Principles of Applied Engineering

Abell Junior High | Academic Year: 2026–2027 | Length of Course: 1 Year **Semester:** S1/S2
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Course Description

Principles of Engineering is a year-long, project-based course that introduces students to engineering design, computer-aided design (CAD), manufacturing, mechanical systems, robotics, automation, and emerging technologies.

Students will learn how engineers identify problems, develop solutions, create prototypes, test ideas, and improve designs using the Engineering Design Process. Throughout the year, students will create digital models, manufacture prototypes using 3D printers and a laser cutter, build and program LEGO® Mindstorms EV3 robots, and explore the engineering applications of unmanned aircraft systems (UAS) using a DJI Mini 5 drone.

The course begins with engineering design fundamentals, measurement, technical documentation, and Tinkercad. Students will develop foundational 3D modeling skills and work toward Tinkercad certification. As students develop a stronger understanding of 3D modeling, they will transition to Onshape to learn parametric modeling and more advanced engineering design techniques.

The iCEV Digital Curriculum Platform will be used throughout the course to support Texas Principles of Applied Engineering TEKS, career exploration, technical instruction, and assessment. Students will complete an iCEV pre-test at the beginning of the course and a post-test near the end of the school year. Standards assessed through iCEV will be incorporated into classroom instruction and reinforced through hands-on activities and projects.

The goal of this course is to give students a strong foundation for future high school engineering and CTE pathways while developing technical skills, problem-solving abilities, teamwork, communication, and engineering thinking.

Course Objectives

By the end of this course, students will be able to:

1. Apply the Engineering Design Process to solve real-world problems.
2. Identify engineering problems, criteria, constraints, and design requirements.
3. Generate, compare, and evaluate multiple possible solutions.
4. Maintain an engineering notebook documenting ideas, sketches, measurements, testing, and design revisions.
5. Use clear written, verbal, and visual communication to present engineering ideas.
6. Use appropriate measurement tools and consistent units.
7. Create technical sketches and accurate 3D models using Tinkercad.
8. Work toward Tinkercad certification.
9. Create parametric CAD models using Onshape.
10. Understand basic engineering drawing and visualization concepts.
11. Design and manufacture prototypes using 3D printing and laser-cutting technologies.

12. Compare material properties and select materials for engineering applications.
13. Explain and apply concepts related to simple machines and mechanical systems.
14. Explore basic electrical and electromechanical systems.
15. Build and program robotic systems using LEGO® Mindstorms EV3.
16. Use motors, sensors, programming, and feedback to develop automated solutions.
17. Analyze how technology affects individuals, society, industry, and the environment.
18. Work effectively as part of an engineering design team.
19. Test, evaluate, and improve engineering solutions.
20. Communicate final engineering solutions through presentations, CAD models, prototypes, engineering notebooks, and technical documentation.

Instructional Materials & Supplies

Classroom Equipment (Provided)

- LEGO Mindstorms EV3 Robotics Kits
- 3D Printers
- Laser Cutter
- Digital Calipers
- Metric Rulers
- Engineering Design Materials

Technology Resources

- Chromebook
- Tinkercad
- Onshape
- iCEV Digital Curriculum Platform
- Google Classroom
- Google Workspace Applications

Student Supplies (suggested)

- Engineering Notebook
- Pencil
- Bluetooth Mouse (Recommended)

Course Organization

The school year is divided into **four 9-week grading periods**.

Each grading period will include at least **20 graded assignments**:

- **18 Minor Assignments**
- **2 Major Assignments**

Minor assignments are used to develop and check individual skills throughout the grading period. Major assignments allow students to demonstrate mastery by applying multiple engineering skills to a larger project or assessment.

Course Outline

Grading Period 1: Engineering Design, Measurement & Tinkercad

Weeks 1–9

Focus

- Introduction to Applied Engineering
- Engineering Careers
- Professionalism
- Engineering Design Process
- Criteria and Constraints
- Engineering Notebooks
- Technical Communication
- Measurement and Precision
- Digital Calipers and Metric Measurement
- Technical Sketching
- Introduction to Computer-Aided Design
- Tinkercad Fundamentals
- Precision 3D Modeling
- Designing for 3D Printing
- Tinkercad Certification Preparation

Students will begin by completing the iCEV pre-test to establish baseline knowledge. Results will help identify concepts that require additional instruction throughout the year.

Students will learn how engineers approach problems while developing foundational CAD, measurement, documentation, and communication skills.

iCEV / TEKS Connections

- Professionalism in the Sciences: 2.A, 2.F
- Introduction to Applied Engineering: 1.A
- STEM Careers: 1.E
- Engineering Design: 1.G, 10.B, 10.C, 10.F, 10.G, 10.H, 10.I, 5.A, 5.C, 5.E
- Engineering Notebooks: 2.A, 2.B, 2.E
- Basic Computer-Aided Drawing: 2.C, 2.D, 9.A–9.H

- Mathematical Principles – Measurements: 3.H, 5.D

Major Assignments

Major 1: Engineering Design & Tinkercad Project
Students will identify a problem, develop multiple concepts, create a CAD model, and document the design process.

