Integrated STEM Unit Planner

Grade 2 Science

Model the Land

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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

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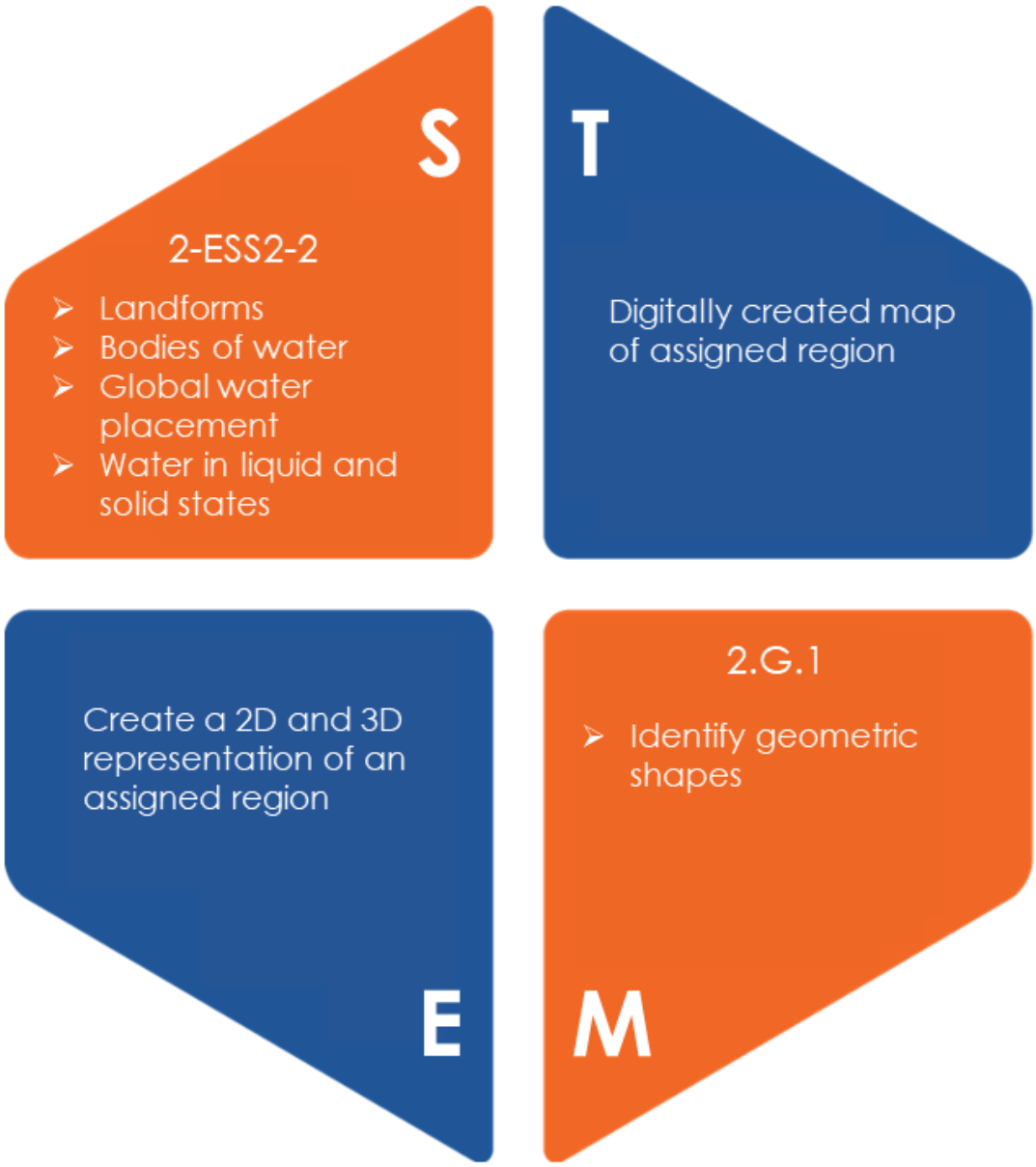
Big Picture

Unit Emblem



Focal Standard

2-ESS2-2 Develop a model to represent the shapes and kinds of land and bodies of water in an area. [*Assessment Boundary: Assessment does not include quantitative scaling in models*.]

