



FORMATIVE ASSESSMENT LESSON PLANS

ENGLISH LANGUAGE ARTS HISTORY

Grade 6



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INTRODUCTION

These lesson plans use multiple documents to teach students how to read and write informational texts in both English Language Arts and history. The purpose of using multiple documents is to show students how real-life texts can corroborate or contradict each other. Seeing and understanding these relationships between texts will help students make sense of the dizzying amount of information that is available to them.

The ultimate goal is to help students achieve independence in crafting their own inquiry questions and to pursue high quality sources that will help them answer those questions. These lessons, with their edited texts and limited content, are intended as training tools to help them achieve that goal. Texts were edited to retain the content most relevant to answering the inquiry question.

While this is not how students would encounter these documents in the real world, the modified texts allow students and teachers to focus on achieving understanding of a complex topic without being obstructed or distracted by content that does not help them answer the specific inquiry. When available, links to original texts are provided for each document. Documents were modified for length, clarity, and reading difficulty. Excerpts of each document were chosen for how well they would help students answer the lesson's inquiry question. Target length for each modified document was 100-500 words.

Teachers are encouraged to make changes to the lesson plans, add or subtract materials, and in general to make these materials their own. While these are presented as exemplar lesson plans that highlight formative assessment, they are truly intended as starting points for your own inquiry.

The core idea is to use multiple sources to help students achieve understanding of complex topics by highlighting the various ways texts interact with each other.

One lesson plan—Egypt II—is a supplement to existing lesson plans developed by the Stanford History Education Group. Instructions on how to obtain those free materials are included in the lesson plans. They are not reproduced here.

Historical lessons (Egypt) were crafted with a specific grade level in mind. Contemporary lessons (School Start Times, Academic Tracking, Zebra Stripes) were written for all three grade levels (grades 6-8). The text of the documents was kept constant. What changed between the grades were the expectations for finding and using evidence in increasingly complex ways.

FORMATIVE ASSESSMENT

Formative assessment is the process of continuously monitoring student learning and providing ongoing feedback on progress toward established learning goals.

The specific elements of formative assessment as used in this set of lessons are defined in the Glossary of Terms, which can be found at the end of this document.

- **LEARNING GOALS**
- **SUCCESS CRITERIA**
- **EVIDENCE-GATHERING OPPORTUNITY**
- **ANTICIPATED STUDENT RESPONSE**
- **PEDAGOGICAL ACTION**
- **PEER AND SELF-ASSESSMENT**
- **CULMINATING TASK**

LEARNING GOALS and **SUCCESS CRITERIA** were developed from Common Core State Standards (CCSS) for English Language Arts. These were supplemented by the C3 Framework for State Social Studies Standards. Each Success Criterion is matched with an appropriate **EVIDENCE-GATHERING OPPORTUNITY** so that teachers can gauge student progress throughout the lesson and make necessary adjustments.

These lesson plans were developed for a general, rather than specific, classroom. Generally, **ANTICIPATED STUDENT RESPONSES** are best formulated with particular students in mind. A few examples are provided throughout the lesson to model what they look like, but these are hardly exhaustive nor do they apply to all students. The same is true of **PEDAGOGICAL ACTIONS**, which generally are specific to the context—the students’ needs, the classroom culture, and the teacher’s expertise and experience. (Please note that in the glossary we have combined these terms as **PLANNED PEDAGOGICAL RESPONSES**.)

A hallmark of formative assessment is **PEER AND SELF-ASSESSMENT**, in which students are able to participate fully in their learning by internalizing and monitoring their progress toward the Learning Goals. An essential requirement for such participation is that Learning Goals and Success Criteria be written in student-friendly language.

In each lesson, a **CULMINATING TASK** provides a final outcome that highlights the deeper learning intended by that lesson. In these lessons, that culminating task is always a writing task, such as constructing an explanation or argument. Other examples of culminating tasks are presenting an oral debate, solving a problem, constructing a model, testing a hypothesis, and so forth.

GENERAL INSTRUCTIONAL TECHNIQUES

In each lesson, teachers are encouraged to use their own instructional techniques. These lesson plans supply content and ancillary materials that can work with a variety of reading and discussion techniques.

Each lesson features the same type of activities, which can be implemented using the instructional techniques that you deem most appropriate for your students. For example, whole class discussion and teacher modeling would be most appropriate at the beginning of the year or when introducing a new strategy or skill.

- 1 READ DOCUMENTS** If students need a great deal of support, the teacher reads the text aloud and shares relevant commentary; this is often referred to as “modeling” or “thinking aloud.” If students need very little support, the documents can be read individually and silently. Other possibilities include reading in small groups, in pairs, or having students take turns reading aloud to the class. Teacher provides guidance as necessary.
- 2 DISCUSS DOCUMENTS** This can be done before, during, or after reading. For example, if the documents are being read out loud by the teacher or as a whole class, it may make sense to discuss as you read. In addition to checking for basic comprehension, point out or elicit the title, source, and purpose of the document. The reading guide provides specific points to discuss in each document. Focus on issues that are relevant to the document’s purpose in the lesson.
- 3 FILL OUT READING GUIDE** As with reading documents, this task can be accomplished with a range of support. Teachers can model, small groups or pairs can collaborate, or students can work individually.
- 4 COMPLETE CULMINATING TASK** The use of this task is flexible. It can be used as a teaching aid, group activity, homework assignment, interim assessment, or final assessment. Every lesson plan has a brief writing assignment as a culminating task.

SUGGESTIONS FROM TEACHERS Some teachers enhanced the culminating task by adding elements, such as telling students to write an argument to be published in a newspaper or to write an explanation for a younger student. Other teacher suggestions were to turn some of the introductory materials into PowerPoint slides with pictures, to show brief videos to establish background knowledge, and to provide vocabulary assistance.

FORMATIVE ASSESSMENT GLOSSARY



LEARNING GOALS

Learning Goals describe what students will learn in a lesson. They state clearly what the student will understand or be able to do by the end of the lesson. The learning can include knowledge, skills, conceptual understanding, analytical principles, and/or procedural fluency. Learning Goals should be general and significant enough that they can apply to a variety of contexts rather than be limited to a specific lesson. Learning Goals are shared with students and written in language that students can understand so that they can monitor, assess, and reflect on their own learning.



SUCCESS CRITERIA

Success Criteria can describe the content of what students will say, make, do, or write to indicate achievement of Learning Goals. Success Criteria specify how students will show progress toward Learning Goals. When writing Success Criteria, teachers should consider the following statement: If students have achieved x [Learning Goal], then they will be able to do a, b, c [Success Criteria]. Like Learning Goals, Success Criteria are written in language students can understand and are shared with students. Success Criteria tell students what they will be able to do once they have achieved the Learning Goal.



EVIDENCE-GATHERING OPPORTUNITIES

Evidence-Gathering Opportunities are learning experiences that both promote and assess student progress toward Success Criteria. When planning a lesson, teachers determine how they will collect evidence of student learning: What will students say, make, do, or write to demonstrate that they have met the Success Criteria? What instructional tasks will generate this information? A well-designed Evidence-Gathering Opportunity serves three functions: (1) describe the evidence that is to be collected; (2) indicate how the teacher will gather that evidence; and (3) provide enough support so that the task will aid students in achieving the associated Success Criterion.

Some examples of how teachers might gather evidence are examining student work, listening to and participating in discussions, observing peer and self-assessment, and questioning students.





PEER AND SELF-ASSESSMENT

Students are the ones who are doing the learning, so they share a responsibility for monitoring their progress toward the lesson's Learning Goals. Students understand and use Learning Goals and Success Criteria to evaluate their own learning and achievement. That said, teachers need to heavily support and guide students in Peer and Self-Assessment. For peer assessment, students need to be taught to assess the work of others and offer constructive advice to their peers. Teachers plan opportunities for Peer and Self-Assessment during the lesson; examples include peer conference, gallery walk, or rubrics.



CULMINATING TASK

Quality instructional tasks, designed to build students' thinking, can reveal substantive insights into how their thinking is developing. The final task in each lesson incorporates all of the lesson's Success Criteria. It provides teachers with the opportunity to assess whether students have accomplished the lesson's Success Criteria and achieved the Learning Goals.



