1865 THE UNIVERSITY OF MAINE

Matthew R. Simmons WINDSTORM CHALLENGE

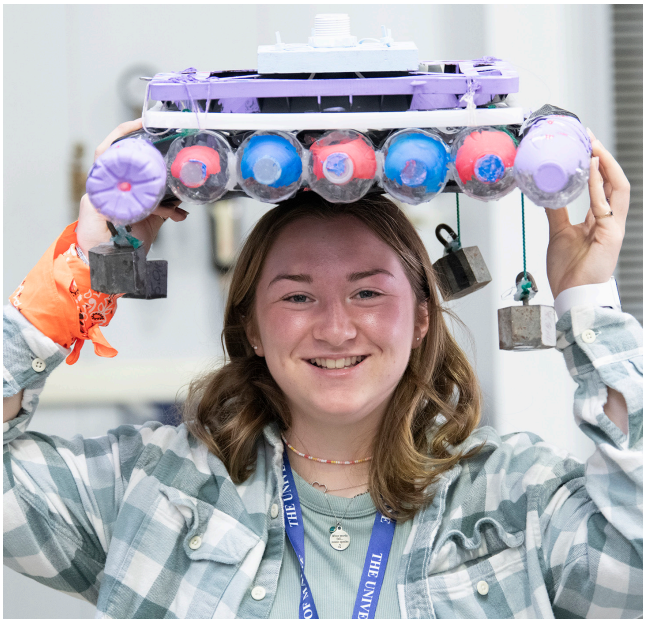
May 10, 2024

Competition Guidebook

ADVANCED STRUCTURES & composites center

What is the Windstorm Challenge?

The Windstorm Challenge asks teams of students to design and construct a floating platform for a scale model wind turbine. The event is designed for student teams with a diverse range of interests and experience. We encourage all middle school and high school students to participate. There will be two divisions for the Windstorm Challenge: High School Track and Middle School Track; rules and requirements will be similar for both age groups. At the end of competition day, the top three teams for both tracks will be announced. An optional curriculum is available to participants of the challenge to engage students in engineering processes, concepts of sustainability and the technology used to harness wind energy. High school participants who complete the curriculum and subsequent assessments can earn University of Maine microcredentials.



Impact

The Matthew R. Simmons Windstorm Challenge centers around preparing the next generation of Maine's workforce and inspiring a future of climate solutions. Exposing middle and high school students to the design and engineering process of projects such as floating offshore wind turbines not only equips students for college, but for their future career as a whole. With the motto "Students first," ASCC is committed to the mission of allowing students an environment to be creative, collaborative, inquisitive, and independent explorers in finding solutions to some of Maine's most pressing issues. The Windstorm Challenge is open to all middle, high, and homeschooled students and is designed for application to a diverse range of academic concentrations and personal interests.

The Challenge

Teams must independently design and construct a floating platform for a 1:100 scale wind turbine, based on the real scale of a 285 foot tall full-scale 5 megawatt turbine. Designs should maximize stability under various wind and wave conditions. On competition day, the platforms will be tested by ASCC engineers using our state-of-the art wind-wave simulation basin. A panel of judges will score teams on platform performance, technical design, and a short oral presentation. A copy of the scoring rubric is provided in this document.

The Curriculum

The optional curriculum will provide students participating in the windstorm challenge with a unique learning experience and provide high school students the opportunity to earn microcredentials. The curriculum will teach students how to think through a design process and utilize problem solving to develop a functional product, understand concepts of engineering and sustainability, different ways to harness energy, and learn about existing renewable wind energy harvesting technologies. This is in line with existing curriculum taught in University of Maine undergraduate courses, thus providing opportunities for students to earn micro-credentials for their participation in the Windstorm Challenge.

Awards

High School Teams: Members of the winning team will be offered an internship at the University of Maine Advanced Structures and Composites Center, contingent upon their enrollment at UMaine; an award valued at more than $65,000!

Note: this award is not a scholarship and is not dispersed to the student in a lump sum. Rather, this value is derived from biweekly paychecks assuming 20 hours/week during the academic year and 30-40 hours/week during the summer months throughout a four-year undergraduate career.

Middle School Teams: Members of the winning three teams will be recognized at the event's award ceremony.

Curriculum and Microcredentials

Windstorm Challenge Micro-Credential

New this year, High School students can opt to earn a micro-credential that verifies the skills they learned by participating in the Windstorm Challenge! The micro-credential and new Windstorm Challenge curriculum have been designed together to provide students and adult supervisors a roadmap for navigating the Windstorm Challenge.