Major 2: Tinkercad Design Challenge / Certification Assessment
Students will demonstrate their ability to create accurate and functional 3D models using Tinkercad.

Grading Period 2: Product Design, Manufacturing & Mechanical Systems

Weeks 10–18

Focus

- Product Design
- User-Centered Design
- Criteria and Constraints
- Material Properties
- Material Selection
- Laboratory Safety
- Equipment Safety
- Manufacturing Processes
- 3D Printing
- Laser Cutting
- Electromechanical Systems
- Simple Machines
- Levers
- Pulleys
- Gears
- Mechanical Advantage
- Motion Transfer
- Team Problem Solving
- Prototype Testing
- Design Iteration

Students will move from digital design into physical manufacturing. They will investigate how materials, manufacturing processes, mechanical systems, and safety affect engineering decisions.

Students will also begin exploring how electrical and mechanical components work together in electromechanical systems.

iCEV / TEKS Connections

- Electromechanical Systems: 1.B, 1.C, 1.D, 7.A, 7.B, 7.C
- Safety Testing & Material Properties: 3.A, 5.B
- Lab Safety: 3.B, 3.C, 3.D, 3.E, 3.F, 3.G
- Team Problem Solving: 8.A, 8.B, 8.C, 8.F
- Design Challenge – Cranes & Compound Pulleys: 10.H
- Design Challenge concepts: 8.D, 8.E, 10.H

Major Assignments

Major 1: Product Design & Manufacturing Project
Students will design and manufacture a product or solution using CAD, 3D printing, laser cutting, or a combination of manufacturing methods.

Major 2: Mechanical Systems Design Challenge
Students will design, construct, test, and improve a mechanical system involving concepts such as gears, pulleys, levers, or motion transfer.

Grading Period 3: Onshape, Robotics & Automation

Weeks 19–27

Focus

- Introduction to Onshape
- Parametric Modeling
- Sketch Constraints
- Dimensions
- Extrusions and Features
- Assemblies
- Engineering Drawings
- Electromechanical Systems
- Basic Electronic Theory
- Robotics Fundamentals
- Motors and Controllers
- Sensors and Inputs
- Programming Fundamentals
- Loops and Conditional Logic
- Open- and Closed-Loop Systems
- Automation
- Team Problem Solving

Students will transition from Tinkercad to Onshape and begin using a more advanced engineering CAD workflow.

Students will also use LEGO® Mindstorms EV3 systems to investigate robotics, sensors, motors, programming, and automation.

Basic electronic theory will be introduced at an age-appropriate level to support students' understanding of electrical, robotic, and electromechanical systems.

iCEV / TEKS Connections

- Basic Computer-Aided Drawing: 2.C, 2.D, 9.A–9.H
- Electromechanical Systems: 1.B, 1.C, 1.D, 7.A, 7.B, 7.C
- Robotics Basics: 10.G, 6.A, 6.B, 6.C, 6.D
- Basic Electronic Theory: 7.D
- Team Problem Solving: 8.A, 8.B, 8.C, 8.F
- Model Development and Testing: 8.D, 8.E

Major Assignments

Major 1: Onshape Engineering Design Project
Students will create an accurate engineering model using parametric modeling techniques and apply the design to a manufactured or functional product.

Major 2: Robotics & Automation Challenge
Students will design, build, program, test, and improve a robotic system that completes a defined engineering task.

Grading Period 4: Emerging Technologies, Drones & Engineering Capstone

Weeks 28–36

Focus

- Impact of Technology
- Emerging Technologies
- Drone Technology
- Unmanned Aircraft Systems
- Drone Components and Systems
- Flight Safety
- Sensors and Automation
- Applications of Drones in Industry
- Engineering Careers
- Engineering Ethics
- Technology and Society
- Research and Problem Identification
- Design Requirements
- CAD Modeling
- Prototype Development
- Testing and Data Collection
- Decision Matrices

- Design Iteration
- Technical Communication
- Engineering Capstone

The DJI Mini 5 will be used primarily for instructor-guided demonstrations and engineering activities.

Students will explore how unmanned aircraft systems are used in fields such as:

- Agriculture
- Construction
- Infrastructure Inspection
- Mapping
- Transportation
- Photography
- Public Safety

Students will also examine how new technologies can create both intended and unintended changes in society.

The year concludes with an Engineering Capstone Project in which students apply the skills developed throughout the course to solve an open-ended engineering problem.

iCEV / TEKS Connections

- Impact of Technology: 1.F, 4.A, 4.B, 4.C, 4.D
- Robotics Basics: 10.G, 6.A, 6.B, 6.C, 6.D
- STEM Careers: 1.E
- Engineering Design: 1.G, 5.A, 5.C, 5.E
- Applied Engineering Capstone: 10.A–10.I, 2.E

Major Assignments

Major 1: Emerging Technology / UAS Engineering Project
Students will investigate an emerging technology or drone application and develop an engineering solution, design, or presentation related to its use.

Major 2: Engineering Capstone Project
Students will identify a real-world problem, research the problem, develop multiple solutions, select a preferred solution, create a prototype or model, test the solution, improve the design, and present their final results.

