DIVE BENEATH THE SURFACE

Lesson 4: Engineering Design: Marine Organisms A & B

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
[Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.]

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence. • Construct an argument with evidence, data, and/or a model. (4-LS1-1)	**LS1.A: Structure and Function.** • Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.(4-LS1-1)	**Systems and System Models.** • A system can be described in terms of its components and their interactions. (4-LS1-1)

Objective:

Students will understand the engineering design process. They will be able to use this process to create a marine organism with structures that serve the function of movement that allow it to survive in a given environment.

Materials

Part A

- Scratch paper
- Blue print worksheet
- 5 structures worksheet (Lesson #2)
- Structure, function, & importance chart
- Environment picture
- Color pencils, markers, crayons, etc.

Part B

- Blue print worksheet (Part A)
- Final marine organism worksheet
- Misc. materials: construction paper, tissue paper, popsicle sticks, pipe cleaners, paper clips, sponges, ping pong balls, rubber bands, string, etc.
- Tape or glue

Part A

Engage

Introduction:

10 minutes

Quick review of 5 structures and functions.

During the activity of this lesson, students will be asked to create a marine organism that incorporates at least one of the focus structures as discussed in the prior lessons. In order for students to be aware of the guidelines of the task they will be completing, it is important be sure each student is reminded of what these 5 structures are.

Have students pull out their 5 Structures and Functions worksheets that was used in Lessons #2 and #3. This will serve as a crucial guide and resource for the design of the organism.

With a partner, have students discuss what the 5 structures are and what their function is. When they have had enough time to adequately converse, return to a whole group discussion. Ask for students to respond with what the 5 structures are (name of structure only). Create a list in a place that will be visible to all students throughout Part A of this lesson. After the list is created, have one or two students give brief descriptions of each.

Introduce Engineering Design Process.

To begin, get an understanding of students' background knowledge and what they already know about engineers.

"With a show of thumbs, who knows what an engineer does? Thumbs up if you know, thumbs to the side if you have heard the word but are not quite sure what they do, and thumbs down if this is maybe the first time you are hearing this word."

Ask for student volunteers to share what they know about engineers and what they do. Be sure to emphasize the key words and ideas the students use to describe engineers.

- "Create"
- "Design"
- "Build"
- "Invent"
- "…for people"
- "To help…"

After several ideas are shared, present the definition of engineer that will be used to guide this lesson.

"An engineer is someone who designs and builds structures and machines that function to fulfill specific objectives and needs."

Invite students to start thinking like engineers. In order for them to successfully do this, they must know the process in which engineers create new things. This is known as the "Engineering Design Process."

Have students show with their fingers how many steps in this process they think there are. There are 5 steps: Ask, Imagine, Plan, Create and Improve. If some students have worked with this process before, challenge them to see if they can remember the specific steps and engineer goes through.

In Part A of this lesson, students will be completing the Ask, Imagine, and Plan stages. Focus on these first when explaining the process to students. Use the outline of the "Engineering Design Process" as provided for reference.

ASK:

- What is the purpose of our design?
- What is the goal?

IMAGINE:

- Brainstorm ideas.
- Be creative!

PLAN:

- Sketch/draw the details of your design.
- Explain reasoning.

CREATE:

- Build it!
- Follow the plan.
- Test it out.

IMPROVE:

- Did you achieve your goal?
- What changes would better your design?

Engineering Design Process

ASK:

- What is the purpose of our design?
- What is the goal?

IMAGINE:

- Brainstorm ideas together.
- Be creative!

PLAN:

- Sketch/draw the details of your design.
- Explain reasoning.

CREATE:

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Explore

Activity Introduction:

10 minutes

ASK: Create an organism that can survive in a kelp forest off the California coast in the Pacific Ocean.

Begin the engineering process by presenting the task to the students. In this case students will be given a specific marine environment, and asked to create and design a marine organism that can survive in this given environment.

Before students move into the brainstorming process, established the guidelines.

Requirements:

1. Must be able to live underwater.
2. Organism needs to have at least one of the 5 structures.
3. The structure(s) used of the 5 discussed, need to serve the function of movement.
4. The purpose of each aspect of the organism should be explained.
5. Be creative and unique!

