

EGYPT, PART I

How Were the Pyramids Built?

HISTORY

Corroborating

ENGLISH LANGUAGE ARTS

Reading Informational Text · Writing an Explanation

GRADE 6

90-135 minutes



PURPOSE

Students examine two documents to learn about a recent scientific theory of how the Egyptian pyramids were built. Sources include a description of a physics study, an ancient tomb painting, and an interview with a scientist. Students learn how different sources can work together to form a cohesive theory of a complex issue and then explain the topic in writing using multiple sources.



STANDARDS

● Common Core State Standards

- 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. [CCSS.ELA-Literacy.RI.6.7](#)
- Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. [CCSS.ELA-Literacy.W.6.2](#)

● C3 Framework for Social Studies State Standards

- Gather relevant information from multiple sources while using the origin, authority, structure, context, and corroborative value of the sources to guide the selection. [C3.D3.1.6-8](#)





LEARNING GOALS

- Use multiple sources to develop an understanding of a topic.
- Understand how documents corroborate each other to strengthen knowledge about a topic.
- Convey understanding of a topic by writing an explanation.



SUCCESS CRITERIA

- 1 Re-state a historical question.
- 2 Using information in documents, explain two different approaches to answering the question.
- 3 Decide which approach is more persuasive and why.
- 4 Write a short response that explains the question, describes two different approaches to answering the question, and tries to answer the question using relevant information from documents and discussion.



CULMINATING TASK

Using the information in these documents and other relevant information introduced in class, write an explanation of how scientists might have solved the question of how the Egyptians built the pyramids.

PART I · INTRODUCTION

The mystery of the pyramids has been unsolved for thousands of years. Many people have theorized about how Egyptians were able to build such large and perfectly aligned structures without modern technology such as the wheel. But to date there has been no universally accepted theory.

Physicists in the Netherlands were inspired by an ancient tomb painting that had apparently been misinterpreted by Egyptologists (see Document B). Egyptologists believed that the water being poured on the sand was part of a purification or religious ritual. The scientists believed, and proved persuasively, that the painting showed that pouring water on sand made it easier to move a heavy sledge.

From an everyday perspective, students may grasp the concept by thinking about playing with sand at the beach or playground. To build a good sandcastle you can't use too little or too much water.

SCIENCE This unit is intended to be brief, and therefore does not provide additional information about friction, granular substances, scientific inquiry, or other issues directly related to science. Some scientific statements were deliberately left in the documents in case the teacher decides to pursue this angle. This information is not necessary for this investigation, but students may be intrigued to learn that the same experiment provided insights not only about an ancient mystery but current environmental concerns. The relevance to today’s world may help students engage more deeply with the topic.

LIMITATIONS Although the sand experiment provides a persuasive explanation for how ancient Egyptians moved heavy loads across sand, it does not answer how they were able to move the stones up the pyramids, nor does it answer how they were able to perfectly align the stones to create such smooth surfaces. Thus, some mysteries of pyramid construction remain unresolved. Consideration of these issues is not necessary to this limited and brief investigation, but it is one way to deepen the complexity if that is desired. The information provided here is not truly sufficient to answer the question of how Egyptians built the pyramids.

SKILLS & STRATEGIES This lesson is intended as an introduction to corroboration. Scientists used two very different data sources—an ancient Egyptian tomb painting and a scientific experiment—to answer a historical question and to advance scientific knowledge about friction and how liquid affects the properties of sand.

Students use different genres of text—an archaeological painting, a description of a science experiment, and an explanation of how the painting had apparently been misinterpreted for years—to understand that knowledge is not static. Even experts can analyze sources and sometimes arrive at conclusions that are later disproved or elaborated upon by new discoveries or fresh insights.

Another skill that is addressed in this lesson is writing an explanation. Notably, students use multiple documents to construct an explanation telling the story of how a scientific study answered a historical question.

STEPS Explain that the pyramids have captivated human imagination since they were built. To this day, we have little knowledge of how the Egyptians were able to build such structures without modern technology.