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iCEV Digital Curriculum & Assessment

iCEV will be used as a supporting instructional and assessment resource throughout the course.

Beginning-of-Year Pre-Test

Students will complete the iCEV Principles of Applied Engineering pre-test near the beginning of the school year.

The pre-test will be used to:

- Establish baseline student knowledge
- Identify strengths and areas requiring additional instruction
- Guide instructional planning
- Measure student growth throughout the year

The pre-test is intended primarily as a diagnostic assessment.

Instruction Throughout the Year

The engineering standards assessed through iCEV will be taught through a combination of:

- Teacher Instruction
- iCEV Lessons
- Engineering Demonstrations
- Engineering Notebook Activities
- Measurement Labs
- CAD Activities
- 3D Printing and Laser Cutting
- Mechanical Design Challenges
- Robotics Activities
- Drone and Emerging Technology Activities
- Team Design Projects
- Engineering Capstone Activities

Whenever possible, concepts introduced through iCEV will be connected to a hands-on engineering experience.

End-of-Year Post-Test

Students will complete the iCEV Principles of Applied Engineering post-test near the end of the school year.

Results will be used to:

- Measure student growth
- Evaluate mastery of engineering concepts
- Identify areas for future instructional improvement
- Provide evidence of student learning across the year-long course

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Grading

Students will receive approximately **20 grades during each 9-week grading period**.

Minor Assignments – 18 Per Grading Period

Minor assignments may include:

- Engineering Notebook Entries
- iCEV Assignments
- Quizzes
- Skill Checks
- Measurement Labs
- CAD Exercises
- Robotics Activities
- Design Process Activities
- Technical Sketches
- Reflections
- Career Exploration Activities
- Classwork

Major Assignments – 2 Per Grading Period

Major assignments may include:

- Engineering Design Projects
- CAD Projects
- Manufacturing Projects
- Mechanical Design Challenges
- Robotics Projects
- Presentations
- Engineering Capstone Projects
- Major Assessments

Student grades will be recorded and available through **PowerSchool**.

Engineering Notebook

Students will maintain an engineering notebook throughout the course.

The notebook will be used to document:

- Problem Statements
- Research
- Brainstorming
- Sketches
- Measurements
- Calculations
- Design Decisions

- Testing Data
- Failures and Problems
- Design Changes
- Reflections

The engineering notebook is an important part of the engineering process and will be used regularly throughout all four grading periods.

Career Exploration

Engineering career exploration will be incorporated throughout the year rather than taught as a separate unit.

Students will explore careers related to:

- Mechanical Engineering
- Civil Engineering
- Electrical Engineering
- Aerospace Engineering
- Robotics Engineering
- Manufacturing Engineering
- Industrial Design
- Engineering Technology
- Computer-Aided Design
- Automation
- Unmanned Aircraft Systems

Students will investigate how education, training, certifications, and technical skills connect to different engineering careers.

Classroom Expectations

Students are expected to:

- Arrive prepared and ready to participate.
- Maintain an organized engineering notebook.
- Follow classroom and laboratory safety procedures.
- Respect classmates, tools, equipment, and technology.
- Participate actively in engineering activities and projects.
- Work collaboratively with team members.
- Complete assignments and projects on time.
- Use technology responsibly.
- Demonstrate perseverance when designs do not work as expected.

Engineering involves testing, failure, redesign, and improvement. Students are expected to learn from unsuccessful designs and use those experiences to improve their solutions.

Safety & Equipment Use

Safety is an essential part of engineering.

Students must:

- Complete required safety instruction and assessments.
- Follow all classroom and laboratory safety procedures.
- Use tools and equipment only as instructed.
- Wear required personal protective equipment when necessary.
- Report damaged tools or equipment immediately.
- Use robotics and manufacturing equipment responsibly.
- Operate specialized equipment only with teacher permission and supervision.

The DJI Mini 5 will be used only during approved, instructor-supervised activities and in accordance with applicable school, district, and flight-safety requirements.

Failure to follow safety procedures may result in loss of laboratory or equipment privileges.

Attendance & Participation

- Principles of Engineering is a hands-on, project-based course. Regular attendance and participation are important for student success.
- Students are responsible for completing missed assignments and project work according to district guidelines.

Academic Integrity

- Students are expected to submit original work and appropriately acknowledge information or ideas obtained from other sources.
- Engineering depends on accurate documentation, responsible use of information, and professional conduct.
- Cheating, plagiarism, or inappropriate use of technology will be addressed according to district policy.

Parent/Guardian Communication

- Student grades will be available through **PowerSchool**.
- Parents and guardians are encouraged to monitor student progress and contact the instructor with questions or concerns.
- Communication between students, families, and the instructor is an important part of student success in Principles of Engineering.

Acknowledgment of Understanding

Please return this signed page by 01/13.

Student Name: _____ **Signature:** _____

Guardian Name: _____ **Signature:** _____

Preferred Contact (Email/Phone): _____

Go to www.midlandisd.net/cte to find more information regarding CTE Nondsicrimination.