Digital Graphics

Course: 56119
Prerequisite: None

Revision 3-12-2024

Course Description:

Digital graphics play a key role in the appearance of almost all print and on-screen designs. In this course, students will learn about packaging design, digital graphics, animation, information design, interactive media, and applying Adobe software. This project-based course will challenge students with creative thinking and real-world problem-solving activities.

(STEELS) Science, Technology & Engineering, and Environmental Literacy & Sustainability Standards:
(K-12 Standards – Adopted November 2022 - STEELS Hub)

Science, Technology & Engineering, and Environmental Literacy & Sustainability Standards:

3.5 Technology and Engineering

- **Applying, Maintaining, and Assessing Technological Products and Systems**
- **Impacts of Technology**
- **Influence of Society on Technological Development**
    - 3.5.9-12.A, 3.5.9-12.B, 3.5.9-12.C, 3.5.9-12.D, 3.5.9-12.E, 3.5.9-12.F, 3.5.9-12.G, 3.5.9-12.H, 3.5.9-12.I (ETS), 3.5.9-12.J, 3.5.9-12.K (ETS), 3.5.9-12.L, and 3.5.9-12.M
- **Design in Technology and Engineering Education**
    - 3.5.9-12.N, 3.5.9-12.O, 3.5.9-12.P, 3.5.9-12.Q, 3.5.9-12.R, 3.5.9-12.S, 3.5.9-12.T (ETS), 3.5.9-12.U, 3.5.9-12.V, 3.5.9-12.W, 3.5.9-12.X, 3.5.9-12.Y (ETS), 3.5.9-12.Z, and 3.5.9-12.AA
- I**ntegration of Knowledge, Technological and Practices**
    - 3.5.9-12.BB, 3.5.9-12.CC, 3.5.9-12.DD, 3.5.9-12.EE, and 3.5.9-12.FF
- **Nature and Characteristics of Technology and Engineering**
- **Core Concepts of Technology and Engineering**
- **History of Technology**
    - 3.5.9-12.GG, 3.5.9-12.HH, 3.5.9-12.II, 3.5.9-12.JJ, 3.5.9-12.KK, 3.5.9-12.LL, 3.5.9-12.MM, 3.5.9-12.NN, 3.5.9-12.OO, 3.5.9-12.PP, and 3.5.9-12.QQ

* (ETS) Engineering, Technology, and Applications of Science – Standards applicable across the Science, Environmental Literacy & Sustainability, and Technology & Engineering content areas.

(STEELS) Science, Technology & Engineering, and Environmental Literacy & Sustainability Standards	College and Career Skills	(SEP) Science and Engineering Practices	(TEP) Technology and Engineering Practices	21st Century Skills
3.5.9-12.Z, 3.5.9-12.HH, 3.5.9-12.II, 3.5.9-12.GG, 3.5.9-12.JJ, 3.5.9-12.BB, and 3.5.9-12.EE	Foundations of Digital Graphics	Obtaining, Evaluating, and Communicating Information	Attention to Ethics	Research Skills and Practices
3.5.9-12.N, 3.5.9-12.LL, 3.5.9-12.R, 3.5.9-12.Y (ETS), 3.5.9-12.OO, and 3.5.9-12 MM	Design Process	Using Mathematics and Computational Thinking	Systems Thinking	Systems Thinking, Initiative, Planning, and Self Direction
3.5.9-12.CC, 3.5-9-12.F, and 3.5.9-12.B	Peer Review and Innovation	Planning and Carrying Out Investigations	Creativity	Creative Thinking, Imagination, and Innovation
3.5.9-12.U, 3.5.9-12.I (ETS), 3.5.9-12.J, 3.5.9-12.S, 3.5.9-12.L, 3.5.9-12.T (ETS), 3.5.9-12.PP, and 3.5.9-12.C	Layout and Design	Asking Questions, and Defining Problems	Asking Questions and Defining Problems	Critical Thinking and Problem Solving
3.5.9-12.DD, 3.5.9-12.E, 3.5.9-12.AA, and 3.5.9-12.O	Applying Knowledge and Technical Skills	Developing & Using Models	Critical Thinking	Information, Media, and Technology Skills
3.5.9-12.Q, 3.5.9-12.V, and 3.5.9-12.P	Applying Design Principles	Developing & Using Models	Making and Doing	Applying Content Knowledge and Skills
3.5.9-12.K (ETS), 3.5.9-12.M, 3.5-9-12.X, and 3.5.9-12.QQ	Experimentation and Development	Constructing Explanations and Designing Solutions	Making and Doing	Productivity, Perseverance, and Self-discipline
3.5.9-12.H, 3.5.9-12.G, 3.5.9-12.KK, 3.5-9-12.W, and 3.5.9-12.D	Testing, Evaluating, and Refining	Engaging in Argument From Evidence	Optimism	Judgments, Decisions, Flexibility, and Adaptability
3.5-9-12.A, 3.5.9-12.NN, and 3.5.9-12.FF	Finalizing and Presenting	Obtaining, Evaluating, and Communicating Information	Communication	Literacy, Communications, and Lifelong Learning
3.5.9-12.N, 3.5.9-12.P, 3.5.9-12.Y (ETS) and 3.5.9-12.X	Digital Graphics Applications	Constructing Explanations and Designing Solutions	Collaboration	Communicating with Digital Media

Course Outline:

Foundations of Digital Graphics

- Digital Graphics Technology
- Communication Systems
- Information Age
- History of Digital Graphics
- Evolution of Digital Graphics
- Career and Professional Skills
- Interdisciplinary Skills

Technological Design Process

- Technological Design Process
- Technological Systems
- Cross Cultural Design
- Design Process Components
- Project Management
- Troubleshooting Flawed Systems

Digital Graphics Peer Review and Innovation

- Peer Review
- Innovation
- Minimalizing Waste

Digital Graphics Layout and Design

- Defining the Purpose of a Design
- Project Planning
- Gathering Information
- Needs and Wants
- Laws, Regulations, and Policies
- Criteria and Constraints
- Computer Modeling
- Minimalizing Negative Impacts

Applying Digital Graphics Knowledge and Technical Skills

- Applying Knowledge
- Applying Technical Skills
- Making and Doing
- Troubleshooting

Applying Design Principles to Digital Graphics

- Design Principles
- Human-Centered Design
- Design Skills

Digital Graphics Experimentation and Development

- Experimentation
- Development
- Design Solution
- Quality Control

Testing, Evaluating, and Refining Digital Graphics

- Testing
- Evaluation
- Refinement
- Optimization
- Sustainability

Finalizing and Presenting Digital Graphics

- Communicating Results
- Technology Diffusion and Adoption
- Globalization Opportunities

Design and Creation of Digital Graphics

- Design Process
- Peer Review and Innovation
- Layout and Design
- Applying Knowledge and Technical Skills
- Apply Design Principles
- Experimentation and Development
- Testing, Evaluating, and Refining
- Finalizing and Presenting

Digital Graphics Applications

- Packaging Design
- Digital Graphic
- Advertising Graphics
- Motion Graphics / Animation
- Information Design
- Interactive Media

Subject: Digital Graphics	**Grade Level:** High School	**Topic:** Foundations of Digital Graphics

Science, Technology & Engineering, and Environmental Literacy & Sustainability Standards:

- **Concept: Digital Graphics Technology**
  - 3.5.9-12.Z Recognize and explain how their community and the world around them informs technological development and engineering design.
- **Concept: Communication Systems**
  - 3.5.9-12.HH Analyze how the Industrial Revolution resulted in the development of mass production, sophisticated transportation and communication systems, advanced construction practices, and improved education and leisure time.
- **Concept: Information Age**
  - 3.5.9-12.II Investigate the widespread changes that have resulted from the Information Age, which has placed emphasis on the processing and exchange of information.
- **Concept: History of Digital Graphics**
  - 3.5.9-12.GG Evaluate how technology and engineering have been powerful forces in reshaping the social, cultural, political, and economic landscapes throughout history.
- **Concept: Evolution of Digital Graphics**
  - 3.5.9-12.JJ Identify and explain how the evolution of civilization has been directly affected by, and has in turn affected, the development and use of tools, materials, and processes.
- **Concept: Career and Professional Skills**
  - 3.5.9-12.BB Assess how similarities and differences among scientific, technological, engineering, and mathematical knowledge and skills contributed to the design of a product or system.
- **Concept: Interdisciplinary Skills**
  - 3.5.9-12.EE Connect technological and engineering progress to the advancement of other areas of knowledge and vice versa.

* (ETS) Engineering, Technology, and Applications of Science – Standards applicable across the Science, Environmental Literacy & Sustainability, and Technology & Engineering content areas.

KEY LEARNING:	**UNIT ESSENTIAL QUESTION:**	**Texts/Resources/Materials:**
(LTTG) Students will be able to engage as technological and engineering literate members of a global society. * (LTTG) PDE Technology & Engineering Long Term Transfer Goals	How can I engage as a technological and engineering literate member of a global society?	Computer Hardware, Computer Software, Adobe Creative Cloud, Online Resources, Presentations, Videos, Tutorials, and Sample Designs

CONCEPT:	**CONCEPT**:	**CONCEPT**:	**CONCEPT**:
Digital Graphics Technology	Communication Systems	Information Age	History of Digital Graphics
Lesson Essential Questions: Why is design important to human activity?	**Lesson Essential Questions:** How do technological advancements define different historical eras?	**Lesson Essential Questions:** How do technological advancements define the Information Age?	**Lesson Essential Questions:** How did digital graphics and digital media advancements change our lives?
CONCEPT:	**CONCEPT**:	**CONCEPT**:	**CONCEPT**:
Evolution of Digital Graphics	Career and Professional Skills	Interdisciplinary Skills	
Lesson Essential Questions: Why does technological knowledge often accelerate alongside other fields?	**Lesson Essential Questions:** How does technology and engineering relate to other content areas?	**Lesson Essential Questions:** How do advancements from one field impact another?	**Lesson Essential Questions:**

Vocabulary	
Academic Specific: Locate, Select, Model, Practice, Apply, Produce, Adjust, Display, Compare, Contrast, Examine, Evaluate, Design, Develop, Create, Invent, and Modify	**Domain (Content) Specific:** **Concept: Digital Graphics Technology** • Community, Development, and Design **Concept: Communication Systems**

	• Development, Industrial Revolution, Mass Production, Transportation, Communication System, Construction, Education, Leisure, Efficiency, and Access **Concept: Information Age** • Information Age, Processing, Exchange, Data, and Information **Concept: History of Digital Graphics** • Era, Social, Cultural, Political, Economic, Landscape, Context, and Scenario **Concept: Evolution of Digital Graphics** • Evolve, Civilization, Affect, Development, Age, Tool, Material, Process, and Technology **Concept: Career and Professional Skills** • Assess, Relate, Similarity, Difference, Interdisciplinary, Development, Improving, Expertise, and Contribute **Concept: Interdisciplinary Skills** • Advancement, Traverse, and Progress

KUD's (know—understand—do)		
Concepts—nouns: (What do students need to know/understand?)	**RR Framework** **Skills—verbs:** (What do students need to be able to do? In which quadrant do the skills belong?) *See page 19 of SAP Learning Environment guide*	
1. Digital Graphics Technology 2. Communication Systems 3. Information Age 4. History of Digital Graphics 5. Evolution of Digital Graphics	Compare, Contrast, Examine, and Evaluate **C**	Design, Develop, Create, Invent, and Modify **D**

6. Career and Professional Skills 7. Interdisciplinary Skills	**A** Locate and Select	**B** Model, Practice, Apply, Produce, Adjust, and Display

Unit Assessment Plan and Resources

- **Concept: Digital Graphics Technology**
  - Learning Experience
    - Students who demonstrate understanding can recognize and explain how their community and the world around them informs technological development and engineering design.
    - Clarifying Statement: Technological developments are best achieved through experiences and interactions within a given context. For example, design of buildings should take into account local conditions including soil type, wind, and snow loads, and should also match local building codes and building styles.
  - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
    - Design is a fundamental human activity.
  - (SEP) Science and Engineering Practices
    - Obtaining, Evaluating, and Communicating Information - Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.
  - (DCI) Disciplinary Core Ideas
    - ISTE 3D - Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.
  - (TEP) Technology and Engineering Practices
    - Attention to Ethics - Assesses technological products, systems, and processes through critical analysis of their impacts and outcomes.
    - Systems Thinking - Designs and troubleshoots technological systems in ways that consider the multiple components of the system.
- **Concept: Communication Systems**
  - Learning Experience
    - Students who demonstrate understanding can analyze how the Industrial Revolution resulted in the development of mass production, sophisticated transportation and communication systems, advanced construction practices, and improved education and leisure time.
    - Clarifying Statement: Major developments of this period included the continuous-process flour mill, power loom and pattern-weaving loom, steam engine, electric motor, gasoline and diesel engines, vulcanized rubber, airplane, telegraph, telephone, radio, and television. The concepts of Eli Whitney's interchangeable parts and Henry Ford's movable conveyor added to advances in the

production of goods. Extended free time was possible for some people as a result of increased efficiency and updated labor laws, and eventually led to more widespread access to education.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Historical eras are often defined by technological advancements.
    - (SEP) Science and Engineering Practices
        - Obtaining, Evaluating, and Communicating Information - Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.
    - (DCI) Disciplinary Core Ideas
        - NAEP T.12.2 - Changes caused by the introduction and use of a new technology can range from gradual to rapid and from subtle to obvious, and can change over time. These changes may vary from society to society as a result of differences in a society's economy, politics, and culture.
    - (TEP) Technology and Engineering Practices
        - Systems Thinking - Designs and troubleshoots technological systems in ways that consider the multiple components of the system.

