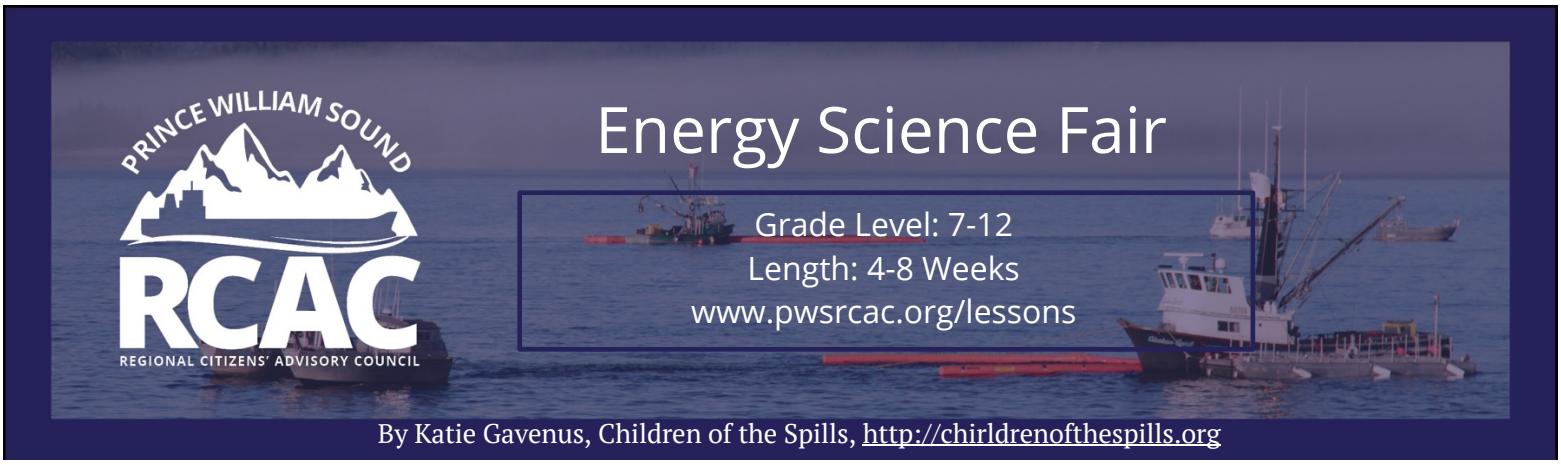

Energy Science Fair

Grade Level: 7-12
Length: 4-8 Weeks
www.pwsrcac.org/lessons

By Katie Gavenus, Children of the Spills, http://chirldrenofthespills.org

NGSS Standards

HS-ETS1-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved by engineering.

HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

HS-ESS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

Related Resources

Rubric Engineering Rubric; Experiment Rubric

Websites
http://www.societyforscience.org/page.aspx?pid=311
http://www.sciencebuddies.org

Overview

There are many innovations yet to be developed in the fields of energy and conservation.

Objectives

- Students will follow the scientific process.
- Students will develop a unique experiment or engineer a product related to the topic of energy and conservation.

Materials

- ☐ ASEF Science Fair Rules & Paperwork (https://www.alaskasciencefair.org/)
- ☐ Materials Required for Science Fair Projects
- ☐ Volunteers
- ☐ Tables
- ☐ Display Board for Exhibits
- ☐ Energy Science Fair Project- Engineering Rubric
- ☐ Energy Science Fair Project- Experiment Rubric

Background

Science fairs are an excellent way to foster curiosity, familiarize students with the scientific method, and encourage independent thinking. There is an established Alaska Science and Engineering Fair in mid-March that students can participate in. Hosting a preliminary science fair at your school is a good way to introduce students to the process and explore different topics in conservation, even if no students choose to participate in the statewide event. Invite local experts in the fields of energy, engineering, and science to be judges.

Notes

From the ASEF website, "The Alaska Science and Engineering Fair is an Intel ISEF-Affiliated Science Fair. All grade K-12 students in Alaska are invited to enter a science, engineering, computer science, mathematics, or ocean sciences project in the Fair. It is not necessary to win at a local fair in order to enter the Alaska Science and Engineering Fair. All Alaskan K-12 students are welcome!"

