Rumson-Fair Haven Regional High School

Course: *Engineering II*
Staff Writers: Jon Reynolds and Jessica Olszewski
Supervisor: Jon Pennetti
Board Approval: August 2026

Section I: Course Description

Engineering II is a full-year elective designed to introduce the high school student to elements of CAD design software, Robotics Engineering, Electrical Engineering, Mechanical Engineering, Automotive Engineering, Aerospace Engineering, as well as Energy Engineering. Students will continue to apply our [Engineering Design Process]() and use it for their designs. The students will learn through lectures, teacher demonstrations, as well as hands-on assignments specifically designed for each unit. Throughout the course, students will use CAD design software for all of their final designs and will improve upon their problem-solving skills through researching, generating project designs, building projects, and redesigning their projects. They will also learn the proper and safe operation of a variety of hand tools and machines.

Section II: NJSLS: New Jersey Student Learning Standards/Learning Objectives:

1. ***2026 New Jersey Student Learning Standards - Science:***
   - "Scientific and technological advances have proliferated and now permeate most aspects of life in the 21st century. It is increasingly important that all members of our society develop an understanding of scientific and engineering concepts and processes. Learning how to construct scientific explanations and how to design evidence-based solutions provides students with tools to think critically about personal and societal issues and needs. Students can then contribute meaningfully to decision-making processes, such as discussions about climate change, new approaches to health care, and innovative solutions to local and global problems."
2. ***2023 New Jersey Student Learning Standards - Mathematics:***
   - "A New Jersey education in Mathematics builds quantitatively and analytically literate citizens prepared to meet the demands of college and career, and to engage productively in an information-driven society; …A high-quality mathematics education fosters a population that…leverages data in decision-making and as a lens for discussing, analyzing, and responding to practical questions, persists to make sense of and model problems arising in everyday life, society, and the workplace, thinks critically and strategically to assess quantitative relationships and to solutions to complex problems, employs precise reasoning and constructs viable arguments to deduce conclusions, recognize false statements and assess peers' reasoning, interprets, evaluates and critiques the mathematics embedded in social, scientific and commercial systems, as well as the claims made in the private and public sectors, communicates precisely when conveying, representing, and justifying both qualitative and quantitative perspectives."
3. ***2023 New Jersey Student Learning Standards - English Language Arts:***
   - "A New Jersey education in English Language Arts builds readers, writers, and communicators prepared to meet the demands of college and career and to engage as productive American citizens with global responsibilities. Students will develop the necessary skills in reading, writing, speaking, and listening that are the foundations for creative and purposeful expression in language; read rich, challenging texts that build their knowledge of the world, grow their confidence and identities as readers, and develop critical thinking skills and vocabulary necessary for long-term success engage in regular, meaningful, writing authentic tasks, exploring valued topics, writing for impact and expression, and sharing their work with others (including authentic audiences) leverage complex texts and digital media to develop comprehension, active listening, and discussion skills ground daily writing and discussion in evidence, fostering an ability to read critically, build arguments, cite evidence, and communicate ideas to contribute meaningfully as productive citizens; evaluate the reliability, credibility, and perspective of authors and speakers across all forms of media; express ideas and knowledge through a variety of modalities and media, and serve as effective communicators who purposefully read, write, and speak across multiple disciplines and learn to persist in reading complex texts, establishing lifelong habits to read voluntarily for pleasure, for further education, for information on public policy, and for advancement in the workplace."
4. ***Standard 8.1 (Computer Science) and 8.2 (Design Thinking) of the 2020 NJSLS:***
   - "The 'Intent and Spirit of the Computer Science and Design Thinking Standards' is to focus on deep understanding of concepts that enable students to think critically and systematically about leveraging technology to solve local and global issues. Authentic learning experiences that enable students to apply content knowledge, integrate concepts across disciplines, develop computational thinking skills, acquire and incorporate varied perspectives, and communicate with diverse audiences about the use and effects of computing prepares New Jersey students for college and careers."
5. ***2020 Career Readiness, Life Literacies, and Key Skills Standards (9.2 and 9.4)***:
   - "Rapid advancements in technology and subsequent changes in the economy have created opportunities for individuals to compete and connect on a global scale. In this increasingly diverse and complex world, the

successful entrepreneur or employee must not only possess the requisite education for specific industry pathways but also employability skills necessary to collaborate with others and manage resources effectively in order to establish and maintain stability and independence. This document outlines concepts and skills necessary for New Jersey's students to thrive in an ever-changing world. Intended for integration throughout all K–12 academic and technical content areas, the New Jersey Student Learning Standards-Career Readiness, Life Literacies, and Key Skills (NJSLS-CLKS) provide the framework for students to learn the concepts, skills, and practices essential to successful navigation."

***Climate Change:** The state of New Jersey has mandated instruction in, "Climate Change across all content areas, leveraging the passion students have shown for this critical issue and providing them opportunities to develop a deep understanding of the science behind the changes and to explore the solutions our world desperately needs."