What are Micro-credentials?

Micro-credentials at the University of Maine System are digital badges awarded to recognize learning of specific skill sets, typically outside of the classroom. They represent unique opportunities for students to validate skills learned through hands-on experiences with a job, project, club, or other context not traditionally part of academic coursework. Each micro-credential has requirements tailored to the specific skill set, but all follow a similar framework. Micro-credentials are a great way to show potential employers, recruiters, or admissions personnel that you have mastered a particular set of skills and have applied those skills in a team or project-based setting. The Windstorm Challenge micro-credential verifies technical learning about renewable energy, offshore wind energy in Maine, physics principles related to offshore wind floating platform design, and the engineering design process as well as essential skills in teamwork, communication, and problem solving.

Who can earn the Windstorm Challenge Micro-credential?

Eligible earners are High School students (grades 9-12) who have parent or guardian permission to earn badges. Learners also must have the cooperation of the adult who is supervising their Windstorm Challenge project. (Likely a teacher, club moderator, youth group leader, or parent). This is because the adult supervisor will need to partner with us to provide details on learning and skill development.

What do I have to do to earn the micro-credential?

Participate on a Windstorm Challenge team, build a platform for competition, and complete the assessments and assignments with the necessary scores. Required assignments include the following:

- A test of knowledge of renewable energy, offshore wind in Maine, physics related to floating offshore wind platform design, and the engineering design process.
- Documentation of teamwork skills.
- Documentation of the stages in your team's engineering design process.
- A reflection on your learning experience including an analysis of the competition results.

We have developed a curriculum that your supervising adult can help you access to make sure you can complete all the requirements. Note that your platform does not have to achieve any specific score in the competition for you to receive the micro-credential.

More information on UMS micro-credentials can be found here:

https://www.maine.edu/student-success/micro-credentials/

How do I sign up for the Windstorm Challenge micro-credential?

Adult supervisors should contact us (email address) if they plan for their students to participate. Individual students do not need to contact us directly.

I'm the Adult Supervisor, what do I have to do?

We are providing a curriculum that will enable your students to earn the Windstorm Challenge micro-credential, but we need your help to evaluate student work to award the credential. We are excited to provide this opportunity and hope you will be willing to partner with us to make it happen!

There are some required assignments that students must complete, regardless of the context in which the student participates (if this is an afterschool club, the students still must do the assignments and receive a score). We will provide rubrics and training on assessing student work, skills, and behaviors as well as be available to answer questions on the micro-credentials. A webinar introducing the rubrics, assignments and other particulars about the micro-credentials will be scheduled for early 2023, and you will receive Continuing Education Units for participating. Please note that the micro-credential is not a requirement for participating in the Windstorm Challenge, but it is a great way for students to show off their newly acquired skills in engineering, teamwork, and problem solving. The curriculum is available to everyone regardless of their decision to participate in the micro-credential.

Guidelines

The middle school teams with the most stable platform, and the high school teams with the most stable platform and most professional presentation will win the Windstorm Challenge. Teams will be scored on a rubric of 100 points; they are graded on the overall performance of their platform **(50pts)**, the quality and creativity of their design **(25pts)** and a presentation demonstrating the team's understanding of concepts learned throughout the challenge **(25pts)**. The wave generator will be used to create waves of approximately 6 inches (scaling to a 50 foot wave on a full-scale platform), and a wind machine will be used to simulate wind forces on the turbine blades by producing wind speeds on the order of 5 to 6 mph (55 mph equivalent at full-scale). Each floating platform will be subjected to continuous wave generation for 90 seconds, during which the maximum acceleration values will be recorded, and overall effectiveness of their designs.

Team Requirements

Each team must pick a name and be accompanied by a chaperone above 18 years of age. Students may only participate on one team per year. There are no limits on the number of teams each school can send. **Each team member must know and identify with their team name prior to arriving at the University on competition day.**

High School Tier (ages ~14-18): At the high school level, groups can enter in teams of at least 2, but no more than 4. The high school bracket will be judged on their platform's performance **(50pts)** (how well it performs in the Wind Wave Basin), design **(25pts)** (thoughtfulness and creativity of design and materials used), and a technical presentation **(25pts)** (reflects your team's thought process and what you learned) for a total of **100 points.**

Middle School Tier (ages ~10-13): Middle school teams must have at least 2 students, but no more than 10 students per team. Middle School brackets will be graded on their performance **(50pts)** and design **(25pts)** according to the same criteria as the high school tier, for a total of **75pts.**

Combined Teams: If teams need to be combined at the high school and middle school level, they will be scored with the high school teams.