PLANNED PEDAGOGICAL RESPONSES

Teachers anticipate student responses to lesson activities and tasks based on their experience and knowledge of the content, students, and the lesson. In particular, teachers should consider common challenges and misconceptions that might affect student understanding and success with the lesson. These challenges can include language demands found in a text or tasks. Teachers ask themselves: (1) *What are common challenges or misconceptions that might arise in teaching this content?* and (2) *How will I support students at these points in the lesson?* Anticipating responses helps teachers envision what student responses will look or sound like during the lesson if students are making (or not making) progress toward the Learning Goals and Success Criteria. By anticipating responses, teachers can plan for, and execute, appropriate pedagogical actions for scenarios that are likely to unfold during the lesson.

As teachers consider the ways they anticipate students will respond to the lesson, they also plan for ways to address any misconceptions, to ensure that certain concepts are mastered before moving on, or to accommodate students' needs. Pedagogical responses are the moves teachers after analyzing evidence of student learning; they are intended to help students progress toward Learning Goals and Success Criteria. Pedagogical responses are based on teachers' interpretation of real-time (or as close to real-time) evidence collected during the lesson. Pedagogical responses include reviewing, modeling, providing examples, prompting, giving feedback, telling, explaining, directing, or continuing, stopping, or adjusting the planned lesson. To be effective, these actions must: be related to the Learning Goals and Success Criteria; be specific and clear; provide suggestions, hints, or cues rather than correct answers; and engage students in the task.



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

- 1 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](#)
- 2 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

- 3 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.
- Communicate 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 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.*
- *Constructing your own response as part of your preparation (or modeling in front of students) is an essential step.*

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 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

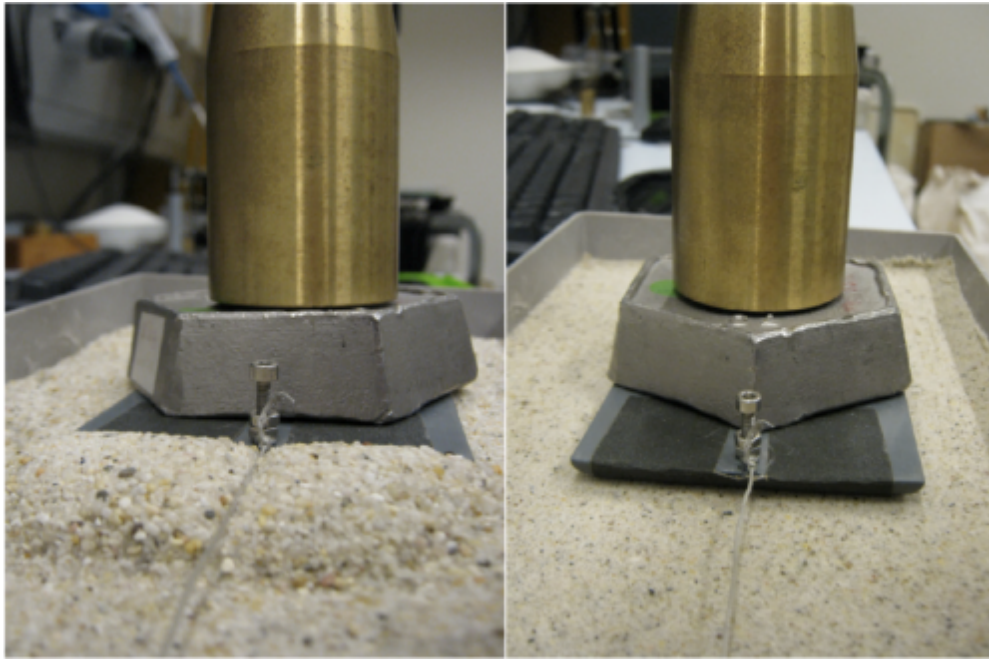
Classroom discussion

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.

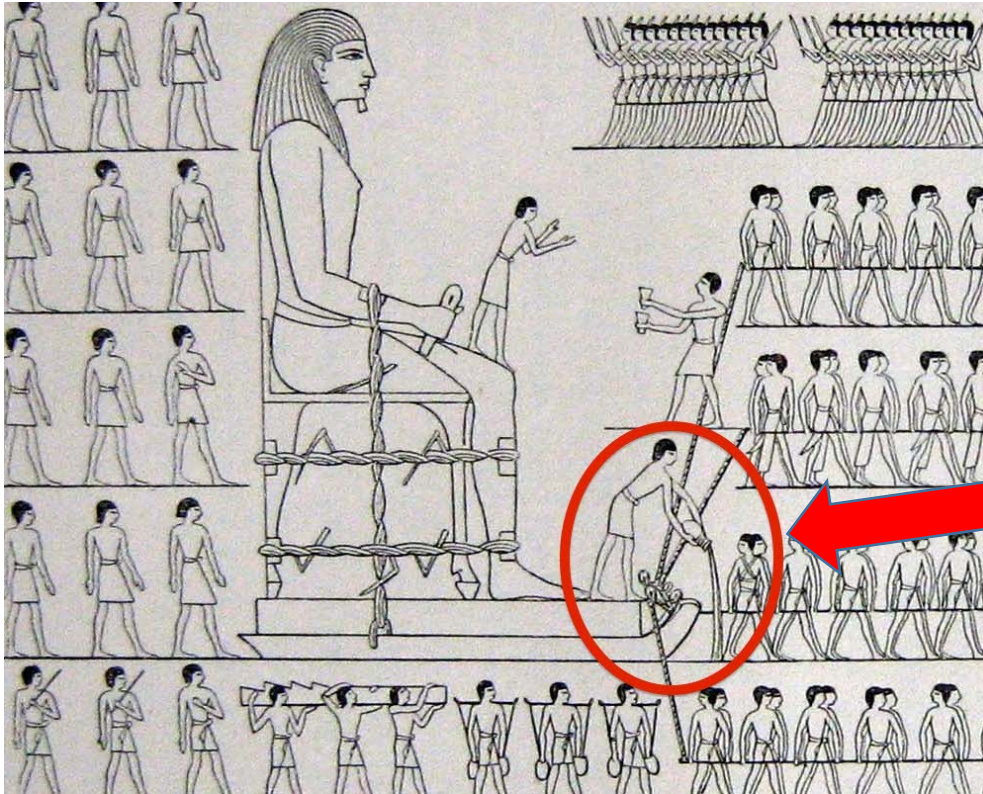
Scientists placed a laboratory version of the Egyptian sledge in a tray of sand. Experiments revealed that the required pulling force decreased proportional to the stiffness of the sand. With the correct amount of water, a sledge glides far more easily over firm desert sand simply because the sand does 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?



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.

EGYPT, PART II

Did Slaves Build the Pyramids?

HISTORY

Corroborating · Sourcing

ENGLISH LANGUAGE ARTS

Reading Informational Text · Writing an Argument

GRADE 6

180-225 minutes



PURPOSE

Students examine five documents to answer the question of whether slaves or paid workers built the Great Pyramid at Giza. Sources include a passage written by ancient Greek historian Herodotus, a high school textbook, and information from three archaeologists.

Please note that this lesson plan is a supplement to the existing lesson plan written by the Stanford History Education Group (SHEG). Their original materials, including the document set, PowerPoint slides, and background information, can be found at <https://sheg.stanford.edu/egyptian-pyramids>. Please download those materials before proceeding, as they cannot be not replicated here and are essential to the lesson.

This lesson can either be taught after Egypt, Part I, which is a shorter and simpler lesson, or it can be taught by itself.

This lesson can also be taught in conjunction with Academic Tracking or School Start Times, which are also lessons about constructing an argument.



