 \text{ seconds}}{} = \frac{}{}
   \]
Cross multiply 2 (quarts) \times 60 (seconds) = 120 quarts
The ratio of quarts to seconds is 2:1. Whether there are 2 quarts or 120 quarts, the ratio is still 2:1.

Pass out Shadoof and Ratio Problems. Students will work in pairs to complete the worksheet. (Grouping Option: Partners) Go over the answers and help those who made mistakes. Give students the Shadoof Math Assessment. (Assessment: Individual)

Assessment
Students will score:
- 80% or higher on the Powerpoint Assessment Checklist for a reading grade.
- 80% or higher on the Social Studies Assessment for a social studies grade.
- 80% or higher on the Science and Engineering Rubric for a science grade.
- 80% or higher on the Shadoof Math Assessment for a math grade.
- 80% or higher on the Vocabulary Test for a reading grade.

Extensions
1. Compare and contrast ancient Egyptian irrigation with modern irrigation used in the United States.
5. Check out modern shadoof irrigation http://www.agriculturesnetwork.org/magazines/global/discussion-on-sustaining-agriculture...
6. Have students make ratio cartoons. Google ratio cartoons for examples.

Sources
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http://www.waterhistory.org/histories/nile/t1.html
http://www.irmuseum.org/exhibit2.aspx
http://www.youtube.com/watch?v=GVte5q8jz7M
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EiE “What is Engineering?” HighTech U Teacher Academy: Critical Thinking: Engineering Design Challenge

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