Stackable Instructionally-embedded Portable Science (SIPS) Assessments Project

Grade 5 Science
Unit 2 End of Unit Assessment Design Patterns
Matter and Energy in Organisms and Ecosystems
August 2023

The SIPS Grade 5 Science Unit 2 End of Unit Assessment Design Patterns, Matter and Energy in Organisms and Ecosystems was developed with funding from the U.S. Department of Education under the Competitive Grants for State Assessments Program, CFDA 84.368A. The contents of this paper do not represent the policy of the U.S. Department of Education, and no assumption of endorsement by the Federal government should be made.

Table of Contents

SIPS Grade 5 Unit 2 End of Unit Assessment Design Patterns (5-LS1-1, 5-LS2-1, 5-PS3-1)

Grade 5 SIPS Design Pattern for 5-LS1-1

Element	Description
Knowledge and Practices (DCI, SEP, CCC)	In this task, students: • demonstrate an understanding of the idea that plants get the materials they need for growth chiefly from air and water. • engage in argument from evidence supporting an argument with evidence, data, or a model. The crosscutting concept of energy and matter is the organizing concept for these disciplinary core ideas.
Performance Expectation	**5-LS1-1** Support an argument that plants get the materials they need for growth chiefly from air and water. [Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.]
Knowledge, Skills, & Abilities (KSAs)	**KSA1:** Identify a claim that plants get the materials they need for growth chiefly from air and water. **KSA2:** Determine if evidence supports the provided claim that plants get the materials they need for growth chiefly from air and water. **KSA3:** Analyze a claim that supports the idea that plants get the materials they need for growth chiefly from air and water. **KSA4:** Make observations about materials needed for plant growth. **KSA5:** Support an argument with evidence that plants get the materials they need for growth chiefly from air and water. **KSA6:** Support an argument with relevant data that plants get the materials they need for growth chiefly from air and water. **KSA7:** Support an argument with a model that plants get the materials they need for growth chiefly from air and water.
Student Demonstration of Learning	• Students identify a given claim to be supported about a given phenomenon or design problem. • Students analyze a given claim to be supported by a given phenomenon or design problem. • Students describe the given evidence, data, and/or models that support the claim. • Students determine whether evidence supports the claim. • Students accurately connect the evidence to support the claim with argumentation. • Students make observations about materials needed for plant growth.

Work Product	● Selected response ● Constructed response ● Interpretation and/or representation of data (e.g., diagrams, flowcharts) ● Support an argument with evidence, data, or a model ● Develop or use a model to describe phenomena
Task Features	● The task focuses on performances for which students' opportunity to learn has prepared them. ● The task is based on the assessed KSA(s) and driven by a high-quality scenario that focuses on a phenomenon or design problem. ● The task scenario is grounded in the phenomena and problems being addressed. ● The task must prompt students to make connections between observed phenomena or evidence and reasoning underlying the observation/evidence. ● The task provides ways for students to make connections of meaningful local, global, or universal relevance. ● The task scenario is sufficient, engaging, relevant, and accessible to a wide range of students. ● The task is accessible, appropriate, and cognitively demanding for all learners, including students with disabilities, and students who are English learners or are working below or above grade level. ● All prompts within a task are fair and equitable and include a range of presentation and response modes. ● The task requires students to use scientific reasoning and process skills to produce evidence that can be used by educators to make inferences about student learning. ● The task requires students to use reasoning and integrate multiple dimensions to (i.e., SEP, DCI, CCC) to support sense-making about phenomena or problems. ● All tasks must elicit core ideas as defined in the PE. ● The task uses information that is scientifically accurate. ● The task must elicit core ideas as defined in the PE. ● The task uses active voice and present tense. ● The task is written at or below grade level. ● The task requires students to measure and describe physical quantities such as weight, time, temperature, and volume. ● The task requires students to make observations and measurements to produce data that can serve as the basis for evidence that can be used to identify materials.

	● The task requires students to make observations and measurements to identify materials based on their properties.

Variable Features (Aspects of an assessment task that <u>can be varied</u> to shift complexity or focus.)	● Complexity of scientific concept(s) to be modeled.
	● Phenomenon addressed in the scenario, including but not limited to:
	  ○ Oxygen gas is part of air.
	  ○ Oxygen is produced in photosynthesis.
	  ○ Plants need some substances (e.g., carbon dioxide in the air) but not others (e.g., soil) to grow.
	  ○ Molecules of water are used in photosynthesis.
	  ○ Plants increase in mass.
	  ○ Plants increase in height.
	  ○ Number of leaves increased.
	● The amount and degree to which evidence is provided that supports a provided claim.
	● Domain-specific vocabulary and definitions.
	● Format of "real-world" phenomenon under investigation: image, data, text, combination.
	● Number, type, and complexity of representations of models, tables, graphs, and/or data sets.