STANDARDS

● Common Core State Standards

- ✓ Determine an author's point of view or purpose in a text and explain how it is conveyed in the text. [CCSS.ELA-Literacy.RI.6.6](#)
- ✓ Identify aspects of a text that reveal an author's point of view or purpose (e.g., loaded language, inclusion or avoidance of particular facts). [CCSS.ELA-Literacy.RH.6-8.6](#)
- ✓ Introduce claim(s) and organize the reasons and evidence clearly. [CCSS.ELA-](#)

Literacy.W.6.1.A

- ✓ Support claim(s) with clear reasons and relevant evidence, using credible sources and demonstrating an understanding of the topic or text. CCSS.ELA-Literacy.W.6.1.B

● **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 and conflict with each other to strengthen knowledge about a topic.
- Communicate understanding of a historical debate by writing an argument in favor of one side.



SUCCESS CRITERIA

- 1 Identify claims and evidence supporting an argument in multiple documents about the same topic.
- 2 Decide whether the evidence in these documents convincing and explain why.
- 3 Identify authors' purpose in a document and how inclusion or avoidance of particular facts affects their credibility.
- 4 Construct an argument that answers the question of whether slaves or paid workers built the Great Pyramid at Giza.



CULMINATING TASK

Using the information in these documents and other information introduced in class, construct an argument discussing whether slaves or paid workers built the Great Pyramid at Giza.

PART I · INTRODUCTION

Did slaves or paid workers build the Egyptian pyramids? Discuss with students why this question is important, not only in interpreting Egypt's past but also its relevance to the present.

SKILLS & STRATEGIES This lesson is intended as extended practice in corroboration. Another skill that is addressed in this lesson is writing an argument.

STEPS Using PowerPoint slides provided by SHEG, establish or review background information about the Egyptian pyramids (steps 1 and 2 of their lesson plan).



ANTICIPATED RESPONSE ~ PEDAGOGICAL ACTION

If students have worked through the Egypt I lesson plan about how the pyramids were built, draw explicit connections between the two lessons, both in content and skills. Both lessons are about how the pyramids were built, and both practice the skill of corroborating documents.

Explain that students will examine five documents to learn about two sides of a historical issue.

Share and discuss Learning Goals and Success Criteria.



ANTICIPATED RESPONSE ~ PEDAGOGICAL ACTION

If students are new to argumentation, you will want to teach or review the concepts of claims and evidence, since these are critical components of this lesson.

PART II · GUIDED PRACTICE

There are two main teaching points in this lesson. First, one of the purposes of using multiple sources is to understand that there can be more than one interpretation of historical “facts,” such as whether slaves or paid workers built the pyramids. Second, it is important to consider authors’ purpose for writing and their inclusion or avoidance of certain facts when determining the credibility of their evidence.

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

Be sure to consider step 3 in the SHEG lesson plan, which details how to present the first two documents.

A graphic organizer, called “Organizing and Evaluating the Evidence,” is provided by SHEG in addition to the document set to help students collect information to use in the culminating task. The graphic organizer prompts students to articulate the claim made in each document, to identify the pieces of evidence used to support the claim, and whether or not the student finds the evidence convincing.



SUCCESS CRITERION #1 ~ EVIDENCE-GATHERING OPPORTUNITY

Identify claims and evidence supporting an argument in multiple documents about the same topic.

- ✓ Check the first two columns of the graphic organizer after reading and discussing each document.

In addition to these aspects of text analysis, another approach to the documents is to consider the authors’ purpose and inclusion or avoidance of particular facts. The information that results will be helpful to students in determining whether they find the evidence convincing. This question is considered in depth below.

DOCUMENT A What aspect of Document A reveals the author’s point of view or purpose? Herodotus’ purpose was to tell stories. He may have embellished for narrative value, or he may be reporting accurately. It’s hard to say with this short excerpt. Although Herodotus is an ancient source, the Great Pyramid was built approximately 2500 BCE and Herodotus was writing 440 BCE so the stories that Egyptians told him were many years after the fact.

DOCUMENT B What aspect of Document B reveals the author’s point of view or purpose? Textbook appears to rely on Herodotus’ account (they use the same details) so the limitations of Herodotus apply also to the textbook. Textbook also reports measurements of the pyramids to include information of their great size, from which we might infer that vast numbers of people took many years to build these structures. It appears the textbook’s purpose is to convey information in a straightforward manner.

DOCUMENT C What aspect of Document C reveals the author’s point of view or purpose? Hawass focuses on the discovery of workers’ tombs, a sign of respect that would not have been accorded to slaves. He omits the possibility that the worker tombs represent only a fraction of the labor force used to build the pyramids. In this document, “author” (i.e., “source”) is really Hawass, not the actual author of the article. The same is true for Documents D and E.

DOCUMENT D What aspect of Document D reveals the author’s point of view or purpose? Lehrner says the tomb graffiti is “one of the most compelling pieces of evidence” about who built the pyramids. He assumes that because a group of workers identified themselves as part of a team and tagged the tombs, it indicates pride in work that would not be characteristic of slaves. In this document, he does not consider the possibility that slave crews may have made these marks. Like Hawass, Lehrner does not address the possibility that at least some of the work was done by slaves.

DOCUMENT E What aspect of Document E reveals the author's point of view or purpose? Shiffman appears to be the most objective because he considers both sides of the argument. He acknowledges that the information available is incomplete and provides direction about what further information is needed to form a more complete conclusion.



SUCCESS CRITERION #2 ~ EVIDENCE-GATHERING OPPORTUNITY

Decide whether the evidence in these documents convincing and explain why.

- ✓ Check the third column of the graphic organizer after reading and discussing each document.



SUCCESS CRITERION #3 ~ EVIDENCE-GATHERING OPPORTUNITY

Identify authors' purpose in a document and how inclusion or avoidance of particular facts affects their credibility.

- ✓ 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, construct an argument discussing whether slaves or paid workers built the Great Pyramid at Giza.

ASSESSMENT You may wish to consider these elements when evaluating student responses to this culminating task.

- 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 Detecting conflict between the sources. This can be fact-based or, in a more advanced response, students may evaluate the credibility of the sources to help them select which argument to pursue.

- 3 Constructing an argument. As in Egypt, Part I, this task requires students to use pieces from different documents to construct a cohesive response. In that lesson, students wrote an explanation. In this one, they write an argument.



ANTICIPATED RESPONSE ~ PEDAGOGICAL ACTION

The graphic organizer was designed to help students collect pieces of evidence necessary to write an argument about this topic. If students do not have time to complete the writing task, the graphic organizer may serve as means to assess whether they were able to collect the necessary pieces.



SUCCESS CRITERION #4 ~ EVIDENCE-GATHERING OPPORTUNITY

Construct an argument that answers the question of whether slaves or paid workers built the Great Pyramid at Giza.

- ✓ This task is intended as a writing task, but it is possible to check for understanding through whole class or small group discussion. Depending on students' needs and classtime available, teacher may wish to turn this into a discussion before or in lieu of the writing assignment.

SAMPLE RESPONSE (teacher version) Egypt, Part II

- *Not intended to be representative of student responses.*
- *Not intended to be comprehensive.*
- *Constructing your own response as part of your preparation (or modeling in front of students) is an essential step.*

DID SLAVES BUILD THE GREAT PYRAMID AT GIZA?

Based on these five documents, it is likely that the slaves built the pyramids at Giza.

Herodotus was an ancient historian who collected stories while traveling. In his book, he says that the Egyptians told him that Cheops forced hundreds of thousands of workers for decades to build the Great Pyramid.

The textbook appears to rely on Herodotus' account, echoing the figures of 100,000 laborers (somewhat inaccurately, since Herodotus reports "100,000 at a time," implying many more people) and 20 years. It adds information about the area, height, and number of blocks.

Dr. Hawass claims that tombs of workers found near the pyramid site indicate that honored laborers built the pyramids. He is "Egypt's archaeology chief" and may be more inclined to believe that slaves did not build the pyramids. (The pyramids are a major tourist attraction, and some people may be put off by the possibility they were built by slaves.)

Dr. Lehrner is a colleague of Dr. Hawass. He points to another piece of archaeological evidence – tomb graffiti. He claims worker crews left signs of their crew names, sometimes named after the pharaohs. From this, he concludes, "This doesn't sound like slavery, does it?"

