

## Energy Conversions

**Problem**

Nottoway County is experiencing an energy crisis. The Nottoway Board of Supervisors has met in special committee and has come to our team to exhaustively research all possible energy solutions. We are to explore nuclear, coal-burning, and hydropower as well as solar and even battery-powered and wood-burning options. The Nottoway Board of Supervisors will use our results to determine the most efficient way to produce energy for Nottoway County.

**Lesson Summary**

*Groups will be given a specific method of producing electricity (those listed in the problem). Students will demonstrate an understanding of the steps taken in energy conversions by creating a model using the Hummingbird robotics kit, as well as researching their method of producing electricity and creating a report about cost-efficiency.*

**Major Topic and SOL**

Math SOL (2009)	8.3, 8.14, 8.7
Science SOL (2010)	PS.1b,g,h,i,jk,l,m,n, PS.6 a,b, PS.5c, PS.11a,b,c,d
Language Arts SOL (2010)	8.1, 8.2, 8.3, 8.6, 8.7, 8.8, 8.9

**Length of Time**

8 - 60 minutes class periods

**Student Objectives**

- The student will show an understanding of the transformation of energy as it moves through our world.
- The student will create a representation of the energy conversions happening in the scenario they are given using the hummingbird robotics kit.
- The student will create a report analyzing the energy conversion method given to their group and their recommendation on whether or not it is a cost-effective option for creating electricity in Nottoway County.
- The student will participate in an oral presentation of their robot, including a brief summary of the written report, a demonstration of the energy transformation robot, and an oral discussion of the problems they encountered during the build and their solutions.

**21<sup>st</sup> Century Skills**

- Critical-Thinking and Problem Solving
- Communication
- Creativity and Innovation
- Collaboration
- Information and Media Literacy
- Contextual Learning

### Assessment Evidence

- Score on use of Hummingbird robotics kit, based upon rubric
- Score on written report and analysis of cost-effectiveness of their option, based upon rubric
- Score on oral presentation, based upon rubric
- Unit Test (not included)
- Group work rating sheet, completed by both by teacher and peers
- Formative daily assessments by teacher of collaboration, creativity, communication, and critical thinking

### Supplies/Materials/Technology

- Per Group of 5-6
  - Hummingbird robotics kit
  - scissors
  - glue gun/sticks
  - tape- scotch, electrical, masking, duct
  - pipe cleaners
  - cardboard
  - popsicle sticks
  - wire
  - string, etc.
- [Connecting Electronics \(video or comic download\)](#)
- [CREATE Lab Visual Programmer](#) (video or comic download)
- Notes on Energy Conversions
- Access to Library/Computers
- Teacher-created model of an energy conversion unrelated to the creation of electricity (we made nuclear—radiant—chemical—mechanical of a rabbit eating a carrot)

### Lesson 1: Introduction to Hummingbird Robotics kit/ Create Visual Programmer basics (in lab)

- Use either the handouts (comics) or videos to model to students how to Connect Electronics and program in CREATE Lab Visual Programmer. Asj students to:
  - install 3 LEDs
    - make those lights flash in succession
  - install a tri-color LED
    - make it flash 3 different colors
  - install a servo & sensor
    - make servo move
    - make sensor react

### Lesson 2: The Problem

- Use the *Problem* and *Lesson Summary* (page 1) to introduce the problem to the students.
- Go over rubrics

- Oral presentation  
[http://rubistar.4teachers.org/index.php?screen=ShowRubric&rubric\\_id=2492526&](http://rubistar.4teachers.org/index.php?screen=ShowRubric&rubric_id=2492526&)
- Robot itself  
[http://rubistar.4teachers.org/index.php?screen=ShowRubric&rubric\\_id=2492525&](http://rubistar.4teachers.org/index.php?screen=ShowRubric&rubric_id=2492525&)
- Written report  
[http://rubistar.4teachers.org/index.php?screen=ShowRubric&rubric\\_id=2492527&](http://rubistar.4teachers.org/index.php?screen=ShowRubric&rubric_id=2492527&)
- Choose method of generating electricity the group would like to research. Ask students what methods they can remember from class instruction. Put up poster with a list after discussion:
  - Ways to generate electricity:
    - Hydropower (dam)
    - Wind
    - Solar
    - Geothermal
    - Nuclear
    - Burning fossil fuels (coal, oil, natural gas)
    - Biomass
    - Prisoners on bicycles
- Each group member will choose a job, but has responsibilities in all actions. Jobs include:
  - Captain
  - Primary planner
  - Primary researcher
  - Primary recorder
  - Primary presenter
  - Primary builder
- Students are asked to create a PowerPoint with images/captions, a vlog, a blog, a facebook page, a journal... something to log their process from plan through stages of testing and modification to final product and that THIS will be the focus of the oral presentation.
- Begin research and planning