Assessment Boundaries	● Assessment does not include molecular explanations of the movement of matter among plants, animals, decomposers, and the environment. ● Assessment does not include molecular explanations or the biochemical mechanisms of photosynthesis.
Technical Terms	• Food chain, food web, ecosystem, photosynthesis, consumer, producer, decomposer, scavenger, bacteria, fungi, decomposition, carnivore, herbivore, oxygen, carbon dioxide, energy, matter, product, reactant, system, organism, biotic, abiotic

Grade 5 SIPS Design Pattern for 5-LS2-1

Element	Description
Knowledge and Practices (DCI, SEP, CCC)	In this task, students: • describe the movement of matter among plants, animals, decomposers, and the environment. • develop and use models and engage in argument from evidence to demonstrate understanding of the core ideas. The crosscutting concept of system models is called out as the organizing concept for these disciplinary core ideas.
Performance Expectation	**5-LS2-1** Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. [Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.] [*Assessment Boundary: Assessment does not include molecular explanations.*]
Knowledge, Skills, & Abilities (KSAs)	**KSA1:** Within the ecosystem, identify the components (i.e., plants, animals, decomposers, gases, air). **KSA2:** Describe the relationship of components in an ecosystem. **KSA3:** Identify the cycling of matter in the system between (components) plants, animals, decomposers, and the environment. **KSA4:** Use a provided model to describe the components' (plants, animals, decomposers) relationships, and interactions among the organisms within a system. **KSA5:** Develop a model using an analogy, example, or abstract representation to describe the movement of matter among plants, animals, decomposers, and the environment.
Student Demonstration of Learning	• Identify the relevant components within an ecosystem for a provided phenomenon. • Accurately describe the relationship of the components for a given phenomenon. • Given a model, identify the cycling of matter between components. • Use a provided model to accurately describe the relationships and interactions among the systems between organisms. • Develop a model to accurately represent the cycling of matter in the system between plants, animals, decomposers, and the environment. • Explain the relevance of each component in an ecosystem. • Define the relationship between components.
Work Product	• Selected response. • Constructed response.

	● Interpretation and/or representation of data (e.g., diagrams, flowcharts). ● Support an argument with evidence, data, or a model. ● Develop or use a model to describe phenomena.
Task Features	● The task focuses on performances for which students' opportunity to learn has prepared them. ● The task is based on the assessed KSA(s) and driven by a high-quality scenario that focuses on a phenomenon or design problem. ● The task scenario is grounded in the phenomena and problems being addressed. ● The task must prompt students to make connections between observed phenomena or evidence and reasoning underlying the observation/evidence. ● The task provides ways for students to make connections of meaningful local, global, or universal relevance. ● The task scenario is sufficient, engaging, relevant, and accessible to a wide range of students. ● The task is accessible, appropriate, and cognitively demanding for all learners, including students with disabilities, and students who are English learners or are working below or above grade level. ● All prompts within a task are fair and equitable and include a range of presentation and response modes. ● The task requires students to use scientific reasoning and process skills to produce evidence that can be used by educators to make inferences about student learning. ● The task requires students to use reasoning and integrate multiple dimensions to (i.e., SEP, DCI, CCC) to support sense-making about phenomena or problems. ● All tasks must elicit core ideas as defined in the PE. ● The task uses information that is scientifically accurate. ● The task must elicit core ideas as defined in the PE. ● The task uses active voice and present tense. ● The task is written at or below grade level. ● The task requires students to measure and describe physical quantities such as weight, time, temperature, and volume. ● The task requires students to make observations and measurements to produce data that can serve as the basis for evidence that can be used to identify materials.
Variable Features (Aspects of an assessment task that <u>can be varied</u> to shift complexity or focus.)	● Complexity of scientific concept(s) to be modeled. ● Domain-specific vocabulary and definitions. ● Types of ecosystems. ● The interaction between components.

	● Compare data from the original substances to data from the substance produced.
	● Convert among different-sized standard measurement units within a given measurement system and use these conversions to explain changes that occur.
	● Contexts include, but are not limited to:
	  ○ Models of energy or matter exchange (e.g., food web, food pyramid).
	  ○ Ecosystem responses to abiotic change.
	  ○ A geochemical cycle.
	  ○ Food chain interactions (e.g., identifying the role of decomposers in a food chain).
	  ○ Introduction of a new or invasive species or population.
	  ○ Loss of an existing species or population.

