



Is It Alive?

Middle School Alignment Document

National Resource Council Framework, Next Generation Science Standards, Common Core State Standards, and 21st Century Skills

WHAT STUDENTS DO: Generate Criteria for Living vs. Non-Living.

This lesson is designed to be an introduction to the characteristics of living things. In **Part A**, students will use research to develop their criteria for determining if something is alive. The class will combine their ideas in a teacher-guided discussion. In **Part B**, they will then use their criteria to determine whether there is anything alive in three different “soil” samples. They will make observations and draw pictures as they collect data from the sample and investigation. The purpose of this lesson is for students to use a critical thinking and a collaborative approach to identifying and applying the criteria needed for life. Students will:

- Use scientific observations to establish criteria,
- Differentiate between living and non-living objects, and
- Attribute criteria as Earth-based definitions of life.

NRC FRAMEWORK / NGSS CORE QUESTION	INSTRUCTIONAL OBJECTIVES (IO)
<p>HOW DO ORGANISMS LIVE, GROW, RESPOND TO THEIR ENVIRONMENT, AND REPRODUCE?</p> <p><i>NGSS Core Question: LS1: From Molecules to Organisms: Structures and Processes</i></p>	<p><i>Students will be able to</i></p> <p>IO1: Generate a list of criteria for the characteristics of life and conduct an investigation using changes over time among three samples as evidence for living/nonliving material.</p>



1.0 About This Activity

The Mars lessons leverage *A Taxonomy for Learning, Teaching, and Assessing* by Anderson and Krathwohl (2001) (see *Section 4* and *Teacher Guide* at the end of this document). This taxonomy provides a framework to help organize and align learning objectives, activities, and assessments. The taxonomy has two dimensions. The first dimension, cognitive process, provides categories for classifying lesson objectives along a continuum, at increasingly higher levels of thinking; these verbs allow educators to align their instructional objectives and assessments of learning outcomes to an appropriate level in the framework in order to build and support student cognitive processes. The second dimension, knowledge, allows educators to place objectives along a scale from concrete to abstract. By employing Anderson and Krathwohl's (2001) taxonomy, educators can better understand the construction of instructional objectives and learning outcomes in terms of the types of student knowledge and cognitive processes they intend to support. All activities provide a mapping to this taxonomy in the Teacher Guide (at the end of this lesson), which carries additional educator resources. Combined with the aforementioned taxonomy, the lesson design also draws upon Miller, Linn, and Gronlund's (2009) methods for (a) constructing a general, overarching, instructional objective with specific, supporting, and measurable learning outcomes that help assure the instructional objective is met, and (b) appropriately assessing student performance in the intended learning-outcome areas through rubrics and other measures. Construction of rubrics also draws upon Lanz's (2004) guidance, designed to measure science achievement.

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. This five-part sequence is the organizing tool for the Mars instructional series. The 5E stages can be cyclical and iterative.



2.0 Instructional Objectives, Learning Outcomes, & Standards

Instructional objectives and learning outcomes are aligned with

- National Research Council's, *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*
- Achieve Inc.'s, *Next Generation Science Standards (NGSS)*
- 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 NGSS Framework and NGSS.
- You will know that you have achieved these instructional objectives if students demonstrate the related **learning outcomes (LO)**.
- You will know the level to which your students have achieved the learning outcomes by using the suggested **rubrics** (see Teacher Guide at the end of this document).

Important Note: This lesson is color-coded to help teachers identify each of the three dimensions of NGSS. The following identifying colors are used: **Practices are blue**, **Cross-Cutting Concepts are green**, and **Disciplinary Core Ideas are orange**.

This color-coding is consistent with the NGSS Performance Expectations and Foundation Boxes.

Quick View of Standards Alignment:

The Teacher Guide at the end of this lesson provides full details of standards alignment, rubrics, and the way in which instructional objectives, learning outcomes, 5E activity procedures, and assessments were derived through, and align with, Anderson and Krathwohl's (2001) taxonomy of knowledge and cognitive process types. For convenience, a quick view follows:



HOW DO ORGANISMS LIVE, GROW, RESPOND TO THEIR ENVIRONMENT, AND REPRODUCE?

