

# Integrated STEM Unit Planner

## Grade 2 Science Disperse the Seeds



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## 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.

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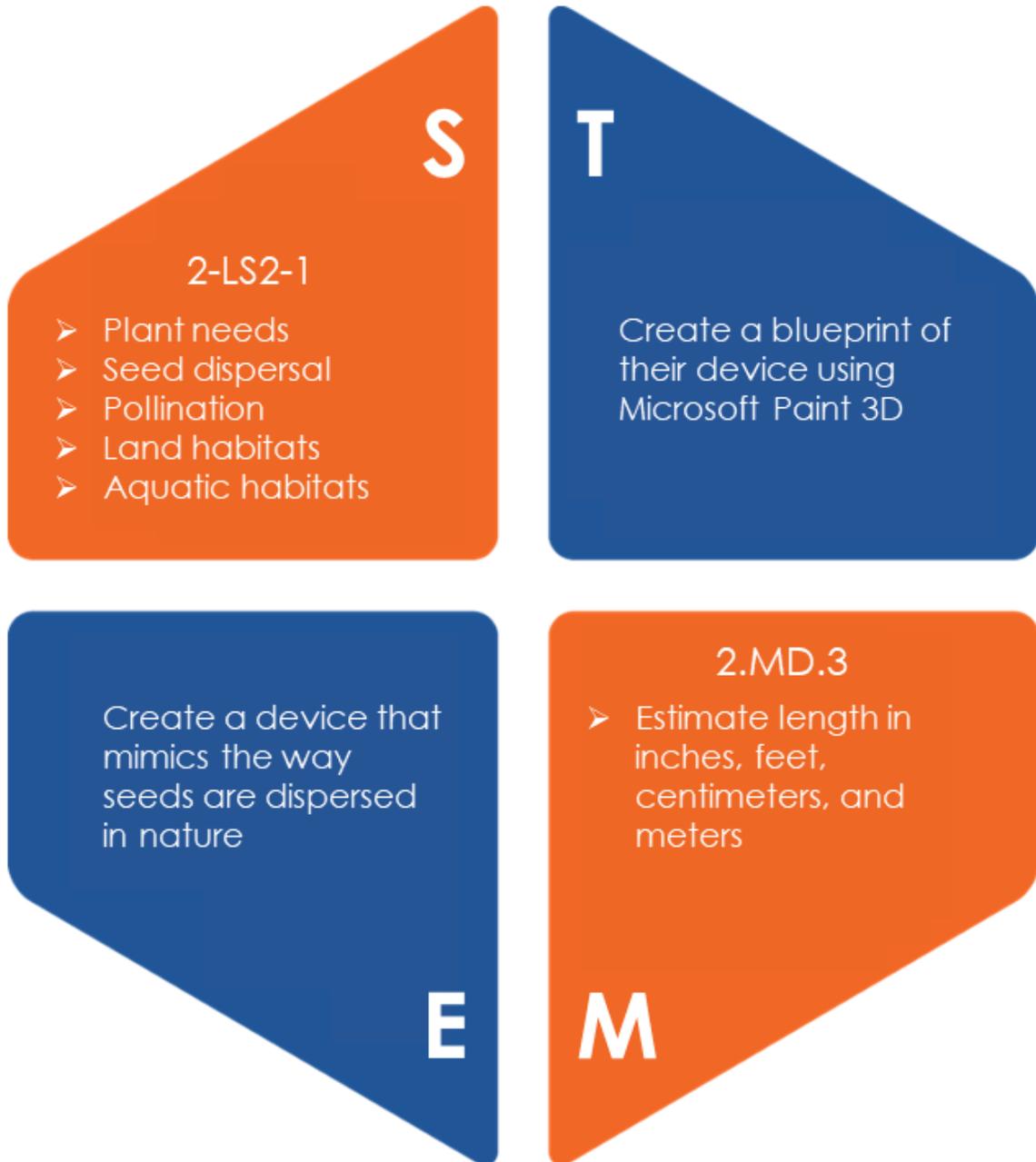
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## Big Picture

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### Unit Emblem



### Focal Standard

**2-LS2-1 Plan and conduct an investigation to determine if plants need sunlight and water to grow.** [Assessment Boundary: Assessment is limited to testing one variable at a time.]