6. ****Amistad Law: N.J.S.A. 18A 52:16A-88:***
   - The inclusion of lessons and resources/texts dealing with the African slave trade, slavery in America, the vestiges of slavery in this country and the contributions of African-Americans to our society will be implemented in English and Social Studies courses in accordance with state law: "Every board of education shall incorporate the information regarding the contributions of African-Americans to our country in an appropriate place in the curriculum of elementary and secondary school students."
7. ****Holocaust Law: N.J.S.A. 18A 35-28:***
   - The inclusion of lessons and resources/texts that enable pupils to identify and analyze applicable theories concerning human nature and behavior; to understand that genocide is a consequence of prejudice and discrimination; and to understand that issues of moral dilemma and conscience have a profound impact on life will be implemented in English and Social Studies courses in accordance with state law: "Every board of education shall include instruction on the Holocaust and genocides in an appropriate place in the curriculum of all elementary and secondary school pupils. The instruction shall further emphasize the personal responsibility that each citizen bears to fight racism and hatred whenever and wherever it happens."
8. ****LGBT and Disabilities Law: N.J.S.A. 18A:35-4.35:***
   - A transformative approach to the inclusion of lessons and resources/texts on the contributions and issues concerning the LGBTQ+ population and people with disabilities will be implemented across all core subjects in accordance with state law: "A board of education shall include instruction on the political, economic, and social contributions of persons with disabilities and lesbian, gay, bisexual, and transgender people, in an appropriate place in the curriculum of middle school and high school students as part of the district's implementation of the New Jersey Student Learning Standards (N.J.S.A.18A:35-4.36). A board of education shall have policies and procedures in place pertaining to the selection of instructional materials to implement the requirements of N.J.S.A. 18A:35-4.35."
9. ****Asian American and Pacific Islanders Legislation: N.J.S.A 4021/A6100:***
   - The inclusion of lessons and resources/texts on the history and contributions of Asian Americans and Pacific Islanders, will enable New Jersey's schools to provide a curriculum that reflects the diversity of our state. In accordance with state law: "A board of education shall include instruction on the history and contributions of Asian Americans and Pacific Islanders in an appropriate place in the curriculum of students in grades kindergarten through as part of the school district's implementation of the New Jersey Student Learning Standards in Social Studies."
10. Acquisition/development/refinement of the higher-order critical thinking skills aligned with the *Revised Bloom's Taxonomy of Cognitive Objectives*

Section III: Curriculum Modifications

The *Engineering II* curriculum is subject to case-by-case modifications to support/advance the needs of all students, including special education students, English language learners, gifted students, and those at risk of school failure. These modifications are based on Individualized Learning Programs (IEPs), recommendations made by the district's Multi-Language Learners (MLL) coordinator, feedback from members of the Intervention & Referral Services Team (*I&RS*) for at-risk students, and 504 Plans.

Coursework and assessments will be modified on an individual basis for students when necessary. Modifications may include but are not limited to those outlined on the Modifications/Accommodations for Technology and Design Courses chart.

Section IV: Preparation for Standardized Testing

Instruction in *Engineering II* is aligned with the requirements of state and national standardized assessments, including the *NJGPA*, *NJSLA*, the *ACT*, the *PSAT,* and the *SAT*.

Section V: Curriculum Pacing Guide

Curriculum Pacing Guide	
Course Title: *Engineering II*	**Grade Level:** 10-12
Unit I: Introduction to CAD	Weeks 1-4
Unit II: Robotics Engineering	Weeks 5-10
Unit III: Electrical Engineering	Weeks 11-16
Unit IV: Mechanical Engineering	Weeks 17-22
Unit V: Automobile Engineering	Weeks 23-28
Unit VI: Aerospace Engineering	Weeks: 29-35
Unit VII: Energy Engineering	Weeks 36-40

Section VI: Primary Texts and Year-Long Instructional Resources
The following texts and instructional resources are employed for all students in *Engineering II*:

- Google Classroom
- CAD Software
- internet resources
- Youtube.com
- Teachengineering.org
- project materials
- Vex Robotics
- Classroom tools and machines

Section VII: Grading Formula and Assessment Modes
Marking period grades in *Engineering II* are determined via a percentage weighting model. The specific grading categories and weightings of each will be determined before the start of each academic year and will be published in the posted/distributed course syllabi.

Assessments in *Engineering II* vary greatly in format, scope/content/skills assessed, and alternative assessments; differentiation in assessments and choice will be incorporated as appropriate. Preliminary assessments of each format will be used as benchmarks, and summative assessments will be created/revised collaboratively each year and planned by members of the *Engineering II* instructional team to inform future learning and to measure student growth.

