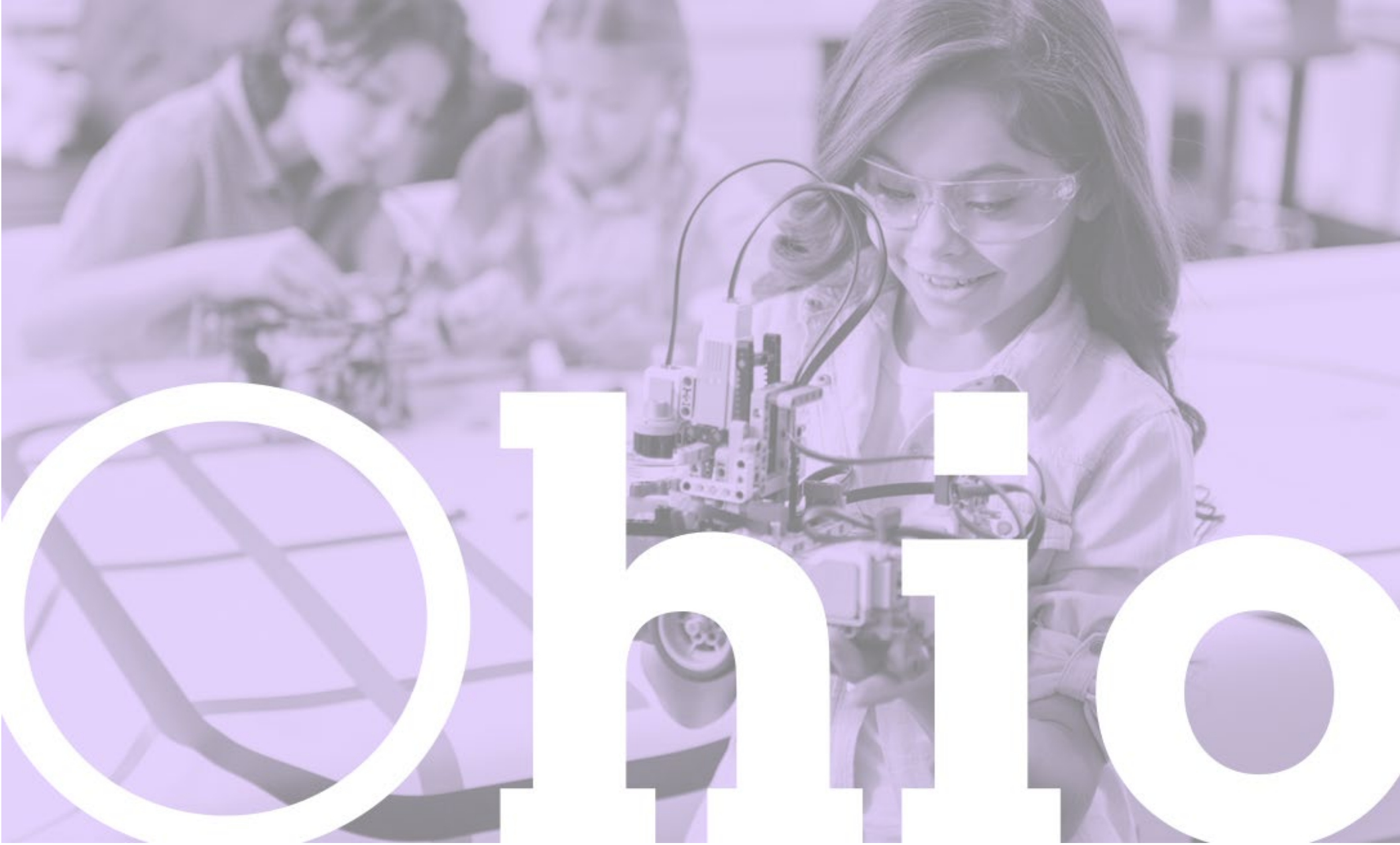


Ohio's Model Curriculum

Technology Grades 6-8

ADOPTED JULY 2022

Ohio | Department of Education

TABLE OF CONTENTS

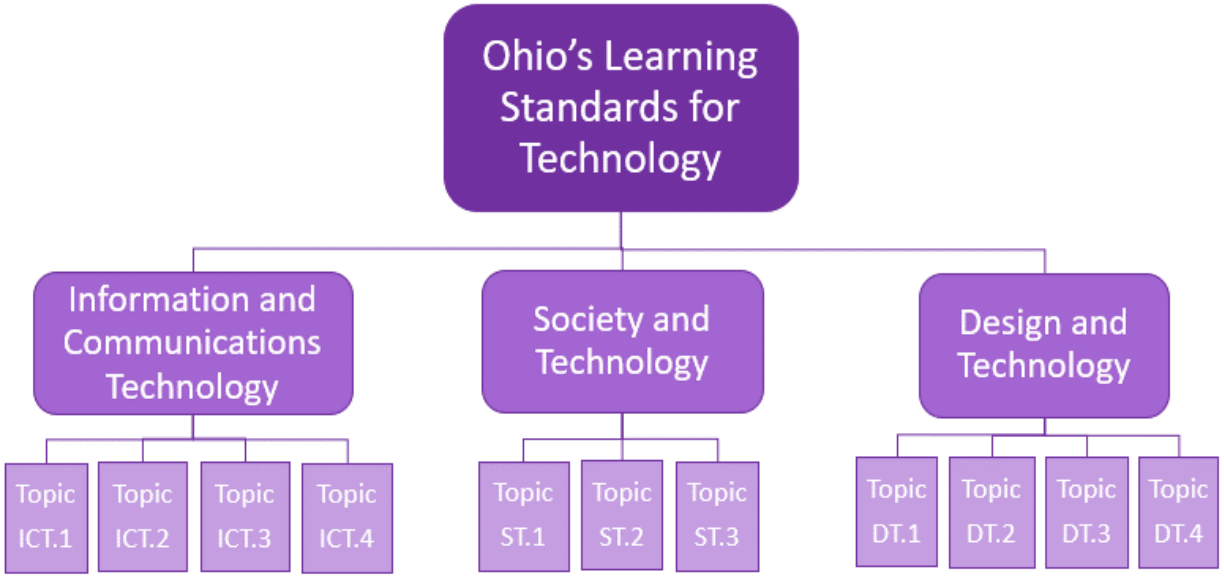
Organization of Ohio's Model Curriculum for Technology

The organization of Ohio's Model Curriculum for Technology follows the same format as Ohio's Learning Standards for Technology. The Technology Learning Standards and Model Curriculum consist of strands, topics and content statements. Both are organized by grade bands so students at the end of each grade band have acquired the knowledge and skills outlined.

Strands are overarching categories and provide three lenses through which kindergarten through grade 12 students consider and engage with technology.

Topics organize and focus the instruction. Each strand is broken into several topics. *Topic statements remain consistent from kindergarten through grade 12*.

Content Statements further refine the topic statements to define what students should know and be able to do at each grade band. Content statements are organized *by K-2, 3-5, 6-8 and 9-12 grade bands*.



STRAND AND TOPIC DESCRIPTIONS

Below, are the strand and topic statements for kindergarten through grade 12:

Information and Communications Technology

The understanding and application of digital learning tools for accessing, creating, evaluating, applying and communicating ideas and information.

Topic 1: Identify and use appropriate digital learning tools and resources to accomplish a defined task.

Topic 2: Use digital learning tools and resources to locate, evaluate and use information.

Topic 3: Use digital learning tools and resources to construct knowledge.

Topic 4: Use digital learning tools and resources to communicate and disseminate information to multiple audiences.

Society and Technology

The interconnectedness of technology, self, society and the natural world, specifically addressing the ethical, legal, political and global impact of technology.

Topic 1: Demonstrate an understanding of technology's impact on the advancement of humanity – economically, environmentally and ethically.

Topic 2: Analyze the impact of communication and collaboration in both digital and physical environments.

Topic 3: Explain how technology, society and the individual impact one another.

Design and Technology

Addresses the nature of technology to develop and improve products and systems over time to meet human/societal needs and wants through design processes.

Topic 1: Define and describe technology, including its core concepts of systems, resources, requirements, processes, controls, optimization and trade-offs.

Topic 2: Identify a problem and use an engineering design process to solve the problem.

Topic 3: Demonstrate that solutions to complex problems require collaboration, interdisciplinary understanding and systems thinking.

Topic 4: Evaluate designs using functional, aesthetic and creative elements.

CONTENT STATEMENTS

Below, is an example of a content statement for grade band 6-8 with its corresponding content statement code. This content statement addresses Topic 2 within the Society and Technology (ST) Strand.

SOCIETY AND TECHNOLOGY

Topic 2: Analyze the impact of communication and collaboration in both digital and physical environments.

6-8.ST.2.a. Critique specific instances of how technology has impacted access to information, communications and collaboration.

The example below breaks down the content statement code into its components.

NOTE: The topic statement numbers and content statement letters do not dictate curriculum or teaching methods. For example, while Topic 1 appears before Topic 2 in the standards for a given grade band, teachers do not need to teach Topic 1 before Topic 2. A teacher might prefer to teach Topic 2 before Topic 1 or to highlight connections by teaching Topic 1 and Topic 2 at the same time.

The lowercase letters for content statements do not indicate a preferred order. They do not identify relationships between content statements across grade bands. They are included to facilitate discussions, planning and implementation of the standards.

Ohio's Model Curriculum & Instructional Supports for Technology

OVERVIEW OF THE MODEL CURRICULUM COMPONENTS

The model curriculum contains two sections: **Expectations for Learning** and **Content Elaborations.**

Expectations for Learning

LEARNING PROGRESSION

Explains the position of the content statement within its respective learning progression, including previous and future learning

IMPORTANT CONCEPTS

Identifies important concepts students should develop

KEY SKILLS/PROCEDURES

Identifies key skills and procedures students should know and demonstrate

The information above clarifies the expectations for student learning and guides teachers in developing lessons and assessments, both formative and summative.

Content Elaborations

CLARIFICATIONS

Provides clarification of the content

CONTENT FOCUS

Identifies the aspects of the content that teachers should stress with their students

OVERVIEW OF THE INSTRUCTIONAL SUPPORTS

Instructional supports will offer instructional strategies and resources that target specific content statements. The Department will add instructional supports as they are identified and developed, after careful vetting and review.

