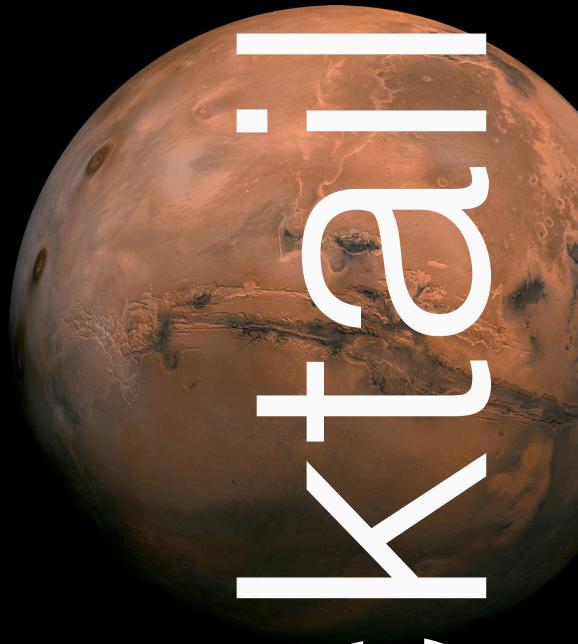
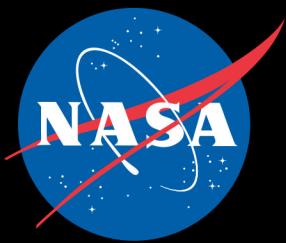


National Aeronautics and Space Administration



High School 21st Century Skills Alignment Document



Mystery of Blacktail Canyon

High School 21st Century Skills Standards Alignment



WHAT STUDENTS DO: Explore a virtual field trip of the Grand Canyon.

Students will explore Grand Canyon, AZ using a virtual field trip (VFT). They will observe the rock record and what these rocks tell us about the life and environments of the past. Then they will apply investigation techniques to the search for life in the solar system.

NRC FRAMEWORK/NGSS CORE & COMPONENT QUESTIONS	INSTRUCTIONAL OBJECTIVES (IO)
HOW AND WHY IS EARTH CONSTANTLY CHANGING? <i>NGSS Core Question: ESS2: Earth's Systems</i> Why do the continents move, and what causes earthquakes and volcanoes? <i>NGSS ESS2.B: Plate Tectonic and Large-Scale System Interactions</i> How do the properties and movement of water shape Earth's surface and affect its systems? <i>NGSS ESS2.C: The Roles of Water in Earth's Surface Processes</i>	<i>Students will be able to</i> IO1: Construct an explanation for why multiple missions are sent to a variety of locations on planetary bodies to investigate their geologic history and search for signatures of life.
HOW CAN THERE BE SO MANY SIMILARITIES AMONG ORGANISMS YET	

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SO MANY DIFFERENT KINDS OF PLANTS, ANIMALS, AND MICROORGANISMS? HOW DOES THE BIODIVERSITY AFFECT HUMANS?

NGSS Core Question: LS4: Biological Evolution: Unity and Diversity

**How does the environment influence
populations of organisms over multiple
generations?**

NGSS LS4.C: Adaptation

**What is biodiversity, how do humans
affect it, and how does it affect humans?**

NGSS LS4.D: Biodiversity and Humans

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1.0 About This Activity

How Students Learn: Science in the Classroom (Donovan & Bransford, 2005) advocates the use of a research-based instructional model for improving students' grasp of central science concepts. Based on conceptual-change theory in science education, the 5E Instructional Model (BSCS, 2006) includes five steps for teaching and learning: Engage, Explore, Explain, Elaborate, and Evaluate. The Engage stage is used like a traditional warm-up to pique student curiosity, interest, and other motivation-related behaviors and to assess students' prior knowledge. The Explore step allows students to deepen their understanding and challenges existing preconceptions and misconceptions, offering alternative explanations that help them form new schemata. In Explain, students communicate what they have learned, illustrating initial conceptual change. The Elaborate phase gives students the opportunity to apply their newfound knowledge to novel situations and supports the reinforcement of new schemata or its transfer. Finally, the Evaluate stage serves as a time for students' own formative assessment, as well as for educators' diagnosis of areas of confusion and differentiation of further instruction. The 5E stages can be cyclical and iterative.