Section VIII: Unit Templates

The following unit templates have been established for the *Engineering II* curriculum by the *Engineering II* instructional team:

<table>
<tr><th colspan="3">Unit I: Introduction to CAD</th></tr>
<tr><th colspan="3">Unit Summary</th></tr>
<tr><td colspan="3">In this unit, students will become familiar with the fundamentals of Computer-Aided Design (CAD) software, a critical tool in modern engineering. Students will learn how to create sketches in different views and formats to accurately represent their project designs, producing digital renderings that refine the design process and lead to geometric precision. This unit also serves as an introduction to the Glowforge laser cutter, providing students with a foundational understanding of its capabilities and operation, though it will not be actively utilized for project fabrication in this specific unit. By the completion of this unit, students will understand the role of CAD in the engineering design process and be prepared to apply these technical skills to future projects where they will fabricate custom components.</td></tr>
<tr><th colspan="3">Standards/Core Ideas/Performance Expectations/Progress Indicators</th></tr>
<tr><td colspan="3">The state standards outlined below, and established by the New Jersey Department of Education, will guide instruction throughout this unit in Engineering II:
● 2026 New Jersey Student Learning Standards: Science
○ HS-ETS1-2, HS-ETS1-4
● 2023 New Jersey Student Learning Standards: Mathematics
○ G.GMD.B.4, G.MG.A.1, G.MG.A.3
● 2020 New Jersey Student Learning Standards: Computer Science and Design Thinking
○ 8.1.12.DA.1, 8.1.12.CS.2, 8.2.12.ED.2, 8.2.12.ED.5
● 2023 New Jersey Student Learning Standards: English Language Arts
○ W.IW.11-12.2, W.WR.11-12.5, SL.PE.11-12.1, SL.PI.11-12.4
● 2020 New Jersey Student Learning Standards: Career Readiness, Life Literacies, and Key Skills
○ 9.4.12.IML.3, 9.4.12.TL.1, 9.4.12.CT.1-2</td></tr>
<tr><th>Unit Essential Questions</th><th colspan="2">Unit Enduring Understandings</th></tr>
<tr><td>● What is the role of CAD software in the modern engineering design process?
● How does CAD software allow engineers to visualize, iterate, and refine designs before physical construction?
● How do digital design files translate into physical objects through laser cutting technology?
● How does learning CAD and laser cutting basics prepare students for future engineering units in the course?
● How does documentation within CAD improve communication of design intent to others?</td><td colspan="2">● CAD software serves as the primary digital environment for engineers to model, simulate, and document designs, acting as a foundational step in the engineering design process.
● CAD enables rapid iteration, allowing engineers to test ideas, identify potential failures, and optimize geometries in a virtual space before committing to costly physical materials.
● Digital design files created in CAD are converted into vector paths that guide the laser cutter, allowing for the direct translation of virtual dimensions into accurate, physical components.
● Mastering CAD and understanding the capabilities of the Glowforge provides the technical literacy required to successfully design, fabricate, and problem-solve throughout subsequent, more advanced engineering units.
● Effective CAD documentation standardizes the communication of complex ideas, ensuring that design intent, measurements, and assembly instructions are clear, professional, and easily understood by collaborators.</td></tr>
<tr><th colspan="3">Evidence of Learning</th></tr>
<tr><td>Formative & Alternative Assessments:
● Introduction to CAD tutorial
● Safety Quiz
● Individual student check-ins with teacher</td><td>Benchmark & Summative Assessments:
● Benchmark Introductory CAD Drawing Assignments (1-4)</td><td>Resources Needed:
● Google Classroom
● Internet resources
● Youtube.com
● Teachengineering.org
● Project materials
● Classroom tools and machines
● Glowforge
● CAD software</td></tr>
</table>

<table>
<tr><th>Unit II: Robotics Engineering</th></tr>
<tr><th>Unit Summary</th></tr>
<tr><td>In this unit, students will become familiar with Robotics. They will learn about how robotics engineers help society and in what ways. A heavy focus for robotics is on developing a system to increase the efficiency, output, and safety of all sorts</td></tr>
</table>

of tasks, including manufacturing and production. They are often faced with a problem and must work towards a solution with given robotic parts, systems, and information. The major component of this unit will be the design, construction, and programming of both VEX and GoPiGo robotic kits. Students will also be taught how to use the Glowforge laser cutter to create replacement components such as gears, axles, and other damaged parts for their robotic systems. Through the completion of this unit, they will understand some of the challenges faced by Robotics Engineers and become familiar with both programming languages. All final sketches in this unit will be completed using CAD.

Standards/Core Ideas/Performance Expectations/Progress Indicators

The state standards outlined below, and established by the New Jersey Department of Education, will guide instruction throughout this unit in *Engineering II:*

- *2026 New Jersey Student Learning Standards: Science*
  - HS-ETS1-2, HS-ETS1-3, HS-ETS1-4
- *2023 New Jersey Student Learning Standards: Mathematics*
  - G.MG.A.1, G.MG.A.3
- *2020 New Jersey Student Learning Standards: Computer Science and Design Thinking*
  - 8.1.12.AP.1, 8.2.12.ED.2, 8.2.12.ED.5, 8.2.12.ETW.1
- *2023 New Jersey Student Learning Standards: English Language Arts*
  - W.IW.11-12.2, W.WR.11-12.5, SL.PE.11-12.1, SL.PI.11-12.4
- *2020 New Jersey Student Learning Standards: Career Readiness, Life Literacies, and Key Skills*
  - 9.4.12.CT.1, 9.4.12.TL.1, 9.4.12.IML.3, 9.4.12.CI.1