These supports will include descriptive examples of instructional strategies. Supports will also identify connections to other content statements in technology, across content areas and to careers to help teachers plan instruction and incorporate technology content into their curricula. Other supports woven throughout will include descriptions of common misconceptions and ways to structure technology experiences that are equitable and accessible to all students.

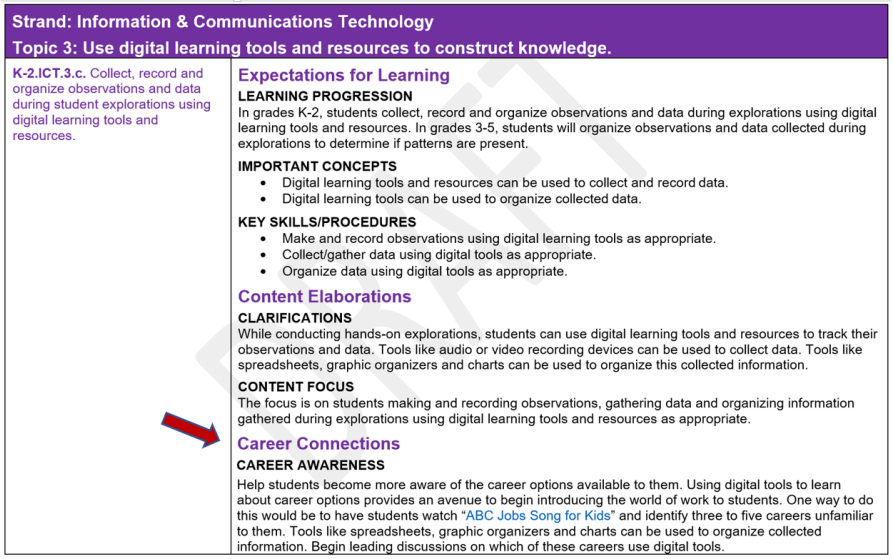
Ohio's Model Curriculum for Technology: Career Connections

It is important for students to understand how the knowledge and skills they acquire in school apply to their ultimate career and life goals. Ohio's Model Curriculum for Technology provides examples of Career Connections. These Career Connections are a starting point for teachers to begin drawing connections to careers for students. The Instructional Supports mentioned earlier will continue this work and address Career Connections more fully.

When developing Career Connections, schools and districts may consider using the Career Connections Framework. The framework is a planning tool districts and schools can use to provide students with opportunities to develop a vision and realistic plans for their future. It aligns the many efforts around college and career readiness to support students in becoming productive and engaged citizens. While many of the career connections throughout this model curriculum are designed to help students become aware, explore and plan for specific careers, it is understood that students often will change career pathways of interest over time.

Throughout Ohio's Learning Standards and Model Curriculum for Technology, many of the skills students are beginning to learn and refine can be associated with work environments. *Career Connections in this model curriculum are organized by the Technology Standards Strands, providing one example per grade band for each strand.* In this way, teachers can see how these connections relate to key technological knowledge and skills in each strand and progress by grade band. The Career Connections lend themselves to interdisciplinary connections and students explore careers that go well beyond those involving information technology. Again, these are a suggested starting point for educators and can be modified or expanded.

Career Connections are located in a separate section within those model curriculum entries that contain them.



Strand: Information & Communications Technology
Topic 3: Use digital learning tools and resources to construct knowledge.

K-2.ICT.3.c. Collect, record and organize observations and data during student explorations using digital learning tools and resources.

Expectations for Learning

LEARNING PROGRESSION
In grades K-2, students collect, record and organize observations and data during explorations using digital learning tools and resources. In grades 3-5, students will organize observations and data collected during explorations to determine if patterns are present.

IMPORTANT CONCEPTS
- Digital learning tools and resources can be used to collect and record data.
- Digital learning tools can be used to organize collected data.

KEY SKILLS/PROCEDURES
- Make and record observations using digital learning tools as appropriate.
- Collect/gather data using digital tools as appropriate.
- Organize data using digital tools as appropriate.

Content Elaborations

CLARIFICATIONS
While conducting hands-on explorations, students can use digital learning tools and resources to track their observations and data. Tools like audio or video recording devices can be used to collect data. Tools like spreadsheets, graphic organizers and charts can be used to organize this collected information.

CONTENT FOCUS
The focus is on students making and recording observations, gathering data and organizing information gathered during explorations using digital learning tools and resources as appropriate.

Career Connections

CAREER AWARENESS
Help students become more aware of the career options available to them. Using digital tools to learn about career options provides an avenue to begin introducing the world of work to students. One way to do this would be to have students watch "ABC Jobs Song for Kids" and identify three to five careers unfamiliar to them. Tools like spreadsheets, graphic organizers and charts can be used to organize collected information. Begin leading discussions on which of these careers use digital tools.

CAREER CONNECTIONS ACROSS K-12

Career Awareness - Elementary Grades (K-5)

Students become familiar with careers through learning that connects classroom instruction to future work. Career awareness strategies show students various types of careers and stimulate interest in future work.

Technology Model Curriculum Example: Giving elementary students opportunities to learn about work environments and discover unique career opportunities associated with the technology skills they are learning will aid in stimulating student interest in future work. Discussing careers that use digital tools can be an effective way to tie technology to career awareness.

> (3-5.ICT.3.c.) Engage students in organizing observations and data collected during student explorations to determine if patterns are present by using a video library such as *Kids Work* and having students record whether the career video they have watched is something they would enjoy doing. Ask students to record this information for multiple careers. Have the class

record their thoughts and then use the class data to determine if there is a pattern across the classroom of the careers that students would and would not enjoy.

Career Exploration - Middle Grades (6-8)

Students explore their career interests through embedded activities. Career exploration strategies are opportunities for students to discover work environments and understand the various aspects of the workplace. Strategies include tools and instruments that help students understand and appreciate their strengths and interests. Students start plans for their future with career information and postsecondary education data. Plans include course selection and planning as well as career aspirations and goals.

Technology Model Curriculum Example: Middle school is an important time for students to begin refining their interests and furthering their understanding of the workplace. These are prime grades to begin having students use their technology knowledge and skills to explore career options in the technology fields.

(6-8.ICT.3.a.) Using OhioMeansJobs K12, ask students to take the Career Cluster Inventory. Students use the Dynamic Career Pathways tool to explore occupations in information technology and the Employment Projections tool to research further and determine whether a career in this industry may be in their future. In the process, they analyze and integrate textual, visual and quantitative information (such as images, diagrams, graphs, infographics, videos and interactives) from multiple digital learning tools and resources. (Students must first create an account on the OhioMeansJobs K-12 website, to take the Career Cluster Inventory.)

Career Planning - High School (9-12)

Students continue career exploration while focusing on career planning. Activities provide advanced experiences that offer hands-on opportunities in the workplace. Career planning strategies focus on making clear links between career options and educational decisions. Students develop the skills to revisit previous exploration and planning strategies as they face career changes throughout life.

Technology Model Curriculum Example: High school students need to begin finalizing their post-high school plans. To gain further insight on what options exist for students, it is important to give students opportunities to interact with and work in the community.

(9-12.DT.4.c.) While critically evaluating a design solution at multiple points of a design process, have students work with their community to identify real-world problems to solve. Consider connecting students to the district's Business Advisory Council to hear about the real issues businesses face. Have students implement the design process to potentially solve those problems with evaluations of the process along the way. Consider how this type of opportunity may lead to an internship or other work-based learning opportunity for students.

BUILDING SKILLS ALIGNED TO THE OHIOMEANSJOBS-READINESS SEAL

Career Connections learning strategies are an effective way for students to establish an understanding of and demonstrate the professional skills that will be essential for success in their career and life goals. The professional skills outlined in the OhioMeansJobs-Readiness Seal can be found across the career connection learning strategies within the model curriculum. These associations will help students make connections to the expected skills and behaviors within the world of work and can be used to support high school students in meeting the seal requirements.

There are clear associations between Ohio's Learning Standards and Model Curriculum for Technology and the professional skills outlined in the OhioMeansJobs-Readiness Seal. For example, a distinct connection exists between the knowledge and skills in the standards and model curriculum and professional skills involving digital technology where the student has "an in-depth understanding of emerging technology and leverages technology to solve problems, complete tasks and accomplish goals." Additional associations (such as those involving creativity and innovation, teamwork and collaboration and critical thinking and problem-solving) exist through the use of the outlined Career Connections found throughout this model curriculum.

Grades 6-8 Model Curriculum

STRAND: INFORMATION AND COMMUNICATIONS TECHNOLOGY

The understanding and application of digital learning tools for accessing, creating, evaluating, applying and communicating ideas and information.

Topic 1: Identify and use appropriate digital learning tools and resources to accomplish a defined task.

6-8.ICT.1.a. Develop criteria for selecting digital learning tools and resources to accomplish a defined task.

Expectations for Learning

LEARNING PROGRESSION

In grades 3-5, students explained the use of selected digital learning tools and resources to support the accomplishment of a task. In grades 6-8, students develop criteria for selecting digital learning tools and resources to accomplish a defined task. In grades 9-12, students will develop criteria to select digital learning tools to support the concurrent management of multiple projects.

IMPORTANT CONCEPTS

- Sets of criteria can help users decide what digital learning tool is best suited to accomplish a task.

KEY SKILLS/PROCEDURES

- Develop criteria for selecting a digital learning tool or resource that is appropriate for accomplishing a task.
- Compare tools or resources using a set of criteria to identify the one(s) most suited for the task.

Content Elaborations

CLARIFICATIONS

After determining the desired end product for the assigned task, students identify the digital learning tool or resource that will be the most effective to accomplish the task. To do so, they will identify the criteria needed to evaluate the suitability of a digital tool or resource for the task, including accessibility, presence of specific features and ease of use. Before students create criteria for selecting a tool (a checklist or rubric), use an example tool and discuss the features.

For example, if the desired task is a multimedia presentation, the choices might include several online tools. Each tool has unique features that may or may not fit the criteria.

CONTENT FOCUS

This content statement focuses on the process of developing the criteria to select digital learning tools needed to accomplish a defined task.

