How Do You Safely Capture A Jellyfish? Educator's Guide

Target Grade(s): 6-8
Time Anticipated: Three, 60-minute periods

Students will learn about how biologist David Gruber and a team of roboticists must create tools to study delicate ocean creatures, like jellyfish, without damaging them. In this design challenge, students will learn about sea jellies (jellyfish), develop a jellyfish model using Jell-o or agar agar, and then design a device to pick it up out of water with the least damage. The lesson concludes by learning about the devices that David Gruber and his team developed.
The terms sea jelly and jellyfish will both be used interchangeably in the resource. Jellyfish is commonly used and might be more familiar for students.

- Original Science Friday Media: Soft Robot Gives Jellyfish a Hug
- Education Activity (please review alongside this guide)
- Jelly Capture Worksheet

Focus Phenomenon

- Jellies floating in the ocean or an image of different jellyfish.
    - MBARI Jellyfish Live Cam *Note: MBARI changes this link every three months.*
- Jam or Jelly in a dish, then spread on bread.

Essential Questions

- Why do scientists need to create specialized tools in different fields of study?
- Why are design constraints and considerations vital to the work of designers and engineers?
- What types of designs might be used to capture a jellyfish for study without harming the animal?

Next Generation Science Standards

This activity can be used to work toward the following performance expectations:

- MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- MS-LS2-5: Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

Objective(s)

- Develop a set of constraints for a tool design based on research gathered about the structure, function, and environment of a jellyfish.
- Assess the quality of your design based on a predefined critera for a successful test.
- Iterate your design based on testing data and feedback.

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Assessment

Jelly Capture Worksheet which contains the following:

- Notice & Wonder Chart
- Research Notes
- Model Development
- Jelly Capture Design Journal (*reflection of the Listen, Analyze, Design, Test, & Iterate stages of the design process)*
  - Definition of constraints and consideration for design
  - Initial design
  - Reflection on first test and design iterations
  - Reflection on second test and design iterations
  - Assessment of final design
- Reflection of David Grueber's design

Recommended: Students present their design to the class as well as offer critique to other students.

ACTIVITY OUTLINE & TIMINGS

Timing	Activity Description & Teacher Considerations	Student Output
7-10 min	**Notice And Wonder** Show videos of jellyfish and have students complete their notice and wonder charts. Have students share and discuss their observations and wonderings (put on a classroom chart of board). Introduce the central question: How would we catch a jellyfish to study one?	Notice & Wonder Chart
15 min	**Sea Jelly Research** Students learn a bit more about sea jellies—their structure, environment, and niche. Push students to move from videos into articles and podcasts that also dive into the amazing world of sea jellies. - Consider assigning each member of a group a different question or resource to dive into. If you do, give groups time to share their learnings and update their note sections.	Sea Jelly Research Notes
35 min	**Sea Jelly Model Development** Using Jell-O, gelatin, or agar agar, modify recipes and have students develop the best sea jelly model to test and discuss the limitations of the model based on their sea jelly research. Decide on the recipe to use as a class for tests. - Be sure to consider the cultural background of your students, gelatin or Jell-O might need to be replaced with something like agar agar. - Depending on time, you can have students create their gelatin models, give them pre-defined recipes, or even pre-create the gelatin models and have groups test different recipes and share out. - Consider having a consensus discussion of the data from tests to determine one model the class will use to test their designs.	Data from Model Tests Model Development Reflection

10 min	**Define The Problem** Listen to an excerpt of David Gruber's interview with Science Friday, where he discusses some of the criteria he has for the successful design of a jellyfish capture device. - Tell students they will be creating a grabber for Jellyfish. - Ask students what the constraints of the grabber are (waterproof, soft, etc). At this point, do not add additional considerations or constraints.	Class question Design criteria and constraints list
45 min	**Listen, Analyze, And Design** Connect research to the defined problem, identify other information needed, generate design constraints and a criteria for success. - Guide class toward defining the questions to be answered before they can create their criteria for success and constraints. Use questions to push students toward adding criteria they might have left out. - Emphasize labels in their design schematics. - At this point, students are building and you are supervising students. Make sure they have access to materials. Make sure there is equitable group work happening. Work with groups struggling to get the capture mechanism to work. - Be sure groups document any changes to their initial design that are made while building their device.	Research analysis Refined criteria for success and constraints Initial Design Schematics Constructured Capture Tool
30 min	**Test & Improve** Students test on gelatin models. Reflect on design and add iterations to new design - Set up a tank with the gelatin Jellyfish models. (Only one model in the water at a time, allow each group to do at least three jelly model grabs. - After testing, have each group discuss how the test went. How do they know if it was gentle enough? What aspects could they improve upon? Allow students to reflect. - If there's time, have students build and test their second device.	Data from tests Schematic for improved design Design reflection questions
25 min	**Presentation & Feedback** *(optional, but suggested)* Give students 10 minutes to prepare their share out. Have each group present their jelly capture device and describe the design process plus ideas for improvement. *Also can be done museum exhibition style.* - 3-4 minute presentation of the group's initial thinking, design, test results, assessment of strengths and weaknesses of the design, and ideas for improvement. - Have other students ask questions and provide kudos and constructive feedback.	Presentation Completed Design Journal
10 min	**David Gruber Reflection** *(optional, but suggested)* Give students the opportunity to watch videos about the development of the "fettuccine finger" robot. Discuss the design that David Gruber and the	Reflection questions

	team from Harvard developed and how it compared to final thinking of each student.	