Dr. Shiffman is not directly involved in research, but is a professor of Classical Studies. He says that there is insufficient evidence to conclude either way. The worker tombs do not rule out the possibility that some percentage of laborers were slaves. He also says there is no direct evidence to prove slavery, but this is not surprising, given that slaves would not have been honored with tombs. He points out that slavery was very common during the time the pyramids were built.

It is possible to accept that all five documents are correct, and still conclude that the pyramids were likely built, at least in part, by slaves. Herodotus' account, while far removed from the time of the pyramids, supports the claim of slavery. The textbook author found his account reliable enough to repeat it. The archaeological evidence cited by Hawass and Lehrner do not preclude the possibility of slavery, which was a common practice at the time the pyramids were built.

SCHOOL START TIMES

Science vs. Real Life

ENGLISH LANGUAGE ARTS

Reading Informational Text · Writing an Argument

GRADE 6

90-135 minutes



PURPOSE

The science behind adolescent sleep is persuasive: teenagers go to sleep and wake up later than other age groups. However, most school start times do not match the biology of adolescent sleep patterns.

In this lesson, students read two documents in order to hypothesize why most school start times do not follow the science of what is best for adolescent health. After considering different sources of information, students then write a short argument about whether they believe school start times should change.



STANDARDS

● Common Core State Standards

- ✓ Introduce claim(s) and organize the reasons and evidence clearly. [CCSS.ELA-Literacy.W.6.1A](#)
- ✓ Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. [CCSS.ELA-Literacy.RI.6.8](#)
- ✓ Support claim(s) with clear reasons and relevant evidence, using credible sources and demonstrating an understanding of the topic or text. [CCSS.ELA-Literacy.W.6.1B](#)



LEARNING GOALS

- Use multiple sources to develop an understanding of a topic.
- Understand how documents can present two sides of an argument to strengthen knowledge about a complex topic.

- Communicate understanding of a topic by writing an argument taking one side of a debate.



SUCCESS CRITERIA

- 1 Identify claims supporting an argument in multiple documents about the same topic.
- 2 Decide whether these claims are supported by evidence.
- 3 Construct an argument that explains your opinion about whether schools should delay start times for adolescents.



CULMINATING TASK

Using the information in these documents and other relevant information introduced in class, write an argument explaining your position on whether schools should have later start times.

PART I · INTRODUCTION

Discuss your students' experiences this morning. Did they have a hard time getting ready for school on time? Introduce the idea that science says pretty clearly that adolescents need to sleep later in the morning. But what about after school activities? Jobs? Child care?

SKILLS & STRATEGIES This is a lesson in identifying claims and evidence about an issue and using that information to construct a personal argument.



ANTICIPATED RESPONSE ~ PEDAGOGICAL ACTION

If students are new to argumentation, you will want to teach or review the concepts of claims and evidence, since these are critical components of this lesson.

Explain that this is an issue with multiple sides. Students will read two documents arguing two different sides of the issue. Using this information, classroom discussion, and relevant personal experience, students will form a personal argument and communicate their positions with supporting reasons.

Share and discuss Learning Goals and Success Criteria.



PART II · GUIDED PRACTICE

There are two main teaching points in this lesson. The first is to learn how to recognize two sides of a complex issue. The second is to collect evidence from different sources and use that evidence to defend personal positions about the issue. In order to accomplish these points, students read and discuss documents; collect and organize information; and integrate that information into a written argument.

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.

Read each document and record evidence from each. A reading guide is provided to help students collect information to use in the culminating task.



SUCCESS CRITERION #1 ~ EVIDENCE-GATHERING OPPORTUNITY

Identify claims supporting an argument in multiple documents about the same topic.

- ✓ Check the reading guide after reading each document and after classroom discussion.



ANTICIPATED RESPONSE ~ PEDAGOGICAL ACTION

This is a topic about which students may have strong personal feelings. Provide opportunity for students to articulate their feelings, opinions, and personal experiences. Guide them in recording these for appropriate use during classroom discussion and in the culminating task.



SUCCESS CRITERION #2 ~ EVIDENCE-GATHERING OPPORTUNITY

Decide whether these claims are supported by evidence.

- ✓ Go through each of the claims students listed in the Reading Guide, and discuss whether or not each is supported by evidence.



DOCUMENT A This is an article from *The Atlantic Monthly*, which has historically been a reliable source of journalism and other genres of writing. For the purposes of this unit, we regard this source as generally credible and objective. In this piece, we have several sources of information:

The Atlantic Monthly, a generally credible source of journalism.

The CDC, a government institute that most people regard as a reliable source of information about health and disease.

The AAP, a professional group of physicians whose recommendations about children's health and safety are widely disseminated by pediatricians.

Mary Carskadon, a professor of psychiatry and human behavior. Carskadon is a proponent of later start times, but her purpose in the article is to list the opposing arguments: problems with bus routes, lack of funds, parents who need adolescents to care for younger kids, conflicts with afterschool sports and other extracurricular activities. Note that the article does not actually interview anyone from the opposing side. Carskadon claims that implementation of later start times is "feasible" despite the many objections "as many school districts have demonstrated" but that "finding creative solutions...isn't always easy." Note that there are no specific answers to the opposition's arguments.

Terra Ziporyn Snider, medical writer, mother, and founder of advocacy group Start School Later. Similar to Carskadon, she believes the real problem to changing start times is "failure of imagination" and does not offer concrete solutions. She too lists some opposing claims, such as missing out on sports, elementary kids starting school while it's still dark, lack of child care.

One might argue that this article reads as a biased piece because it did not interview anyone from the opposing side, choosing to rely on one side's regurgitation of their claims. For the purposes of this introductory lesson, however, it is possible to simply list these opposing arguments, and comment on the credibility of the article or of Carskadon and Snider. In other words, although these obstacles to later start times are raised, no substantive solutions are offered. Counter to that, it is true that school districts have adjusted start times, although the details of implementation are not listed or considered in this document.

DOCUMENT B This is a letter from the Superintendent of Issaquah Schools, Ron Thiele, in Issaquah, Washington. The largest nearby school district, Seattle, had adjusted start times for middle and high school after considerable debate. Issaquah also considered this proposal and ultimately rejected it for the coming school year. The superintendent lists these as the primary sources and reasons:

AAP and CDC recommendations for later start times to benefit adolescents' health.

"More than 11,000 community members" who did not express a clear majority in favor of the change.

Ending school at 4 p.m. is too late and may have negative impact on students who work after school, provide childcare, or do afterschool sports and activities. Thiele points out while additional sleep benefits students, so too does engagement in after school activities.

Elementary parents who do not want earlier start times for younger children. In Issaquah, there must be at least one hour between elementary and secondary bus runs.

PART III · CULMINATING TASK

PROMPT Using information from these two documents as well as your relevant personal experience and knowledge, write a claim about whether school start times should change in districts with early start times. Support your claim with evidence.

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 Identifying a variety of claims and supporting evidence from documents, classroom discussion, and personal experience.
- 2 Using evidence appropriately to support position. Be sure that personal or anecdotal evidence is to supplement and enhance, not replace, sociological and scientific evidence.



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 #3 ~ EVIDENCE-GATHERING OPPORTUNITY

Construct an argument that explains your opinion about whether schools should delay start times for adolescents.

- ✓ Check responses to the culminating task, considering the elements described above.