Topic 1: Identify and use appropriate digital learning tools and resources to accomplish a defined task.	
6-8.ICT.1.b. Select and use digital learning tools or resources to support planning, implementing and reflecting upon a defined task.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students identified and used digital learning tools or resources with guidance to support planning, implementing and reflecting upon a defined task. In grades 6-8, students select and use digital learning tools or resources to support planning, implementing and reflecting upon a defined task. In grades 9-12, students will learn how to develop strategies for using digital learning tools and resources to plan, implement and reflect on complex tasks. **IMPORTANT CONCEPTS** • Appropriate digital learning tools or resources will aid completion of a task. **KEY SKILLS/PROCEDURES** • Identify the task and desired outcome. • Select the digital learning tools or resources that support the task. • Use the digital tools or resources to complete the defined task. • Use digital tools or resources to reflect upon the completed task. **Content Elaborations** **CLARIFICATIONS** A wide variety of digital learning tools and resources can be used to plan, implement and reflect on a desired task. Resources may include databases, e-books, blogs, podcasts, multimedia or social media. **CONTENT FOCUS** The focus is on identifying the digital learning tools or resources that can be used to plan, implement and reflect on a defined task.

Topic 1: Identify and use appropriate digital learning tools and resources to accomplish a defined task.	
6-8.ICT.1.c. Evaluate the use of digital learning tools and resources to support learning and productivity.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students explained the use of selected digital learning tools and resources to support productivity and learning. In grades 6-8, students learn how to evaluate the use of digital learning tools and resources to support learning and productivity. In grades 9-12, students will learn how to analyze and evaluate the ease of use and effectiveness of available features of selected digital learning tools and resources. **IMPORTANT CONCEPTS** • Evaluating the use of digital learning tools and resources to complete tasks builds an understanding of how to use tools and resources to support productivity and learning. • Tools such as checklists and rubrics aid understanding of which digital learning tools or resources can be used to effectively accomplish a task. **KEY SKILLS/PROCEDURES** • Identify the task, intended goal(s) and desired outcome(s). • Select the digital learning resources and tools that support the task based on the intended goal(s) and outcome(s) of the task. • Reflect upon using the selected tools or resources to complete the task and evaluate their effectiveness in accomplishing the intended goal(s) and outcome(s) of the defined task. **Content Elaborations** **CLARIFICATIONS** By evaluating the wide variety of digital learning tools and resources, students can understand how they can be used to support learning and productivity. Students should evaluate the features of a digital learning tool or resource using a set of criteria like a checklist or rubric to choose the right tool or resource for a task. Evaluating the use of a tool or resource after completing the task is necessary for further refining selection criteria and improving the use of tools and resources to complete similar tasks in the future. For example, if a student is asked to keep a digital journal, the assignment could involve looking at online blogging tools. Students would determine which tool includes the features that fit the task and, after completing a journal entry, evaluate the experience of using the selected blogging tool. **CONTENT FOCUS** Given a defined task, students use intended task goals and outcomes to determine an appropriate digital learning tool or resource for completing the task. Students evaluate the use of the selected tool or resource to complete the task and consider how effectively it supports their learning and productivity.

Topic 2: Use digital learning tools and resources to locate, evaluate and use information.	
6-8.ICT.2.a. Use advanced search techniques to locate needed information using digital learning tools and resources.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students learned appropriate search techniques needed to locate information using digital learning tools and resources. In grades 6-8, students learn advanced search techniques to locate information using digital learning tools and resources. In grades 9-12, students will learn advanced search and filtering techniques to locate information using digital learning tools and resources. **IMPORTANT CONCEPTS** • There are differences between basic and advanced search techniques. • Knowing and utilizing both basic and advanced search techniques will help in searching topics. **KEY SKILLS/PROCEDURES** • Identify the information needed. • Use advanced search techniques to locate needed information using digital learning tools and resources. • Compare basic and advanced search results by conducting both types of searches. **Content Elaborations** **CLARIFICATIONS** Advanced search techniques can be used to help locate needed information in a quicker, more efficient manner. Students should be able to use a variety of search techniques to locate information including keywords, Boolean operators (such as AND, OR, NOT), quotation marks filtering, truncation and other advanced search techniques. For example, a basic search for the keyword *dog* would have millions of results with all kinds of information that is not necessarily about a dog. With advanced techniques, students can filter the search and results. For example, including a specific breed of dog, like a bloodhound, with a Boolean operator such as AND or quotation marks around the word will decrease the number of search results. Using filters like the exact phrase *bloodhound AND dog* or "bloodhound dog" will bring up a list of search results that better match the student's needs. Advanced search techniques will give the user a more manageable number of results. **CONTENT FOCUS** This content statement focuses on basic and advanced search techniques to help students locate the specific information that is needed.

Topic 2: Use digital learning tools and resources to locate, evaluate and use information.	
6-8.ICT.2.b. Use multiple criteria to evaluate the validity of information found with digital learning tools and resources.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students used multiple criteria developed with guidance to differentiate between relevant and irrelevant information found with digital learning tools and resources. In grades 6-8, students use multiple criteria to evaluate the validity of information found with digital learning tools and resources. In grades 9-12, students will construct an evaluative process for information sources independently. **IMPORTANT CONCEPTS** • It is necessary to use multiple criteria to evaluate the validity of information found using digital learning tools and resources. • Accuracy, perspective, credibility and relevance are criteria that can be used to evaluate the validity of information found using digital learning tools and resources. • Understanding how to utilize predetermined criteria will aid the development of self-determined criteria. **KEY SKILLS/PROCEDURES** • Apply multiple criteria to evaluate the validity of information. • Compare predetermined criteria to student-developed criteria. **Content Elaborations** **CLARIFICATIONS** In order for students to determine the validity of information they find, they should know what the term "criteria" means and how it applies when using digital learning tools and resources to locate information. One way to introduce the topic is to use a predetermined set of criteria and demonstrate how these criteria apply when using one tool or resource to find information. The criteria would look at the accuracy, perspective, credibility and relevance of the information located. For example, as the group reviews and discusses the tool or resource, students create their own lists of questions to include in their criteria. Those criteria can be used to evaluate digital materials. **CONTENT FOCUS** The focus is on using multiple criteria to determine the validity of information found using a digital learning tool or resource. Criteria include accuracy, perspective, credibility and relevance.

Topic 2: Use digital learning tools and resources to locate, evaluate and use information.	
6-8.ICT.2.c. Apply principles of copyright, use digital citation tools and use strategies to avoid plagiarism.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students learned basic ideas of plagiarism and copyright and with guidance cited sources using digital citation tools. In grades 6-8, students apply principles of copyright, use digital citation tools and use strategies to avoid plagiarism. In grades 9-12, students will apply principles of copyright, use digital citation tools and use strategies to avoid plagiarism when using the work of others as well as creating personal work. **IMPORTANT CONCEPTS** • Legal and ethical guidelines must be followed when completing a task and providing correct citations. **KEY SKILLS/PROCEDURES** • Define and explain plagiarism. • Explain the principles of copyright. • Use digital citation tools to create documentation of research. **Content Elaborations** **CLARIFICATIONS** Students need to understand how to gather and document information from multiple sources, including digital resources. It is essential they understand there are ethical and legal ramifications to claiming ownership of work that is not their own. There are many free and easy-to-use digital citation tools students can use to create documentation for their work. In addition, many digital resources, like databases, provide links to citations that are already in the correct format. By consistently documenting their work, students will gain a better understanding of the copyright laws and avoid plagiarism. **CONTENT FOCUS** The focus is on the importance of providing documentation of all content found using digital resources and learning tools and knowing how to cite sources with digital citation tools.

Topic 3: Use digital learning tools and resources to construct knowledge.	
6-8.ICT.3.a. Analyze and integrate textual, visual and quantitative information (e.g., images, diagrams, maps, graphs, infographics, videos, animations, interactives) from multiple digital learning tools and resources.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students gathered, organized and summarized information from multiple digital sources. In grades 6-8, students analyze and integrate textual, visual and quantitative information from multiple digital learning tools and resources. In grades 9-12, students will synthesize textual, visual and quantitative research and data from a variety of digital learning tools and resources. **IMPORTANT CONCEPTS** • Textual, visual and quantitative information each bring a different layer of information to content. **KEY SKILLS/PROCEDURES** • Identify the task, desired outcome and information needs. • Compare and analyze the differences between content communicated using textual, visual and quantitative information. • Reflect upon how textual, visual and quantitative information are integrated into the completed task and how they work together to build understanding. **Content Elaborations** **CLARIFICATIONS** When collecting information from multiple digital learning tools and resources, students will encounter textual, visual and quantitative information. They need to be able to analyze and integrate these different types of information into their own original work as they construct a more full understanding of a topic or concept. For example, a project about heart disease in women might include using a multitude of resources that provide different types of information, including databases, graphs, maps, videos and images. Students would review the materials, analyze and collect pertinent information and use the information needed for the project to be complete. Considering the types of information being used, students would analyze which digital tool would be most useful for the completed project, such as an infographic, slideshow, table, video or other method. **CONTENT FOCUS** This content statement focuses on students applying knowledge of quantitative, textual and visual forms of information to determine what types of information need to be integrated to construct an understanding of a topic or concept.

<table>
<tr><th colspan="2">Topic 3: Use digital learning tools and resources to construct knowledge.</th></tr>
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Career Connections

CAREER EXPLORATION

Using OhioMeansJobs K12, students take the Career Cluster Inventory and ask themselves, "Am I interested in a career in the information technology field?" (Students must first create an account on the OhioMeansJobs K-12 website, to take the Career Cluster Inventory.) Students use the Dynamic Career Pathways tool to explore occupations in this industry while using the Employment Projections tool to research further and determine whether a career in information technology may be in their future.

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<tr><td>6-8.ICT.3.b. Analyze data collected or retrieved from a variety of digital learning tools and resources to determine if patterns or trends are present.</td><td>

Expectations for Learning

LEARNING PROGRESSION

In grades 3-5, students organized observations and data collected during student explorations to determine if patterns were present. In grades 6-8, students analyze data collected or retrieved from a variety of digital learning tools and resources to determine if patterns or trends are present. In grades 9-12, students will analyze relationships and forecast outcomes using data collected by students or retrieved from a variety of digital learning tools and resources.

IMPORTANT CONCEPTS

- Patterns or trends exist in some data sets.

KEY SKILLS/PROCEDURES

- Identify the task and determine what data is needed to address the task.
- Collect data during student investigations or from multiple resources using a variety of digital learning tools.
- Using a data set, identify patterns or trends.
- Reflect upon observed patterns or trends.

Content Elaborations

CLARIFICATIONS

Collecting data using a variety of digital learning tools and resources is an essential skill for students. Students should be able to analyze a variety of data from multiple resources to determine patterns or trends (for example, consistencies or emerging trends). Students can collect their own data during investigations and gather data from sources for analysis, such as online databases, social media, news media, infographics, videos and images.