- **Concept: Information Age**
    - Learning Experience
        - Students who demonstrate understanding can investigate the widespread changes that have resulted from the Information Age, which has placed emphasis on the processing and exchange of information.
        - Clarifying Statement: The development of binary language, transistors, microchips, and an electronic numerical integrator and calculator (ENIAC) led to an explosion of computers, calculators, and communication processes to quickly move information from place to place. Holography, cybernetics, xerographic copying, the breeder reactor, the hydrogen bomb, the lunar module, communication satellites, prefabrication, and gene editing have all been major developments during this time period.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Historical eras are often defined by technological advancements.
    - (SEP) Science and Engineering Practices
        - Obtaining, Evaluating, and Communicating Information - Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.
    - (DCI) Disciplinary Core Ideas
        - NAEP T.12.11 - Give examples to illustrate the effects on society of the recording, distribution, and access to information and knowledge that have occurred in history, and discuss the effects of those revolutions on societal change.
    - (TEP) Technology and Engineering Practices
        - Systems Thinking - Designs and troubleshoots technological systems in ways that consider the multiple components of the system.

- **Concept: History of Digital Graphics**
    - Learning Experience

        - Students who demonstrate understanding can evaluate how technology and engineering have been powerful forces in reshaping the social, cultural, political, and economic landscapes throughout history.
        - Clarifying Statement: Communication, agriculture, and transportation, for example, have evolved out of the political, economic, and social interests and values of the times.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Historical eras are often defined by technological advancements.
    - (SEP) Science and Engineering Practices
        - Obtaining, Evaluating, and Communicating Information - Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.
    - (DCI) Disciplinary Core Ideas
        - ETS1.A: Defining & 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.
    - (TEP) Technology and Engineering Practices
        - Making and Doing - Demonstrates the ability to regulate and improve making and doing skills.
        - Attention to Ethics - Assesses technological products, systems, and processes through critical analysis of their impacts and outcomes.

- **Concept: Evolution of Digital Graphics**
    - Learning Experience
        - Students who demonstrate understanding can identify and explain how the evolution of civilization has been directly affected by, and has in turn affected, the development and use of tools, materials, and processes.
        - Clarifying Statement: The Stone Age started with the development of stone tools used for hunting, cutting, and pounding vegetables and meat and progressed to the harnessing of fire for heating, cooking, and protection. The Bronze Age began with the discovery of copper and copper-based metals. The wide application of new agricultural technologies such as the sickle, plow, windmill, and irrigation enabled farmers to grow more food. Sustained technological advancement caused many people to migrate from farms to developing towns and cities. Other influential developments in this age included weaving machines and the spinning wheel, which advanced the making of cloth. The invention of gunpowder and guns was an improvement over previous weapons for both hunting and protection.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Historically, technological knowledge has accelerated along with other fields.
    - (SEP) Science and Engineering Practices
        - Obtaining, Evaluating, and Communicating Information - Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.
    - (DCI) Disciplinary Core Ideas

        - NAEP T.12.2 - Changes caused by the introduction and use of a new technology can range from gradual to rapid and from subtle to obvious, and can change over time. These changes may vary from society to society as a result of differences in a society's economy, politics, and culture.
    - (TEP) Technology and Engineering Practices
        - Attention to Ethics - Assesses technological products, systems, and processes through critical analysis of their impacts and outcomes.

- **Concept: Career and Professional Skills**
    - Learning Experience
        - Students who demonstrate understanding can assess how similarities and differences among scientific, technological, engineering, and mathematical knowledge and skills contributed to the design of a product or system.
        - Clarifying Statement: Developing and improving products or systems require scientific, engineering, and technical expertise. Articulating how knowledge and skills from each contributed or will contribute to a product or system is a necessary component of innovation and design. One way this can be accomplished is by evaluating a completed engineering design task and identifying the elements from other academic disciplines that contributed to the completion of the task.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Technology and engineering are interdisciplinary, relating to more than one content area.
    - (SEP) Science and Engineering Practices
        - Engaging in Argument From Evidence - Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.
    - (DCI) Disciplinary Core Ideas
        - NAEP D.12.2 - Engineers use science, mathematics, and other disciplines to improve technology, while scientists use tools devised by engineers to advance knowledge in their disciplines. This interaction has deepened over the past century.
    - (TEP) Technology and Engineering Practices
        - Making and Doing - Demonstrates the ability to regulate and improve making and doing skills.
        - Systems Thinking - Designs and troubleshoots technological systems in ways that consider the multiple components of the system.

- **Concept: Interdisciplinary Skills**
    - Learning Experience
        - Students who demonstrate understanding can connect technological and engineering progress to the advancement of other areas of knowledge and vice versa.
        - Clarifying Statement: For instance, cloud data storage aided the connectivity of physical devices, known as the Internet of Things (IoT). This advancement has enabled real-time mathematical, economic, medical, and other applications of data collection, analysis, and production. These advancements in turn are being applied to a multitude of areas, including the emerging field of "Smart Highways," infrastructure integrated with sensors to collect data on road conditions and weather to better aid in the decision-making process of road crews and local authorities.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Technological knowledge and practices advance – and are advanced by – other fields.
    - (SEP) Science and Engineering Practices

        - Obtaining, Evaluating, and Communicating Information - Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.
    - (DCI) Disciplinary Core Ideas
        - ETS1.A: Defining and Delimiting Engineering Problems - Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
        - NAEP D.12.1 - Advances in science have been applied by engineers to design new products, processes, and systems, while improvements in technology have enabled breakthroughs in scientific knowledge.
    - (TEP) Technology and Engineering Practices
        - Systems Thinking - Designs and troubleshoots technological systems in ways that consider the multiple components of the system.
        - Optimism - Shows persistence in addressing technological problems and finding solutions to those problems.

* (Learning Experience) A learning experience refers to any interaction, activity, or other experience in which students acquire new understanding, knowledge, behaviors, or skills.
* (Big Idea #) PDE Technology & Engineering Curriculum Framework Big Ideas
* (SEP) PDE Science and Engineering Practices
* (DCI) PDE Disciplinary Core Ideas
* (TEP) PDE Technology and Engineering Practices

Subject: Digital Graphics	**Grade Level:** High School	**Topic:** Technological Design Process

Science, Technology & Engineering, and Environmental Literacy & Sustainability Standards:

- **Concept: Technological Design Process**
    - 3.5.9-12.N Analyze and use relevant and appropriate design thinking processes to solve technological and engineering problems.
- **Concept: Technological Systems**
    - 3.5.9-12.LL Analyze the stability of a technological system and how it is influenced by all of the components in the system, especially those in the feedback loop.
- **Concept: Cross Cultural Design**
    - 3.5.9-12.R Use a design thinking process to design an appropriate technology for use in a different culture.
- **Concept: Design Process Components**

- 3.5.9-12.Y (ETS) Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

- **Concept: Project Management**
  - 3.5.9-12.OO Use project management tools, strategies, and processes in planning, organizing, and controlling work.

- **Concept: Troubleshooting Flawed Systems**
  - 3.5.9-12 MM Troubleshoot and improve a flawed system embedded within a larger technological, social, or environmental system.

* (ETS) Engineering, Technology, and Applications of Science – Standards applicable across the Science, Environmental Literacy & Sustainability, and Technology & Engineering content areas.

KEY LEARNING:	**UNIT ESSENTIAL QUESTION:**	**Texts/Resources/Materials:**
(LTTG) Students will be able to analyze a problem in its entirety while recognizing the subcomponents interacting with human-made and natural environments. * (LTTG) PDE Technology & Engineering Long Term Transfer Goals	How can I analyze a problem in its entirety while recognizing the subcomponents interacting with human-made and natural environments?	Computer Hardware, Computer Software, Adobe Creative Cloud, Online Resources, Presentations, Videos, Tutorials, and Sample Designs

CONCEPT: Technological Design Process	**CONCEPT**: Technological Systems	**CONCEPT**: Cross Cultural Design	**CONCEPT**: Design Process Components
Lesson Essential Questions: How are requisite skills applied in technology and engineering design?	**Lesson Essential Questions:** How do system components work together to achieve a desired goal?	**Lesson Essential Questions:** How are cross cultural design skills applied in technology and engineering design?	**Lesson Essential Questions:** Why is there no single correct solution in design?
CONCEPT: Project Management	**CONCEPT**: Troubleshooting Flawed Systems	**CONCEPT**:	**CONCEPT**:
Lesson Essential Questions: How are various resources used in	**Lesson Essential Questions:** How do system components work	**Lesson Essential Questions:**	**Lesson Essential Questions:**

technology and engineering activities?	together to achieve a desired goal?		

Vocabulary	
Academic Specific: Locate, Select, Model, Practice, Apply, Produce, Adjust, Display, Compare, Contrast, Examine, Evaluate, Design, Develop, Create, Invent, and Modify	**Domain (Content) Specific:** **Concept: Technological Design Process** • Analysis, Use, Requisite Skill, Empathy, Ideation, and Design Thinking **Concept: Technological Systems** • Stability, Analysis, Interrelated, Influence, Component, Feedback, Loop, Automatic, Manual, and Control **Concept: Cross Cultural Design** • Examine, Culture, Design Thinking, and Access **Concept: Design Process Components** • Engineering, Systematically, and Priority **Concept: Project Management** • Project Management, Teamwork, Responsibility, Plan, Organize, and Control **Concept: Troubleshooting Flawed Systems** • Troubleshoot, Embed, Improve, System, Technological, Social, Environmental, Investigate, and Flaw

KUD's (know—understand—do)	
	RR Framework
Concepts—nouns: (What do students need to know/understand?)	**Skills—verbs:** (What do students need to be able to do? In which quadrant do the skills belong?) *See page 19 of SAP Learning Environment guide*

1. Technological Design Process 2. Technological Systems 3. Cross Cultural Design 4. Design Process Components 5. Project Management 6. Troubleshooting Flawed Systems	Compare, Contrast, Examine, and Evaluate **C**	Design, Develop, Create, Invent, and Modify **D**
	A Locate and Select	**B** Model, Practice, Apply, Produce, Adjust, and Display

Unit Assessment Plan and Resources

- **Concept: Technological Design Process**
  - Learning Experience
    - Students who demonstrate understanding can analyze and use relevant and appropriate design thinking processes to solve technological and engineering problems.
    - Clarifying Statement: High school students can benefit from examining relationships to technology in other cultures, such as the access (or lack of access) to technologies in specific cultures. For example, people in many locations around the world lack ready access to clean water. Strategies to address this problem will vary according to the resources and circumstances of a given location.
  - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
    - There are requisite skills used in technology and engineering design.
  - (SEP) Science and Engineering Practices
    - Constructing Explanations and Designing Solutions - Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.
  - (DCI) Disciplinary Core Ideas
    - NAEP D.12.8 - Meet a sophisticated design challenge by identifying criteria and constraints, predicting how these will affect the solution, researching and generating ideas, and using trade-offs to balance competing values in selecting the best solution.
  - (TEP) Technology and Engineering Practices
    - Critical Thinking - Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

- **Concept: Technological Systems**
  - Learning Experience

        - Students who demonstrate understanding can analyze the stability of a technological system and how it is influenced by all of the components in the system, especially those in the feedback loop.
        - Clarifying Statement: Automated control systems in a vehicle, for example, automatically detect and control the speed of the vehicle.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - A system is a group of interrelated components designed collectively to achieve a desired goal.
    - (SEP) Science and Engineering Practices
        - Constructing Explanations and Designing Solutions - Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.
    - (DCI) Disciplinary Core Ideas
        - ETS1.C: Optimizing the Design Solution - Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.
    - (TEP) Technology and Engineering Practices
        - Making and Doing - Demonstrates the ability to regulate and improve making and doing skills.
        - Systems Thinking - Designs and troubleshoots technological systems in ways that consider the multiple components of the system.

