 

**ELEMENTARY SCHOOL**

**Sustainable Science**

**Desalination Design Challenge**

**Lesson 6: Desalination Design**

**Teacher Background and Overview:**

Engineering is a constant process of evaluation, feedback, and modification. Because of this, the prototype for a new product or process is almost always different than the final design. In this lesson, students participate in the engineering design process as they construct their desalinators, capture data, and think critically about the effectiveness of their prototype. They will then propose and justify a change to their design that will improve their device.

**Time Required:**

Multi-day project (2 to 3 45-minute lessons)

**Learning Objectives:** Students will…

* Build a desalination device.
* Evaluate and modify a prototype using the engineering design process.
* Collaborate with a team to present the desalinator’s overall performance based on criteria from the evaluation scale.

**Standards:**

***NGSS***

**3-5-ETS1-2** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

**3-5-ETS1-3** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

***Massachusetts Standards***

*STE*

**5.3-5-ETS3-2(MA)** Use sketches or drawings to show how each part of a product or device relates to other parts in the product or device.

**5-ESS3-2(MA)** Test a simple system designed to filter particulates out of water and propose one change to the design to improve it.

*ELA & Literacy*

**SL.5.1** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others’ ideas and expressing their own clearly.

**SL.5.4** Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.

**SL.5.5** Include multimedia components and visual displays in presentations when appropriate to enhance the development of main ideas or themes.

**Materials:**

* Sketches from Lesson 5
* Salt water
* Copies of Student Lab Report

Suggested:

* Plastic baggies
* Clear plastic containers
* Plastic wrap
* Dark plastic and/or cloth and/or construction paper
* Sticky notes
* Colored pencils/pens (for showing revisions on sketches)

**Teacher Preparation:**

* Gather materials for students’ projects.

**Keys to Success:**

* You may wish to have students set up their desalination devices in the morning so that they can check them in the afternoon, 3 to 4 hours later.

**Extension Options:**

* To extend the lab, teams can make the changes to their device that they propose at the conclusion of their Student Lab Report, and then reevaluate its effectiveness.
* In place of the pair-and-share between teams to showcase the different desalination devices, the class could participate in a “Design Showcase.” In this event, one partner stays with their device and the other walks around to learn what other teams did. After a few minutes, the partners switch, so that everyone has a turn to share about their own device and to learn about the other teams’ desalinators.
* If time is limited, desalinators can be checked either 3 to 4 hours after being set up, or the following day, rather than at both times.
* When considering the “sustainable materials” row of the evaluation, encourage students to think about the materials they used. Challenge them to consider whether they are renewable or recyclable. The goal is to have students think critically about what they are using, not just the end results.

**Procedure:**

Part 1:

1. Pass out student prototype sketches from Lesson 5.
2. Teams assemble their desalinators based on their sketches.
3. Instruct students that any changes they have made to their prototype design related to feedback and revisions should be clearly shown on their sketches.
4. Have teams set up their desalinators for testing. Place the desalinators in direct sunlight or in a warm part of the classroom, if possible.
5. Check back on the desalinators in 3 to 4 hours and the next morning to assess the success of the devices.

Part 2: (3 to 4 hours later and the following morning)

1. Pass out the Lesson 6 Student Lab Reports.
2. Have teams check their desalinators after 3 to 4 hours; provide hydrometers so the students can test their evaporated water to confirm salt was removed from the saltwater sample.
3. Instruct students to record their observations and data in Table 1 of their Lab Report.
4. Have teams reflect on their original prototype design and predictions of how their device would work, and where condensation, precipitation, and evaporation occurred. Have teams relabel the sketch with different-color pencils to show their observations and changes.
5. Instruct teams to use the Rubric on their Lab Report to evaluate their device.
6. Have teams propose one change they could make to their device and predict how that change would affect their results. Use the Lab Report to record these predictions.

Part 3: (after testing)

1. Pair each student team with another team and have them share their desalination devices with each other. Within each group of four, students should share: 1) what they predicted, 2) what they observed, and 3) what changes they are proposing to make to their prototype and why.

**Wrap-Up/Assessment:**

1. Students will turn in their sketches along with their Student Lab Report for assessment.

**Name(s):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

***Desalination Design Challenge: Lesson 6 Student Lab Report***

You will construct your desalination device based off of your sketch, and then evaluate how well it works. Use this Lab Report to capture your observations and data, as well as to reflect on any changes that might help improve your desalinator.

**Predictions:**

How much fresh water do you predict your desalinator will produce after 4 hours? By the next day?

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Explain how your desalinator will create fresh water.

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**Data and Observations:**

How is your constructed desalinator different from the sketch of your desalinator? Justify your changes.

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Collect all your data and observations in Table 1. Remember to use units where you need them!

**Table 1: Desalination Progress Throughout the Day**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Initial | Middle of day | End of day | Beginning of day 2 |
| Time |  |  |  |  |
| Hydrometer reading |  |  |  |  |
| Observations |  |  |  |  |

**Discussion:**

Evaluate your desalinator by circling the number you feel best describes your agreement with the following statements, using the number key below. Write a sentence to justify each answer.

1 – Strongly Disagree 2 – Disagree 3 – Neither Agree Nor Disagree 4 – Agree 5 – Strongly Agree

My desalinator works well.

1 2 3 4 5

Explanation:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

My desalinator is built from sustainable materials.

1 2 3 4 5

Explanation:

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My desalinator has a simple design.

1 2 3 4 5

Explanation:

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My desalinator is structurally stable.

1 2 3 4 5

Explanation:

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My desalinator is efficient.

1 2 3 4 5

Explanation:

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**Conclusion:**

How did your desalinator’s results compare to what you predicted would happen? Explain.

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Using the information you have collected, what changes would you propose to improve the functioning of your desalination device? How do you think these changes would make your desalinator work better?

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