Important: The organisms created do not have to be "realistic." They can be as creative as desired. All that is necessary is that the reason for each design selection can be explained in terms of its function to help the organism survive in the kelp forest.

IMAGINE

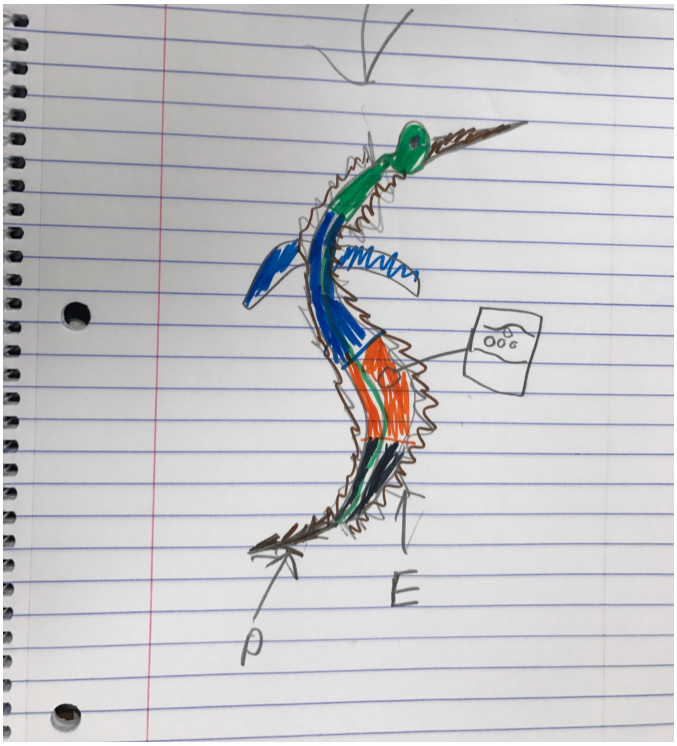
Before working with a partner, students will begin imagining possible organisms individually.

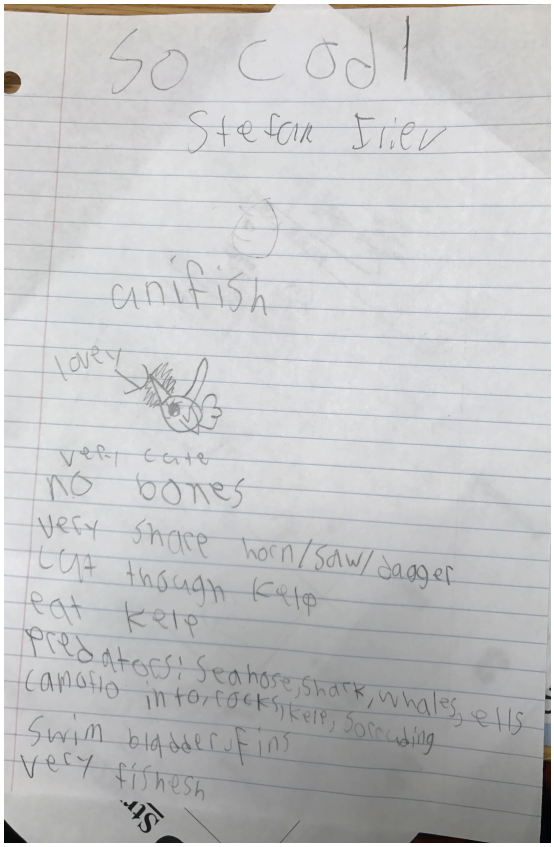
Provide guiding questions to jumpstart thinking and highlight important things that should be considered for design.

- Is your organism a plant or animal?
- Will your organism move? How will it move?
- How will your organism get its food?
    - Will it eat other marine animals or plants?
    - Will it get its energy from the sun?
- Does the organism have predators? How will it escape or hide from these predators?
- What structures will allow it to perform these functions?

Give students about 5 minutes to begin rough sketches and notes of what they are imagining they want their organism to look like. This can be done on any scratch piece of paper. After the students have finished they will then move into the step of formally planning the design of their organism. This will be done in partners.