Overview

Sequence 1: Teachers engage students with an anchoring phenomenon by showing local maps. Students will learn about the various landforms in the state. Students will review the map and identify the different landforms and water forms represented.

The design challenge will be introduced: to build of model of a bridge connecting two different landforms across a body of water. Students will ***ask*** questions about the challenge including: What kind of model can I create to show different landforms and different bodies of water? What kind of materials can I use to build the bridge? What kind of shapes do I want to represent on each side of the body of water?

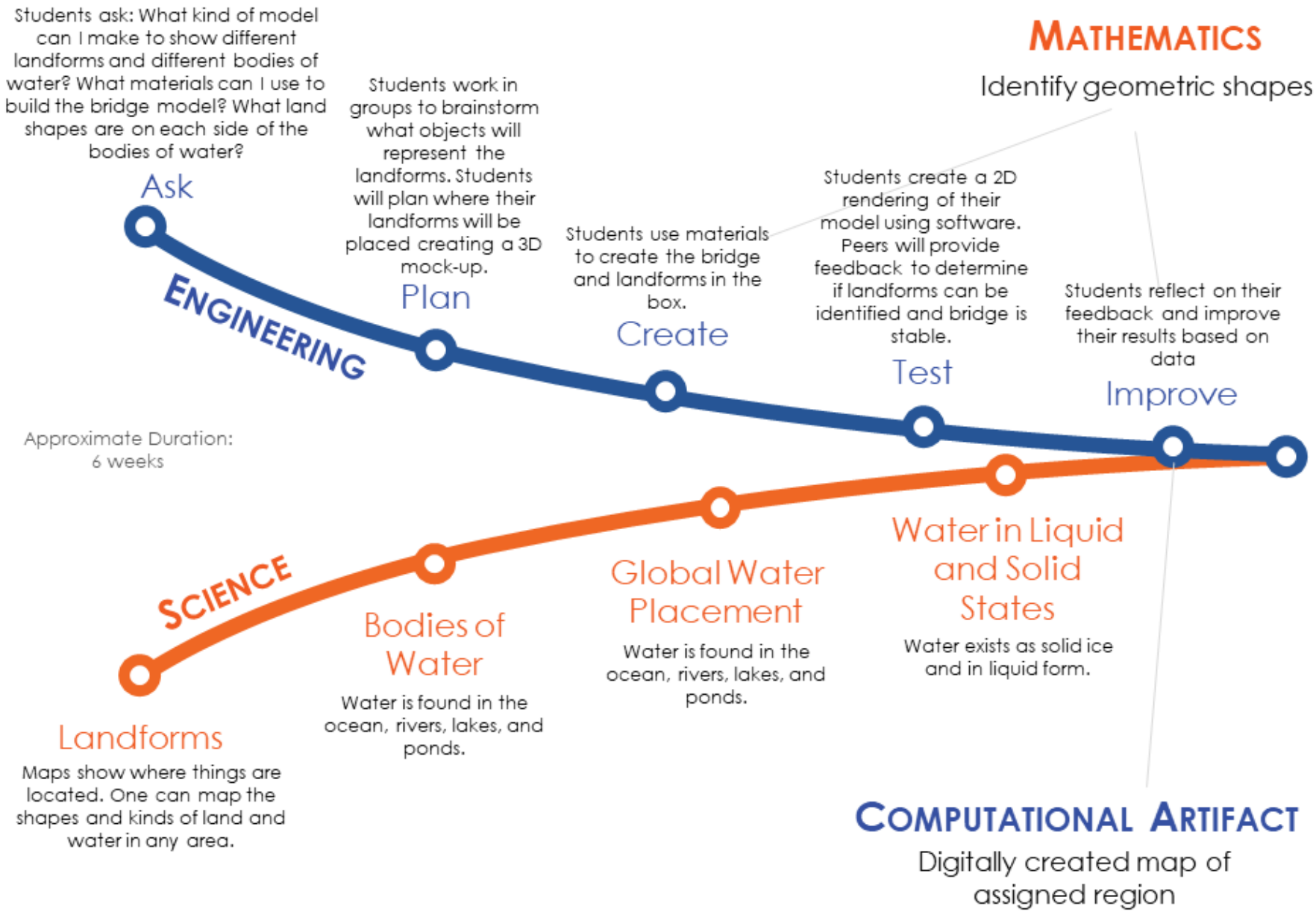
Sequence 2: Students learn more about bodies of water, including oceans, lakes, rivers, ponds and streams. Students will brainstorm in groups to determine what they can use to represent the landforms and the bridge. They will ***plan*** and create a 3-D mock-up of their model.