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Topic 3: Use digital learning tools and resources to construct knowledge.	
	CONTENT FOCUS The focus is on identifying patterns or trends in a given data set.
6-8.ICT.3.c. Create artifacts using digital learning tools and resources to demonstrate knowledge.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-12, students create artifacts using digital learning tools and resources to demonstrate knowledge. Since this content statement is present in multiple grade bands, student artifacts will vary based on grade-level content. Artifacts should progress in complexity, variety and sophistication as students reach each grade band. **IMPORTANT CONCEPTS** • People can create artifacts to demonstrate learning using digital learning tools and resources. **KEY SKILLS/PROCEDURES** • Identify the task and desired outcome. • Create an artifact using digital learning tools and resources. • Use digital learning tools and resources to demonstrate knowledge. • Reflect upon whether the intended knowledge has been demonstrated through the artifact created using digital tools and resources. **Content Elaborations** **CLARIFICATIONS** To demonstrate their knowledge gained from using digital learning tools and resources, students should be able to produce a variety of artifacts. By creating, building or publishing original content, students should be able to show how they can utilize digital tools and resources to produce their own unique artifacts. Some examples of artifacts that students could create to demonstrate knowledge include multimedia presentations with sound and images, professional documents (such as newsletters or flyers), a podcast, a website, a blog post or other options. **CONTENT FOCUS** The focus is on the creation of artifacts to demonstrate students' learning and knowledge by utilizing digital learning tools and resources.

Topic 4: Use digital learning tools and resources to communicate and disseminate information to multiple audiences.	
6-8.ICT.4.a. Use digital learning tools and resources to identify communication needs considering goals, audience and content.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students discussed and identified with guidance communication needs for a task considering the goals, audience and content. In grades 6-8, students use digital learning tools and resources to identify communication needs considering goals, audience and content. In grades 9-12, students will use digital learning tools and resources to identify communication needs considering goals, audience, content, access to tools or devices and additional factors. **IMPORTANT CONCEPTS** • Identifying communication needs is the first step in developing a plan to communicate and disseminate information. • Digital learning tools and resources can be used to identify communication needs. **KEY SKILLS/PROCEDURES** • Identify goals, audience and content to determine communication needs. • Use digital learning tools to collect information regarding communication needs. **Content Elaborations** **CLARIFICATIONS** Identifying communication needs is an important part of any project and must take place before disseminating information to an audience. Students identify communication needs as they determine their communication goals, consider the content they want to share and determine the audience they wish to reach. Students can use a variety of digital learning tools and resources to identify the communication needs they must take into consideration to meet their goals. One example might be to use digital survey or poll tools to identify the characteristics of their audience (such as language spoken, familiarity with content to be shared and accessibility needs) to determine their communication needs. **CONTENT FOCUS** This content statement focuses on using digital learning tools and resources to identify communication needs based upon the goals, audience and content.

Topic 4: Use digital learning tools and resources to communicate and disseminate information to multiple audiences.	
6-8.ICT.4.b. Select and use a variety of media formats to communicate information to a target audience.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students selected with guidance media formats appropriate to content and audience. In grades 6-8, students independently select and use a variety of media formats to communicate information to a target audience. In grades 9-12, students will develop, implement and evaluate a communication plan to disseminate information to multiple audiences. **IMPORTANT CONCEPTS** • Selecting and using appropriate media formats can help communicate information to a target audience. **KEY SKILLS/PROCEDURES** • Select media formats that are suited to the information and intended audience. **Content Elaborations** **CLARIFICATIONS** After identifying the target audience, students should be able to select and use the appropriate media format(s) to communicate information. The selection is based on a number of factors, including the purpose of the communication, needs of the audience and goal of the project. For example, if the audience is a group of preschoolers, then the communication method might involve video or interactive media that relies heavily on the visual aspect. On the other hand, if the intended audience is young adults, then various forms of social media might be a better communication method. **CONTENT FOCUS** The focus is on selecting and using a variety of media formats in ways that effectively communicate to a target audience. Other factors also should be considered when choosing the media format, including project goals and the purpose of the communication.

Topic 4: Use digital learning tools and resources to communicate and disseminate information to multiple audiences.	
6-8.ICT.4.c. Discuss and identify ways to communicate and disseminate information so that users with varied needs can access information.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students evaluated the features of digital learning tools and resources based on the characteristics of a specific audience. In grades 6-8, students discuss and identify ways to communicate and disseminate information so that users with varied needs can access information. In grades 9-12, students will integrate accessibility principles to effectively communicate to, and meet the needs of, multiple audiences. **IMPORTANT CONCEPTS** • Users have different communication needs; information should be disseminated in ways to meet those needs. **KEY SKILLS/PROCEDURES** • Identify the communication needs of an audience. • Discuss appropriate dissemination formats and methods. • Select digital tool(s) for dissemination. • Share the communication. **Content Elaborations** **CLARIFICATIONS** It is important for information to be accessible to all audiences. When students create and disseminate information, they should consider that their audiences may contain individuals with specific needs. By creating information in a format that allows access to the greatest number of users, students can reach users with varied needs. For example, students may need to format their communications in ways that are accessible to screen readers or by including captions or transcripts with videos. **CONTENT FOCUS** The focus is on identifying and discussing the ways to communicate and disseminate information to audiences with varied needs.

Topic 4: Use digital learning tools and resources to communicate and disseminate information to multiple audiences.	
6-8.ICT.4.d. Evaluate the effectiveness of a digital tool to communicate information with multiple audiences.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students evaluated the features of digital learning tools based on the characteristics of a specific audience. In grades 6-8, students evaluate the effectiveness of a digital tool to communicate information with multiple audiences. In grades 9-12, students will use digital learning tools to represent and model complex systems of information to a target audience. Students also will evaluate communication plans they develop for disseminating information to multiple audiences. **IMPORTANT CONCEPTS** • Digital tools can be evaluated based on their effectiveness in communicating information with multiple audiences. **KEY SKILLS/PROCEDURES** • Develop criteria for evaluating the effectiveness of digital tools to communicate with the intended audience(s). • Evaluate the effectiveness of a selected digital tool to communicate information based on audience. **Content Elaborations** **CLARIFICATIONS** Evaluating a plan for sharing digital information in terms of whether the appropriate digital tools were used for communication is essential to determining which tools are most effective for communicating with different audiences. For example, students might use a rubric or a checklist to evaluate the communication plan and which digital tools to use with the intended audience. Some tools work well for multiple audiences, while others are more effective with one type of audience over another. **CONTENT FOCUS** The focus is on evaluating the effectiveness of the digital tools selected for communicating information to the intended audiences.

STRAND: SOCIETY AND TECHNOLOGY

The interconnectedness of technology, self, society and the natural world, specifically addressing the ethical, legal, political and global impact of technology.

Topic 1: Demonstrate an understanding of technology's impact on the advancement of humanity – economically, environmentally and ethically.

6-8.ST.1.a. Advocate and exhibit ethical, legal and responsible practices when utilizing technology.

Expectations for Learning

LEARNING PROGRESSION

In grades 3-5, students demonstrated appropriate use of technology and understood why it is important to make ethical and responsible decisions while using technology. In grades 6-8, students advocate and exhibit ethical, legal and responsible practices when utilizing technology. In grades 9-12, students will interpret and put into practice ethical considerations and legal requirements involved in the creation and use of digital technologies.

IMPORTANT CONCEPTS

- Technology has many benefits, but there are times when cautions arise and reflections on its impact need to be made clear.
- As a society, we need to consider, in a thoughtful manner, the significance of technological advances.
- Keeping ethics at the forefront is an important and vital part of a healthy technological society.

KEY SKILLS/PROCEDURES

- Demonstrate knowledge of ethical questions and explore possible implications. (For example, what potential risks could be involved with submitting your DNA to an online site?)
- Defend a position taken about an ethical issue concerning technology.

Content Elaborations

CLARIFICATIONS

Learners using technology need to recognize ethical and legal issues concerning technology use before decision-making. Students need to consider ethical and legal practices involving topics such as privacy, digital bullying, human interactions online or intellectual property.

Ethical use of technology should be embedded throughout the curriculum. Students should be aware of examples of ethical questions in regard to technology, such as bioengineering or genetically altered DNA. As technology advances, students should understand what questions need to be posed for examining the potential impact on users, bystanders and society.

Topic 1: Demonstrate an understanding of technology's impact on the advancement of humanity – economically, environmentally and ethically.	
	CONTENT FOCUS This content statement focuses on providing guidance and support that allows students to pose, research and defend positions taken about ethical questions concerning technology. (For example, in a discussion about driverless cars, who would be at fault in the event of an accident?)
6-8.ST.1.b. Explore the advantages and disadvantages of widespread use, accessibility and reliance on technology in one's world.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students identified positive and negative impacts their use of technology can have on their community. In grades 6-8, students explore advantages and disadvantages of widespread use, accessibility and reliance on technology in their world. In grades 9-12, students will debate the advantages and disadvantages of widespread use, accessibility and reliance on technology locally and globally. **IMPORTANT CONCEPTS** • Technology impacts society as a whole so potential advantages and disadvantages need to be considered. • Technological advancements can have potential pitfalls. **KEY SKILLS/PROCEDURES** • Communicate ways in which a technological advancement has both positive and negative impacts on a large scale. • Cite examples of widespread use of technology in everyday life (such as online texts, paper-free classrooms and multiple devices per user). • Discuss and provide evidence for potential pitfalls in the widespread use of technology. **Content Elaborations** **CLARIFICATIONS** Due to the widespread use, accessibility and reliance on technology, technology has had a significant impact on the business, communication and connectiveness of the world. While exploring the positive impacts of technological innovations, students also must consider how potential misuses and unintended negative consequences can come into effect. Globalization, a concept in which people operate on an international scale, has allowed for greater access to one another but also may have some consequences that need to be explored. Students can examine how the spread of technology and its use can have far-reaching impacts. For example, the growing demand for and reliance on electricity around the world can increase fossil fuel use, which can increase pollution.