DOCUMENT A The Atlantic Monthly

The Atlantic Monthly *is a magazine that focuses on foreign affairs, politics, the economy, and political trends.*

- 1 For the first time, the federal Centers for Disease Control and Prevention (CDC) is urging education policymakers to start middle- and high-school classes later in the morning. The idea is to improve the odds of adolescents getting sufficient sleep so they can thrive both physically and academically.
- 2 The CDC's recommendations come a year after the American Academy of Pediatrics (AAP) urged schools to adjust start times so more kids would get the recommended 8.5 to 9.5 hours of nightly rest. Both the CDC and the AAP cited significant risks that come with lack of sleep, including higher rates of obesity and depression and motor-vehicle accidents among teens as well as an overall lower quality of life.
- 3 Here's what the research shows: Adolescents' "internal clocks"—the circadian rhythms that control a human's responses to stimuli and determine sleep patterns—operate differently than those of other age groups. It's typically more difficult for adolescents to fall asleep earlier in the evening than it is for other age groups. And while teenagers are going to bed later, their school start times are often becoming earlier as they get to middle and high school.
- 4 Mary Carskadon, a professor of psychiatry and human behavior, notes that there are passionate arguments on both sides of the debate. In some districts, the start times are largely dictated by local transportation companies, with school boards and superintendents contending they lack the funds to change things. Meanwhile, parents are often reluctant to have teens start later, whether because they rely on having older children at home in the afternoons to take care of younger siblings or because they're concerned that it will interfere with extracurricular opportunities. Indeed, there's always a vocal chorus warning that later start times will hurt high-school sports.
- 5 But none of those worries override the reality that, as Carskadon put it, "everybody learns better when they're awake."
- 6 Implementing later start times can be feasible without causing major disruptions, as many school districts have demonstrated, Carskadon said. But it requires that all stakeholders commit to a time-consuming process of finding creative solutions, which isn't always easy.
- 7 Terra Ziporyn Snider, a medical writer and mother of three, has emerged as a national advocate for later start times. Snider cited widespread challenges hindering schools from making the switch. Getting school systems to change takes more than just presenting scientific evidence, said Snider, the co-founder of the nonprofit advocacy group Start School Later.
- 8 "You start talking about changing start times, and people immediately jump to all kinds of conclusions. Teens will miss out on sports. Little kids will go to school in the dark and get run over by a car. What will happen to my child care?" Snider said. "A lot of these fears and speculations turn out to be red herrings. The real obstacles are failure of imagination."
- 9 "It's becoming increasingly embarrassing to say, 'If we start school later, what happens to my kid's three-hour soccer practice?'" Snider said. "We have to convince school systems this has to happen for the health of kids. It's not a negotiable school budget item—it's an absolute requirement."

SOURCE *The Atlantic Monthly*, "Why School Should Start Later in the Morning," August 17, 2015. This document has been modified for length and reading level. The original can be found at <http://www.theatlantic.com/education/archive/2015/08/why-school-should-start-later/401489/>

DOCUMENT B Superintendent's Letter

Issaquah, Washington, is a small city outside Seattle, Washington. In 2015, Seattle Public Schools adopted late start times for middle and high schools because of the benefits for students' health. Issaquah also considered changing start times but, as the superintendent explains below, they decided against it.

Dear Issaquah Community,

- 1 I want to thank the thousands of community members who have provided input on the District's proposed change to school start times.
- 2 In fall 2015, the district proposed a change to school start times. Secondary schools would start at 9:00 a.m. and end at 3:55 p.m. Elementary schools would start at 8:00 a.m. and end at 2:25 p.m.
- 3 The proposal was created to address concerns that adolescents are not getting the right amount of sleep, as recommended by the American Academy of Pediatrics and the Centers for Disease Control. I have stated publicly that I agree that our secondary start times are too early and that some students are not getting enough sleep.
- 4 I have heard from more than 11,000 community members. From this input, it is evident that we do not have a clear majority in favor of the District's proposal. Additionally, several important concerns emerged from your input.
- 5 While many of you believe that the current start times at our secondary schools are too early, many also believe that ending secondary schools at nearly 4:00 p.m. is too late. The worry around ending school this late is the potential negative impact on students' ability to work after school, provide childcare for their younger siblings, or participate in after school activities such as tutoring, clubs, and athletics. I will also note that while the sleep study data is compelling, there is a strong body of research that links school engagement and success to participation in after school activities.
- 6 I also received a strong message from many elementary parents that they do not favor earlier start times for their children.
- 7 In light of the lack of consensus and the desire to consider alternate proposals, there will be no change to start times. Instead, I will work to develop a new proposal that moves us closer to the recommended start times for secondary students with less impact to the elementary schedule. This alternate proposal must still be fiscally feasible and take into account our geographically large district with routes that require a minimum of one hour between elementary and secondary bus runs.
- 8 The District will continue to talk with the community and our students about the important health benefits of sleep. We will also observe and learn from our neighboring districts that are implementing later start times this coming school year.
- 9 Finally, I want to thank the community for their input. I recognize that many people will not be happy with my decision, but I am hopeful that our community can unite around an alternate proposal in the future.

Sincerely,
Ron Thiele, Superintendent

SOURCE *Superintendent's Announcement on School Start and End Times*, March 1, 2016. This document has been modified for length and reading level. The original can be found at <http://www.issaquah.wednet.edu/news-details/2016/03/01/superintendent%27s-announcement-on-school-start-and-end-times>

READING GUIDE School Start Times

SOURCE	ARGUMENTS FOR LATER START TIMES	ARGUMENTS FOR EARLIER START TIMES
CLASSROOM DISCUSSION		
PERSONAL EXPERIENCE		
DOCUMENT A The Atlantic Monthly		
DOCUMENT B Superintendent's Letter		
What is your argument?		

In the chart above, mark the evidence you plan to use in your argument.



Using information from these two documents as well as your relevant personal experience and knowledge, write a claim about whether school start times should change in districts with early start times. Support your claim with evidence.

ACADEMIC TRACKING

Choosing Excellence Over Equity?

ENGLISH LANGUAGE ARTS

Reading Informational Text · Writing an Argument

GRADE 6

90-135 minutes



PURPOSE

Students read two documents about academic tracking, the practice of placing students into different classes based on early school performance. They examine two sides of the issue. After reading the documents and discussing the issue, students communicate their own positions with supporting reasons.



STANDARDS

● Common Core State Standards

- 1 Introduce claim(s) and organize the reasons and evidence clearly. [CCSS.ELA-Literacy.W.6.1A](#)
- 2 Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. [CCSS.ELA-Literacy.RI.6.8](#)
- 3 Support claim(s) with clear reasons and relevant evidence, using credible sources and demonstrating an understanding of the topic or text. [CCSS.ELA-Literacy.W.6.1B](#)



LEARNING GOALS

- Use multiple sources to develop an understanding of a topic.
- Understand how documents can present two sides of an argument to strengthen knowledge about a complex topic.
- Communicate understanding of a topic by writing an argument taking one side of a debate.



SUCCESS CRITERIA

- 1 Identify claims and evidence supporting an argument in multiple documents about the same topic.
- 2 Decide whether the evidence in these documents convincing and explain why.
- 3 Construct an argument that explains your opinion about whether middle school students should be tracked into different levels of academic classes.



CULMINATING TASK

Using the information in these documents and other relevant information introduced in class, write an argument explaining your position on whether middle school students should be tracked into different academic classes.

PART I · INTRODUCTION

Tracking students into different academic and career paths is a common practice, not only in the United States but throughout the world. Vocational training in high school used to be prevalent throughout the United States and is regaining popularity today despite a decades-long push to encourage all students to go to college. How early should students commit to an academic or career path? Should everyone to go to college? How long should students spend exploring different subjects and possibilities before committing to something and becoming proficient in it? Is middle school too early, or just right?



ANTICIPATED RESPONSE ~ PEDAGOGICAL ACTION

There are many sociological issues that can be discussed in the context of academic tracking. In these two documents, one of the most prominent and sensitive issues is the effect of academic tracking on students of different races. Consider beforehand whether to make this a key feature of the lesson. Depending on students' interests and needs, decide whether to discuss this unit only in terms of reasons for and against academic tracking or to devote additional time to the issue of race.

LITERATURE This unit was written in response to teachers' request for an informational text set that might help students explore the idea of society's role in determining young people's futures. This theme often occurs in dystopian books like *The Giver* by Lois Lowry.

SKILLS & STRATEGIES This is a lesson in identifying claims and evidence about an issue and using that information to construct a personal argument.



ANTICIPATED RESPONSE ~ PEDAGOGICAL ACTION

If students are new to argumentation, you will want to teach or review the concepts of claims and evidence, since these are critical components of this lesson.

STEPS Discuss your school's policies and practices regarding academic tracking. How are your students affected by it? If relevant, draw connections to books your students are familiar with in which society dictates the futures of young people by choosing their career paths.

Explain that this is an issue with multiple sides. Students will read two documents arguing two different sides of the issue. Using this information, classroom discussion, and relevant personal experience, students will form a personal argument and communicate their positions with supporting reasons.