Sequence 3: Students work will revise their design and use the materials provided to ***create*** a bridge and the landforms. They will be learning about how water is dispersed across the Earth as well as in the local area.

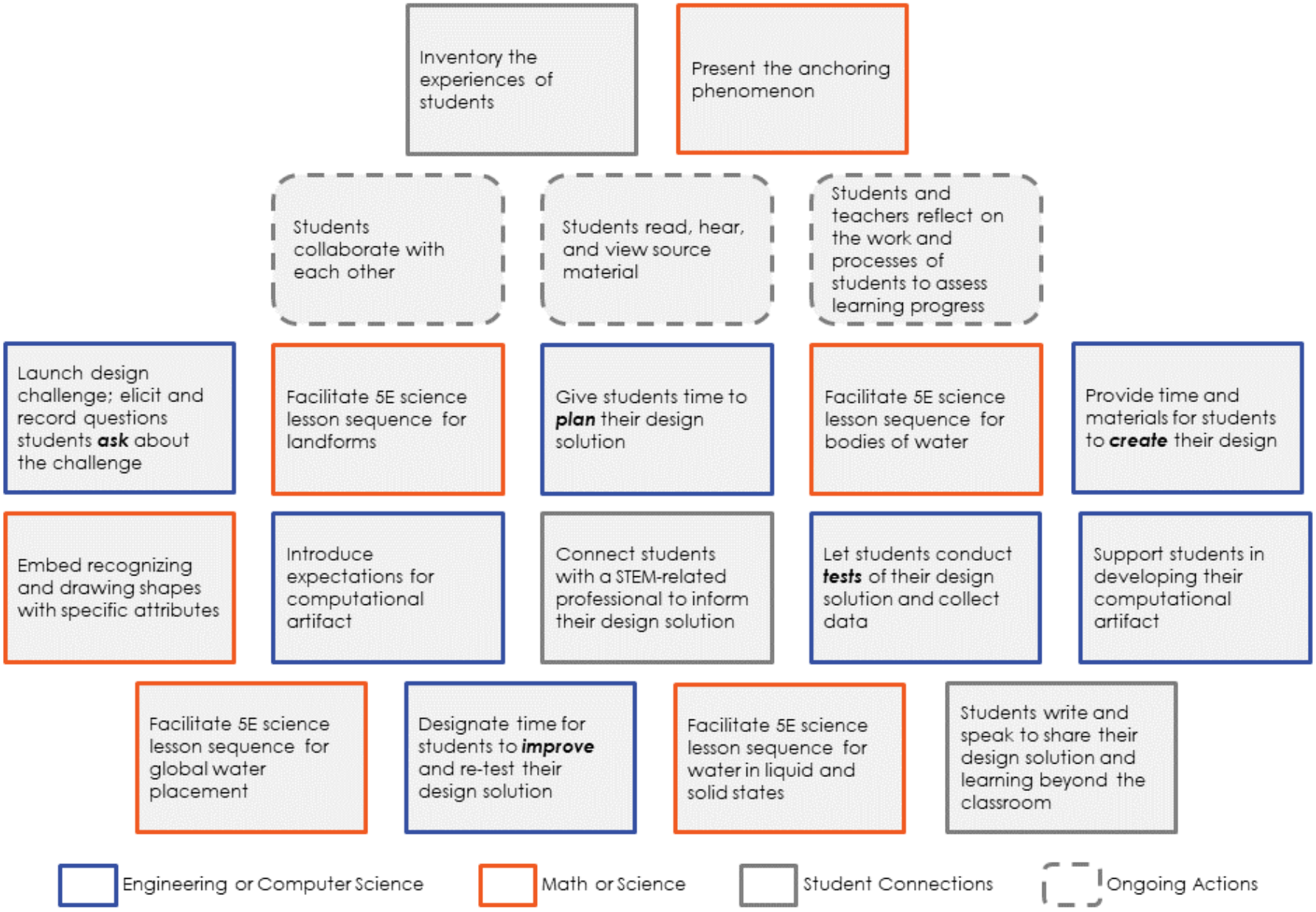
Sequence 4: Students ***test*** their design by developing a 2-D rendering of their model that can be reviewed by their peers. Students will collect data in the form of feedback and consider how their design can be improved.

