Integrated STEM Unit Planner

Grade 3 Science

Simulate an Animal Adaptation

Share your success and questions: prek12stem.com

PreK-12STEM
Community Training & Assistance Center (CTAC)
Tracy Unified School District

About the Integrated STEM Units

The integrated STEM units are a product of the partnership between Community Training and Assistance Center (CTAC) and Tracy Unified School District (TUSD) in California, funded in part through the Education Innovation and Research (EIR) program of the U.S. Department of Education in 2018. Teacher leaders came together to develop innovative units that align to STEM standards for student learning—namely the Next Generation Science Standards (NGSS) for California Public Schools, the Computer Science Content Standards derived from the national K-12 Computer Science Framework, and the California Common Core State Standards.

Each integrated unit brings together the following:

- an engineering design challenge
- one or more computational artifacts
- core science and math content
- language building opportunities
- engagement supports

Students in each grade level, pre-kindergarten through twelve, engage with the unit for about one or two months as part of their required coursework. The units are integrated and self-contained as a means to provide all students with equitable STEM experiences.

About the Partners

Community Training and Assistance Center (CTAC) is a national not-for-profit organization with a demonstrated record of success in the fields of education and community development. Tracy Unified School District, located in California's Central Valley, serves approximately 15,000 students. Fifty leading teachers from the district contributed to the development of the units. Computer Science integrations resulted with support from the San Joaquin County Office of Education and Bootstrap of Brown University.

Terms of Use

Contents

Big Picture 1
- Unit Emblem 1
- Overview 2
- Integrated Unit Storyline 3
- Integrated Unit Wayfinder 4

STEM Dive 5
- Engineering 5
- Computer Science (Technology) 6
- Science 7
- Mathematics 9
- English Language Arts and Development 10
- Unit Vocabulary 11

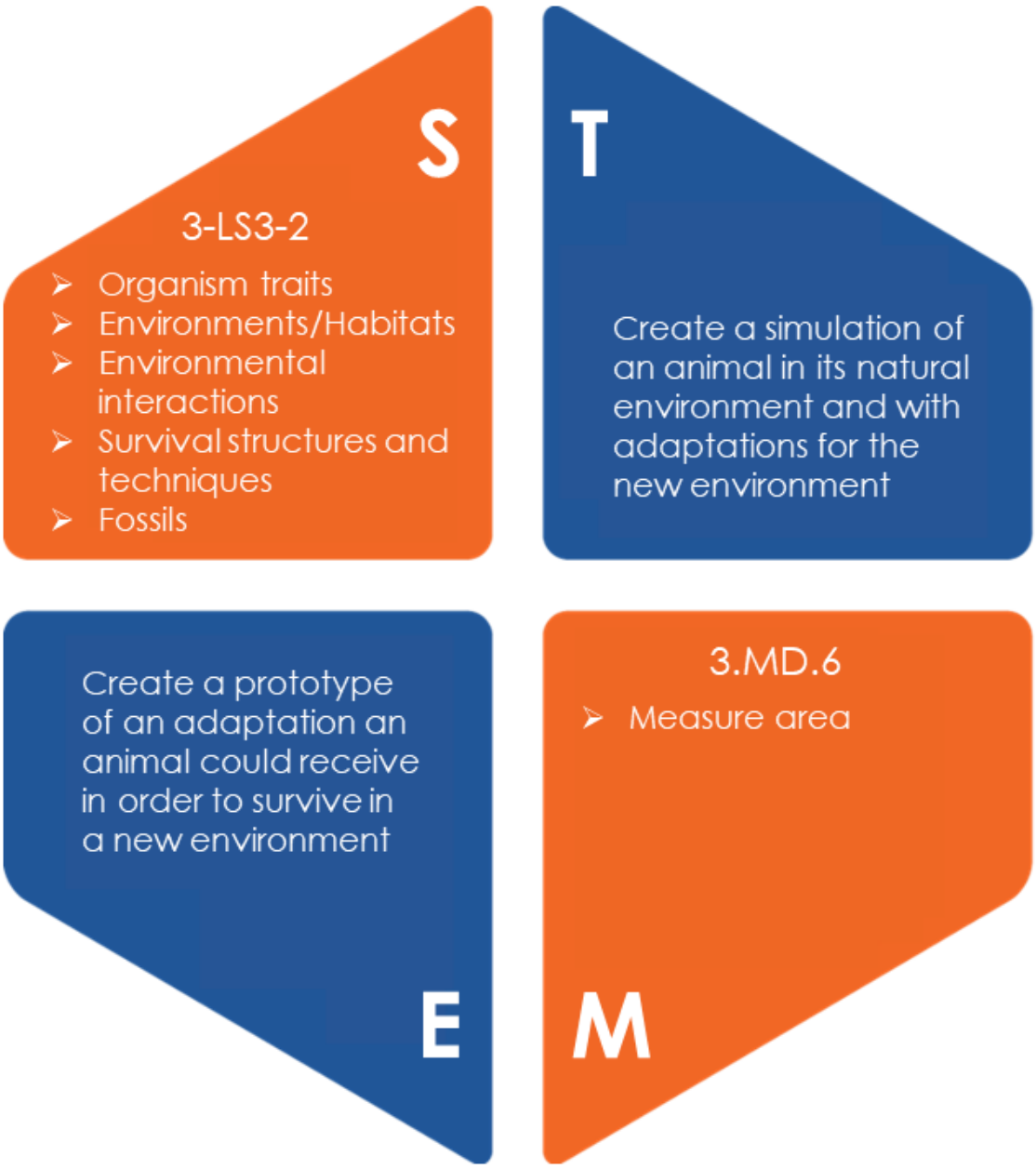
Assessment Tools 12
- Student Experience Inventory 12
- Student Self-Assessment of Engineering 13
- One-Point Design Challenge Rubric 14

