



The 10th Annual Matthew R. Simmons **WINDSTORM CHALLENGE**

Science & Engineering Guide

This guide in conjunction with the Windstorm Curriculum and Buoyancy & Stability slides help build the knowledge and skills needed to successfully compete in the Windstorm Challenge!

The Windstorm Curriculum focuses on renewable energy, sustainability, and offshore wind in Maine. The Science & Engineering Guide contains structured guidance for tasks associated with the Windstorm Challenge micro-credential, but can be used by anyone to help progress through the engineering design process. The Buoyancy & Stability slides provide a closer look at the science and engineering principles directly applied to floating offshore wind platforms.

Level 1

Windstorm Challenge Level 1 badge is about building knowledge about offshore wind, the steps in the engineering design process and the science and engineering principles that apply to floating platform design.

Building knowledge- links are provided as resources, you may use any other materials you have available to teach these topics. The outline below represents the order suggested for the material.

Windstorm Curriculum

Engineering design process

<https://www.teachengineering.org/populartopics/designprocess>

Forces

Newton's Laws

Reading: <https://www1.grc.nasa.gov/beginners-guide-to-aeronautics/newtons-laws-of-motion/#:~:text=What%20are%20Newton's%20Laws%20of,the%20amount%20of%20force%20applied>

Video: <https://www.khanacademy.org/science/hs-physics/x215e29cb31244fa1:forces-and-motion>

Simulation:

<https://phet.colorado.edu/en/simulations/forces-and-motion-basics/activities> **Force Diagrams**

Video: <https://www.khanacademy.org/science/in-in-class11th-physics/in-in-class11th-physics-laws-of-motion/in-in-class11-introduction-to-forces-and-free-body-diagrams-ap/v/types-of-forces-and-free-body-diagrams>

Examples also in Buoyance & Stability slides

Buoyancy & Stability Slides

Activity Buoyancy - (45 minutes) <https://extension.umaine.edu/4h/stem-toolkits/off>

[shore-wind/#activity-1-buoyancy](#)

- Assesment-** Prove your knowledge- take the Windstorm Quiz and score 80% or better to get the Level 1 badge

Level 2

Windstorm Challenge Level 2 is about forming your team and getting started on the design process to build your platform for the Windstorm Challenge Competition. In addition to working through the design process, students build skills in collaboration and creative problem-solving. Each section below describes tasks or assignments that will count towards earning the Level 2 Windstorm badge. In addition, students will earn the Collaboration and Creative Problem Solving microbadges!

1. Team Charter (Collaboration micro-badge requirement)

The Team Charter is a document developed by each team that provides a blueprint for team interactions. It lays out rules and processes for creating a positive team environment and addressing issues that may arise during the project. The Team Charter should be developed as a team, include input from all team members, and be signed by the whole team.

- Diversity links:
 - <https://www.edweek.org/policy-politics/opinion-the-importance-of-diverse-perspectives-and-how-to-foster-them/2018/11>
 - <https://www.capitalonecareers.com/why-you-need-diversity-of-thought-on-your-team>
 - https://greatergood.berkeley.edu/article/item/how_diversity_makes_us_smarter
- Team charter links:
 - <https://miro.com/guides/team-charter/>
 - <https://www.ccl.org/articles/leading-effectively-articles/what-is-this-team-for-and-why-am-i-here/>

Create a Team Charter that outlines the rules and processes your team will follow to create a positive working environment. The Team Charter should start with a diversity statement that acknowledges that different perspectives strengthen teams and highlights how the team will seek out and use their own diverse perspectives during the Windstorm Challenge. Next outline rules or a process for the following scenarios: general interactions with teammates, whole team discussions, making decisions as a team, preventing conflicts from occurring, resolving conflicts that do occur, and dividing tasks or roles fairly.

Students should also be aware of the Teamwork Behavior Rubric criteria required to earn the Collaboration micro-badge. The behaviors outlined in the rubric demonstrate that the student is following the Team Charter and contributing to a positive team environment. Educators may choose to have students complete the Teamwork Behavior Rubric as a self-assessment and/or assess teammates to gather data on student behaviors in addition to their own observations. Only the educator assessment will be submitted as evidence for earning the Collaboration microbadge however.

2. Understanding the Problem (Creative Problem Solving micro-badge requirement)

- Define the Problem** (Suggest students complete individually, then combine with group to share ideas, especially priorities for Design Strategy)
 - Links:

- <https://static.nsta.org/ecybermission-files/helpdocs/ED%20Defining%20the%20Problem.pdf>
- <https://www.youtube.com/watch?v=iwddgAoGBqg>

Read the Windstorm Guidebook. Write a Problem Statement that will help guide you through the design process. The Problem Statement must include the following information:

Description of the design task objectives. What does the platform need to do? What does the team need to do? Remember physical performance of the platform is only one part of the competition.