Sequence 5: Students reflect on what they learned from their test and feedback and will revise the plan to ***improve*** their model.

Integrated Unit Storyline



Integrated Unit Wayfinder



STEM Dive

Engineering

Design Challenge: Create a 2D and 3D representation of an assigned region.

Type of Engineering: Civil Engineering

The Engineering Design Process (EDP) and Engineering Standards

EDP Step	Standard and Grade Band End Points from the *Framework*
Ask *What kind of model can I make to show different landforms and different bodies of water? What materials can I use to build the bridge model? What land shapes are on each side of the bodies of water?*	**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 brainstorm what objects will represent the landforms. Students will plan where their landforms will be placed creating a 3D mock-up.*	**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 *Students use materials to create the bridge and landforms in the box.*	
Test *Students create a 2D rendering of their model using software. Peers will provide feedback to determine if landforms can be identified and bridge is stable.*	**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 *Students reflect on their feedback and improve their results based on data*	

Computer Science (Technology)

Computer Science Integrations

Description of Student Engagement

Students create a digital 2D map of their assigned region.

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)

- Digitally created 2D map in 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.AP.13** Decompose the steps needed to solve a problem into a sequence of instructions.
- **K-2.AP.15** Give attribution when using the ideas and creations of others while developing programs.
- **K-2.AP.16** Debug errors in an algorithm or program that includes sequences and simple loops.
- **K-2.AP.17** Describe the steps taken and choices made during the iterative process of program development.

Science

Focal Standard

2-ESS2-2 Develop a model to represent the shapes and kinds of land and bodies of water in an area. [*Assessment Boundary: Assessment does not include quantitative scaling in models.*]

Related Content Standards

2-ESS2-3 Obtain information to identify where water is found on Earth and that it can be solid or liquid.

Anchoring Phenomenon

Teachers engage students with an anchoring phenomenon by showing relief maps of the state (see resource folder). (Topographic maps are also available from the United States Geological Survey's topoView[i] at https://ngmdb.usgs.gov/topoview/viewer/#4/39.98/-100.06)

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
Landforms	• Maps show where things are located. One can map the shapes and kinds of land and water in any area. (2-ESS2-2)	7
Bodies of Water	• Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. (2-ESS2-3)	7
Global Water Placement	• Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. (2-ESS2-3)	7
Water in Liquid and Solid States	• Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. (2-ESS2-3)	7

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 identify geometric shapes in their models.

Standards for Mathematical Content

2.G.1 Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces.1 Identify triangles, quadrilaterals, pentagons, hexagons, and cubes.