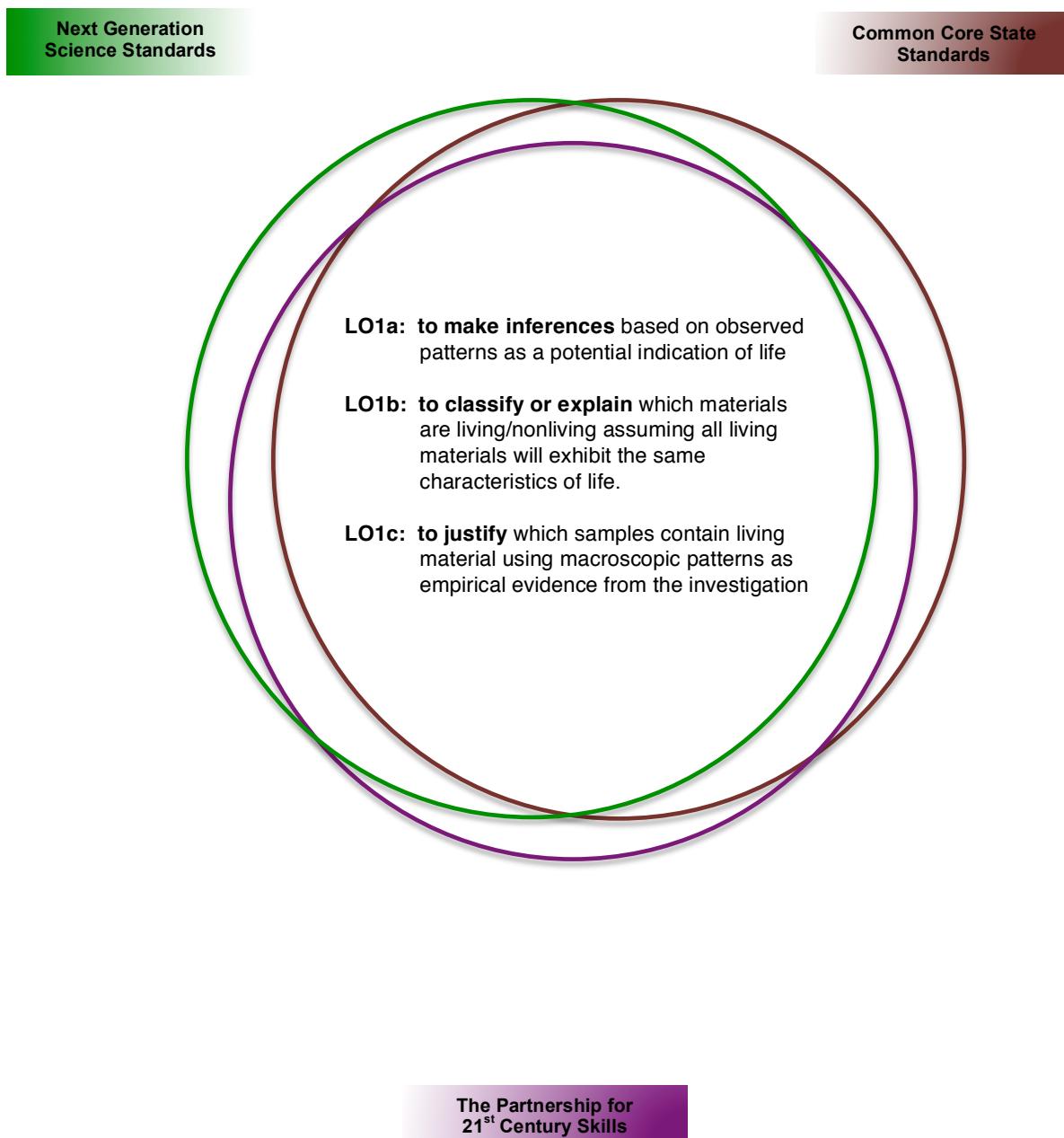
NGSS Core Question: LS1: From Molecules to Organisms: Structures and Processes

Instructional Objective (IO) Students will be able to:	Learning Outcomes (LO) Students will demonstrate the measurable abilities	Standards Students will address
IO1: Generate a list of criteria for the characteristics of life and conduct an investigation using changes over time among three samples as evidence for living/nonliving material	LO1a: to make inferences based on observed patterns as a potential indication of life LO1b: to classify or explain which materials are living/nonliving assuming all living materials will exhibit the same characteristics of life LO1c: to justify which samples contain living material using macroscopic patterns as empirical evidence from the investigation	DISCIPLINARY CORE IDEAS: LS1: From Molecules to Organisms: Structures and Processes PRACTICES: <ol style="list-style-type: none"> 1. Asking Questions and Defining Problems 2. Planning and Carrying out Investigations 3. Analyzing and Interpreting Data 4. Constructing Explanations and Designing Solutions 5. Engaging in Argument from Evidence CROSSCUTTING CONCEPTS: <ol style="list-style-type: none"> 1. Patterns 2. Cause and Effect: Mechanism and Prediction 3. Stability and Change <p>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</p>



3.0 Learning Outcomes, 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, ELA Common Core Standards, and the 21st Century Skills and visually determine where there are overlaps in these documents.





4.0 Evaluation/Assessment

Use the (*L*) *Is It Alive? 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 Next Generation Science Standards, Common Core State Standards, and 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.
- Anderson, L.W., & Krathwohl (Eds.). (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. New York: Longman.
- 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>



IS IT ALIVE?

Teacher Guide

(I) Teacher Resource. Is it Alive? NGSS Alignment (1 of 3)

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.

****Note:** You may see Practices, DCI's, or Crosscutting Concepts from earlier grades. This has been done strategically to spiral learning to support student cognitive development of learning progressions, preparing them for more difficult tasks. This will be indicated in the rubric below with *italics*.

Next Generation Science Standards Alignment (NGSS)			
Instructional Objective <i>Students will be able to</i>	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts
IO1: Generate a list of criteria for the characteristics of life and conduct an investigation using changes over time among three samples as evidence for living/nonliving material.	<p>Asking Questions and Defining Problems: Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.</p> <p>Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information</p> <p>Planning and Carrying out Investigations: Collect data to produce data as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.</p> <p>Analyzing and Interpreting Data: Analyze and interpret data to provide evidence for phenomena.</p> <p>Analyze and interpret data to determine similarities and differences in findings.</p> <p>Constructing Explanations and Designing Solutions:</p>	<p>LS1: From Molecules to Organisms: Structures and Processes: How do organisms live, grow, respond to their environment, and reproduce? All living organisms are made of cells. Life is the quality that distinguishes living things—composed of living cells—from nonliving objects or those that have died. While a simple definition of life can be difficult to capture, all living things—that is to say all organisms—can be characterized by common aspects of their structure and functioning. Organisms are complex, organized, and built on a hierarchical structure, with each level providing the foundation for the next, from the chemical foundation of elements and atoms, to the cells and systems of individual organisms, to species and populations living and interacting in complex ecosystems. Organisms can be made of a single cell or millions of cells working together and include animals, plants, algae, fungi, bacteria, and all other microorganisms.</p>	<p>Patterns: Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. (Reconnection to K-2 Crosscutting Statement)</p> <p>Macroscopic patterns are related to the nature of microscopic and atomic-level structure.</p> <p>Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems.</p> <p>Patterns can be used to identify cause and effect relationships.</p> <p>Cause and Effect: Mechanism and Prediction: Cause and effect relationships may be used to predict phenomena in natural or designed systems.</p>



	<p>Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.</p> <p>Engaging in Argument from Evidence: Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.</p>	<p>Organisms respond to stimuli from their environment and actively maintain their internal environment through homeostasis. They grow and reproduce, transferring their genetic information to their offspring. While individual organisms carry the same genetic information over their lifetime, mutation and the transfer from parent to offspring produce new combinations of genes. Over generations natural selection can lead to changes in a species overall; hence, species evolve over time. To maintain all of these processes and functions, organisms require materials and energy from their environment; nearly all energy that sustains life ultimately comes from the sun.</p>	<p>Stability and Change: Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales, including the atomic scale.</p> <p>Scientific Knowledge Assumes an Order and Consistency in Natural Systems: Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.</p>
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IS IT ALIVE?