- **Concept: Cross Cultural Design**
    - Learning Experience
        - Students who demonstrate understanding can use a design thinking process to design an appropriate technology for use in a different culture.
        - Clarifying Statement: High school students can benefit from examining relationships to technology in other cultures, such as the access (or lack of access) to technologies in specific cultures. For example, people in many locations around the world lack ready access to clean water. Strategies to address this problem will vary according to the resources and circumstances of a given location.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - There are requisite skills used in technology and engineering design.
    - (SEP) Science and Engineering Practices
        - Constructing Explanations and Designing Solutions - Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.
    - (DCI) Disciplinary Core Ideas
        - NAEP T.12.1 - The decision to develop a new technology is influenced by societal opinions and demands. These driving forces differ from culture to culture.
    - (TEP) Technology and Engineering Practices
        - Making and Doing - Demonstrates the ability to regulate and improve making and doing skills.
        - Attention to Ethics - Assess technological products, systems, and processes through critical analysis of their impacts and outcomes.

- **Concept: Design Process Components**
    - Learning Experience
        - Students who demonstrate understanding can design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

        - Clarifying Statement: Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - There is no single, best solution as designs can always be improved and refined.
    - (SEP) Science and Engineering Practices
        - Constructing Explanations and Designing Solutions - Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.
    - (DCI) Disciplinary Core Ideas
        - ETS1.C: Optimizing the Design Solution - Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.
    - (TEP) Technology and Engineering Practices
        - Systems Thinking - Designs and troubleshoots technological systems in ways that consider the multiple components of the system.
        - Making & Doing - Demonstrates the ability to regulate and improve making and doing skills.

- **Concept: Project Management**
    - Learning Experience
        - Students who demonstrate understanding can use project management tools, strategies, and processes in planning, organizing, and controlling work.
        - Clarifying Statement: Management is sometimes defined as getting work done through other people. Teamwork, responsibility, and interpersonal dynamics play a significant role in the development and production of technological products. Management processes are used to oversee and guide these functions.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Technology and engineering activities require resources.
    - (SEP) Science and Engineering Practices
        - Planning and Carrying Out Investigations - Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts.
    - (DCI) Disciplinary Core Ideas
        - ETS1.A: Defining and Delimiting Engineering Problems - Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
    - (TEP) Technology and Engineering Practices
        - Collaboration - Assesses technological products, systems, and processes through critical analysis of their impacts and outcomes.
        - Communication - Conveys ideas clearly in constructive insightful ways, including through written and oral communication and via mathematical and physical models.

- **Concept: Troubleshooting Flawed Systems**
    - Learning Experience

        - Students who demonstrate understanding can troubleshoot and improve a flawed system embedded within a larger technological, social, or environmental system.
        - Clarifying Statement: Systems are made up of components (i.e., subsystems). A food processor is only one component in a larger food preparation system that, in turn, is a component in a larger home system. Troubleshooting a flawed system or product allows students to identify possible areas for improvement. For example, a recycling program at their school might have very low participation rates by students and staff members. Investigating the components of the program (system) will help students identify ways to improve it.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - A system is a group of interrelated components designed collectively to achieve a desired goal.
    - (SEP) Science and Engineering Practices
        - Asking Questions and Defining Problems - Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.
    - (DCI) Disciplinary Core Ideas
        - NAEP D.12.17 - Analyze a system malfunction using logical reasoning (such as a fault tree) and appropriate diagnostic tools and instruments. Devise strategies and recommend tools for fixing the problem.
        - ISTE 1D - Students understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies.
    - (TEP) Technology and Engineering Practices
        - Making and Doing - Demonstrates the ability to regulate and improve making and doing skills.
        - Systems Thinking - Designs and troubleshoots technological systems in ways that consider the multiple components of the system.
        - Optimism - Shows persistence in addressing technological problems and finding solutions to those problems.

* (Learning Experience) A learning experience refers to any interaction, activity, or other experience in which students acquire new understanding, knowledge, behaviors, or skills.
* (Big Idea #) PDE Technology & Engineering Curriculum Framework Big Ideas
* (SEP) PDE Science and Engineering Practices
* (DCI) PDE Disciplinary Core Ideas
* (TEP) PDE Technology and Engineering Practices

Subject: Digital Graphics	**Grade Level:** High School	**Topic:** Digital Graphics Peer Review and Innovation

Science, Technology & Engineering, and Environmental Literacy & Sustainability Standards:

- **Concept: Peer Review**

- 3.5.9-12.CC Analyze how technology transfer occurs when a user applies an existing innovation developed for one function for a different purpose.

- **Concept: Innovation**
  - 3.5-9-12.F Evaluate a technological innovation that arose from a specific society's unique need or want.

- **Concept: Minimalizing Waste**
  - 3.5.9-12.B Critically assess and evaluate a technology that minimizes resource use and resulting waste to achieve a goal.

* (ETS) Engineering, Technology, and Applications of Science – Standards applicable across the Science, Environmental Literacy & Sustainability, and Technology & Engineering content areas.

KEY LEARNING:	**UNIT ESSENTIAL QUESTION:**	**Texts/Resources/Materials:**
(LTTG) Students will be able to acquire, analyze, and evaluate information to reach an informed conclusion, using logic and reasoning skills. * (LTTG) PDE Technology & Engineering Long Term Transfer Goals	How can I acquire, analyze, and evaluate information to reach an informed conclusion, using logic and reasoning skills?	Computer Hardware, Computer Software, Adobe Creative Cloud, Online Resources, Presentations, Videos, Tutorials, and Sample Designs

CONCEPT:	**CONCEPT**:	**CONCEPT**:	**CONCEPT**:
Peer Review	Innovation	Minimalizing Waste	
Lesson Essential Questions:	**Lesson Essential Questions:**	**Lesson Essential Questions:**	**Lesson Essential Questions:**
How do advancements from one field impact another?	How does technology and engineering address the needs and wants of society?	Why is it important to sustainably manage technological resources?	

Vocabulary

Academic Specific:	**Domain (Content) Specific:**
Locate, Select, Model, Practice, Apply, Produce, Adjust, Display, Compare, Contrast, Examine, Evaluate, Design, Develop, Create, Invent, and Modify	**Concept: Peer Review** • Innovation, Invention, Setting, Transfer, Develop, Function, Purpose, Field of Study, and Advance **Concept: Innovation**

	• Innovation, Need, Want, and Society **Concept: Minimalizing Waste** • Assess, Critical Thinking, Evaluate, Resource, Waste, Goal, Solution, and Impact

KUD's (know—understand—do)		
Concepts—nouns: (What do students need to know/understand?)	**RR Framework** **Skills—verbs:** (What do students need to be able to do? In which quadrant do the skills belong?) *See page 19 of SAP Learning Environment guide*	
1. Peer Review 2. Innovation 3. Minimalizing Waste	Compare, Contrast, Examine, and Evaluate **C**	Design, Develop, Create, Invent, and Modify **D**
	A Locate and Select	**B** Model, Practice, Apply, Produce, Adjust, and Display

Unit Assessment Plan and Resources

• **Concept: Peer Review**
  ○ Learning Experience
  ▪ Students who demonstrate understanding can analyze how technology transfer occurs when a user applies an existing innovation developed for one function for a different purpose.
  ▪ Clarifying Statement: For example, aerospace composite materials were used to design an advanced, lightweight, and easy-to-maneuver wheelchair. Similarly, memory foam was originally invented as a means of improving safety in aircraft seating. Students can

engage in passive research related to this standard as well as actively engaging in it through tasks such as conducting strength testing with novel building materials.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Technological knowledge and practices advance – and are advanced by – other fields.
    - (SEP) Science and Engineering Practices
        - Engaging in Argument From Evidence - Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.
    - (DCI) Disciplinary Core Ideas
        - HS-PS3-3 - Design, build, and refine a device that works within given constraints to convert on form of energy into another form of energy.
        - NAEP T.12.4 - Analyze cultural, social, economic, or political changes (separately or together) that may be triggered by the transfer of a specific technology from one society to another. Include both anticipated and unanticipated effects.
    - (TEP) Technology and Engineering Practices
        - Critical Thinking - Uses evidence to better understand and solve problems in technology and engineering including applying computational thinking.

- **Concept: Innovation**
    - Learning Experience
        - Students who demonstrate understanding can evaluate a technological innovation that arose from a specific society's unique need or want.
        - Clarifying Statement: As engineers modify technological systems, materials are often chosen based on local environmental factors, locally available materials, and cost. Modes of transportation differ depending upon population density, availability, safety, speed, geography, and cost. Energy sources are chosen based on considerations such as proximity to source, cost-effectiveness, and environmental impact.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - The needs and wants of society often shape technology and engineering developments.
    - (SEP) Science and Engineering Practices
        - Obtaining, Evaluating, and Communicating Information - Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.
    - (DCI) Disciplinary Core Ideas
        - NAEP T.12.1 - The decision to develop a new technology is influenced by societal opinions and demands. These driving forces differ from culture to culture.
    - (TEP) Technology and Engineering Practices
        - Optimism - Shows persistence in addressing technological problems and finding solutions to those problems.

- **Concept: Minimalizing Waste**
    - Learning Experience

        - Students who demonstrate understanding can critically assess and evaluate a technology that minimizes resource use and resulting waste to achieve a goal.
        - Clarifying Statement: By focusing on a "wicked problem"—one that is complex, has multiple possible solutions, and requires consideration of various perspectives—students can be challenged to go through a process of problem finding/defining, investigation, and design to find technological solutions that are more beneficial for society and the environment. VUCA problems—ones that are volatile, uncertain, complex, and ambiguous—challenge students to actively engage in the engineering design process to find technological solutions that are beneficial to society and minimize negative environmental impact and nonconsumable by-products.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Responsible creation and use of technology requires the sustainable use of renewable and non-renewable resources and handling of waste.
    - (SEP) Science and Engineering Practices
        - Using Mathematics and Computational Thinking - Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems.
    - (DCI) Disciplinary Core Ideas
        - HS-ESS3-4 - Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
    - (TEP) Technology and Engineering Practices
        - Critical Thinking - Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

* (Learning Experience) A learning experience refers to any interaction, activity, or other experience in which students acquire new understanding, knowledge, behaviors, or skills.
* (Big Idea #) PDE Technology & Engineering Curriculum Framework Big Ideas
* (SEP) PDE Science and Engineering Practices
* (DCI) PDE Disciplinary Core Ideas
* (TEP) PDE Technology and Engineering Practices

Subject: Digital Graphics	**Grade Level:** High School	**Topic:** Digital Graphics Layout and Design

Science, Technology & Engineering, and Environmental Literacy & Sustainability Standards:

- **Concept: Defining the Purpose of a Design**
    - 3.5.9-12.U Evaluate and define the purpose of a design.
- **Concept: Project Planning**

- 3.5.9-12.I (ETS) 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.

- **Concept: Gathering Information**
  - 3.5.9-12.J Synthesize data and analyze trends to make decisions about technological products, systems, or processes.

- **Concept: Needs and Wants**
  - 3.5.9-12.S Conduct research to inform intentional inventions and innovations that address specific needs and wants.

- **Concept: Laws, Regulations, and Policies**
  - 3.5.9-12.L Interpret laws, regulations, policies, and other factors that impact the development and use of technology.

- **Concept: Criteria and Constraints**
  - 3.5.9-12.T (ETS) Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

- **Concept: Computer Modeling**
  - 3.5.9-12.PP Demonstrate the use of conceptual, graphical, virtual, mathematical, and physical modeling to identify conflicting considerations before the entire system is developed and to aid in design decision making.

- **Concept: Minimalizing Negative Impacts**
  - 3.5.9-12.C Develop a solution to a technological problem that has the least negative environmental and social impact.

* (ETS) Engineering, Technology, and Applications of Science – Standards applicable across the Science, Environmental Literacy & Sustainability, and Technology & Engineering content areas.

KEY LEARNING:	**UNIT ESSENTIAL QUESTION:**	**Texts/Resources/Materials:**
(LTTG) Students will be able to apply investigation, imagination, innovative thinking, and physical skills to accomplish goals. * (LTTG) PDE Technology & Engineering Long Term Transfer Goals	How can I apply investigation, imagination, innovative thinking, and physical skills to accomplish goals?	Computer Hardware, Computer Software, Adobe Creative Cloud, Online Resources, Presentations, Videos, Tutorials, and Sample Designs

CONCEPT:	**CONCEPT**:	**CONCEPT**:	**CONCEPT**:
Defining the Purpose of a Design	Project Planning	Gathering Information	Needs and Wants

Lesson Essential Questions: Why is there no single correct solution in design?	**Lesson Essential Questions:** How can one assess the impact of technology and engineering on society?	**Lesson Essential Questions:** How do costs, benefits, and tradeoffs factor into decisions made about technology and engineering?	**Lesson Essential Questions:** How do needs and wants drive design?
CONCEPT: Laws, Regulations, and Policies	**CONCEPT**: Criteria and Constraints	**CONCEPT**: Computer Modeling	**CONCEPT**: Minimalizing Negative Impacts
Lesson Essential Questions: How do the values and beliefs of societies shape attitudes toward technology?	**Lesson Essential Questions:** How do criteria and constraints drive design?	**Lesson Essential Questions:** Why is it important to understand, use, assess, and create technological products, systems, and ways of thinking?	**Lesson Essential Questions:** Why is it important to sustainably manage technological resources?