Homeschool or Community Teams: We invite community and homeschool teams to participate in the Windstorm Challenge. Team requirements will fall in the same age categories as listed above.

If your team or anyone on your team has accommodations for learning accessibility, please contact **Taylor Ward** at **taylor.ward@maine.edu** to see which tier bracket is best for your student.

Windstorm Challenge Judges

Performance Judges: Members of our offshore wind basin testing team will facilitate the testing and scoring of your technical performance.
Platform Design Judge : Prior to testing, teams will meet with technical experts from UMaine or industry to talk about the technical design decisions you've made. Judges will view the platforms with teams present and ask questions about specific design choices. Judging is based on the team's understanding of the technical concepts outlined in the curriculum, explanation of material and design choices, design strategy and execution, creativity, and platform construction.
Presentation Judges (High School Only): Teams will give a prepared slideshow presentation outlining their design process to the judges. Judges are experts from the industry and UMaine specializing in communications, team dynamics, organization and process. Judging is based on the team's ability to communicate their design process, problem solving skills, and teamwork as well as on the presentation organization and public speaking skills.

Inclination Test

Platform Pre-testing

All teams are encouraged to perform pre-testing in advance of the competition. Each team must successfully pass two levels of pre-testing. We strongly encourage teams to complete the float and inclination tests prior to competition day, to ensure you can test your platform. Teams have the opportunity to submit videos of the successful inclination and float tests prior to event day.

Float Test: Each platform, with the simulation turbine attached, must be placed in water for a minimum of 30 seconds to determine whether or not the platform floats.

Inclination Test: During the Float Test, with the simulation turbine attached to each platform, Pull the turbine back so that it's tilted back approximately 45 degrees. Release the turbine and ensure the model comes back to a near-upright position and does not fall over.

What to Expect on Competition Day

- **Check In:** Teams will check in upon arrival and receive nametags (including your team name and code), a Windstorm Challenge T-Shirt and their team packet.
- **Presentation:** Please be at the designated location 10 minutes prior to your scheduled presentation times. Each team will receive a presentation time slot prior to arriving on campus. On the day of the competition, the team's presentation will be loaded and displayed on an ASCC computer by a Windstorm Challenge volunteer. Teams do not need to bring their own devices to display the presentation.
- **Ticket to Test**: Teams will receive their ticket to test, which will be presented to the testing team once they have successfully passed the float and inclination tests. Teams who have submitted videos of the pre-tests prior to competition day will have their Ticket to Test in their team packet.
- **Repair Station:** There will be a station with various tools and supplies for any last minute fixes.
- **Lunch:** will be provided for students and staff. If you have any dietary restrictions please contact **Taylor Ward** at **taylor.ward@maine.edu**
- Additional activities will be available on campus for students. More details will be available closer to the date of competition.
- **Missing Your Test Time:** For the event to go smoothly, and to give as many people a fair chance as possible, **we cannot garuntee that all teams will be able to test in the event they miss their original time slot.** So it is important to follow guidebook rules and regulations to avoid missing your time. There are many things that might prevent a team from successfully testing their platforms. Some of these include but are not limited to:

-Platform is unable to launch safely/falls apart
-Platform is too large or doesn't fit given peramiters
-Having an improper turbine attachment point (male coupler) or inadequate mooring attachment points
-Changing team names or members last minute
-Missing your time-slot due to poor time management.

If your school or teams needs a specific testing time, please contect us as soon as possible.