Teacher Guide

(I) Teacher Resource. Soda Straw Rockets NGSS Alignment (2 of 3)

Next Generation Science Standards Alignment (NGSS)			
Learning Outcomes <i>Students will be able to</i>	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts
LO1a: to make inferences based on observed patterns as a potential indication of life	<p>Asking Questions and Defining Problems: Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.</p> <p>Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information</p> <p>Analyzing and Interpreting Data: Analyze and interpret data to provide evidence for phenomena.</p> <p>Analyze and interpret data to determine similarities and differences in findings.</p> <p>Constructing Explanations and Designing Solutions: Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.</p> <p>Engaging in Argument from Evidence: Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.</p>	<p>LS1: From Molecules to Organisms: Structures and Processes: How do organisms live, grow, respond to their environment, and reproduce? All living organisms are made of cells. Life is the quality that distinguishes living things—composed of living cells—from nonliving objects or those that have died. While a simple definition of life can be difficult to capture, all living things—that is to say all organisms—can be characterized by common aspects of their structure and functioning. Organisms are complex, organized, and built on a hierarchical structure, with each level providing the foundation for the next, from the chemical foundation of elements and atoms, to the cells and systems of individual organisms, to species and populations living and interacting in complex ecosystems. Organisms can be made of a single cell or millions of cells working together and include animals, plants, algae, fungi, bacteria, and all other microorganisms.</p> <p>Organisms respond to stimuli from their environment and actively maintain their internal environment through homeostasis. They grow and reproduce, transferring their genetic information to their offspring. While individual organisms carry the same genetic information over their lifetime, mutation and the transfer from parent to offspring produce new combinations of genes. Over generations natural selection can lead to changes in a species overall; hence, species evolve over time. To maintain all of these processes and</p>	<p>Patterns: Macroscopic patterns are related to the nature of microscopic and atomic-level structure.</p> <p>Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems.</p> <p>Patterns can be used to identify cause and effect relationships.</p> <p>Cause and Effect: Mechanism and Prediction: Cause and effect relationships may be used to predict phenomena in natural or designed systems.</p> <p>Stability and Change: Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales, including the atomic scale.</p> <p>Scientific Knowledge Assumes an Order and Consistency in Natural Systems: Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.</p>

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		<p>functions, organisms require materials and energy from their environment; nearly all energy that sustains life ultimately comes from the sun.</p>	
LO1b: to classify or explain which materials are living/nonliving assuming all living materials will exhibit the same characteristics of life	<p>Asking Questions and Defining Problems: Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.</p> <p>Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information</p> <p>Analyzing and Interpreting Data: Analyze and interpret data to provide evidence for phenomena.</p> <p>Analyze and interpret data to determine similarities and differences in findings.</p> <p>Constructing Explanations and Designing Solutions: Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.</p> <p>Engaging in Argument from Evidence: Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem</p>	<p>LS1: From Molecules to Organisms: Structures and Processes: How do organisms live, grow, respond to their environment, and reproduce?</p> <p>All living organisms are made of cells. Life is the quality that distinguishes living things—composed of living cells—from nonliving objects or those that have died. While a simple definition of life can be difficult to capture, all living things—that is to say all organisms—can be characterized by common aspects of their structure and functioning. Organisms are complex, organized, and built on a hierarchical structure, with each level providing the foundation for the next, from the chemical foundation of elements and atoms, to the cells and systems of individual organisms, to species and populations living and interacting in complex ecosystems. Organisms can be made of a single cell or millions of cells working together and include animals, plants, algae, fungi, bacteria, and all other microorganisms.</p> <p>Organisms respond to stimuli from their environment and actively maintain their internal environment through homeostasis. They grow and reproduce, transferring their genetic information to their offspring. While individual organisms carry the same genetic information over their lifetime, mutation and the transfer from parent to offspring produce new combinations of genes. Over generations natural selection can lead to changes in a species overall; hence, species evolve over time. To maintain all of these processes and functions, organisms require materials and energy from their environment; nearly all energy that sustains life ultimately comes from the sun.</p>	<p>Patterns: Macroscopic patterns are related to the nature of microscopic and atomic-level structure.</p> <p>Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems.</p> <p>Patterns can be used to identify cause and effect relationships.</p> <p>Cause and Effect: Mechanism and Prediction: Cause and effect relationships may be used to predict phenomena in natural or designed systems.</p> <p>Stability and Change: Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales, including the atomic scale.</p> <p>Scientific Knowledge Assumes an Order and Consistency in Natural Systems: Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.</p>
LO1c: to justify which samples contain	<p>Analyzing and Interpreting Data: Analyze and interpret data to provide evidence for phenomena.</p>	<p>LS1: From Molecules to Organisms: Structures and Processes: How do organisms live, grow, respond to their</p>	<p>Patterns: Macroscopic patterns are related to the nature of microscopic and atomic-level</p>



