Activity 6:
Sea Vegetable Challenge

Learning Targets:

- Understand the value of aquaculture in Maine.
- Apply their creativity and imagination to create biological and business models.
- Develop an engineering solution prototype that will meet a societal demand for food.
- Design an engineering solution given constraints on cost and materials.

Length: 60-90 minutes

Key Concepts:

- Seaweeds have adaptations that cause them to survive well, less well, or not at all in certain habitats.
- Just like vegetables, seaweed is a crop that can be farmed. It requires different methods because of the marine environment.
- Engineers work together to share ideas.

Essential Questions:

1. Why is aquaculture important?
2. What are the benefits of aquaculture farms over land farms for the production of food?
3. How does a marine environment affect sea vegetable production?
4. Who works to create aquaculture farms?

Enduring Understandings:

1. Aquaculture provides food and fuel. It also helps the environment. Sea vegetables contain nutrients and iodine. They are used as a thickening agent in substances like toothpaste. They are also used in skin care and cosmetic products.
2. Aquaculture does not require fresh water, fertilizer, pesticides, or land space. It does not cause land erosion or deforestation. Aquaculture is renewable and low cost. Aquaculture is an alternative to overfishing. Sea vegetables remove

nitrogen and toxins from seawater and absorb $C0_2$ (carbon dioxide) as they grow.

3. Sea vegetables need different adaptations and ways to grow than land plants. The marine environment provides sea vegetables with the proper nutrients they need to grow.
4. Scientists and engineers work together to create aquaculture farms.

Background for Facilitator:

Aquaculture is an important part of Maine's economy and produces resources for the community. Seaweed farming, a type of aquaculture, is the practice of cultivating and harvesting seaweed. Modern seaweed farmers are pioneering new designs in "sea vegetable" aquaculture. Farmers grow high quality and abundant food, while also improving the environment. In comparison with other agricultural and aquaculture operations, seaweed farms are extremely sustainable because they don't rely on freshwater, fertilizer, or deforestation. Since seaweed is a great source of food, fuel, and environmental remediation, it is important that we continue to innovate new and exciting ways to cultivate these species.

This activity is designed to be done in a longer session. If extended time is not available, you may consider delivering Part 1 and Part 2 into two activity sessions.

Vocabulary List:

Sea Vegetable: An edible seaweed.

Aquaculture: The cultivation of aquatic organisms (such as fish, shellfish, sea vegetables, etc.) for food or other purposes.

Materials:

- Scrap paper (**Facilitator Note: not included**)
- Poster board or 15 sheets of newsprint
- 1 box of colored pencils
- 1 set of play money
- 1 ball of wax cord
- 1 roll of mesh fabric
- 30 straws
- 30 coffee stirrers
- 100 toothpicks
- 30 craft sticks
- 50 paper clips
- 30 clothespins

- 30 cups
- 50 rubber bands
- 1 roll of aluminum foil
- 5 "Seaweed Farm Materials Cost" sheets

Methods:

Engage

1. Access youth's prior knowledge about the common seaweed species found in Maine:
   a. Who can remember the names of some common seaweeds in Maine?
   b. What do they look like? Describe their characteristics.
   c. Where do they live? Describe their habitat.
   d. What do they need to survive?
   e. What are some ways humans use these seaweeds? **Answer: food, fuel, thickening agent in things like toothpaste, skin care and cosmetic products.**
2. Introduce this activity by announcing that they will be given an opportunity to create and farm their own species of seaweed. Watch YouTube: ICCA - Maine Kelp Farming, Ocean Approved video on kelp farming in Maine.

3. They will need to determine:
   a. What their seaweed species needs to survive
   b. What habitat their seaweed species lives in
   c. How humans will use their seaweed species

Explore

Part 1

4. Divide into 5 cooperative learning groups.
5. Distribute paper and/or newsprint and colored pencils to each group.
6. Encourage each group to work together to create a detailed illustration of their new seaweed species. Have them consider:
   a. What is the name of your seaweed species?
   b. What does it need to survive?
   c. Where does it live?
   d. How do other organisms interact with your seaweed?
   e. What adaptations does it have that help it to survive?
   f. What product does it make that is useful to humans?
   g. Why would anyone want to buy it?

7. When they have addressed all of the points above, distribute another piece of newsprint paper and/or poster board to each group.
8. Direct them to create an advertisement, flier, fact sheet, brochure, commercial, or public service announcement to advertise their new seaweed species.
9. Encourage youth to use labels, pictures, bold text, and other visual features to describe their species to people who have never seen it before and to convince them to buy it.

Explain

10. Direct each group to present their new seaweed species to the others.
11. Facilitate a reflection of the presentations:
    a. Would you want to buy or use any of these seaweed species?
    b. What would happen if we brought these species to Maine?
    c. Is there such a thing as bringing too many new species to Maine? What might be the consequences of that?

Elaborate

Part 2

12. Introduce the next part of the activity by focusing on how their new seaweed species will be farmed:
    a. Let's pretend that you all have been given the opportunity to farm your new species in Maine.
    b. Think about what your particular farm would look like.
    c. How does a seaweed farm differ from a farm on land?
13. Explain the directions for the next part of the activity:
    a. Each group will be given $50 and a list of available materials to build a seaweed farm.
    b. You need to work together as scientists and engineers to design a farm within your budget.
    c. You need to consider the following things:
        i. How does your farm support the needs of your seaweed?
        ii. How does your farm protect your seaweed from predators?
        iii. Where is your farm located?
        iv. How does your farm interact with the surrounding environment?
        v. How will sea farmers access your seaweed?
        vi. How will your seaweed be harvested?

14. Encourage youth to brainstorm on paper before they purchase any materials.
15. Logistically, this part of the activity is best organized if the facilitator acts as the "banker" or "store". All of the materials are kept together in one place, and the youth can come to the facilitator to "purchase" or "return" the items.
16. Encourage youth to calculate the amount of change they will need from the store after they purchase items.
17. As the youth finish building their farms, encourage them to prepare a brief presentation to give to the other groups. Be sure all scientific and engineering aspects are discussed.

Evaluate

18. Engage the youth in a discussion of their experience:
    a. What were some of the challenges in building a farm for your species?
    b. What were some of the things you had to consider when building your farm?
    c. What jobs would people need to do in order for your farm to operate?
    d. What if your seaweed was really popular and you had to expand your farm, what would you do differently?
19. Overfishing has occurred in the waters near a town in Maine named (**you or youth invent a fictitious name**). Write to the local fisherman's council with the proposal of locating your offshore seaweed farm there. Convince them of the benefits to their community and to people in general.

Extension Ideas:

- Ask youth to take this activity one step further and build a mechanism for harvesting the seaweed off their farm.

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