# Unit 05: Civil Engineering and Site Planning

Content Area: **Applied Technology**
Course(s):
Time Period: **Marking Period 3**
Length: **3 weeks**
Status: **Published**

## Summary

Introduction

Students will gain and develop knowledge and understandings related to civil engineering and site planning. Students will develop previously and newly learned CAD skills to employ this program as a tool to communicate a design of systems that relate to civil engineering. The plans will incorporate design features that include traffic, parking, and drainage.

Revision Date: July 2021

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| MA.A-SSE | Seeing Structure in Expressions |
| LA.RH.11-12 | Reading History |
| MA.A-SSE.A | Interpret the structure of expressions |
| | Key Ideas and Details |
| MA.A-SSE.A.1 | Interpret expressions that represent a quantity in terms of its context. |
| LA.RH.11-12.1 | Accurately cite strong and thorough textual evidence, (e.g., via discussion, written response, etc.), to support analysis of primary and secondary sources, connecting insights gained from specific details to develop an understanding of the text as a whole. |
| MA.A-SSE.A.1a | Interpret parts of an expression, such as terms, factors, and coefficients. |
| LA.RH.11-12.2 | Determine the theme, central ideas, information and/or perspective(s) presented in a primary or secondary source; provide an accurate summary of how key events, ideas and/or author's perspective(s) develop over the course of the text. |
| LA.RH.11-12.3 | Evaluate various perspectives for actions or events; determine which explanation best accords with textual evidence, acknowledging where the text leaves matters uncertain. |
| LA.WHST.11-12 | Writing History, Science and Technical Subjects |
| | Text Types and Purposes |
| LA.WHST.11-12.1 | Write arguments focused on discipline-specific content. |
| SCI.HS-ESS3 | Earth and Human Activity |
| | Constructing Explanations and Designing Solutions |
| SCI.HS-ESS3-2 | Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. |
| | Engaging in Argument from Evidence |
| SCI.HS-ESS3-3 | Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. |
| | Using Mathematics and Computational Thinking |
| SCI.HS-ESS3-4 | Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural systems. |
| | Analyzing and Interpreting Data |

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| SCI.HS-ESS3-6 | Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity (i.e., climate change). |
| | Using Mathematics and Computational Thinking |
| SCI.HS-ETS1 | Engineering Design |
| SCI.HS-ETS1-1 | Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. |
| | Asking Questions and Defining Problems |
| SCI.HS.ETS1.A | Delimiting Engineering Problems |
| | Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. |
| SCI.HS-ETS1-2 | Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. |
| | Using Mathematics and Computational Thinking |
| SCI.HS.ETS1.B | Developing Possible Solutions |
| | Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. |
| CS.9-12.8.2.12.EC.1 | Analyze controversial technological issues and determine the degree to which individuals, businesses, and governments have an ethical role in decisions that are made. |
| CS.9-12.8.2.12.EC.2 | Assess the positive and negative impacts of emerging technologies on developing countries and evaluate how individuals, non-profit organizations, and governments have responded. |
| CS.9-12.8.2.12.EC.3 | Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology on the individual, culture, society, and environment and share this information with the appropriate audience. |
| CS.9-12.8.2.12.ED.1 | Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers. |
| CS.9-12.8.2.12.ED.2 | Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback. |
| CS.9-12.8.2.12.ED.3 | Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis. |
| CS.9-12.8.2.12.ETW.4 | Research historical tensions between environmental and economic considerations as driven by human needs and wants in the development of a technological product and present the competing viewpoints. |
| CS.9-12.EC | Ethics & Culture |
| CS.9-12.ED | Engineering Design |
| CS.9-12.NT | Nature of Technology |
| CRP.K-12.CRP7 | Employ valid and reliable research strategies. |
| CRP.K-12.CRP7.1 | Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices in their workplace situation. |