## Overview

Sequence 1: Teachers engage students with an anchoring phenomenon by showing a video of an environment that is damaged and then its appearance after reforestation has been completed. During the entry event, teachers present the driving essential question: How do living things within a habitat depend on each other to survive? By the end of this unit, students will understand that different landscapes support different types of life. They will identify the needs of plants and draw conclusions about the relationships between animals and plants in an ecosystem. The various activities, in and out of the classroom, will lead the students to inquire about the needs of animals and plants surviving within their habitats.

These initial discussions lead to the design challenge which is to create a device that mimics the way seeds are dispersed in nature (e.g., balloon being used to provide the wind, cotton balls mimicking animal's fur, etc.). Students **ask** questions about the challenge including: What kind of seeds are there? How do seeds move? How do farmers disperse seeds?

Sequence 2: Students learn more about plant needs and seed dispersal in nature. Using the knowledge they have gained, students begin to **plan** their device, evaluating possible ways they could disperse seeds and begin to draw an initial plan considering materials provided.

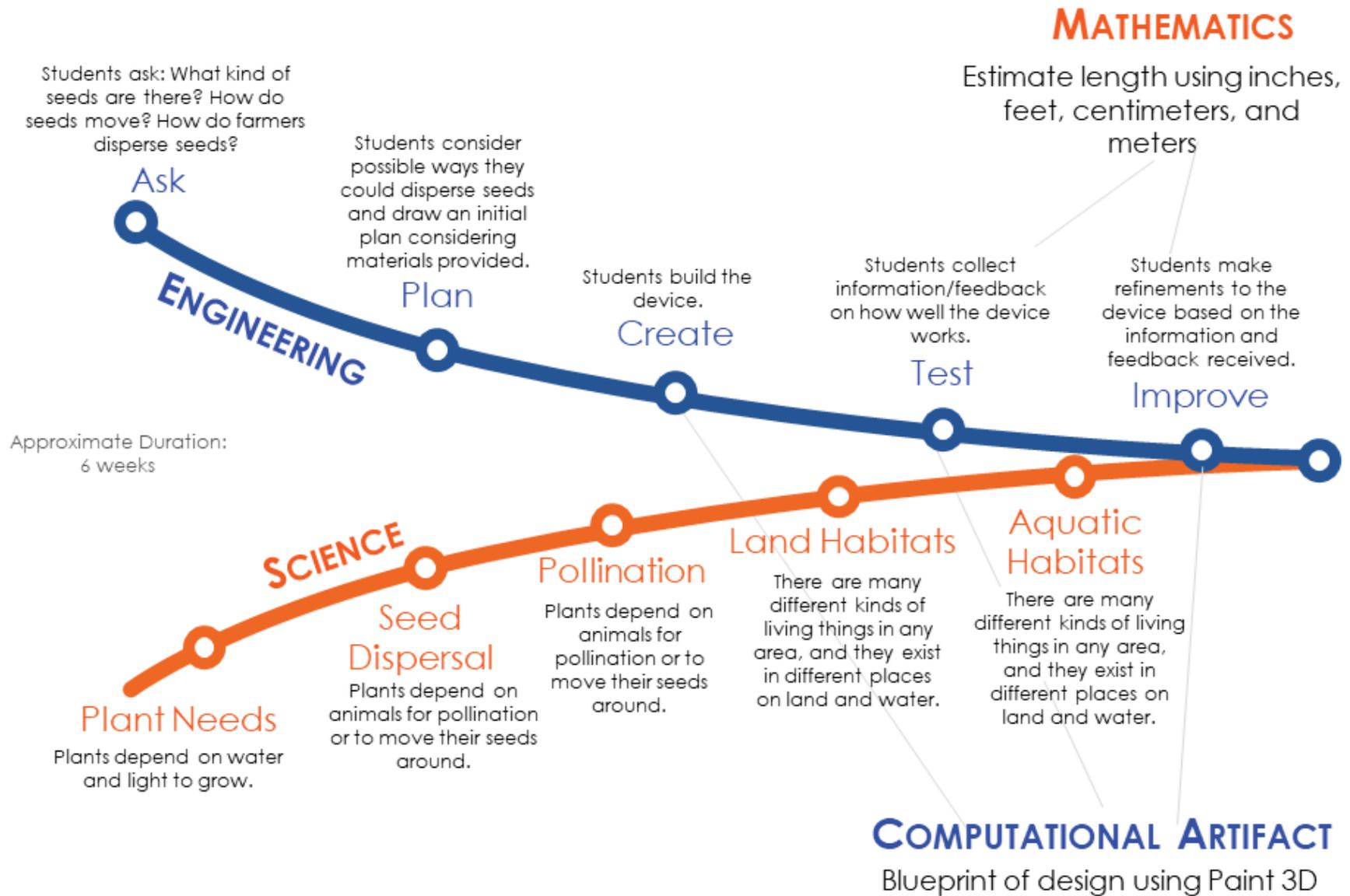
Sequence 3: Students will work in groups to **create** their device as they learn more about pollination and strategies for conveying designs through drawing, sketches or visual models.

