Integrated STEM Unit Planner

Pre-Kindergarten and Transitional Kindergarten Science Build a Birdfeeder

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

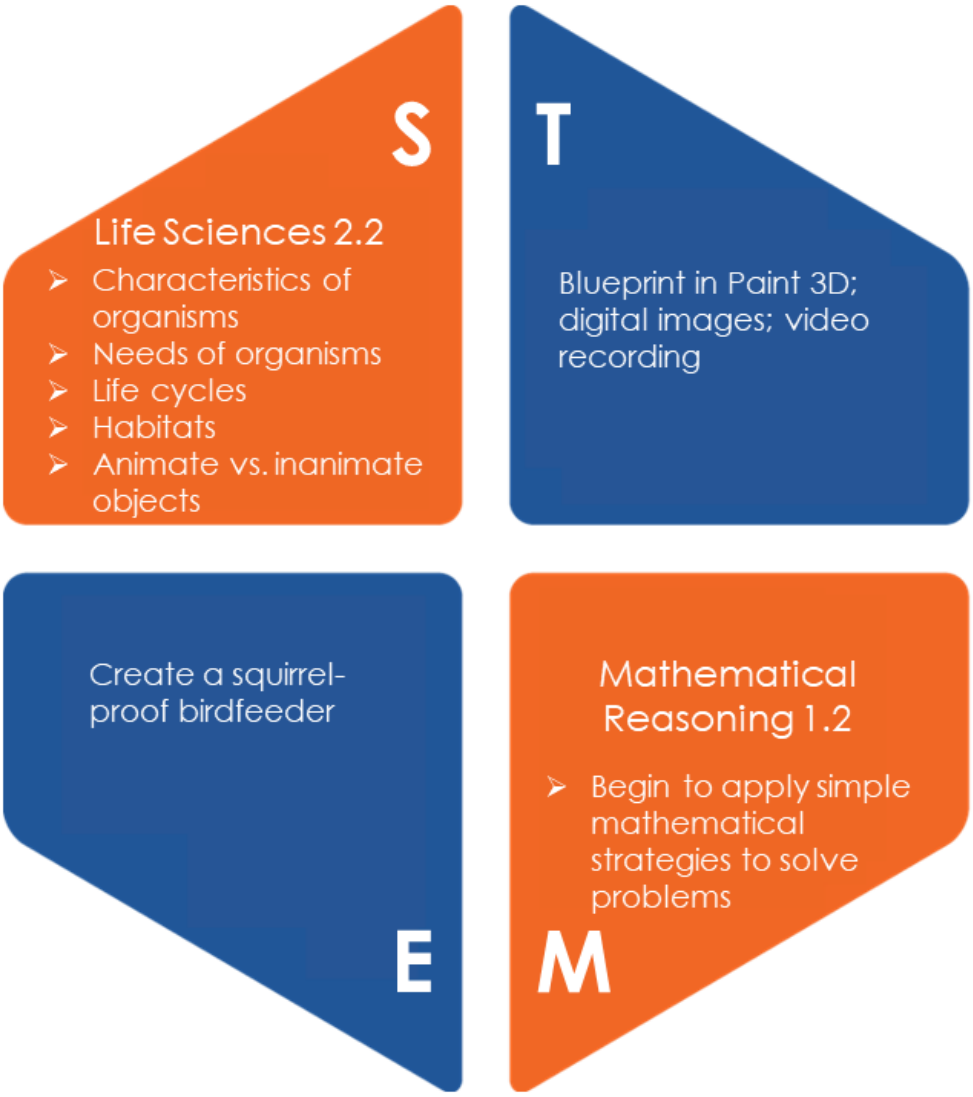
Community Training and Assistance Center (CTAC) is a national not-for-profit organization with a demonstrated record of success in the fields of education and community development. Tracy Unified School District, located in California's Central Valley, serves approximately 15,000 students. Fifty leading 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

Unit Emblem



Focal Standard

Life Sciences	
2.0 Changes in Living Things	
At around 48 months of age	*At around 60 months of age*
2.2 Recognize that animals and plants require care and begin to associate feeding and watering with the growth of humans, animals, and plants.	**2.2 Develop a greater understanding of the basic needs of humans, animals, and plants (e.g., food, water, sunshine, shelter).**

Overview

Sequence 1: Teachers engage students with an anchoring phenomenon by showing pictures of plants, humans, and other animals at various stages of their development. Teachers facilitate students' thinking through an inquiry chart (I notice, I think, I wonder). During this time, teachers introduce the driving essential question: How does a living thing stay alive?