Engagement 15
- Community and Career Connections 15
- Materials List 16
- Distance Learning Modifications 16

Endnotes 16

Big Picture

Unit Emblem



Focal Standard

3-LS3-2 Use evidence to support the explanation that traits can be influenced by the environment. [Clarification Statement: Examples of the environment affecting a trait could include normally tall plants grown with insufficient water are stunted; and, a pet dog that is given too much food and little exercise may become overweight.]

Overview

Sequence 1: Teachers engage students with an anchoring phenomenon by showing the video of camouflaged animals and insects: https://www.youtube.com/watch?v=RBdbGPK1ZlQ (Talltanic, 2017).[i] During the entry event teachers will introduce the driving essential question: How does the environment in which they live affect living organisms? Students will discuss how the structural adaptations of the animals have helped them survive in the environment. The teacher facilitates students' thinking through an inquiry anchor (What did you *notice*? What did you *think*? What do you still *wonder*?).

This inquiry process connects the driving essential question with the supporting questions: How do organisms' traits help them survive in different environments? And, what happens to organisms when the environment changes? This leads to the design challenge which is to figure out the adaptations needed for an animal they select to survive in a new environment.

Students ***ask*** questions about the challenge including: What adaptations does your animal have that help it survive in its natural habitat? Which of these adaptations will help it survive in the new environment and which will not help?