Vocabulary

Academic Specific:

Locate, Select, Model, Practice, Apply, Produce, Adjust, Display, Compare, Contrast, Examine, Evaluate, Design, Develop, Create, Invent, and Modify

Domain (Content) Specific:

Concept: Defining the Purpose of a Design

- Trade-off, Resource, Criteria, Constraint, Function, Form, Purpose, Evaluate, and Define

Concept: Project Planning

- Prioritized Criteria, Trade Offs, and Aesthetics

Concept: Gathering Information

- Data, Information, Synthesis, Analysis, Trend, Product, System, Process, Benefit, and Tradeoff

Concept: Needs and Wants

- Making, Research, Invention, Innovation, Need, and Want

Concept: Laws, Regulations, and Policies

- Interpret, Law, Regulation, Policy, Develop, and Use

Concept: Criteria and Constraints

- Qualitative, Quantitative, Societal Needs, and Societal Wants

	Concept: Computer Modeling • Model, Prototype, Graphical, Virtual, Mathematical, Physical, Troubleshooting, and Simulation **Concept: Minimalizing Negative Impacts** • Development, Solution, Technical Problem, Impact, Sustainability, Identification, Analysis, Investigation, and Design

KUD's (know—understand—do)		
Concepts—nouns: (What do students need to know/understand?)	**RR Framework** **Skills—verbs:** (What do students need to be able to do? In which quadrant do the skills belong?) *See page 19 of SAP Learning Environment guide*	
1. Defining the Purpose of a Design 2. Project Planning 3. Gathering Information 4. Needs and Wants 5. Laws, Regulations, and Policies 6. Criteria and Constraints 7. Computer Modeling 8. Minimalizing Negative Impacts	Compare, Contrast, Examine, and Evaluate **C**	Design, Develop, Create, Invent, and Modify **D**
	A Locate and Select	**B** Model, Practice, Apply, Produce, Adjust, and Display

Unit Assessment Plan and Resources

• **Concept: Defining the Purpose of a Design**
  ○ Learning Experience
  ▪ Students who demonstrate understanding can evaluate and define the purpose of a design.

        - Clarifying Statement: In order to move forward with the best solution, it is often necessary to determine a design that best fits a number of measures such as trade-offs, resources, criteria, constraints, function, form, etc. A product must be a balance of these measures to best fit the intended use and audience.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - There is no single, best solution as designs can always be improved and refined.
    - (SEP) Science and Engineering Practices
        - Obtaining, Evaluating, and Communicating Information - Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.
    - (DCI) Disciplinary Core Ideas
        - NAEP D.12.8 - Meet a sophisticated design challenge by identifying criteria and constraints, predicting how these will affect the solution, researching and generating ideas, and using trade-offs to balance competing values in selecting the best solution.
    - (TEP) Technology and Engineering Practices
        - Communication - Conveys ideas clearly in constructive, insightful ways, including through written and oral communication and via mathematical and physical models.

- **Concept: Project Planning**
    - Learning Experience
        - Students who demonstrate understanding can 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.
        - Clarifying Statement: When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Technology and engineering have both positive and negative impacts on society and the environment.
    - (SEP) Science and Engineering Practices
        - Constructing Explanations and Designing Solutions - Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.
    - (DCI) Disciplinary Core Ideas
        - ETS1.B: Developing Possible Solutions - When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.
    - (TEP) Technology and Engineering Practices
        - Critical Thinking - Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

- **Concept: Gathering Information**
    - Learning Experience

        - Students who demonstrate understanding can synthesize data and analyze trends to make decisions about technological products, systems, or processes.
        - Clarifying Statement: Deductive thinking and synthesis techniques can assist in this process. Students should consider historical events, global trends, and economic factors, and they should evaluate and consider how to manage the risks incurred by technological development.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Decisions made about technology and engineering involve consideration of costs, benefits, and tradeoffs.
    - (SEP) Science and Engineering Practices
        - Using Mathematics and Computational Thinking - Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems.
    - (DCI) Disciplinary Core Ideas
        - ETS1.B: Developing Possible Solutions - When evaluating solutions, it is important to consider a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.
    - (TEP) Technology and Engineering Practices
        - Critical Thinking - Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

- **Concept: Needs and Wants**
    - Learning Experience
        - Students who demonstrate understanding can conduct research to inform intentional inventions and innovations that address specific needs and wants.
        - Clarifying Statement: Years of research led to the design and development of laser systems used in atmospheric studies and other applications (LiDAR or LADAR). This same type of laser system was then modified and reapplied to treat the buildup of plaque in the arteries through laser angioplasty (i.e., surgical repair of a blood vessel such as an artery).
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Design optimization is driven by criteria and constraints.
    - (SEP) Science and Engineering Practices
        - Obtaining, Evaluating, and Communicating Information - Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.
    - (DCI) Disciplinary Core Ideas
        - ETS1.A: Defining and Delimiting Engineering Problems - Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
    - (TEP) Technology and Engineering Practices
        - Critical Thinking - Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

- **Concept: Laws, Regulations, and Policies**
  - Learning Experience
    - Students who demonstrate understanding can interpret laws, regulations, policies, and other factors that impact the development and use of technology.
    - Clarifying Statement: Laws, regulations, and policies shape the development and use of technology. Students should understand, in increasingly sophisticated ways, how technology assessment impacts policy development.
  - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
    - The values and beliefs of societies shape attitudes toward technology.
  - (SEP) Science and Engineering Practices
    - Obtaining, Evaluating, and Communicating Information - Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.
  - (DCI) Disciplinary Core Ideas
    - ETS1.A: Defining and Delimiting Engineering Problems - Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
  - (TEP) Technology and Engineering Practices
    - Communication - Conveys ideas clearly in constructive, insightful ways, including through written and oral communication and via mathematical and physical models.

- **Concept: Criteria and Constraints**
  - Learning Experience
    - Students who demonstrate understanding can analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
    - Clarifying Statement: 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.
  - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
    - Design optimization is driven by criteria and constraints.
  - (SEP) Science and Engineering Practices
    - Asking Questions and Defining Problems - Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.
  - (DCI) Disciplinary Core Ideas
    - ETS1.A: Defining and Delimiting Engineering Problems - Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.

        - ETS1.A: Defining and 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.
    - (TEP) Technology and Engineering Practices
        - Critical Thinking - Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

- **Concept: Computer Modeling**
    - Learning Experience
        - Students who demonstrate understanding can demonstrate the use of conceptual, graphical, virtual, mathematical, and physical modeling to identify conflicting considerations before the entire system is developed and to aid in design decision making.
        - Clarifying Statement: When making final decisions for designs, it is important to consider all relationships between design choices and end product results. Models and prototypes of all kinds can be useful in troubleshooting these relationships prior to developing final solutions. These models can vary from high-tech software to low-cost physical models of solutions.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - The study of technology and engineering involves the ability to understand, use, assess, and create technological products, systems, and ways of thinking.
    - (SEP) Science and Engineering Practices
        - Developing & Using Models - Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.
    - (DCI) Disciplinary Core Ideas
        - ISTE 6C - Students communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations.
    - (TEP) Technology and Engineering Practices
        - Making and Doing - Demonstrates the ability to regulate and improve making and doing skills.

- **Concept: Minimalizing Negative Impacts**
    - Learning Experience
        - Students who demonstrate understanding can develop a solution to a technological problem that has the least negative environmental and social impact.
        - Clarifying Statement: Students can be challenged to engage in problem identification, analysis, investigation, and design to find technological solutions that improve people's living conditions or that improve the well-being of individuals or members of a group
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Responsible creation and use of technology requires the sustainable use of renewable and non-renewable resources and handling of waste.
    - (SEP) Science and Engineering Practices
        - Asking Questions and Defining Problems - Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.

- (DCI) Disciplinary Core Ideas
  - ETS1.B: Developing Possible Solutions - When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.
- (TEP) Technology and Engineering Practices
  - Attention to Ethics - Assesses technological products, systems, and processes through critical analysis of their impacts and outcomes.

* (Learning Experience) A learning experience refers to any interaction, activity, or other experience in which students acquire new understanding, knowledge, behaviors, or skills.
* (Big Idea #) PDE Technology & Engineering Curriculum Framework Big Ideas
* (SEP) PDE Science and Engineering Practices
* (DCI) PDE Disciplinary Core Ideas
* (TEP) PDE Technology and Engineering Practices

Subject: Digital Graphics	**Grade Level:** High School	**Topic:** Applying Digital Graphics Knowledge and Technical Skills

Science, Technology & Engineering, and Environmental Literacy & Sustainability Standards:

- **Concept: Applying Knowledge**
  - 3.5.9-12.DD Develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system.
- **Concept: Applying Technical Skills**
  - 3.5.9-12.E Evaluate how technology and engineering advancements alter human health and capabilities.
- **Concept: Making and Doing**
  - 3.5.9-12.AA Safely apply an appropriate range of making skills to a design thinking process.
- **Concept: Troubleshooting**
  - 3.5.9-12.O Apply appropriate design thinking processes to diagnose, adjust, and repair systems to ensure precise, safe, and proper functionality.

* (ETS) Engineering, Technology, and Applications of Science – Standards applicable across the Science, Environmental Literacy & Sustainability, and Technology & Engineering content areas.

KEY LEARNING:	**UNIT ESSENTIAL QUESTION:**	**Texts/Resources/Materials:**
(LTTG) Students will be able to demonstrate integrity and conscientiousness, considering ethical issues involved. * (LTTG) PDE Technology & Engineering Long Term Transfer Goals	How can I demonstrate integrity and conscientiousness, considering ethical issues involved?	Computer Hardware, Computer Software, Adobe Creative Cloud, Online Resources, Presentations, Videos, Tutorials, and Sample Designs

CONCEPT:	**CONCEPT**:	**CONCEPT**:	**CONCEPT**:
Applying Knowledge	Applying Technical Skills	Making and Doing	Troubleshooting
Lesson Essential Questions: How does technology and engineering relate to other content areas?	**Lesson Essential Questions:** How does changing technology impact the individual, culture, and environment?	**Lesson Essential Questions:** Why is making a necessary component of design?	**Lesson Essential Questions:** What is the value of iteration within the design process?

Vocabulary

Academic Specific:	**Domain (Content) Specific:**
Locate, Select, Model, Practice, Apply, Produce, Adjust, Display, Compare, Contrast, Examine, Evaluate, Design, Develop, Create, Invent, and Modify	**Concept: Applying Knowledge** • Technological Literacy, Synthesize, Knowledge, Improve, Design, Construct, Execute, Plan, and Solve **Concept: Applying Technical Skills** • Evaluate, Advancement, Alteration, Capability, Examine, Effect, and Impact **Concept: Making and Doing** • Safe, Skill, Making, and Design Thinking **Concept: Troubleshooting** • Design Thinking, Diagnose, Adjust, Repair, Precise, Safe, Proper, Functionality, Monitor, Maintenance, and Iterate

<table>
<tr><th colspan="3">KUD's (know—understand—do)</th></tr>
<tr><td>Concepts—nouns:
(What do students need to know/understand?)</td><td colspan="2"><u>RR Framework</u>

Skills—verbs:
(What do students need to be able to do? In which quadrant do the skills belong?)
See page 19 of SAP Learning Environment guide</td></tr>
<tr><td rowspan="2">1. Applying Knowledge
2. Applying Technical Skills
3. Making and Doing
4. Troubleshooting</td><td>Compare, Contrast, Examine, and Evaluate
C</td><td>Design, Develop, Create, Invent, and Modify
D</td></tr>
<tr><td>A
Locate and Select</td><td>B
Model, Practice, Apply, Produce, Adjust, and Display</td></tr>
</table>

<table>
<tr><th>Unit Assessment Plan and Resources</th></tr>
<tr><td>

- **Concept: Applying Knowledge**
  - Learning Experience
    - Students who demonstrate understanding can develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system.
    - Clarifying Statement: Designing, maintaining, and improving products or systems often require unique knowledge and skills. Technologically and engineering literate citizens are capable of synthesizing knowledge from science, mathematics, and other disciplines to design, construct, and execute a plan to solve a system's design problem.
  - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
    - Technology and engineering are interdisciplinary, relating to more than one content area.
  - (SEP) Science and Engineering Practices
    - Asking Questions and Defining Problems - Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.
  - (DCI) Disciplinary Core Ideas

</td></tr>
</table>

        - NAEP D.12.2 - Engineers use science, mathematics, and other disciplines to improve technology, while scientists use tools devised by engineers to advance knowledge in their disciplines. This interaction has deepened over the past century.
    - (TEP) Technology and Engineering Practices
        - Making and Doing - Demonstrates the ability to regulate and improve making and doing skills.
        - Systems Thinking - Designs and troubleshoots technological systems in ways that consider the multiple components of the system.