Students will begin to learn about the characteristics and needs or organisms as they explore answers to this question. Teachers introduce the design challenge: To building a squirrel-proof bird feeder. Teachers may wish to show the first 2 minutes of the YouTube Video called Building the Perfect Squirrel-Proof Bird Feeder by Mark Rober (2020)[i]. (https://bit.ly/3Gw0vvd)

Students will begin to ***ask*** questions like: What does a living thing need to grow? How do you know if something is alive? How does a living thing change as it grows? What would happen if some need is not being met for a plant or animal?

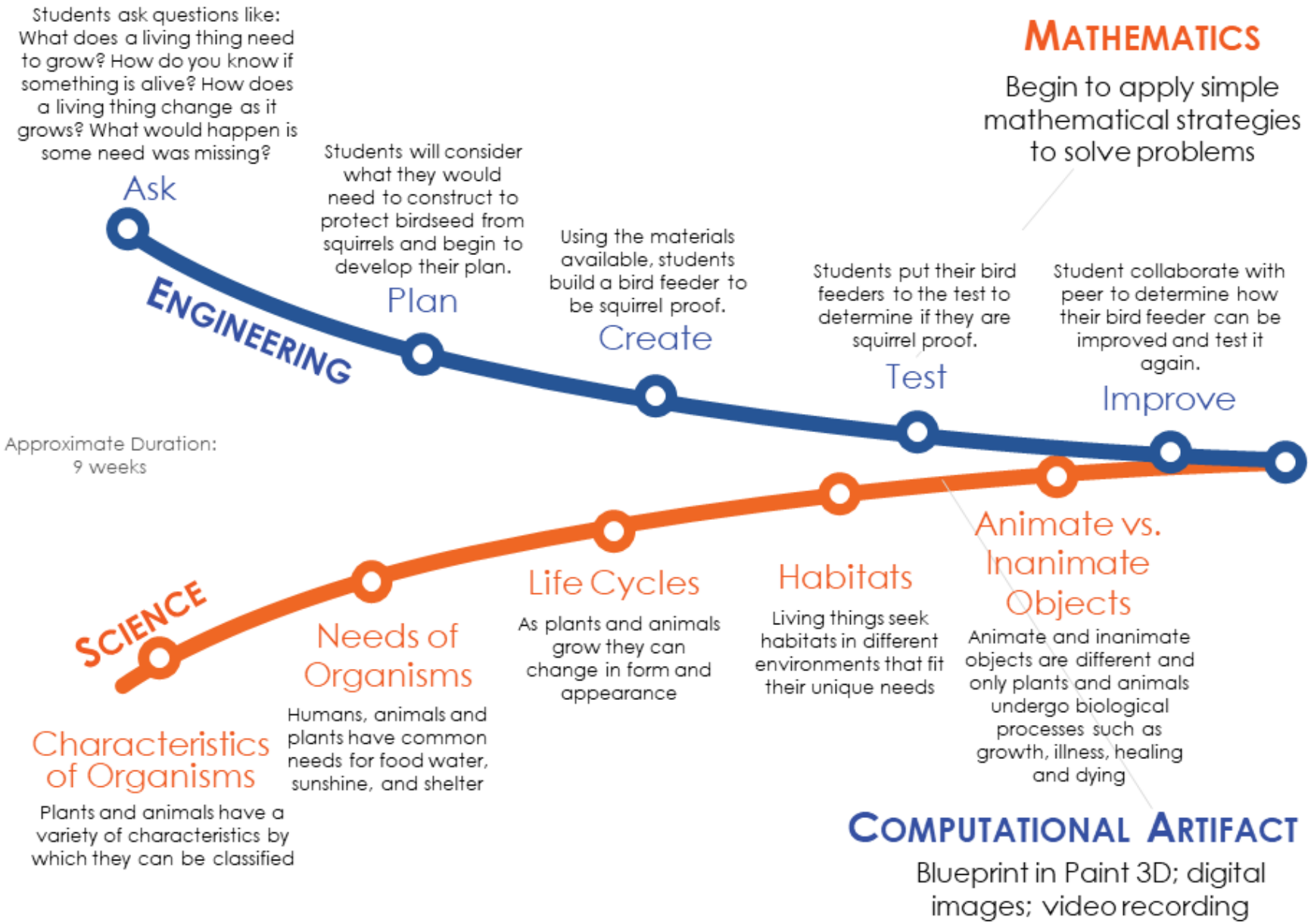
Sequence 2: Students will learn more about the life cycles of plants and animals. As they continue to consider the engineering standard, they will consider the materials available for their bird feeder and begin to ***plan*** their model.

