Science Challenges
The Wind Turbine

A "Science Challenge'' is an organized activity using science and engineering skills as a basis for experience and investigation. They could be added to a school's climate program or their house league, extending the interest in the "STEAM" model.

Each group of students enters the event and pits their ingenuity, inventiveness, creative problem-solving techniques, knowledge, and imagination against other groups. It is designed to be fun, highly motivational, allowing students to plan and work cooperatively. The elements of luck and chance may pervade certain areas in the competition but add to the spirit of it.

Why Should We Do Science Challenges Activities

- Stimulate (or re-awaken) natural curiosity and a sense of discovery on the part of the student.
- They allow an opportunity for CREATIVITY in science.
- Potentially use and test short-term problem-solving skills as opposed to the more long-term science fair project.
- Enhance the class schedule/routine.
- Opportunity for application of material supplied in class.
- Help build (or re-build) self-confidence.
- Develop and encourage good student/teacher rapport.
- Highlight science as something that is FUN!
- An opportunity for group work and help develop positive peer interaction in the class.
- Allow the application of the scientific method
- A source of success for all levels (and thus are a motivational tool)

This project may be organized in many ways. A few variations are listed below:

- They can be done as individual or group activities. Whole grade. (allow for age/grade abilities)
- You could do this as a regular part of the class, as a science club activity or a competition.
- You may wish to have the students compete against each other, against other classes, or against established records. (School records)

  At the end of the day, you do what you feel works best with the situation you are in.

Teaching Notes

This build challenge should follow after initial instruction and investigations into structural stability, efficiency, and electricity. Students need to have an opportunity to apply their learning to a design/build challenge. Divide into groups, preferably 4-5 students per group.

Objectives

Investigation Principles	Learning Goals
➢ Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. ➢ 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. ➢ Work collaboratively. ➢ Implement the engineering design process with multiple iterations of their design.	➢ Scientific inquiry/experimentation skills ➢ Initiating and planning (e.g., asking questions, clarifying problems, planning procedures) ➢ Technological problem-solving skills ➢ Sc. gr. 6 - 3.5 identify ways in which electrical energy is transformed into other forms of energy ➢ Sc. gr. 7 - 2.4 use technological problem-solving skills to determine the most efficient way for a structure ➢ Sc. gr. 8 - 2.4 use technological problem-solving skills to investigate a system that performs a function or meets a need
Materials	**Assessment Opportunities**
➢ Class Time ➢ Tracking forms (supplies) ➢ Materials for build supplied by Kidder.ca	➢ Evidence of planning before construction ➢ Justification for design choices ➢ Design/Aesthetics ➢ Structural Integrity ➢ Efficient use of material ➢ Is able to make revisions to designs based on tests

Teachers will present the challenge in whatever format you would like --using a Prezi, EMaze, even creating a fun video presenting the kids with the challenge. Giving them the process ahead of time will help them see where they are going to be building and understand better the idea of redesign to improve.

Students review the challenge and have an opportunity to ask any clarifying questions. Students organize themselves, gather materials, and set up work areas. The teacher facilitates groups and learning, asking questions and helping to guide thinking and application of concepts to design.

Teach and model a simple data table to help them collect their data.

Encourage them to use Educreations to visualize their thinking.

The teacher also monitors time. Encourage one thing at a time

Design Suggestions

Material Constraints: Each group receives the build kit from Kidder.ca, and may only use those materials. Tools and safety equipment are supplied by the classroom. Glue is a convener decision. Hot glue guns or wood glue. (Wood glue is supplied in the kit but takes longer to dry, and is harder to disassemble if redesigned.)

Student Handout

The Challenge

Kidder Wind Turbine

Introduction

Design and build a wind turbine. It will need to be structurally sound, and generate power. It will need to be between 20 and 30 cm tall (using only the materials supplied in the Kidder Popsicle Stick Wind Turbine Kit). You are being assessed on your creativity, your design and build quality, as well as adaptation and problem-solving.

Materials (Kidder Kit)

- 100 x popsicle sticks
- 1 x high generator torque motor
- 1 x aluminum clip - motor holder
- 2 x LED lights (colours vary)
- 1 x mixed gear pack (1 of each 10,20,30,40,50 teeth + bushings)
- 2 ft of red stranded wire
- 2 ft of black stranded wire
- 1 x 4mmx16" wooden dowel
- 1 x large 8" straw
- 20" wax paper for gluing surface
- 3" of double-sided foam tape
- optional (1 x 118 mL craft glue)

1 - Design

No building is to take place at this time.

This project is to be constructed out of only the materials provided. No other materials are to be added to the design or used to secure the structure. The Wind turbine needs to be between 20 and 30 cm tall, built out of the popsicle sticks provided.It must be an independently stable structure, without any adhesive connections to the table or counter surface.

Students work together to create a design for their Wind Turbine.

Sketch out ideas and discuss with the team using materials from Kidder kit.

Research is encouraged into designs for the construction and the design of the blades. Time Constraints: Students will have a certain amount of time (you can decide) to create the contraption for the first testing cycle.

Students can use a digital platform (Sketch-up, Tinkercad, Google Doc, Educreations... to visualize thinking.)