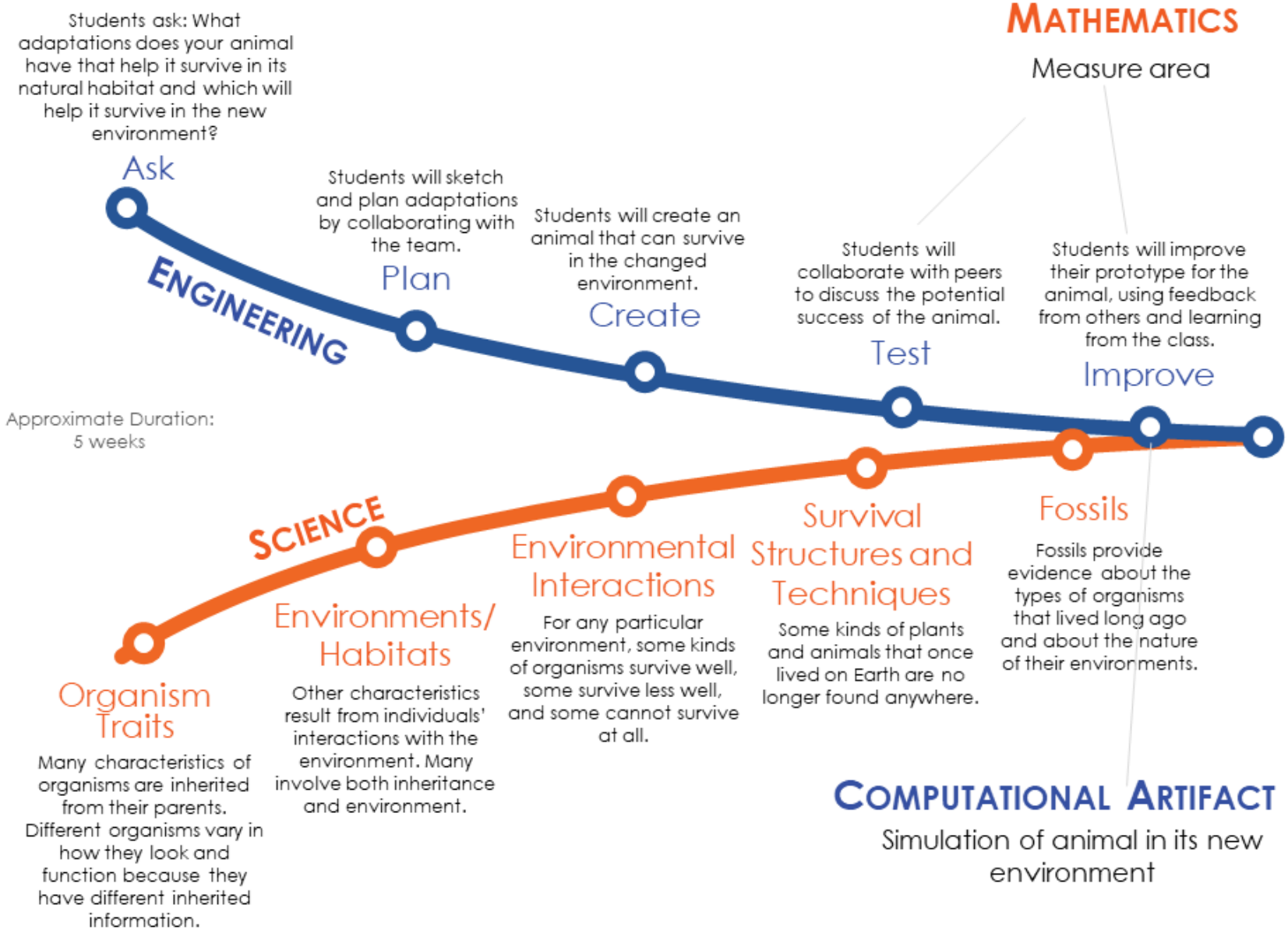
Sequence 2: Students learn more about habitats, and interactions between traits and the environment. Using knowledge gained, students will ***plan*** their animal prototype and adaptions to a new biome they select. They will consider which traits would increase the survivability of the animal in their new circumstances.

Sequence 3: Students will ***create*** a new animal adaptation, using available materials. They will expand their understanding of plant and animal survival, and why some are successful while others are not.