Sequence 3: Based on the plan, students will ***create*** their bird feeder. Students will continue to learn about habitats of various animals and plants.

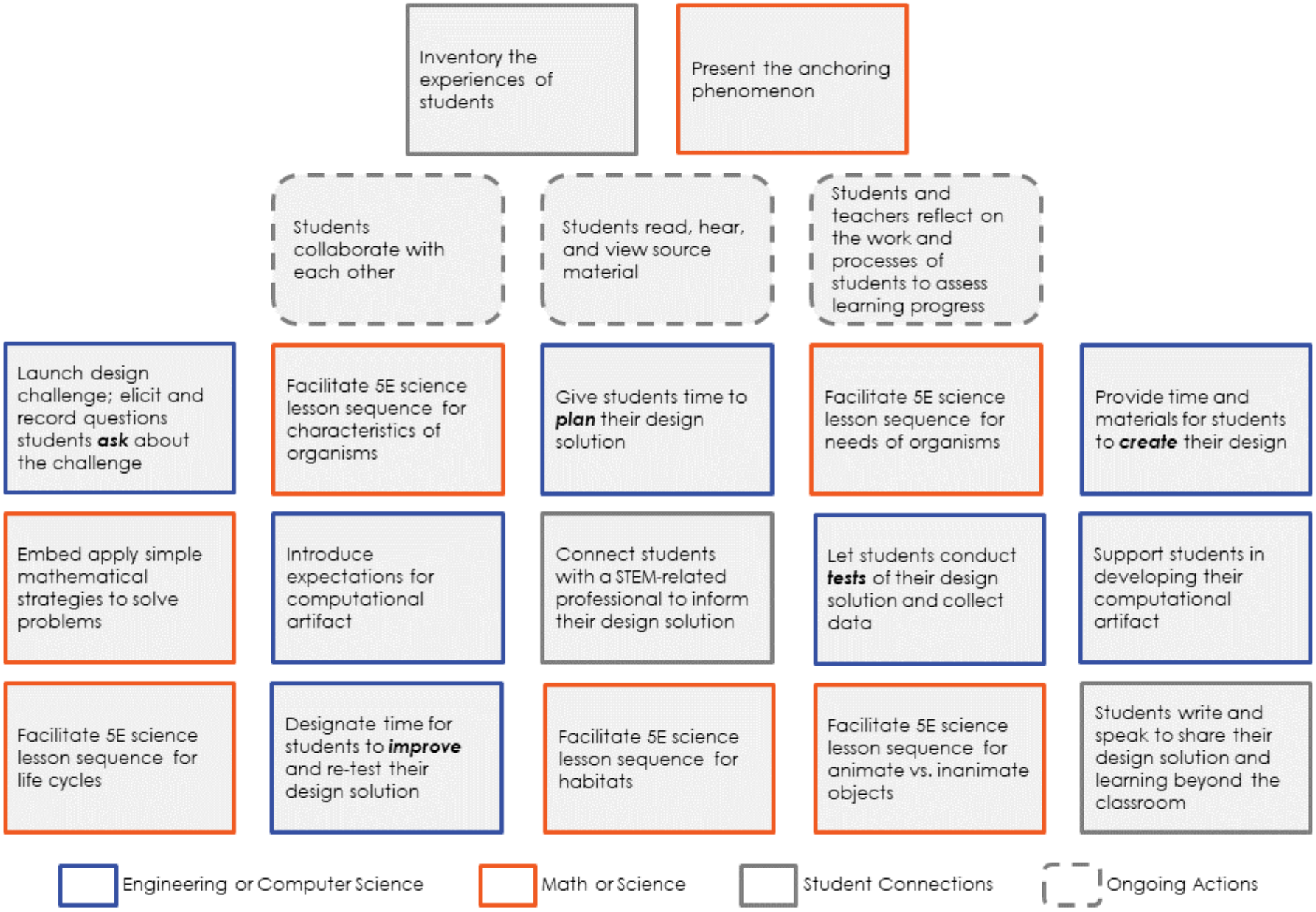
Sequence 4: Students will learn more about how to differentiate animate and inanimate objects. Students will ***test*** the effectiveness of their bird feeder design to determine if they are squirrel-proof.