Options: If students have cameras, they can record their work and discussion

2 - Present Design

After the students have had time to research and design their turbine designs they will present it to their teacher (or judges). At this time the teacher (judge) can ask questions and make suggestions and critique the design. The team can be assessed upon their understanding of the design and their response to the questions.

Teacher guides them to presentation expectations:

- Reflect on the design process
- Materials used
- Efficiency and motion concepts integrated into the design
- Next steps and recommendations for more redesign, if needed.

Students can choose a presentation platform--suggestions are Shadow Puppet EDU, Google Slides, or Keynote.

3 - Build

During this stage, students can amend the design based on critiques of their design presentation. If there are alterations to the design, they must be submitted to confirm the changes. This must be completed before building commences. The building must be done off of the latest design created. All building must be done during assigned time frames to ensure equal opportunity for all teams.

4 - Tests
Students test their designs, measuring and collecting data.
You can have as many testing cycles as you want.
(More tests create more data, but do not impede other groups)
Google Docs/Sheets (preference) to record data and If students have devices, they can use cameras to take pictures of the different steps along the way and import them into their data tables. What do you think worked in your design?
Once data is collected, the team should discuss results, possibly comparing with other groups, and then going back to design and consider a ReDesign for improvement for the next testing.

Students can record and take pictures of the design as needed.

5 - Rebuild
Students compare results and graph differences, identifying design elements that proved successful. Based on your data, what do you think you want to change about your design? (Encourage one thing at a time)
Students will then go back to their design and make changes to improve it to make the ball go farther. Students will keep track of what they change. Once students have collected data, the teacher refers back to the original presentation for the next steps: ReDesign and Test Again. Monitor time and facilitate groups.
Students build, noting changes and then testing again for new results.
Conduct a second set of tests. Complete as many rounds of testing as you feel is necessary.

6 - Final Presentation
For their presentations, students reflect on the design process, materials used, collaboration in the group, force and motion concepts integrated into the design, their final design and data, and next steps and recommendation for more redesign, if needed.

Shadow Puppet EDU, Google Slides, or Keynote.

RUBRIC

SIMPLE CHALLENGE

Challenge: Wind Turbine	
Success Criteria ☐ Voltmeter score (Scale the scoring to fit the number of teams) ☐ Structure Stability ☐ Evidence Of Design/Redesign Thinking	Highest to lowest 5 4 3 2 1 5 4 3 2 1

PROBLEM SOLVING SCORING CHALLENGE

Challenge: Wind Turbine					
Making The Plan					
☐ Evidence Of Planning Before Construction	5	4	2	2	1
☐ Justification For Design Choices Is Provided (Based On Research)	5	4	3	2	1
Executing And Evaluating The Plan					
☐ Uses Materials effectively	5	4	3	2	1
☐ Evidence Of Re-evaluating Their Design When Necessary	5	4	3	2	1
Successful Task Completion					
☐ Structural Integrity Design/Aesthetics	5	4	3	2	1
☐ Efficient Use Of Material And Energy Source	5	4	3	2	1
Teamwork					
☐ Evidence Of Collaboration And Cooperation Between Team Members	5	4	3	2	1
☐ Equal Participation Of All Members In Each Phase Of The Process	5	4	3	2	1
Discussion Of Tasks					
☐ Effectively Communicates Why Their Design Works/ Or Doesn't Work	5	4	3	2	1
☐ Communicates Benefits Of Design With Knowledge And Confidence	5	4	3	2	1
Voltmeter Score					
☐ Score based on highest to lowest (Scale scoring for number of teams)					
Feedback:					

Frequently Asked Questions (FAQ)

1) **Who in your school will take part?**
   This could be a school-wide program, grade level or restricted to the science classrooms.
2) **When will you hold it?**
   Two weeks near the end of a unit that culminates in this project displaying all of the skills and knowledge learned. A good time would be leading up to Education Week, to display the results.
3) **How will you divide up the students?**
   Draw lots, random selection but a good mix
   Let students pick their own working groups
4) **Prizes**
   You can make the Certificates or use the attached
   Medallions/Ribbons
   Buttons of glory
   Displays of some of the winning entries?
   Mention winners (Newsletters, P.A. announcements)
5) **Will you assign marks?**
   Participation.
   Co-operative planning obvious time spent in pre-planning and/or research
   There are Science, Mathematics, Language and Artist marks to be drawn from this activity as well as Learning Skills: Collaboration, Initiative, and Organization.
6) **Do you want judges?**
   Not necessary, but you could get "celebrity" judges, other staff members, or outside judges?
7) **Where will you run the event?**
   Classrooms
   If this becomes a school-wide event it could lend itself to a gym for judging and spectators (parents, other classes)

Attached Documents

DESIGN SHEETS

Project:	Time Allowed:
Limitations:	Sketch:
Research:	
Design Ideas:	
Notes:	

Current Model:

Working Drawing:

Materials:

Certificate of Excellence

awarded to

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for

For showing great success in creativity, critical thinking and collaboration during their design and build Wind Turbine Challenge.

____________________ ____________________

date Signature

KIDDER
SCIENCE IN THE MAKING