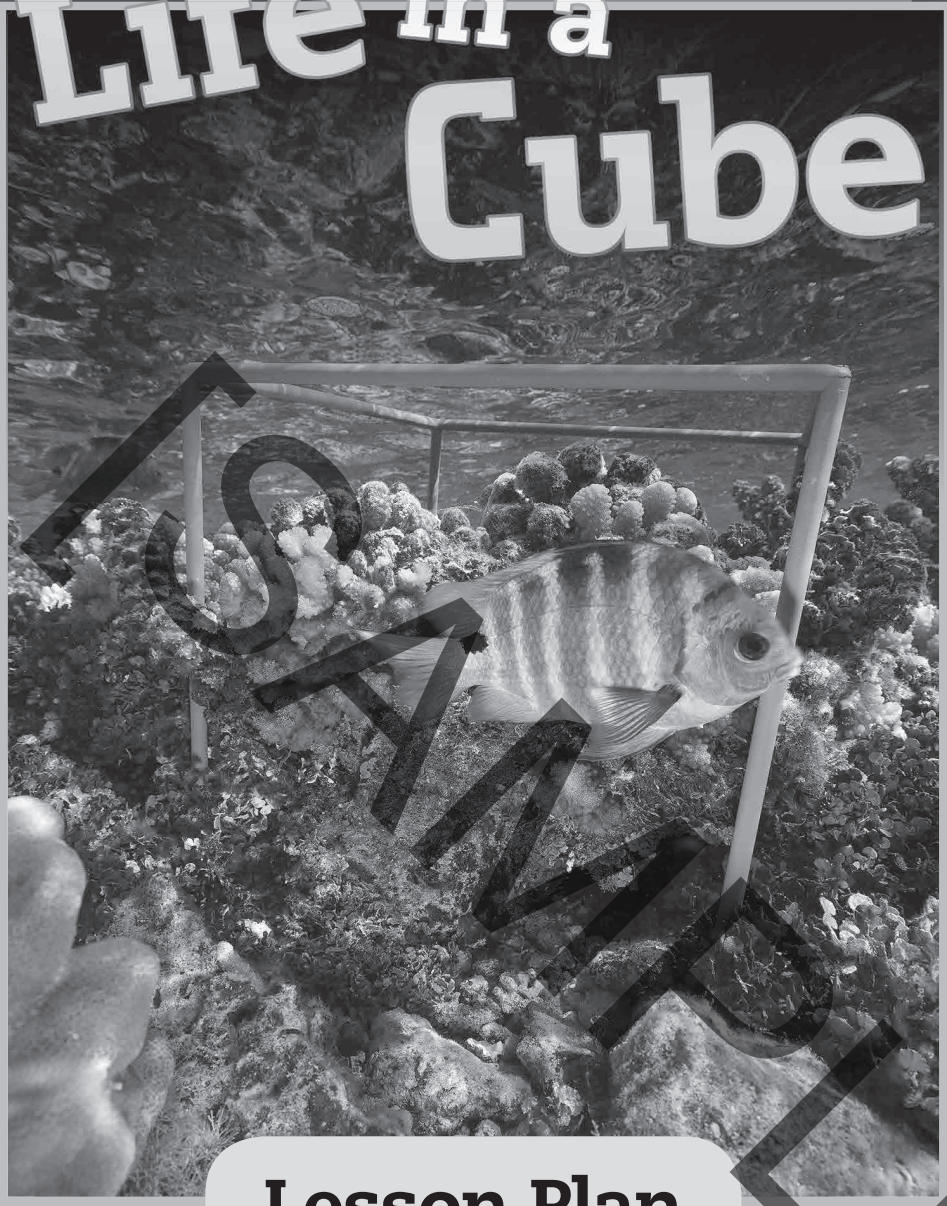
Life in a Cube



Unit 1
Animals & Ecosystems

SAMPLE

Lesson Plan

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Answer Key: *Life in a Cube*

page 10—Comparing Text Structures

Responses will vary. Example:

Page: 22; **Summary:** The loss of coral will have many effects. Fish will die or leave, and some people may go hungry. Sources of medication will be lost. Also, shores will be changed.