Unit Essential Questions	Unit Enduring Understandings
• What does a robotics engineer do? • How does digital design (CAD) translate into physical, functional components for robots? • How does the Glowforge laser cutter enable the creation of custom parts like gears, cams, and propellers? • How are VEX and GoPiGo systems constructed and programmed to solve specific tasks? • What challenges do robotics engineers face when designing and manufacturing custom robotic systems?	• Robotics Engineers design, construct, and program systems to increase efficiency, safety, and productivity across various industries. • CAD software acts as the primary interface for digital design, allowing engineers to translate virtual ideas into precise, cuttable files. • The Glowforge laser cutter allows for the rapid fabrication of custom, mission-critical robotic components, such as gears, cams, and propellers, which may not be available in standard kits. • Construction and programming of robotic platforms like VEX and GoPiGo require a systematic application of engineering design, logic, and mechanical assembly to achieve operational goals. • Robotics engineers must constantly overcome challenges related to component integration, mechanical failure, and programming limitations to develop effective, custom robotic solutions.

Evidence of Learning

Formative & Alternative Assessments:	Benchmark & Summative Assessments:	Resources Needed:

• Each Step of the Engineering design process will be turned in:
  • Ask to identify the need and constraints
  • Research the problem
  • Imagine possible solutions
  • Plan by selecting a promising solution
  • Create a prototype
  • Test and evaluate the prototype
  • Improve and redesign as needed
• Individual student check-ins with teacher
	• VEX robot (Benchmark)
	• GoPiGo robot
		• Google Classroom
		• Internet resources
		• Youtube.com
		• Teachengineering.org
		• Project materials
		• Classroom tools and machines
		• Glowforge
		• CAD software

Unit III: Electrical Engineering

Unit Summary

In this unit, students will become familiar with Electrical Engineering. They will learn about how Electrical Engineers help society and in what ways. Electrical engineers are concerned with the study, design, and application of all equipment, devices, and systems that use electricity, electronics, or electromagnetism. Students will gain an understanding of circuit

fundamentals, specifically the difference between open and closed circuits and the proper grounding of circuits to ensure safety and function. The major component of this unit will be the design, construction, and testing of two different, small circuit systems. Here, they will work with and learn about many electrical components. Through the completion of this unit, they will understand some of the challenges faced by electrical engineers and be proficient at soldering. All final sketches in this unit will be completed using CAD.
Standards/Core Ideas/Performance Expectations/Progress Indicators
The state standards outlined below, and established by the New Jersey Department of Education, will guide instruction throughout this unit in *Engineering II:* ● *2026 New Jersey Student Learning Standards: Science* ○ HS-ETS1-1, HS-ETS1-2, HS-ETS1-3 ● *2023 New Jersey Student Learning Standards: Mathematics* ○ G.MG.A.1, G.MG.A.3, A-CED.A.4 ● *2020 New Jersey Student Learning Standards: Computer Science and Design Thinking* ○ 8.2.12.ED.2, 8.2.12.ED.5, 8.2.12.ITH.1, 8.2.12.EC.1 ● *2023 New Jersey Student Learning Standards: English Language Arts* ○ W.IW.11-12.2, W.WR.11-12.5, SL.PE.11-12.1, SL.PI.11-12.4 ● *2020 New Jersey Student Learning Standards: Career Readiness, Life Literacies, and Key Skills* ○ 9.4.12.CI.1, 9.4.12.CT.1, 9.4.12.TL.1

Unit Essential Questions	Unit Enduring Understandings
● What is the scope of work for an electrical engineer? ● What distinguishes an open circuit from a closed circuit in terms of functionality? ● Why is proper grounding essential for the safety and reliability of electrical systems? ● What roles do capacitors, transistors, semiconductors, and transformers play within an electrical circuit? ● What challenges do electrical engineers face when designing and prototyping small-scale circuit systems? ● How does CAD improve the accuracy and documentation of electrical circuit designs?	● Electrical engineers design, build, and maintain systems that leverage electricity, electronics, and electromagnetism to solve real-world problems. ● A closed circuit allows current to flow, enabling the device to function, whereas an open circuit creates a gap that interrupts the flow of energy. ● Proper grounding provides a safe, low-resistance path for fault currents, protecting both the user and the electrical equipment from hazards. ● Electrical components such as capacitors, transistors, semiconductors, and transformers act as the building blocks of circuits, allowing engineers to control, store, and transform energy. ● Engineers must manage complex variables such as component compatibility, power constraints, and safety standards when troubleshooting and constructing functional circuits. ● CAD serves as a critical tool for creating precise, replicable circuit designs and documentation, bridging the gap between theoretical schematics and physical construction.

