

Phase I – Research and Planning

1. Identify the “Big” concept to be covered by the engineering design challenge.

The big concept to be covered through this design challenge is creative ways in which to utilize renewable energy resources to create something valuable.

2. Research appropriate learning standards associated with the topic.

- 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.
- 3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- 3-5-ETS1-3. 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.

3. Identify and discuss the different types of problem solving and declarative/procedure knowledge needed.

- Problem solving skills needed:
 - Define the problem and identify criteria and constraints
 - Brainstorm and research possible solutions that meet the constraints and criteria
 - Choose the best solution from possibilities and create a design plan
 - Create a prototype/ model
 - Plan and carry out fair tests to identify aspects of the model/prototype that need to be improved.
- Declarative knowledge needed:
 - Know that energy as the ability to do work.
 - Know that there is a difference between renewable vs. nonrenewable energy.
 - Know what it means to conserve energy
 - Know some examples of renewable energy sources.
 - Know what variables and constraints are
 - Know why the design process must be utilized
 - Know that different materials will yield different results
- Procedural knowledge needed:
 - This is a moderately structured problem because there is one right answer (creating a sail car), but multiple acceptable solutions.
 - Students need to, “have more declarative knowledge, use skills of mental modeling, problem representation, analogical/abstract reasoning, and evaluation, all within the context, and they must invent a strategy which suits the context” (Kirkley 2003).

4. Explore objectives and ancillary concepts/content covered by the project.

After this activity students should be able to:

- Describe how wind forms.
- Describe different sources of energy.
- Explain that wind energy is a renewable and sustainable form of power production.
- Relate how different shapes and angles affect sail (and wind turbine) design and performance through the testing and improvement stages of the engineering design process.
- Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- 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.
- Apply their knowledge of renewable energy resources as a viable option of protecting the earth's resources and environment.

5. Identify possible activities.

- Create a wind powered sail car
- Create a water filtration system out of household items
- Create a air filtration system out of household items
- Create a model of an oil spill clean up effort

6. Select the best activity for your classroom.

The best activity for my class is to create a wind powered sail car. Through this activity I want to integrate the 5th grade standards of protecting earth's resources and identifying matter by its properties. This activity will accomplish both of these goals by having students gain a greater understanding of the use of wind power as a renewable resource and by utilizing different materials to construct their car, they can identify the properties of matter.

Resources

Emily Gill, Kristi Ekern, Wyatt Champion, Denise W. Carlson. "Gone with the Wind Energy: Design-Build-Test Mini Sail Cars! - Activity." *TeachEngineering.org*, 20 Apr. 2020, www.teachengineering.org/activities/view/cub_sailcars_activity1.

Kirkley, Jamie. "Principles for Teaching Problem Solving." *Plato Learning*, Plato Learning, 2003.