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: Craft and Structure

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

Reading Standard: Integration of Knowledge and Ideas

RI.2.8 Describe how reasons support specific points the author makes in a text.

Writing Standard: Text Types and Purposes

W.2.1 Write opinion pieces in which they introduce the topic or book they are writing about, state an opinion, supply reasons that support the opinion, use linking words (e.g., because, and, also) to connect opinion and reasons, and provide a concluding statement or section.

Writing Standard: Research to Build and Present Knowledge

W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).

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.2.1.c** Ask for clarification and further explanation as needed about the topics and texts under discussion.

Speaking and Listening Standard: Presentation of Knowledge and Ideas

SL.2.4 Tell a story or recount an experience with appropriate facts and relevant, descriptive details, speaking audibly in coherent sentences.

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.c** Use reflexive pronouns (e.g., myself, ourselves).
- **L.2.1.d** Form and use the past tense of frequently occurring irregular verbs (e.g., sat, hid, told).
- **Lk.2.1.e** Use adjectives and adverbs and choose between them depending on what is to be modified.

Unit Vocabulary

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

- **bay**: A bay is a small body of water set off from the main body. (Source: https://www.merriam-webster.com/dictionary/bay)
- **canyon**: A canyon is a deep narrow valley with steep sides and often with a stream flowing through it. (Source: https://www.merriam-webster.com/dictionary/canyon)
- **delta**: A delta is a piece of land in the shape of a triangle or fan made by deposits of mud and sand at the mouth of a river. (Source: https://www.merriam-webster.com/dictionary/delta)
- **fresh water**: Fresh water is not salty and is considered suitable for drinking. (Adapted from: https://www.merriam-webster.com/dictionary/fresh%20water)
- **glacier**: A glacier is a large body of ice moving slowly down a slope or over a wide area of land. (Source: https://www.merriam-webster.com/dictionary/glacier)
- **hill**: A hill is a usually rounded elevation of land lower than a mountain. (Source: https://www.merriam-webster.com/dictionary/hill)
- **lake**: A lake is a large inland body of standing water. (Source: https://www.merriam-webster.com/dictionary/lake)
- **levee**: A levee is a bank built along a river to prevent flooding. (Source: https://www.merriam-webster.com/dictionary/levee)
- **liquid**: A liquid flows freely like water and is neither solid nor gaseous. (Adapted from: https://www.merriam-webster.com/dictionary/liquid)
- **map**: A map is a picture or chart that shows the rivers, mountains, streets, etc., in a particular area. (Source: https://www.merriam-webster.com/dictionary/map)
- **mountain**: A mountain is an area of land that rises very high above the land around it and that is higher than a hill. (Source: https://www.merriam-webster.com/dictionary/mountain)
- **ocean**: An ocean is one of the five large areas of salt water that cover much of the Earth's surface. (Source: https://www.merriam-webster.com/dictionary/ocean)

- **peninsula**: A peninsula is a piece of land that is almost entirely surrounded by water and is attached to a larger land area. (Source: https://www.merriam-webster.com/dictionary/peninsula)

- **plateau**: A plateau is a large flat area of land that is higher than other areas of land that surround it. (Source: https://www.merriam-webster.com/dictionary/plateau)

- **pond**: A pond is a body of water usually smaller than a lake. (Source: https://www.merriam-webster.com/dictionary/pond)

- **reservoir/dam**: A reservoir is a usually artificial lake that is used to store a large supply of water for use in people's homes, in businesses, etc. (Source: https://www.merriam-webster.com/dictionary/reservoir). The reservoir may be created by adding a dam that is either a high bank of earth or a cement structure that holds back water.