Text Structure: Problem/Solution; **Page:** 24; **Summary:** The loss of coral reefs is a problem people are trying to solve. People can build adaptive reefscapes and grow polyps in tanks before placing them back with the coral in the sea.

page 11—Why Save Coral Reefs?

Responses will vary. Example:

Opinion: People should work to protect and save coral reefs because they are important for both animals and humans.

Reason: First, coral reefs are one of the most diverse habitats in the world and are packed with more than one million species that live there.

Reason: Also, many animals, such as fish, sea turtles, dolphins, and manatees, rely on coral reefs for food.

Reason: Finally, humans in different parts of the world depend on fish in coral reefs as their main food source.

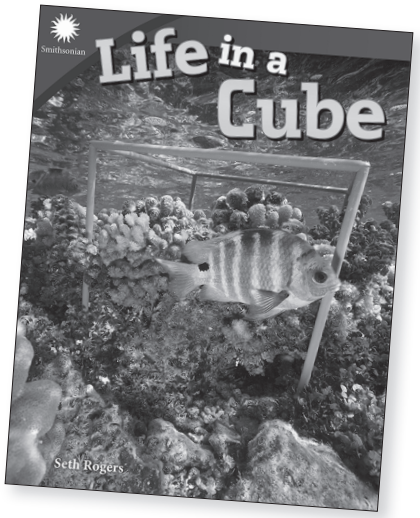
Conclusion: Humans and ocean life rely on coral reefs for many reasons, but people must take action to help protect and save them before it is too late.

page 17—*Life in a Cube* Quiz

1. D
2. B
3. A
4. C
5. Responses will vary. Example: Creating adaptive reefscapes is the best solution to help save coral reefs. Scientists add different types of coral to the reef that can adapt to dangers, such as changes in the ocean's temperature.

Life in a Cube

Materials



- *Life in a Cube* books
- copies of student activity sheets (pages 9–19)
- camera or video camera (optional)
- 10 index cards (1 set per team)
- **STEAM Challenge materials include but are not limited to the following:**
  - ✓ aluminum foil
  - ✓ cardboard pieces
  - ✓ cardboard tubes
  - ✓ construction paper
  - ✓ craft sticks
  - ✓ glue
  - ✓ markers
  - ✓ masking tape
  - ✓ newspaper
  - ✓ paint
  - ✓ plastic wrap
  - ✓ spray bottle

Learning Objectives

- **Reading:** Compare and contrast the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in two or more texts.
- **Writing:** Write opinion pieces on topics or texts, supporting a point of view with reasons and information.
- **Speaking and Listening:** Engage effectively in a range of collaborative discussions with diverse partners on grade-appropriate topics and texts, building on and expressing ideas clearly.
- **Engineering:** Define an engineering problem, design and evaluate solutions, and optimize a design based on test results.

Phenomena

The diversity and amount of life in an area differs from one ecosystem to another.

Lesson Timeline

Day 1	Day 2	Day 3	Day 4	Days 5–10
Introductory and **Before Reading Activities** (page 4)	**During Reading Activities** (page 5)		**After Reading Activities** (page 5)	**STEAM Challenge** and **Assessments** (pages 6–8)
Define the STEAM Challenge, and practice identifying text structures.	Research Liittschwager's cube, find two text structures and summarize parts of the text, and brainstorm design solutions.		Write opinion pieces for blogs about why people should help protect and save coral reefs.	Design, build, test, improve, reflect on, and share models of observation cubes. Complete the assessments.

Life in a Cube (cont.)

STEAM Vocabulary

aquatic	biodiversity	biologists
interdependence	phytoplankton	zoologist

Introductory Activity

Define the Problem

1. Ask students to identify a location on school grounds that may contain the most life. Have students make predictions about the types of life that may be found in the location, and make a class list on the board. Ask them to suggest how they might observe the area for life, including any tools they would use. If possible, visit the location, and have students record observations of any life found there.
2. Distribute the *Life in a Cube* books to students. Reveal the STEAM Challenge by reading aloud pages 28 and 29 of the book. As you read, explain each step of the engineering design process.
   - Display the Interactiv-eBook for a more digitally enhanced introduction to the challenge.
3. Distribute *Make a Plan* (page 9) to students. Have them summarize the challenge. Summaries should include constraints and criteria. Provide the following sentence frame to help students summarize: *Make a _____ that measures exactly _____ and is _____.*

   Note: You may wish to distribute all student activity sheets as one packet. They will be used throughout the STEAM Challenge.