Sequence 4: Students then begin to **test** their prototype, collecting feedback from their peers and testing to see how far seeds can be dispersed using their model.

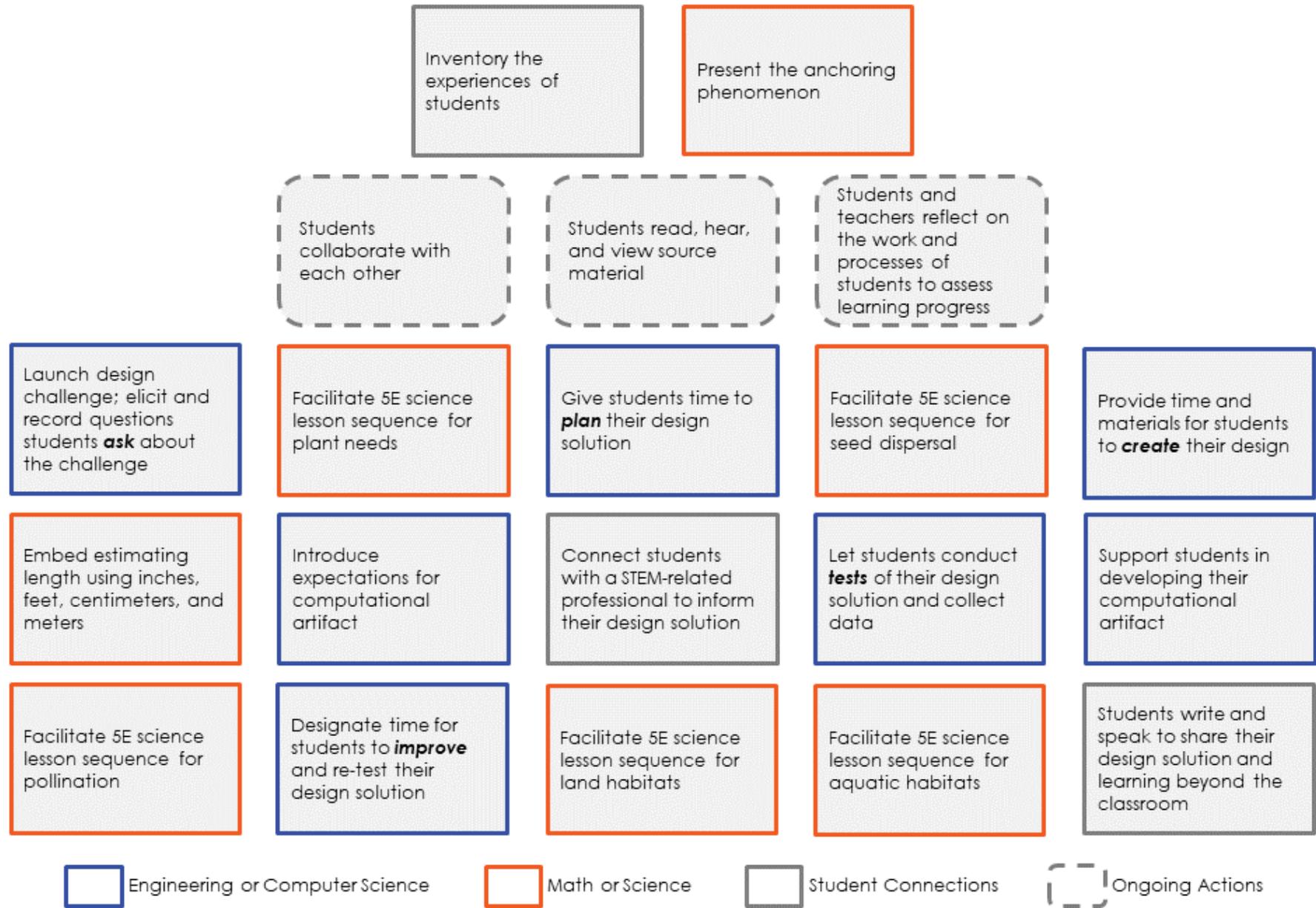
Sequence 5: Students reflect on their data and revise the plan to **improve** their device and then conduct follow-up tests on their improved seed dispersal device. Students will complete blueprint of their design using Microsoft Paint 3D®.