Topic 1: Demonstrate an understanding of technology's impact on the advancement of humanity – economically, environmentally and ethically.	
	Transportation technology increases the spread of diseases, both in their geographical reach and the decreased time needed to spread. The spread of invasive species also is faster and wider reaching due to transportation technology. **CONTENT FOCUS** The focus is on exploring examples of the impacts of technology involving widespread use, accessibility and reliance in terms of topics such as social media, medical advances, governmental impacts, environmental regulations or finance and industry.
6-8.ST.1.c. Review and demonstrate ethical considerations and legal requirements involved in the creation and use of digital technologies.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students explained how to use technology legally and responsibly and discussed basic laws and rules that apply to digital content and information. Students began to apply these basic rules with guidance. In grades 6-8, students further investigate ethical considerations and legal requirements involved in creating artifacts using digital technologies. Students demonstrate ethical and legal practices. In grades 9-12, students will interpret ethical considerations and legal requirements involved in creating artifacts using digital technologies. Students will apply ethical and legal practices. **IMPORTANT CONCEPTS** • Every person has a responsibility to understand and adhere to usage and copyright laws. • Every person has a responsibility to understand the difference between copyright infringement, plagiarism and piracy. **KEY SKILLS/PROCEDURES** • Demonstrate appropriate use of copyright laws, intellectual property rights and usage permissions. • Define fair use, plagiarism, piracy and copyright infringement. • Use tools to determine usage rights of digital technology. **Content Elaborations** **CLARIFICATIONS** There are varying levels of permissions granted to be able to create, use, edit and reproduce digital artifacts, including Computer-Aided Design files (CAD) used with 3D printers. If students use digital technologies to create, edit or reproduce artifacts (such as digital images, online videos, source code, apps and games) outside of legal permissions, there are legal ramifications. In addition to copyright laws (including Creative Commons guidelines), students should be introduced to the

Topic 1: Demonstrate an understanding of technology's impact on the advancement of humanity – economically, environmentally and ethically.	
	idea of fair use principles and usage rights and continue to build on their understanding of intellectual property. For example, students could explore the appropriate use of icons, logos and graphics in relation to trademark and trade name rights. **CONTENT FOCUS** The focus is on modeling digital responsibility when creating, editing or reproducing artifacts with digital technologies using content created by others.
6-8.ST.1.d. Analyze an environmental concern and investigate technology solutions to that problem.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students continued to explore positive and negative impacts of technology use on a community. In grades 6-8, students analyze specific environmental concerns and investigate technology solutions to address those concerns. In grades 9-12, students will select a technology and analyze the global impact of this technology across multiple disciplines. **IMPORTANT CONCEPTS** • Concerns exist that affect local and global communities economically, environmentally and ethically. • Multiple factors, both positive and negative, contribute to the impact of environmental concerns, as well as to their possible solutions. • Technological solutions have intended and often unintended consequences on a community when they are put into action. **KEY SKILLS/PROCEDURES** • Evaluate the effectiveness of a technological solution to an environmental concern. • Consider the economic, environmental and ethical impacts on the community when evaluating a technological solution. **Content Elaborations** **CLARIFICATIONS** Communities face a number of concerns that affect them economically, environmentally and ethically. Environmental, as well as economic and ethical concerns, range from local concerns specific to that community to global concerns such as efficient energy practices and pollution. Technologies can be created or adapted in an attempt to address concerns. Governmental policies can influence the creation and adoption of technologies. Policies developed to help guide users can be the

Topic 1: Demonstrate an understanding of technology's impact on the advancement of humanity – economically, environmentally and ethically.	
	source for requirements (criteria and constraints) during a design process. Meeting these requirements may involve trade-offs, like valuing lower emissions from a car over a slightly higher cost to consumers. For example, there are concerns about the impact of fuel emissions on the quality of our air, so automobile designers have created products like hybrid and fully electric cars that reduce emissions. **CONTENT FOCUS** The focus is on analyzing and defining the contributing factors to an identified environmental concern and then evaluating technological solutions for this concern.

Topic 2: Analyze the impact of communication and collaboration in both digital and physical environments.	
6-8.ST.2.a. Critique specific instances of how technology has impacted access to information, communications and collaboration.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students created a plan and selected collaboration and/or communication tools to complete a given task. In grades 6-8, students critique specific instances of how technology has impacted access to information, communications and collaboration. In grades 9-12, students will demonstrate and advocate effective collaboration strategies and techniques using technology. **IMPORTANT CONCEPTS** • The advancement of technology changes the way people access information, communicate and collaborate. **KEY SKILLS/PROCEDURES** • Analyze the immediate and long-term impact of a new technology on how people access information. • Analyze the immediate and long-term impact of a new technology on how people communicate and collaborate. • Compare the effectiveness of a historical technology with a modern technology that accomplishes the same task. **Content Elaborations** **CLARIFICATIONS** Throughout time, people have created technologies that change how we access information and communicate and collaborate with each other. This increased communication and access to information has provided greater opportunities for various groups of people to create new inventions and innovations. With the creation of the internet, ideas have been able to spread rapidly, giving rise to new inventions and innovations worldwide. For example, as technology progresses, more students are able to access information and problem-solve using various tools in both quantity and quality, such as audio books, videos, calculators and microscopes. Cloud-based technology has vastly improved the ability for students to collaborate. **CONTENT FOCUS** This content statement focuses on critiquing specific instances of technology to understand how technology has changed the way people access information, communicate and collaborate. These investigations can examine modern examples or historical ones.

Topic 2: Analyze the impact of communication and collaboration in both digital and physical environments.	
	Career Connections **CAREER EXPLORATION** Students use digital tools to conduct research on which careers or occupations have been most impacted over time. Which careers or occupations no longer exist or have dramatically changed over the last 10, 20 or 50 years because of technological advances? Which careers or occupations exist now that did not exist in the last 10, 20 or 50 years because of technological advances? How has access to information, collaboration and communication changed because of technology in these careers or occupations? Students conduct interviews with professionals in their community to learn about their career journeys. When inviting professionals to share their work experiences with students, consider professionals that represent diverse groups and populations.
6-8.ST.2.b. Explain the positive and negative impact the use of technology can have on personal, professional and community relationships.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students practiced positive behaviors while communicating and collaborating with their peers. They also identified the positive and negative impact the use of technology can have on relationships, communities and self. In grades 6-8, students explain how technology use can have both positive and negative impacts on personal, professional and community relationships. In grades 9-12, students will describe and demonstrate professionalism and civility while communicating and collaborating in all environments. They also will analyze how social media impacts society, individuals and organizations. **IMPORTANT CONCEPTS** • The use of technology can impact a person's personal relationships positively and negatively. Using technology as a way to connect with other individuals in new ways may be viewed as a positive impact. Technology use that results in a decrease in the need for person-to-person interaction may be perceived as a negative impact. • The use of technology can impact a person's professional relationships positively and negatively. Using technology for increased collaboration may be viewed as having a positive impact on professional relationships. Technology use that results in increasing job demands may be perceived as a negative impact on professional relationships. • The use of technology can impact a person's community relationships positively and negatively. An online community for a neighborhood can inform residents about useful resources that are available. This same online community also may become a source of rumors and false information.

Topic 2: Analyze the impact of communication and collaboration in both digital and physical environments.	
	KEY SKILLS/PROCEDURES • Communicate examples of positive and negative impacts of a specific technology use on personal, professional and community life. • Weigh the positive and negative effects of a specific technology's use to determine its overall impact. **Content Elaborations** **CLARIFICATIONS** Increased technology use can have both positive and negative impacts on personal, professional and community relationships. For example, having immediate access to information and communication through the internet and social media can affect these relationships in positive and negative ways. The ability to access and produce content easily can give users more control over developing technological solutions. As people learn about technology related to production (such as tools used in a maker space), they can make products that meet their needs and wants. On the one hand, this may limit collaboration with others because they may not need to rely on community sources previously used to meet their needs. On the other hand, people may join new communities that share their interest in meeting that need or want or are interested in that type of "making." **CONTENT FOCUS** Focus the discussion on the positive and negative impacts that increased technology use has on people's personal lives, professional lives and community relationships.
6-8.ST.2.c. Investigate how social media impacts society and the digital identities of individuals and organizations.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students identified the positive and negative impact the use of technology can have on relationships, communities and themselves. In grades 6-8, students investigate how social media impacts society and the digital identities of individuals and organizations. In grades 9-12, students will analyze how social media impacts society, individuals and organizations. **IMPORTANT CONCEPTS** • There is a potential impact on one's digital identity through the use of social media. • Individuals need to be able to analyze their own personal identities in social media. • Public companies and individuals use their social media to influence or create public identity. • Individuals and organizations are able to misrepresent themselves through their online presence and use that for malicious purposes.

Topic 2: Analyze the impact of communication and collaboration in both digital and physical environments.	
	KEY SKILLS/PROCEDURES • List examples of social media use both in and out of the classroom that promotes a digital identity. • Demonstrate how public entities have an influence on their digital identities by citing how public opinion may be formed through their social media (such as political, business and entertainment). • Review a public identity to determine opportunities for positive self-branding. **Content Elaborations** **CLARIFICATIONS** Social media has become closely tied to how people identify organizations or persons. Social media can impact the digital identity of individuals and organizations and can be used to manipulate a digital identity with potential beneficial or harmful results. The importance of understanding how social media can impact digital identity can be seen when considering online shopping and commerce. A customer would want to ensure the merchandise they buy is from the source intended, and the business would want to ensure the customer is indeed a real person. Additionally, social media often showcases people's living experiences. Students should recognize how their social media impacts the way they are viewed in real life. Potentially hazardous posts or accounts linked to users can impact school, financing, work and personal relationships. This may be demonstrated in the classroom through sharing examples of reputable digital identities as students conduct research or cite examples. Another example could be analyzing how a business or organization uses social media as an advertising platform. **CONTENT FOCUS** The focus is on the impact of social media on society and the digital identities of organizations and the individual.
6-8.ST.2.d. Apply appropriate interactions and digital etiquette in varying contexts, reflecting upon potential impacts in both digital and physical environments.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students explored positive and negative ways to communicate and collaborate. In grades 6-8, students practice digital etiquette in varying contexts and reflect on the impacts of their actions on both digital and physical environments. In grades 9-12, students will manage and adjust appropriate interactions and digital etiquette in varying contexts in digital, physical and cultural environments.