Examples of Sketches:





Explain

Activity

25-30 minutes

PLAN

For the activity portion of this lesson, students will be working as teams of 2. In these pairs, students will begin to see how their ideas can be worked together to create their ideal marine organism.

To complete the formal planning of their design, each group will be given a blueprint planning sheet. Before handing the worksheets out, it is important to be sure that students are familiar with what a blue print is, what its purposes are, and how it should be filled out.

This blueprint worksheet provides students a place to draw their design and room beneath the sketch to answer some guiding questions to be sure they are meeting the requirements of the task they have been asked to complete.

In addition to the blueprint, students will also have a worksheet that provides space for them to specifically identify the structures of their organism, the function of those structures, and why it is important that it has those structures in order to survive.

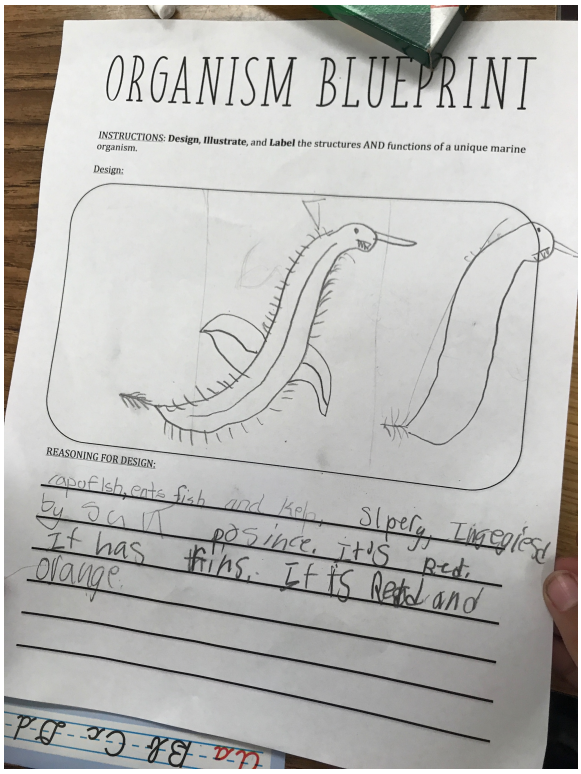
Pairs will have about 15 minutes to complete their blueprint and structure and function outline before sharing ideas with other class mates.