Before Reading

1. Write the vocabulary words on the board, and read them aloud. Have students write the words and rank each word on a scale of 1 to 10 based on how well they know the word, with 1 being very unfamiliar and 10 being very familiar. Point out that the words may have greek or latin roots that students are familiar with, which might increase familiarity. Have students share definitions or examples of words they know well.
2. Tell students that authors of nonfiction texts use different text structures to organize and present information to readers. Explain to students that chronological, description, problem and solution, compare and contrast, and cause and effect are examples of text structures. Point out that authors may use several types of text structures throughout a piece of writing. Ask students to brainstorm reasons for using each type of text structure.
3. Tell students that you will read a short passage about the growth of different types of coral polyps. Read the sidebar "Pacing Polyps" on page 17 of the *Life in a Cube* book. Guide students to identify the compare and contrast text structure. Draw a Venn diagram on the board. Read the text again, and have volunteers complete the Venn diagram to compare and contrast staghorn coral and massive coral.

Life in a Cube (cont.)

During Reading

Research and Brainstorm

1. Distribute the *Life in a Cube* books to students. Read pages 4–13 aloud. Pause periodically to identify text structures. For example, on pages 10–13, discuss how the author compares and contrasts the different habitats where Liittschwager places his cubes. You may also want to discuss with students that the author uses a descriptive text structure to tell about each location, but when they are presented one after the other, the compare and contrast text structure of that chapter is apparent.
   - Display the Interactiv-eBook for a more digitally enhanced reading experience. You may wish to have students annotate the PDFs as you read.
   - Play the audio recording as students follow along to serve as a model of fluent reading. This may be done in small groups or at a listening station. The recording will help **English language learners** practice fluency and aid in comprehension.
2. Distribute *Comparing Text Structures* (page 10) to students. Have students read the book in pairs. Ask them to look for and discuss different text structures as they read. Have students find, record, and summarize an example of the cause and effect text structure and one other text structure.
3. Have students record ideas they have for their designs on their *Make a Plan* activity sheets.

After Reading

1. Play a short game to review the vocabulary words. Divide the class into two teams. Choose one artist from each team. Show the artists one of the vocabulary words. Have artists draw their own representations of the word on the board.
2. Have students guess the word for their team. Award a point to the team that guesses the word first. Continue play until all words have been used. **Note:** You may add related words to make the game more challenging.
3. Tell students that scientists and engineers share knowledge and research with the public in various ways, including through publications, museums, conferences, and the media. Explain to students that many people visit online blogs to learn about current events in science and engineering. Point out that blog writers may also present opinions or write to convince others about a topic.
4. Distribute *Why Save Coral Reefs?* (page 11) to students. Tell students that they will use evidence from the *Life in a Cube* book to convince people to help save coral reefs. Remind them to clearly introduce the topic, present logically ordered reasons supported by facts and details from the books, include transitional words and phrases, and provide closure.
   - Support students by providing transitional words and phrases, such as *first, also, in addition,* and *lastly*.
5. Have students use their graphic organizers to write blog posts either using computers or on separate sheets of paper. Ask students to include relevant titles and at least one illustration that further demonstrates the importance of coral reefs.

Life in a Cube (cont.)

Prep

- Review all designs prior to building.
- Prepare all materials for the STEAM Challenge.