**Lessons 3-5:** Research and planning in library (Try to include a visit from a Nuclear Health Scientist)

- Research requirements include using 2 media types and citing 3 distinct sources properly. Library/Media Specialist can provide most recent published texts on energy types, purchased specifically to support this unit/curriculum. Instruction on online research, including website integrity delivered before research commencement. Students are encouraged to search for the following information:
  - Invention/discovery of...
  - Development of...
  - Historical applications of...
  - Environmental impact of...
  - Jobs created by...
  - Will new buildings need to be built? Cost?
  - Cost efficiency of...

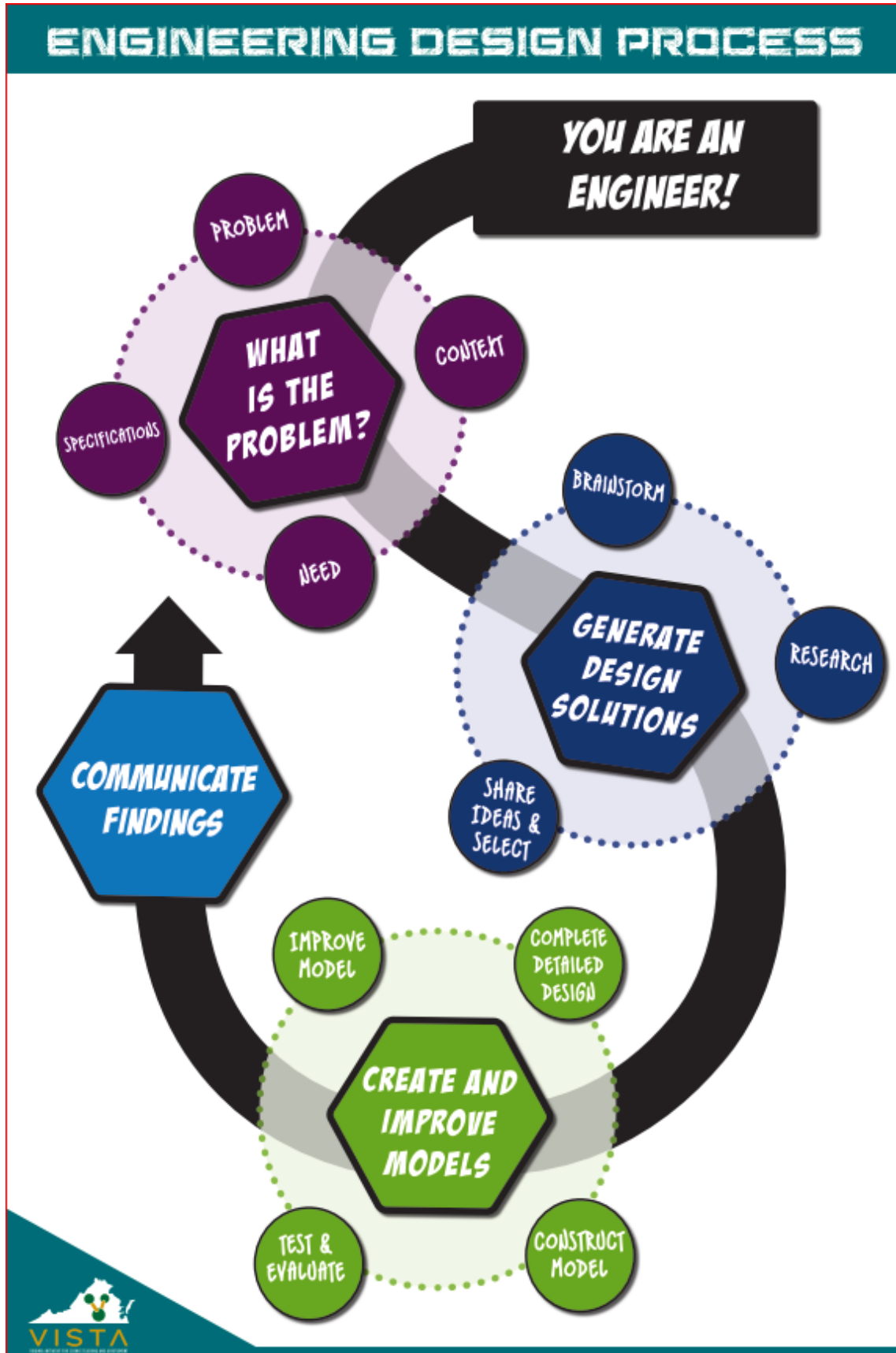
- **\*DON'T FORGET\*** -citations –charts –diagrams –graphs –tables
- Designing and creating a schematic of robots. Meet with the builder and planner to discuss the basic requirements of the robot (has to fit on the table, does NOT have to have “arms & legs & head”, needs to CLEARLY represent the energy transformations happening for their form of electricity creation; may use images from online (with citations) or draw/create out of craft materials