Prince William Sound Regional Citizens' Advisory Council is a sponsor of ASEF and sponsors an annual award including cash prize for projects related to oil spill prevention or clean up at three age levels (elementary, middle school, and high school).

Preparation

A science fair is no simple undertaking. It is well worth involving a number of volunteers, including a fair coordinator, mentors for projects, and judges. Read through the ASEF rules and Intel ISEF-Affiliated Science Fair tips and resources (http://www.societyforscience.org/page.aspx?pid=311).

Introducing the Lesson

Ask students to create a list of important innovations and research in the fields of energy and conservation. Discuss as a class how those innovations and research were developed.

Activity

1. Review the inquiry-based scientific process. Explain that there are many different ways to build scientific knowledge. This is only one of many processes that are used in science, but it is a good starting point for a science fair project:
   - choose a "testable" question
   - conduct background research
   - form a hypothesis
   - design an experiment
   - collect data
   - draw conclusions based on data
   - prepare report and exhibit
   - discuss findings with peers and experts
   - identify new questions to pursue
2. Projects to create a new product often follow a different process, called the Engineering Process:
   - define a need

- develop or establish design criteria
- conduct background research
- prepare preliminary designs and material list
- build and test prototype
- retest and redesign
- present results

3. Explain to students that they are going to design their own inquiry-based science research project or engineering project on a topic related to energy or conservation. Provide students with some examples of successful science fair projects.
4. If you want to address specific NGSS performance expectation(s), share the performance expectation(s) with students. Break the performance expectation(s) into smaller components that students can easily understand and review the key requirements of the performance expectation(s).
5. You may wish to divide students into teams, or have students participate individually. Work with students as they identify a research question or engineering need and pair students with mentors. Review ASEF rules and guide students to the ISEF website for resources on completing a science fair project. Science Buddies (http://www.sciencebuddies.org/) also provides more resources for students.
6. Provide time in class for students to work on projects and check in frequently with students and mentors.

>>*Educator Tip: Because not all students will have someone at home who can help them develop their science fair project, it is critical for equity of learning and opportunity to provide time in class. You may also consider offering study hall options or after school assistance, but don't let this substitute for adequate in- class time.*

7. Prepare a large space (school gym or cafeteria) for the science fair. Have students set up their display boards on the tables. Invite community members and other classes to attend the fair. Enlist a panel of expert judges to discuss each project with its creator and decide upon awards. Any participant can choose to move on to the Alaska Science and Engineering Fair, but the top projects should definitely be encouraged to do so.

Wrap-up

Bring the class together. Discuss what students learned about their topics and from their classmates, as well as how they approached the scientific/engineering process. Identify new questions or challenges that arose through projects. Guide students to write thank you notes to volunteer judges, coordinators, and mentors.

Assessment

Use the Energy Science Fair Project Rubrics as appropriate to evaluate student work. If you have chosen to address specific NGSS performance expectation(s), include key aspects of the performance expectation in the rubric you use.

