WindWise Education

Wind Energy Activities for Students

APPENDIX TO UNIT 3

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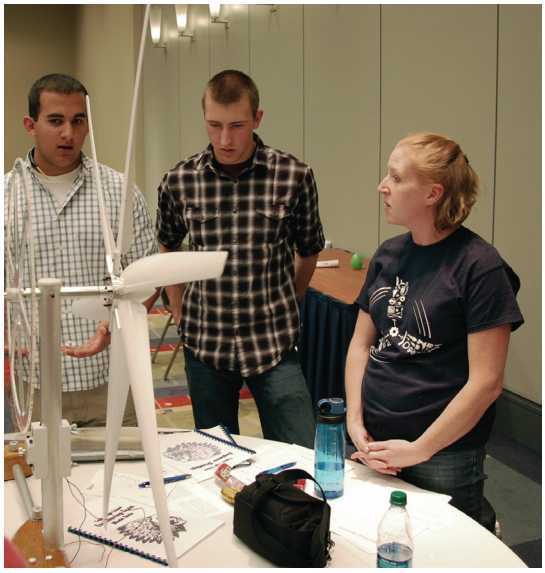
USING WINDWISE TO PREPARE FOR A KIDWIND CHALLENGE

WHAT THE KIDWIND CHALLENGE?

The KidWind Challenge is a hands-on application of renewable energy education. Student teams put their knowledge of wind power to work as they design and construct wind turbines that will produce as much power as possible.

Teams earn points for efficiency, creativity, and power output, but at its core the competition is about exploring wind energy and making learning fun. Participating in a KidWind Challenge Event or Online can be a great way to complete a wind energy unit using WindWise lessons.

Unlike many other student competitions, teachers can cover a number of standards as student teams build their turbines and prepare to compete.



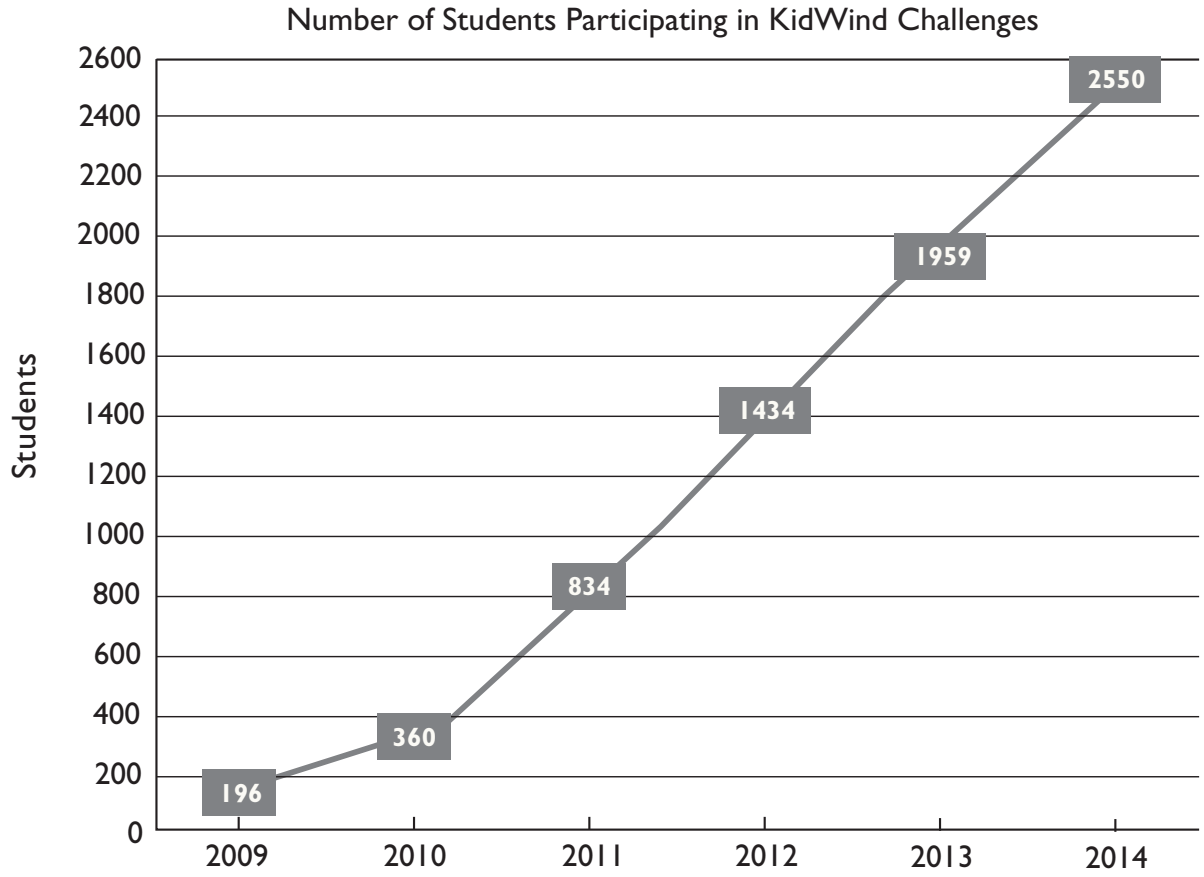
Students talking to judges at the 2014 National KidWind Challenge.