- **river**: A river is a large natural flow of water that crosses an area of land and goes into an ocean, a lake, etc. (Source: https://www.merriam-webster.com/dictionary/river)

- **salt water**: Salt water is water that contains a lot of salt, such as if found in the oceans. (Adapted from: https://www.merriam-webster.com/dictionary/salt%20water)

- **slope**: A slope is ground that slants downward or upward. (Source: https://www.merriam-webster.com/dictionary/slope)

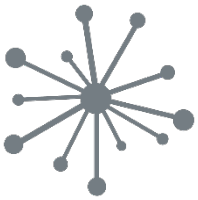
- **solid**: A solid is something (as a cube) that has length, width, and thickness or a substance that keeps its size and shape. (Source: https://www.merriam-webster.com/dictionary/solid)

- **swamp**: A swamp is land that is always wet and often partly covered with water. (Source: https://www.merriam-webster.com/dictionary/swamp)

- **valley**: A valley is an area of low land between hills or mountains. (Source: https://www.merriam-webster.com/dictionary/valley)

- **volcano**: A volcano is an opening in the earth's crust from which hot or melted rock and steam erupt. (Source: https://www.merriam-webster.com/dictionary/volcano)

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. Think about a place outside you have been that is flat. What did it look like? What did you do?

2. Think about a place outside you have seen that is not flat. What did it look like? What did you do?

3. Where have you found water outside before? Have you seen it anywhere outside of our community?

Aligned Learnings

1. Responses to this item provide insight into students' experience with landforms and/or bodies of water. 2-ESS2-2

2. Responses to this item provide insight into students' experiences with landforms and/or bodies of water. 2-ESS2-2

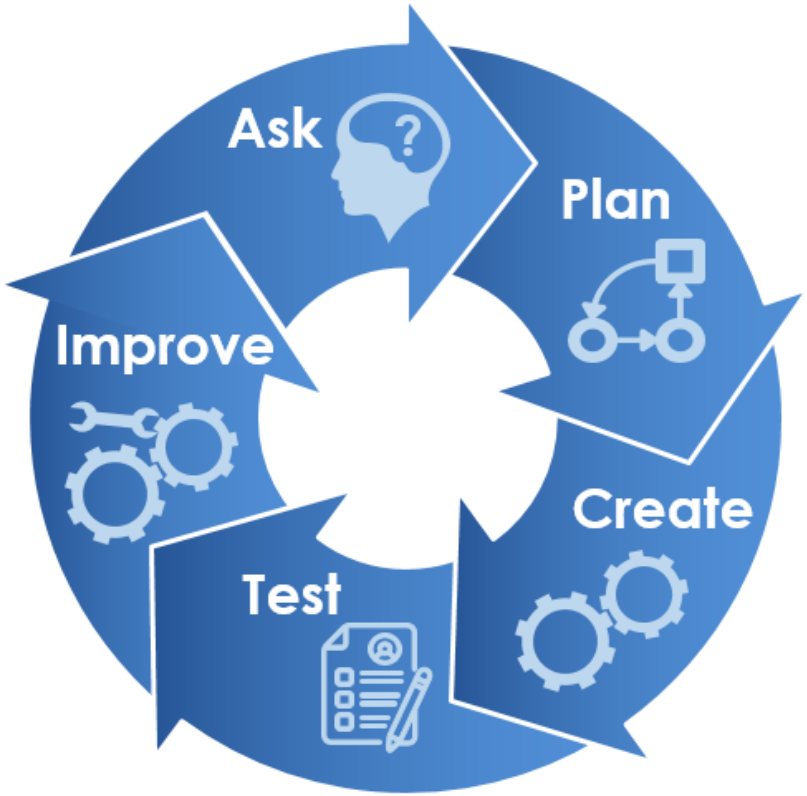
3. Responses to this item provide insight into students' experiences with different bodies of water. 2-ESS2-2, 2-ESS2-3

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 civil 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 a 2D map of their region. (K-2.DA.7, K-2.DA.8)	
	Collaboration Students contribute and support others with honesty and kindness (SL.2.1)	
	Communication Students speak and write about their ideas clearly using accurate vocabulary (W.2.1, W.2.7). Students will share thoughts, read, and listen to learn from others. (SL.2.1)	
	Science Students can show the shapes of water and landforms in 2D and 3D. (2-ESS2-2, 2-ESS2-3)	