- **Concept: Applying Technical Skills**
    - Learning Experience
        - Students who demonstrate understanding can evaluate how technology and engineering advancements alter human health and capabilities.
        - Clarifying Statement: Evaluative tools can be used to examine existing or proposed technologies to assess their positive and negative effects on humans. For example, CRISPR-Cas9 technology has been hailed as a tool for modifying human genetic material to reduce the risk of inherited disease. At the same time, there are medical and ethical concerns surrounding application of this technology to humans.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Use of technology can lead to fundamental changes in individuals, human cultures, and the environment.
    - (SEP) Science and Engineering Practices
        - Engaging in Argument From Evidence - Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.
    - (DCI) Disciplinary Core Ideas
        - NAEP T.12.13 - Disparities in the technologies available to different groups of people have consequences for public health and prosperity, but deciding whether to introduce a new technology should consider local resources and the role of culture in acceptance of the new technology.
    - (TEP) Technology and Engineering Practices
        - Critical Thinking - Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

- **Concept: Making and Doing**
    - Learning Experience
        - Students who demonstrate understanding can safely apply an appropriate range of making skills to a design thinking process.
        - Clarifying Statement: Students independently identify and safely use appropriate tools and processes to complete a design making task. Students recognize their own knowledge and skill gaps, pursue opportunities to develop necessary skills, and become more confident and competent in making.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Making is an inherent part of technology and engineering design.
    - (SEP) Science and Engineering Practices
        - Constructing Explanations and Designing Solutions - Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.

- (DCI) Disciplinary Core Ideas
  - ETS1.B: Developing Possible Solutions - Both physical models and computers can be used in various ways to aid in the engineering design process.
  - ISTE 4C - Students develop, test and refine prototypes as part of a cyclical design process.
- (TEP) Technology and Engineering Practices
  - Making and Doing - Demonstrates the ability to regulate and improve making and doing skills.

- **Concept: Troubleshooting**
  - Learning Experience
    - Students who demonstrate understanding can apply appropriate design thinking processes to diagnose, adjust, and repair systems to ensure precise, safe, and proper functionality.
    - Clarifying Statement: For many consumer products, federal and state laws require safety information. Tools are used by students for diagnosis, adjustments, and repair. Monitoring the operation, adjusting the parts, and regular maintenance of a system are part of keeping systems in good working order and maintaining safety.
  - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
    - Design in technology and engineering is iterative.
  - (SEP) Science and Engineering Practices
    - Constructing Explanations and Designing Solutions - Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.
  - (DCI) Disciplinary Core Ideas
    - ETS1.C: Optimizing the Design Solution - Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.
    - NAEP D.12.18 - Analyze a complicated system to identify ways that it might fail in the future. Identify the most likely failure points and recommend safeguards to avoid future failures.
  - (TEP) Technology and Engineering Practices
    - Making and Doing - Demonstrates the ability to regulate and improve making and doing skills.
    - Systems Thinking - Designs and troubleshoots technological systems in ways that consider the multiple components of the system.

* (Learning Experience) A learning experience refers to any interaction, activity, or other experience in which students acquire new understanding, knowledge, behaviors, or skills.
* (Big Idea #) PDE Technology & Engineering Curriculum Framework Big Ideas
* (SEP) PDE Science and Engineering Practices
* (DCI) PDE Disciplinary Core Ideas
* (TEP) PDE Technology and Engineering Practices

Subject: Digital Graphics	**Grade Level:** High School	**Topic:** Applying Design Principles to Digital Graphics

Science, Technology & Engineering, and Environmental Literacy & Sustainability Standards:

- **Concept: Design Principles**
  - 3.5.9-12.Q Implement and critique principles, elements, and factors of design.
- **Concept: Human-Centered Design**
  - 3.5.9-12.V Apply principles of human-centered design.
- **Concept: Design Skills**
  - 3.5.9-12.P Apply a broad range of design skills to a design thinking process.

* (ETS) Engineering, Technology, and Applications of Science – Standards applicable across the Science, Environmental Literacy & Sustainability, and Technology & Engineering content areas.

KEY LEARNING:	**UNIT ESSENTIAL QUESTION:**	**Texts/Resources/Materials:**
(LTTG) Students will be able to demonstrate integrity and conscientiousness, considering ethical issues involved. * (LTTG) PDE Technology & Engineering Long Term Transfer Goals	How can I demonstrate integrity and conscientiousness, considering ethical issues involved?	Computer Hardware, Computer Software, Adobe Creative Cloud, Online Resources, Presentations, Videos, Tutorials, and Sample Designs

CONCEPT:	**CONCEPT**:	**CONCEPT**:	**CONCEPT**:
Design Principles	Human-Centered Design	Design Skills	
Lesson Essential Questions:	**Lesson Essential Questions:**	**Lesson Essential Questions:**	**Lesson Essential Questions:**
How are designs influenced by universal principles and elements of design?	How are requisite skills applied in technology and engineering design?	Why is there no single correct solution in design?	
Vocabulary			

Academic Specific:	**Domain (Content) Specific:**
Locate, Select, Model, Practice, Apply, Produce, Adjust, Display, Compare, Contrast, Examine, Evaluate, Design, Develop, Create, Invent, and Modify	**Concept: Design Principles** • Line, Shape, Space, Value, Form, Texture, Color, Balance, Rhythm, Pattern, Emphasis, Contrast, Unity, and Movement **Concept: Human-Centered Design** • Human-Centered Design, Principle, Relationship, Designed Environment, Ergonomics, Designing, Constructing, and Implementing **Concept: Design Skills** • Creativity, Collaboration, Resourcefulness, Ideation, and Design Thinking

<table>
<tr><th colspan="3">KUD's (know—understand—do)</th></tr>
<tr><td>Concepts—nouns:
(What do students need to know/understand?)</td><td colspan="2"><u>RR Framework</u>

Skills—verbs:
(What do students need to be able to do? In which quadrant do the skills belong?)
See page 19 of SAP Learning Environment guide</td></tr>
<tr><td rowspan="2">1. Design Principles
2. Human-Centered Design
3. Design Skills</td><td>Compare, Contrast, Examine, and Evaluate

C</td><td>Design, Develop, Create, Invent, and Modify

D</td></tr>
<tr><td>A

Locate and Select</td><td>B

Model, Practice, Apply, Produce, Adjust, and Display</td></tr>
</table>

Unit Assessment Plan and Resources

- **Concept: Design Principles**
  - Learning Experience
    - Students who demonstrate understanding can implement and critique principles, elements, and factors of design.
    - Clarifying Statement: Students independently select, evaluate, and implement principles, elements, and other factors to improve their designs. The principles of design include balance, rhythm, pattern, emphasis, contrast, unity, and movement. The elements of design include line, shape, space, value, form, texture, and color. Additional design factors that can be applied to physical objects include ergonomics, energy efficiency, reliability, durability, safety, ease of manufacture, and aesthetics.
  - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
    - There are universal principles and elements of design.
  - (SEP) Science and Engineering Practices
    - Constructing Explanations and Designing Solutions - Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.
  - (DCI) Disciplinary Core Ideas
    - Developing Possible Solutions - When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.
  - (TEP) Technology and Engineering Practices
    - Attention to Ethics - Assesses technological products, systems, and processes through critical analysis of their impacts and outcomes.
    - Critical Thinking - Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

- **Concept: Human-Centered Design**
  - Learning Experience
    - Students who demonstrate understanding can apply principles of human-centered design.
    - Clarifying Statement: Students consider the relationship between humans and the designed environment while designing, constructing, and implementing a solution. Students will synthesize their understanding of human-centered design through critical evaluation of design decisions and their appropriateness for the intended users.
  - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
    - There are requisite skills used in technology and engineering design.
  - (SEP) Science and Engineering Practices
    - Constructing Explanations and Designing Solutions - Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.
  - (DCI) Disciplinary Core Ideas

        - ETS1.A: Defining and Delimiting Engineering Problems - Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
    - (TEP) Technology and Engineering Practices
        - Creativity - Elaborates and articulates novel ideas and aesthetics.
        - Attention to Ethics - Assess technological products, systems, and processes through critical analysis of their impacts and outcomes.

- **Concept: Design Skills**
    - Learning Experience
        - Students who demonstrate understanding can apply a broad range of design skills to a design thinking process.
        - Clarifying Statement: Students engage in meaningful discourse about the essential skills they have applied when engaged in designing, constructing, and implementing a solution. These include creativity, collaboration, resourcefulness, ideation, learning through failure, and many other essential skills of design.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - There is no single, best solution as designs can always be improved and refined.
    - (SEP) Science and Engineering Practices
        - Constructing Explanations and Designing Solutions - Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.
    - (DCI) Disciplinary Core Ideas
        - ISTE 4A - Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
    - (TEP) Technology and Engineering Practices
        - Making and Doing - Demonstrates the ability to regulate and improve making and doing skills.

* (Learning Experience) A learning experience refers to any interaction, activity, or other experience in which students acquire new understanding, knowledge, behaviors, or skills.
* (Big Idea #) PDE Technology & Engineering Curriculum Framework Big Ideas
* (SEP) PDE Science and Engineering Practices
* (DCI) PDE Disciplinary Core Ideas
* (TEP) PDE Technology and Engineering Practices

Subject: Digital Graphics	**Grade Level:** High School	**Topic:** Digital Graphics Experimentation and Development

Science, Technology & Engineering, and Environmental Literacy & Sustainability Standards:

- **Concept: Experimentation**
  - 3.5.9-12.K (ETS) 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.
- **Concept: Development**
  - 3.5.9-12.M Develop a device or system for the marketplace.
- **Concept: Design Solution**
  - 3.5-9-12.X Implement the best possible solution to a design using an explicit process.
- **Concept: Quality Control**
  - 3.5.9-12.QQ Implement quality control as a planned process to ensure that a product, service, or system meets established criteria.

* (ETS) Engineering, Technology, and Applications of Science – Standards applicable across the Science, Environmental Literacy & Sustainability, and Technology & Engineering content areas.

KEY LEARNING:	**UNIT ESSENTIAL QUESTION:**	**Texts/Resources/Materials:**
(LTTG) Students will be able to employ hands-on problem solving, i.e., designing, making/building, producing, and evaluating outcomes. * (LTTG) PDE Technology & Engineering Long Term Transfer Goals	How can I employ hands-on problem solving, i.e., designing, making/building, producing, and evaluating outcomes?	Computer Hardware, Computer Software, Online Resources, Presentations, Videos, Tutorials, and Sample Designs

CONCEPT:	**CONCEPT**:	**CONCEPT**:	**CONCEPT**:
Experimentation	Development	Design Solution	Quality Control
Lesson Essential Questions:	**Lesson Essential Questions:**	**Lesson Essential Questions:**	**Lesson Essential Questions:**
How do costs, benefits, and tradeoffs factor into decisions made about technology and engineering?	How does technology and engineering address the needs and wants of society?	Why is there no single correct solution in design?	How are various resources used in technology and engineering activities?
Vocabulary			

Academic Specific:	**Domain (Content) Specific:**
Locate, Select, Model, Practice, Apply, Produce, Adjust, Display, Compare, Contrast, Examine, Evaluate, Design, Develop, Create, Invent, and Modify	**Concept: Experimentation** • Engineering Design Process, Computer Simulation, Systems, and Model **Concept: Development** • Develop, Device, System, Marketplace, Research & Development, and Production **Concept: Design Solution** • Optimization, Explicit Process, and Design **Concept: Quality Control** • Quality Control, Planned Process, and Criteria

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Locate and Select</td><td>B

Model, Practice, Apply, Produce, Adjust, and Display</td></tr>
</table>

Unit Assessment Plan and Resources

- **Concept: Experimentation**
  - Learning Experience
    - Students who demonstrate understanding can 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.
    - Clarifying Statement: Both physical models and computers can be used in various ways to aid in the engineering design process.
  - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
    - Decisions made about technology and engineering involve consideration of costs, benefits, and tradeoffs.
  - (SEP) Science and Engineering Practices
    - Using Mathematics and Computational Thinking - Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems.
  - (DCI) Disciplinary Core Ideas
    - 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.
  - (TEP) Technology and Engineering Practices
    - Critical Thinking - Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

- **Concept: Development**
  - Learning Experience
    - Students who demonstrate understanding can develop a device or system for the marketplace.
    - Clarifying Statement: Research on specific topics of interest to the government or business and industry can provide more information on a subject, and, in many cases, can provide information needed to create an invention or innovation. R&D helps to prepare a product or system for final production. Product development of this type frequently requires sustained effort from teams of people having diverse backgrounds.
  - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
    - The needs and wants of society often shape technology and engineering developments.
  - (SEP) Science and Engineering Practices
    - Constructing Explanations and Designing Solutions - Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.
  - (DCI) Disciplinary Core Ideas

        - NAEP D.12.6 - Engineering design is a complicated process in which creative steps are embedded in content knowledge and research on the challenge. Decisions on trade-offs involve systematic comparisons of all costs and benefits, and final steps may involve redesigning for optimization.
    - (TEP) Technology and Engineering Practices
        - Making and Doing - Demonstrates the ability to regulate and improve making and doing skills.

