

Engineering Essentials (PLTW) YAG

Middle School Delivery | One High School Elective Credit | Full Year | 36 Weeks | PLTW Activity-, Project-, Problem-Based Curriculum

Course Information: Texas-approved innovative course: Engineering Essentials (PLTW), PEIMS N1303760, abbreviation ENGESS, 1.0 elective credit. The state framework lists Grades 9–12 and no prerequisite. This YAG preserves the PLTW Engineering Essentials sequence—Unit 1 Inclined to Design, Unit 2 Make it Move, Unit 3 Power it Up, and Unit 4 Make a Plan—while supporting local delivery at the middle school level as the broad introduction to the district engineering pathway. Instruction emphasizes engineering mindset, design process, systems and computational thinking, experimental design, modeling, statistical/mathematical analysis, project management, communication, collaboration, professionalism, ethics, and career awareness. ACCESS may support career and postsecondary exploration.

GP	Wks	Unit & Focus	Major Learning Tasks & Assessments	Integrated EKS / PLTW Domains	Extension Activities
1	1–3	PLTW Unit 1 – Inclined to Design Lesson 1.1: Engineers and Engineering	- Explore perceptions of engineers, engineering disciplines and how engineering improves lives - Develop engineering-mindset habits including curiosity, perseverance, adaptability and evidence-based decision making - Investigate global engineering challenges and select a challenge of personal/community significance - Research credible evidence and create a persuasive technical presentation - Establish engineering notebook, collaboration and professional communication routines	- Engineering Mindset - Career Awareness - Communication - Collaboration - Professionalism & Ethics	- ACCESS: engineering pathway exploration - Global challenge presentation - Engineering career profile
1	4–6	PLTW Unit 1 – Inclined to Design Lesson 1.2: Systems and the Engineering Design Process	- Introduce systems, subsystems, inputs/outputs and systems thinking - Apply an iterative engineering design process to define and address a need - Use geographic information systems (GIS) to investigate natural and human-made systems - Practice computational thinking and modeling to interpret spatial information - Introduce project-management tools, schedules and documentation	- Design Process - Systems Thinking - Computational Thinking - Modeling - Project Management	- GIS exploration - Systems map - Design-process mini challenge
1	7–8	PLTW Unit 1 – Inclined to Design Lesson 1.3: Product Design	- Explore ethical perspectives and ethical implications of engineering decisions - Design an experiment to gain information needed for a design decision - Analyze physical properties, sustainability and design trade-offs - Use data/evidence to compare product concepts - Communicate a justified design recommendation	- Experimental Design - Physical Properties - Engineering Mindset - Professionalism & Ethics - Modeling	- Product investigation - Ethics scenario - Experimental design task
1	9	PLTW Unit 1 – Inclined to Design Lesson 1.4: Natural Disaster Relief Center	- Use GIS maps/layers to define a natural-disaster response problem - Work independently and collaboratively to develop a relief-center system - Apply systems thinking, project management and the engineering design process - Evaluate social, environmental and logistical considerations - Present and defend the proposed system	- Design Process - Systems Thinking - Modeling - Project Management - Communication & Collaboration	- Relief-center design review - GIS map product - Community-response connection
2	10–12	PLTW Unit 2 – Make it Move Lesson 2.1: Machines / Statics	- Investigate simple and compound machines and their applications - Develop conceptual, graphic, mathematical, computer and physical models - Use experimental design to test a compound machine against criteria - Develop introductory 3-D solid-modeling skills - Design a working mechanical model incorporating a prototyped/3-D modeled component	- Physical Properties - Modeling - Experimental Design - Design Process - Computational Thinking	3-D modeling activity - Machine investigation - Prototype build
2	13–14	PLTW Unit 2 – Make it Move Lesson 2.2: Mechanical Motion	- Calculate and interpret gear ratio and mechanical advantage - Explore linear, rotational and other types of motion and motion conversion - Use mathematical models to predict mechanical-system behavior - Compare limitations of conceptual, computer, mathematical and physical models - Apply the design process to reduce effort or improve mechanical performance	- Mathematical Modeling - Modeling - Computational Thinking - Design Process - Physical Properties	- Gear/mechanical advantage challenge - Motion-conversion model - Data analysis