Evidence of Learning		
Formative & Alternative Assessments: ● Each Step of the Engineering design process will be turned in: 1. Ask to identify the need and constraints 2. Research the problem 3. Imagine possible solutions 4. Plan by selecting a promising solution 5. Create a prototype 6. Test and evaluate the prototype 7. Improve and redesign as needed ● Individual student check-ins with teacher	**Benchmark & Summative Assessments:** ● Functional Circuit Project ● Sound Activated Circuit Project ● Light Activated Circuit Project	**Resources Needed:** ● Google Classroom ● Internet resources ● Youtube.com ● Teachengineering.org ● Project materials ● Classroom tools and machines ● Glowforge ● CAD software

Unit IV: Mechanical Engineering
Unit Summary

<table>
<tr><td colspan="6">In this unit, students will become familiar with Mechanical Engineering. They will learn about how Mechanical Engineers help society and in what ways. Mechanical engineers are concerned with combining physics and mathematical principles to design, build, and maintain mechanical systems. Though broad in scope, mechanical engineers deal with industrial equipment, engine systems, and other aspects of machinery. The major component of this unit will be the design, construction, and testing of a simple vehicle that utilizes a worm gear. Students will also be taught how to use the Glowforge laser cutter to fabricate custom worm gears for their vehicle projects. Through the completion of this unit, they will understand some of the challenges faced by mechanical engineers, gain experience with laser cutting technology, and be able to identify worm gear ratios. All final sketches in this unit will be completed using CAD.</td></tr>
<tr><th colspan="6">Standards/Core Ideas/Performance Expectations/Progress Indicators</th></tr>
<tr><td colspan="6">The state standards outlined below, and established by the New Jersey Department of Education, will guide instruction throughout this unit in Engineering II:

2026 New Jersey Student Learning Standards: Science
HS-ETS1-2, HS-ETS1-3, HS-ETS1-4
2023 New Jersey Student Learning Standards: Mathematics
G.MG.A.1, G.MG.A.3
2020 New Jersey Student Learning Standards: Computer Science and Design Thinking
8.2.12.ED.2, 8.2.12.ED.5, 8.2.12.ETW.1, 8.2.12.ETW.4
2023 New Jersey Student Learning Standards: English Language Arts
W.IW.11-12.2, W.WR.11-12.5, SL.PE.11-12.1, SL.PI.11-12.4
2020 New Jersey Student Learning Standards: Career Readiness, Life Literacies, and Key Skills
9.4.12.CI.1, 9.4.12.CT.1, 9.4.12.TL.1
</td></tr>
<tr><th colspan="3">Unit Essential Questions</th><th colspan="3">Unit Enduring Understandings</th></tr>
<tr><td colspan="3">
What does a mechanical engineer do?
How does digital design (CAD) translate into functional mechanical components?
How does the Glowforge laser cutter facilitate the fabrication of custom worm gears for mechanical projects?
What is the mechanical function and advantage of a worm gear in power transmission?
How do engineers determine and calculate worm gear ratios for specific mechanical applications?
What challenges do mechanical engineers face when designing and testing complex gear-driven systems?
</td><td colspan="3">
Mechanical engineers design, build, and maintain diverse systems by applying physics and mathematical principles to solve industrial and mechanical challenges.
CAD software is the essential foundation for translating abstract designs into precise, digital files ready for manufacturing.
The Glowforge laser cutter enables rapid, precise fabrication of custom components like worm gears, allowing for project-specific customization that standard kits may not provide.
Worm gears serve as critical components in power transmission, offering unique torque and speed reduction capabilities that are distinct from other gear types.
Understanding and calculating gear ratios is vital for mechanical engineers to optimize the output and efficiency of gear-driven systems.
Mechanical engineers must navigate trade-offs between friction, mechanical advantage, and component integrity to successfully design and construct effective machinery.
</td></tr>
<tr><th colspan="6">Evidence of Learning</th></tr>
<tr><td colspan="2">Formative & Alternative Assessments:

Each Step of the Engineering design process will be turned in:

Ask to identify the need and constraints
Research the problem
Imagine possible solutions
Plan by selecting a promising solution
Create a prototype
Test and evaluate the prototype
Improve and redesign as needed

Individual student check-ins with teacher
</td><td colspan="2">Benchmark & Summative Assessments:
Worm Gear Project</td><td colspan="2">Resources Needed:

Google Classroom
Internet resources
Youtube.com
Teachengineering.org
Project materials
Classroom tools and machines
Glowforge
CAD software
</td></tr>
</table>

Unit V: Automobile Engineering

Unit Summary

In this unit, students will become familiar with Automobile Engineering. They will learn about how automobile engineers help society and in what ways. Automobile engineers are a part of a subset of mechanical engineering that focuses specifically on the manufacture of vehicles, along with the components that make up the vehicle, including energy and propulsion systems. The major component of this unit will be the design, construction, and testing of a magnetic levitation car and a compressed air car. Students will also be taught how to use the Glowforge laser cutter to create precision components for their various car projects. Through the completion of this unit, they will understand some of the challenges faced by automobile engineers, gain experience with laser cutting technology, and have the opportunity to test their designs in a wind tunnel before they race them. All final sketches in this unit will be completed using CAD.