Sequence 5: Students will reflect on what they learned from their test and observations of others' bird feeders and will revise the plan to ***improve*** their bird feeder.

Integrated Unit Storyline



Integrated Unit Wayfinder



STEM Dive

Engineering

Design Challenge: Create a birdfeeder that is squirrel proof.

Type of Engineering: Structural Engineer

The Engineering Design Process (EDP) and Engineering Standards

EDP Step	Standard and Grade Band End Points from the *Framework*
Ask *What does a living thing need to grow? How do you know if something is alive? How does a living thing change as it grows? What would happen is some need was missing?*	**K-2-ETS1-1.** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool. • A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2-ETS1-1) • Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1) • Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1)
Plan *Students will consider what they would need to construct to protect birdseed from squirrels and begin to develop their plan.*	**K-2-ETS1-2.** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-2-ETS1-2)
Create *Using the materials available, students build a bird feeder to be squirrel proof.*	
Test *Students put their bird feeders to the test to determine if they are squirrel proof.*	**K-2-ETS1-3.** Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs. • Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2-ETS1-3)
Improve *Student collaborate with peer to determine how their bird feeder can be improved and test it again.*	

Computer Science (Technology)

Computer Science Integrations

Description of Student Engagement

1. Students will make a Microsoft Paint 3D blueprint of their structure.
2. Students will take a digital photo of their structure.
3. Students will make a video recording of their structure.

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)

- Microsoft Paint 3D blueprint of structure
- Digital image of structure
- Video recording of structure

Hardware

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

- Computer with camera and video recorder

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

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

- Microsoft Paint 3D
- Camera and video editing software

Standards

- **K-2.DA.7** Store, copy, search, retrieve, modify, and delete information using a computing device, and define the information stored as data.
- **K-2.DA.8** Collect and present data in various visual formats.
- **K-2.DA.9** Identify and describe patterns in data visualizations, such as charts or graphs, to make predictions.

Foundations in Science

Focal Standard

Life Sciences	
2.0 Changes in Living Things	
At around 48 months of age	*At around 60 months of age*
2.2 Recognize that animals and plants require care and begin to associate feeding and watering with the growth of humans, animals, and plants.	**2.2 Develop a greater understanding of the basic needs of humans, animals, and plants (e.g., good, water, sunshine, shelter).**