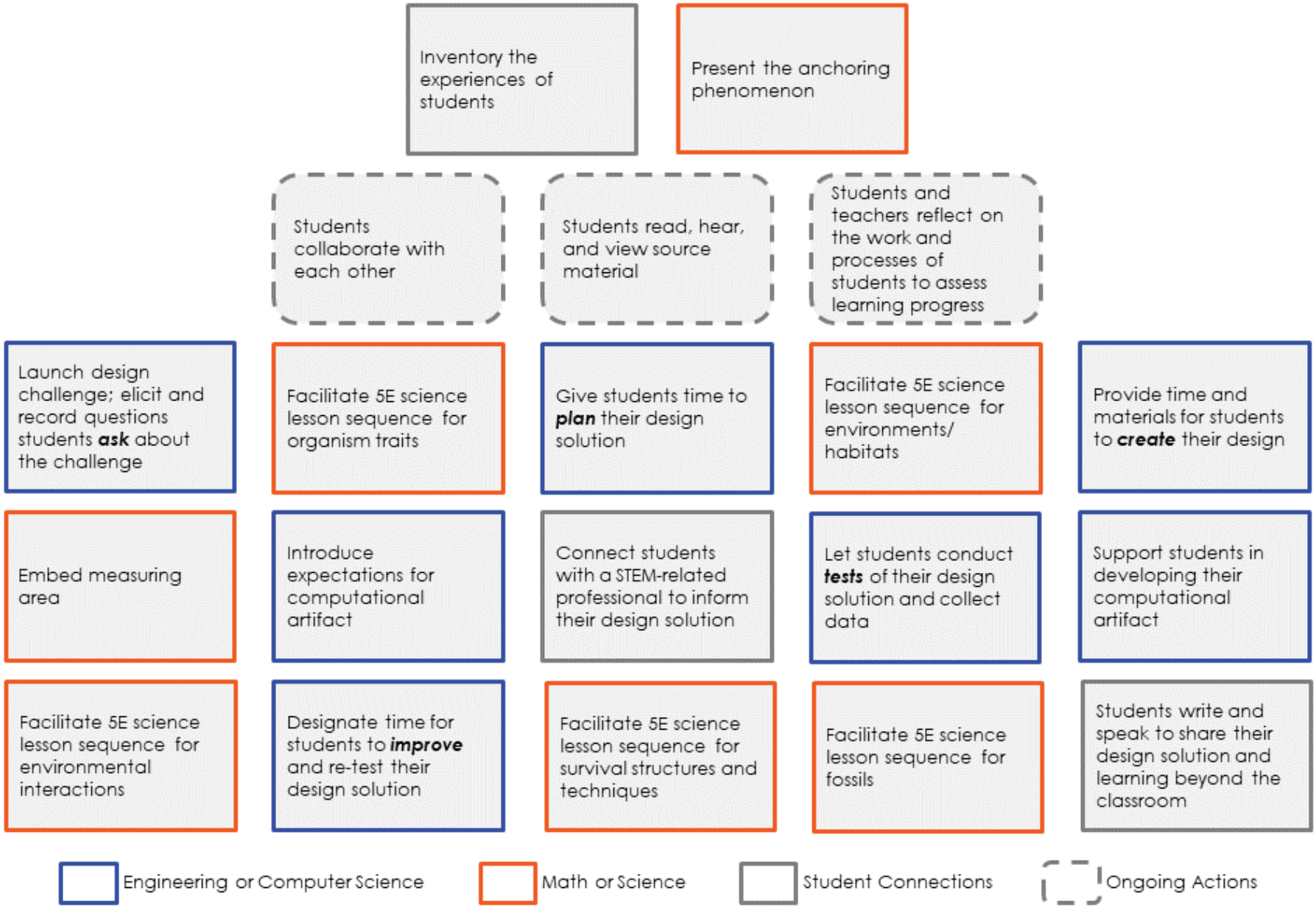
Sequence 4: Students then begin to ***test*** their prototype animal, collecting data from discussion with their peers to determine how well they have adapted their animal.

Sequence 5: Students reflect on their data gathered and revise the plan to ***improve*** their model. Students will a computer-based simulation demonstrating their animals and the structural adaptations they have added to help it survive in a new biome.

Integrated Unit Storyline



Integrated Unit Wayfinder



STEM Dive

Engineering

Design Challenge: Create a prototype of an adaptation an animal could receive in order to survive in a new environment.