living material using macroscopic patterns as empirical evidence from the investigation	<p>Analyze and interpret data to determine similarities and differences in findings.</p> <p>Constructing Explanations and Designing Solutions: Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.</p> <p>Engaging in Argument from Evidence: Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.</p>	<p>environment, and reproduce?</p> <p>All living organisms are made of cells. Life is the quality that distinguishes living things—composed of living cells—from nonliving objects or those that have died. While a simple definition of life can be difficult to capture, all living things—that is to say all organisms—can be characterized by common aspects of their structure and functioning. Organisms are complex, organized, and built on a hierarchical structure, with each level providing the foundation for the next, from the chemical foundation of elements and atoms, to the cells and systems of individual organisms, to species and populations living and interacting in complex ecosystems. Organisms can be made of a single cell or millions of cells working together and include animals, plants, algae, fungi, bacteria, and all other microorganisms.</p> <p>Organisms respond to stimuli from their environment and actively maintain their internal environment through homeostasis. They grow and reproduce, transferring their genetic information to their offspring. While individual organisms carry the same genetic information over their lifetime, mutation and the transfer from parent to offspring produce new combinations of genes. Over generations natural selection can lead to changes in a species overall; hence, species evolve over time. To maintain all of these processes and functions, organisms require materials and energy from their environment; nearly all energy that sustains life ultimately comes from the sun.</p>	<p>structure.</p> <p>Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems.</p> <p>Patterns can be used to identify cause and effect relationships.</p> <p>Cause and Effect: Mechanism and Prediction: Cause and effect relationships may be used to predict phenomena in natural or designed systems.</p> <p>Stability and Change: Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales, including the atomic scale.</p> <p>Scientific Knowledge Assumes an Order and Consistency in Natural Systems: Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.</p>
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**Teacher Guide****IS IT ALIVE?****(I) Teacher Resource. Is it Alive? NGSS Activity Alignment (3 of 3)**

Next Generation Science Standards Activity Alignments (NGSS)				
Activity	Phases of 5E Instructional Model	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts
Identifying Prior Knowledge	Engage	Asking Questions and Defining Problems: Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.	LS1: From Molecules to Organisms: Structures and Processes: How do organisms live, grow, respond to their environment, and reproduce? All living organisms are made of cells. Life is the quality that distinguishes living things—composed of living cells—from nonliving objects or those that have died. While a simple definition of life can be difficult to capture, all living things—that is to say all organisms—can be characterized by common aspects of their structure and functioning. Organisms are complex, organized, and built on a hierarchical structure, with each level providing the foundation for the next, from the chemical foundation of elements and atoms, to the cells and systems of individual organisms, to species and populations living and interacting in complex ecosystems. Organisms can be made of a single cell or millions of cells working together and include animals, plants, algae, fungi, bacteria, and all other microorganisms. Organisms respond to stimuli from their environment and actively maintain their internal environment through homeostasis. They grow and reproduce, transferring their genetic information to their offspring. While individual organisms carry the same genetic information over their lifetime, mutation and the transfer from parent to offspring produce new combinations of genes. Over generations natural selection can lead to changes in a species overall; hence, species evolve over time. To maintain all of these processes and functions, organisms require materials and energy from	Patterns: Macroscopic patterns are related to the nature of microscopic and atomic-level structure.



			their environment; nearly all energy that sustains life ultimately comes from the sun.	
(A) Students Sheet #1	Explore	<p>Asking Questions and Defining Problems: Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.</p> <p>Constructing Explanations and Designing Solutions: Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.</p> <p>Engaging in Argument from Evidence: Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.</p>	<p>LS1: From Molecules to Organisms: Structures and Processes: How do organisms live, grow, respond to their environment, and reproduce? All living organisms are made of cells. Life is the quality that distinguishes living things—composed of living cells—from nonliving objects or those that have died. While a simple definition of life can be difficult to capture, all living things—that is to say all organisms—can be characterized by common aspects of their structure and functioning. Organisms are complex, organized, and built on a hierarchical structure, with each level providing the foundation for the next, from the chemical foundation of elements and atoms, to the cells and systems of individual organisms, to species and populations living and interacting in complex ecosystems. Organisms can be made of a single cell or millions of cells working together and include animals, plants, algae, fungi, bacteria, and all other microorganisms. Organisms respond to stimuli from their environment and actively maintain their internal environment through homeostasis. They grow and reproduce, transferring their genetic information to their offspring. While individual organisms carry the same genetic information over their lifetime, mutation and the transfer from parent to offspring produce new combinations of genes. Over generations natural selection can lead to changes in a species overall; hence, species evolve over time. To maintain all of these processes and functions, organisms require materials and energy from their environment; nearly all energy that sustains life ultimately comes from the sun.</p>	<p>Patterns: Macroscopic patterns are related to the nature of microscopic and atomic-level structure.</p>