Related Content Standards

Scientific Inquiry	
1.0 Observation and Investigation	
At around 48 months of age	*At around 60 months of age*
1.1 Demonstrate curiosity and raise simple questions about objects and events in their environment.	1.1 Demonstrate curiosity and an increased ability to raise questions about objects and events in their environment.
1.2 Observe objects and events in the environment and describe them.	1.2 Observe objects and events in the environment and describe them in greater detail.
1.4 Compare and contrast objects and events and begin to describe similarities and differences.	1.4 Compare and contrast objects and events and describe similarities and differences in greater detail.
1.5 Make predictions and check them, with adult support, through concrete experiences.	1.5 Demonstrates an increased ability to make predictions and check them (e.g., may make more complex predictions, offer ways to test predictions, and discuss why predictions were correct or incorrect).
1.6 Make inferences and form generalizations based on evidence.	1.6 Demonstrate an increased ability to make inferences and form generalizations based on evidence.
2.0 Documentation and Communication	
2.1 Record observations or findings in various ways, with adult assistance, including pictures, words (dictated to adults), charts, journals, models, and photos.	2.1 Record information more regularly and in greater detail in various ways, with adult assistance, including pictures, words (dictated to adults), charts, journals, models,

	photos, or by tallying and graphing information.
2.2 Share findings and explanations, which may be correct or incorrect, with or without adult prompting.	2.2 Share findings and explanations, which may be correct or incorrect, more spontaneously and with greater detail.
Life Sciences	
1.0 Properties and Characteristics of Living Things	
1.1 Identify characteristics of a variety of animals and plants, including appearance (inside and outside) and behavior, and begin to categorize them.	1.1 Identify characteristics of a greater variety of animals and plants and demonstrate an increased ability to categorize them.
1.2 Begin to indicate knowledge of body parts and processes (e.g., eating, sleeping, breathing, walking) in humans and other animals.	1.2 Indicate greater knowledge of body parts and processes (e.g., eating, sleeping, breathing, walking) in humans and other animals.
1.3 Identify the habitats of people and familiar animals and plants in the environment and begin to realize that living things have habitats in different environments.	1.3 Recognize that living things have habitats in different environments suited to their unique needs.
1.4 Indicate knowledge of the difference between animate objects (animals, people) and inanimate objects. For example, expect animate objects to initiate movement and to have different insides than inanimate objects.	1.4 Indicate knowledge of the difference between animate and inanimate objects, providing greater detail, and recognize that living things (humans, animals, and plants) undergo biological processes such as growth, illness, healing, and dying
2.0 Changes in Living Things	
2.1 Observe and explore growth and changes in humans, animals, and plants and demonstrate an understanding that living things change over time in size and in other capacities as they grow.	2.1 Observe and explore growth and changes in humans, animals, and plants and demonstrate an understanding that living things change over time in size and in other capacities as they grow and go through transformations related to the life cycle (for example, from a caterpillar to butterfly).

Anchoring Phenomenon

Teachers engage students with an anchoring phenomenon by showing pictures of plants, animals and humans at various stages of development.

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 [1]	# of Days
Characteristics of Organisms	• Identify characteristics of a greater variety of animals and plants and demonstrate an increased ability to categorize them. (Life Sciences, 1.1)	10
Needs of Organisms	• Indicate greater knowledge of body parts and processes (e.g., eating, sleeping, breathing, walking) in humans and other animals. (Life Sciences 1.2) • Develop a greater understanding of the basic needs of humans, animals, and plants (e.g., good, water, sunshine, shelter). (Life Sciences 2.2)	10
Life Cycles	• Observe and explore growth and changes in humans, animals, and plants and demonstrate an understanding that living things change over time in size and in other capacities as they grow and go through transformations related to the life cycle (for example, from a caterpillar to butterfly). (Life Sciences 2.1)	10
Habitats	• Recognize that living things have habitats in different environments suited to their unique needs. (Life Sciences 1.3)	10
Animate vs. Inanimate Objects	• Indicate knowledge of the difference between animate and inanimate objects, providing greater detail, and recognize that living things (humans, animals, and plants) undergo biological processes such as growth, illness, healing, and dying. (Life Sciences 1.4)	10

[1] Key learnings are drawn from the standards designed for students who are 60-months of age. Address the parallel standards for younger students by reviewing the 48-months standards in the table above.

Foundations in Mathematics

Description of Student Engagement

As students decide their design for the bird feeder, they will consider the type of shapes and the sizes of structures that will be the best fit for making the feeder squirrel proof.