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2.0 Instructional Objectives, Learning Outcomes, Standards, & Rubrics

Visit <https://infiniscope.org/lesson/mystery-blacktail-canyon/> for access to the digital learning experience, lesson plans, standards alignment documents, and additional resources.

Instructional objectives and learning outcomes are aligned with

- Achieve Inc.'s, *Next Generation Science Standards (NGSS)*
- National Research Council's, *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*
- National Governors Association Center for Best Practices (NGA Center) and Council of Chief State School Officers (CCSSO)'s, *Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects*
- Partnership for 21st Century Skills, *A Framework for 21st Century Learning*

The following chart provides details on alignment among the core and component NGSS questions, instructional objectives, learning outcomes, and educational standards.

- Your **instructional objectives (IO)** for this lesson align with the 21st Century Skills.
- You will know that you have achieved these instructional objectives if students demonstrate the related **learning outcomes (LO)**, also aligned with 21st Century Skills.
- You will know the level to which your students have achieved the learning outcomes by using the suggested **rubrics**.

Quick View of Standards Alignment:

This alignment document provides full details of the way in which instructional objectives, learning outcomes, 5E activity procedures, and rubric assessments were derived through, and align with the 21st Century Skills. For convenience, a quick view follows:

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HOW AND WHY IS EARTH CONSTANTLY CHANGING?

NGSS Core Question: *ESS2: Earth's Systems*

Why do the continents move, and what causes earthquakes and volcanoes?

NGSS ESS2.B: Plate Tectonic and Large-Scale System Interactions

How do the properties and movement of water shape Earth's surface and affect its systems?

NGSS ESS2.C: The Roles of Water in Earth's Surface Processes

HOW CAN THERE BE SO MANY SIMILARITIES AMONG ORGANISMS YET SO MANY DIFFERENT KINDS OF PLANTS, ANIMALS, AND MICROORGANISMS?

HOW DOES THE BIODIVERSITY AFFECT HUMANS?

NGSS Core Question: LS4: Biological Evolution: Unity and Diversity

How does the environment influence populations of organisms over multiple generations?

NGSS LS4.C: Adaptation

What is biodiversity, how do humans affect it, and how does it affect humans?