(B) Student Sheet #2	Explain	<p>Analyzing and Interpreting Data: Analyze and interpret data to provide evidence for phenomena.</p> <p>Analyze and interpret data to determine similarities and differences in findings.</p> <p>Asking Questions and Defining Problems: Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information</p> <p>Constructing Explanations and Designing Solutions: Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.</p>	<p>LS1: From Molecules to Organisms: Structures and Processes:</p> <p>How do organisms live, grow, respond to their environment, and reproduce?</p> <p>All living organisms are made of cells. Life is the quality that distinguishes living things—composed of living cells—from nonliving objects or those that have died. While a simple definition of life can be difficult to capture, all living things—that is to say all organisms—can be characterized by common aspects of their structure and functioning. Organisms are complex, organized, and built on a hierarchical structure, with each level providing the foundation for the next, from the chemical foundation of elements and atoms, to the cells and systems of individual organisms, to species and populations living and interacting in complex ecosystems. Organisms can be made of a single cell or millions of cells working together and include animals, plants, algae, fungi, bacteria, and all other microorganisms.</p> <p>Organisms respond to stimuli from their environment and actively maintain their internal environment through homeostasis. They grow and reproduce, transferring their genetic information to their offspring. While individual organisms carry the same genetic information over their lifetime, mutation and the transfer from parent to offspring produce new combinations of genes. Over generations natural selection can lead to changes in a species overall; hence, species evolve over time. To maintain all of these processes and functions, organisms require materials and energy from their environment; nearly all energy that sustains life ultimately comes from the sun.</p>	<p>Patterns: Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems.</p> <p>Patterns can be used to identify cause and effect relationships.</p> <p>Cause and Effect: Mechanism and Prediction Cause and effect relationships may be used to predict phenomena in natural or designed systems.</p> <p>Scientific Knowledge Assumes an Order and Consistency in Natural Systems: Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.</p>
(C & D) Data Chart #1 and Data Chart #2	Explore	<p>Planning and Carrying Out Investigations: Collect data to produce data as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.</p>	<p>LS1: From Molecules to Organisms: Structures and Processes:</p> <p>How do organisms live, grow, respond to their environment, and reproduce?</p> <p>All living organisms are made of cells. Life is the quality that distinguishes living things—composed of living cells—from nonliving objects or those that have died. While a simple definition of life can be difficult to capture, all living things—that is to say all organisms—can be characterized by common aspects of their</p>	<p>Stability and Change: Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales, including the atomic scale.</p> <p>Patterns: Patterns can be used to identify cause and effect relationships.</p>



			<p>structure and functioning. Organisms are complex, organized, and built on a hierarchical structure, with each level providing the foundation for the next, from the chemical foundation of elements and atoms, to the cells and systems of individual organisms, to species and populations living and interacting in complex ecosystems. Organisms can be made of a single cell or millions of cells working together and include animals, plants, algae, fungi, bacteria, and all other microorganisms.</p> <p>Organisms respond to stimuli from their environment and actively maintain their internal environment through homeostasis. They grow and reproduce, transferring their genetic information to their offspring. While individual organisms carry the same genetic information over their lifetime, mutation and the transfer from parent to offspring produce new combinations of genes. Over generations natural selection can lead to changes in a species overall; hence, species evolve over time. To maintain all of these processes and functions, organisms require materials and energy from their environment; nearly all energy that sustains life ultimately comes from the sun.</p>	
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(J) Teacher Resource. Is it Alive? CCSS Alignment (1 of 2)

 Common Core State Standards			
Instructional Objective <i>Students will be able to</i>	Reading Standards for Literacy in Science and Technical Subjects (6-8)	Writing Standards for Literacy in Science and Technical Subjects (6-8)	Speaking and Listening Standards (6–8)
IO1: Generate a list of criteria for the characteristics of life and conduct an investigation using changes over time among three samples as evidence for living/nonliving material		<p>Text Types and Purposes: Write arguments focused on discipline-specific content.</p> <ul style="list-style-type: none"> a. Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically. b. Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources. c. Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence. d. Establish and maintain a formal style. e. Provide a concluding statement or section that follows from and supports the argument presented. <p>Research to Build and Present Knowledge: Conduct short research projects to answer a question (including a self-</p>	<p>Comprehension and Collaboration:</p> <p>Grade 6: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p> <ul style="list-style-type: none"> a. Come to discussions prepared, having read or studied required material; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion. b. Follow rules for collegial discussions, set specific goals and deadlines, and define individual roles as needed. c. Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion. d. Review the key ideas expressed and demonstrate understanding of multiple perspectives through reflection and paraphrasing. <p>Grade 7: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p> <ul style="list-style-type: none"> a. Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion. b. Follow rules for collegial discussions, track progress toward specific goals and deadlines, and define individual roles as needed. c. Pose questions that elicit elaboration and respond to others' questions and comments with relevant observations and ideas that bring the discussion back on topic as needed.



		<p>generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.</p>	<p>d. Acknowledge new information expressed by others and, when warranted, modify their own views.</p> <p>Grade 8: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p> <ul style="list-style-type: none">a. Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.b. Follow rules for collegial discussions and decision-making, track progress toward specific goals and deadlines, and define individual roles as needed.c. Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas.d. Acknowledge new information expressed by others, and, when warranted, qualify or justify their own views in light of the evidence presented.
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(J) Teacher Resource. Is it Alive? CCSS Alignment (2 of 2)

 Common Core State Standards			
Learning Outcome <i>Students will be able</i>	Reading Standards for Literacy in Science and Technical Subjects (6-8)	Writing Standards for Literacy in Science and Technical Subjects (6-8)	Speaking and Listening Standards (6–8)
LO1a: to make inferences based on observed patterns as a potential indication of life			<p>Comprehension and Collaboration:</p> <p>Grade 6: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p> <ul style="list-style-type: none"> a. Come to discussions prepared, having read or studied required material; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion. b. Follow rules for collegial discussions, set specific goals and deadlines, and define individual roles as needed. c. Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion. d. Review the key ideas expressed and demonstrate understanding of multiple perspectives through reflection and paraphrasing. <p>Grade 7: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p> <ul style="list-style-type: none"> a. Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion. b. Follow rules for collegial discussions, track progress toward specific goals and deadlines, and define individual roles as needed. c. Pose questions that elicit elaboration and respond to others' questions and comments with relevant observations and