Standards for Mathematical Content

Mathematical Reasoning	
1.0 Children use mathematical thinking to solve problems that arise in their everyday environment.	**1.0 Children expand the use of mathematical thinking to solve problems that arise in their everyday environment.**
At around 48 months of age	*At around 60 months of age*
1.1 Begin to apply simple mathematical strategies to solve problems in their environment.	1.1 Identify and apply a variety of mathematical strategies to solve problems in their environment.

Foundations in Language and Literacy

Listening and Speaking	
1.0 Language Use and Conventions	
At around 48 months of age	*At around 60 months of age*
1.1 Use language to communicate with others in familiar social situations for a variety of basic purposes, including describing, requesting, commenting, acknowledging, greeting, and rejecting.	1.1 Use language to communicate with others in both familiar and unfamiliar social situations for a variety of basic and advanced purposes, including reasoning, predicting, problem solving, and seeking new information.
2.0 Vocabulary	
2.2 Understand and use accepted words for categories of objects encountered and used frequently in everyday life	2.2 Understand and use accepted words for categories of objects encountered in everyday life.
2.3 Understand and use simple words that describe the relations between the objects.	2.3 Understand and use both simple and complex words that describe the relations between objects.
Reading	
3.0 Alphabetics and Word/Print Recognition	
3.1 Recognize the first letter of own name.	3.1 Recognize own name or other common words in print.
4.0 Comprehension and Analysis of Age-Appropriate Text	
4.2 Demonstrate knowledge from informational text through labeling, describing, playing, or creating artwork.	4.2 Use information from informational text in a variety of ways, including describing, relating, categorizing, or comparing and contrasting.
Writing	
1.0 Writing Strategies	
1.2 Write using scribbles that are different from pictures.	1.2 Write letters or letter-like shapes to represent words or ideas.

Unit Vocabulary

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

- **animal part names (tail; ears; claws, wings, legs or fins; beak or mouth; coverings including scales, feathers, and fur)**: these are a variety of ways to label the parts of animal anatomy.
    - A **tail** is the rear part of an animal or a usually slender flexible growth that extends from this part (Source: https://www.merriam-webster.com/dictionary/tail).
    - **Claws** are sharp usually thin and curved nails on the fingers or toes of an animal (as a cat or bird) (Source: https://www.merriam-webster.com/dictionary/claws).
    - **Wings** are paired movable feathered or membranous parts with which a bird, bat, or insect flies (Source: https://www.merriam-webster.com/dictionary/wings). Animals who cannot fly may have 2 or more **legs** which allow them to move. Not all animals have legs or wings (e.g., snakes). **Fins** are any of the thin parts that stick out from the body of a water animal and especially a fish and are used in moving or guiding the body through the water (Source: https://www.merriam-webster.com/dictionary/fin).
    - A **beak** is the hard usually pointed parts that cover a bird's mouth (Source: https://www.merriam-webster.com/dictionary/beak). Turtles also have beaks but do not have teeth, like birds. Other mammals, such as the platypus, and other birds, such as geese, have similar structures, but they are usually called bills. Most other animals' mouths are filled with teeth or some other structure for grinding food.
    - Animals' bodies are covered by a variety of structures usually designed for protection. **Scales** are small stiff plates that cover much of the body of some animals (as fish and snakes) (Source: https://www.merriam-webster.com/dictionary/scales). **Feathers** are the light horny growths that make up the outer covering of a bird (Source: https://www.merriam-webster.com/dictionary/feathers). **Fur** is the hairy coat of a mammal especially when fine, soft, and thick (Source: https://www.merriam-webster.com/dictionary/fur).
- **compete (for food and/or shelter)**: To compete means to seek or look for something that someone or something else is also seeking. For example, animals in the same habitat compete for food and shelter: They all need both food and shelter and there may not be enough food or shelter available to meet the needs of all of the animals in the habitat.

- **egg/larva/pupa/adult**: The stages in the life cycle of an insect are: egg (usually round and small objects laid by adults near a likely food source); larva (the worm-like animal that hatches from the egg, a temporary form); pupa (occurs when the larva matures and may build a cocoon or a hard shell to protect itself while it changes shape), and the adult stage when the insect is fully grown.

