

Ninth-grade students walk into Mr. Cornwall's to discover a question on the board: Our society is dependent on a steady source of electricity most of which still comes from burning fossil fuels; what does it take to replace fossil fuels with renewable fuel sources? Students explore this topic in self-selected small groups while generating lists of alternative fuel sources. They compile a list on the board identifying biofuel, wind, solar, water & nuclear sources of energy. Next, they watch a short film describing how coal is harvested, transported and burned for to produce electricity. A guest speaker from the local utilities company shares information on local electricity distribution. Students learn that their city uses coal as a primary source and that this is converted into electricity by transformers before the electricity travels to buildings around town in wires. Additionally, students work in cooperative groups of 3-4 students and conduct some computer-based research on primary and secondary sources of energy. All along, they record their ideas in their lab notebooks.

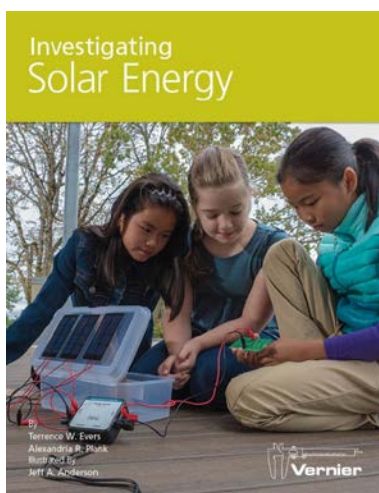
The next day they play with materials from a science kit and begin to explore series and parallel circuits. Student groups are given a series of cards with different complex challenges to solve using the kit materials. Mr. Cornwall asks them to record all observations in picture form and in text form in their science notebooks. He asks them to record what they think will happen and then what did happen.

The following day, Mr. Cornwall displays a diagram of schematics and they learn how physicists illustrate circuits. They now convert their original diagram into science schematics. Mr. Cornwall reviews some simple mathematics problems with the class as they begin to add up the amount of voltage that each battery in their circuit has and the amount needed to light up different light bulbs. After this review, they explore an interactive website (www.phet.colorado.edu) which allows them to build circuits that are more complicated (by combining both series and parallel circuits).

On another day, students are given materials to design circuits using solar panels and/or wind turbines. Again, they record ideas, schematics and calculations in their science notebooks.

The next day, Mr. Cornwall puts students into small groups and then gives them a task: after removing the batteries from your calculator, you must use solar and/or wind energy to power the calculator. The team must work together to design the alternative energy system. Students must illustrate their schematic plans in their notebook and calculate voltage. Mr. Cornwall continually asks groups questions to assess their understanding of circuits, resistors, and switches.

When the calculators all function, three weeks after their unit began, students write a full description of how their team worked together to experiment, problem-solve, and design the alternative energy system.



Self-selected Groups

1	2	3	4	5	6
Paul	Maria	Annie	Roberto	Lance	Ben
Juan	Gabriella	Mary	Greg	Lisa	Ruth
Peter	Susan	Juanita	Daniel	Katie	Amy
Julian	Michelle	Kaya	Nico	Malcolm	Micah

Teacher Observations:

Students in their self-selected groups are conducting internet research. Although not required, Mr. Cornwall encourages all the groups to discuss how to divide up the work so they are efficient. All the groups follow his advice, for the most part, and he notices from the back of the room that all students are quietly working at their computers. When he walks up closer, he notices that Paul is distracted with another website on lighting design. Mr. Cornwall knows that Paul works on the theater tech team and encourages him to jot down the website so Paul can review it outside of class. However, he also notices that Lance is looking a hybrid car website. Mr. Cornwall, who owns a hybrid car, encourages Lance to connect this interest to the current assignment. He then looks at Malcolm to include him in the conversation. Malcolm responds that his family doesn't own a car and he's not interested them. Lisa, though, jumps in and starts sharing her thoughts on hybrid cars.

Teacher-selected Groups

1	2	3	4	5	6
Paul	Maria	Annie	Roberto	Lance	Ben
Juan	Gabriella	Mary	Greg	Lisa	Ruth
Peter	Susan	Juanita	Daniel	Katie	Amy
Michelle	Julian	Nico	Kaya	Malcolm	Micah

Teacher Observations:

Michelle and Kaya both seem to be quiet in their respective groups. Mr. Cornwall notices that neither of these student initiates discussion in their respective groups, although both participate once the discussion has started. After spending some time with group 4, the teacher notices that Greg, who is clearly excited about the project, has lots of ideas. Mr. Cornwall also notices that Kaya has one of the ideas that Greg just described written down in her notebook. When he asks her why she didn't share this with the group, she explains that she already shared this idea 10 minutes earlier, but assures him that they must have forgotten. When Mr. Cornwall observes group 5, he notices that all four students are equally talkative. In group 6, he notices that, although only Ben and Ruth seem to be doing most of the talking, all four are taking notes and adding to their group's diagram. This is like what he observes about group 2, where Julian and Gabriella seem to do much of the talking, while including Maria and Susan's ideas.

Questions/prompts:

1. On page 1, identify the following:
 - a. What did Mr. Cornwall do that you hope to do in your own teaching?
 - b. What did Mr. Cornwall do that you do not think you'd do as a teacher and why?
2. On page 2, identify the following:
 - a. How did the group compositions differ between self- and group-selected?
 - b. What did Mr. Cornwall notice about the group dynamics in different groups?
3. Based on this vignette, what are some implications for *inquiry-based teaching*, *assessment*, and *grouping* in a secondary science class?