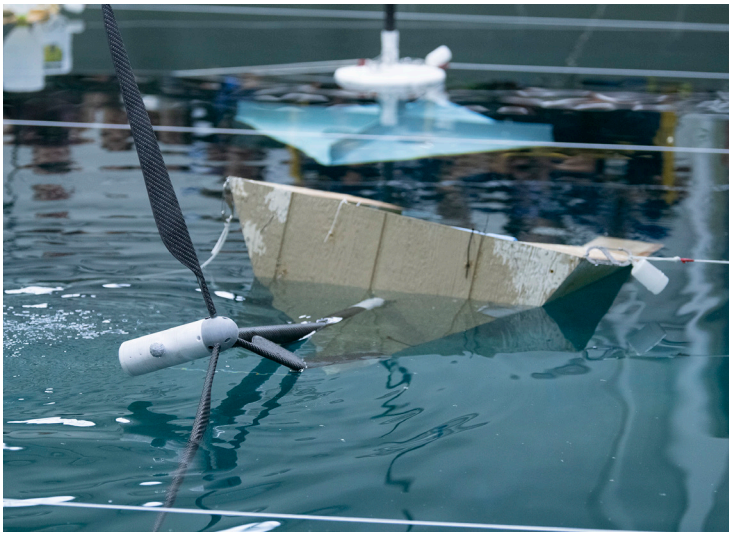
Stability and Performance (50pts)

- Rank order scoring will be used, as in previous years, based on the test results in the basin for a maximum of 50 points.
- The grading metric for stability of the competing platform will be based upon the magnitude of the nacelle's acceleration, or on how much and how fast the top of the wind turbine moves.
- The team whose nacelle moves the least will be given a perfect score for the testing portion of competition. The remaining teams will be scored based on how close they are to that model.
- Stability will be determined using either an accelerometer or an optical 3D motion tracking device fixed to the top of the wind turbine.

The accelerometer is similar to what is used in cell-phones and video game controllers to measure motion. The optical tracking is measured using multiple 3d-tracking cameras that measure the movement in all directions hundreds of times a second. We use the same system that Hollywood studios and videogame makers use to track actors and create state of the art entertainment, we just use ours for science. For more information on the equipment we use, follow the QR codes below.

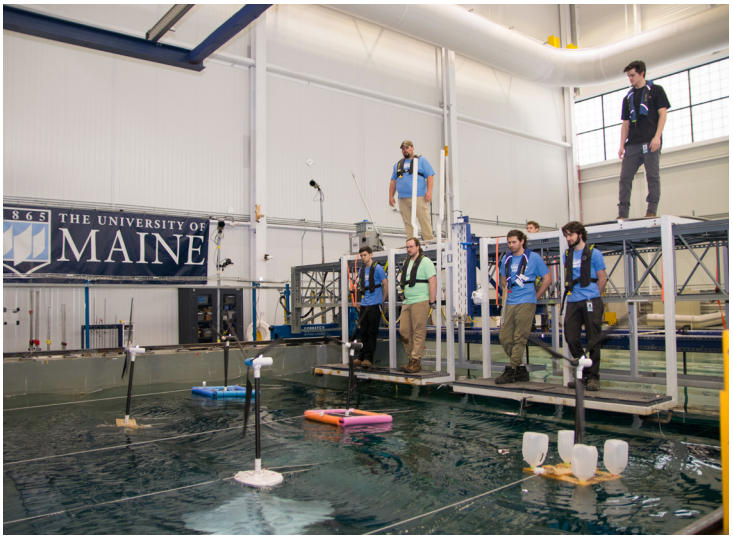
Axivity AX3 3-axis logging Accelerometer

http://axivity.com/product/ax3



Qualisys Motion Tracker

https://www.qualisys.com/entertainment/animation/



Presentation (25 pts)

Each team will create a presentation that reviews the engineering design process used to develop, build, and test their platforms and the specifications of the final design. Teams should identify problems faced and highlight solutions that emphasize the team's creativity and resilience. In addition, teams should reflect on the overall success of the team and the contributions of each team member. Successful presentations will convey the team's enthusiasm for the project, clearly communicate the ideas and processes used, and engage the audience and stimulate discussion after the presentation.

- Presentations will be scored on the successful communication of the design process, problem identification and solutions, slide content and organization, public speaking skills, and teamwork using the rubric below.
- Presentations must be submitted to the ASCC one week prior to competition day. Teams can email their presentations to **Taylor Ward** at **taylor.ward@maine.edu**
- Teams should plan for their presentation to be 4-6 minutes in length with another 2-4 minutes of discussion with the presentation judges.
- Teams should be prepared to answer questions about the engineering design process, inspiration for the design, the learning process, working together as a team, etc.

