Lesson Overview

The time blocks on Days 7 through 10 provide students with class work time to collect data and make design decisions to be reflected and justified in their final oral presentations. Although the components of the design challenge were introduced in earlier lessons, they are reviewed again and students use class time to further test their blade designs, collect and organize their data, and incorporate all of the required elements into their final competition presentations.

Connecting to the Next Generation Science Standards

On Days 7 through 10, students demonstrate understanding of the performance expectations and three dimensions developed throughout the module. These lessons serve as a performance assessment in which all of the performance expectations and dimensions are addressed in the final presentations. Reference the performance expectations, disciplinary core ideas, science and engineering practices, and crosscutting concepts referenced in this module's front matter.

Basic Teacher Preparation

No additional materials are required to prepare for Days 7 through 10. However, structural process guidelines should be used to help students complete the design challenge. Suggestions are provided but can be replaced with other strategies, as needed.

Materials List

<table>
<thead>
<tr>
<th>Item</th>
<th>Description/Additional Information</th>
<th>Quantity</th>
<th>Where to Locate/Buy</th>
</tr>
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<tbody>
<tr>
<td>Access to computers and slide presentation program (such as PowerPoint)</td>
<td>Optional. Presentations can use hand written or drawn work in place of slide shows.</td>
<td>Depends on availability</td>
<td>Computer lab or classroom</td>
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Days 7 and 8: Design a Wind Turbine Blade

Introduction (10 minutes)

Review the important elements of the final design project from the Design Challenge handout (Appendix C) and summarized here:

- Students must keep track of their data collected (from various trials) and be prepared to share it.
- Students must keep track of all their models explaining how the wind turbine generates electricity and be prepared to share them during their presentation.
- Students may further refine their models during the design process.
- Once a final design is chosen, students must draw a blueprint or model that shows the key elements of their selected blade design and how the blades work on the turbine. Key elements must be labeled.
- Each team gives a 4- to 5-minute oral presentation explaining the rationale behind their design as well as the data collected. Students must use their models to explain their reasoning.
- Each individual team member writes up his or her own abstract (summary of the research process and findings).
- Each team member has a role in the presentation (Design Lead, Data Manager, Engineering Modeler, or Summarizer and Test Demonstrator)
- At the end of each oral presentation, the team conducts three trials with the optimized turbine blades.

Review the Presentation Rubric (Appendix D) for the final presentations.

Design Work: Designing, Building, and Testing (35 minutes)

Tell students that during Days 7 and 8, they should focus on the data collection portion of the process. Remind teams that they need to collect data on their multiple blade-testing trials. Students can use one of the sample data collection tables (see Days 3 and 4), or students can develop their own. Teams must have data to justify their final design choices—this is the time to be sure adequate documentation is occurring.

Remind teams that work time for Day 9 includes other aspects of their project work, so they should complete all test trials and data collection by the end of Day 8.

As students work, emphasize the idea that all design decisions must be grounded in student models for how a wind turbine works. Tell students they must work to explain their reasoning for design decisions using their models.

Lesson Close (5 minutes)

Have students clean up. Poll the class to see how many teams have decided on their optimal blade design. Describe the homework.
Homework

Have each student draw a model of their selected blade design in their science journal over the evening. Students should come prepared to share with their teams and the teacher during the next class period.
Day 9: Design a Wind Turbine Blade

Introduction (15 minutes)

Ask students to share their sample models and diagrams with their teams. Ask students to identify one aspect they like about each diagram and one detail they have a question about. Encourage mention of specifics, such as labels, measurements, simple and clear drawings, and so forth. Ask each team to discuss how to modify their own diagrams to best represent their design.

Next, have students practice justifying their design decisions using their model of how a wind turbine works. Remind students to ground their claims in evidence.

Design Work: Team Presentation (25 minutes)

During the next time block, ask students to determine who will assume responsibilities for each portion of their presentation. The roles can be shown on a white board or in a handout. Remind students that presentations should be 4- to 5-minutes long. Here are the roles and key questions for each role:

- **Design Lead:** Who will explain the main features of the team’s design? What are the optimal features of your design? Why do you think it is successful? How are you going to share your information visually—chart, slide show, or another way?
- **Data Manager:** What data did your team collect that supports the design selection? What data collection tools did your team choose? What were the results? How are you going to share this information visually—chart, slide show, or another way?
- **Engineering Modeler:** What diagram or model best illustrates the features of your team’s design? What key pieces of the design do you want to point out to the class? How are you going to share this information visually—chart, slide show, or another way?
- **Summarizer and Test Demonstrator:** Who will briefly summarize the testing experience and conduct the three test trials?

If time permits, give students time to practice their presentations.

Lesson Close (10 minutes)

During the last 10 minutes of the class, explain that each student must complete a final deliverable that summarizes the project—a summary abstract. Share with students the Abstract Rubric included in Appendix C. Inform students that their individual abstract is due the day after final presentations.
Day 10: Presentations

Introduction (5 minutes)

Day 10 includes time for culminating presentations and final design testing for each team. Here are some considerations:

- Review the presentation schedule for the class.
- Decide if you want to invite a panel of “special guests” for the presentations.
- Encourage the class to ask questions after each presentation.
- Remember that each team conducts three final trials with their blade design.
- Consider providing some recognition to the winning team (such as prizes or certificates for teams whose blade design generates the most electricity).

Whole Group Discussion: Culminating Presentations (40 minutes)

Students make their presentations, respond to questions, and conduct their final blade testing. Consider using the Presentation Rubric found in Appendix D to assess student presentations.

Lesson Close (5 minutes)

Recognize team accomplishments and the successful completion of an engineering design cycle. Remind students that final design abstracts for each student are due during the next class period.

Assessment

Use the final design build and presentation as a summative assessment for the module. An Abstract Rubric is included in Appendix C, and the Presentation Rubric is in Appendix D.

Community Connections

If possible, invite engineers, parents, guardians, family members, volunteers, or other teachers to participate as a panel audience (and allowed them to ask questions) during the final presentations.

Suggested Teacher Resources

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<tr>
<th>Design Challenge</th>
<th>Alternative Energy Teacher Handbook, Appendix C</th>
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<tbody>
<tr>
<td>Presentation Rubric</td>
<td>Alternative Energy Teacher Handbook, Appendix D</td>
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