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| CRP.K-12.CRP8 | Utilize critical thinking to make sense of problems and persevere in solving them. |
| CRP.K-12.CRP8.1 | Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others. |
| CRP.K-12.CRP9 | Model integrity, ethical leadership and effective management. |
| CRP.K-12.CRP9.1 | Career-ready individuals consistently act in ways that align personal and community-held ideals and principles while employing strategies to positively influence others in the workplace. They have a clear understanding of integrity and act on this understanding in every decision. They use a variety of means to positively impact the directions and actions of a team or organization, and they apply insights into human behavior to change others' action, attitudes and/or beliefs. They recognize the near-term and long-term effects that management's actions and attitudes can have on productivity, morals and organizational culture. |
| CRP.K-12.CRP10 | Plan education and career paths aligned to personal goals. |
| CRP.K-12.CRP10.1 | Career-ready individuals take personal ownership of their own education and career goals, and they regularly act on a plan to attain these goals. They understand their own career interests, preferences, goals, and requirements. They have perspective regarding the pathways available to them and the time, effort, experience and other requirements to pursue each, including a path of entrepreneurship. They recognize the value of each step in the education and experiential process, and they recognize that nearly all career paths require ongoing education and experience. They seek counselors, mentors, and other experts to assist in the planning and execution of career and personal goals. |
| CRP.K-12.CRP11 | Use technology to enhance productivity. |
| SCI.HS-ETS1-2 | Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. |
| SCI.HS-ETS1-4 | Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. |
| SCI.HS-ETS1-3 | Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. |
| SCI.HS-ETS1-1 | Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. |
| WRK.9.2.12.CAP | Career Awareness and Planning |
| WRK.9.2.12.CAP.4 | Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment. |
| WRK.9.2.12.CAP.5 | Assess and modify a personal plan to support current interests and post-secondary plans. |
| WRK.9.2.12.CAP.6 | Identify transferable skills in career choices and design alternative career plans based on those skills. |
| TECH.8.1.12 | Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge. |
| TECH.8.1.12.A | Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations. |
| TECH.8.1.12.A.1 | Create a personal digital portfolio which reflects personal and academic interests, |

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| | achievements, and career aspirations by using a variety of digital tools and resources. |
| TECH.8.1.12.A.2 | Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review. |
| TECH.8.1.12.A.CS1 | Understand and use technology systems. |
| TECH.8.1.12.A.CS2 | Select and use applications effectively and productively. |
| TECH.8.1.12.C | Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. |
| TECH.8.1.12.C.1 | Develop an innovative solution to a real world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community. |
| TECH.8.1.12.C.CS1 | Interact, collaborate, and publish with peers, experts, or others by employing a variety of digital environments and media. |
| TECH.8.1.12.D | Digital Citizenship: Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. |
| TECH.8.1.12.F | Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. |
| TECH.8.1.12.F.CS1 | Identify and define authentic problems and significant questions for investigation. |
| TECH.8.2.12 | Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment. |
| TECH.8.2.12.A | The Nature of Technology: Creativity and Innovation: Technology systems impact every aspect of the world in which we live. |
| TECH.8.2.12.A.1 | Propose an innovation to meet future demands supported by an analysis of the potential full costs, benefits, trade-offs and risks, related to the use of the innovation. |
| TECH.8.2.12.A.2 | Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste. |
| TECH.8.2.12.A.3 | Research and present information on an existing technological product that has been repurposed for a different function. |
| TECH.8.2.12.A.CS1 | The characteristics and scope of technology. |
| TECH.8.2.12.A.CS2 | The core concepts of technology. |
| TECH.8.2.12.A.CS3 | The relationships among technologies and the connections between technology and other fields of study. |
| TECH.8.2.12.B | Technology and Society: Knowledge and understanding of human, cultural and society values are fundamental when designing technology systems and products in the global society. |
| TECH.8.2.12.B.4 | Investigate a technology used in a given period of history, e.g., stone age, industrial revolution or information age, and identify their impact and how they may have changed to meet human needs and wants. |
| TECH.8.2.12.B.5 | Research the historical tensions between environmental and economic considerations as driven by human needs and wants in the development of a technological product, and present the competing viewpoints to peers for review. |
| TECH.8.2.12.B.CS3 | The role of society in the development and use of technology. |
| TECH.8.2.12.B.CS4 | The influence of technology on history. |
| TECH.8.2.12.C | Design: The design process is a systematic approach to solving problems. |

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| TECH.8.2.12.C.5 | Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled. |
| TECH.8.2.12.C.CS1 | The attributes of design. |
| TECH.8.2.12.D.1 | Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review. |
| TECH.8.2.12.D.3 | Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system. |
| TECH.8.2.12.D.CS1 | Apply the design process. |
| TECH.8.2.12.D.CS2 | Use and maintain technological products and systems. |
| TECH.8.2.12.D.CS3 | Assess the impact of products and systems. |
| TECH.9.4.12.CI | Creativity and Innovation |
| TECH.9.4.12.CI.2 | Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8). |
| TECH.9.4.12.CT | Critical Thinking and Problem-solving |
| TECH.9.4.12.CT.1 | Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3). |
| TECH.9.4.12.TL | Technology Literacy |
| | Career planning requires purposeful planning based on research, self-knowledge, and informed choices. |
| | Engineers use science, mathematics, and other disciplines to improve technology. Increased collaboration among engineers, scientists, and mathematicians can improve their work and designs. Technology, product, or system redesign can be more difficult than the original design. |
| | Innovative ideas or innovation can lead to career opportunities. |
| | Engineering design evaluation, a process for determining how well a solution meets requirements, involves systematic comparisons between requirements, specifications, and constraints. |
| | Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed. |
| | Collaborative digital tools can be used to access, record and share different viewpoints and to collect and tabulate the views of groups of people. |
| | Engineering design is a complex process in which creativity, content knowledge, research, and analysis are used to address local and global problems. Decisions on trade-offs involve systematic comparisons of all costs and benefits, and final steps that may involve redesigning for optimization. |