- **Concept: Design Solution**
    - Learning Experience
        - Students who demonstrate understanding can implement the best possible solution to a design using an explicit process.
        - Clarifying Statement: Students design within provided criteria and constraints and recognize trade-offs associated with optimization.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - There is no single, best solution as designs can always be improved and refined.
    - (SEP) Science and Engineering Practices
        - Constructing Explanations and Designing Solutions - Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.
    - (DCI) Disciplinary Core Ideas
        - NAEP D.12.8 - Meet a sophisticated design challenge by identifying criteria and constraints, predicting how these will affect the solution, researching and generating ideas, and using trade-offs to balance competing values in selecting the best solution.
        - ISTE 4C - Students develop, test and refine prototypes as part of a cyclical design process.
    - (TEP) Technology and Engineering Practices
        - Making and Doing - Demonstrates the ability to regulate and improve making and doing skills.
        - Optimism - Shows persistence in addressing technological problems and finding solutions to those problems.

- **Concept: Quality Control**
    - Learning Experience
        - Students who demonstrate understanding can implement quality control as a planned process to ensure that a product, service, or system meets established criteria.
        - Clarifying Statement: Quality control is concerned with how well a product, service, or system conforms to specifications and tolerances required by the design. For example, a set of rigorous international standards has been established to help companies systematically increase the quality of their products and operations.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Technology and engineering activities require resources.
    - (SEP) Science and Engineering Practices
        - Planning and Carrying Out Investigations - Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts.
    - (DCI) Disciplinary Core Ideas
        - HS-ESS3-4 - Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
    - (TEP) Technology and Engineering Practices

- Making and Doing - Demonstrates the ability to regulate and improve making and doing skills.
- Optimism - Shows persistence in addressing technological problems and finding solutions to those problems.

* (Learning Experience) A learning experience refers to any interaction, activity, or other experience in which students acquire new understanding, knowledge, behaviors, or skills.
* (Big Idea #) PDE Technology & Engineering Curriculum Framework Big Ideas
* (SEP) PDE Science and Engineering Practices
* (DCI) PDE Disciplinary Core Ideas
* (TEP) PDE Technology and Engineering Practices

Subject: Digital Graphics	**Grade Level:** High School	**Topic:** Testing, Evaluating, and Refining Digital Graphics

Science, Technology & Engineering, and Environmental Literacy & Sustainability Standards:

- **Concept: Testing**
  - 3.5.9-12.H Evaluate ways that technology and engineering can impact individuals, society, and the environment.
- **Concept: Evaluation**
  - 3.5.9-12.G Evaluate a technological innovation that was met with societal resistance impacting its development.
- **Concept: Refinement**
  - 3.5.9-12.KK Relate how technological and engineering developments have been evolutionary, often the result of a series of refinements to basic inventions or technological knowledge.
- **Concept: Optimization**
  - 3.5-9-12.W Optimize a design by addressing desired qualities within criteria and constraints while considering trade-offs.
- **Concept: Sustainability**
  - 3.5.9-12.D Critique whether existing or proposed technologies use resources sustainably.

* (ETS) Engineering, Technology, and Applications of Science – Standards applicable across the Science, Environmental Literacy & Sustainability, and Technology & Engineering content areas.

KEY LEARNING:	**UNIT ESSENTIAL QUESTION:**	**Texts/Resources/Materials:**
(LTTG) Students will be able to investigate better solutions through a belief that opportunities can be found in every challenge. * (LTTG) PDE Technology & Engineering Long Term Transfer Goals	How can I investigate better solutions through a belief that opportunities can be found in every challenge?	Computer Hardware, Computer Software, Adobe Creative Cloud, Online Resources, Presentations, Videos, Tutorials, and Sample Designs

CONCEPT: Testing	**CONCEPT**: Evaluation	**CONCEPT**: Refinement	**CONCEPT**: Optimization
Lesson Essential Questions: How can one assess the impact of technology and engineering on society?	**Lesson Essential Questions:** How do the values and beliefs of societies shape attitudes toward technology?	**Lesson Essential Questions:** How has technology both created and solved problems?	**Lesson Essential Questions:** How do criteria and constraints drive design?
CONCEPT: Sustainability	**CONCEPT**:	**CONCEPT**:	**CONCEPT**:
Lesson Essential Questions: Why is it important to sustainably manage technological resources?	**Lesson Essential Questions:**	**Lesson Essential Questions:**	**Lesson Essential Questions:**

Vocabulary	
Academic Specific: Locate, Select, Model, Practice, Apply, Produce, Adjust, Display, Compare, Contrast, Examine, Evaluate, Design, Develop, Create, Invent, and Modify	**Domain (Content) Specific:** **Concept: Testing** • Evaluate, Technology, Engineering, Individual, Society, Environment, Impact, and Sustainability **Concept: Evaluation**

	• Evaluate, Innovation, Society, Resistance, Norm, Development, Resolve, Conflict, Consensus, and Value **Concept: Refinement** • Evolutionary, Refinement, Invention, Innovation, Engineer, Designer, Technician, Technique, and Process **Concept: Optimization** • Making, Criteria, Constraints, Optimal, Optimize, Approach, Solution, and Trade-off **Concept: Sustainability** • Critique, Sustainability, Evaluate, and Investigate

KUD's (know—understand—do)		
Concepts—nouns: (What do students need to know/understand?)	**RR Framework** **Skills—verbs:** (What do students need to be able to do? In which quadrant do the skills belong?) *See page 19 of SAP Learning Environment guide*	
1. Testing 2. Evaluation 3. Refinement 4. Optimization 5. Sustainability	Compare, Contrast, Examine, and Evaluate **C**	Design, Develop, Create, Invent, and Modify **D**
	A Locate and Select	**B** Model, Practice, Apply, Produce, Adjust, and Display

Unit Assessment Plan and Resources

- **Concept: Testing**
  - Learning Experience
    - Students who demonstrate understanding can evaluate ways that technology and engineering can impact individuals, society, and the environment.
    - Clarifying Statement: A variety of approaches and resources can be used by students when asked to evaluate given technologies. These include technology assessment, cost-benefit analysis, risk assessment, environmental impact analysis, and case studies, among others. By applying evaluative techniques, students can analyze the relationships between resources and technology to improve sustainability efforts. This process should be accompanied by an understanding of the importance of evaluating technologies in a holistic manner.
  - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
    - Technology and engineering have both positive and negative impacts on society and the environment.
  - (SEP) Science and Engineering Practices
    - Engaging in Argument From Evidence - Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.
  - (DCI) Disciplinary Core Ideas
    - HS-LS2-7 - Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
    - NAEP T.12.4 - Analyze cultural, social, economic, or political changes (separately or together) that may be triggered by the transfer of a specific technology from one society to another. Include both anticipated and unanticipated effects.
  - (TEP) Technology and Engineering Practices
    - Attention to Ethics - Assesses technological products, systems, and processes through critical analysis of their impacts and outcomes.

- **Concept: Evaluation**
  - Learning Experience
    - Students who demonstrate understanding can evaluate a technological innovation that was met with societal resistance impacting its development.
    - Clarifying Statement: Throughout history, societies have made moral, ethical, and political decisions impacting the development of technological solutions and innovations. Sometimes those decisions are controversial and multifaceted. Societies differ in their norms and methods for resolving the problems that arise when conflicting values preclude consensus. For example, Germany made the decision to phase out all use of nuclear power due to public opposition to this energy source.
  - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
    - The values and beliefs of societies shape attitudes toward technology.
  - (SEP) Science and Engineering Practices
    - Obtaining, Evaluating, and Communicating Information - Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.
  - (DCI) Disciplinary Core Ideas

        - ETS1.A: Defining and Delimiting Engineering Problems - Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
    - (TEP) Technology and Engineering Practices
        - Critical Thinking - Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

- **Concept: Refinement**
    - Learning Experience
        - Students who demonstrate understanding can relate how technological and engineering developments have been evolutionary, often the result of a series of refinements to basic inventions or technological knowledge.
        - Clarifying Statement: For example, the development of the pencil was a long and tedious process. Engineers, designers, and technicians developed many different techniques and processes and used a variety of materials in order to develop the best pencil possible. Agricultural techniques were developed to improve the cultivation of food and its supply. Other developments include better ways to communicate through the development of paper, ink, and the alphabet; to navigate with boats; to understand human anatomy; and to provide access to clean drinking water.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Historically, technology has both created and solved problems.
    - (SEP) Science and Engineering Practices
        - Obtaining, Evaluating, and Communicating Information - Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.
    - (DCI) Disciplinary Core Ideas
        - NAEP T.12.2 - Changes caused by the introduction and use of a new technology can range from gradual to rapid and from subtle to obvious, and can change over time. These changes may vary from society to society as a result of differences in a society's economy, politics, and culture.
    - (TEP) Technology and Engineering Practices
        - Making and Doing - Demonstrates the ability to regulate and improve making and doing skills.

- **Concept: Optimization**
    - Learning Experience
        - Students who demonstrate understanding can optimize a design by addressing desired qualities within criteria and constraints while considering trade-offs.
        - Clarifying Statement: Students evaluate criteria and constraints in the technology and engineering design process to select optimal approaches for their design solutions. Students at this level should be able to articulate a rationale (e.g., design matrix) for their decisions in the design, construction, and implementation of their solution.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Design optimization is driven by criteria and constraints.

- (SEP) Science and Engineering Practices
  - Constructing Explanations and Designing Solutions - Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.
- (DCI) Disciplinary Core Ideas
  - ETS1.C: Optimizing the Design Solution - Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.
- (TEP) Technology and Engineering Practices
  - Optimism - Shows persistence in addressing technological problems and finding solutions to those problems.

- **Concept: Sustainability**
  - Learning Experience
    - Students who demonstrate understanding can critique whether existing or proposed technologies use resources sustainably
    - Clarifying Statement: By applying the evaluative tools described above, students can investigate ways that resources used to create and operate a given technology can be improved to enhance the sustainability of the technology. For example, they could evaluate how students are currently transported to and from school and devise ways to reduce fuel use. Strategies could include promoting bike riding by installing covered bike racks, re-routing vehicles to avoid long wait times, shifting school bus schedules to prevent extended idling times, and so on.
  - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
    - Responsible creation and use of technology requires the sustainable use of renewable and non-renewable resources and handling of waste.
  - (SEP) Science and Engineering Practices
    - Engaging in Argument From Evidence - Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.
  - (DCI) Disciplinary Core Ideas
    - HS-ESS3-3 - Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
  - (TEP) Technology and Engineering Practices
    - Attention to Ethics - Assesses technological products, systems, and processes through critical analysis of their impacts and outcomes.

* (Learning Experience) A learning experience refers to any interaction, activity, or other experience in which students acquire new understanding, knowledge, behaviors, or skills.
* (Big Idea #) PDE Technology & Engineering Curriculum Framework Big Ideas
* (SEP) PDE Science and Engineering Practices
* (DCI) PDE Disciplinary Core Ideas
* (TEP) PDE Technology and Engineering Practices

Subject: Digital Graphics	**Grade Level:** High School	**Topic:** Finalizing and Presenting Digital Graphics

Science, Technology & Engineering, and Environmental Literacy & Sustainability Standards:

- **Concept: Communicating Results**
  - 3.5-9-12.A Use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems.
- **Concept: Technology Diffusion and Adoption**
  - 3.5.9-12.NN Analyze the rate of technological and engineering development and predict future diffusion and adoption of new innovations and technologies.
- **Concept: Globalization Opportunities**
  - 3.5.9-12.FF Evaluate how technology enhances opportunities for new products and services through globalization.

* (ETS) Engineering, Technology, and Applications of Science – Standards applicable across the Science, Environmental Literacy & Sustainability, and Technology & Engineering content areas.