Type of Engineering: Bioengineering

The Engineering Design Process (EDP) and Engineering Standards

EDP Step	Standard and Grade Band End Points from the *Framework*
Ask *What adaptations does your animal have that help it survive in its natural habitat? Which of these adaptations will help it survive in the new environment and which will not help?*	**3-5-ETS1-1.** Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. • Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)
Plan *Students will sketch and plan adaptations by collaborating with the team.*	**3-5-ETS1-2.** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. • Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2) • At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2)
Create *Students will create an animal that can survive in the changed environment.*	
Test *Students will collaborate with peers to discuss the potential success of the animal.*	**3-5-ETS1-3.** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. • Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3) • Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)
Improve *Students will improve their prototype for the animal, using feedback from others and learning from the class.*	

Computer Science (Technology)

Computer Science Integrations

Description of Student Engagement

Students will create a simulation of an animal in a new environment.

Computational Artifact

Definition: Anything created by a human using a computational thinking process and a computing device. A computational artifact can be, but is not limited to, a program, image, audio, video, presentation, or web page file. (Source: College Board, 2016)

- Screen shots or video recording of the animal with its adaptation in its new environment, along with an explanation of how the adaptation helps the animal.

Hardware

Definition: The physical components that make up a computing system, computer, or computing device. (Source: MDESE, 2016)

- Computer

Software (includes programs, applications, websites, etc.)

Definition: Programs that run on a computing system, computer, or other computing device. (Source: k12cs.org)

- Scratch

Standards

- **3-5.AP.13** Decompose problems into smaller, manageable tasks which may themselves be decomposed.
- **3-5.AP.17** Test and debug a program or algorithm to ensure it accomplishes the intended task.
- **3-5.AP.18** Perform different roles when collaborating with peers during the design, implementation, and review stages of program development.
- **3-5.AP.19** Describe choices made during program development using code comments, presentations, and demonstration.

Science

Focal Standard

3-LS3-2 Use evidence to support the explanation that traits can be influenced by the environment. [Clarification Statement: Examples of the environment affecting a trait could include normally tall plants grown with insufficient water are stunted; and, a pet dog that is given too much food and little exercise may become overweight.]

Related Content Standards

3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. [Clarification Statement: Examples of data could include type, size, and distributions of fossil organisms. Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms.] [*Assessment Boundary: Assessment does not include identification of specific fossils or present plants and animals. Assessment is limited to major fossil types and relative ages*.]

3-LS4-3 Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]

Anchoring Phenomenon

Teachers engage students with an anchoring phenomenon by showing the video of camouflaged animals and insects: https://www.youtube.com/watch?v=RBdbGPK1ZlQ

Content Outline

Below is a content outline for the science content in this unit. It includes the key concepts within the unit along with an approximate number of days it would take to facilitate a sufficient amount of student learning experiences. For each key concept, key learnings appear, which come from the grade band endpoints in *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (source: https://www.nextgenscience.org/framework-k-12-science-education). The storyline begins with an anchoring phenomenon.

Key Concept	Key Learnings	# of Days
Organism Traits	• Many characteristics of organisms are inherited from their parents. (3-LS3-1) • Different organisms vary in how they look and function because they have different inherited information. (3-LS3-1)	5

Key Concept	Key Learnings	# of Days
Environments/ Habitats	• Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. (3-LS3-2) • The environment also affects the traits that an organism develops. (3-LS3-2)	5
Environmental Interactions	• For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. (3-LS4-3) • Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. (3-LS3-2) • The environment also affects the traits that an organism develops. (3-LS3-2)	5
Survival Structures and Techniques	• For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. (3-LS4-3) • Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. (3-LS3-2) • The environment also affects the traits that an organism develops. (3-LS3-2)Some kinds of plants and animals that once lived on Earth are no longer found anywhere. (Note: Moved from K-2) (3-LS4-1)	5
Fossils	• Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments. (3-LS4-1)	5

Science and Engineering Practices	Crosscutting Concepts
1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations **4. Analyzing and interpreting data** 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions **7. Engaging in argument from evidence** 8. Obtaining, evaluating, and communicating information	**1. Patterns** **2. Cause and effect** **3. Scale, proportion, and quantity** 4. Systems and system models 5. Energy and matter 6. Structure and function 7. Stability and change

Note. Bolded items are called out specifically in the standards cluster for this unit.