Topic 2: Analyze the impact of communication and collaboration in both digital and physical environments.	
	IMPORTANT CONCEPTS • Anonymity online can potentially impact how a user behaves. • There are positive and negative aspects to online behavior. • Rules for digital etiquette may vary based on context. **KEY SKILLS/PROCEDURES** • List both positive and negative aspects of anonymity online. • Apply personal etiquette strategies when using online media. • Vary online behaviors according to rules for digital etiquette that are appropriate to different contexts. **Content Elaborations** **CLARIFICATIONS** Digital etiquette is the personal responsibility all users have to conduct themselves online appropriately and with integrity. It should reflect social guidelines followed when interacting face-to-face in the real world. Technology users may struggle with their online behavior and the potential impacts on others. Negativity online can impact how students view themselves and others. Student choices and words have a real-life impact. Joking and sarcasm are not always understood clearly in a digital format. Teach users strategies for evaluating when posting online in varying contexts. **CONTENT FOCUS** The focus is on students applying digital etiquette and maintaining appropriate interactions depending on the context of online situations. Students also should understand the impacts of inappropriate interactions that can occur in both the digital and physical world.

Topic 3: Explain how technology, society and the individual impact one another.	
6-8.ST.3.a. Discuss and define how issues (e.g., economic, political, scientific and cultural) are influenced by the development and use of technology.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students described the advantages and disadvantages of technology to understand the relationship between technology, society and the individual. In grades 6-8, students discuss how the development and use of technology has influenced societal issues. In grades 9-12, students will provide examples of how demand for technology has shaped the cultural, political and economic landscape. **IMPORTANT CONCEPTS** • The development and use of a technology can impact various sectors of society (such as economic, political, scientific and cultural). • The development and use of a technology can have positive and negative impacts on society. **KEY SKILLS/PROCEDURES** • Discuss and define how the development and use of a particular technology has impacted a sector(s) of society (such as economic, political, scientific and cultural). **Content Elaborations** **CLARIFICATIONS** The development and use of technology (technological knowledge, artifacts, infrastructure, tools, materials, processes and products) can influence many types of societal issues. For example, ethanol production and use can have a potential impact on a range of sectors of society. Students could consider impacts such as how the process of producing ethanol from corn influences the use of croplands, availability of food and cost of fuel. Other examples of the technological impact on society include how employment has been influenced by the development and use of new technologies, such as displacement of workers due to robotics and automation and new careers that also can be created due to the development of new technology. Political and cultural impacts on society can be seen when considering how societal movements can gain momentum from the spread of information through technology. Students could identify one or more societal movements that have been influenced by the internet and social media. **CONTENT FOCUS** This content statement focuses on the influence technology use and development can have on different kinds of issues (such as economic, political, scientific and cultural).

Topic 3: Explain how technology, society and the individual impact one another.	
6-8.ST.3.b. Explain how new technology development is driven by factors such as commercialization, creative/ inventive thinking and cultural/historical influence.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students identified and discussed the impacts of technology use on self and others. In grades 6-8, students continue to examine the impacts of technology use, focusing on societal issues. Students also explain societal factors that drive the development of new technology, such as commercialization, creative/inventive thinking and cultural/historical influence. In grades 9-12, students will discuss how new technology has resulted when ideas, knowledge or skills have been shared across multiple fields. **IMPORTANT CONCEPTS** • Technological needs or wants drive what innovators develop for the public. • Technology is developed and improved upon based on public demand. • Adoption of new products and systems is based upon how well the technology satisfies the needs or wants of the users. **KEY SKILLS/PROCEDURES** • Identify examples of new technology that have been developed to meet the public's commercial and/or cultural needs or wants. • Describe characteristics of companies that are quick to adopt new technology. **Content Elaborations** **CLARIFICATIONS** New technology is driven by groups that define a societal need or want. Inventive thinkers determine needs and wants and create devices and systems that address these demands that may gain a large base of users. Those inventions or innovations generally are a result from what industry, business and consumers find to be valuable, based on their needs, culture and group history. Students could find examples of new technology that have been developed that meet their needs and wants or those of their community (such as improvements to sports gear, accessibility of voting machines, energy-efficient transportation and added functionality of computer apps or programs). Students could explore those examples to determine how they are relevant to their own community and how those examples benefit both the producers and consumers. **CONTENT FOCUS** The focus is on exploring the factors that drive new technology development.

Topic 3: Explain how technology, society and the individual impact one another.	
6-8.ST.3.c. Analyze how technological innovations and inventions can have multiple applications, both intended and unintended.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students demonstrated how technology innovations/inventions can have multiple applications. In grades 6-8, students analyze how technological innovations and inventions can have multiple applications, both intended and unintended. In grades 9-12, students will discuss how technological innovation has resulted when ideas, knowledge or skills have been shared across multiple fields. **IMPORTANT CONCEPTS** • Technological innovations and inventions can have multiple uses. • The multiple uses of a technological innovation or invention may have been intended or unintended. • Technological innovations and inventions also may be used in alternative ways than those for which they were originally designed. **KEY SKILLS/PROCEDURES** • Identify a technological innovation or invention that has been used in multiple ways, explaining its multiple uses in terms of its intended purpose and unintended applications. **Content Elaborations** **CLARIFICATIONS** Technological innovations and inventions can have multiple applications and be repurposed for new uses in new contexts. For example, the slippery chemical coating Teflon has been used in multiple ways. While an early use of Teflon was for military applications during World War 2, it is now best known for its use in nonstick cookware. Other uses for Teflon include nail polish, carpet protection and windshield wiper blades. New applications for an innovation or invention may have been unintended by the original developers. For example, there are drugs that were developed for a particular treatment purpose and later discovered to be effective in treating a different condition (such as drugs developed to treat diabetes that are being tested for the treatment of Parkinson's disease). **CONTENT FOCUS** The focus is on analyzing specific examples of the intended and unintended applications of technology inventions and innovations. Intended applications can be both positive and negative, as can unintended applications.

Topic 3: Explain how technology, society and the individual impact one another.	
6-8.ST.3.d. Describe the impact of an individual's wants, values and interests on the development of new technologies.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students discussed the impacts technology has on their daily lives. In grades 6-8, students describe the impacts of an individual's wants, values and interests on the development of new technologies. In grades 9-12, students will discuss how technological innovations have resulted when ideas, knowledge or skills have been shared across multiple fields. **IMPORTANT CONCEPTS** • Individual wants, needs, values and interests determine new technologies that are developed. • Successful technological innovations gain greater public use when a larger population adopts those new innovations and can drive production of variations of that new technology. **KEY SKILLS/PROCEDURES** • Provide examples of recent innovations that have become mainstream and the needs that have been met as a result. Describe the impact of individual wants, interests and values on the mainstream uses of these innovations. • Provide examples of innovations that are popular, resulting in development of variations on that technology. • Provide examples of innovations that did not become widely used and provide possibilities why. **Content Elaborations** **CLARIFICATIONS** Developers of new technologies are innovators that respond to the needs and wants of consumers. Consumers can include individuals, business clients or industrial users. Many products are developed to satisfy larger companies' desires to meet the needs and wants of individuals. Consumers' adoption of new technological solutions reflects their values and interests. While consumers recognize the need for transportation to move from place to place, their values may impact whether they choose to purchase an electric, hybrid or gas-powered car. Consumers' style preferences impact new features that may be incorporated into a car's design (such as changes in contour and new color options). Students could investigate the impact of wants, values and interests on new technologies like genetically engineered food, alternative energy sources, smartphone advancements and increased wireless hardware. **CONTENT FOCUS** The focus is on discussing recent examples of new technologies that have become prevalent in terms of how these technologies have (or have not) met individuals' wants, needs, values and interests.

Topic 3: Explain how technology, society and the individual impact one another.	
6-8.ST.3.e. Manage components of one's digital identity and one's digital footprint.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students identified components that make up their own digital identities and digital footprints. In grades 6-8, students manage components of their digital identities and digital footprints. In grades 9-12, students will analyze and influence their digital identities and digital footprints while considering past, present and future implications. **IMPORTANT CONCEPTS** • Individuals develop their online presence through the creation and use of online accounts and uploading and posting text and materials to online platforms (such as social media sites and online communities for coding and games). **KEY SKILLS/PROCEDURES** • Discuss examples of online platforms that define a person's digital identity. • Demonstrate ways in which a person can maintain a positive online presence. • Describe examples of how a person's digital footprint (also called digital tattoo) might become a help or a hindrance later in life. **Content Elaborations** **CLARIFICATIONS** Individuals add to their digital identity through the creation of online accounts such as email, social media and accounts set up through institutions, entertainment outlets, purchases and online subscriptions. When individuals create and interact with these online accounts, they contribute to the online activities that make up their digital footprint or tattoo. A person's posts, comments, subscriptions, downloads and uploads are all information that could potentially be accessed at a later date by him or herself and others. Students should investigate examples of both positive and negative individual online presence and how those examples can determine a person's digital identity and digital footprint. **CONTENT FOCUS** The focus is on helping students manage their digital identities and footprints. Students can accomplish this as they identify and review components that are a part of their digital identities and footprints (such as accounts created and posts).

Topic 3: Explain how technology, society and the individual impact one another.	
6-8.ST.3.f. Evaluate current and past revisions to laws, rules and policies as society responds to technological advancements.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students discussed basic rules and laws that protect someone's ownership of ideas and content found online. In grades 6-8, students evaluate revisions to laws, rules and policies as society responds to technological advancements (such as revisions to laws that address ownership involving online ideas and content). In grades 9-12, students will forecast the need to review, adapt and innovate laws and policies applied to copyrights, patents, trademarks and speech. **IMPORTANT CONCEPTS** • Laws made prior to the widespread use of the internet do not necessarily carry over to situations involving digital actions. • Governments must make new laws or revise previous laws to respond specifically to technological advancements. • New laws and policies often are challenged on a case-by-case basis. **KEY SKILLS/PROCEDURES** • Provide examples of how a previous law can and cannot be applied to a similar circumstance with the introduction of a technological advancement (such as laws involving a behavior that is now carried out online). • Provide examples of a new or revised law, rule or policy that has been introduced due to a technological advancement (for example, laws that specifically address ownership of online content or online crimes such as fraud; traffic laws that have changed as modes of transportation have evolved; and institutional policies that address online misconduct such as bullying). Explain why these changes have been made. **Content Elaborations** **CLARIFICATIONS** The growth and spread of the internet provide many examples for examining the impact of technological advancements on laws, rules and policies. Technological advancements have created challenges in the application of concrete laws with regard to freedom of speech, individual security, protection of personal information and regulation of the internet. State and federal government responses have attempted to address these issues, often on a case-by-case basis. Institutions have developed policies for its employees, consumers and students to curb malicious use of the internet. Autonomous vehicles provide another example, as they will require a host of changes in laws, access to highways and operation standards on transportation routes.