STEAM Challenge

Design and Build

1. As a class, discuss the following questions to connect the reading to the STEAM Challenge:
   - *Where did Liittschwager place his cubes?* Have students recall that Liittschwager placed his cubes in various habitats, including a forest, shrubland, a cloud forest canopy, a river, a coral reef, and in the bay near the Golden Gate Bridge.
   - *What type of material did Liittschwager use to build his cubes?* Make sure students discuss that Liittschwager made his cube with 12 stainless steel rods that were sturdy and could be put together and taken apart as needed.
2. Distribute previously completed activity sheets. Review the STEAM Challenge on pages 28 and 29. List materials on the board. Discuss with students some outdoor areas within close proximity that may contain high biodiversity. Identify a location for students to test their cubes.
3. Ask students to independently sketch and label two designs on their *Make a Plan* activity sheets.
4. Organize students into teams. Distribute one copy of *Collaborative Design* (page 12) to each team. Ask teams to have members share their designs. Then, have each group choose, sketch, and label a team design. (Team designs must be submitted for approval before building begins.)
   - Challenge students by adding constraints (e.g., design the cube so that it can be put together and taken apart, use four materials or less to build the model).
5. Explain to students that when they build their models, they must follow their design plans. Reassure them that they will have an opportunity to change and improve their designs after they present them. Review classroom expectations for working with materials. Then, give teams time to gather materials and build models.
   - Digitally record students' processes to share at a later date with students and parents.
6. Distribute *Think about It* (page 13) to students. Explain that reflection is an important part of the engineering design process. Read aloud questions 1 and 2 on the activity sheets, and have students write their responses. Ask volunteers to share.

Life in a Cube (cont.)

Prep

- Review all designs prior to building.
- Prepare all materials for the STEAM Challenge.

STEAM Challenge

Test and Improve

1. As a class, discuss the following questions to connect the reading to the STEAM Challenge:
   - *Why did Liittschwager place his photographs on plain, white backgrounds?* Point out that details of the samples are easier to see when they are placed on plain, white backgrounds.
   - *How are scientists hoping to improve the current method for coral transplants?* Guide students to recall that scientists are working on a design that will allow them to work on a much larger area at a time.
2. Have teams transport their cubes to the testing location. Tell students that they will first test whether their cubes are waterproof and durable, and then observe life that passes through their cubes. Explain that teams will offer feedback after each test. Use *Friendly Feedback* (page 14) to review best practices for giving feedback.
3. Distribute *Cube Test Results* (page 15) to students. Tell them that they will use the top of their tables to write the results from the water and drop tests for their team's models and the bottom of the table to record observations.
4. Gather teams for the testing. Ask a member of each team to tell how their models blend into the environment. Ask another member of each team to spray the cube with water and drop the cube from 1 meter (3 feet) high. A successful design blends in with the environment and survives the durability tests. Ask volunteers to give friendly feedback.
5. Allow time for teams to observe their cubes. Ask teams to place their cubes in the planned location and to observe and sketch any life that passes through the cube for 20 minutes. If time permits, have students observe the cubes for at least two hours during the course of a week. Have teams share the different types of life that passed through the cube during the observation period and how well their cube held up.
   - You may choose to have students photograph or video record their cubes as part of their observations.
6. Provide time for teams to brainstorm ways to improve their designs based on test results and feedback. Refer students back to their *Collaborative Design* activity sheets. Ask them to sketch their improved designs and explain any changes. Have students submit improved designs for approval before building.
   - Challenge successful teams with additional constraints or criteria for the second design (e.g., secure the cube at a height above ground level).
7. Have teams gather materials to improve their designs. Then, have them make improvements and retest their cubes. **Note:** You may choose to have them complete their observations a second time or just retest the durability of their cubes.
8. Have students answer questions 3 and 4 on their *Think about It* activity sheets.

Life in a Cube (cont.)