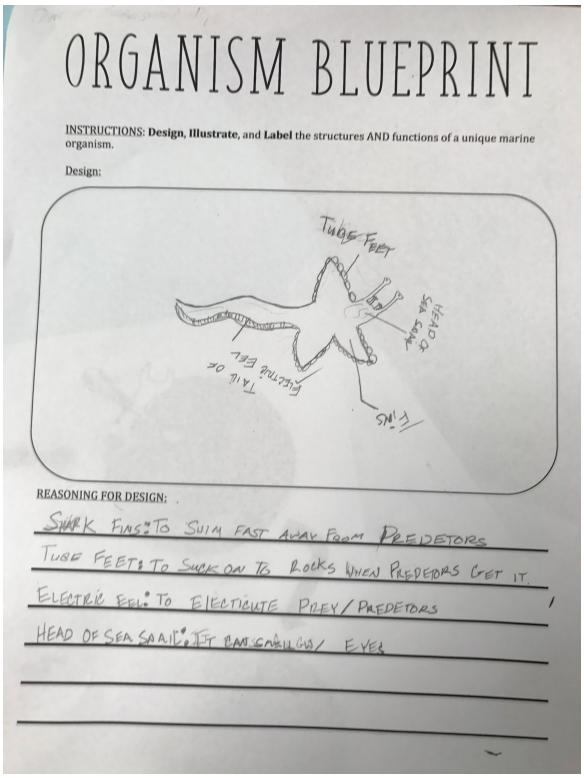
Collaborate

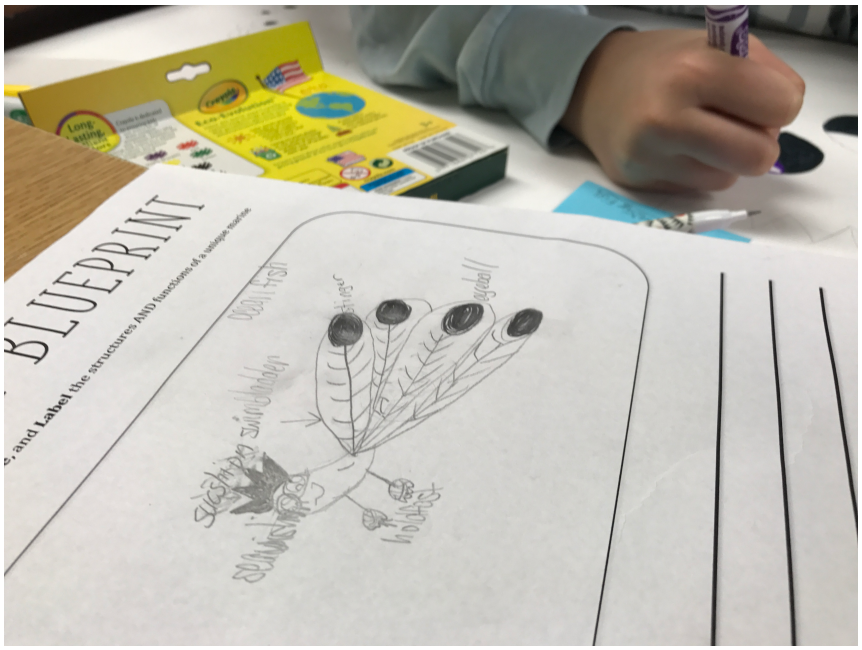
When the blueprints have been completed create groups of 2-3 partner pairs. In these groups partners will share their ideas with the other pairs and explain why they made the choices they did for their design. After each pair has shared within their group, encourage students to ask clarifying questions and give constructive critique. This should take about 5 minutes.

As Part A of this lesson concludes, give partners the last minutes address their design one more time after what they learned in their discussions with their other classmates. Now would be a great time to make changes to their design based on feedback from classmates or ideas shared by classmates that they had not thought of before. Students will be creating physical models of these organisms in Part B of this lesson so this would also be a great time for students to think about what materials they might use to create their organism.

Examples of Blueprints:







Part B

Explain

Activity Preperation

10 minutes

PLAN

Begin lesson by having students revisit design with their partner. Remind students of the requirements as set in Part A and have them confirm that their design has met all of these. While addressing the requirements present the task students are being asked to complete as well as displaying the image of the marine environment, kelp forest, for reference.

ASK: Create an organism that can survive in a kelp forest off the California coast in the Pacific Ocean.

Requirements:

1. Must be able to live underwater.
2. Organism needs to have at least one of the 5 structures.
3. The structure(s) used of the 5 discussed, need to serve the function of movement.
4. The purpose of each aspect of the organism should be explained.
5. Be creative and unique!

Review Engineering Design Process. Students have now worked their ways through the Ask, Imagine, and Plan stages. In Part B of Lesson #4 they will now be completing the Create and Improve steps in this design process. Ask for student volunteers to remind the class of what these stages are comprised of.

CREATE:

- Build it!
- Follow the plan.
- Test it out.

IMPROVE:

- Did you achieve your goal?
- What changes would better your design?

Now that the students will begin building physical models of their organisms it is essential to set some guidelines in regards to the size of the organism that is built. This is important to conserve materials, for time management, and for safety. Listed below are some simple guidelines that can work universally in any classroom.

Guidelines of size:

- Must be able to be held in two hands with upward facing palms.
- Needs to be able to sit within the dimensions of their desktop.
- The organism, while placed on top of the desk, should be no taller than the student while sitting in their chair at desk. If the organism construction reaches above the sitting students head it is too tall.

Now that the students are prepared to begin building the organism, present to them the available materials. Included are building materials listed as

suggestions but anything will work. It is the job of the students as engineers to be creative in the use of what is provided to them.

- Construction paper, tissue paper, popsicle sticks, pipe cleaners, paper clips, sponges, ping pong balls, rubber bands, string, etc.
- Tape or glue.