Student testing their blades at the 2013 MN Renewable Energy Challenge

The main goals of the KidWind Challenge are to:

- Get students excited about the promise and opportunities of renewable energy—specifically wind power—and its relationship to global climate change.
- Foster opportunities for students to build, test, explore, and understand wind energy technology at a manageable scale.
- Get students—particularly girls and underrepresented populations—excited about careers in STEM fields related to renewable energy.
- Build capacity of teachers, coaches, and other educators to better understand the technology, opportunity, challenges, and limitations of wind energy.
- Connect students to mentors and role models in the renewable energy industry.

You will not be alone if you decide to participate in a KidWind Challenge. KidWind has been holding student challenges for 5 years. Since the first Challenge Event was held in New York in 2009, over 5000 students have competed in 75+ Events across the country.



Our 2013-14 Challenge season

- 350 turbines submitted to the KidWind Challenge Online
- 27 KidWind Challenge Events hosted across 13 different US states, Washington DC, Canada, and the US Virgin Islands
- 1500 participants engaged in KidWind Challenge Events
- 1000 educators and coaches trained – through in-person workshops to extend the reach of KidWind's expertise across the world
- 52,550 students impacted – through classroom curriculum, Challenges, teacher workshops, and more

If you are curious in learning more we recommend visiting the KidWind Challenge website to find the rules and guidelines. This document introduces a number of ideas and concepts to get you started.

TWO KINDS OF KIDWIND CHALLENGES

KidWind Challenge Online

This is a space for student teams of all ages from around the world to build the best turbine they can, calculate their own performance, and upload self-reported results for judging. The Online KidWind Challenge is free and always open for teachers and students to use.

The KidWind Challenge Event

This event brings together teams of students in grades 4-12 to test the efficiency and design of their wind turbines in the high-speed KidWind Wind Tunnel and to be judged by wind industry experts. Registration is required and details vary by location. Typically the schedules are released in August or September of each school year.

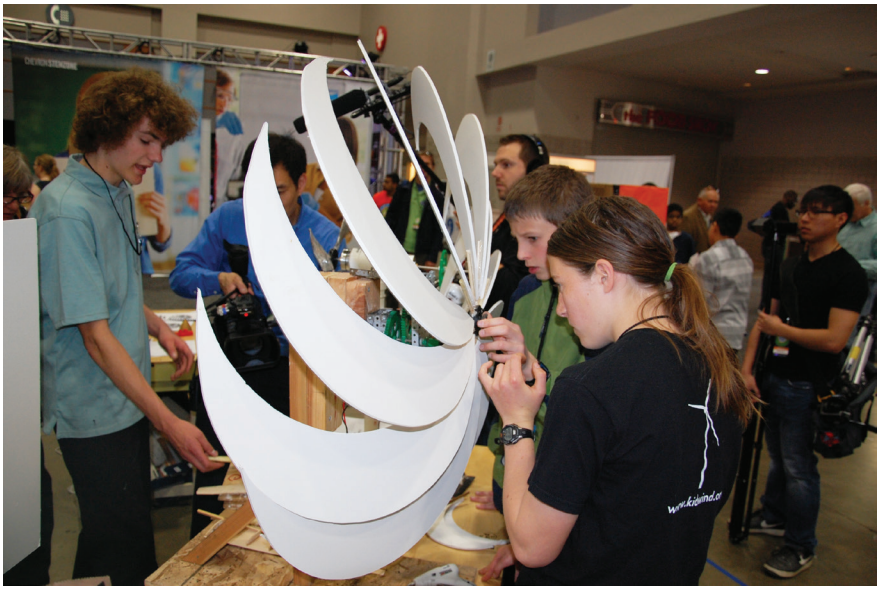
USING WINDWISE MATERIALS TO PREPARE FOR A KIDWIND CHALLENGE

Getting a team ready for a KidWind Challenge may seem a little intimidating at first. Not only do teams have to build a whole turbine from scratch, they also must understand basic science and technology about wind energy along with the environmental and social impacts of wind development.

