Unit 2.3 Residential Design

Content Area: **Science**
Course(s): **Civil Eng & Arc**
Time Period: **Semester 1**
Length: **6 weeks**
Status: **Published**

Standards

NGSS:

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. (HS.ETS1.2)
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. (HS.ETS1.3)
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. (HS.ETS1.4)

Common Core:

Mathematical Practice

Modeling With Geometry
-Apply Geometric Concepts In Modeling Situations

2. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).* (G.MG.2)
3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).* (G.MG.3)

English Language Arts

Key Ideas and Details

1. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text. (AS.R.1)

4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone. (AS.R.4)
7. Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words. (AS.R.7)
10. Read and comprehend complex literary and informational texts independently and proficiently. (AS.R.10)

Text Types and Purposes

2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content. (AS.W.2)
4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (AS.W.4)
8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism. (AS.W.8)
9. Draw evidence from literary or informational texts to support analysis, reflection, and research. (AS.W.9)
10. Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences. (AS.W.10)

Comprehension and Collaboration

1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively. (AS.SL.1)
2. Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. (AS.SL.2)
4. Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience. (AS.SL.4)
5. Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. (AS.SL.5)
6. Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate. (AS.SL.6)

Conventions of Standard English

1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. (AS.L.1)
2. Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. (AS.L.2)
6. Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to

comprehension or expression. (AS.L.6)

ED	Engineering Design
	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.
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.
8.2.12.ED.2	Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.
8.2.12.ED.4	Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.
	Engineering design evaluation, a process for determining how well a solution meets requirements, involves systematic comparisons between requirements, specifications, and constraints.
8.2.12.ED.5	Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).
NT	Nature of Technology
	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.
8.2.12.NT.1	Explain how different groups can contribute to the overall design of a product.
8.2.12.NT.2	Redesign an existing product to improve form or function.
TEC.9-12.8.1.12.A.1	Construct a spreadsheet, enter data, and use mathematical or logical functions to manipulate data, generate charts and graphs and interpret the results.
TEC.9-12.8.1.12.A.2	Produce and edit a multi-page document for a commercial or professional audience using desktop publishing and/or graphic software.
TEC.9-12.8.1.12.F.1	Select and use specialized databases for advanced research to solve real world problems.
TEC.9-12.8.2.12.A.1	Design and create a technology product or system that improves the quality of life and identify trade-offs, risks and benefits.
TEC.9-12.8.2.12.B.1	Design and create a product that maximizes conservation and sustainability of a scarce resource by using the design process and entrepreneurial skills.
TEC.9-12.8.2.12.B.2	Design and create a prototype for solving a global problem, documenting how the proposed design features affect the feasibility of the prototype through the use of engineering, drawing and other technical methods of illustration.
TEC.9-12.8.2.12.E.1	Devise a technological product or system, addressing a global issue, using the design process and provide documentation through drawings, data and materials that reflect diverse cultural perspectives.
TEC.9-12.8.2.12.F.3	Select and utilize resources that have been modified by digital tools in the creation of a technological product or system (CNC equipment, CAD software).
TEC.9-12.8.2.12.G.1	Analyze the interactions among various technologies and collaborate to create a product

or system demonstrating their interactivity.

Enduring Understandings

- Responsible designers maximize the potential of the property, minimize impact on the environment, and incorporate universal design concepts in order to create an attractive and functional space.
- Responsible designers anticipate the needs and requirements of the users.
- Codes are created to protect the health and safety of the public, dictate the minimum requirements that must be met in a building project, and constrain the location of structures, utilities, building construction, and landscape components placed on a site.
- Appropriate flow rate, pressure, and water quality are necessary for effective water supply and use.
- When utilities are not available within a reasonable distance to be economically brought on site, substitutions must be designed and constructed.
- Utilities and systems must be properly sized to minimize cost and appropriately serve the project and the structure occupants.
- The design of electrical and plumbing systems must be carefully integrated into the architectural and structural design of a building.
- Careful landscape design that takes into consideration local environmental conditions can improve energy efficiency, reduce noise, reduce water usage, reduce storm water runoff, and improve the visual impact of a building project.
- Storm water runoff from a site often increases when the site is developed and is frequently regulated by local jurisdictions.
- Universal Design involves the design of products and environments to be usable by all people and includes barrier free accessibility to projects that may be required by federal regulations.
- Green or sustainable design reduces the negative impact of a project on the environment and human health and improves the performance of the project during its life-cycle.