NGSS LS4.D: Biodiversity and Humans

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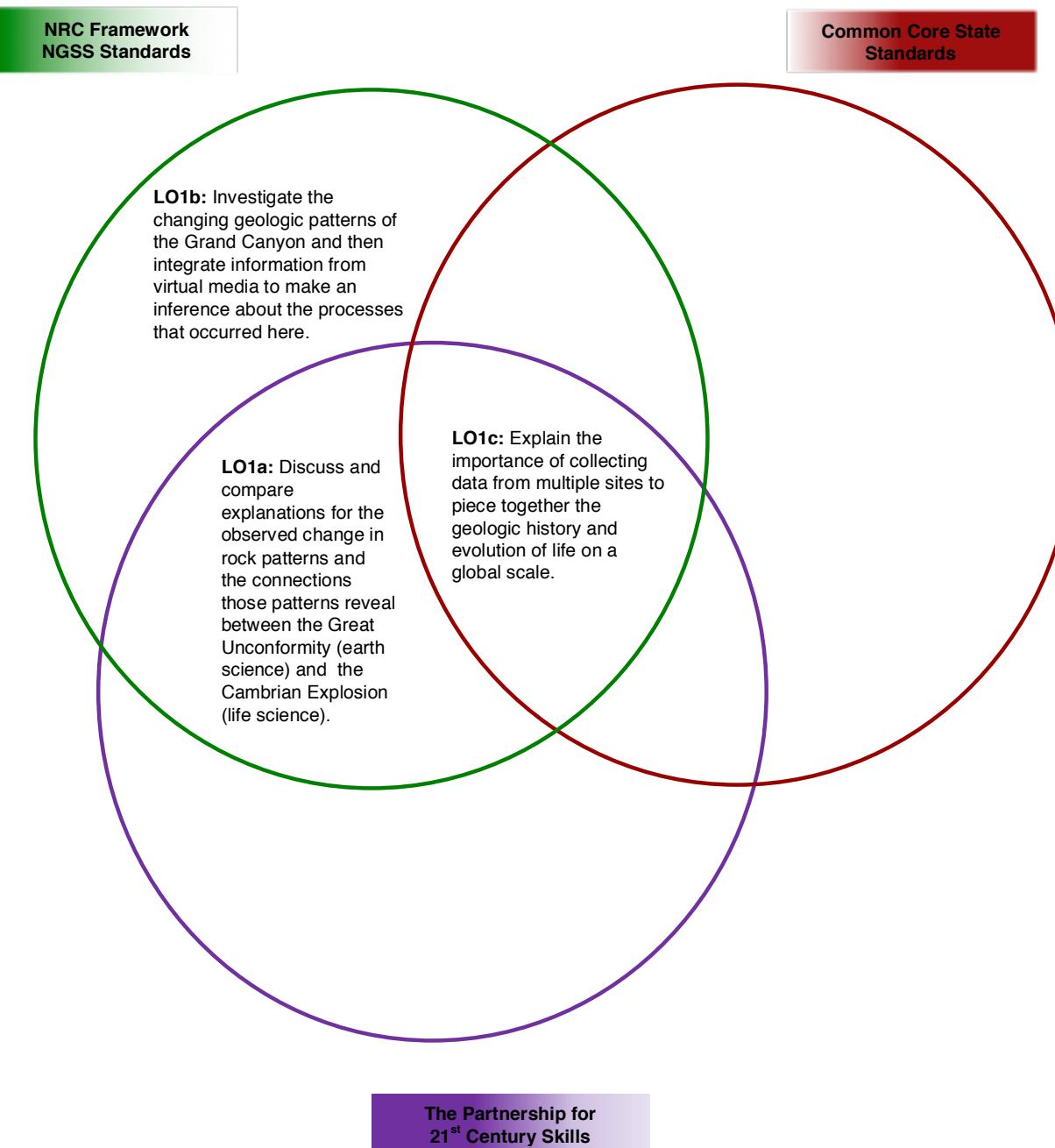
Instructional Objective <i>Students will be able to</i>	Learning Outcomes <i>Students will demonstrate the measurable abilities</i>	Standards <i>Students will address</i>
IO1: Construct an explanation for why multiple missions are sent to a variety of locations on planetary bodies to investigate their geologic history and search for signatures of life.	LO1a: Discuss and compare explanations for the observed change in rock patterns and the connections those patterns reveal between the Great Unconformity (earth science) and the Cambrian Explosion (life science). LO1b: Investigate the changing geologic patterns of the Grand Canyon and then integrate information from virtual media to make an inference about the processes that occurred here. LO1c: Explain the importance of collecting data from multiple sites to piece together the geologic history and evolution of life on a global scale.	Grade 12 Benchmarks Flexibility and Adaptability Collaboration Critical Thinking and Problem Solving

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3.0 Learning Outcomes, NRC Framework, NGSS, Common Core, & 21st Century Skills Connections

The connections diagram is used to organize the learning outcomes addressed in the lesson to establish where each will meet the Next Generation Science Standards, Common Core Standards, and the 21st Century Skills and visually determine where there are overlaps in these documents. See NGSS Alignment Document and Common Core State Standards Alignment Document for details on their specific alignments.



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4.0 Evaluation/Assessment

Use the (N) *Mystery of Blacktail Canyon Alignment Rubric* as a formative and summative assessment, allowing students to improve their work and learn from mistakes during class. The rubric evaluates the activities using the 21st Century Skills.

