

Pequannock Township School District

Curriculum Syllabus

Engineering and Design / Grade 8

Course Description:

In this course on Engineering and Design, students are introduced to the basic principles behind engineering and the types of engineering. Students learn about the techniques of engineering and problem solving, including brainstorming and the engineering design process. Students also enhance their technical writing and formal presentation skills. Engineers are challenged to think "outside of the box" as they envision, design and create complex projects, products, and processes. Engineers are intimately involved in almost everything in our human-made world.

Course Proficiencies:

The following is a list of proficiencies that describe what students are expected to know and be able to do as a result of successfully completing this course. The following proficiencies are the basis of the assessment of student achievement. The learner will demonstrate mastery of:

1. Each student will implement problem-solving strategies to solve a problem in school or the community. 9.1.8.A.2
2. Students will develop strategies to reinforce positive attitudes and productive behaviors that impact critical thinking and problem solving skills. 9.1.8.A.1
3. Students will summarize strategies used by various organizations and agencies to solve problems that impact communities, and compare them with strategies used by similar organizations in another state or country. 9.1.8.A.3
4. Each student will employ technological tools to expedite workflow 9.4.12.O.22.
5. Students will demonstrate appropriate safety practices in environments in this cluster to ensure a safe workplace. 9.4.12.O.44
6. Students will be able to support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources. WHST.6-8.1B
7. Each student will explain the interdependence of a subsystem that operates as part of a system. 8.2.8.G.2
8. Each student will analyze the interactions among various technologies and collaborate to create a product or system demonstrating their interactivity. 8.2.12.G.1

9. Design and create a product that maximizes conservation and sustainability of a scarce resource, using the design process and entrepreneurial skills throughout the design process. 8.2.12.B.1
10. Each student will develop the necessary skills to follow the design process during prototype creation. MS-ETS1-1 - 4
11. Students will communicate clearly and effectively and with reason. CRP4.
12. Each student will utilize critical thinking to make sense of problems and persevere in solving them. CRP8.
13. Each student will work productively in teams while using cultural global competence. CRP12.

Scope and Sequence - 1 Trimester Course

Unit 1 - Review of Engineering and Design

As students begin the trimester in this class, there are essentials that need to be understood and mastered. The most important essential in any class, classroom or laboratory is safety. Following and understanding safety rules and why these rules are important will help keep students from being injured. Additionally and obviously, the proper handling of equipment and supplies by the student and influencing peers to follow those same rules, he/she will control his/her own safety.

Outstanding presentations of completed work can sometimes be more important than the content of that presentation. Proper and neat lettering, neat line work, correct measurements, simplification of fractions, and presenting information verbally and written are lifelong necessary skills. All will be addressed at the beginning of every STEM subject area course at PV Middle School.

Unit 2 - Bridge Building

When civil engineers design bridges, they must take into account various factors like balance and motion. This unit introduces the principles behind bridge design where students will reinforce their understanding of push and pull as they explore how forces act on different structures. They will use what they know about balance and force as they research beam, arch, and suspension bridges and learn how bridge designs counteract and redirect forces and motion. In the final design challenge of this unit, students plan, build, and test their own bridges using the materials given and following set criteria. Students also learn about the many cost factors that comprise the economic considerations of bridge building. Bridges are unique challenges that take advantage of the creative nature of engineering.

Unit 3 - Catapult Launcher

Engineers design structures for a multitude of purposes. Some industrial management engineers design toys such as darts and nerf guns that obviously requires knowledge of force,

angles, and distance. This unit introduces the principles behind catapult design where students will reinforce their understanding of push and pull forces as they explore how angles may affect distance in a catapult. In this final design challenge, students plan, build, and test their own catapults that launch a bouncy ball over twenty feet but can also be calibrated to a smaller distance.

Assessments

Evaluation of student achievement in this course will be based on the following:

1. Verbal and written presentations of information, demonstration of appropriate lab conduct, explanation of the interdependence of parts to form a more complex system.
2. Bridge design project, presentations
3. Verbal and written presentations of information, demonstration of appropriate lab conduct, explanation of projectile motion, participation and accuracy of catapult.

Curriculum Resources

Anchor Programs/Teacher Materials

- Investigative subsystem packet and research websites
- 16 scale ruler
- engineering drawings (aerial views and cross sections)
- model objects (to use to create drawings)
- Various tools including, crosscut saw, hammer, chisel, portable electric drill, coping saw, circle template, ruler, pencil, wood vise, and square.
- Chromebooks for report and presentation creation

Home and School Connection

The following are suggestions and/or resources that will help parents support their children:

- Have ongoing discussions on overall lab safety and the importance of following lab rules
- Explore resources such as <https://www.mindresearch.org/stem-resources> and <https://www.edutopia.org/article/STEM-resources-downloads>
- Visit places such as the Liberty Science Center to further promote student exploration of STEM topics