Mathematics

Description of Student Engagement

Students will compute the surface area of their organism's current and future environment. (Optional: Student compute the optimal number of organisms per specified area).

Standards for Mathematical Content

3.MD.6 Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units).

Standards for Mathematical Practice

MP.1 Make sense of problems and persevere in solving them.

MP.2 Reason abstractly and quantitatively.

MP.3 Construct viable arguments and critique the reasoning of others.

MP.4 Model with mathematics.

MP.5 Use appropriate tools strategically.

MP.6 Attend to precision.

MP.7 Look for and make use of structure.

MP.8 Look for and express regularity in repeated reasoning.

Note. Bolded items are emphasized in this unit.

English Language Arts and Development

Reading Standard: Key Ideas and Details

RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.

RI.3.2 Determine the main idea of a text; recount the key details and explain how they support the main idea.

Reading Standard: Craft and Structure

RI.3.6 Distinguish their own point of view from that of the author of a text.

Writing Standard: Text Types and Purposes

W.3.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

- **W.3.2.a** Introduce a topic and group related information together; include illustrations when useful to aiding comprehension.
- **W.3.2.b** Develop the topic with facts, definitions, and details.
- **W.3.2.c** Use linking words and phrases (e.g., also, another, and, more, but) to connect ideas within categories of information.
- **W.3.2.d** Provide a concluding statement or section.

Speaking and Listening Standard: Comprehension and Collaboration

SL.3.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 3 topics and texts*, building on others' ideas and expressing their own clearly.

- **SL.3.1.a** Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion.
- **SL.3.1.b** Follow agreed-upon rules for discussions (e.g., gaining the floor in respectful ways, listening to others with care, speaking one at a time about the topics and texts under discussion).
- **SL.3.1.c** Ask questions to check understanding of information presented, stay on topic, and link their comments to the remarks of others.
- **SL.3.1.d** Explain their own ideas and understanding in light of the discussion.

Speaking and Listening Standard: Presentation and Knowledge of Ideas

SL.3.4 Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.

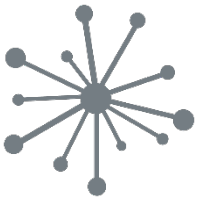
Unit Vocabulary

The following terms reflect the core vocabulary students should understand and use in this unit.

- **adaptation**: An adaptation is a trait that an organism has developed to enable it to survive in a certain habitat. (Sourced from FWS[1]: https://bit.ly/3AbVSmi)
- **biome**: The earth is one very large biome, a place defined by particular, overlapping habitats. The most dominant biomes are deserts, tundra, grasslands, and large forested groups such as the rainforest and northern temperate forests. (Sourced from FWS: https://bit.ly/3EperGq)
- **biomimicry**: Biomimicry is the imitation of natural biological designs or processes in engineering or invention. (Source: https://www.merriam-webster.com/dictionary/biomimicry) For example, planes have wings similar to birds' wings.
- **camouflage**: Camouflage is the hiding or disguising of something by covering it up or changing the way it looks. (Source: https://www.merriam-webster.com/dictionary/camouflage)
- **ecosystem**: An ecosystem includes all living things and nonliving things in an area, as well as the interactions between them. (Sourced from the EPA[2]: https://bit.ly/3hgRH16)
- **endangered**: An endangered species is a type of animal or plant that has become very rare and that could die out completely. (Source: https://www.merriam-webster.com/dictionary/endangered)
- **environment**: The environment is the air, water, and land in or on which people, animals, and plants live. (Source: https://dictionary.cambridge.org/us/dictionary/english/environment)
- **extinct**: An extinct species is a species (plant or animal) that no longer exists. (Sourced from FWS: https://bit.ly/3htAG3R)
- **fossil**: A fossil is a trace or print or the remains of a plant or animal of a past age preserved in earth or rock (Source: https://www.merriam-webster.com/dictionary/fossil)
- **habitat**: A habitat is the place or environment where a plant or animal naturally lives and grows (a group of particular environmental conditions). (Sourced from FWS: https://bit.ly/3htAG3R)
- **pollution**: Pollution is caused by substances that make land, water, air, etc., dirty and not safe or suitable to use. (Source: https://www.merriam-webster.com/dictionary/pollution)
- **structure**: A structure is something built or arranged in a definite way. (Source: https://www.merriam-webster.com/dictionary/structure)