Share and discuss Learning Goals and Success Criteria.

PART II · GUIDED PRACTICE

There are two main teaching points in this lesson. The first is to learn how to recognize two sides of a complex issue. The second is to collect evidence from different sources and use that evidence to defend personal positions about the issue. In order to accomplish these points, students read and discuss documents; collect and organize information; and integrate that information into a written argument.

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.

Read each document and record evidence from each. A reading guide is provided to help students collect information to use in the culminating task.



SUCCESS CRITERION #1 ~ EVIDENCE-GATHERING OPPORTUNITY

Identify claims and evidence supporting an argument in multiple documents about the same topic.

- ✓ Check the first column of the reading guide after reading each document and after classroom discussion.
- ✓ Discuss the issue of academic tracking as it is presented in the documents and as it relates to students' lives.



ANTICIPATED RESPONSE ~ PEDAGOGICAL ACTION

This is a topic about which students may have strong personal feelings. Provide opportunity for students to articulate their feelings, opinions, and personal experiences. Guide them in recording these for appropriate use during classroom discussion and in the culminating task.



ANTICIPATED RESPONSE ~ PEDAGOGICAL ACTION

Students may be tempted to simplify the argument by stating that whatever works for the individual student is what should be done. While acknowledging the importance of individual students being able to choose their own trajectory, guide the discussion to address the larger policy issues. Which is the greater good: producing excellence and providing challenging academic experiences at the potential expense of students who do not get tracked into higher academic classes or providing equal experiences to all children? In theory both should be possible; what is the reality?



SUCCESS CRITERION #2A ~ EVIDENCE-GATHERING OPPORTUNITY

Decide whether the evidence in these documents convincing and explain why.

- ✓ Check the second column of the reading guide after reading each document and after classroom discussion.

DOCUMENT A This document argues against academic tracking. It uses evidence from both sides in order to acknowledge opposing claims.

Arguments for tracking:

- tracking allows students to learn at their own level
- teachers have a hard time teaching in large classes with a wide range of needs
- elite classes keep wealthier families in the public school system

Arguments against tracking:

- tracking favors white students and keeps minority students from equal opportunity and achievement
- students in the advanced classes get advantages that other students don't get
- perpetuates the achievement gap
- can see which classrooms are higher or lower level based on racial composition of the class
- historically, tracking was based on wealth—vocational paths for working-class students, general education paths for wealthier students

DOCUMENT B This document argues for academic tracking. Like Document A, it uses evidence from both sides. The article's main point is that the two new research studies described here refute some of the arguments for tracking that were raised in Document A. (It is not a direct rebuttal to that document, but to the issue in general.)

Arguments for tracking:

- without tracking in math, there won't be enough students to master higher level math; they need to start early, in 8th grade
- need to cultivate talent over time, as with sports superstars. High performing athletes receive specialized training very early.
- researchers found high achieving black and Hispanic students flourished in gifted classrooms; they also found that black and Hispanic students in regular classrooms did not suffer negative consequences
- tracking can close the achievement gap; white students of similar academic abilities did as well in regular classrooms as they did in the gifted classrooms while black and Hispanic students of similar academic abilities did much better in gifted classrooms than in regular classrooms
- it's possible that black and Hispanic students excelled in the gifted classrooms because teachers' expectations were higher or because peers in gifted classrooms were more supportive of academic success, i.e., it was "cool" to be smart

Arguments against tracking:

- progressive educators: promotes inequality because higher income, white, and Asian kids more likely to get into elite classrooms
- students who are not in elite classrooms become demoralized
- curriculum in regular classrooms could get watered down
- better teachers and more resources go to elite classrooms

- in math, students who don't get into algebra by 8th grade less likely to enter advanced math and science later on



SUCCESS CRITERION #2B ~ 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 argument explaining your position on whether middle school students should be tracked into different academic classes.

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 Identifying a variety of claims and supporting evidence from documents, classroom discussion, and personal experience.
- 2 Using evidence appropriately to support position. Be sure that personal or anecdotal evidence is to supplement and enhance, not replace, sociological and scientific evidence.



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 #3 ~ EVIDENCE-GATHERING OPPORTUNITY

Construct an argument that explains your opinion about whether middle school students should be tracked into different levels of academic classes.

- 4 Check responses to the culminating task, considering the elements described above.



READING GUIDE (teacher version) Academic Tracking

- 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	ARGUMENTS FOR TRACKING	ARGUMENTS AGAINST TRACKING
DOCUMENT A Modern-Day Segregation	<ul style="list-style-type: none"> * tracking allows students to learn at their own level * teachers have a hard time teaching in large classes with a wide range of needs * elite classes keep wealthier families in the public school system 	<ul style="list-style-type: none"> * tracking favors white students and keeps minority students from equal opportunity and achievement * students in the advanced classes get advantages that other students don't get * perpetuates the achievement gap * can see which classrooms are higher or lower level based on racial composition of the class * historically, tracking was based on wealth—vocational paths for working-class students, general education paths for wealthier students
DOCUMENT B The Upside of Academic Tracking	<ul style="list-style-type: none"> * without tracking in math, there won't be enough students to master higher level math; they need to start early, in 8th grade * need to cultivate talent over time, as with sports superstars. High performing athletes receive specialized training very early. * high achieving black and Hispanic students flourished in gifted classrooms; black and Hispanic students in regular classrooms did not suffer negative consequences * tracking can close the achievement gap; white students of similar academic abilities did as well in regular classrooms as they did in the gifted classrooms while black and Hispanic students of similar academic abilities did much better in gifted classrooms than in regular classrooms * it's possible that black and Hispanic students excelled in gifted classrooms because teachers' expectations were higher or because peers were more supportive of academic success, i.e., it was "cool" to be smart 	<ul style="list-style-type: none"> * progressive educators: promotes inequality because higher income, white, and Asian kids more likely to get into elite classrooms * students who are not in elite classrooms become demoralized * curriculum in regular classrooms could get watered down * better teachers and more resources go to elite classrooms * in math, students who don't get into algebra by 8th grade less likely to enter advanced math and science later on

DOCUMENT A Modern-Day Segregation

The U.S. Department of Education says the tracking favors white students and keeps students of color from long-term equal achievement.

- 1 The U.S. Department of Education is trying to eliminate the practice of “tracking”—designating students for separate educational paths based on their academic performance as teenagers.
- 2 Some educators say that tracking perpetuates a modern system of segregation that favors white students and keeps minority students from equal opportunity and achievement.
- 3 Proponents of tracking say that the practices allow students to learn at their own levels and prevent a difficult situation for teachers: large classes where children with a wide range of different needs and skill levels are mixed together. In many districts, the higher-level instruction in “gifted and talented” or advanced placement classes is what keeps wealthier families from entirely abandoning the public school system.
- 4 But opponents say the ill effects for the students in the lower-skilled classes negate the advantages that the students in the advanced classes gain. Many education researchers have argued that tracking perpetuates class inequality and is partially to blame for the stubborn achievement gap in the U.S. educational system—between white and Asian students on one side, and black and Latino students on the other.
- 5 One New Jersey parent, Walter Fields, describes watching the effect of tracking first hand with his own African-American daughter, who was denied entry to an advanced freshman math class. She had the grades and standardized test scores to take the higher-level math class, Fields says, but didn’t get the required recommendation from a teacher. That didn’t change until Fields and his wife petitioned the principal to allow their daughter to take the higher-level class.
- 6 “You can literally walk down a hallway and look in a classroom and know whether it’s an upper-level class or a lower-level class based on the racial composition of the classroom,” Fields said.
- 7 Tracking has been around since the beginning of the 20th century, when students were placed on different school trajectories after a certain age. The tracking was often based on class—vocational paths for those from working-class backgrounds and general education paths for wealthier students.

SOURCE “Modern-Day Segregation in Public Schools,” *The Atlantic Monthly*, November 2014. *The Atlantic Monthly* is a publication that focuses news and commentary. This document has been modified for length, clarity, and reading difficulty. The original text can be found at: <http://www.theatlantic.com/education/archive/2014/11/modern-day-segregation-in-public-schools/382846/>

DOCUMENT B The Upside of Academic Tracking

Two new studies suggest that black and Hispanic students thrive in elite academic classes.