ANTICIPATED RESPONSE ~ PEDAGOGICAL ACTION

Your students’ interests and needs will dictate how much background and complexity to introduce. For example, there are some pretty far-fetched theories that may engage students (e.g., aliens) but these may distract more than inform. At minimum, establish that while there are many theories about the pyramids, there has been up to this point insufficient evidence to arrive at a universally accepted explanation.

Explain that students will examine two documents to learn about a new theory.

Share and discuss Learning Goals and Success Criteria.



ANTICIPATED RESPONSE ~ PEDAGOGICAL ACTION

After reviewing this lesson, if you anticipate the content will be too difficult for your students, you may wish to show a one-minute video called “Scientists Discover How Egyptian Pyramid Workers Moved Massive Stones,” which summarizes the content of this lesson. Watching this video prior to the lesson might promote comprehension of materials, but will remove the “discovery” element of working through the documents without this knowledge. Another option is to view it after reading the documents but before introducing the culminating task in order to supplement students’ comprehension of the issues.
<https://www.youtube.com/watch?v=QzKgknx8ysQ>

MORE INFORMATION In case further details are of interest to students, here is some background about pyramid construction from the Smithsonian website:

“There has been speculation about pyramid construction. Egyptians had copper tools such as chisels, drills, and saws that may have been used to cut the relatively soft stone. The hard granite, used for burial chamber walls and some of the exterior casing, would have posed a more difficult problem. Workmen may have used an abrasive powder, such as sand, with the drills and saws. Knowledge of astronomy was necessary to orient the pyramids to the cardinal points, and water-filled trenches probably were used to level the perimeter. A tomb painting of a colossal statue being moved shows how huge stone blocks were moved on sledges over ground first made slippery by liquid. The blocks were then brought up ramps to their positions in the pyramid. Finally, the outer layer of casing stones was finished from the top down and the ramps dismantled as the work was completed.”

“The Egyptian Pyramid,” Smithsonian Institute

http://www.si.edu/encyclopedia_si/nmnh/pyramid.htm

A longer article addressing many construction issues can be found here:

“Probing Question: How were the Egyptian pyramids built?” Penn State News

<http://news.psu.edu/story/141300/2008/03/24/research/probing-question-how-were-egyptian-pyramids-built>

PART II · GUIDED PRACTICE

There are two main teaching points in this lesson. First, using different sources of information to help establish new knowledge strengthens the credibility of that knowledge.

This is one function of the historical reading skill of corroborating. Here, students corroborate the tomb painting with the science experiment. They also use information from these sources to construct an explanation of this historical puzzle. Second, students should understand that is possible for knowledge, whether historical or scientific, to be revised in the face of new information.

Specific instructional methods are left to the teacher’s discretion. Some examples and suggestions are described in the section “General Instructional Techniques.” Whether this work is done as a whole class, as small group or pair work, or individually is up to the teacher.

A reading guide is provided to help students collect information to use in the culminating task.



SUCCESS CRITERION #1 ~ EVIDENCE-GATHERING OPPORTUNITY

Re-state a historical question.

- Check student responses through discussion or in writing on “Classroom discussion” section of the reading guide.

DOCUMENT A Scientists replicated Egyptian sledges in a laboratory and studied the ways that the addition of water affected the ability to move the sledges across sand.



ANTICIPATED RESPONSE ~ PEDAGOGICAL ACTION

The tomb painting in Document B is both the inspiration and corroboration for the experiment described in Document A. This detail can be hard to understand since it is not the classic case of corroboration using historical sources. It is rare to conduct a physics experiment to test a theory inspired by archaeology. Because this is such an unusual case of corroboration, this aspect has been elided from the lesson, but feel free to bring it up if students wonder how scientists came up with their research question. If you think it would interest students, this detail can be your transition into reading Document B.



DOCUMENT B Without the wall painting, how persuasive would the results of the sand experiment by itself have been? (Assuming the scientists had been able to conduct the experiment without having been first inspired by the painting.) In other words, if the painting did not exist, would the scientists’ theory of how Egyptians moved heavy objects be as believable?