## Integrated Unit Storyline



# Integrated Unit Wayfinder



## STEM Dive



### Engineering

**Design Challenge:** Create a device that mimics the way seeds are dispersed in nature.

**Type of Engineering:** Agricultural Engineering

#### The Engineering Design Process (EDP) and Engineering Standards

EDP Step	Standard and Grade Band End Points from the <i>Framework</i>
<p><b>Ask</b> <i>What kind of seeds are there? How do seeds move? How do farmers disperse seeds?</i></p>	<p><b>K-2-ETS1-1.</b> 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.</p> <ul style="list-style-type: none"> <li>• A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2-ETS1-1)</li> <li>• Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1)</li> <li>• Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1)</li> </ul>
<p><b>Plan</b> <i>Students consider possible ways they could disperse seeds and draw an initial plan considering needs materials.</i></p>	<p><b>K-2-ETS1-2.</b> 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.</p> <ul style="list-style-type: none"> <li>• 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)</li> </ul>
<p><b>Create</b> <i>Students build the device.</i></p>	
<p><b>Test</b> <i>Students collect information/feedback on how well the device works.</i></p>	<p><b>K-2-ETS1-3.</b> Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.</p> <ul style="list-style-type: none"> <li>• Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2-ETS1-3)</li> </ul>
<p><b>Improve</b> <i>Students make refinements to the device based on the information and feedback received.</i></p>	





## Computer Science (Technology)

### Computer Science Integrations

#### *Description of Student Engagement*

Students create a blueprint of their device using Microsoft Paint 3D®.

#### *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)

- Blueprint of students' device using Microsoft Paint 3D

#### *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)

- Microsoft Paint 3D

#### *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.NI.4** Model and describe how people connect to other people, places, information and ideas through a network.)





## Science

### Focal Standard

**2-LS2-1 Plan and conduct an investigation to determine if plants need sunlight and water to grow.** [Assessment Boundary: Assessment is limited to testing one variable at a time.]

### Related Content Standards

**2-LS2-2 Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.**

**2-LS4-1 Make observations of plants and animals to compare the diversity of life in different habitats.** [Clarification Statement: Emphasis is on the diversity of living things in each of a variety of different habitats.] [Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.]

### Anchoring Phenomenon

Teachers engage students with an anchoring phenomenon by showing the video of location that had a serious loss of habitat and a time lapse of how it has been re-forested and reclaimed over time. [One sample video is here.](#) (Captain Planet, 2019)<sup>i</sup>

### 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
Plant needs	<ul style="list-style-type: none"><li>Plants depend on water and light to grow. (2-LS2-1)</li></ul>	6
Seed dispersal	<ul style="list-style-type: none"><li>Plants depend on animals for pollination or to move their seeds around. (2-LS2-2)</li></ul>	6
Pollination	<ul style="list-style-type: none"><li>Plants depend on animals for pollination or to move their seeds around. (2-LS2-2)</li><li>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. (ETS1.B, 2-LS2-2, secondary)</li></ul>	6