Energy Science Fair Project Grading Rubric - Engineering

Teacher Name: _____

Student Name: _____

CATEGORY	4	3	2	1
Idea	Independently identified a design solution which was interesting to the student, relevant to the topic, and which could be tested.	Identified, with adult help, a design solution which was interesting to the student, relevant to the topic, and which could be tested.	Identified, with adult help, a design solution which could be tested.	Identified a design solution that could not be tested/investigated or one that did not merit investigation.
Information Gathering	Accurate information taken from several sources in a systematic manner.	Accurate information taken from a couple of sources in a systematic manner.	Accurate information taken from a couple of sources but not systematically.	Information taken from only one source and/or information not accurate.
Plan	Provided an accurate, easy-to-follow plan with clear measurements and and labeling for all components.	Provided an accurate plan with clear measurements and labeling for most components.	Plan does not show measurements clearly or is otherwise inadequately labeled.	Did not provide a plan OR the plan was quite incomplete.
Construction -Materials	Appropriate materials were selected and creatively modified in ways that made them even better.	Appropriate materials were selected and there was an attempt at creative modification to make them even better.	Appropriate materials were selected.	Inappropriate materials were selected and contributed to a product that performed poorly.
Construction - Care Taken	Great care taken in construction process so that the structure is neat, attractive and follows plans accurately.	Constuction was careful and accurate for the most part, but 1-2 details could have been refined for a more attractive product.	Construction accurately followed the plans, but 3-4 details could have been refined for a more attractive product.	Construction appears careless or haphazard. Many details need refinement for a strong or attractive product.
Modification/Testing	Clear evidence of troubleshooting, testing, and refinements based on data or scientific principles.	Clear evidence of troubleshooting, testing and refinements.	Some evidence of troubleshooting, testing and refinements.	Little evidence of troubleshooting, testing or refinement.
Function	Product or structure functions extraordinarily well, holding up under atypical stresses.	Product or structure functions well, holding up under typical stresses.	Product or structure functions pretty well, but deteriorates under typical stresses.	Fatal flaws in function with complete failure under typical stresses.
Display	Each element in the display had a function and clearly served to illustrate some aspect of the experiment. All items, plans, graphs etc. were neatly and correctly labeled.	Each element had a function and clearly served to illustrate some aspect of the experiment. Most items, plans, graphs etc. were neatly and correctly labeled.	Each element had a function and clearly served to illustrate some aspect of the experiment. Most items, plans, graphs etc. were correctly labeled.	The display seemed incomplete or chaotic with no clear plan. Many labels were missing or incorrect.
Conclusion/Summary	Student provided a detailed discussion of results clearly based on the product function, testing data and related to previous research findings.	Student provided a somewhat detailed discussion of results clearly based on the product function and previous research findings.	Student provided a discussion of results with some reference product function.	No discussion was apparent OR important details were overlooked.

Energy Science Fair Project Grading Rubric - Experiment

Teacher Name: _____

Student Name: _____

CATEGORY	4	3	2	1
Idea	Independently identified a question which was interesting to the student, relevant to the topic, and which could be investigated.	Identified, with adult help, a question which was interesting to the student, relevant to the topic, and which could be investigated.	Identified, with adult help, a question which could be investigated.	Identified a question that could not be tested/investigated or one that did not merit investigation.
Hypothesis Development	Independently developed an hypothesis well-substantiated by a literature review and observation of similar phenomena.	Independently developed an hypothesis somewhat substantiated by a literature review and observation of similar phenomena.	Independently developed an hypothesis somewhat substantiated by a literature review or observation of similar phenomena.	Needed adult assistance to develop an hypothesis or to do a basic literature review.
Descripton of Procedure	Procedures were outlined in a step-by-step fashion that could be followed by anyone without additional explanations. No adult help was needed to accomplish this.	Procedures were outlined in a step-by-step fashion that could be followed by anyone without additional explanations. Some adult help was needed to accomplish this.	Procedures were outlined in a step-by-step fashion, but had 1 or 2 gaps that require explanation even after adult feedback had been given.	Procedures that were outlined were seriously incomplete or not sequential, even after adult feedback had been given.
Variables	Independently identified and clearly defined which variables were going to be changed (independent variables) and which were going to be measured (dependent variables).	Independently identified which variables were going to be changed (independent variables) and which were going to be measured (dependent variables). Some feedback was needed to clearly define the variables.	With adult help, identified and clearly defined which variables were going to be changed (independent variables) and which were going to be measured (dependent variables).	Adult help needed to identify and define almost all the variables.
Data Collection	Data was collected several times. It was summarized, independently, in a way that clearly describes what was discovered.	Data was collected more than one time. It was summarized, independently, in a way that clearly describes what was discovered.	Data was collected more than one time. Adult assistance was needed to clearly summarize what was discovered.	Data was collected only once and adult assistance was needed to clearly summarize what was discovered.
Display	Each element in the display had a function and clearly served to illustrate some aspect of the experiment. All items, graphs etc. were neatly and correctly labeled.	Each element had a function and clearly served to illustrate some aspect of the experiment. Most items, graphs etc. were neatly and correctly labeled.	Each element had a function and clearly served to illustrate some aspect of the experiment. Most items, graphs etc. were correctly labeled.	The display seemed incomplete or chaotic with no clear plan. Many labels were missing or incorrect.
Conclusion/Summary	Student provided a detailed conclusion clearly based on the data and related to previous research findings and the hypothesis statement(s).	Student provided a somewhat detailed conclusion clearly based on the data and related to the hypothesis statement(s).	Student provided a conclusion with some reference to the data and the hypothesis statement(s).	No conclusion was apparent OR important details were overlooked.