Many students can start tinkering around with materials and successfully build a wind turbine without doing these lessons, but using WindWise materials as a foundational tool will successfully prepare your team for the competition and the turbine construction.

There is more to the KidWind Challenge than simply building and testing a classroom-scale wind turbine. Successful teams also demonstrate knowledge regarding the challenges and opportunities that wind energy presents from a social, biological and economic perspective.

Below are some lesson pathways based on the amount of time that you have to get your team ready for a KidWind Challenge. With these pathways the expectation is that your teams will have additional time after school or at home to work on the construction of their turbine. If you do not have this luxury, you should plan to give student teams at least 7-10 class periods to build and test a functional wind powered device. This can be longer or shorter depending on the materials you have in your classroom and the experience of your students.



Middle school students doing their final tweaks at the the 2014 National KidWind Challenge.

By having your students build and test blades and then upload them to the KidWind Challenge Online you can give them a feeling for the performance data we collect at a KidWind Challenge Event.

Materials needed to participate in a KidWind Challenge

Although KidWind has lots of kits and equipment that you can use to explore wind power and participate in a challenge, you really only need one part–the KidWind Wind Turbine Generator (Vernier Part # KW-GEN) After that you can use anything you want to build your turbine. For more details read the rules and guidelines document at http://challenge.kidwind.org.

4-5 Class Periods: A quick dip

With this much time you should focus on making and testing blades, which greatly affect overall turbine performance.

- Start with WindWise Lesson # 10–Which blades are best? This lesson will let students explore the fundamentals of blade design.
- If you have more time move to WindWise Lesson #11–How can I design better blades? To see if they can start optimizing design.
- Finally, have students upload their data to the KidWind Challenge Online.

8-10 Class Periods: Swim around and explore

With this much time you can help to situate your learning about wind energy.

- Learn about the different sources and forms of energy using WindWise Lesson #1 – Understanding sources and forms of energy.
- Explore ancient windmills by doing a MacGyver Windmills project using WindWise Lesson #8–How does a windmill work? Students need to take a bag of junk and build a wind turbine that lifts weights. This is one of our most popular lessons and teaches students to be creative with limited materials!
- Graduate to understanding basic blade dynamics and power output using WindWise Lessons #10 & #11. If you have some time upload your results to the KidWind Challenge Online.
- Finish your unit with some sociology in Lesson #15 – How do people feel about wind power?

15 + Class Periods: Go deep

With this much time you can really dig into complicated subjects and learn about how turbines work, how wind power fits into the current electrical system, and the biological and social impacts of wind power.

- Learn about the different sources and forms of energy using WindWise Lesson #1 – Understanding sources and forms of energy.
- Understand where your electricity comes from using WindWise Lesson #2 – Understanding electric power generation.
- Explore topography and wind interactions using WindWise Lesson #5 – Where is it windy?
- Explore ancient windmills by doing a MacGyver Windmills project using WindWise Lesson #8–How does a windmill work? Students need to take a bag of junk and build a wind turbine that lifts weights. This is one of our most popular lessons and teaches students to be creative!
- Learn how a generator works using WindWise Lesson #9 – Building a generator. If time allows, try to hook up the windmill you made in WindWise lesson #8 to the generators you build in Lesson #9.
- Graduate to understanding basic blade dynamics and power output in WindWise Lessons #10 & #11.

- Learn how wind can impact birds and bats by exploring WindWise Lessons # 13 and #14, or examine how people feel about wind power with Lesson #15.
- Next build some turbines and head over the KidWind Challenge Online or an Event near you and you will be rocking experts!

CONCEPTS RELATED TO PREPARING FOR A KIDWIND CHALLENGE

While the KidWind Challenge is an open-ended design event, it is underpinned by a diversity of skills and concepts that are important to all types of educators in the STEAM space. Below are list of concepts that WindWise lessons can help to introduce. This is highly dependent on how much time you spend on the WindWise lessons and what lessons you introduce to the students

Inquiry and science process

Students set up experiments and collect data on how well their turbine performs as they make design changes. They use both simple and sophisticated tools as they travel through the design, test and evaluation process.