**Lessons 6-9:** Building of Robots, Troubleshooting, Writing of reports in library

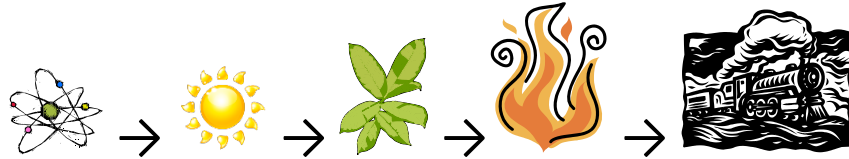
- Check to make sure students are journaling their troubleshooting and as the robot works through stages of development
- Check they are meeting the minimum for use of components
- Ironing out bugs
- Finalizing & printing written reports
- Rehearsing for presentations

**Lesson 10:** Oral presentations of robots in library

- All students must participate at least slightly (you may want to allow an extra day for this!)



Lesson Contributed by: Kate Harris and Judith Deichman  
Funded through a 2014 State Council of Higher Education for Virginia (SCHEV) grant, PI STEM



## Energy Transformation PBL module

using The Hummingbird Robotics kit (by Birdbrain Technologies)

For this unit, you will be receiving an additional test grade for a project, in the form of a Problem-Based Learning module. This means that your group will be given responsibilities and a problem to solve. Your group will need to:

- research the method of creating electricity that you're given
- create a written report of at least 250 words, using and citing at least 3 sources from 2 media types (rubric attached)
- create a robot using a minimum of 3 components that illustrates the form of creating energy you've been given (rubric attached)
- complete a 2-5 minute presentation of what your group has created (may include a PowerPoint with pictures but does not have to; MUST include a run through of your robot; rubric attached)
- Every person must turn in one of THESE SHEETS (completed) to receive a grade.

**Due Date:** \_\_\_\_\_

Method of creating electricity your group will research: \_\_\_\_\_

Job assignments and rating of that person's contribution (0 = other people had to do their job always; 1= other people had to do their job sometimes; 2= they needed to be reminded often to do their job or were absent often; 3= they did their job; 4= they did their job well and helped others with their job when needed

Captain: \_\_\_\_\_ 0 1 2 3 4 5

Primary Researcher: \_\_\_\_\_ 0 1 2 3 4 5

Primary Recorder: \_\_\_\_\_ 0 1 2 3 4 5

Primary Planner: \_\_\_\_\_ 0 1 2 3 4 5

Primary Builder: \_\_\_\_\_ 0 1 2 3 4 5

Primary Presenter: \_\_\_\_\_ 0 1 2 3 4 5

Your group's overall score: \_\_\_\_\_