			<p>d. ideas that bring the discussion back on topic as needed.</p> <p>Grade 8: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p> <ul style="list-style-type: none"> a. Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion. b. Follow rules for collegial discussions and decision-making, track progress toward specific goals and deadlines, and define individual roles as needed. c. Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas. d. Acknowledge new information expressed by others, and, when warranted, qualify or justify their own views in light of the evidence presented.
LO1b: to classify or explain which materials are living/nonliving assuming all living materials will exhibit the same characteristics of life		<p>Text Types and Purposes: Write arguments focused on discipline-specific content.</p> <ul style="list-style-type: none"> a. Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically. b. Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources. c. Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence. 	<p>Comprehension and Collaboration:</p> <p>Grade 6: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p> <ul style="list-style-type: none"> a. Come to discussions prepared, having read or studied required material; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion. b. Follow rules for collegial discussions, set specific goals and deadlines, and define individual roles as needed. c. Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion. d. Review the key ideas expressed and demonstrate understanding of multiple perspectives through reflection and paraphrasing. <p>Grade 7: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p>



		<p>d. Establish and maintain a formal style.</p> <p>e. Provide a concluding statement or section that follows from and supports the argument presented.</p> <p>Research to Build and Present Knowledge: Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.</p>	<p>topics, texts, and issues, building on others' ideas and expressing their own clearly.</p> <p>a. Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.</p> <p>b. Follow rules for collegial discussions, track progress toward specific goals and deadlines, and define individual roles as needed.</p> <p>c. Pose questions that elicit elaboration and respond to others' questions and comments with relevant observations and ideas that bring the discussion back on topic as needed.</p> <p>d. Acknowledge new information expressed by others and, when warranted, modify their own views.</p> <p>Grade 8: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p> <p>a. Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.</p> <p>b. Follow rules for collegial discussions and decision-making, track progress toward specific goals and deadlines, and define individual roles as needed.</p> <p>c. Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas.</p> <p>d. Acknowledge new information expressed by others, and, when warranted, qualify or justify their own views in light of the evidence presented.</p>
LO1c: to justify which samples contain living material using macroscopic patterns as empirical evidence from the investigation		<p>Text Types and Purposes: Write arguments focused on discipline-specific content.</p> <p>a. Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.</p> <p>b. Support claim(s) with logical</p>	<p>Comprehension and Collaboration:</p> <p>Grade 6: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p> <p>a. Come to discussions prepared, having read or studied required material; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.</p> <p>b. Follow rules for collegial discussions, set specific goals and</p>



		<p>reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.</p> <ul style="list-style-type: none"> c. Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence. d. Establish and maintain a formal style. e. Provide a concluding statement or section that follows from and supports the argument presented. <p>Research to Build and Present Knowledge: Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.</p>	<ul style="list-style-type: none"> c. deadlines, and define individual roles as needed. c. Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion. d. Review the key ideas expressed and demonstrate understanding of multiple perspectives through reflection and paraphrasing. <p>Grade 7: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p> <ul style="list-style-type: none"> a. Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion. b. Follow rules for collegial discussions, track progress toward specific goals and deadlines, and define individual roles as needed. c. Pose questions that elicit elaboration and respond to others' questions and comments with relevant observations and ideas that bring the discussion back on topic as needed. d. Acknowledge new information expressed by others and, when warranted, modify their own views. <p>Grade 8: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p> <ul style="list-style-type: none"> a. Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion. b. Follow rules for collegial discussions and decision-making, track progress toward specific goals and deadlines, and define individual roles as needed. c. Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas. d. Acknowledge new information expressed by others, and, when warranted, qualify or justify their own views in light of the evidence presented.
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IS IT ALIVE?

Teacher Guide

(J) Teacher Resource. Is it Alive? 21st Century Skills Alignment

21 st Century Skills		
Learning Outcomes <i>Students will demonstrate the measurable abilities</i>	21 st Century Skill	Grade 8 Benchmark
LO1a: to make inferences based on observed patterns as a potential indication of life	Collaboration	Students work collaboratively with others, either virtually or face-to-face, while participating in scientific discussions and appropriately using claims, evidence, and reasoning.
	Social & Cross-Cultural Skills	Students are able to structure scientific discussions to allow for differing opinions, observations, experiences, and perspectives.
LO1b: to classify or explain which materials are living/nonliving assuming all living materials will exhibit the same characteristics of life	Social & Cross-Cultural Skills	Students are able to structure scientific discussions to allow for differing opinions, observations, experiences, and perspectives.
	Collaboration	Students work collaboratively with others, either virtually or face-to-face, while participating in scientific discussions and appropriately using claims, evidence, and reasoning.
LO1c: to justify which samples contain living material using macroscopic patterns as empirical evidence from the investigation	Social & Cross-Cultural Skills	Students are able to structure scientific discussions to allow for differing opinions, observations, experiences, and perspectives.
	Collaboration	Students work collaboratively with others, either virtually or face-to-face, while participating in scientific discussions and appropriately using claims, evidence, and reasoning.



IS IT ALIVE?

Teacher Guide

(L) Teacher Resource. Is it Alive? NGSS Rubric (1 of 3)

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



Next Generation Science Standards Alignment (NGSS)

Learning Outcome	Expert	Proficient	Intermediate	Beginner
LO1a. to make inferences based on observed patterns as a potential indication of criteria for life	Clearly identifies observed patterns and explains how the patterns support inferences about criteria for life. Clearly shows that multiple criteria are necessary to differentiate between living and non-living.	Uses observed patterns to make inferences about criteria of life. Recognizes that several criteria are necessary to differentiate between living and non-living.	Describes observations and identifies most patterns of observations. Uses some of these observations of patterns to make inferences about criteria of life. Begins to show awareness that criteria of life are more complex than 'it moves, so it must be alive.'	Describes observations but does not identify patterns or make inferences about what patterns indicate about criteria of life. Stated criteria of life include naïve reasoning such as it moves or it is an animal.
LO1b: to classify or explain which materials are living/nonliving assuming all living materials will exhibit the same characteristics of life.	Clearly understands that all living things will exhibit the same characteristics of life and uses these characteristics to classify materials as living and nonliving and uses criteria to explain classification.	Clearly understands that all living things will exhibit the same characteristics of life and uses these characteristics to classify materials as living and nonliving.	Classifies materials as living/nonliving using somewhat consistent criteria. Exhibits difficulty explaining classification based on rules.	Classifies materials as living/nonliving without using a universal set of criteria. Exhibits misconceptions or naïve reasoning about criteria for classification.
LO1c. to justify which samples contain living material using macroscopic patterns as empirical evidence from the investigation	Justifies classification of samples as living/nonliving using macroscopic patterns as evidence. Clearly shows rational and relates reasoning to investigation.	Justifies classification of samples as living/nonliving using macroscopic patterns as evidence.	Classifies samples as living/nonliving using macroscopic patterns of behavior in most instances. Does not consistently justify classification.	Classifies samples as living/nonliving based on prior knowledge, misconceptions or naïve reasoning.

