



This Web-based Science Inquiry focuses on the ideas of engineering and basic science content. Students from ages 12 to 18 can use this site if you as a teacher tailor it to meet their needs.

This site contains the following **National Science Education Standards** :

- Use appropriate tools and techniques to gather, analyze, and interpret data
- Develop descriptions, explanations, predictions, and models using evidence
- Think critically and logically to make the relationships between evidence and explanations
- Recognize and analyze alternative explanations and predictions
- Communicate scientific procedures and explanations
- Use technology to improve investigations and communications
- Formulate and revise scientific explanations and models using logic and evidence

This site contains the following **Pennsylvania Science and Technology Academic Standards** :

- 3.1.12 A-Apply concepts of systems, subsystems, feedback and control to solve complex technological problems
- 3.2.12 A-Evaluate the nature of scientific and technological knowledge
- 3.2.12 C-Apply the elements of scientific inquiry to solve multi-step problems
- 3.2.12 D-Analyze and use the technological design process to solve problems
- 3.6.7 and 3.6.10 and 3.6.12 C-Apply physical technologies of structural design, analysis and engineering, personnel relations, financial affairs, structural production, marketing, research and design to real world problems
- 3.7.7 and 3.7.10 D- Utilize computer software to solve specific problem

Procedures

- Break the students up into groups of three. Each student will become the design engineer expert in a different field of materials: metals, ceramics, and polymer (and composites), and each one will either be the drafter (Your job is to be in charge of drawing out the constraints on the product, and make sure that during the design process you really keep your group focused on meeting the needs of the product redesign as well as understanding the constraints),

communicator (Your job is to lead up the presentation at the end of this project. You will contribute to the rest of the process, but you will be in charge of heading how you are going to communicate your decision of material, and helping that to get done), and the arbitrator (You are there to make the final decision on which material will be selected and you will be in charge of ending any disputes between your group members. You will have to remind your other group members to pay attention to the material constraints). If there are four learners in a group split up the polymer-composite section, and make the other student another arbitrator.

- The students will go to the Your Job page and pick, as a group, which product they want to redesign (unless you want your whole class to do the same product).
- Then the students will have to travel through the whole task page, hitting every link so that they can begin to understand what a design engineer does, and specifically what they will have to do (You can have them travel through the index if it is easier for them to follow).
- Make sure they fill out their Constraints worksheet.
- Next the students go to the Materials Selection Evidence page. At this page the whole group will go through learning about basic principles of materials and what they should look for in their choice of a new material. Then the students will split up looking at the specific links about metals, ceramics, and polymers (composites).
- Make sure the students each fill out a Why pick my Material Class? Hand out.
- Then the students come together again to go to the Design Iteration page. At this page the students will look at certain materials that they feel might be a good fit. The students will then fill in the Pros and Cons hand out (a couple of times for different materials). The students will then be instructed to look at the cons of their choice and see if there is another material that wouldn't have these cons. The students will learn that design is an iterative process, and will have to look at several materials, and alternative choices.
- Then the students will go to the Defense of Selection page and report their selection in a manner of your choosing. Three methods are outlined under the ways to report section(classroom Debate, Online Communicating, Making a Prototype).
- There are also classroom activities and extension activities on this page.
- If you have any questions email Kelly at kpe2@lehigh.edu with the subject "WBI materials HELP!"
- Also if you choose for the students to report their findings through the Web form, you must email Kelly at kpe2@lehigh.edu, with your teacher information, school, email address and grade, and she will email you the link that shows where the information is posted. This is kept hidden to avoid the temptation of students to look at other selection choices, before they're finished.