- **life cycle**: A life cycle is the series of stages through which a living thing passes from the beginning of its life until its death. (Source: https://www.merriam-webster.com/dictionary/life%20cycle)

- **milkweed**: Milkweed is a plant with milky juice and clusters of flowers. (Source: https://www.merriam-webster.com/dictionary/milkweed) Butterflies are particularly attracted to milkweed.

- **plant part names (roots, stem, leaves, flower, fruit, seed)**: The parts of plants can be labelled and categorized based on purpose.

    - **The roots** of a plant are the part of a plant that grows underground, gets water from the ground, and holds the plant in place (Source: https://www.merriam-webster.com/dictionary/roots).

    - Plant **stems** are the main stalks of a plant that develops buds and shoots and usually grows above ground (Source: https://www.merriam-webster.com/dictionary/stems). Stems provide the support for other parts of the plants.

    - The **leaves** of a plant are the flat and typically green parts of a plant that grow from a stem or twig (Source: https://www.merriam-webster.com/dictionary/leaf).

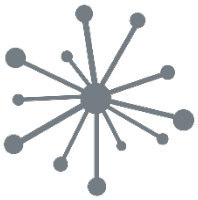
    - **Flowers** are the parts of a plant that are often brightly colored, that usually last a short time, and from which seeds or fruit develop (Source: https://www.merriam-webster.com/dictionary/flower).

    - **Fruit** are the parts of the plant that have seeds in it (Source: https://www.merriam-webster.com/dictionary/fruit). Fruits are often sweet (such as oranges and apples) and used in cooking and snacks (nuts and berries).

- **seed**: A seed is a tiny developing plant that is enclosed in a protective coat usually along with a supply of food and that is able to develop under suitable conditions into a plant like the one that produced it (Source: https://www.merriam-webster.com/dictionary/seed).

- **survive**: To survive means to remain alive or to continue to live (Source: https://www.merriam-webster.com/dictionary/survive).

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. What kinds of animals have you seen before? What did you notice about them?
2. What kinds of plants have you seen before? What did you notice about them?
3. What kinds of places have you seen these plants and animals?

Aligned Learnings

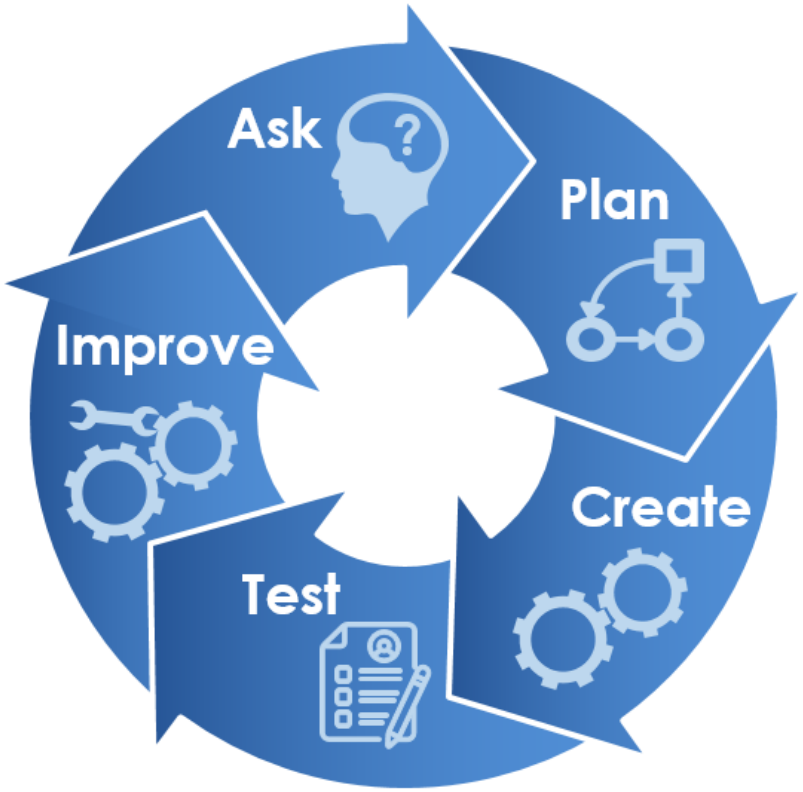
1. Responses to these items provide insight into students' experiences with animals. (Life Sciences 1.1, 1.2, 2.2)
2. Responses to these items provide insight into students' experiences with plants. (Life Sciences 1.1, 1.2, 2.2)
3. Responses to these items provide insight into students' experiences with habitats. (Life Sciences 1.3, 2.2)

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 structural engineer.