**IS IT ALIVE?****Teacher Guide****(L) Teacher Resource. Is it Alive? CCSS Rubric (2 of 3)****Common Core – ELA**

	Expert	Proficient	Intermediate	Beginner
Text Type and Purposes	Introduces topic clearly, provides a general observation and focus, and groups related information logically; Develops the topic with facts, definitions, concrete details, or other examples related to the topic; Links ideas using words, phrases, and clauses; Use domain-specific vocabulary to explain the topic; Provides a concluding statement related to the explanation.	Introduces topic clearly, provides a general observation, or groups related information logically; Develops the topic with concrete details, or other examples related to the topic; Links ideas using words or phrases; Uses domain-specific vocabulary to explain the topic; Provides a concluding statement related to the explanation.	Introduces topic, provides a general observation; Develops the topic with details, or other examples related to the topic; Links ideas using words or phrases; Uses domain-specific vocabulary to explain the topic; May or may not provide a concluding statement.	Introduces topic; Develops the topic with details, or other examples, potentially unrelated; Uses specific vocabulary to explain the topic; May or may not provide a concluding statement.
Research to Build and Present Knowledge	Recalls relevant information from experience; summarizes information in finished work; draws evidence from informational texts to support analysis, reflection, and research.	Recalls relevant information from experience; draws evidence from informational texts to support analysis, reflection, and research.	Recalls information from experience; draws evidence from informational texts to support analysis, reflection, and research.	Recalls information from experience.
Comprehension and Collaboration	Clearly articulates ideas in collaborative discussion while following agreed upon class rules for discussion. Extremely prepared drawing from experiences. Asks clarifying questions to ensure full understanding of content. Articulates own ideas related to the discussion and connects others ideas to own.	Articulates ideas in collaborative discussion while following agreed upon class rules for discussion. Prepared for discussion by drawing from experiences. Asks questions. Articulates own ideas related to the discussion.	Interested in collaborative discussion. Asks questions. Articulates own ideas related to the discussion.	Interested in collaboration with peers.



IS IT ALIVE?

Teacher Guide

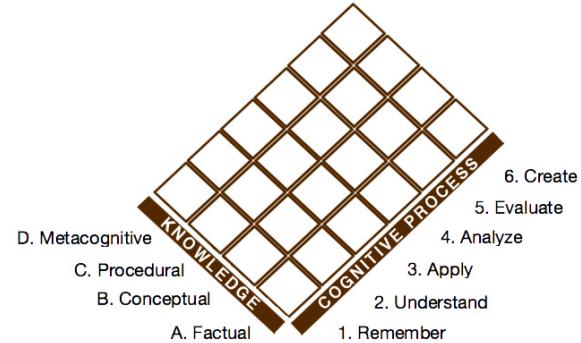
(L) Teacher Resource. Is it Alive? 21st Century Skills Rubric (3 of 3)**Partnership for 21st Century Skills**

	Expert	Proficient	Intermediate	Beginner
Effectiveness of social and cross-cultural collaboration with team members and class.	Extremely interested in collaborating in the group. Actively provides solutions to problems, listens to suggestions from others, attempts to refine them, monitors group progress, and attempts to ensure everyone has a contribution.	Extremely Interested in collaborating in the group. Actively provides suggestions and occasionally listens to suggestions from others. Refines suggestions from others.	Interested in collaborating in the group. Listens to suggestions from peers and attempts to use them. Occasionally provides suggestions in group discussion.	Interested in collaborating in the group.



(M) Teacher Resource. Placement of Instructional Objective and Learning Outcomes in Taxonomy (1 of 3)

This lesson adapts Anderson and Krathwohl's (2001) taxonomy, which has two domains: Knowledge and Cognitive Process, each with types and subtypes (listed below). Verbs for objectives and outcomes in this lesson align with the suggested knowledge and cognitive process area and are mapped on the next page(s). Activity procedures and assessments are designed to support the target knowledge/cognitive process.