5.0 References

- Achieve, Inc. (2013). *Next generation science standards*. Achieve, Inc. on behalf of the twenty-six states and partners that collaborated on the NGSS.
- Bybee, R., Taylor, J., Gardner, A., Van Scotter, P., Carson Powell, J., Westbrook, A., Landes, N. (2006) *The BSCS 5E instructional model: origins, effectiveness, and applications*. Colorado Springs: BSCS.
- Donovan, S. & Bransford, J. D. (2005). *How Students Learn: History, Mathematics, and Science in the Classroom*. Washington, DC: The National Academies Press.
- Miller, Linn, & Gronlund. (2009). *Measurement and assessment in teaching*. Upper Saddle River, NJ: Pearson.
- National Academies Press. (1996, January 1). *National science education standards*. Retrieved February 7, 2011 from http://www.nap.edu/catalog.php?record_id=4962
- National Governors Association Center for Best Practices & Council of Chief State School Officers. (2010). *Common Core State Standards*. Washington, DC: Authors.
- National Research Council. (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas*. Committee on a Conceptual Framework for New K-12 Science Education Standards. Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.
- The Partnership for 21st Century Skills (2011). *A framework for 21st century learning*. Retrieved March 15, 2012 from <http://www.p21.org/>

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**MYSTERY OF BLACKTAIL CANYON****Teacher Guide****(M) Teacher Resource. Mystery of Blacktail Canyon 21st Century Skills Alignment (1 of 2)**

You will know the level to which your students have achieved the **Learning Outcomes**, and thus the **Instructional Objective(s)**, by using the suggested **Rubrics** below.

 Partnership for 21st Century Skills		
Instructional Objective	21st Century Skill	Grade 12 Benchmark
IO1: Construct an explanation for why multiple missions are sent to a variety of locations on planetary bodies to investigate their geologic history and search for signatures of life.	Flexibility and Adaptability	Students are able to successfully apply their scientific knowledge and scientific reasoning skills to a variety of situations and new areas of study.



MYSTERY OF BLACKTAIL CANYON

Teacher Guide

(M) Teacher Resource. Mystery of Blacktail Canyon 21st Century Skills Alignment (2 of 2)

Partnership for 21 st Century Skills		
Learning Outcomes	21 st Century Skill	Grade 12 Benchmark
LO1a: Discuss and compare explanations for the observed change in rock patterns and the connections those patterns reveal between the Great Unconformity (earth science) and the Cambrian Explosion (life science).	Collaboration	Students collaborate with peers and experts during scientific discourse and appropriately defend arguments using scientific reasoning, logic, and modeling.
LO1c: Explain the importance of collecting data from multiple sites to piece together the geologic history and evolution of life on a global scale.	Critical Thinking and Problem Solving	Students understand that scientific research and experimentation are guided by fundamental concepts, and that investigations are conducted for different reasons, such as exploring new phenomena, building on previous results, comparing different theories, and addressing problems facing society.

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MYSTERY OF BLACKTAIL CANYON

Teacher Guide

(N) Teacher Resource. Mystery of Blacktail Canyon 21st Century Skills Alignment Rubric

Related Rubrics for the Assessment of Learning Outcomes Associated with the Above Standard(s):

**Partnership for 21st Century Skills**

	Expert	Proficient	Intermediate	Beginner
Flexibility and Adaptability	Successfully connects NASA exploration activities to scientific thinking on planetary history using multiple connected lines of evidence in the explanation.	Successfully connects NASA exploration activities to scientific thinking on planetary history using at least one connected line of evidence in the explanation.	Mentions NASA exploration activities using at least one connected line of evidence in the explanation.	Mentions NASA exploration activities in the explanation.
Collaboration	Extremely interested in collaborating. Actively provides potential explanations, listens to suggestions from others, attempts to refine them, monitors group progress, and attempts to ensure everyone has a contribution.	Extremely interested in collaborating. Actively provides potential explanations and occasionally listens to suggestions from others. Refines suggestions from others.	Interested in collaborating. Listens to suggestions from peers and attempts to use them. Occasionally provides suggestions in group discussion.	Interested in collaborating.
Critical Thinking and Problem Solving	Develops a detailed explanation for collecting data at multiple sites to piece together the geologic history of <u>and</u> evolution on Earth as an example of scientific research.	Develops an explanation for collecting data at multiple sites to piece together the geologic history of <u>and</u> evolution on Earth as an example of scientific research.	Develops an explanation for collecting data at multiple sites focusing on either the geologic history of Earth <u>or</u> evolution on Earth.	Develops an explanation for collecting data at multiple sites.

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