SUCCESS CRITERION #2
~ EVIDENCE-GATHERING OPPORTUNITY

Using information in documents, explain two different approaches to answering the question.

- Check student responses through discussion or in writing on first two questions of “Document B: Two Interpretations” section of the reading guide.



SUCCESS CRITERION #3
~ EVIDENCE-GATHERING OPPORTUNITY

Decide which approach is more persuasive and why.

- Check student responses through discussion or in writing on last question of “Document B: Two Interpretations” section of the reading guide.

PART III · CULMINATING TASK

PROMPT Using the information in these documents and other relevant information introduced in class, write an explanation of how scientists might have solved the historical question of how the Egyptians built the pyramids.

ASSESSMENT You may wish to consider these elements when evaluating student responses to this culminating task. The amount and method of writing depends on your students’ needs.

- 1 Corroborating. Students should use information from more than one source and explain explicitly the relationship between these sources or connect the information in their written response in a way that indicates their understanding of the relationships (for example, by using appropriate connectives, or using pieces of information from different sources in a complex sentence).
- 2 Understanding that knowledge can change and how it changes. This lesson shows how the same ancient painting was interpreted in very different ways, leading to

different conclusions. In this case, reading both documents is necessary to developing a complete understanding of the topic.

- 3 Writing an explanation. This task requires students to use information from both documents to construct a cohesive explanation.



ANTICIPATED RESPONSE ~ PEDAGOGICAL ACTION

The reading guide was designed to help students collect pieces of information necessary to write an explanation of the topic, not as a culminating task. However, if students do not have time to complete the writing task, the reading guide may serve as means to assess whether they were able to collect the necessary pieces.



SUCCESS CRITERION #4 ~ EVIDENCE-GATHERING OPPORTUNITY

Write a short response that explains the question, describes two different approaches to answering the question, and tries to answer the question using relevant information from documents and discussion.

- Check student responses to the culminating task.

READING GUIDE (teacher version) Egypt, Part I

- *Sample answers are not intended to be comprehensive.*
- *Add other questions that would be helpful to your students.*
- *Blank reading guide is after the documents.*

SOURCE

CLASSROOM DISCUSSION

What question were Egyptologists trying to answer?

** how Egyptians built the pyramids without modern technology*

What were some problems Egyptologists had in answering the question?

** lack of evidence
* misinterpretation of tomb painting*

DOCUMENT

A

Sand Experiment

What question were scientists trying to answer?

** how Egyptians built the pyramids without modern technology*

How did they answer this question?

** conducting a scientific experiment inspired by the tomb painting*

DOCUMENT

B

Two Interpretations

How did scientists interpret the tomb painting?

** worker is pouring water in front of the sledge to reduce friction in sand*

How did Egyptologists interpret the tomb painting?

** worker is pouring water in front of the sledge as a purification ritual*

Which interpretation do you think is more persuasive? Why do you think so?

** probably the scientists'
* it makes sense and is supported by the results of the scientific experiment*

SAMPLE RESPONSE (teacher version) Egypt, Part I

- *Not intended to be representative of student responses.*
- *Not intended to be comprehensive.*

For thousands of years, no one has known for sure how the Egyptians were able to build the pyramids. Without modern technology like wheels, how did they move such heavy stones and statues across the desert?

An ancient wall painting shows a group of workers pulling a sledge with a large statue. At the front of the sledge a man is pouring liquid into the ground. For years, Egyptologists believed this was a purification ritual. But recently, scientists tested a new idea. **They believed that the reason was scientific, and that the worker was pouring water into the sand in order to reduce friction.** *This would to make it easier to move the sledge. Just as you add water to sand at the beach in order to build a strong sandcastle, Egyptians added water to firm up the sand so that mounds of loose sand would not collect in front of the sledge and make it harder to pull.*

In the laboratory, scientists created a sledge and pulled them across dry sand and wet sand. They discovered that with the right amount of water, the sledge glided much more easily and therefore required much less effort to move. This experiment confirmed that the scientists' explanation for the wall painting was very likely, and that at least in the matter of how the Egyptians moved extremely heavy objects, we now have a scientifically-confirmed theory that also agrees with the archaeological evidence.