Students will decide which materials they will need to, based on their design decide which materials they will need. Have materials laid out and organized in a way that allows students to safely and respectfully access them without assistance. After students have created a list of materials needed, they should wait until they have been approved by the teacher to begin collecting. As students begin to finish up their lists excuse them, one partner out of the pair at a time, to visit the materials table. By checking the list of materials students are planning to use prior to collection, the potential of wasting materials by taking them in excess or taking unnecessary supplies is eliminated.

Elaborate

Activity

20 minutes

CREATE

This will be the most unstructured portion of the lesson. Now that students have completed their design plans and collected their materials they will move into the creation stage and build the physical model of their marine organism.

Walking around classroom and meeting with each partner group help guide them and answer any questions they may have. Give reminders of time remaining to help students with time management and ensuring they will be able to complete their organism in its entirety.

Students will also be given a worksheet titled “Final Marine Organism” which will be a requirement to fill out for the presentation portion of this lesson. Time will be given to complete this before presentations but if students begin to finish early, they should begin filling out this worksheet.

As students finish, they should also begin returning extra materials and cleaning up their work spaces.

Evaluate

Final Activity

20 minutes

PRESENT

As they finish up the building of their marine organism students should begin filling out their worksheet titled “Final Marine Organism.” That will serve as a guide for other students during the gallery walk.

Gallery walk will occur in two parts. First group will walk around classroom observing final organisms. One person from the partners will stay with their organisms to answer any questions classmates may have about their organism. After 5 minutes, partners will trade roles and the new group of observers will begin gallery walk.

During gallery walk each student will be given two sticky notes to write on. Each student is expected to comment on two different organisms. No organism should have more than 5 sticky notes at its station. This ensures that every organism gets the attention it deserves for all of the hard work the student engineers who designed it put in to creating it. Provide suggestions for comments that a quality contributions by suggesting some things students should consider while on the gallery walk.

- What stood out to you about this organism?
- What do you like most about it?

- What structure did they include on their organism that you think was a really good idea?
- Is there something they included on their organism that you wish you would have included on yours?
- Why do you think their organism would successfully survive in the kelp forest?

IMPROVE

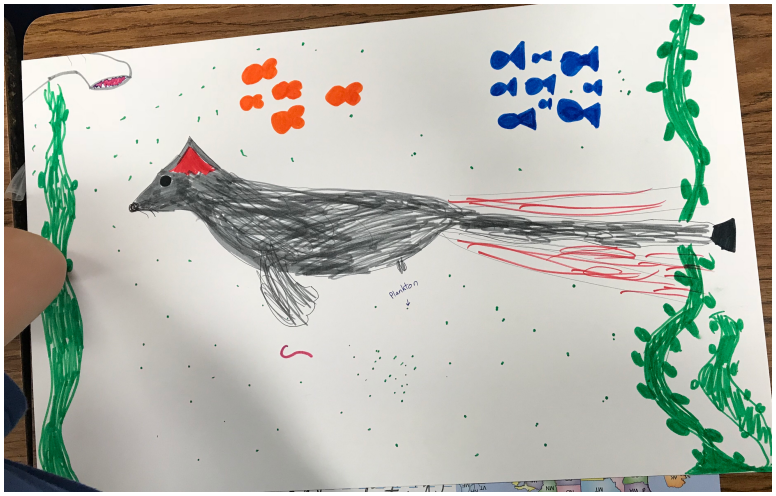
Students will return to their desks with their organisms and sticky notes with classmates' comments and have a brief discussion with partner about the feedback they received.

To concluded this final lesson, students will write a journal reflection on the Engineering Design Process and what they have learned throughout the 4 lessons. Things addressed in this reflection can include:

- What was the most difficult thing about building the organism?
- Why was it important to spend time to plan out design before building it?
- What improvements would they make for their design?
- How can they use what they learned about the design process for other assignments and tasks?
- What was your favorite thing that you learned?
- Who can you teach about marine organisms and their structures and functions?
- Why is it important for us to be scientific thinkers?

Teacher can collect these reflections and use them as the assessment of the lesson. They can also use the “Final Marine Organism” worksheet for this purpose as well.


Alien Animal


Plankton