	5 points	3 points	1 point
Design Process	The design process is discussed in-depth including design options, and evaluation and decision-making process. Final design is shown, and key design elements discussed.	The design process is outlined with limited discussion of design options, and the evaluation and decision-making process. Final design is shown with minimal discussion.	The design process is not clearly outlined or is missing key steps (design options, evaluation, decision-making process). Final design is shown with no discussion.
Problem Solving	The team identified and analyzed problems faced during the design or building process. Solutions indicate creativity and resilience.	The team identified obstacles faced and presented solutions without providing much analysis. Solutions are reasonable.	The team identified obstacles faced but were unable to provide solutions or the solutions were not clearly related to the problem.
Content	Presentation is logically organized. Slides are visually engaging, containing drawings, photos, figures, or other visuals with minimal text. Fonts are clearly visible.	Presentation is well organized. Slides provide some visual interest with graphics or photos but also contain significant text. Fonts are readable but not optimal.	Presentation is somewhat confusing. Slides contain nearly all text and fonts are not readable due to size or style.
Delivery	All speakers effectively communicated and engaged listeners. Speakers are confident and relaxed, make eye contact with listeners, and speak with normal tone, volume, and rate.	Most speakers engaged listeners fairly well. Some nervousness in body language or speech patterns. Speakers stayed calm and completed the presentation.	Most speakers had difficulty engaging listeners. Conveyed nervousness through body language or speech patterns. Presentation was very short.
Teamwork	Design: Team member contributions to the design process are described and evenly distributed. Presentation: Speaking time is evenly divided among the team. All team members help answer questions.	Design: Team member contributions are not well described or are distributed unevenly. Presentation: Speaking time is not evenly divided, but all team members speak. Not everyone answers questions.	Design: Team member contributions are not discussed or are distributed extremely unevenly. Presentation: One or more team members do not speak. Only one team member answers questions.

Platform Design (25pts)

Design judges inspect the platform and ask the team questions to assess the design choices and technical knowledge based on the rubric below. Students do not pitch or present the project, only answer judges.

- Teams are **encouraged** and **rewarded** for using recycled materials. We encourage teams to try to stay under $100 for the total cost of their platform.
- Completed platforms (excluding the turbine and anchors) **must** be no more than 30 inches wide, 30 inches long, and 40 inches deep.
- Platforms (without turbines attached) must weigh less than 30 pounds.
- Each platform must embed the three provided eye hooks in their platform where technicians will attach mooring lines, with forward facing eye hooks clearly marked.
- Male couplers **must** be firmly attached to platform designs. Failure to include the turbine coupler will result in disqualification as we will be unable to perform testing. There will be a day of repair station students can use in case any issues arise.

	5 points	3 points	1 point
Creativity & Innovation	Platform incorporates unique design elements making an immediate and memorable impression.	Platform has some interesting design components but isn't highly memorable.	Platform mimics an established design with no unique or interesting design elements.
Construction & Craftsmanship	Platform is very well-constructed with neat cuts, gluing, painting etc. Platform is visually striking.	Platform construction is good with some evident sloppiness in cuts, gluing, painting etc. Platform is visually appealing.	Platform is unstable and poorly constructed with considerable sloppiness in cuts, gluing, painting etc. Platform is not visually appealing.
Material Choices	Unique, unexpected, or recycled materials used throughout the design.	Some unique materials are used for a small part of the design.	No unique materials used.
Technical Knowledge	Team displays considerable technical knowledge by answering all or nearly all technical questions easily and correctly and linking science principles to design choices.	Team displays some technical knowledge by answering most technical questions correctly and attempting to link science principles to design choices (although not always correctly).	Team displays little technical knowledge, does not answer technical questions correctly and cannot link science principles to design choices.
Design Strategy & Execution	Design strategy is logical, succinct, and reflected in design choices. Ex: Our goal was to minimize cost by using recycled materials. The design uses all or mostly recycled materials.	Design strategy is unclear but reflected in design choices. Ex: Recycling is important. The design uses mostly recycled materials.	Design strategy is not logical and does not reflect actual design.

Materials

Windstorm Model Kit

After registration, teams will be mailed a basic, model turbine for pre-competition testing to simulate the approximate weights and dimensions of the official test turbine, provided the day of by the ASCC. The model turbine is only an approximation of the final test turbine weight **(~700 grams)**. Your Windstorm Challenge Kit will include the required coupler and moorings which are essential to the success of your designs . Directions for assembly are included in this guidebook. **Note:** This year we will begin replacing the wooden model blades with a template to cut your own out of cardboard, foam, or any recycled material!