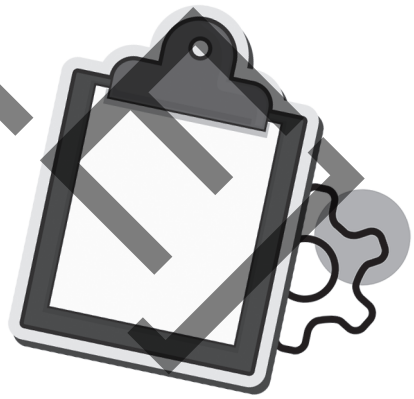
STEAM Challenge

Reflect and Share

1. Provide each team with 10 index cards and ask students to number the cards 1–10. Prepare several statements relating to collaboration and communication during the STEAM Challenge. Statements may include: *All members of our team shared an idea. Our team listened to each other well. All members of our team participated in building the model.*
2. Read a statement aloud. Allow time for students to discuss the statement, and have students hold up a number to score their team. Explain that a 1 would be the worst score, and a 10 would be the best score. Invite teams to share an explanation for their scores. Ask students to suggest ways they could improve collaboration and communication in future group settings.
3. Have students answer question 5 on their *Think about It* activity sheets.
4. Distribute *Engineering Design Process* (page 16) and review how students used the steps to complete the challenge. Have them annotate the infographics with details specific to this challenge.
5. Read "Career Advice" on page 32 of the book. Ask students to brainstorm other tips for a career as a biologist.

Assessment Activities

1. Have students complete a short posttest, *Life in a Cube Quiz* (page 17), to assess the lesson's objectives.
   - Students may complete the Interactiv-eBook activities in the Digital Resources for assessment purposes.
2. Have students complete *Teamwork Rubric* (page 18) and *Engineering Design Process Checklist* (page 19) to reflect on and evaluate their work and collaboration skills.
3. Have students complete the Read and Respond questions from the book.
   - Possible answers to the questions can be found in the Digital Resources (cube_reproducibles.pdf).



Name: _____ Date: _____

Make a Plan

Directions: Summarize the challenge. Brainstorm ideas, and sketch two designs. Circle your favorite.

Challenge: _____

_____

_____

Brainstorm

Design 1

Design 2

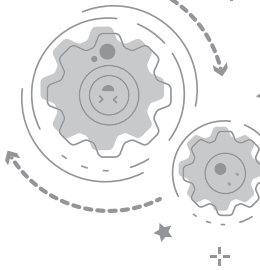
Name: _____ Date: _____

Comparing Text Structures

Directions: Find an example of a cause-and-effect text structure in the book. Summarize the text with that text structure. Then, find a different text structure, and summarize the text.

Text Structure	Summary
Cause and Effect Page(s): _____	
_____ Page(s): _____	

Name: _____ Date: _____



Why Save Coral Reefs?

Directions: State your opinion about why people should help protect coral reefs. Support your opinion with three reasons, and write a conclusion statement.

Opinion	
Reason	
Reason	
Reason	
Conclusion	

Team Members: _____

Date: _____

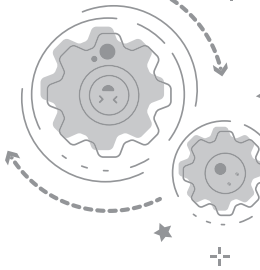
Collaborative Design

Directions: Sketch your team's design in the first box. Sketch your team's improved design in the second box. Label each design with materials needed and the purpose of each part.

Design 1

Design 2

Name: _____ Date: _____



Think about It

1. What did your team struggle with? How did you deal with it? _____

_____

_____

_____

2. How did you contribute to your team? _____

_____

_____

3. How did you use science, technology, engineering, the arts, and/or math in your designs? _____

_____

_____

_____

_____

_____

4. What was successful about your first design? How did you improve it? _____

_____

_____

_____

5. What is the most important thing you learned? What questions do you still have?

_____

_____

_____

_____

Name: _____ Date: _____

Friendly Feedback

Directions: Feedback can help people improve their work. Use these sentence stems to give feedback to your peers.

Clarify

Can you explain _____ ?

Why did you choose to _____ ?

How did you _____ ?

Warm Feedback

I like _____ because _____ .

It is interesting that _____ .

_____ is a good idea because _____ .

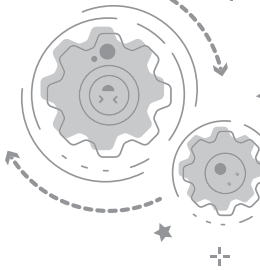
Cool Feedback

Have you thought about _____ ?

I wonder if _____ .

You might want to try _____ .