Key Concept	Key Learnings	# of Days
Land habitats	<ul style="list-style-type: none"> <li>There are many different kinds of living things in any area, and they exist in different places on land and in water. (2-LS4-1)</li> </ul>	6
Aquatic habitats	<ul style="list-style-type: none"> <li>There are many different kinds of living things in any area, and they exist in different places on land and in water. (2-LS4-1)</li> </ul>	6

Science and Engineering Practices	Crosscutting Concepts
<ol style="list-style-type: none"> <li><b>Asking questions and defining problems</b></li> <li><b>Developing and using models</b></li> <li><b>Planning and carrying out investigations</b></li> <li>Analyzing and interpreting data</li> <li>Using mathematics and computational thinking</li> <li>Constructing explanations and designing solutions</li> <li><b>Engaging in argument from evidence</b></li> <li>Obtaining, evaluating, and communicating information</li> </ol>	<ol style="list-style-type: none"> <li>Patterns</li> <li><b>Cause and effect</b></li> <li>Scale, proportion, and quantity</li> <li>Systems and system models</li> <li>Energy and matter</li> <li><b>Structure and function</b></li> <li>Stability and change</li> </ol>

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



# Mathematics

## Description of Student Engagement

Students estimate the distance of seed dispersal using multiple units of measure.

## Standards for Mathematical Content

**2.MD.3** Estimate lengths using units of inches, feet, centimeters, and meters.

## 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 Idea and Details

**RI.2.1** Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text.

**RI.2.2** Identify the main topic of a multi-paragraph text as well as the focus of specific paragraphs within the text.

### Reading Standard: Craft and Structure

**RI.2.5** Know and use various text features (e.g., captions, bold print, subheadings, glossaries, indexes, electronic menus, icons) to locate key facts or information in a text efficiently.

### Writing Standard: Text Types and Purposes

**W.2.2** Write informative/explanatory texts in which they introduce a topic, use facts and definitions to develop points and provide a concluding statement or section.

### Writing Standard: Production and Distribution of Writing

**W.2.5** With guidance and support from adults and peers, focus on a topic and strengthen writing as needed by revising and editing.

### Speaking and Listening Standard: Comprehension and Collaboration

**SL.2.1** Participate in collaborative conversations with diverse partners about grade 2 topics and texts with peers and adults in small and larger groups.

**SL.2.2.a** (CA) Give and follow three and four step oral directions.

**SL.2.3** Ask and answer questions about what a speaker says in order to clarify comprehension, gather additional information, or deepen understanding of a topic or issue.

### Language: Conventions of Standard English

**L.2.1** Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

- **L.2.1.a.** Use collective nouns (e.g., group).
- **L.2.1.b** Form and use frequently occurring irregular plural nouns (e.g., feet, children, teeth, mice, fish).
- **L.2.1.e** Use adjectives and adverbs, and choose between them depending on what is to be modified.

**L.2.2** Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

- **L.2.2.b** Use commas in greetings and closings of letters.
- **L.2.2.c** Use an apostrophe to form contractions and frequently occurring possessives.





## Unit Vocabulary

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

- **conditions:** Conditions are the way things are at a certain time or in a certain place. (Source: <https://www.merriam-webster.com/dictionary/condition>) For example, in the room you are in now, the conditions include things such as how hot or cold it is, how bright it is, how many other people are in the room with you, among others.
- **disperse:** To disperse means to break up and scatter. (Source: <https://www.merriam-webster.com/dictionary/disperse>).
- **diversity:** Diversity is the condition or fact of being different or varied, or of having variety. (Adapted from: <https://dictionary.cambridge.org/us/dictionary/english/diversity>)
- **ecosystem:** An ecosystem includes all living things and nonliving things in an area, as well as the interactions between them. (Sourced from the EPA<sup>1</sup>: <https://bit.ly/3hgRH16>)
- **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>)
- **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<sup>2</sup>: <https://bit.ly/3htAG3R>)
- **mimic:** To mimic means to naturally look like or behave like (something). (Adapted from: <https://www.merriam-webster.com/dictionary/mimic>). Some plants and animals mimic other plants and animals in order to remain hidden or to seem harmless.
- **pollinate:** To pollinate means to carry pollen from one part of a plant to another part of a plant, or from one plant to another in order to produce seeds. (Adapted from: <https://www.merriam-webster.com/dictionary/pollinate>)
- **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>)

