



# Stackable Instructionally- embedded Portable Science (SIPS) Assessments Project

## Grade 8 Science Unit 3 Student Profile Understanding Earth History and the Origin of Species January 2023

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## SIPS Grade 8 Science Unit 3 Student Profile

The Stackable, Instructionally-embedded, Portable Science (SIPS) Assessments Unit 3 Student Profile describes what students should know and be able to demonstrate **prior to, during**, and at the **culmination** of three-dimensional science instruction in Unit 3 to prepare for new and increasingly sophisticated learning opportunities in Unit 3. The student profile is intended to build science educators' understanding of the targeted student learning outcomes and how they are situated in the context of year-long instruction to promote and inform the intentional selection of curricular materials and design of instructional opportunities to achieve these outcomes for all students. In addition, the end-of-unit profile can support discussion with students, parents, and guardians about the Unit 3 topic of interest "Understanding Earth History and the Origin of Species" and the knowledge, skills, and abilities to which teaching and opportunities to learn will be based.

The SIPS Assessments Unit 3 student profile provides a description of:

1. The necessary **prior learning opportunities** and **prior knowledge and skills** that students are expected to have acquired for all three dimensions—Science and Engineering Practices (SEPs), Disciplinary Core Ideas (DCIs), and Crosscutting Concepts (CCCs)—before engaging in Unit 3, "Understanding of Earth History and the Origin of Species." These prior learning opportunities and knowledge and skills serve as entry points to the unit to ensure readiness and to foster understanding of new and increasingly sophisticated learning experiences. This section also includes an explanation of how prior learning, knowledge, and skills will be built upon in the unit.
2. The **knowledge, skills, and abilities students are expected to learn and demonstrate by the end of the unit** when provided with opportunities to integrate scientific and engineering practices with important disciplinary core ideas and crosscutting concepts to scientifically investigate and understand natural phenomena and solve important science and engineering design problems.
3. The **learning experiences in Unit 4 that allow students to build from and expand their learning in Unit 3** to effectively engage in the SEPs to sense-make using acquired scientific knowledge and understanding of the CCCs in the context of multiple DCIs. This section highlights key connections among important scientific ideas, practices, and concepts that students investigate as they progress from one unit to the next.

The following sections describe the prior learning and knowledge, skills, and abilities that students are expected to bring to and acquire by the end of the unit, respectively, and how these knowledge, skills, and abilities prepare students to deepen their science learning in Unit 4. The content in these sections draws from the dimensional appendices of the NGSS (Appendix E, Appendix F, Appendix G), the performance expectations articulated in the NGSS, A Framework for K12 Science Education, and Stage 1 of the SIPS Unit 3 map.

### 1. Prior Learning Opportunities

By building on familiarity with previous Unit 2 ideas related to gravity and motion of objects in the solar system, Unit 3 allows students to use and extend this knowledge to the history of Earth found within the solar system and the origin of its species. Unit 3 focuses on the history of Earth and how the fossil structures found within it are genetically related to present-day life forms.

Essential prior learning (from earlier grades) from upper elementary (Grades 3–5) and middle school (Grades 6 and 7) related to the DCIs, CCCs, and SEPs are provided in Appendix A.

## 2. End-of-Unit Learning Outcomes

Measurement targets are narrative descriptions that integrate the DCIs, SEPs, and CCCs into a single statement representing what is to be taught and assessed in each unit. The SIPS Measurement Target for this Unit is:

- Students are able to apply Science and Engineering Practices with emphasis on analyzing and interpreting various forms of data and information to construct and support explanations related to patterns in the change of lifeforms in the history of Earth, similarities and differences among organisms, patterns in the cause and effect relationships related to the inheritance of traits through natural selection and changes in populations over time.

By engaging in this unit, students will further deepen their knowledge about evidence of a common ancestor interpreted through fossil records and how differences in their structure help explain present-day organisms. They will also learn how rock strata help us explain the history of Earth. In this unit, there is significant overlap and synergy between the DCI and CCC dimensions, where patterns of different scales and proportions are traced throughout the multiple components of a system represented in a model. Similarly, the particular SEPs allow students to analyze and interpret data and consider other evidence to develop models and explanations around the history of life on Earth.

Descriptions of the specific learning expectations associated with each dimension are elaborated below.

### *DCI*

The Grade 8 Unit 3 topic, “Understanding Earth History and the Origin of Species” organizes six performance expectations that together enable analysis and interpretation of fossil data that explains how the history of various life forms. Also, through the use of mathematical and computational thinking, students are able to place the events leading to Earth’s formation on a geological time scale. In working with these disciplinary core ideas, students are positioned to understand the structures of rock strata. They will also understand how natural selection and adaptation helped define the function of structures found in various life forms, and how it led to genetic diversity.