Assessment Boundaries	● Assessment does not include molecular explanations of the movement of matter among plants, animals, decomposers, and the environment. ● Assessment does not include molecular explanations or the biochemical mechanisms of photosynthesis.
Technical Terms	● Food chain, food web, ecosystem, photosynthesis, consumer, producer, decomposer, scavenger, bacteria, fungi, decomposition, carnivore, herbivore, oxygen, carbon dioxide, energy, matter, product, reactant, system, organism, biotic, abiotic

Grade 5 SIPS Design Pattern for 5-PS3-1

Element	Description
Knowledge and Practices (DCI, SEP, CCC)	In this task, students: • explain that energy in animals' food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). • explain that food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and motion. • develop and use models to demonstrate understanding of the core ideas. The crosscutting concept of energy and matter is the organizing concept for these disciplinary core ideas.
Performance Expectation	**5-PS3-1** Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun. [Clarification Statement: Examples of models could include diagrams and flow charts.]
Knowledge, Skills, & Abilities (KSAs)	**KSA1:** Develop and or use a model with provided information (i.e., a specific mammal, insect, set of living things, sun) to show that energy from the sun is transferred to animals through a chain of events that begins with plants producing food and then being eaten by animals. **KSA2:** Given a set of animals, show the flow of energy used for body repair, body warmth, and motion. **KSA3:** Describe how variables can change the flow of energy among animals. **KSA4:** Interpret data and how it shows the cause/effect of the flow of energy. **KSA5:** Use the evidence/data to construct a claim about the flow of energy needed for survival (body warmth, body repair, motion). **KSA6:** Explain how animals need energy to survive.
Student Demonstration of Learning	• Model correctly uses provided information to show the flow of energy within a group of living things. • Model accurately demonstrates how cause and effect changes energy flow. • Correctly use the model to show how variables affect the flow of energy. • Accurately interpret data and use it to explain the flow of energy with animals. • Create a representation that would include all components of how animals need energy to survive.
Work Product	• Selected response. • Constructed response.

	● Interpretation and/or representation of data (e.g., diagrams, flowcharts). ● Support an argument with evidence, data, or a model. ● Development of or use of a model to describe phenomena.
Task Features	● The task focuses on performances for which students' opportunity to learn has prepared them. ● The task is based on the assessed KSA(s) and driven by a high-quality scenario that focuses on a phenomenon or design problem. ● The task scenario is grounded in the phenomena and problems being addressed. ● The task must prompt students to make connections between observed phenomena or evidence and reasoning underlying the observation/evidence. ● The task provides ways for students to make connections of meaningful local, global, or universal relevance. ● The task scenario is sufficient, engaging, relevant, and accessible to a wide range of students. ● The task is accessible, appropriate, and cognitively demanding for all learners, including students with disabilities, and students who are English learners or are working below or above grade level. ● All prompts within a task are fair and equitable and include a range of presentation and response modes. ● The task requires students to use scientific reasoning and process skills to produce evidence that can be used by educators to make inferences about student learning. ● The task requires students to use reasoning and integrate multiple dimensions to (i.e., SEP, DCI, CCC) to support sense-making about phenomena or problems. ● All tasks must elicit core ideas as defined in the PE. ● The task uses information that is scientifically accurate. ● The task must elicit core ideas as defined in the PE. ● The task uses active voice and present tense. ● The task is written at or below grade level. ● The task requires students to make observations and measurements to produce data that can serve as the basis for evidence about energy flow.
Variable Features (Aspects of an assessment task that <u>can be varied</u> to shift complexity or focus.)	● Complexity of scientific concept(s) to be modeled. ● Number, type, and complexity of representations of models (e.g., energy transfer from the Sun to other organisms, a set of models of energy transfer from the Sun to other organisms). ● Features of model(s) to be identified.

	● Domain-specific vocabulary and definitions.
	● Format of "real-world" phenomenon under investigation: image, data, text, combination.
	● Phenomena include, but are not limited to:
	  ○ Production of plant matter via photosynthesis.
	  ○ Consumption of plant matter by primary consumers.
	  ○ Use of energy (i.e., food) to facilitate biological processes (growth, maintenance of heat, movement, bodily repair, cell replication).

Assessment Boundaries	● Assessment does not include molecular explanations of the movement of matter among plants, animals, decomposers, and the environment. ● Assessment does not include molecular explanations or the biochemical mechanisms of photosynthesis.
Technical Terms	• Food chain, food web, ecosystem, photosynthesis, consumer, producer, decomposer, scavenger, bacteria, fungi, decomposition, carnivore, herbivore, oxygen, carbon dioxide, energy, matter, product, reactant, system, organism, biotic, abiotic

References

Achieve, Inc. (2009). *A framework to evaluate cognitive complexity in science assessments.* Retrieved from https://www.achieve.org/cognitive-complexity-frameworks

Achieve, Inc. ( ) *Equity in three-dimensional science assessments.* Retrieved from http://www.achieve.org/files/sites/default/files/equity_02142019%20(3).pdf

Achieve, Inc. (2018). Science task screener. Washington, DC: Author.