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:

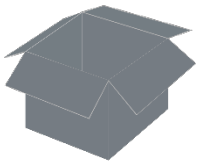
- Expose students to STEM as it applies in various careers
- Enrich student learning through collaborating with STEM professionals
- Help students see themselves doing the actual work of STEM

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

- **Geologist** (Agriculture and Natural Resources)
- **Surveyor** (Building and Construction Trades)
- **Environmental Engineer** (Energy, Environment and Utilities)

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:

- **Geologist** (Agriculture and Natural Resources)
  - What kind of landforms are in our immediate area?
  - What kind of rock or soil is most common in our area? Is there a risk of erosion or wear of soil or rock in our area? What causes it?
  - How has the geology of our area changed over time? What led to those changes?
  - What does a geologist do on a daily basis?
- **Surveyor** (Building and Construction Trades)
  - What tools do you use to make a survey of the land?
  - How do you use landmarks or landforms to line up your surveys or to make notations about the land?
  - How do you designate or show changes in the elevation or height of the land?
  - How would you survey a river bed or lake? Is it any different from how you would survey on land?
  - What happens if there is something like a big boulder in the way of where you need to complete a survey?
- **Environmental Engineer** (Energy, Environment and Utilities)
  - Suppose someone wants to build a dam or a bridge over a waterway, what factors do you examine to be sure putting in the dam or bridge will not hurt the environment?
  - What data do you collect in these cases, and what data do you look at to determine if a problem might occur?
  - Do you ever follow-up on places you have reviewed to see what happens after the change has been made?
  - What are negative effects that might occur if a dam or a bridge is built?



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):

- ☐ tub for sand (rough size: 14 x 10 x 3 inches)
- ☐ tub for gravel (rough size: 14 x 10 x 3 inches)

Consumable Equipment (classroom totals):

- ☐ printouts of landforms (8 sets of 10 images)
- ☐ 32 containers of Green Play-Doh, Air Dry Clay or Modeling clay
- ☐ 32 containers of Blue Play-Doh, Air Dry Clay or Modeling clay
- ☐ 160 craft sticks
- ☐ 32 rolls of clear tape
- ☐ 200 pipe cleaners
- ☐ 100 index cards
- ☐ 160 (3 oz. size) paper cups
- ☐ 200 toothpicks
- ☐ 1 roll of aluminum foil
- ☐ 60 yards of string
- ☐ 2 lbs. of pea gravel
- ☐ 50 lb. bag of desert sand
- ☐ 1 set of 15 sheets of 9 X 12 felt sheets
- ☐ cardboard (from site or home as available)
- ☐ notebook paper (from site, to use as filling for taller landforms like mountains)

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):

- ☐ Printouts of Landforms (1 set of 10 images, and 1 select full images)
- ☐ 1 container of Green Play-Doh, Air Dry Clay or Modeling clay
- ☐ 1 containers of Blue Play-Doh, Air Dry Clay or Modeling clay
- ☐ 5 craft sticks
- ☐ 1 roll of clear tape
- ☐ 6 pipe cleaners
- ☐ 3 index cards
- ☐ 6 (3 oz. size) paper cups
- ☐ 8 toothpicks
- ☐ 1 10x10 section of aluminum foil
- ☐ 2 yards of string
- ☐ handful amount of pea gravel
- ☐ 1 cup X amount of desert sand
- ☐ 2 square feet amount of felt/material
- ☐ 3 index cards
- ☐ cardboard (from site or home as available)
- ☐ notebook paper (from site, to use as filling for taller landforms like mountains)

Endnotes

[i] United States Geological Survey. (n.d.). *topoView.* https://ngmdb.usgs.gov/topoview/viewer/#4/40.01/-100.06)