A wind turbine uses many different systems (blades, generators, drive train, towers and loads) that all function together in the wind environment. To build a successful turbine, students will need to be analytical as they determine the major drivers of performance in each system, and understand how they influence one another.

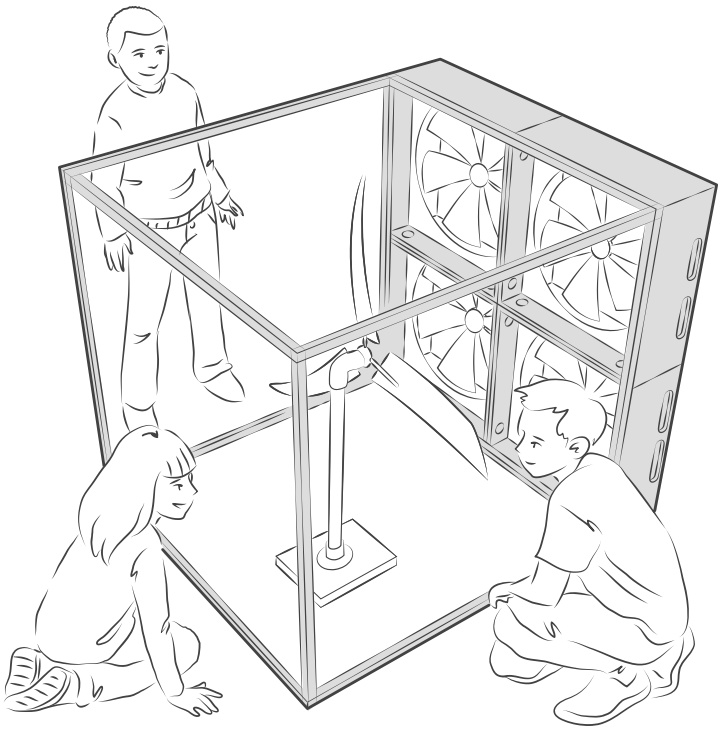
#8 – How does a windmill work?
#9 – How does a generator work?
#10 – Which blades are best?
#11 – How can I design better blades?

Energy and energy transfer

At the KidWind Challenge, students build and refine an energy transformation device: moving air is transformed into rotating blades, which rotate a generator, which in turn transforms this movement into electricity which can be converted into light, sound or motion.

During each step of this process, students focus on the forces acting upon the turbine, and must understand how energy works in order to optimize the transformation process.

#1 – Understanding sources and forms of energy
#2 – Understanding electric power generation
#8 – How does a windmill work?
#9 – How does a generator work?



Physical science
From understanding how a generator works to analyzing action and reaction forces acting on a spinning blade, there are a number of physical science concepts that can be explored while building a wind turbine.

#8 – How does a windmill work?
#9 – How does a generator work?
#10 – Which blades are best?
#11 – How can I design better blades?


A typical entry to a KidWind Challenge Event.

Earth science
We cannot talk about how a wind turbine operates without thinking about the fundamentals of where wind comes from. Understanding the flow of wind and what causes it is vital to siting wind energy facilities, forecasting wind resources, optimizing wind turbines, and more.

#4 – What causes wind?
#5 – Where is it windy?
#6 – What are wind shear and turbulence?
#16 – What factors influence offshore wind?

Biology & human impacts of natural resource use
The understanding that humans contribute to environmental issues like climate change has required us to start thinking more holistically about where our energy comes from and where it goes. One of the major reasons society is looking to generate more energy from the wind is that wind power is a renewable resource that reduces carbon emissions. Students engage in lessons that illuminate costs of relying on conventional energy sources, and cover the materials necessary to have informed discussions about other energy source like wind.

#3 – What is the cost of inefficiency?
#12 – How does energy affect wildlife?
#17 – Where do you put a wind farm?

Engineering design
The KidWind Challenge revolves around hands-on engineering and design to build and test a functional wind turbine. Students think critically to define the problem to be solved, design and evaluate proper solutions, and optimize their design to build the best turbine possible. There is always lots of tinkering, crafting, and good old trial-and-error involved, making the process—and the lessons extracted from it—memorable.