[1] FWS = U.S. National Fish and Wildlife Service
[2] EPA = Environmental Protection Agency

Assessment Tools



Student Experience Inventory

Teachers can use the following prompts with students prior to the beginning of the unit or early in the unit in order to learn about students' experiences that relate to the unit. Teachers can make informed instructional decisions based on this learning, enabling tailored opportunities for students to make their own meaning.

Student Prompts

1. Tell me about an animal you have seen or heard about that you find interesting. What is the animal? What can you tell me about it? Where does it live?

2. Tell me about a crammed desk you have had or seen. (Additional prompts: What kinds of things do you remember finding? Were there lots of old papers in there?)

3. If we helped a local zoo create a new exhibit, what animal would you like to help it showcase? What kinds of things would we need to bring to the exhibit to help it survive?

Aligned Learnings

1. Responses to this item provide insight into students' experiences with animals, their environment, and their structures. 3-LS3-2

2. Responses to this item provide insight into students' experiences with items that have been undisturbed for a long period of time. 3-LS4-1

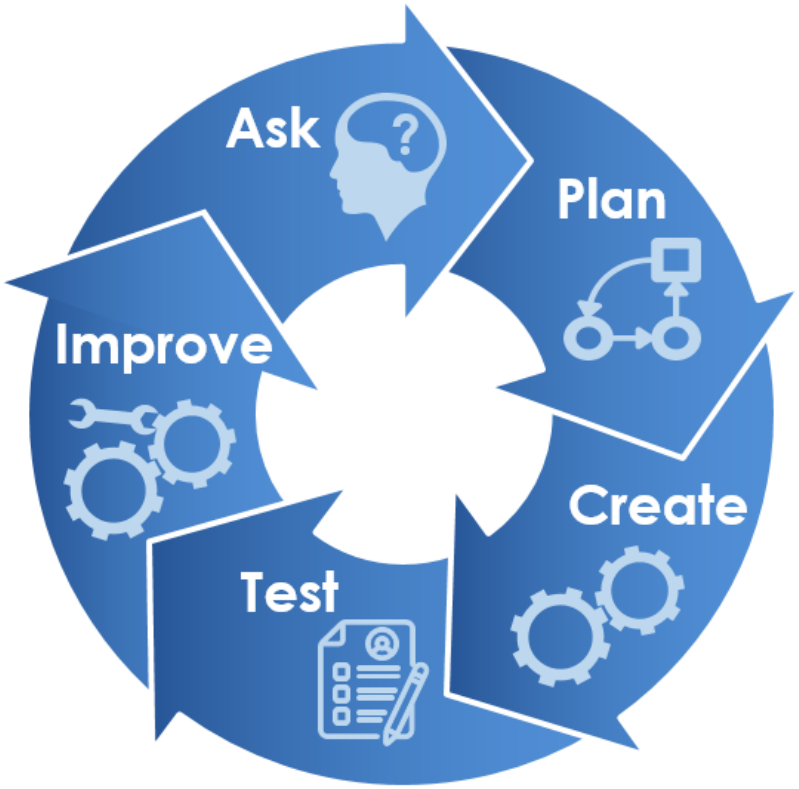
3. Responses to this item provide insight into students' experiences animals' environmental needs. 3-LS4-3

Student Self-Assessment of Engineering

Improve:
Here is what would make my design better and why…

Ask:
Here is what I am wondering about before I plan my design…

Plan:
Here are my design ideas for the project…



Test:
Here are the data I collected…

Create:
Here is what I think about what I made compared to what I planned, and here is what I think will happen when I test it…

I am doing the work of a bioengineer

One-Point Design Challenge Rubric

Criteria serve as a primary reference point throughout the engineering design process. Teachers use the criteria **to communicate expectations** and **to guide students**. With teacher guidance, students use the criteria to inform and reflect on their work.