### *CCC*

Over the course of Unit 3, students will identify and represent patterns, especially as they relate to cause-and-effect relationships, including multifaceted causes. Students also make use of scale (Scale, Proportion, and Quantity) in their explanations and models and use Structure and Function to interrogate inheritance and variations in traits.

### *SEP*

Over the course of Unit 3, students will gain much experience and practice with constructing explanations and developing models. When constructing explanations, they will consider the validity/reliability of the evidence, describe relationships between variables, and make sense of real-world phenomena, examples, and/or events related to the history of Earth or life on Earth. In support of these explanations and models, students will gain experience with analyzing and representing data to reveal patterns and cause/effect relationships in the adaptation and change in life on Earth.

### 3. Connections to Unit 4 Learning Opportunities

#### *DCI*

Unit 3 focuses extensively on how changes in life and land over Earth's history, how this is related to the adaptations and evolutionary pressures on all types of organisms, and how we use the fossil record and rock strata to learn about the history of organisms and landforms/rocks. These ideas prepare students for Unit 4, in which they will focus on criteria and constraints applied to tasks involving properties and characteristics of simple waves to bring about successful design solutions.

#### *CCC*

Unit 3 CCCs focus on using Patterns, Scale, Proportion, Quantity, Structure and Function, and Cause and Effect to organize Earth's history and to identify cause and effect relationships as they pertain to the adaptations and evolutionary pressures on all types of organisms, and how we use the fossil record and rock strata to learn about the history of organisms and landforms/rocks. Of these, Patterns and Structure and Function are also used in Unit 4. Students' experiences in Unit 3 with representing patterns in graphs/charts and considering how structures enable different functions will connect directly with their use of those two CCCs in Unit 4 when developing models of waves and designing solutions that use waves.

#### *SEP*

Unit 3 SEPs focus predominantly on Constructing Explanations but also include Developing Models and Using Mathematics and Computational Thinking. Modeling and Computational Thinking are used again in the next unit through Unit 4's focus on waves. These models of waves (including mathematical models) offer an opportunity for students to develop their skills and abilities by using models even further in Unit 4.

### Appendix A. DCI, CCC, and SEP Prior Learning Opportunities

**DCIs – ESS1.C, LS4.A, LS4.B, LS3.A, LS3.B, ETS1.A, PS4.A, & PS4.B** (from NGSS Appendix E: DCI Progression within NGSS)

- **Prior Learning from 3-5** (NRC Framework)
  - Fossils provide evidence about the types of organisms (both visible and microscopic) that lived long ago and about the nature of their environments. Fossils can be compared with one another and to living organisms according to their similarities and differences.
  - Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing.
  - Changes in an organism's habitat are sometimes beneficial to it and sometimes harmful. For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot.
  - Earth has changed over time. Understanding how landforms develop, are weathered (broken down into smaller pieces), and erode (get transported elsewhere) can help infer the history of the current landscape. Local, regional, and global patterns of rock formations reveal changes over time due to Earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. Patterns of tree rings and ice cores from glaciers can help reconstruct Earth's recent climate history.

- **Prior learning from this grade band (e.g., Grades 6 & 7):**

- Minimal/ Not Applicable

### CCC - Patterns

- **Prior learning from 3-5:** Students identify similarities and differences, identify patterns related to time, and use patterns to make predictions and categorizations.

- Ten Grade 3-5 PEs use this CCC. Some uses are similar to the elements of the CCC used in this unit's 2 PEs with Patterns CCC (e.g., 3-PS2-2 involves making a prediction, which is possible because of cause-and-effect relationships; 5-ESS1-2 involves representing data in graphical displays to reveal patterns).

- **Prior learning from this grade band (e.g., Grades 6 & 7):** Students are expected to use graphs, charts, and images to identify patterns in data. They are also expected to use cause-and-effect relationships to identify patterns in data (Appendix G).

- Multiple MS PEs use this CCC, so students will likely have some experience with the CCC's MS elements prior to starting Grade 8 Unit 3.

### CCC – Cause & Effect

- **Prior learning from 3-5:** Students become adept at identifying/testing causes and effects and become aware that events can be correlated but not causally related.

- 13 Grade 3-5 PEs use this CCC, so students will likely have substantial experience with the CCC prior to middle school. An example PE that uses the CCC in a way that presages this unit's PE's CCC element (*Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability*) is 4-ESS3-2 (*Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*) because solutions' effectiveness can be impacted by multiple factors and their intended effects might be best described probabilistically.

- **Prior learning from this grade band (e.g., Grades 6 & 7):** Students gain experience with multifaceted causal relationships, distinguishing between correlation and causation, and using cause-and-effect relationships to make predictions.