Topic 3: Explain how technology, society and the individual impact one another.	
	CONTENT FOCUS The focus is on considering laws made prior to a technological advancement and evaluating how these laws now apply, using examples of recent cases (such as the spread of online information and laws about freedoms, widespread internet usage and laws pertaining to scientific and medical advancements). Teachers can show examples of institutional policies that have resulted from advancements in technology (such as school policies revised to address cell phone use).

STRAND: DESIGN AND TECHNOLOGY

Addresses the nature of technology to develop and improve products and systems over time to meet human/societal needs and wants through design processes.

Topic 1: Define and describe technology, including its core concepts of systems, resources, requirements, processes, controls, optimization and trade-offs.

6-8.DT.1.a. Explore and document how technology can impact efficiency.

Expectations for Learning

LEARNING PROGRESSION

In grades 3-5, students demonstrated how applying human knowledge using tools and machines could extend human capabilities to meet needs and wants. In grades 6-8, students explore and document how technology can impact efficiency, as well as analyze the impact these tools and processes have on natural and human-designed worlds. In grades 9-12, students will begin the study of systems theory. Students will explore and document how systems theory includes the concepts of system dynamics, systems thinking and computational thinking.

IMPORTANT CONCEPTS

- Technology changes over time to increase efficiency.
- Technology can cause unintentional consequences that decrease efficiency.

KEY SKILLS/PROCEDURES

- Define the term "efficiency" and its relationship to productivity.
- Provide examples of technological "improvements." Investigate an example of a technological "improvement" to determine changes in "efficiency."

Content Elaborations

CLARIFICATIONS

Technology is created to extend human capabilities. This could be as simple as a hammer and as complex as robotics. All technology has an impact on a person's effectiveness in completing tasks. While the goal is to use technology to increase efficiency, there may be unintentional consequences that result in decreases in efficiency. For example, the development of robotics has increased the efficiency of manufacturing production. However, manufacturers that use robotic equipment connected to networks and the internet may be vulnerable to cyber attacks (such as accessing proprietary information and taking unauthorized control of equipment). Another possible unintended consequence is disruption of employment and the requirement of workers to learn new skills.

Topic 1: Define and describe technology, including its core concepts of systems, resources, requirements, processes, controls, optimization and trade-offs.	
	CONTENT FOCUS This content statement focuses on analyzing the impact a specific technology has on efficiency in the field or industry that it is being used. This can include positive and negative impacts on individuals, communities and global society.
6-8.DT.1.b. Analyze how tools, materials and processes are used to alter the natural and human-designed worlds.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students defined and described core concepts of technology, including describing how processes are used to produce a result and demonstrating how using tools and machines extends human capabilities to meet our needs and wants. In grades 6-8, students continue to define and describe core concepts of technology, including analyzing how tools, materials and processes are used to alter the natural and human-designed worlds. In grades 9-12, students will discuss how the design process builds on the core concepts of technology, including the relationship between systems. **IMPORTANT CONCEPTS** • Human-designed tools, materials and processes change the natural and human-designed worlds over time. **KEY SKILLS/PROCEDURES** • Identify examples of tools, materials and processes that have impacted the natural and human-designed world. Explain how these tools, materials and processes are used to alter the natural and human-designed worlds. **Content Elaborations** **CLARIFICATIONS** Over the course of human history tools, materials and processes have changed both the natural and human-designed worlds. The following example illustrates how the use of tools, materials and processes can have varied impacts on both the natural and human-designed worlds. Raw material like bauxite is mined then processed to produce aluminum. The aluminum is then used in soda cans and other products. The process of removing the bauxite from the ground has impacts on the natural world and the people who live near the mine (such as the disruption of habitats and harm to crops). The process of producing the aluminum from the raw bauxite ore also impacts the natural and human-designed worlds (such as the use of renewable/non-renewable energy and technologies developed for producing aluminum), as does the production and use of soda cans.

Topic 1: Define and describe technology, including its core concepts of systems, resources, requirements, processes, controls, optimization and trade-offs.	
	CONTENT FOCUS The focus is not on the differences between natural and human-designed worlds, but rather on how tools, materials and processes are used to change the form of materials. The emphasis is placed on how materials are processed and the benefits this transformation brings to the productivity of systems.
6-8.DT.1.c. Define and categorize the requirements of a design as either criteria or constraints.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students gave examples of how requirements for a product limited the design possibilities for that product. In grades 6-8, students define and categorize the requirements of a design as either criteria or constraints. Students consider criteria and constraints to justify decisions when developing products and systems to solve problems. In grades 9-12, students will evaluate a design solution, considering design requirements and making adjustments needed to complete a design that meets these requirements. **IMPORTANT CONCEPTS** • Every design has certain criteria and constraints that must be considered for that design to be considered successful. **KEY SKILLS/PROCEDURES** • Identify the requirements of a design as either a criterion or constraint. **Content Elaborations** **CLARIFICATIONS** When designing the solution to a challenge, it is important to explore and document the requirements of a design. Students must consider both criteria and constraints when developing their designs. Criteria are requirements for a design to be successful. Constraints are limitations on the design, such as materials, time, space, budget and human resources. To help students define and categorize design requirements into criteria and constraints, consider having them use a design process to develop a solution to a problem. Students can use design criteria and constraints to justify their decisions when developing their solutions (6-8.DT.2.d.). **CONTENT FOCUS** The focus is on determining the requirements for a design and categorizing them as either criteria or constraints.

Topic 1: Define and describe technology, including its core concepts of systems, resources, requirements, processes, controls, optimization and trade-offs.	
6-8.DT.1.d. Explain how optimization is the process of making a product as fully functional and effective as possible.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students gave examples of how requirements for a product limited the design possibilities for that product. In grades 6-8, students explain how optimization is the process of making a product as fully functional and effective as possible within given design requirements. In grades 9-12, students will consider optimizing design solutions as part of a design process as they evaluate a solution in terms of design requirements. **IMPORTANT CONCEPTS** • A product can be improved in terms of its function and effectiveness as designers retrace steps with each iteration of a design process and continue to evaluate and refine a product solution. **KEY SKILLS/PROCEDURES** • Describe improvements that have been or could be made to a particular product in terms of the product's functionality and effectiveness. Explain how these improvements relate to the optimization of the product's design. **Content Elaborations** **CLARIFICATIONS** During or after the creation of a product, the outcome may be improved to be more functional or effective through a design process referred to as optimization. Optimization typically includes testing a design solution by collecting data to evaluate how well the solution meets design requirements. To reach an optimum solution, a product usually requires further refinements; designers analyze test results, modify the design accordingly and then retest the modified design solution. The design process used is evaluated to determine which steps may need to be retraced to refine and improve the product. Often this can occur multiple times, with the product becoming more functional and effective each time. **CONTENT FOCUS** The focus is on defining, explaining and providing examples of optimization. Improvements to optimize a design could take place within a design process, before a final product or process is completed, or by making improvements upon an already-existing product.

Topic 1: Define and describe technology, including its core concepts of systems, resources, requirements, processes, controls, optimization and trade-offs.	
6-8.DT.1.e. Describe how trade-offs involve a choice of one quality over another.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students gave examples of how requirements for a product can limit the design possibilities for that product. In grades 6-8, students consider criteria and constraints to justify design decisions and describe how trade-offs involve a choice of one quality over another. In grades 9-12, students will consider trade-offs as part of a design process as they evaluate design solutions, checking the solutions against criteria and constraints. **IMPORTANT CONCEPTS** • A trade-off involves making strategic and intentional design decisions considering the advantages and disadvantages of a balance between qualities that are not mutually attainable. **KEY SKILLS/PROCEDURES** • Provide the advantages and disadvantages of a balance between qualities that are not mutually attainable when considering a trade-off(s) concerning a particular design. **Content Elaborations** **CLARIFICATIONS** During a design process, every decision involves trade-offs. A trade-off involves reducing or eliminating a particular quality, quantity or even characteristic of a design to gain in a different aspect. Designs can be limited by multiple constraints (such as funding, time or materials). Compromises, or trade-offs, may need to be made when considering these constraints in terms of required criteria for a design (such as weighing the benefits of using a stronger material against the higher cost of that material). **CONTENT FOCUS** The focus is on defining and identifying trade-offs involving choices of one quality over another based on design constraints.
6-8.DT.1.f. Give examples of how trade-offs must occur when optimizing a design in order to maintain design requirements.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students gave examples of how requirements for a product can limit the design possibilities for that product. In grades 6-8, students give examples of how trade-offs must occur when optimizing a design to maintain design requirements. In grades 9-12, students will discuss optimization and trade-offs in terms of their design solutions. As part of a design process, students will evaluate design solutions, considering design requirements, and make trade-offs to optimize their solutions.

Topic 1: Define and describe technology, including its core concepts of systems, resources, requirements, processes, controls, optimization and trade-offs.	
	IMPORTANT CONCEPTS • Every decision in product design includes trade-offs. To meet design constraints while maximizing product functionality and effectiveness, a trade-off is required. **KEY SKILLS/PROCEDURES** • Identify an example of a trade-off and explain how making this trade-off helps to optimize a design given the constraints. **Content Elaborations** **CLARIFICATIONS** Trade-offs are essential in a design process. When given constraints, a designer needs to explore ways to optimize the design by balancing qualities that are not mutually attainable yet increase effectiveness and efficiency. During a design process, trade-offs will need to be made to meet design requirements. Consider examples such as how improving fuel efficiency can require making a trade-off in the size, power or utility of the vehicle. **CONTENT FOCUS** The focus is on providing examples of how designers and engineers make trade-offs to optimize a design within the given constraints.

Topic 2: Identify a problem and use an engineering design process to solve the problem.	
6-8.DT.2.a. Apply a complete design process to solve an identified individual or community problem: research, develop, test, evaluate and present several possible solutions, and redesign to improve the solution.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students planned and implemented a design process. In grades 6-8, students apply a complete design process to solve an identified individual or community problem. In grades 9-12, students will implement, document and present a design process as applied to a particular product, process or problem. They will use an evaluation process, that includes the use of models, to check for proper design and note areas where improvements are needed. **IMPORTANT CONCEPTS** • People use a design process to solve individual or community problems. **KEY SKILLS/PROCEDURES** • Identify a problem that can be addressed using a design process. • Apply each step in a design process to design solutions that meet an identified need or want. **Content Elaborations** **CLARIFICATIONS** A design process is a cyclical and continuous process consisting of a series of steps. It can be used as a plan to generate multiple solutions for creating a product or system to help alleviate or solve a problem or to meet a need or want. Below is an example of a complete design process students can use to solve an individual or community problem. • Students identify an individual problem, need or want. • In the research phase, students identify constraints (such as time, money, materials and circumstances) and any previous systems or products already used to address this issue. • In the develop phase, they design and create a prototype for testing. • In the test phase, students collect data about how well the prototype works to solve the identified problem. • In the evaluate phase, they determine the effectiveness of the design and decide whether modifications can be made. • Students present several possible solutions and share any findings gained through the design process that should be implemented. • Redesigning typically happens after the evaluate phase but can occur at any point within the process.