SOURCES

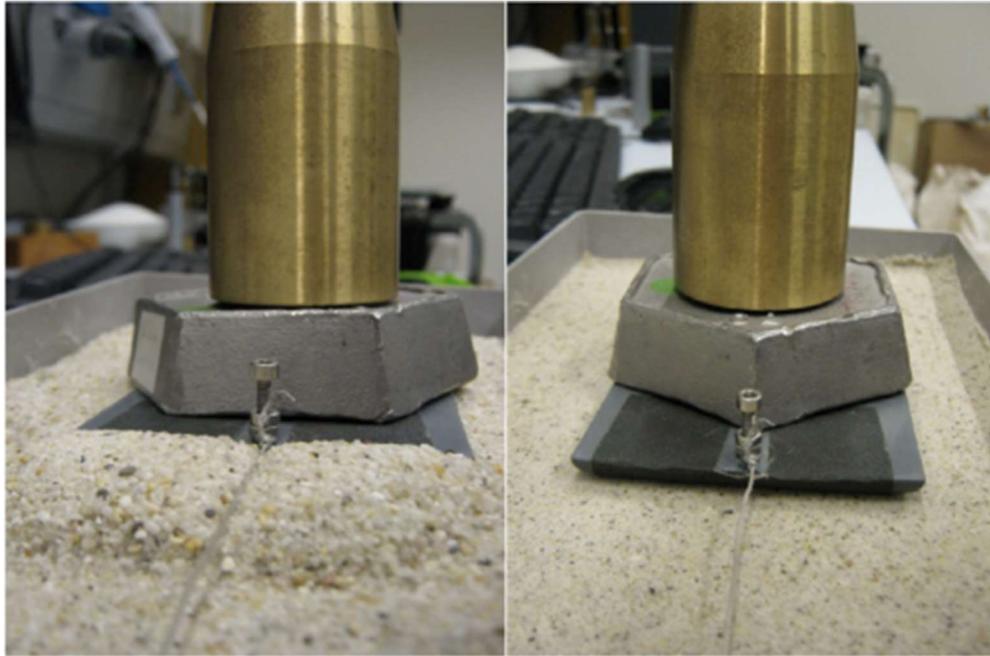
Classroom discussion

Document A

Document B

DOCUMENT A Sand Experiment

Scientists claim that the ancient Egyptians probably poured water on sand in order to make it easier to pull sledges that transported heavy objects for building the pyramids.



A large pile of sand collects in front of the sledge when it is pulled over dry sand (left). On the wet sand (right) this does not happen.

For the construction of the pyramids, the ancient Egyptians had to transport heavy blocks of stone and large statues across the desert. The Egyptians therefore placed the heavy objects on a sledge that workers pulled over the sand.

Scientists placed a laboratory version of the Egyptian sledge in a tray of sand. Experiments revealed that the required pulling force decreased proportional to the stiffness of the sand. With the correct amount of water, a sledge glides far more easily over firm desert sand simply because the sand does not pile up in front of the sledge as it does in the case of dry sand.