- 15 middle school PEs use this CCC, so students will likely have substantial experience with the CCC during Grades 6 and 7. For example, MS-ESS2-5 (*Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.*) implies examining multifaceted causes and probabilistic outcomes.

### CCC – Structure & Function

- **Prior learning from 3-5:** Students move beyond structures to also consider substructures, and how substructures can sometimes be observed and serve different functions.

- No Grade 3-5 PEs use this CCC, so students will likely have minimal experience with this CCC prior to starting middle school.

- **Prior learning from this grade band (e.g., Grades 6 & 7):** Students visualize, model, and describe functions in terms of how they are enabled by different structures and how materials (and their properties) can enable these functions.

- Five middle school PEs use this CCC and MS-LS1-2 uses the same element of the Structure and Function CCC as used in this unit's PE.

### CCC - Scale, Proportion, & Quantity

- **Prior learning from 3-5:** Students are expected to understand that events depend on phenomena that operate at very different scales, but also that fundamental interactions are present through these differences. They are also expected to understand the importance of units and their association with observable quantities.
  - In Grades 3-5, students learn to recognize that natural objects and observable phenomena exist from the very small to the immensely large. They will also learn to use standard units to measure and describe physical quantities such as weight, time, temperature, and volume. (Appendix G)
- **Prior learning from this grade band (e.g., Grades 6 & 7):** Students are expected to become adept at working across different scales and how phenomena observed at one scale may not be observable at another scale. They use proportional relationships (e.g., speed) to gather information about the magnitude of properties and processes.
  - Multiple middle school PEs use this CCC, so students will likely have some experience with the middle school CCC elements during Grades 6 and 7.

### SEP - Developing and Using Models

- **Prior learning from 3-5:** Students continue developing their modeling skills and abilities by developing and revising different types of models, along with beginning to consider that models can have limitations. [Appendix G]
  - PE 4-PS4-2 is an example of a 3-5 grade band PE that uses a Developing and Using Models SEP element that is very similar to the SEP element used in this unit.
- **Prior learning from this grade band (e.g., Grades 6 & 7):** Students develop, use, and revise models to describe, test, and predict more abstract phenomena and to design systems.
  - Multiple middle school PEs use this SEP, so students will likely have some experience with the middle school SEP elements prior to starting Grade 8 Unit 2. MS-PS4-2 is an example MS PE that uses the same SEP element as this unit's PE (MS-LS3-1).

### SEP - Analyzing and Interpreting Data

- **Prior learning from 3-5:** Students will have experience with the collection of data using quantitative approaches to collecting data and conducting multiple trials of qualitative observations. They will be able to carry out the analysis and interpretation of the data using logical reasoning, mathematics, and/or computation.
  - In Grades 3-5, students will represent data in tables and/or various graphical displays to reveal patterns that indicate relationships. They will analyze data to refine a problem statement or the design of a proposed object, tool, or process.
- **Prior learning from this grade band (e.g., Grades 6 & 7):** Students will build understanding and skills with quantitative analysis of data. They will distinguish between correlation and causation and carry out basic statistical techniques of data and error analysis.

- Multiple middle school PEs use this SEP, so students will likely have some experience with the SEP's element of determining similarities and differences in their data prior to starting Grade 8 Unit 3.

### **SEP – Constructing Explanations and Designing Solutions**

- **Prior learning from 3-5:** Students will have experience using evidence to (a) construct explanations for describing/predicting phenomena and (b) design solutions to problems.
  - In Grades 3-5, multiple PEs use this SEP and relate to the 3 elements of this SEP that are used in Unit 3. For example, in 3-LS4-2 students use evidence to construct an explanation for the phenomena of natural selection pressures, in 3-LS3-2 students use evidence to support an explanation of the relationship between environmental factors and trait expression, and in 4-ESS3-1 students identify evidence that supports an explanation that landscapes change over time.
- **Prior learning from this grade band (e.g., Grades 6 & 7):** During all middle school grades, students will construct explanations and design solutions that are supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
  - An example middle school PE that uses a similar SEP element as MS-ESS1-4 (this unit) is MS-ESS2-2 *Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.*

### **SEP – Using Mathematics and Computational Thinking**

- **Prior learning from 3-5:** This SEP is not introduced in K-5 until Grade 5 (5-PS1-2 and 5-ESS2-2). Therefore, it is likely that students will have minimal exposure to formal learning of this SEP prior to middle school.
- **Prior learning from this grade band (e.g., Grades 6 & 7):** This SEP is only used in 2 PEs in the 6-8 grade band (MS-PS4-1 and MS-LS4-6 (this unit)). Therefore, it is likely that students will have minimal exposure to formal learning of this SEP in Grades 6 and 7.