- 1 Tracking, the practice of putting a small group of higher achieving students into higher level classes, isn't popular with progressive educators. Opponents to tracking say it promotes inequality in our schools because higher income and white or Asian kids are more likely to get into the elite classrooms. Students who aren't chosen can become demoralized, or the curriculum can get too watered down. Great teachers and extra resources get steered to these honors programs, leaving the kids who need the most help with less.
- 2 Two new studies make a compelling case for continuing to teach top students in separate classrooms. A math study suggests that the U.S. won't produce enough students, including blacks and Hispanics, who can master higher mathematics if schools don't prepare them separately, starting in eighth grade. The second study finds that tracking can close the achievement gaps between high-IQ minority students and white students.
- 3 "You need to cultivate talent over time in mathematics," says Tom Loveless, the author of the math study. "I draw the analogy to sports. We're not shocked to hear that the high school quarterback star started playing football when he was eight, and that he was offered completely different opportunities to cultivate his talent."
- 4 Math isn't football, of course, and schools strive to help all children excel at math. But this research raises an age-old question of whether excellence is sacrificed by efforts to promote equity.
- 5 Tracking in eighth-grade math—steering only some students to algebra—is a critical decision in a student's life. Kids who don't study algebra in eighth grade rarely go on to calculus and advanced science classes.
- 6 Loveless studied the effect of tracking on black and Hispanic students and found that they did better on the Advanced Placement (AP) tests in states where there was more tracking.
- 7 The second study found big benefits for high-achieving minority students in the "gifted" classes. The researchers found that these high-achieving black and Hispanic students flourished.
- 8 There was no trade-off between excellence and equity in this case: the researchers didn't find negative consequences for students who weren't selected to enter the gifted classrooms.
- 9 The benefits of gifted classes were biggest for minority students. The researchers didn't find great gains for high-achieving white students. Whites of similar academic abilities did about as well in the regular class as they did in the gifted class.
- 10 "Placement in a gifted class effectively closes the underachievement gap," the authors wrote.

- 11 The researchers hypothesize two reasons for this: teacher expectations and peer pressure. In regular classrooms, teachers may not be pushing minority students as hard as they could be pushed. But in gifted classrooms, teachers are expecting excellence from everyone. Secondly, the researchers wonder if smart minority students are particularly susceptible to peer pressure in regular classrooms, where it's not "cool" to be smart. In the gifted classrooms, classmates may be more supportive of academic success.
- 12 The big argument against tracking is that black and Hispanic students are penalized by it. But perhaps tracking is what is needed to get more blacks and Hispanics into the elite ranks of top scientists and mathematicians."

SOURCE "The Upside of Academic Tracking," published in *The Atlantic Monthly*, written by The Hechinger Report, March 2016. The Hechinger Report is a news site that uses research and classroom stories to report on inequality and innovation in education. It is funded by private donors and multiple education foundations. *This document has been modified for length, clarity, and reading difficulty. The original text can be found at:* <http://www.theatlantic.com/education/archive/2016/03/the-upside-of-tracking/475956/>

READING GUIDE Academic Tracking

SOURCE	ARGUMENTS FOR TRACKING	ARGUMENTS AGAINST TRACKING
<p>CLASSROOM DISCUSSION</p>		
<p>PERSONAL EXPERIENCE</p>		
<p>DOCUMENT</p> <p>A</p> <p>Modern-Day Segregation</p>		
<p>DOCUMENT</p> <p>B</p> <p>The Upside of Academic Tracking</p>		

What is your argument?

In the chart above, mark the evidence you plan to use in your argument.



DATE

CULMINATING TASK Academic Tracking

Using the information in these documents and other relevant information introduced in class, write an argument explaining your position on whether middle school students should be tracked into different academic classes.



WHY DO ZEBRAS HAVE STRIPES?

Science vs. Common Belief

ENGLISH LANGUAGE ARTS

Reading Informational Text · Writing an Explanation

GRADE 6

90-135 minutes



PURPOSE

This inquiry invites students to state and revise their understanding of a seemingly simple question: Why do zebras have stripes?

Students will pose an answer to the question based on their prior knowledge and then read four documents about the topic. Each successive document will introduce information, sometimes conflicting, to help answer the question.



STANDARDS

● Common Core State Standards

- ✓ Compare and contrast one author's presentation of events with that of another. [CCSS.ELA-Literacy.RI.6.9](#)
- ✓ Develop a topic with relevant facts, definitions, concrete details, quotations, or other information and examples. [CCSS.ELA-Literacy.W.6.2.B](#)



LEARNING GOALS

- Use multiple sources to develop an understanding of a topic.
- Understand how texts can present multiple explanations of a phenomenon to strengthen knowledge about a complex topic.
- Communicate understanding of a complex topic by writing an explanation.



SUCCESS CRITERIA

- 1 Identify different explanations of the same phenomenon in multiple documents.

- 2 Decide whether these explanations are supported by evidence.
- 3 Using multiple sources of information, construct an explanation that answers the inquiry question.



CULMINATING TASK

Using the information in these documents and other relevant information introduced in class, write an explanation of why zebras have stripes.

PART I · INTRODUCTION

Introduce the inquiry. *Today we're going to read to find out why zebras have stripes. Why do you think they have stripes?* Elicit responses. It's most likely that students will say "camouflage" or "confuse predators."

SCIENCE NOTE Many people think that zebra stripes have to do with evading predators. Scientists are now persuaded that this is not likely. (You may wish to keep this information from the students so that they can discover this for themselves as they read the documents.) They are not sure exactly why zebras have stripes, but their strongest current theories do not seem to have anything to do with large predators. As stated in the Next Generation Science Standards (NGSS), scientific findings are often revised in light of new evidence. For those who are particularly interested, there is a long history of zebra inquiry (even Darwin was puzzled by this question). You could also investigate how and why the popular conception of zebra stripes came to be – discuss adaptation and the limits of our ability to speculate on reasons why things have come to be.



ANTICIPATED RESPONSE ~ PEDAGOGICAL ACTION

If students are eager to know more about the science behind this lesson, be prepared with further resources or be prepared to redirect the lesson to focus on reading and writing informational text.

Explain that this is an issue with multiple possibilities. Students will read four documents that provide different information about the topic. Using this information and classroom discussion, and relevant background knowledge (e.g., about scientific process), students will be able to provide an explanation to the inquiry question.

Share and discuss Learning Goals and Success Criteria.

PART II · GUIDED PRACTICE

There are two main teaching points in this lesson. The first is to learn to recognize even seemingly simple questions may not have simple answers. The second is to collect evidence from different sources and use that evidence to understand a complex topic. In order to accomplish these points, students read and discuss documents; collect and organize information; and integrate that information into a written explanation.

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.

Read each document and record evidence from each. A reading guide is provided to help students collect information to use in the culminating task.



SUCCESS CRITERION #1 ~ EVIDENCE-GATHERING OPPORTUNITY

Identify different explanations of the same phenomenon in multiple documents.

- ✓ Check the reading guide after reading each document and after classroom discussion.



ANTICIPATED RESPONSE ~ PEDAGOGICAL ACTION

This is a topic about which students may have strong personal feelings. Provide opportunity for students to articulate their feelings, opinions, and personal experiences. Guide them in recording these for appropriate use during classroom discussion and in the culminating task.



SUCCESS CRITERION #2 ~ EVIDENCE-GATHERING OPPORTUNITY

Decide whether these explanations are supported by evidence.

- ✓ As you read through each document, discuss whether each explanation is supported by evidence. Indicate this on the reading guide.

RELIABILITY OF SOURCES In this document set, the popular (and inaccurate) conception about zebra stripes was found in the kids' website from the San Diego Zoo. The National

Geographic website for kids was slightly more accurate and introduced the idea that scientists are not sure. It also listed a few of the theories. Both these sites were likely written by non-scientists, but we don't know because there is no author given. There is also no date given, so there's no way to know if they have considered the most current research. The other two documents were taken from reputable print media and had named authors. The named authors are probably professional writers. They would not wish their reputation to suffer by reporting inaccurate information. The two researchers are both scientists at reputable universities. We don't know much more about them than that. They seemed to use similar scientific methods (finding correlations) although Larison went one step further and used her findings to predict accurately. This gives additional credibility to her study.