Standards/Core Ideas/Performance Expectations/Progress Indicators

The state standards outlined below, and established by the New Jersey Department of Education, will guide instruction throughout this unit in *Engineering II:*

- *2026 New Jersey Student Learning Standards: Science*
  - HS-ETS1-2, HS-ETS1-4
- *2023 New Jersey Student Learning Standards: Mathematics*
  - G.MG.A.1, G.MG.A.3
- *2020 New Jersey Student Learning Standards: Computer Science and Design Thinking*
  - 8.2.12.ED.2, 8.2.12.ED.5, 8.2.12.ETW.1, 8.2.12.ETW.4
- *2023 New Jersey Student Learning Standards: English Language Arts*
  - W.IW.11-12.2, W.WR.11-12.5, SL.PE.11-12.1, SL.PI.11-12.4
- *2020 New Jersey Student Learning Standards: Career Readiness, Life Literacies, and Key Skills*
  - 9.4.12.CI.1, 9.4.12.CT.1, 9.4.12.TL.1

Unit Essential Questions	Unit Enduring Understandings
• What does an automobile engineer do? • How does laser cutting technology facilitate the creation of precision components for vehicle projects? • How does digital design (CAD) translate into physical components using the Glowforge? • How do propulsion systems, such as compressed air or DC motors, influence vehicle design and efficacy? • What challenges must be overcome to successfully design and construct a Magnetic Levitation or Compressed Air vehicle? • What is drag, and how does it impact vehicle performance and speed? • How is a wind tunnel used to collect data for optimizing aerodynamic designs?	• Automobile engineers design, test, and manufacture complex vehicle systems, including propulsion and energy components. • Laser cutting technology allows for the precise, efficient fabrication of intricate vehicle components based on digital designs. • Digital design (CAD) acts as the foundation for manufacturing, enabling the transition from virtual models to physical, high-tolerance components using tools like the Glowforge. • Propulsion systems, such as DC motors and compressed air, dictate the efficiency and performance capabilities of a vehicle. • Success in designing vehicles like MagLev or compressed air models requires solving complex engineering challenges related to structural stability, propulsion, and physics. • Drag is an aerodynamic force that opposes vehicle motion; minimizing it is a primary design goal for increasing speed. • Wind tunnel testing provides the quantitative data necessary to evaluate aerodynamic effectiveness and refine vehicle designs for optimal performance.

Evidence of Learning

Formative & Alternative Assessments:	**Benchmark & Summative Assessments:**	**Resources Needed:**
• Each Step of the Engineering design process will be turned in: 1. Ask to identify the need and constraints 2. Research the problem 3. Imagine possible solutions 4. Plan by selecting a promising solution 5. Create a prototype 6. Test and evaluate the prototype 7. Improve and redesign as needed	• MagLev Project • Compressed Air Car Project (Summative)	• Google Classroom • Internet resources • Youtube.com • Teachengineering.org • Project materials • Classroom tools and machines • Glowforge • CAD software

● Individual student check-ins with teacher		

<table>
<tr><th colspan="3">Unit VI: Aerospace Engineering</th></tr>
<tr><th colspan="3">Unit Summary</th></tr>
<tr><td colspan="3">In this unit, students will become familiar with aerospace engineering. They will learn about how aerospace engineers help society and in what ways. With a focus on industries including designing or building aircraft, projectiles, spacecraft, and other areas of research and development for aerodynamically fit materials sent flying through the air or space. The major component of this unit will be the design, construction, and testing of a glider, a trebuchet, and a rocket. Students will also use the Glowforge laser cutter to fabricate custom nose cones for their rockets. Through the completion of this unit, they will understand some of the challenges faced by aerospace engineers and be able to understand the terminology used in this industry. All final sketches in this unit will be completed using CAD.</td></tr>
<tr><th colspan="3">Standards/Core Ideas/Performance Expectations/Progress Indicators</th></tr>
<tr><td colspan="3">The state standards outlined below, and established by the New Jersey Department of Education, will guide instruction throughout this unit in Engineering II:
● 2026 New Jersey Student Learning Standards: Science
○ HS-ETS1-2, HS-ETS1-3, HS-PS2-1
● 2023 New Jersey Student Learning Standards: Mathematics
○ G.MG.A.1, G.MG.A.3, N-Q.A.1
● 2020 New Jersey Student Learning Standards: Computer Science and Design Thinking
○ 8.2.12.ED.2, 8.2.12.ED.5, 8.2.12.ETW.1
● 2023 New Jersey Student Learning Standards: English Language Arts
○ W.IW.11-12.2, W.WR.11-12.5, SL.PE.11-12.1, SL.PI.11-12.4
● 2020 New Jersey Student Learning Standards: Career Readiness, Life Literacies, and Key Skills
○ 9.4.12.CI.1, 9.4.12.CT.1, 9.4.12.TL.1</td></tr>
<tr><th>Unit Essential Questions</th><th colspan="2">Unit Enduring Understandings</th></tr>
<tr><td>● What does an aerospace engineer do?
● How does CAD software enable the creation of aerodynamic components?
● How does the Glowforge laser cutter allow for custom nose cone fabrication?
● What are the four forces of flight, and how do they impact aerospace vehicles?
● How do control surfaces and movement axes influence vehicle stability?
● How does projectile motion in gliders and trebuchets differ from rocket flight dynamics?
● What engineering trade-offs are necessary when balancing aerodynamic efficiency with structural integrity?</td><td colspan="2">● Aerospace engineers design and test aircraft and spacecraft, applying principles of aerodynamics, propulsion, and structural integrity to solve complex flight challenges.
● CAD software serves as the essential digital foundation for translating aerodynamic theories and designs into precise, manufacturable models.
● The Glowforge laser cutter provides the rapid prototyping capability to fabricate custom, aerodynamically optimized nose cones, which are vital for maintaining rocket flight stability.
● Successful flight requires a deep understanding and precise management of the four fundamental forces: lift, drag, thrust, and weight.
● Engineers manipulate control surfaces to manage roll, pitch, and yaw, enabling stable and predictable flight paths for aerospace vehicles.
● Different aerospace vehicles function under distinct physical laws; distinguishing between projectile motion and rocket dynamics is crucial for optimizing the performance of gliders, trebuchets, and rockets.
● Aerospace engineers must solve complex design problems by carefully navigating the trade-offs between maximizing aerodynamic efficiency, minimizing component weight, and ensuring overall structural strength.</td></tr>
<tr><th colspan="3">Evidence of Learning</th></tr>
<tr><td>Formative & Alternative Assessments:
● Each Step of the Engineering design process will be turned in:
1. Ask to identify the need and constraints
2. Research the problem
3. Imagine possible solutions
4. Plan by selecting a promising solution</td><td>Benchmark & Summative Assessments:
● Glider Project
● Trebuchet Project (Summative)</td><td>Resources Needed:
● Google Classroom
● Internet resources
● Youtube.com
● Teachengineering.org
● Project materials
● Classroom tools and machines
● Glowforge
● CAD software</td></tr>
</table>