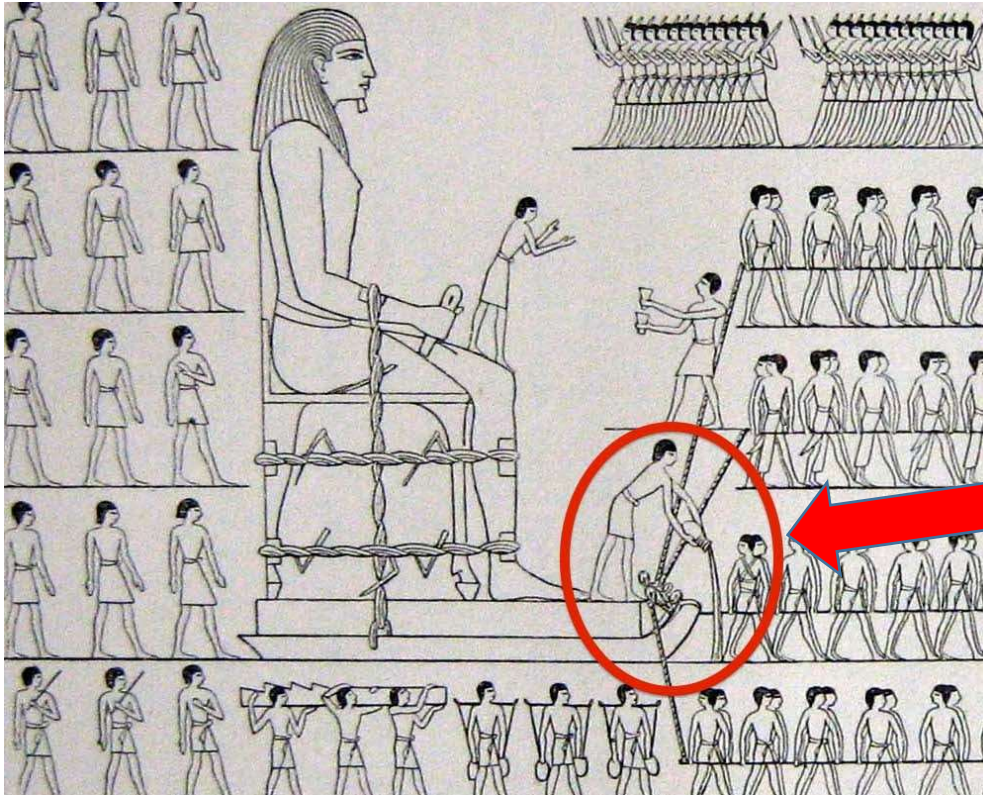
Besides revealing something about the ancient Egyptians, the results are also interesting for modern-day applications. We still do not fully understand the behavior of granular material like sand. Granular materials are, however, very common. Other examples are asphalt, concrete, and coal. This research could therefore be useful for examining how to optimize the transport of granular material, which currently accounts for about 10% of the worldwide energy consumption.

SOURCE “Ancient Egyptians transported pyramid stones over wet sand,” phys.org, April 30, 2014. *This document has been modified for length, clarity, and reading difficulty. The original text can be found at:*

<http://phys.org/news/2014-04-ancient-egyptians-pyramid-stones-sand.html>

DOCUMENT B Two Interpretations

One of the scientists who conducted the sand experiment describes an ancient Egyptian wall painting and explains two different theories of why the worker was pouring water in front of the sledge.



Wall painting from tomb of Djehutihotep, around 1900 B.C.

Adding more evidence to the conclusion that Egyptians used water is an ancient wall painting. It appears to show a person standing at the front of a massive sledge, pouring water onto the sand just in front of the sled. What this man was doing has been a matter of great debate and discussion.

“Egyptologists had been interpreting the water as part of a purification ritual, and had never sought a scientific explanation,” said scientist Daniel Bonn. “And friction is a terribly complicated problem. Even if you realize that wet sand is harder—you cannot build a sandcastle with dry sand—the consequences of that for friction are hard to predict.”

He said the experiment not only solved “the Egyptian mystery, but also shows, interestingly, that the stiffness of sand is directly related to the friction force.”

SOURCE “The surprisingly simple way Egyptians moved massive pyramid stones without modern technology,” The Washington Post, May 2, 2014. *This document has been modified for length, clarity, and reading difficulty. The original text can be found at:*
<https://www.washingtonpost.com/news/morning-mix/wp/2014/05/02/the-surprisingly-simple-way-egyptians-moved-massive-pyramid-stones-without-modern-technology/>

READING GUIDE Egypt, Part I

SOURCE

CLASSROOM DISCUSSION

What question were Egyptologists trying to answer?

What were some problems Egyptologists had in answering the question?

DOCUMENT

A

Sand
Experiment

What question were scientists trying to answer?

How did they answer this question?

DOCUMENT

B

Two
Interpretations

How did scientists interpret the tomb painting?

How did Egyptologists interpret the tomb painting?

Which interpretation do you think is more persuasive? Why do you think so?