2	15–17	PLTW Unit 2 – Make it Move Lesson 2.3: Mechanical Systems	• Integrate mechanical concepts into a solution intended to improve people's lives • Apply design process, experimental design, systems thinking and project management • Develop a testable prototype and collect performance data • Use statistical/mathematical evidence to refine the mechanical solution • Present the final mechanical system and reflect on societal impact and team performance	• Design Process • Experimental Design • Systems Thinking • Project Management • Statistical Analysis • Communication & Collaboration	• Mechanical systems project • Peer review • Technical presentation
2	18	Semester 1 Exam – Engineering Essentials	• Cumulative written/performance assessment • Engineering mindset, design process, systems, GIS, ethics, modeling and mechanical-system application • Engineering notebook and Semester 1 portfolio review	• Cumulative Unit 1–2 EKS/domains	• Targeted review/remediation
3	19–22	PLTW Unit 3 – Power it Up Lesson 3.1: Energy Conversion	• Investigate energy forms, electrical generation, transfer and societal impact • Identify circuit components and represent circuits with physical, schematic and computer models • Measure voltage, current and resistance safely • Design experiments and analyze data to determine mathematical relationships in circuits • Use mathematical modeling to apply voltage-current-resistance relationships	• Experimental Design • Modeling • Mathematical Modeling • Physical Properties • Systems Thinking	• Circuit investigation • Energy-use analysis • Circuit simulation
3	23–25	PLTW Unit 3 – Power it Up Lesson 3.2: Logic	• Represent digital inputs/outputs using truth tables and logic expressions • Investigate logic gates and build/simulate digital circuits • Apply computational and algorithmic thinking to control-system problems • Program a microcontroller for data collection, sensing and actuation • Collaboratively design an input/control device using multiple sensors	• Computational Thinking • Modeling • Design Process • Systems Thinking • Collaboration	• Logic-gate challenge • Microcontroller programming • Sensor/input device
3	26–27	PLTW Unit 3 – Power it Up Lesson 3.3: Electromechanical Systems	• Integrate electrical, digital, mechanical and programmed components • Develop a proof-of-concept electromechanical prototype to perform specified functions • Use project-management tools and team roles during development • Test, analyze and improve system performance • Apply ethical engineering practice and communicate technical decisions	• Design Process • Systems Thinking • Project Management • Experimental Design • Professionalism & Ethics • Communication & Collaboration	• Electromechanical prototype • Formal test report • Design review
4	28–30	PLTW Unit 4 – Make a Plan Lesson 4.1: Urban Design	• Analyze population growth, urbanization and infrastructure challenges • Investigate urban subsystems that support high-density communities • Evaluate risk, trade-offs and environmental/social/economic impacts • Collaboratively develop an urban redevelopment plan • Use evidence and systems thinking to justify design decisions	• Systems Thinking • Engineering Mindset • Design Process • Professionalism & Ethics • Communication & Collaboration	• Urban redevelopment plan • Risk/trade-off analysis • Career connection
4	31–32	PLTW Unit 4 – Make a Plan Lesson 4.2: Maps as Models	• Use online GIS tools to support engineering and urban-planning decisions • Collect, organize and interpret geospatial data • Produce maps that model spatial information • Apply GIS to feasibility, traffic, flood, waste or other infrastructure scenarios • Evaluate limitations and reliability of geospatial data/models	• Modeling • Computational Thinking • Engineering Mindset • Systems Thinking • Communication	• GIS feasibility study • Geospatial data collection • Technical map
4	33–34	PLTW Unit 4 – Make a Plan Lesson 4.3: The Sustainable Urban Environment	• Investigate sustainable urban systems and infrastructure • Analyze environmental, social and economic trade-offs • Use data, mathematical/statistical analysis and models to compare alternatives • Apply design and systems thinking to improve an urban environment • Document and communicate evidence-based recommendations	• Systems Thinking • Statistical Analysis • Mathematical Modeling • Design Process • Professionalism & Ethics	• Sustainability analysis • Data/model comparison • Design recommendation