Approaches Expectations *Notes on how to improve the project*	**Meets Expectations** *Criteria indicating success*	**Exceeds Expectations** *Notes on how project goes beyond expectations*
	Engineering Students participate in the 5-part engineering design process, use data, and make thoughtful improvements to their design. (3-5-ETS1-1, 3-5-ETS1-2, 3-5-ETS1-3)	
	Computer Science Students create a simulation of the adaptations of their animal to the changed environment. (3-5.AP.13, 3-5.AP.17, 3-5.AP.18, 3-5.AP.19)	
	Collaboration Students give and receive input with kindness and honesty. (SL.3.1)	
	Communication Students speak and write about their ideas clearly using accurate vocabulary (W.3.2). I can share thoughts, read, and listen to learn from others. (SL.3.4)	
	Science Students use evidence to explain that traits can be influenced by the environment, explain the importance of habitat to survival and interpret data from fossils to understand prior environmental conditions. (3-LS3-2, 3-LS4-1, 3-LS4-3)	

Engagement

Community and Career Connections

During the unit, students engage with STEM professionals who can inform students' work at some point during the engineering design process. The interaction with STEM professionals serves a few purposes:

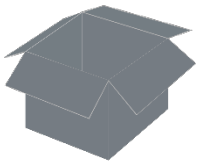
- Expose students to STEM as it applies in various careers
- Enrich student learning through collaborating with STEM professionals
- Help students see themselves doing the actual work of STEM

Below are a few potential STEM-related professionals that align to one of California's 15 industry sectors for Career and Technical Education:

- **Animal Handler or Trainer** (Agriculture and Natural Resources)
- **Exhibit Planner for Zoo** (Hospitality, Tourism and Recreation)
- **Waste Management worker** (Public Services)

The interactive experience will ideally be co-constructed by the teacher and professional. In coordinating with the professional, a few questions appear below that can be used to guide the planning and live interaction with students:

- **Animal Handler or Trainer** (Agriculture and Natural Resources)
  - What kinds of animals do you work with regularly?
  - Are there differences from one animal to another in the same species in terms of how easy or difficult they are to train?
  - What advice to you have for a person who encounters an animal in the wild that seems to want to harm the person?
  - What strategies do you use to train animals?
  - What is the biggest problem you ever encountered with an animal?
- **Exhibit Planner for Zoo** (Hospitality, Tourism and Recreation)
  - What factors do you consider when deciding the best size, structure, and interactive elements of an enclosure for animals?
  - Are there animals who have a more difficult time adapting to the zoo environment than others? Why is that?
  - What design actions do you take to make the environment for the animals is as similar to their natural environment as possible?
  - What role does the public play in the kind of designs you are able to create?
  - What is one problem you are currently facing in your day-to-day work?
- **Waste Management worker (**Public Services)
  - What are some of the things that people can recycle?
  - What are some things people tend not to know that they can recycle?
  - How do you treat waste material while trying to protect the environment?
  - Have you noticed any unusual or surprising animals or plants that tend to want to grow in or near the waste material?
  - What kind of education is required for your job?



Materials List

The items in the materials list below reflect total quantities for a class of 32 students, allowing for 8 groups of 4 students.

Consumable Equipment (classroom totals):

- ☐ 32 cans of Play-Doh® or modeling clay
- ☐ 32 color print sets each containing 5 biome pictures (aquatic, desert, forest, grassland, and tundra)

Distance Learning Modifications

In distance learning, the design challenge will be conducted by students individually at home. Student collaboration will need to occur remotely with a modified materials list.

Modified Materials List (student totals):

- ☐ 1 can of Play-Doh® or modeling clay
- ☐ 1 color print set containing 5 biome pictures (aquatic, desert, forest, grassland, and tundra)

Endnotes

[i] Talltanic. (2017, January 10). *12 coolest camouflage animals and insects.* YouTube. https://www.youtube.com/watch?v=RBdbGPK1ZlQ