#8 – How does a windmill work?
#9 – How does a generator work?
#10 – Which blades are best?
#11 – How can I design better blades?

For a full list of standards related to WindWise Lessons please see page 19 of WindWise.

Participants at the Collegiate Wind Competition making final adjustments.

If the KidWind Challenge gets your students really excited, let them know that this is a young, growing industry. We are going to need engineers, environmental scientists, biologists, and a wide range of other experts to move toward a responsible energy future.

If you want to provide further inspiration and a possible "next step" for your students, check out the Collegiate Wind Competition. Think of it like a KidWind Challenge for college students!

The Collegiate Wind Competition challenges undergraduate students from multiple disciplines to design, build, and test a wind turbine to perform according to a customized, market data-derived business plan; and to deliver formal presentations demonstrating their knowledge of key market drivers and deployment acceleration opportunities. The DOE Collegiate Wind Competition contests are designed to interest students from a variety of engineering and business programs, engaging them in a project—a complex task with no single solution, a test that inspires ingenuity—that provides real-world experience as they prepare to enter the workforce.

Webpage — http://wind.energy.gov/windcompetition/

OTHER ENERGY CHALLENGES, COMPETITIONS AND OPPORTUNITIES

By participating in a KidWind Challenge you can build skills for high school and college and get ready for the other energy-based student challenges that are offered around the country.

We know wind is not the only energy source out there so if your students are excited by energy-focused challenges there are lots of opportunities out there to explore.

Middle School Only

AMERICA'S HOME ENERGY EDUCATION CHALLENGE—http://homeenergychallenge.org/—America's Home Energy Education Challenge gives students the chance to LEARN about energy, DEVELOP techniques for reducing energy consumption, and SAVE money in their own homes by reducing household energy use.

FUTURE CITY—http://futurecity.org/—The Future City Competition is a national, project-based learning experience where students in 6th, 7th, and 8th grade imagine, design, and build cities of the future. Students work as a team with an educator and engineer mentor to plan cities using SimCity™ software; research and write solutions to an engineering problem; build tabletop scale models with recycled materials; and present their ideas before judges.

JUNIOR SOLAR SPRINT (JSS)—http://jrsolarsprint.org/—Students experience the automotive design process they research, build and race a solar power model car.

High School Only

MAINE WIND BLADE CHALLENGE—http://mainewindbladechallenge.com/—More than 50 Maine high school teams compete each year to create an energy-producing set of wind blades in the annual Wind Blade Challenge. Produced through hands-on science and engineering school course work, students design, infuse, manufacture and test blades, going up against competitors during the one-day challenge. Educators and manufacturers collaborate on this successful and growing STEM (science, technology, engineering and math) challenge, hosted by UMaine each year, raising career aspirations for students and developing a workforce for Maine's growing composites industry.

SOLAR ROLLERS—http://www.energeticsed.org/solar-rollers/—Solar-powered remote control cars, hand-built and raced by high school teams.

Elementary, Middle & High School

SIEMENS WE CAN CHANGE THE WORLD CHALLENGE—http://www.wecanchange.com/—The Siemens We Can Change the World Challenge is a national environmental sustainability competition for grades K-12 students. Through project-based learning, students learn about science and conservation while creating solutions that impact their planet.

NATIONAL SCIENCE BOWL—http://science.energy.gov/wdts/nsb/middle-school/—The U.S. Department of Energy (DOE) National Science Bowl® is a nationwide academic competition that tests students' knowledge in all areas of science and mathematics. Teams face-off in a fast-paced question-and-answer format, being tested on a range of science disciplines including biology, chemistry, Earth science, physics, energy, and math.

MATHMATICS ENGINEERING SCIENCE ACHIEVEMENT (MESA)—http://mesa.ucop.edu/—MESA works with thousands of educationally disadvantaged students so they excel in math and science and graduate with math-based degrees. MESA is nationally recognized for its innovative academic development program. The occasionally have competitions on energy related subjects. They have chapters in AZ, CO, MD, NM, OR, PA, UT, WA, NV.

Science Fairs

Take your wind turbine research to the next level and enter it into one of these national science fairs.

DISCOVERY YOUNG SCIENTIST—http://www.youngscientistchallenge.com/

GOOGLE SCIENCE FAIR—https://www.googlesciencefair.com/en/

INTEL INTERNATIONAL SCIENCE AND ENGINEERING FAIR—https://student.societyforscience.org/intel-isef