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. (K-2-ETS1-1, K-2-ETS1-2, K-2-ETS1-3)	
	Computer Science Students create blueprint of their structure in Paint 3D, take a digital image of their structure, and video record their structure. (K-2.DA.7, K-2.DA.8, K-2.DA.9)	
	Collaboration Students contribute and support others with honesty and kindness (Listening and Speaking 1.1)	
	Communication Students speak and write about their ideas clearly using accurate vocabulary (Listening and Speaking 2.3, Writing 1.2). Students will share thoughts, read, and listen to learn from others. (Listening and Speaking 1.1)	
	Science Students will identify body and plant parts and life cycle processes in humans, plants and animals (Life Sciences.2.2)	

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:

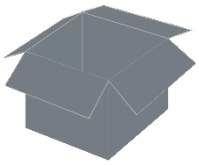
- Expose students to STEM as it applies in various careers
- Enrich student learning through collaborating with STEM professionals
- Help students see themselves doing the actual work of STEM

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

- **Animal Behaviorist** (possibly an animal trainer) (Agriculture and Natural Resources)
- **Pediatrician** (Health Science and Medical Technology)
- **Nursery (plant) Employee** (Agriculture and Natural Resources)

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 Behaviorist** (possibly an animal trainer) (Agriculture and Natural Resources)
  - What animal behaviors are innate, or something that they know automatically before anyone or any other animal teaches them?
  - What motivates animals or in other words, what do animals need to survive?
  - Sometimes we hear about animals that are "food aggressive". Can you explain what that means and why that happens?
  - What is the most important thing to remember if you are trying to train a pet to do something?
- **Pediatrician** (Health Science and Medical Technology)
  - Other than size differences, what are the most noticeable changes in children as they grow up?
  - Do all children grow and develop at the same pace? If not, why not?
  - What difference does the amount or quality of food available to a child make in terms of their development?
  - How do children's physical and mental abilities change over time? What could impact how well or how fast a child develops these abilities?
- **Nursery (plant) Employee** (Agriculture and Natural Resources)
  - How do you grow something from seed? What is the first step?
  - What do plants need in order to grow? How do you provide that in the nursery?
  - What are some things that lead to plants have stunted or slowed growth or that might lead to an early death of the plant?
  - What is a common mistake that people make when they get a plant from a nursery and then plant it around their home? If someone is choosing a plant, what factors about location, sunlight, wind, and water should they consider?



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.

Permanent Equipment (classroom totals):

- ☐ 1 scooper (for teacher use with shortening)
- ☐ 1 large spoon (for teacher use with seed)

Consumable Equipment (classroom totals):

- ☐ 5 pounds bird seed
- ☐ 1 (16 ounce) container of shortening or sunflower seed butter
- ☐ 1 skein of yarn or string (approximately 360 feet)
- ☐ 8 rolls of clear tape
- ☐ 160 craft sticks (20 per group)

Consumable Equipment (from home or site as available):

- ☐ recyclable materials (e.g. cardboard, plastic milk cartons, Pringles containers, tennis ball containers)

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:

- ☐ 1 large handful (about a quarter cup) of bird seed
- ☐ 1 spoonful or scoop of shortening or sunflower seed butter
- ☐ 30 craft sticks
- ☐ 1 roll clear tape
- ☐ 1 yard of yarn or string
- ☐ recyclable materials from home

Endnotes

[i] Rober, M. (2020, May 24). *Backyard squirrel maze 1.0 – Ninja warrior course*. YouTube. https://www.youtube.com/watch?v=hFZFjoX2cGg