5. Create a prototype 6. Test and evaluate the prototype 7. Improve and redesign as needed ● Individual student check-ins with teacher		

Unit VII: Energy Engineering
Unit Summary
In this unit, students will become familiar with energy engineering. They will learn about how energy engineers help society and in what ways. Energy engineers combine scientific principles with environmental engineering processes to increase efficiency, sustainability, and the development of renewable energy sources. The major component of this unit will be the design, construction, and testing of a solar panel vehicle. Students will also be taught how to use the Glowforge laser cutter to fabricate custom components for their energy-efficient designs. Through the completion of this unit, they will understand some of the challenges faced by Energy Engineers, distinguish between traditional and alternative energy sources such as solar, wind, tidal, hydroelectric, and biomass, and explain how solar panels function. All final sketches in this unit will be completed using CAD.
Standards/Core Ideas/Performance Expectations/Progress Indicators
The state standards outlined below, and established by the New Jersey Department of Education, will guide instruction throughout this unit in *Engineering II:* ● *2026 New Jersey Student Learning Standards: Science* ○ HS-ETS1-2, HS-ETS1-3, HS-PS3-3 ● *2023 New Jersey Student Learning Standards: Mathematics* ○ G.MG.A.1, G.MG.A.3 ● *2020 New Jersey Student Learning Standards: Computer Science and Design Thinking* ○ 8.2.12.ED.2, 8.2.12.ED.5, 8.2.12.EC.1, 8.2.12.ETW.1 ● *2023 New Jersey Student Learning Standards English Language Arts* ○ W.IW.11-12.2, W.WR.11-12.5, SL.PE.11-12.1, SL.PI.11-12.4 ● *2020 New Jersey Student Learning Standards: Career Readiness, Life Literacies, and Key Skills* ○ 9.4.12.CI.1, 9.4.12.CT.1, 9.4.12.TL.1

Unit Essential Questions	Unit Enduring Understandings
● What does an energy engineer do to improve efficiency and sustainability? ● How does digital design (CAD) assist in the planning and development of renewable energy systems? ● How does the Glowforge laser cutter enable the fabrication of custom, energy-efficient components? ● How do solar panels function to convert energy, and what is their role in modern power systems? ● How do renewable sources like wind, tidal, hydroelectric, and biomass energy work to generate power? ● What engineering challenges do energy engineers face when designing and implementing sustainable power solutions?	● Energy engineers apply scientific principles and environmental processes to develop sustainable energy solutions that increase global efficiency and reduce waste. ● CAD software is a critical design tool that allows engineers to model and refine complex energy systems before construction. ● The Glowforge laser cutter provides the capability to rapidly fabricate custom, precision components that are essential for building energy-efficient prototypes and models. ● Solar panels operate by converting light into electrical energy, serving as a primary technology in the shift toward sustainable power. ● Renewable energy sources—including wind, tidal, hydroelectric, and biomass—operate on distinct physical principles, each offering unique advantages for large-scale energy production. ● Energy engineers must solve multi-faceted problems that balance technical efficiency, economic viability, and environmental sustainability in every project.