KEY LEARNING:	**UNIT ESSENTIAL QUESTION:**	**Texts/Resources/Materials:**
(LTTG) Students will be able to exchange and explain ideas by sharing information with a larger community. * (LTTG) PDE Technology & Engineering Long Term Transfer Goals	How can I exchange and explain ideas by sharing information with a larger community?	Computer Hardware, Computer Software, Adobe Creative Cloud, Online Resources, Presentations, Videos, Tutorials, and Sample Designs

CONCEPT:	**CONCEPT**:	**CONCEPT**:	**CONCEPT**:
Communicating Results	Technology Diffusion and Adoption	Globalization Opportunities	
Lesson Essential Questions:	**Lesson Essential Questions:**	**Lesson Essential Questions:**	**Lesson Essential Questions:**
Why is it important for people to be technologically literate?	How does the interdisciplinary nature of technology and engineering influence human activity?	How do advancements from one field impact another?	

Vocabulary	
Academic Specific: Locate, Select, Model, Practice, Apply, Produce, Adjust, Display, Compare, Contrast, Examine, Evaluate, Design, Develop, Create, Invent, and Modify	**Domain (Content) Specific:** **Concept: Communicating Results** • Technological Literacy, Communication, Process, Procedure, Maintain, and Assess **Concept: Technology Diffusion and Adoption** • Invention, Innovation, Diffusion, and Interdisciplinary **Concept: Globalization Opportunities** • Exponential Growth, Innovation, Invention, Advancement, Opportunity, Globalization, Product, and Service

KUD's (know—understand—do)		
Concepts—nouns: (What do students need to know/understand?)	**RR Framework** **Skills—verbs:** (What do students need to be able to do? In which quadrant do the skills belong?) *See page 19 of SAP Learning Environment guide*	
1. Communicating Results 2. Technology Diffusion and Adoption 3. Globalization Opportunities	Compare, Contrast, Examine, and Evaluate **C**	Design, Develop, Create, Invent, and Modify **D**
	A Locate and Select	**B** Model, Practice, Apply, Produce, Adjust, and Display

Unit Assessment Plan and Resources

- **Concept: Communicating Results**
  - Learning Experience
    - Students who demonstrate understanding can use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems.
    - Clarifying Statement: Examples of such techniques include flow charts, drawings, graphics, symbols, spreadsheets, graphs, time charts, and web pages. The audiences can be peers, teachers, local community and business members, and the global community
  - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
    - Technologically literate people are well equipped to learn about and use technological products and systems.
  - (SEP) Science and Engineering Practices
    - Obtaining, Evaluating, and Communicating Information - Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.
  - (DCI) Disciplinary Core Ideas
    - ETS1.B: Developing Possible Solutions - Both physical models and computers can be used in various ways to aid in the engineering design process.
    - ETS1.B: Developing Possible Solutions - 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 their needs.
  - (TEP) Technology and Engineering Practices
    - Communication - Clearly coveys ideas in constructive ways, including through written and oral communication and via mathematical and physical models.

- **Concept: Technology Diffusion and Adoption**
  - Learning Experience
    - Students who demonstrate understanding can analyze the rate of technological and engineering development and predict future diffusion and adoption of new innovations and technologies.
    - Clarifying Statement: The rate of development of inventions and innovations is affected by many factors, such as time and monetary investment. Many new technologies build upon previous technologies, often resulting in quick development and dispersion. For example, the rapid development of consumer scale drone technologies has built upon earlier military applications of these devices.
  - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
    - The study of technology and engineering as a human activity is interdisciplinary.
  - (SEP) Science and Engineering Practices
    - Developing & Using Models - Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.
  - (DCI) Disciplinary Core Ideas

        - ETS1.B: Developing Possible Solutions - When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.
    - (TEP) Technology and Engineering Practices
        - Making and Doing - Demonstrates the ability to regulate and improve making and doing skills.
        - Optimism - Shows persistence in addressing technological problems and finding solutions to those problems.

- **Concept: Globalization Opportunities**
    - Learning Experience
        - Students who demonstrate understanding can evaluate how technology enhances opportunities for new products and services through globalization.
        - Clarifying Statement: Developing countries have in many cases bypassed telephone landlines in adopting cellular technology, which has been used not just for communication but also to complete a variety of other tasks, such as banking. This concept is referred to as late-comer advantage. The exponential growth curve of technology has led to innovations and advancements once thought unattainable. Advancements and cost reduction of technologies such as rapid prototyping, desktop CNC, and microcontrollers have provided opportunities for new and innovative product ideas.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Technological knowledge and practices advance – and are advanced by – other fields.
    - (SEP) Science and Engineering Practices
        - Obtaining, Evaluating, and Communicating Information - Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.
    - (DCI) Disciplinary Core Ideas
        - 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.
    - (TEP) Technology and Engineering Practices
        - Optimism - Shows persistence in addressing technological problems and finding solutions to those problems.

* (Learning Experience) A learning experience refers to any interaction, activity, or other experience in which students acquire new understanding, knowledge, behaviors, or skills.
* (Big Idea #) PDE Technology & Engineering Curriculum Framework Big Ideas
* (SEP) PDE Science and Engineering Practices
* (DCI) PDE Disciplinary Core Ideas
* (TEP) PDE Technology and Engineering Practices

Subject: Digital Graphics	**Grade Level:** High School	**Topic:** Design and Creation of Digital Graphics

Science, Technology & Engineering, and Environmental Literacy & Sustainability Standards:

- 3.5.9-12.N Analyze and use relevant and appropriate design thinking processes to solve technological and engineering problems.
- 3.5.9-12.P Apply a broad range of design skills to a design thinking process.
- 3.5.9-12.Y (ETS) Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- 3.5.9-12.X Implement the best possible solution to a design using an explicit process.

* (ETS) Engineering, Technology, and Applications of Science – Standards applicable across the Science, Environmental Literacy & Sustainability, and Technology & Engineering content areas.

KEY LEARNING:	**UNIT ESSENTIAL QUESTION:**	**Texts/Resources/Materials:**
(LTTG) Students will be able to employ hands-on problem solving, i.e., designing, making/building, producing, and evaluating outcomes. (LTTG) Students will be able to collaborate as part of a team, valuing the contributions of all members. * (LTTG) PDE Technology & Engineering Long Term Transfer Goals	How can I employ hands-on problem solving, i.e., designing, making/building, producing, and evaluating outcomes? How can I collaborate as part of a team, valuing the contributions of all members?	Computer Hardware, Computer Software, Adobe Creative Cloud, Online Resources, Presentations, Videos, Tutorials, and Sample Designs

CONCEPT:	**CONCEPT**:	**CONCEPT**:	**CONCEPT**:
Design Process	Peer Review and Innovation	Layout and Design	Applying Knowledge and Technical Skills
Lesson Essential Questions:	**Lesson Essential Questions:**	**Lesson Essential Questions:**	**Lesson Essential Questions:**
How can I apply the design process to create effective digital graphic designs?	How can I peer review and / or improve student produced or professionally produced digital graphic designs?	How can I layout and design digital graphic applications to create effective designs?	How can I apply digital graphic design knowledge and technical skills to create effective digital graphic designs?

CONCEPT: Apply Design Principles	**CONCEPT**: Experimentation and Development	**CONCEPT**: Testing, Evaluating, and Refining	**CONCEPT**: Finalizing and Presenting
Lesson Essential Questions: How can I apply design principles to create effective digital graphic designs?	**Lesson Essential Questions:** How can I use experimentation to design and develop effective digital graphic designs?	**Lesson Essential Questions:** How can I test, evaluate, and refine digital graphic designs?	**Lesson Essential Questions:** How can I finalize and present digital graphic designs?

Vocabulary

Academic Specific:

Locate, Select, Model, Practice, Apply, Produce, Adjust, Display, Compare, Contrast, Examine, Evaluate, Design, Develop, Create, Invent, and Modify

Domain (Content) Specific:

Concept: Design Process

- Design Process and Systems Thinking

Concept: Peer Review and Innovation

- Peer Review, Compare, Contrast, Invention, Innovation, Imagination, and Research Skills

Concept: Layout and Design

- Initiative, Planning, Self-Direction, Brainstorming, Audience, Creative Thinking, Layout, Theme, Criteria, and Constraints

Concept: Applying Knowledge and Technical Skills

- Content Knowledge, Content Skills, Critical Thinking, Problem Solving, Design, Guidelines, Form, Function, Locating, Selecting, Creating, Adjusting, Producing, and Applying

Concept: Apply Design Principles

- Balance, Visual Hierarchy, Focal Point, Contrast, Unity, Repetition, Alignment, Proximity, Spatial Depth, Illusion, Grid, and Template

Concept: Experimentation and Development

- Experimentation, Development, Practice, Format, Multi-Side Designs, Two Dimensional, Three Dimensional, and Modeling

Concept: Testing, Evaluating, and Refining

	• Examine, Evaluate Usability, Self-Evaluation, Optimization, Trade-offs, Craftsmanship, Critique, User Experience, End-User, Function, Judgments, Decisions, Flexibility, Modifying, and Adaptability **Concept: Finalizing and Presenting** • Finalizing, Information, Media, Technology Skills, Productivity, Perseverance, Self-Discipline, Literacy, Communications, Lifelong Learning, Design Concept, Display, Proof Sheet, and Mock-Up

<table>
<tr><th colspan="3">KUD's (know—understand—do)</th></tr>
<tr><td>Concepts—nouns:
(What do students need to know/understand?)</td><td colspan="2"><u>RR Framework</u>

Skills—verbs:
(What do students need to be able to do? In which quadrant do the skills belong?)
See page 19 of SAP Learning Environment guide</td></tr>
<tr><td rowspan="2">1. Design Process
2. Peer Review and Innovation
3. Layout and Design
4. Applying Knowledge and Skill
5. Apply Design Principles
6. Experimentation and Development
7. Testing, Evaluating, and Refining
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D</td></tr>
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Locate and Select</td><td>B
Model, Practice, Apply, Produce, Adjust, and Display</td></tr>
</table>

Unit Assessment Plan and Resources
Common Summative Activities/Performance Tasks/Assessments (from assessment bank): • **Concept: Design Process**   ○ Learning Experience

        - Students will form ideas, gather information, create or gather design elements, organize and arrange design elements, and convert their ideas into design solutions that solve digital graphic design problems.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - A system is a group of interrelated components designed collectively to achieve a desired goal.
    - (SEP) Science and Engineering Practices
        - Constructing Explanations and Designing Solutions - Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.
    - (DCI) Disciplinary Core Ideas
        - ISTE 4A - Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
        - NAEP D.12.8 - Meet a sophisticated design challenge by identifying criteria and constraints, predicting how these will affect the solution, researching and generating ideas, and using trade-offs to balance competing values in selecting the best solution.
    - (TEP) Technology and Engineering Practices
        - Systems Thinking - Designs and troubleshoots technological systems in ways that consider the multiple components of the system.

- **Concept: Peer Review and Innovation**
    - Learning Experience
        - Students can learn an enormous amount about design by assessing how others have successfully solved the same problem. Any design problem can be solved in a great number of ways, but each design solution bears positive and negative consequences. Utilizing peer review questions, students will examine, evaluate, and peer review sample student produced and professionally produced design solutions. Students will examine how and why the designer arranged design elements, why the designer choose the design elements, does the design clearly communicate the intended message and does the design solution work. Students will use what they observe to brainstorm ideas, innovate, and begin to visually represent their own creative ideas.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Technological knowledge and practices advance – and are advanced by – other fields.
    - (SEP) Science and Engineering Practices
        - Engaging in Argument From Evidence - Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.
    - (DCI) Disciplinary Core Ideas
        - HS-PS3-3 - Design, build, and refine a device that works within given constraints to convert on form of energy into another form of energy.
        - NAEP T.12.4 - Analyze cultural, social, economic, or political changes (separately or together) that may be triggered by the transfer of a specific technology from one society to another. Include both anticipated and unanticipated effects.
    - (TEP) Technology and Engineering Practices

        - Critical Thinking - Uses evidence to better understand and solve problems in technology and engineering including applying computational thinking.

- **Concept: Layout and Design**
    - Learning Experience
        - Students will design, develop, and create effective designs that convey a message to an audience, is a visual representation of an idea, and relies on the creation, selection, and organization of visual elements.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Decisions made about technology and engineering involve consideration of costs, benefits, and tradeoffs.
    - (SEP) Science and Engineering Practices
        - Asking Questions and Defining Problems - Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.
    - (DCI) Disciplinary Core Ideas
        - ETS1.B: Developing Possible Solutions - When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.
    - (TEP) Technology and Engineering Practices
        - Asking Questions and Defining Problems - Define a simple problem that can be solved through the development of a new or improved object or tool.