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<sup>1</sup> EPA = Environmental Protection Agency

<sup>2</sup> FWS= U.S. Fish and Wildlife Service



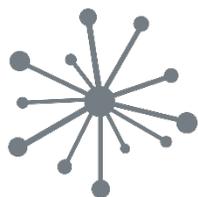
- **soil:** Soil is the loose surface material of the earth in which plants grow. (Source: <https://www.merriam-webster.com/dictionary/soil>)
- **temperature:** Temperature is degree [amount] of hotness or coldness as measured on a scale. (Source: <https://www.merriam-webster.com/dictionary/temperature>)
- **water:** Water is the clear liquid that has no color, taste, or smell, that falls from clouds as rain, that forms streams, lakes, and seas, and that is used for drinking, washing, etc. (Source: <https://www.merriam-webster.com/dictionary/water>)



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## Assessment Tools

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### 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 a time you saw a plant grow or made it grow.
2. Tell me about a time that you have seen something blown around.
3. Tell me about a time when you have watched a video of a bee or saw a bee around you. (Additional prompts: What was it near? How did it move around? What happened as you were watching?)
4. Have you visited or seen television shows or videos of other places outside of our own community?

#### Aligned Learnings

1. Responses to this item provide insight into students' experiences with plant growth and habitats. 2-LS2-1 and 2-LS4-1
2. Responses to this item provide insight into students' wind as a potential dispersal agent. 2-LS2-2
3. Responses to this item provide insight into students' experiences with making observations of animals dispersing pollen. 2-LS2-2
4. Responses to this item provide insight into students' experiences with varying habitats.





## Student Self-Assessment of Engineering

### Improve:

Here is what would make my design better and why...

### Ask:

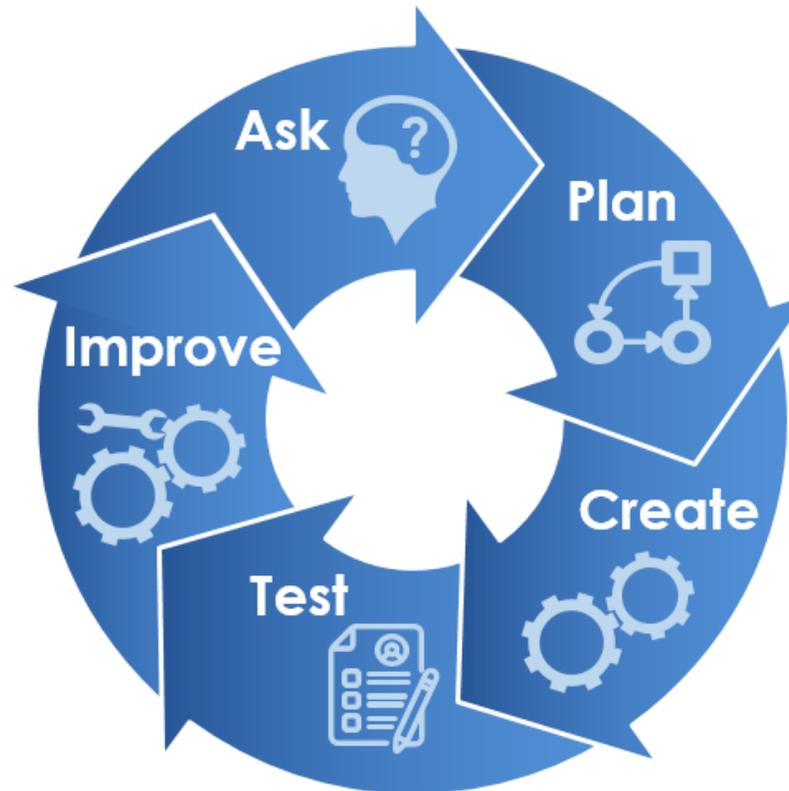
Here is what I am wondering about before I plan my design...