Platforms

Students are encouraged to upcycle materials into their platform designs. Platforms will be scored on their innovation, craftsmanship, use of materials and technical design. There are no restrictions on the materials and methods used, but please do so under adult supervision using proper safety PPE (Personal Protective Equipment). Models need to be safe to handle (no sharp edges, etc) and durable enough to hand off to the basin team for launch.

Turbine Couplers

Model kits will include a **male and female PVC coupler** that are essential to the success of your team's platform. The male coupler will need to be well integrated into each team's platform design, as it is the attachment mechanism for the official test turbine. **Please note:** the coupler has a specific arrangement in order to work on competition day. The **male coupler must** be attached in such a way that the competition day turbine can screw into the platform and be sturdy enough that the attachment can withstand the forces of a wind turbine. Coupling should be embedded in their platforms so they sit approximately 4" above the water line for optimal turbine height. **Important: Failure to include the turbine coupler will prevent teams from being able to test.** There will be spare parts at the repair station on the day of the event. Please reference model kit instructions for more details.

Moorings

You will be provided with three eye hooks that **must** be integrated into each team's platform design. The eye hooks should be located approximately 120 degrees apart from one another on the underside of the platform. The "forward-facing" (i.e. facing the direction of the wind and waves) eye hook should be clearly marked with paint or an arrow.

Competition Day Repair Stations

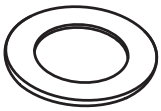
The ASCC will provide repair stations available to students throughout the day in order to troubleshoot any last minute problems that may arise. These stations will include a wide range of supplies for students to make repairs or alterations during the competition like 5 min epoxy, Gorilla tape (wide and narrow), various sizes of zip ties, nylon rope, pipe insulation, eye bolts, s-biners, screws, corner braces.

If you have any issues with your kits, please contact **Taylor Ward** at **taylor.ward@maine.edu**