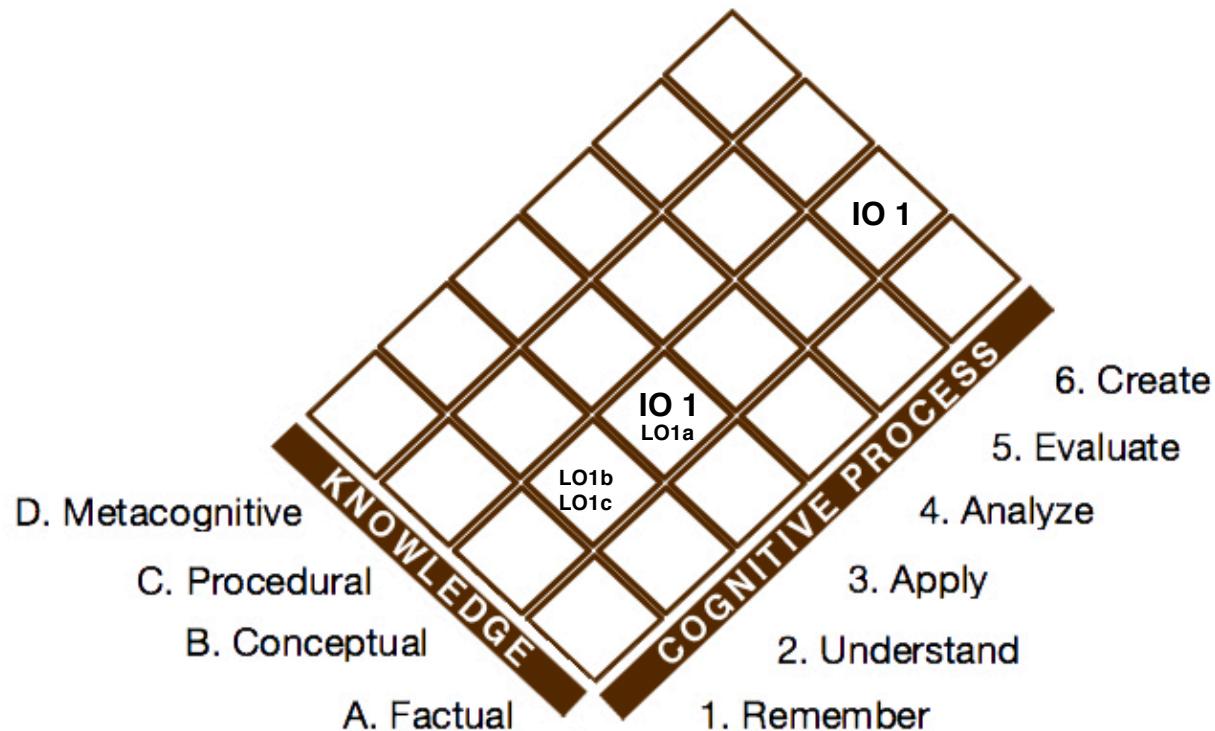


Knowledge	Cognitive Process
A. Factual Aa: Knowledge of Terminology Ab: Knowledge of Specific Details & Elements	1. Remember 1.1 Recognizing (Identifying) 1.2 Recalling (Retrieving)
B. Conceptual Ba: Knowledge of classifications and categories Bb: Knowledge of principles and generalizations Bc: Knowledge of theories, models, and structures	2. Understand 2.1 Interpreting (Clarifying, Paraphrasing, Representing, Translating) 2.2 Exemplifying (Illustrating, Instantiating) 2.3 Classifying (Categorizing, Subsuming) 2.4 Summarizing (Abstracting, Generalizing) 2.5 Inferring (Concluding, Extrapolating, Interpolating, Predicting) 2.6 Comparing (Contrasting, Mapping, Matching) 2.7 Explaining (Constructing models)
C. Procedural Ca: Knowledge of subject-specific skills and algorithms Cb: Knowledge of subject-specific techniques and methods Cc: Knowledge of criteria for determining when to use appropriate procedures	3. Apply 3.1 Executing (Carrying out) 3.2 Implementing (Using)
D. Metacognitive Da: Strategic Knowledge Db: Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge Dc: Self-knowledge	4. Analyze 4.1 Differentiating (Discriminating, distinguishing, focusing, selecting) 4.2 Organizing (Finding coherence, integrating, outlining, parsing, structuring) 4.3 Attributing (Deconstructing) 5. Evaluate 5.1 Checking (Coordinating, Detecting, Monitoring, Testing) 5.2 Critiquing (Judging) 6. Create 6.1 Generating (Hypothesizing) 6.2 Planning (Designing) 6.3 Producing (Constructing)

**(M) Teacher Resource. Placement of Instructional Objective and Learning Outcomes in Taxonomy (2 of 3)**

IO1: Generate a list of criteria for the characteristics of life and conduct an investigation using changes over time among three samples as evidence for living/nonliving material (6.1, 3.1; Ba)

- LO1a. to make inferences based on observed patterns as a potential indication of life (2.5; Ba)
- LO1b. to classify or explain which materials are living/nonliving assuming all living materials will exhibit the same characteristics of life (2.7; Ba)
- LO1c. to justify which samples contain living material using macroscopic patterns as empirical evidence from the investigation (2.7; Ba)



**(M) Teacher Resource. Placement of Instructional Objective and Learning Outcomes in Taxonomy (3 of 3)**

The design of this activity leverages Anderson & Krathwohl's (2001) taxonomy as a framework. Below are the knowledge and cognitive process types students are intended to acquire per the instructional objective(s) and learning outcomes written for this lesson. The specific, scaffolded 5E steps in this lesson (see 5.0 Procedures) and the formative assessments (worksheets in the Student Guide and rubrics in the Teacher Guide) are written to support those objective(s) and learning outcomes. Refer to (M, 1 of 3) for the full list of categories in the taxonomy from which the following were selected. The prior page (M, 2 of 3) provides a visual description of the placement of learning outcomes that enable the overall instructional objective(s) to be met.

At the end of the lesson, students will be able

- IO1:** **Generate** a list of criteria for the characteristics of life **and conduct an investigation** using changes over time among three samples as evidence for living/nonliving material
- 6.1: to generate
 - 3.1: to carry out
- Ba: Knowledge of classifications and categories

To meet that instructional objective, students will demonstrate the abilities:

- LO1a:** **to make inferences** based on observed patterns as a potential indication of life
- 3.2: to infer
- Ba: Knowledge of classifications and categories
- LO1b:** **to classify or explain** which materials are living/nonliving assuming all living materials will exhibit the same characteristics of life
- 2.7: to explain
- Ba: Knowledge of classifications and categories
- LO1c:** **to justify** which samples contain living material using macroscopic patterns as empirical evidence from the investigation
- 2.7: to explain
- Ba: Knowledge of classifications and categories