### 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 an agricultural 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.

<b>Approaches Expectations</b> <i>Notes on how to improve the project</i>	<b>Meets Expectations</b> <i>Criteria indicating success</i>	<b>Exceeds Expectations</b> <i>Notes on how project goes beyond expectations</i>
	<b>Engineering</b> 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)	
	<b>Computer Science</b> Students create a blueprint of their device in Microsoft Paint 3D. (K-2.DA.7, K-2.DA.8)	
	<b>Collaboration</b> Students contribute and support others with honesty and kindness. (SL.2.1)	
	<b>Communication</b> Students speak and write about their ideas clearly using accurate vocabulary (W.2.2). I can share thoughts, read, and listen to learn from others. (SL.2.3)	
	<b>Science</b> Students show with pictures or notes of how plants and animals depend on each other to survive. (2-LS2-1, 2-LS2-2, 2-LS4-1)	



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## Engagement

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### 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:

- **Beekeeper** (Agriculture and Natural Resources)
- **Park Ranger** (Hospitality, Tourism and Recreation)
- **Model Maker, Puppeteer, or Graphic Designer** (Arts, Media, and Entertainment)

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:

- **Beekeeper** (Agriculture and Natural Resources)
  - Why are bees important to the growth of plants?
  - What does a beekeeper do to increase the bee population and keep them healthy?
  - Are there particular kinds of bees that you work with? Are there any health problems or other animals that make it hard for bees to survive?
  - Is beekeeping dangerous? How do you keep from being stung?
  - What do you do with your bees? Do you keep them for honey or are they sometimes used to help pollinate crops?
- **Park Ranger** (Hospitality, Tourism and Recreation)
  - What kinds of habitats are present in your park?
  - How diverse are the plants animals in the park? Would you give us some examples?
  - How are the plants and animals different in appearance, behavior, or growth depending upon their specific habitat?
  - What do you think is the most interesting plant or animal in your area?
  - What is one problem you are currently facing in your day-to-day work?
- **Model Maker, Puppeteer, or Graphic Designer** (Arts, Media, and Entertainment)
  - What kinds of models/puppets/designs do you typically create?
  - What materials or tools do you use in creating the models/puppets/designs?
  - What do you do to make sure that what you create mimics the thing you are trying to model as closely as possible? Do you use measurements to try to make sure what you create is close in size or proportion to what you are modeling?
  - What is the hardest thing that you have to do in your job on a day-to-day basis?





## 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):

- 160 craft sticks
- 32 rolls of clear tape
- 200 pipe cleaners
- 32 sheets of cardstock
- 100 sheets of multi-colored tissue paper
- 160 (3 oz. size) paper cups
- 160 balloons
- 32 coffee filters
- 200 toothpicks
- 64 cupcake liners
- 1 roll of wax paper
- 1 roll of aluminum foil
- 44 yards (1 skein) of string or yarn
- 5 lbs. of mustard seed (smaller size is better)
- 14 lbs. of grass seed (about the size of a grain of rice)
- 1 can of spray adhesive (such as 505 temporary basting spray)



## 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):

- 5 craft sticks
- 1 roll of clear tape
- 6 pipe cleaners
- 1 sheet of cardstock
- 3 sheets of multi-colored tissue paper
- 5 (3 oz. size) paper cups
- 3 balloons
- 5 coffee filters
- 15 toothpicks
- 5 cupcake liners
- 1 square foot of wax paper
- 1 square foot of aluminum foil
- 1 yard of string or yard
- 30 seeds (mustard seed if available, other smaller sizes also work)
- 30 grass seeds (about the size of a grain of rice)



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## Endnotes

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<sup>i</sup> Captain Planet. (2019, February 3). *Photographer and wife plant 2 million trees to restore destroyed forest – Even animals return.* <https://www.captain-planet.net/how-a-brazilian-photographer-restored-an-entire-forest-with-2-7-million-trees-in-20-years/>