Achieve, Inc. (2020) STEM Teaching Too #29. *Steps to designing three-dimensional assessments that connect to students' interests, experiences, and identities*. Retrieved from: http://stemteachingtools.org/brief/29

Achieve, Inc. ( ) Task annotation project in Science: phenomena. Retrieved from https://www.achieve.org/publications/science-task-annotations-phenomena

Achieve, Inc ( ) Task annotation project in Science: sense-making. Retrieved from https://www.achieve.org/our-initiatives/equip/tools-subject/science/task-annotation-project-science

American Educational Research Association (AERA), the American Psychological Association (APA), and the National Council on Measurement in Education (NCME) Joint Committee on Standards for Educational and Psychological Testing. (2014). *Standards for educational and psychological testing*. Washington DC: AERA.

California Assessment of Student Performance and Progress (CAASPP) System. California Science Test (CAST) Item Specifications Retrieved from : CAST Item Specifications - California Assessment of Student Performance and Progress (CAASPP) System (CA Dept of Education)

Forte, E. (2013a). *Re-conceptualizing alignment in the evidence-centered design context*. Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA.

Forte, E. (2013b). *Evaluating alignment for assessments developed using evidence-centered design*. Paper presented at the Annual Meeting of the National Council on Measurement in Education, San Francisco, CA.

Haertel, G., Haydel DeBarger, A., Cheng, B., Blackorby, J., Javitz, H., Ructtinger, L., Snow, E., Mislevy, R. J., Zhang, T., Murray, E., Gravel, J., Rose, D., Mitman Colker, A., & Hansen, E. G. (2010). Using Evidence-Centered Design and Universal Design for Learning to Design Science Assessment Tasks for Students with Disabilities (*Assessment for Students with Disabilities Technical Report* 1). Menlo Park, CA: SRI International.

Harris, C., Krajcik, J., Pellegrino, J. W., & DeBarger, A. (2019). Designing knowledge-in-use assessments to promote deeper learning. Educational Measurement: Issues and Practice, Summer 2019, 38(2), 53-67.

McElhaney, K. W., Gane, B. D., Harris, C. J., Pellegrino, J. W., DiBello, L. V., & Krajcik, J. S. (2016, April). *Using learning performances to design three-dimensional assessments of science proficiency*. Paper presented at the NARST Annual International Conference, Baltimore, MD.

Mislevy, R. J., Almond, R. G., and Lukas, J. F. (2003). A brief introduction to evidence centered design. Princeton, NJ: Educational Testing Service.

Mislevy, R. J., & Haertel, G. (2006). Implications of evidence-centered design for educational assessment. Educational Measurement: Issues and Practice, 25, 6-20.

National Governors Association Center for Best Practices, Council of Chief State School Officers Title: Common Core State Standards (insert specific content area if you are using only one) Publisher: National Governors Association Center for Best Practices, Council of Chief State School Officers, Washington D.C. Copyright Date: 2010 For more information, please visit our pages for Developers & Publishers, Terms of Use, and Public License.

National Research Council. (2001). *Knowing what students know: The science and design of educational assessment*. Committee on the Foundations of Assessment. Pellegrino, J., Chudowsky, N., and Glaser, R., editors. Board on Testing and Assessment, Center for Education, Division of Behavioral and Social Sciences and Education. Washington DC: National Academy Press.

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.

National Research Council. (2014). *Developing Assessments for the Next generations of Science Standards*. 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.

NGSS Lead States. (2013). Appendix D – "ALL Standards, ALL Students": Making the Next Generation Science Standards Accessible to All Students. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.

NGSS Lead States. (2013). Appendix E – Progressions Within the Next Generation Science Standards. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.

NGSS Lead States. (2013). Appendix F – Science and Engineering Practices in the NGSS. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.

NGSS Lead States. (2013). Appendix G – Crosscutting Concepts. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.

NGSS Network. (2016). *NGSS example bundles*. Retrieved from https://www.nextgenscience.org/resources/bundling-ngss

NGSS Lead States. (2013). *Next generation science standards: For states, by states.* Washington, DC: National Academies Press.

Nichols, P. D., Kobrin, J. L., Lai, E., Koepfler, J. D. (2017). The role of theories of learning and cognition in assessment design and development. A. A. Rupp & J. P. Leighton (Eds.) *The Handbook of Cognition and Assessment: Frameworks, Methodologies, an Applications, First Edition*, pp. 41-74. New York: Wiley Blackwell.

Norris, M., & Gong, B. (2014) *Thinking about claims for the next generation science standards*. Paper presented at the Annual Meeting of the National Council for Measurement in Education Conference, Toronto, Canada.