Essential Questions

- How do you achieve a balance between cost-saving measures, important features, and environmental responsibility when designing a residential structure?
- What are the advantages and disadvantages of using 3D architectural software rather than creating hand-produced plans?
- Why are organizations such as LEED important?
- When planning a project, how does the availability of public utilities impact the design?
- What options are available for the management of wastewater from a building?
- What are the important considerations when design a plumbing system?
- Why should a designer know about the different types of lighting and their applications?
- What are the important considerations when designing an electrical system?
- What information is important when documenting the design of a building?

Knowledge and Skills

It is expected that students will:

- Apply elements of good residential design to the design of a basic house to meet the needs of a client.
- Create a home design that complies with applicable codes and requirements.
- Incorporate sustainable building principles and universal design concepts into a residential design.
- Create bubble diagrams and sketch a floor plan.
- Identify residential foundation types and choose an appropriate foundation for a residential application.
- Calculate the head loss and estimate the water pressure for a given water supply system.
- Create sketches to document a preliminary plumbing and a preliminary electrical system layout for a residence that complies with applicable codes.
- Design an appropriate sewer lateral for wastewater management for a building that complies with applicable codes.
- Create a site opportunities map and sketch a project site.
- Choose an appropriate building location on a site based on orientation and other site-specific information.
- Calculate the storm water runoff from a site before and after development.
- Document the design of a home using 3D architectural design software and construction drawings.

Assessments

https://docs.google.com/document/d/1wR7bQF-8AQoRrt0g4C3hKja0yjwDjC9_BiAmONWbTcI/edit

Modifications

https://docs.google.com/document/d/1ODqaPP69YkcFiyG72fIT8XsUIe3K1VSG7nxuc4CpCec/edit

Resources

- 2.3.KT ResidentialDesign.docx
- 2.3.1.P AffordableHousingDesign.doc
- 2.3.1.P.RU AffordableHousingDesignRubric.doc
- 2.3.1.P AffordableHousingDesign.ppt
- 2.3.1.P.SRa NewConstructionGuideline.doc
- 2.3.2.A GreenBuildingSustainableDesign.doc
- 2.3.2.A GreenBuildingSustainableArchitecture.ppt
- 2.3.3.A DesigningClient.doc
- 2.3.3.A.SR ClientSurvey.doc
- 2.3.3.A IntroductionBuildingCodes.ppt

- 2.3.3.A UniversalDesign.ppt
- 2.3.3.A PlanningSketchingFloorPlan.ppt
- 2.3.3.A AffordableHomeSiteHANDOUT.doc
- 2.3.3.A AffordableHomeSiteHANDOUT.dwfx
- 2.3.3.A AffordableHomeSiteHANDOUT.pdf
- 2.3.3.A ElementsGoodFloorPlan.doc
- 2.3.3.A FloorPlanSymbolsHandout.doc
- 2.3.3.A ResCodeRequirements2009.doc
- 2.3.3.A.SR Principles of Universal Design.pdf
- 2.3.4.A AddingGreen.doc
- 2.3.4.A.SR LEEDCreditRecordSheetAffHouse.xls
- 2.3.4.A PlanningENERGYSTAR.ppt
- 2.3.4.A PlanningLEED.ppt
- 2.3.5.A ResidentialFoundations.doc
- 2.3.5.A ResidentialFoundations.ppt
- 2.3.5b.A ResidentialConcreteEstimation(Optional).docx
- 2.3.5b.A EstimatingCostConcreteFoundationFooting.ppt
- 2.3.6.A ResidentialElectricalSystems.doc
- 2.3.6.A ElectricalSystems.ppt
- 2.3.6.A.SRa ResidentialElectricalCodeReq.doc
- 2.3.6.A.SRb CommonElectricalSymbols.doc
- 2.3.7.A ResidentialSitePlanning.doc
- 2.3.7.A AffordableHomeSitePlanStudentRevitFile.rvt
- 2.3.7.A ResidentialSitePlanConsiderations.ppt
- 2.3.7.A SitePlanRequirements.ppt
- 2.3.7.A.SR EngineeringWeatherDataIndianapolis.pdf
- 2.3.8.A ResidentialWaterSupply.doc
- 2.3.8.A WaterSupply.ppt
- 2.3.9.A ResidentialPlumbing.doc
- 2.3.9.A PlumbingSystem.ppt
- 2.3.9.A.SR ResidentialPlumbingCodeRequirements.doc
- 2.3.10.A WastewaterManagement.doc
- 2.3.10.A WastewaterManagement.ppt
- 2.3.11.A CalculatingPropertyDrainage.doc
- 2.3.11.A Storm Water Runoff.ppt