## Essential Questions/Enduring Understandings

**Essential Questions:**

How do you apply the design loop to solve a problem?

What science and technical information is needed solve engineering problems?

How do we communicate engineering solutions to technological problems with CAD?

**Enduring Understandings:**

Professional engineers are responsible for creating designs that are in compliance with local codes.

Codes are put in place to protect the general public Professional engineers are legally responsible for their designs.

Science and technological norms play a critical role in solving engineering problems.

## Objectives

**Students will know:**

The definition of engineering.

The scale and units of engineering drawings is different from architectural drawings.

Professional engineers are licensed by the State.

That professional engineers design parking lots to ensure public health and safety.

That parking lot design must be considerate of pedestrian safety, vehicular safety, and environmental impact.

How to design a parking lot for vehicular traffic.

The parts of a water runoff management system.

About local and state codes that effect the amount of impervious space permitted.

How to use CAD to draw a site plan with engineered systems.

Projects have environmental impacts.

About career paths to become a civil engineer and what they do.

**Students will be skilled at:**

Creating drawings in CAD that illustrate their understanding of the technology required to make a design.

Modifying details that relate to design development.

Analyzing safety concerns.

Drafting plan drawings using software that communicate a solution to a defined audience.

Creating presentations in a digital portfolio.

## Learning Plan

Preview the essential questions and connect to learning throughout the unit.

Guiding Questions: What are the characteristics of a good parking lot? (size of spaces, pedestrian and car safety) How about on a rainy day? What are the components of a parking lot?

Lecture and readings on parts of parking lots, driveways, water retention systems, and components.

Lecture on quantifying parts of a system

Demonstration on drawing components of a system

Student will use previous plans of a building of their own design as a basis for the design of a site plan that incorporates the unit's content. This will include calculations of runoff; impervious area and a written description of how the engineering systems work.

Formative assessments will be conducted throughout the design process.

Summative assessment will be conducted by the student and teacher using a rubric specific to the design problem.

Unit test or quiz.

Writing prompt.

## Assessment

**Formative Assessment:**
Class Discussion
Teacher Feedback

**Summative assessment:**
Answer the essential questions.

Design a site plan and draw it using CAD. The design will demonstrate their ability to use the design process and scientific principles to solve an engineering problem. Demonstrate the ability to use software and technical drawing conventions to communicate a design. The presentation will include a written description that describes the technical aspects of the proposal. The presentation will be included in an electronic portfolio. Maintain a log to explain how the design evolved, including sources of information and criticism. The presentation will be evaluated using teacher and student designed rubrics.

Pass written quizzes and tests about subject materials.

Write a response to one or more writing prompts. Possible prompts: The definition of engineering is, the application of science to benefit mankind. An example of how this applies to civil engineers is…" What is the difference between a professional engineer and an engineer?

Students will present their digital portfolio.

**Alternative Assessment**
Presentation on drawing components of a system

**Benchmark Assessment**
Final Exam

## Materials

The CADD LAB-computers equipped with up-to-date AutoCAD and/or other design and drafting software, presentation software, productivity software, a scanner and printers/plotters.

Traditional drafting equipment and supplies-vellum, colored and graphite pencils, pen and ink, drawing boards, tape, scissors, t-squares, triangles etc.

Chip-board, X-acto knives and other model making supplies.

A computer with INTERNET based presentation software (i.e. Prezi and Google Slides) and Microsoft Powerpoint.

Smartboard for demonstrations by the teacher and presentations by students.

## Integrated Accommodation and Modifications Spec Ed, ELL, At-Risk, G&T, Career Education, 504's

See the linked document for Integrated Accommodation and Modifications, Special Education, English Language Learners, At-Risk, Gifted and Talented, Career Education and 504s.