Evidence of Learning		
Formative & Alternative Assessments: ● Each Step of the Engineering design process will be turned in: 1. Ask to identify the need and constraints 2. Research the problem	**Benchmark & Summative Assessments:** ● Solar Panel Project (Summative) ● Generator Project/ Presentation	**Resources Needed:** ● Google classroom ● Internet resources ● Youtube.com ● Teachengineering.org ● Project materials ● Classroom tools and machines ● Glowforge

3. Imagine possible solutions 4. Plan by selecting a promising solution 5. Create a prototype 6. Test and evaluate the prototype 7. Improve and redesign as needed ● Individual student check-ins with teacher		● CAD software

Section IX: Unit Reflection

The *Engineering II* instructional team must confer upon the completion of each instructional unit in the *Engineering II* curriculum and rate the degrees to which the instructional units meet performance criteria established by the New Jersey Department of Education using the Unit Reflection Form. Completed unit reflection forms should be used by the instructional team for future modifications within the *Engineering II* curriculum.

Unit Reflection Form: *Engineering II*			
Lesson Activities:	**Strongly**	**Moderately**	**Weakly**
Foster student use of technology as a tool to develop critical thinking, creativity, and innovation skills;			
Are challenging and require higher-order thinking and problem-solving skills;			
Allow for student choice;			
Provide scaffolding for acquiring targeted knowledge/skills;			
Integrate modern, global perspectives, especially those regarding diversity, genocide, global issues, and historical ones regarding racial relations;			
Integrate 21st century skills;			
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills;			
Are varied to address different student learning styles and preferences;			
Are differentiated based on student needs;			
Are student-centered, with the teacher acting as a facilitator and co-learner during the teaching and learning process;			
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives;			
Provide opportunities for student reflection and self-assessment;			

Provide data to inform and adjust instruction to better meet the varying needs of learners.			

Appendix

Writing Instruction and the RFH Community

Writing instruction should happen across the RFH Community. Writing across the curriculum is a philosophy that advances the belief that writing is a method of learning. Since all departments are committed to helping students learn, writing must be used as a methodology to advance student learning.

Each academic discipline has its own unique conventions, formats and structures. It is the responsibility of each department to agree upon domain-specific writing praxes, model them for students, and require them to utilize them on a consistent basis. Students must understand that acceptable writing in one domain may not be acceptable writing in another area. The development of domain-specific writing skills supports the overall development of the student writer because all writing is grounded in the writing situation: audience, context, purpose, subject, and writer. Representatives from the academic disciplines must share their domain-specific writing praxes with each other, identify intersections, and determine how to address perceived gaps that limit student learning.

Students must experience writing situations that help them learn how to think creatively and critically and communicate effectively in the academic disciplines. Writing instruction, regardless of the academic discipline, must always reinforce student understanding of the writing situation. When students experience writing situations, they must study examples of domain-specific writing in order to understand how writers communicate in discipline-related contexts. This does not mean information embedded in textbooks. Domain-specific writing is writing that is used to inform and influence readers as it draws them into an established circle of discourse. Students must use these non-fiction texts to develop the close reading skills that will shape their own writing. Focused engagement with domain-specific writing should not be limited to basic reading comprehension and topical understanding. It must also include the analysis of the writing situation that is represented in the text: audience, context, purpose, subject, and writer. The close reading of well-written texts—regardless of the domain—will show students the importance of writing mechanics, diction, and syntax. The development of close reading skills will also help the students grow in terms of their ability to construct and advance independent and original claims that are well-supported by evidence. Domain-specific writing is grounded in positioning of claims and the effective use of evidence.

The final written product is important; nevertheless, the learning that results in this production must not be devalued. The writing process is not limited to the basic steps of planning, drafting, revising, and editing/proofreading. It is a complex sequence of critical and creative thinking and writing that leads to the production of a text that provides evidence of learning and understanding. Students must ultimately develop the ability to self-assess the effectiveness of their writing as a representation of the writing situation. Without the use of models that evidence learning and understanding, students will not develop the ability to self-assess their own work—the true outcome of the writing process.

What types of writing situations should RFH students engage in?

RFH students should engage in writing situations across the curriculum that require them to:

- write to improve mechanical proficiency, diction usage, and syntactical sophistication
- write to narrate, describe, and reflect
- write to summarize and report
- write to classify and define
- write to explain how process leads to an outcome
- write to compare, contrast and evaluate
- write to speculate on cause and effect
- write to propose solutions and solve problems
- write to analyze

These writing situations should be positioned in a coordinated, developmental sequence that extends across the academic disciplines.

Upon Completion of Grade 12, RFH students must be ready to transition to the following writing situations:

- write to analyze
- write to persuade (argument)

The core foci of first-year college writing courses are analysis and argument. These courses orient the students to the demands and expectations of writing for the academic culture of college. At colleges/universities with carefully coordinated writing programs, students must demonstrate proficiency in analysis and argument before they transition to upper level courses that require them to engage in the following writing situation:

- write to investigate (research)