DOCUMENT A Short excerpt intended for children, from the San Diego Zoo website. Says definitively that zebra stripes are intended to confuse predators. No other theories given.

DOCUMENT B From the National Geographic website, written for children. Adds to Document A by giving multiple theories and by introducing the concept that "scientists aren't sure."

DOCUMENT C First document with an author and date. Also a different genre (magazine article). Introduces a specific scientist (Tim Caro) and his explanation: repel flies.

DOCUMENT D Another document with author and date. Note that it is the same parent source as Document A (National Geographic). Includes the scientist from Document C as a source of information. Multiple scientific theories are being studied in order to explain this phenomenon. No clear answer appears to exist, but it is not likely to be the reason cited in Document A (confuse predators) which may also be the most common answer given by students at the start of the lesson.

PART III · CULMINATING TASK

PROMPT Using the information in these documents and other relevant information from class, write an explanation of why zebras have stripes..

Help students use evidence appropriately to support their explanation. Be sure that personal or anecdotal evidence is used to supplement and enhance, not replace, textual and scientific evidence.



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 #3 ~ **EVIDENCE-GATHERING OPPORTUNITY**

Using multiple sources of information, construct an explanation that answers the inquiry question.

- ✓ Check responses to the culminating task, considering the elements described above.

DOCUMENT A San Diego Zoo website



When zebras are grouped together, their stripes make it hard for a lion or leopard to pick out one zebra to chase. Different zebra species have different types of stripes, from narrow to wide. In fact, the further south you travel on the African plains, the farther apart the stripes on the zebras get!

SOURCE San Diego Zoo website

<http://kids.sandiegozoo.org/animals/mammals/zebra>

Retrieved September 2015. No author. Date when text was written unstated.

DOCUMENT B National Geographic website



When zebras are grouped together, their stripes make it hard for a No animal has a more distinctive coat than the zebra. Each animal's stripes are as unique as fingerprints—no two are exactly alike—although each of the three species has its own general pattern.

Why do zebras have stripes at all? Scientists aren't sure, but many theories center on their utility as some form of camouflage. The patterns may make it difficult for predators to identify a single animal from a running herd and distort distance at dawn and dusk. Or they may dissuade insects that recognize only large areas of single-colored fur or act as a kind of natural sunscreen. Because of their uniqueness, stripes may also help zebras recognize one another.

SOURCE National Geographic website

<http://animals.nationalgeographic.com/animals/mammals/zebra/>

Retrieved September 2015. No author. Date when text was written unstated.

APRIL 11, 2014

HOW ZEBRAS GOT THEIR STRIPES

BY MICHAEL LEMONICK



How did the zebra get its stripes? You would think that someone would have come up with the answer by now. In fact, it remains a mystery.

Scientists have puzzled for years over this mystery. The problem isn't that they have no good ideas. It's that they have too many good ideas. Maybe stripes let zebras blend in with environment, so that predators can't see them. Maybe they make it hard for predators to judge a zebra's speed and distance when it's running. Maybe stripes discourage flies from biting. Maybe they attract mates. Maybe stripes allow herd members to recognize each other. Maybe stripes protect against the heat.

These are all good explanations for a zebra's stripes. Until recently it's been hard to choose. But now a study offers the best evidence to date for one explanation: that the stripes discourage flies from biting.

"The fly hypothesis has proven to be the best one so far," Daniel Rubenstein, a biologist at Princeton and zebra expert, who wasn't involved in the study, said. "And this study adds new support to the idea." Discouraging bites from flies is useful since they often carry diseases.

Before the recent study, there was already evidence that flies avoid landing on stripes. "We know they don't like stripes, but we don't know why," said Tim Caro, a biologist at the University of California Davis. He is the main author of the new study.

Previous experiments used striped surfaces like flypaper, not real zebras, since getting a zebra to stand around in a lab would be tough.

So Caro tried a different way. He looked at all 20 species of wild zebras and horses. He looked at how much striping each species has, and the environment around each species. For example, how many large predators, climate, or the kind of plants in the area.

Only one of these reasons explained whether a species was more striped, less striped, or stripeless: flies. Caro said the relationship was very clear. "I was rather surprised," he said. "I found again and again that animals with many stripes are in areas that have many biting flies."

Caro is relieved that this question appears to have been answered at last. "We can stop asking the question 'Why stripes?' and start asking 'Why don't flies like to land on stripes?'" he said. Caro is also interested in whether it's disease or blood loss that makes fly bites such a problem. "That's what happens in science," he said. "You answer one question and it leads to six more."

Why Do Zebras Have Stripes? New Study Makes Temperature Connection



Zebras in warmer climates sport more stripes, perhaps to keep them cool or healthy.

By **Christine Dell'Amore**, National Geographic

PUBLISHED JANUARY 15, 2015

A leopard may not be able to change its spots, but some zebras change their stripes. Zebras in warmer places have more stripes, a new study shows, which might help answer an age-old question: Why stripes? The answer probably comes down to keeping zebras cool and fending off disease-causing insects that are more common in hotter climates, researchers reported Tuesday.

This “stripe riddle” has puzzled scientists, including Darwin, for over a century. There are five main hypotheses for why zebras have the stripes: to repel insects, to provide camouflage through some optical illusion, to confuse predators, to reduce body temperature, or to help the animals recognize each other.

A new study shows that temperature is the factor most strongly linked to striping: the warmer it is, the more stripes on the zebra.

Of Every Stripe

Brenda Larison, a biologist at the University of California, Los Angeles, visited 16 zebra populations throughout Africa and studied their stripe patterns.

Larison’s team measured 29 environmental factors—such as soil moisture, rainfall, prevalence of disease—carrying flies, and distribution of lions—and determined which ones were related to differences in stripe patterns. The two factors that mattered most, said Larison, were how consistent the temperature was in a particular area and the average temperature during the coldest part of the year.

The researchers then went a step further, using their hypothesis to predict the striping patterns of zebra populations not included in the study. “We were able to show that we could predict it with significant accuracy,” Larison said.

Cooling Effect?

Why temperature affects striping is another question, she said, but there are two possible reasons.

One is the “cooling eddy” theory. When air hits a zebra, the currents are stronger and faster over the black parts (since black absorbs more heat than white) and slower over the white. At the juncture of these two opposing airflows, little eddies of air may swirl and serve to cool a zebra’s skin.

For instance, Larison said, there’s evidence that heavily striped zebras have lower skin temperatures than other non-striped mammals in the same area.

The other idea holds that more stripes may be a barrier against disease, since disease-carrying flies tend to like it hot. Experiments in the field have shown that flies don’t like landing on striped surfaces.

Tim Caro, a biologist at the University of California, Davis, supports the disease theory. “We’re getting a lot of similarities in our findings,” said Caro, whose own research showed that striping is linked to repelling biting flies.

“Diseases carried by horseflies are really nasty,” he said. “They can hold a lot of diseases, and it’s possible that those diseases are going to be more of a problem under warmer, wetter conditions.”

Kiss of Death for Lion Hypothesis

Neither the new study nor Caro’s work found a link between striping and lion populations.

“A lot of people in the public think that stripes have to do with confusing predators,” he said.

“This is the kiss of death for that particular idea.”

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READING GUIDE Why Do Zebras Have Stripes?

A Source: San Diego Zoo website Author: _____ Date: _____

Theories: _____

Evidence: _____

B Source: National Geographic website Author: _____ Date: _____

Theories: _____

Evidence: _____

C Source: *New Yorker* article Author: _____ Date: _____

Theories: _____

Evidence: _____

D Source: *National Geographic* article Author: _____ Date: _____

Theories: _____

Evidence: _____



DATE _____

Why Do Zebras Have Stripes?

Using the information in these documents and other relevant information introduced in class, write an explanation of why zebras have stripes.

