

Introduction to Engineering 101

Note to the teacher

The goal of the Engineering 101 section of the course is to help students understand engineering: what engineers do, the processes they use, their problem solving methodologies, and how they work together in teams. On the curriculum page there is a link named Project Management that will take you to a PDF called “Definitions of Engineering.” The PDF compiles approximately 20 different definitions for engineering that are quickly found when you type “define engineering” into an Internet search engine. I ask students to select their favorite definitions and then we talk about them. For school purposes, a very simple definition is: Engineers are people that use math and science to solve problems and apply processes to manage projects.

Engineers, like all other workers, need to be able to work with others. The projects in this section are designed to give students the opportunity to work in teams. Upon completion of the Engineering 101 section of this curriculum students will be able to:

- a) Function on multi-disciplinary teams
- b) Communicate effectively using all forms of verbal and non-verbal communications
- c) Describe various methods used to manage and schedule projects
- d) Participate in and conduct design reviews
- e) Identify, formulate solutions for, and solve engineering problems using engineering design processes

There are several common threads that are interwoven throughout each activity: engineering process, project management, communications, and teamwork. In each activity, students will be given a problem, a finite set of resources, and a limited amount of time. They must then develop and implement their own plans to solve the problem. The understanding and effective application of engineering processes and techniques are essential to the successful completion of the project within the given constraints. At the end of each project the teacher needs to debrief with students; discuss what worked and what didn't work on their teams, and review project management strategies. Switch teams at the end of each problem.

It is important to hold to the class assigned due dates. This is especially important with the first project. If you extend the due date, the students will expect that to happen in the future. Students will take as much time as you give them to solve the problem. Help students to manage their projects by introducing project scheduling techniques. You will find several examples in the Project Management section of the curriculum.

Initially, we developed three projects for this section of the curriculum:

- The Rube Goldberg Challenge, intended to introduce students to problem solving and teamwork;
- The VEX Goldberg Perpetual Motion Challenge, which adds control to project management, teamwork, and problem solving; and
- The Brighton Hot Dog Challenge, which is a theme based work cell that could be modified to suit your needs.

All three challenges are focused on developing the same set of skills and workplace competencies. You can pick whichever is most suitable to the level of experience and amount of time available to your class.

Selection Criteria (to help you pick which project is best for your classroom)

Project	Time Required (Approximate)	Experience Level	Other Requirements
<u>Rube Goldberg</u>	<u>1 week class (mostly homework)</u>	<u>Introductory</u>	
<u>VEX Goldberg Perpetual Motion Machine</u>	<u>4-5 weeks</u>	<u>Recommended: Students should know how to program with sensors</u>	<u>Programming Kit</u>
<u>Brighton Hot Dog Challenge</u>	<u>4-5 weeks</u>	<u>Recommended: Students must know how to program with sensors</u>	<u>Programming Kit</u>

Deleted: Approximate classroom time

Deleted: this depends on the amount of time students have to work on the project, much of the Rube Goldberg challenge is a homework assignment

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Project Preparation

Teaching engineering (project management, teamwork, and problem solving) is an iterative process, just like engineering process is. You will not teach students all of the process skills they need with the first project. The suggested sequence is:

- Introduce what engineering is. (Defines of Engineering PDF)
- Teach what Engineering Process is (Engineering Process PDF)
- Give the students a problem to solve
- Talk about working in teams (Working in Teams PowerPoint, Engineering 101)
- Handout “The First Team Meeting PDF” (Project Management/First Team Meeting PDF)
- Teach how teams brainstorm solutions to a problem (Brainstorming PowerPoint, Engineering 101)
- Handout Brainstorming PDF for the students notebooks (Project Management PDF/Brainstorming Primer)
- Break class into teams and assign them to brainstorm solutions to the problem
- Introduce “Time Management” introduce what a Gantt Chart is (Project Management/Time Management/Gantt Chart PDF) pass the sample chart out for students to keep in their notebooks
- Talk about breaking the project into manageable parts, assigning deliverables, and self assigning due dates
- Assign students to develop a Gantt Chart
- Solve the problem
- Iteratively test solution
- Present solution
- Debrief

Deleted: Rube Goldberg Challenge – One week¶

¶ The VEX Goldberg Perpetual Motion Machine – 4-5 weeks¶

¶ The Hot Dog Challenge – 4-5 weeks¶

Each time the student participates in the engineering design process they will improve. The first project may be a disaster for some teams. The most important part of the above process for new learners is the debrief session. Students need to recognize that this process will be with them in some form for the rest of their lives and so it is important that they become good at it.

Students will be able to:

1. Function on multi-disciplinary teams
2. Communicate effectively using all forms of verbal and non-verbal communications
3. Describe various methods used to manage and schedule projects
4. Participate in and conduct design reviews
5. Identify, formulate solutions for, and solve engineering problems using engineering design processes

Suggested order of projects

1. Rube Goldberg Challenge – No VEX parts, all recycled parts. Can be done at home as a homework assignment over the weekend and then brought to class. There are lots of examples of Rube Goldberg Machines on the Internet.

2. VEX Goldberg Perpetual Motion Machine – This is a cooperative challenge where teams must work together to solve an engineering challenge. This project can be done using the VEX starter kit and remote control or can be made more interesting using the programming kit and sensors.

3. The Automated Work Cell (Hot Dog Challenge) – This project can be modified however the teacher sees fit. The idea behind the challenge was to challenge the students to develop an automated system. The solution to the system is up to the students.