Name: _____ Date: _____



Cube Test Results

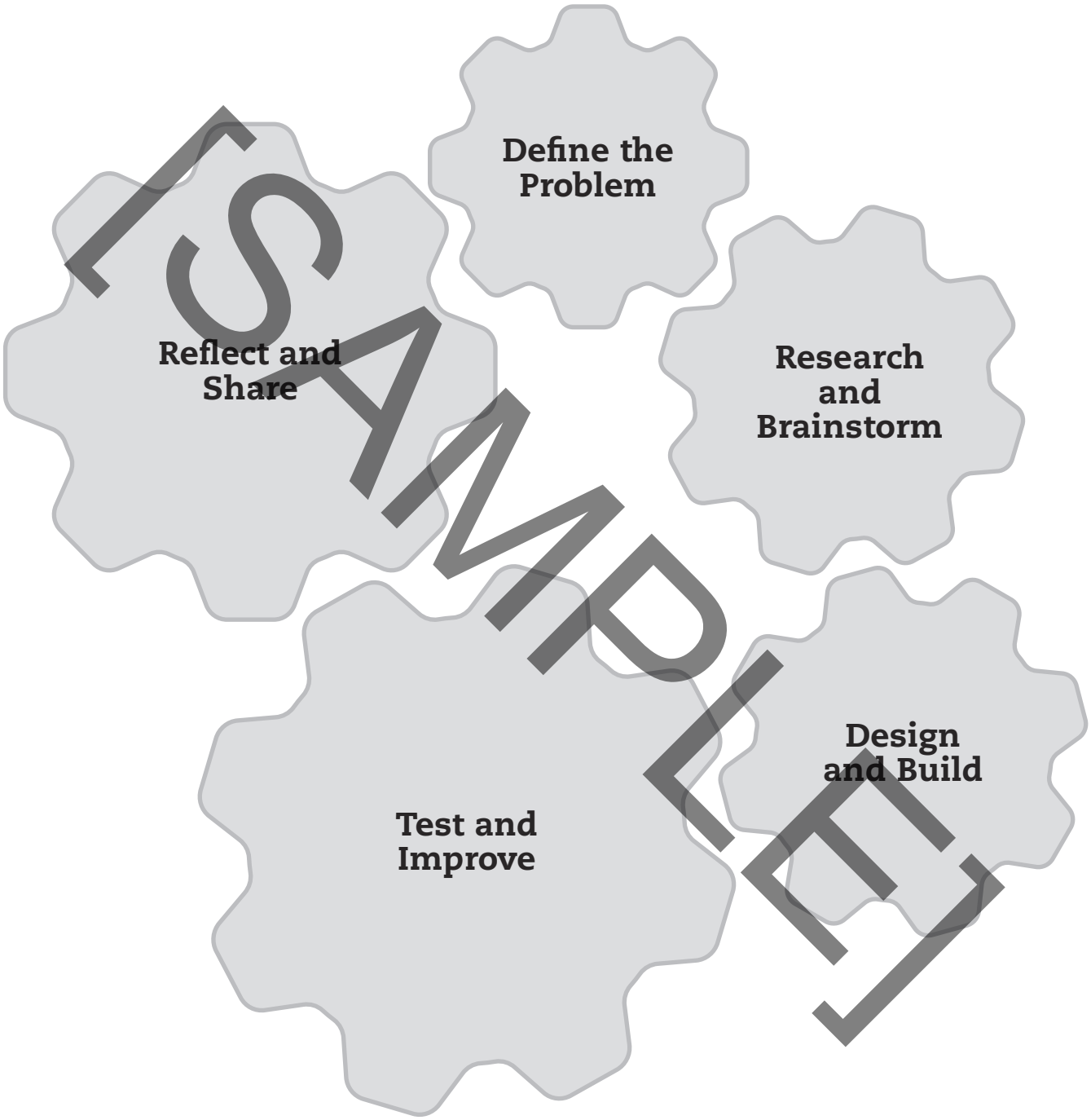
Directions: Record notes and sketches for at least four types of life that pass through your cube. Check boxes to show whether your team's model met the design constraints and criteria.