Constraints. What are the rules that must be followed? What other criteria must you consider?

Design Strategy. Identify design priorities. What is important to your team? Explain why the priorities are important. Think about global, societal, or environmental impacts. Design drivers should vary between groups. Some ideas could include aesthetics (Does it look cool?), cost (Is it cheap?), simplicity (Is it easy to build?), and sustainability (Can it be recycled?). Make sure to include definitions of the keywords in your design strategy, don't just say "sleek and sustainable", explain what that means to you and why it is important.

Research the Problem

- Reputable Sources links:
 - <https://www.scribbr.com/working-with-sources/credible-sources/>
 - <https://libguides.library.umaine.edu/fakenews/home>
- Offshore wind guide from UMaine library- good place to start research!
 - <https://libguides.library.umaine.edu/friendly.php?s=offshorewind>

What types of designs are already in use? What types of designs are used for similar applications? (ex: boats, buoys, weather sensors, pool toys, etc) How do those designs work? What scientific concepts do you need to apply to your design?

3. Design Process (Creative Problem Solving badge requirement. Educators to assess group documents.)

This section outlines the processes used to develop the design including generating and evaluating ideas, selecting the best ideas, and developing a plan for gathering information or testing the design.

Ideation (Brainstorming)

- <https://www.youtube.com/watch?v=yAidvTKX6xM>
- <https://www.wework.com/ideas/professional-development/creativity-culture/effective-brainstorming-techniques>

Devise at least 3 models that could work for the platform design. The models should be significantly different from each other. Include sketches or CAD drawings to visualize the models. Include preliminary material ideas and cost estimates.

Selection (Decision Matrix)

- <https://jason.org/wp-content/uploads/2016/05/JASON-Learning-Decision-Matrix-Engineering.pdf>
- <https://www.simplilearn.com/what-is-decision-matrix-how-to-use-article>

Create a Decision Matrix based on the judging criteria and any other relevant criteria for sourcing and building the models. Weigh each criteria according to the Design Strategy outlined in the Problem Statement.

Use the Decision Matrix to assess each model. Option to build small scale models to gather additional data for assessment on performance, ease of construction, etc. Analyze the results and choose the best model for construction.

Testing Plan

Analyze your design features, materials, and likely construction steps to identify 3 potential trouble spots or failures. Develop a plan for collecting data about these likely trouble spots in your selected design prior to Windstorm Competition Day. This could involve building small-scale models to experiment with construction techniques, gathering feedback from others on design aesthetics, testing full scale models in a community pool or large water tank, etc. The plan should include what you will test, how you will test, and why the test will be useful.

4. Iteration: Engineering Notebook (Creative Problem Solving badge requirement. Kept individually by each team member) Option to keep all parts of the Design Process in the Engineering Notebook too.

<https://www.science.org/content/article/how-keep-lab-notebook>

<https://www.youtube.com/watch?v=GU4VYtfUM6k>

Pre-Build Troubleshooting

Collect any pre-construction data included in your Testing Plan. Record testing results and note any decisions made or alterations to your design in your Engineering Notebook. Testing may uncover a larger problem (this is good! It's why you did the test!) with one or more aspects of the design. Just use the previous Design Process steps (Ideation, Selection and Testing) again for these specific problems. Record everything in your Engineering Notebook. Finalize the materials list and outline the steps in construction.

Building

Construct your platform. Use your Engineering Notebook to record any problems that arise during construction and the solutions you chose (Remember you can use the Ideation, Selection and Testing framework to make decisions!).

Analysis

Carry out any remaining parts of your Testing Plan. Analyze the results to determine if design modifications are required. Refer back to the science concepts to determine causes of any design failures. Go back to the Design Process Ideation, Selection and Testing framework if needed. You may need several cycles to get the design to work the way you want, this is normal! Keep track of all changes to the design in your Engineering Notebook. Make sure you have a clear record of all the final materials and design elements.

Level 3

Compete in the Windstorm Challenge and reflect on your learning experience!

Students will need to submit a reflection on learning that will be assessed by ASCC faculty or staff to earn the Level 3 Windstorm Badge and complete the Windstorm Challenge Micro-credential!

Final Reflection: Reflect on your experience participating in the Windstorm Challenge. Limit of 750 words or 5 minutes if recorded. Include the following sections:

- Windstorm Debrief:** What went well, what went wrong, how could you improve? Address technical performance, design, and presentation experience.
- Skill Assessment:** What skills did you learn? Provide examples of your skill progression throughout the project.
- Future Goals:** Discuss how the skills you developed will help you achieve success in the future, either in school or in your career.