- **Concept: Applying Knowledge and Technical Skills**
    - Learning Experience
        - Students will model, practice, and apply digital graphics knowledge, selection tools, marquee tools, lasso tools, cropping tools, photo editing tools, eraser tools, painting tools, color tools, brush tools, pen tools, type tools, shape tools, magnification tools, image tools, layer tools, effect tools, filter tools, and / or blending options to design, develop, and create custom designs.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - There are requisite skills used in technology and engineering design.
    - (SEP) Science and Engineering Practices
        - Using Mathematics and Computational Thinking - Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems.
    - (DCI) Disciplinary Core Ideas
        - ETS1.B: Developing Possible Solutions - Both physical models and computers can be used in various ways to aid in the engineering design process.
        - NAEP D.12.17 - Analyze a system malfunction using logical reasoning (such as a fault tree) and appropriate diagnostic tools and instruments. Devise strategies and recommend tools for fixing the problem.
    - (TEP) Technology and Engineering Practices

        - Critical Thinking - Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

- **Concept: Applying Design Principles**
    - Learning Experience
        - Students will model, practice, and apply balance, visual hierarchy, focal point, contrast, unity, repetition, alignment, proximity, spatial depth, illusion, grid, and template to design, develop, and create effective designs.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - There are universal principles and elements of design.
    - (SEP) Science and Engineering Practices
        - Constructing Explanations and Designing Solutions - Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.
    - (DCI) Disciplinary Core Ideas
        - Developing Possible Solutions - When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.
    - (TEP) Technology and Engineering Practices
        - Attention to Ethics - Assesses technological products, systems, and processes through critical analysis of their impacts and outcomes.
        - Critical Thinking - Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking.

- **Concept: Experimentation and Development**
    - Learning Experience
        - Students will experiment with design principles, experiment with tools and technical skills, experiment with fundamental elements of design, experiment with expressing their creative ideas, experiment with custom fonts, experiment with color, and experiment with visual effects to design, develop, and create design solutions.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - The needs and wants of society often shape technology and engineering developments.
    - (SEP) Science and Engineering Practices
        - Constructing Explanations and Designing Solutions - Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.
    - (DCI) Disciplinary Core Ideas
        - NAEP D.12.6 - Engineering design is a complicated process in which creative steps are embedded in content knowledge and research on the challenge. Decisions on trade-offs involve systematic comparisons of all costs and benefits, and final steps may involve redesigning for optimization.
    - (TEP) Technology and Engineering Practices

        - Making and Doing - Demonstrates the ability to regulate and improve making and doing skills.

- **Concept: Testing, Evaluating, and Refining Designs**
    - Learning Experience
        - Design is not measured in terms of right or wrong, but rather by the degree of success demonstrated in problem solving. Students will examine, test, evaluate, and refine their design solutions to ensure they work, are neat, clean, accurate, and functional, communicate the intended message, and meet the needs and wants of the end-user. Students will utilize self-evaluation tools and questions to examine and evaluate their design solutions.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Technology and engineering have both positive and negative impacts on society and the environment.
    - (SEP) Science and Engineering Practices
        - Engaging in Argument From Evidence - Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.
    - (DCI) Disciplinary Core Ideas
        - HS-LS2-7 - Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
        - NAEP T.12.4 - Analyze cultural, social, economic, or political changes (separately or together) that may be triggered by the transfer of a specific technology from one society to another. Include both anticipated and unanticipated effects.
    - (TEP) Technology and Engineering Practices
        - Attention to Ethics - Assesses technological products, systems, and processes through critical analysis of their impacts and outcomes.

- **Concept: Finalizing and Presenting Designs**
    - Learning Experience
        - Students will finalize and digitally present functional, aesthetically pleasing, thought provoking, and expressive designs that solve communications problems. Students will convert raw projects and / or files into a format that can be view by any person on any computer.
    - (Big Idea) Technology & Engineering Curriculum Framework Big Ideas
        - Technologically literate people are well equipped to learn about and use technological products and systems.
    - (SEP) Science and Engineering Practices
        - Obtaining, Evaluating, and Communicating Information - Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.
    - (DCI) Disciplinary Core Ideas
        - ETS1.B: Developing Possible Solutions - Both physical models and computers can be used in various ways to aid in the engineering design process.

- ETS1.B: Developing Possible Solutions - 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 their needs.

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  - Communication - Clearly coveys ideas in constructive ways, including through written and oral communication and via mathematical and physical models.

* (Learning Experience) A learning experience refers to any interaction, activity, or other experience in which students acquire new understanding, knowledge, behaviors, or skills.
* (Big Idea #) PDE Technology & Engineering Curriculum Framework Big Ideas
* (SEP) PDE Science and Engineering Practices
* (DCI) PDE Disciplinary Core Ideas
* (TEP) PDE Technology and Engineering Practices

Subject: Digital Graphics	**Grade Level:** High School	**Topic:** Digital Graphics Applications

Science, Technology & Engineering, and Environmental Literacy & Sustainability Standards:

- 3.5.9-12.N Analyze and use relevant and appropriate design thinking processes to solve technological and engineering problems.
- 3.5.9-12.P Apply a broad range of design skills to a design thinking process.
- 3.5.9-12.Y (ETS) Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- 3.5.9-12.X Implement the best possible solution to a design using an explicit process.

* (ETS) Engineering, Technology, and Applications of Science – Standards applicable across the Science, Environmental Literacy & Sustainability, and Technology & Engineering content areas.

KEY LEARNING:	**UNIT ESSENTIAL QUESTION:**	**Texts/Resources/Materials:**
(LTTG) Students will be able to employ hands-on problem solving, i.e., designing, making/building, producing, and evaluating outcomes. (LTTG) Students will be able to collaborate as part	How can I employ hands-on problem solving, i.e., designing, making/building, producing, and evaluating outcomes?	Computer Hardware, Computer Software, Adobe Creative Cloud, Online Resources, Presentations, Videos, Tutorials, and Sample Designs

of a team, valuing the contributions of all members. * (LTTG) PDE Technology & Engineering Long Term Transfer Goals	How can I collaborate as part of a team, valuing the contributions of all members?	

CONCEPT: Packaging Design	**CONCEPT**: Digital Graphics	**CONCEPT**: Advertising Graphics	**CONCEPT**: Motion Graphics / Animation
Lesson Essential Questions: How can I design, develop, create, and evaluate effective packaging designs?	**Lesson Essential Questions:** How can I design, develop, create, and evaluate effective digital graphics?	**Lesson Essential Questions:** How can I design, develop, create, and evaluate effective advertising graphics?	**Lesson Essential Questions:** How can I design, develop, create, and evaluate effective animations?
CONCEPT: Information Design	**CONCEPT**: Interactive Media	**CONCEPT**:	**CONCEPT**:
Lesson Essential Questions: How can I design, develop, create, and evaluate effective information designs?	**Lesson Essential Questions:** How can I design, develop, create, and evaluate effective interactive media designs?	**Lesson Essential Questions:**	**Lesson Essential Questions:**

Vocabulary	
Academic Specific: Locate, Select, Model, Practice, Apply, Produce, Adjust, Display, Compare, Contrast, Examine, Evaluate, Design, Develop, Create, Invent, and Modify	**Domain (Content) Specific:** **Concept: Packaging Design** • Mandatory Information, Design Panels, Multiple Sided Designs, and Packaging Design **Concept: Digital Graphics** • Thumbnail Sketches, Roughs, Comprehensive (Comp), Digital Graphic Design, PSD, JPEG, GIF, PNG, Vector Image, Raster Image, and Resolution **Concept: Advertising Graphics**

	• Diversity, Dual Meaning Messages, Deception, Emotional Response, Ethical Issues, Persuasion, Print Advertising, Unconventional Advertising, and Methods of Persuasion **Concept: Motion Graphics / Animation** • Timeline, Stage, Key Frame, Frame, Persistence of Vision, Storyline, Pacing, Tempo, Duration, Motion Graphics, Animation Technologies, and Animated GIF **Concept: Information Design** • Publications, Theme, Information Design, Print Media, and Portable Document Format (PDF) **Concept: Interactive Media** • Interactive Experience, Information Architecture, Navigation Systems, Buttons, Interactive Media, Website Design, Hyperlinking, and Homepage

KUD's (know—understand—do)		
Concepts—nouns: (What do students need to know/understand?)	**RR Framework** **Skills—verbs:** (What do students need to be able to do? In which quadrant do the skills belong?) *See page 19 of SAP Learning Environment guide*	
1. Packaging Design 2. Digital Graphics 3. Advertising Graphics 4. Motion Graphics / Animation 5. Information Design	Compare, Contrast, Examine, and Evaluate **C**	Design, Develop, Create, Invent, and Modify **D**

6. Interactive Media	**A** Locate and Select	**B** Model, Practice, Apply, Produce, Adjust, and Display

Unit Assessment Plan and Resources

Common Summative Activities/Performance Tasks/Assessments (from assessment bank):

- **Concept: Packaging Design**
  - Learning Experience
    - Students will layout, design, develop, and create attractive, legible, informational, and functional two and three-dimensional packaging appropriate for the intended audience and marketplace. Students will consider all sides in the design and will include all mandatory information such as nutritional information, ingredients, weight, bar codes, and / or pertinent information. Students will attempt to use design to seduce the audience into purchasing a product.
  - Performance Task
    - Students will be challenged with complex digital graphics problems to solve, designing, developing, creating, and evaluating effective package designs. Based on the criteria and constraints, students will determine the best possible solutions to meet the needs and wants of the end-user(s). Students will design, develop, create, and evaluate their design solutions.

- **Concept: Digital Graphics**
  - Learning Experience
    - Students will design, develop, and create effective graphics that convey a message to an audience, is a visual representation of an idea, and relies on the creation, selection, and organization of visual elements.
  - Performance Task
    - Students will be challenged with complex digital graphics problems to solve, designing, developing, creating, and evaluating effective digital graphic designs. Based on the criteria and constraints, students will determine the best possible solutions to meet the needs and wants of the end-user(s). Students will design, develop, create, and evaluate their design solutions.

- **Concept: Advertising Graphics**
  - Learning Experience
    - Students will layout, design, develop, and create a specific advertising message constructed to inform, persuade, promote, provoke, or motivate people. Students will attempt to grab the audience's attention, communicate a message, respect the viewer, be ethical, promote one product or service over another, persuade the target audience, and call people to action by motivating behaviors. Students will examine why they are advertising, who they are talking to, what do their audience currently think, what would they like the audience to think, what is the single most persuasive idea they can convey, and why should the audience believe it.

- Performance Task
  - Students will be challenged with complex digital graphics problems to solve, designing, developing, creating, and evaluating effective advertising graphic designs. Based on the criteria and constraints, students will determine the best possible solutions to meet the needs and wants of the end-user(s). Students will design, develop, create, and evaluate their design solutions.

- **Concept: Motion Graphics / Animation**
  - Learning Experience
    - Students will be able to identify who are the viewers, which design choices are appropriate for the audience, what is the purpose of the design, what information or message must be communicated, and where will it be seen.
  - Performance Task
    - Students will be challenged with a complex digital graphics problem to solve, designing, developing, creating, and evaluating effective animation designs. Based on the criteria and constraints, students will determine the best possible solution to meet the needs and wants of the end-user(s). Students will design, develop, create, and evaluate their design solutions.

- **Concept: Information Design**
  - Learning Experience
    - Students will layout, design, develop, and create information design applications that involve making large amounts of information clear and accessible to the intended audience. Students will produce designs that clearly communicate, make information easily accessible, and enhance any type of information for the end-user's understanding. Students will create and organize design elements such as type and visuals on a page. Students will establish an underlying structure that helps in maintaining clarity, legibility, balance, and unity when working with a multipage format. Students will establish a flow or sense of visual consistency from one page to another. Students will use design to grab the reader's attention, generate intrigue, attract readers to specific content, and communicate messages quickly and clearly. Students will design for graphic impact and readability.
  - Performance Task
    - Students will be challenged with complex digital graphics problems to solve, designing, developing, creating, and evaluating effective information designs. Based on the criteria and constraints, students will determine the best possible solutions to meet the needs and wants of the end-user(s). Students will design, develop, create, and evaluate their design solutions.

- **Concept: Interactive Media**
  - Learning Experience
    - Students will layout, design, develop, and create interactive media that secures the viewer's involvement with compelling and engaging interactive experiences and enhances the viewer's knowledge and interest. The media will allow the viewer to become an active participant by moving forward and backward through the presentation. Students will design a presentation that is clear, organized, useful, easy to understand, frustration-free, media-rich, and respect the user. Students will design a presentation with a streamlined visual layout that provides an immediate sense of location at all times, one that offers consistent elements from page to page. Students will fit elements into a limited space, arrange elements so that they are functional and accessible, create a consistent look between pages, and establish a visual hierarchy.
  - Performance Task

- Students will be challenged with complex digital graphics problems to solve, designing, developing, creating, and evaluating effective interactive media. Based on the criteria and constraints, students will determine the best possible solutions to meet the needs and wants of the end-user(s). Students will design, develop, create, and evaluate their design solutions.

* (Learning Experience) A learning experience refers to any interaction, activity, or other experience in which students acquire new understanding, knowledge, behaviors, or skills.
* (Performance Task) A performance task is any learning or assessment that asks students to perform to demonstrate their knowledge, understanding, and proficiency.