4	35	PLTW Unit 4 – Make a Plan Lesson 4.4: A Better Place	• Integrate GIS, systems thinking, sustainability and engineering design in the culminating PLTW problem • Develop and refine a solution to improve community safety, function or well-being • Use project management and peer review to complete deliverables • Present technical evidence, models and design rationale to an audience • Reflect on engineering careers, personal growth and readiness for the district's high-school engineering pathway	• All Engineering Essentials EKS/domains	• Community design presentation • Engineering portfolio • ACCESS: pathway transition
4	36	Semester 2 Exam & Engineering Essentials Showcase	• Cumulative written/performance assessment • Electrical/electromechanical systems, urban systems, GIS, sustainability and integrated engineering application • Final engineering portfolio, project presentation and reflection	• Cumulative all EKS/domains	• Family/stakeholder showcase

Engineering Essentials (PLTW) Essential Knowledge and Skills Coverage Checklist

Coverage verification: The Texas Engineering Essentials innovative-course framework is integrated across the PLTW sequence. The checklist below uses the framework's recurring knowledge-and-skill domains so the PLTW curriculum remains intact while every required area is intentionally taught and assessed.

EKS Domain	Knowledge & Skills Focus	YAG Placement	Coverage
Engineering Mindset	Self-direction, creativity, adaptability, perseverance, evidence-based judgment	Units 1–4; recurring APB work	100%
Design Process	Problem definition, criteria/constraints, ideation, selection, development, testing and iteration	Units 1–4	100%
Systems Thinking	Systems/subsystems, interactions, impacts, trade-offs and interconnected decisions	Units 1, 2, 3 and 4	100%
Computational Thinking	Algorithms, data, digital tools, simulation and computational problem solving	Units 1–4; especially 3	100%
Experimental Design	Questions, variables, procedures, measurement, testing, data and evidence	Units 1–3; reinforced Unit 4	100%
Physical Properties	Material/component/system properties that influence engineering solutions	Units 1–3; reinforced Unit 4	100%
Modeling	Conceptual, graphic, GIS, 3-D, physical, circuit, mathematical and other models	Units 1–4	100%
Mathematical Modeling	Quantitative relationships used to represent/predict engineering behavior	Units 2–4	100%
Statistical Analysis	Collection, representation, analysis and interpretation of data for decisions	Units 2–4	100%
Career Awareness	Engineering fields, roles, pathways and professional practice	Units 1–4	100%
Professionalism & Ethics	Ethical reasoning, societal impacts, responsibility and professional behavior	Units 1–4	100%
Project Management	Planning, schedules, responsibilities, progress monitoring and deliverables	Units 1–4	100%
Collaboration	Team roles, consensus, feedback, peer review and shared problem solving	Units 1–4	100%
Communication	Technical writing, notebooks, visual/model-based communication and presentations	Units 1–4	100%

Implementation Notes

- Preserve the PLTW activity-, project-, problem-based instructional sequence. The four PLTW units and lesson order are the primary pacing structure rather than substituting unrelated engineering units.
- The official Texas innovative-course framework identifies Engineering Essentials as a one-credit elective for Grades 9–12 with no prerequisite. Local middle-school delivery should follow district credit, enrollment, teacher-training, and innovative-course implementation requirements.
- PLTW identifies GIS, 3-D solid modeling, prototyping, experimental design, testing, project management, peer review, statistical analysis, mathematical modeling, computational thinking, collaboration, communication, and ethical reasoning as important recurring experiences in Engineering Essentials.
- The progression is intentionally introductory and broad. It should prepare students for later district engineering courses by building confidence with design, mechanical systems, electrical/electromechanical systems, modeling, GIS, data, documentation, teamwork, and engineering problem solving without duplicating an advanced high-school course.
- Weeks 18 and 36 are reserved for cumulative semester exams. No PLTW unit crosses the semester boundary: Units 1–2 are completed in Semester 1 and Units 3–4 in Semester 2.