Test Results	
❑ accurate size ❑ waterproof	❑ durable when dropped from 1 meter (3 feet) ❑ blends into surroundings

Observations	
1.	**3.**
2.	**4.**

Name: _____ Date: _____

Engineering Design Process



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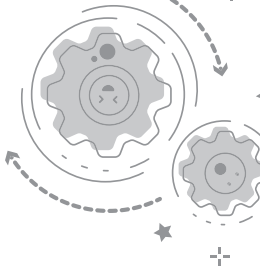


Life in a Cube Quiz

Directions: Read each question. Choose the best answer. Fill in the bubble for the answer you have chosen. Answer the last question in complete sentences.

1. Which text structure is used to organize similarities and differences between two or more things?

- (A) description
- (B) cause and effect
- (C) problem and solution
- (D) compare and contrast

2. How is the shrubland habitat Liittschwager observed different from the forest habitat he observed?

- (A) It is full of various types of life.
- (B) The land is drier.
- (C) It is an aquatic environment.
- (D) There are insects.

3. What causes coral bleaching?

- (A) warming ocean water
- (B) new coral polyps
- (C) adaptive reefscapes
- (D) extracting medicine

4. Coral polyps _____ algae when the ocean water gets too warm.

- (A) thrive
- (B) adapt
- (C) eject
- (D) reproduce

5. What do you think is the best solution to help save coral reefs? Why?

_____

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Teamwork Rubric

Directions: Think about how you worked in your team. Score each item on a scale of 4 to 1.

4 = Always 3 = Often 2 = Sometimes 1 = Never

I listened to people on my team.	4	3	2	1
I helped people on my team.	4	3	2	1
I shared ideas with people on my team.	4	3	2	1
We made choices as a team.	4	3	2	1
Total				

What is one thing your team did well? _____

_____

_____

What could your team do better next time? _____

_____

What else do you want your teacher to know about your team? _____

_____

_____

Name: _____ Date: _____

Engineering Design Process Checklist

Directions: Check the boxes to show that you completed each step.

Define the Problem

- ❑ I understood and explained the problem in my own words.

Research and Brainstorm

- ❑ I used research to help me brainstorm solutions.

Design and Build

- ❑ I planned and made a model.
- ❑ I thought like a mathematician or an engineer.

Test and Improve

- ❑ I used criteria to evaluate designs.
- ❑ I improved designs based on test results.
- ❑ I thought like a mathematician or an engineer.

Reflect and Share

- ❑ I shared my results and reflected on my work.

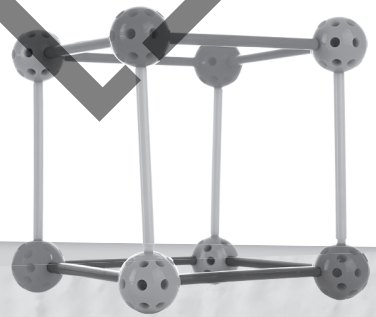
STEAM CHALLENGE

Define the Problem

Life can be found all around us. It is easier to see creatures that would normally hide from view when your sample size is small. Your task is to create a 30 cm × 30 cm × 30 cm (1 ft. × 1 ft. × 1 ft.) cubic frame and re-create Liittschwager's experiment in your local area.

Constraints: Your cube's length, width, and height must measure exactly 30 cm (or exactly 1 ft.) each.

Criteria: Your cube must be durable and waterproof to withstand possible weather conditions. It should blend with its surroundings and be placed where it will have the most biodiversity pass through it.



1 Research and Brainstorm

What materials would work best to build your cube? How will you construct it? Where will you place your cube? How will you photograph the samples you find? How will you replace samples when you are finished?

2 Design and Build

Choose where to place your cube. Where would the most biodiversity likely be? What color will you paint your cube to make it blend in with its environment? Build your cube.

3 Test and Improve

Test your cube's durability by spraying it with water and dropping it from 1 meter (1 yard) high. Did your cube stay dry and in one piece? If not, modify your design. Place your cube outdoors, and observe it for at least two hours over the course of one week. Take pictures or make detailed observations to keep a record. Was your cube placed in a good location? Was it difficult to observe your samples?

4 Reflect and Share

Create a museum exhibit that displays your cube and the photos and observations from your project. Include a short summary that explains where you placed your cube and what you found. What might have happened if you had chosen a different location? What if you left your cube outside for longer?