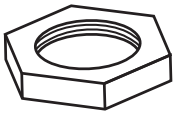
WINDSTORM CHALLENGE
Kit Contents

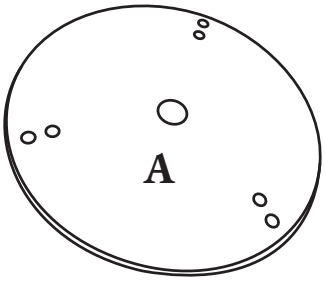

1x Lock Washer


6x Small Screw (J)
1x Large Screw

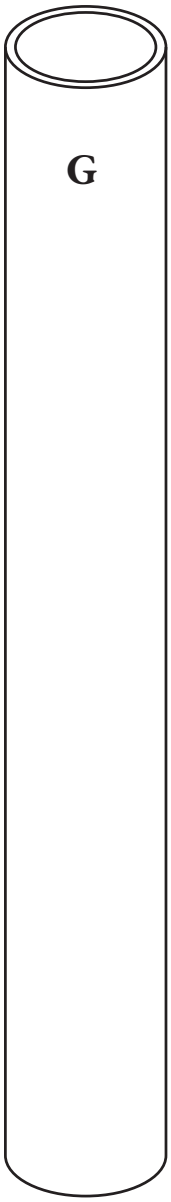

6x Small Washer (K)
1x Large Washer


3x Eye Hook


6x Small Nut (L)
1x Large Nut

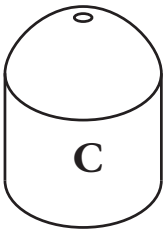


1x Wooden Disk

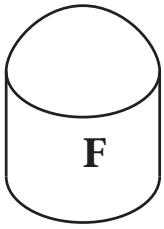


1x Long Pipe

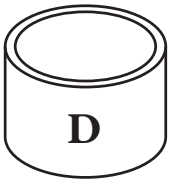
1x Blade Template



1x Dome Pipe w/Hole

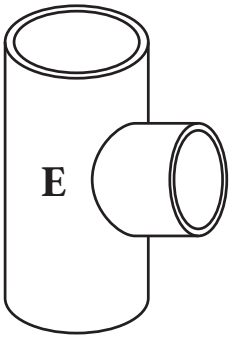


1x Dome Pipe

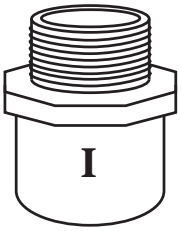


2x Short Pipe

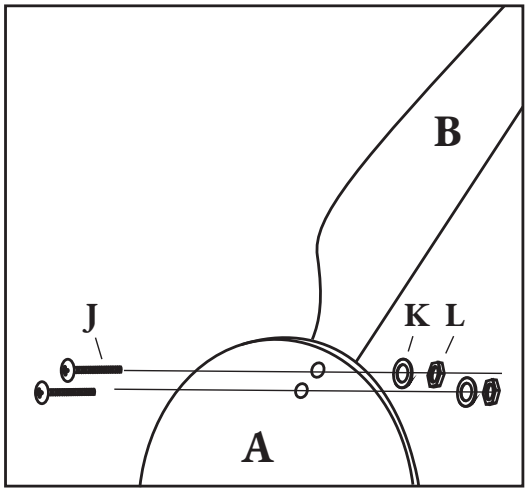
1x Female Coupler



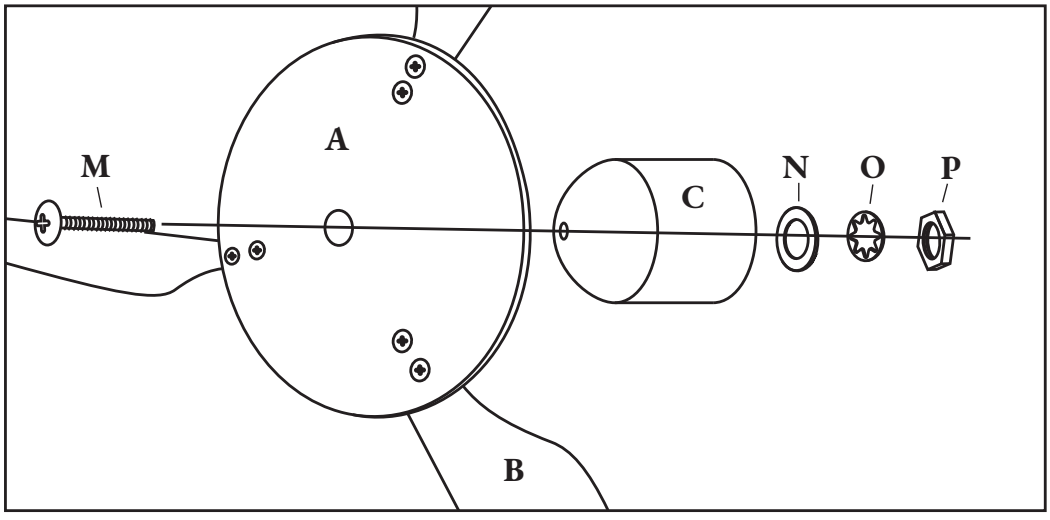
1x T Pipe

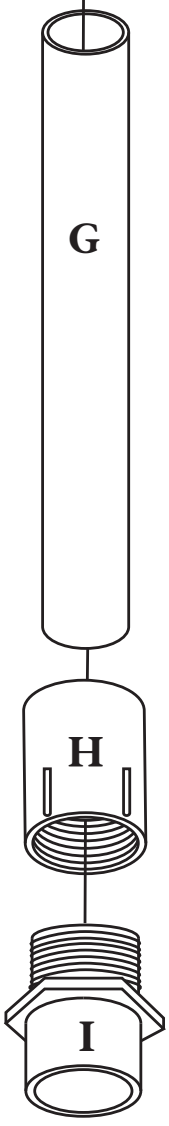


1x Male Coupler



Cut out x3 blades from cardboard, foam, or other recycleable materials. If your kit comes with blades as we phase out, keep them around for future years!





Resources

University of Maine Media Release Agreement

We request that participants fill out a Media Release Agreement form (parent or guardian signature is required if the visitor is under 18.) Forms can be emailed to **Taylor Ward** at **taylor.ward@maine.edu** and can be found with the following QR code or link:
https://umaine.edu/campusrecreation/wp-content/uploads/sites/11/2021/04/Photo-Release-fillable.pdf

Travel Support

Travel stipends are available for schools participating in the Windstorm Challenge. Please contact Taylor Ward to indicate your interest and need in a travel stipend. Requests will be granted based on availability of funds and will be prioritized for schools by need.

COVID-19- No masks or vaccination documentation is required. All of the University of Maine's Covid-19 guidelines can be found with the following QR code or link:
https://umaine.edu/return/category/health-and-safety/

If you have any questions, concerns or accommodation requests please do not hesitate to contact **Taylor Ward** at **taylor.ward@maine.edu**