Topic 2: Identify a problem and use an engineering design process to solve the problem.	
	CONTENT FOCUS This content statement focuses on students carrying out a design process and producing a tangible result. Less emphasis is given to students understanding specific definitions of the steps in the design process. **Career Connections** **CAREER EXPLORATION** Locate a community member who holds an occupation in the area of the problem students identified. Invite that professional to be a classroom speaker to share with the students more about his or her everyday work, the components of his or her job and skills related to the career choice. The invited speaker also can discuss the importance of professional skills and how the skills requirements of the OhioMeansJobs-Readiness Seal are used in the professional's role. In addition, the professional can provide feedback on the students' prototypes. Opportunities for further research on these occupations can be found on the OhioMeansJobs K-12 website.
6-8.DT.2.b. Describe how invention is a process of turning ideas and imagination into devices and systems.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students identified problems and used a design process to develop possible solutions. They also demonstrated how technology inventions can have multiple applications, solving problems beyond those originally intended. In grades 6-8, students understand that inventions are created through a design process, and they apply a design process to solve a problem. In grades 9-12, students will implement, document and present a design process as applied to a particular product, process or problem. **IMPORTANT CONCEPTS** • Inventions are brand new devices or systems that did not exist previously. • Inventions are created through a design process. • Inventions are created to address a problem, need or want. • Inventions are different from innovations. **KEY SKILLS/PROCEDURES** • Define the term invention and give examples of devices and systems that are inventions. • Describe how an invention is a product of a design process. • Compare and contrast similarities between inventions and innovations.

Topic 2: Identify a problem and use an engineering design process to solve the problem.	
	Content Elaborations **CLARIFICATIONS** An invention is a brand-new device or system that did not exist prior to its creation. It is created because of an identified need or want. Examples of devices that are inventions include the telescope, the telephone, video game consoles and the internet. Examples of systems that are inventions are the assembly line and ride-sharing services. People use a design process to turn their ideas into devices or systems. **CONTENT FOCUS** The focus is on understanding that a design process turns ideas into inventions. Everything that has been invented, whether a new technology or old technology, has gone through a design process, with the invention being the end result. Needs and wants drive invention.
6-8.DT.2.c. Explain how innovation is the process of modifying an existing system or system element(s) to improve it.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students identified problems and used a design process to develop possible solutions. They also demonstrated how technology innovations can have multiple applications, solving problems beyond those originally intended. In grades 6-8, students explain how innovation is the process of modifying an existing system or system element(s) to improve it. In grades 9-12, students will implement, document and present a design process as applied to a particular product, process or problem. They will use an evaluation process, which includes the use of models, to check for proper design and note areas where improvements are needed. **IMPORTANT CONCEPTS** • Innovations are different from inventions; they are improvements to existing devices or systems/system element(s). • Innovations are created out of a desire to improve upon an existing device or system to better meet a need or want. • Innovations are created through a design process. **KEY SKILLS/PROCEDURES** • Define the term innovation and give examples of devices and systems/system elements(s) that are innovations. • Describe how an innovation is a product of a design process. • Compare and contrast similarities between inventions and innovations.

Topic 2: Identify a problem and use an engineering design process to solve the problem.	
	Content Elaborations **CLARIFICATIONS** Innovation differs from invention because innovation builds on or modifies an invention that already exists. As is the case for developing an invention, a design process can be used to design and evaluate the effectiveness of an innovation. Modifications made to automobiles provide examples of innovations. The introduction of crash avoidance, automatic parking systems and self-driving capabilities are innovations. **CONTENT FOCUS** The focus is on how a design process applies to the development of an innovation. All innovations, whether they are applied to devices or systems, have gone through this iterative process, with the innovation being the end result.
6-8.DT.2.d. Consider multiple factors, including criteria and constraints, (e.g., research, cost, time, materials, feedback, safety) to justify decisions when developing products and systems to solve problems.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students gave examples of how requirements for a product limited the design possibilities for that product and considered solutions addressing simple design restrictions. In grades 6-8, students consider multiple factors, including criteria and constraints, to justify their design decisions. In grades 9-12, students will use a design process to solve a problem, determining the design requirements, criteria and constraints. They will evaluate a design solution prototype, checking the solution against criteria and constraints they developed. **IMPORTANT CONCEPTS** • Multiple factors, including constraints and criteria, can change the path designers take as they progress through the design process, influencing the decisions designers make and the design solutions they choose. • Designers consider factors such as design criteria (like goals, functional qualities and safety) and constraints (like cost, complexity and size) to justify their design decisions and the solutions they choose. **KEY SKILLS/PROCEDURES** • Identify constraints and criteria when designing a product or system to solve a problem. • Apply knowledge of design criteria and constraints while using a design process to develop a product or system to solve a problem. • Justify decisions about a product or system design by referencing multiple factors, including design criteria and constraints.

Topic 2: Identify a problem and use an engineering design process to solve the problem.	
	Content Elaborations **CLARIFICATIONS** The process of designing a product always includes constraints or limitations. Designers need to consider various limitations, including finances, availability and deadlines, and balance these considerations with design criteria involving functionality and effectiveness (such as which materials and resources to use). Many times designers need to justify their decisions to intended users. If their solution does not meet the design criteria, then the product may need to be redesigned and retested. **CONTENT FOCUS** The focus is on students using criteria and constraints to justify decisions they make as they design solutions using a design process. Criteria and constraints guide the design process at pivotal points. These may occur after brainstorming possible solutions, after creating and testing them or when presenting modification of designs.
6-8.DT.2.e. Identify and explain why effective designs develop from non-linear, flexible application of a design process.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students planned and implemented a design process. In grades 6-8, students apply a complete design process to solve an identified problem. Students identify and explain why effective designs develop from the non-linear, flexible applications of this process. In grades 9-12, students will evaluate a design solution using conceptual, physical, digital and mathematical models at various intervals of a design process. They will check for proper design, note areas where improvements are required and adjust processes and outcomes as needed. **IMPORTANT CONCEPTS** • A design process does not necessarily follow a preset, linear, step-by-step sequence. • Adjustments can be made at any interval within a design process, and steps may be repeated as the process dictates. • Applying a nonlinear, flexible approach to a design process promotes developing an effective design.

Topic 2: Identify a problem and use an engineering design process to solve the problem.	
	KEY SKILLS/PROCEDURES • Demonstrate flexibility in the application of a design process. • Communicate the sequence used in a specific design task and the adjustments made to the process. • Explain how adjustments to the design process used impact the effectiveness of the resulting design. **Content Elaborations** **CLARIFICATIONS** Engineering design processes share important components, such as researching a problem, developing and testing solutions and evaluating a solution's effectiveness. To arrive at an effective solution, components of a design process can be applied flexibly, in a variety of orders, as needed. The process often is iterative; once developers create and test a specific design, they may need to redesign their solution based on its effectiveness, constraints and other criteria. Even if a designer feels as if the product or system solves a problem, other designers and customers may have additional requirements not met by the design. **CONTENT FOCUS** The focus is on students using a design process in a flexible, nonlinear manner and understanding how this approach can result in increased effectiveness of their design and the design process they use.

Topic 3: Demonstrate that solutions to complex problems require collaboration, interdisciplinary understanding and systems thinking.	
6-8.DT.3.a. Collaborate to solve a problem as an interdisciplinary team modeling different roles and functions.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students described how people from different disciplines combined their skills in the design and production of a product. In grades 6-8, students collaborate to solve a problem as an interdisciplinary team modeling different roles and functions. In grades 9-12, students will evaluate a technological problem that has benefited from a multidisciplinary approach. **IMPORTANT CONCEPTS** • Collaboration is important when solving complex problems. • Contributions from team members with knowledge from different disciplines are critical when collaborating on complex problems. **KEY SKILLS/PROCEDURES** • Identify potential team roles, considering the tasks and knowledge required to solve a complex problem. • Explain the roles within a team, the responsibilities of each role and how different roles will work together. • Leverage the individual strengths within a team with the aim to maximize team effectiveness while solving a complex problem. **Content Elaborations** **CLARIFICATIONS** Cross-discipline collaboration is needed to solve many complex technological problems, because each member of an interdisciplinary team is able to bring a different strength and perspective to the process of developing an effective solution. The disciplines involved and the tasks required by a project help determine specific roles and functions of team members. For example, developing a robot to perform a needed task could require team designers that would apply science and math concepts to develop the physical structure of the robot and programmers that would apply knowledge of computer science as they develop code to control the robot's actions. Clear project documentation would require applying technical writing skills. **CONTENT FOCUS** This content statement focuses on students, as part of an interdisciplinary team, determining and assigning group roles as necessary, recognizing individual strengths within a group and using those strengths to accomplish group goals.

Topic 3: Demonstrate that solutions to complex problems require collaboration, interdisciplinary understanding and systems thinking.	
6-8.DT.3.b. Explain ways that invention and innovation within one field can transfer into other fields of technology.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students explored and documented connections between technology and other fields of study. In grades 6-8, students explain ways that inventions and innovations within one field can transfer into other fields of technology. In grades 9-12, students will evaluate a technological problem that has benefited from a multidisciplinary approach. **IMPORTANT CONCEPTS** • Inventions and innovations have potential uses other than their intended applications. • An invention or innovation developed to solve a problem in one field of technology can be used to solve problems in other technological fields. **KEY SKILLS/PROCEDURES** • Explain how technology transfer can occur. Use examples that illustrate how an invention or innovation developed for a specific purpose within one application was able to be used for a different purpose(s) in another application (such as the fabric Kevlar's use in gloves to protect from cuts and in tires to resist damage from broken glass). • Investigate intended and potential technology usage. **Content Elaborations** **CLARIFICATIONS** An invention or innovation developed for use in one field can often be applied to, or in other words, transferred to, multiple fields of technology and impact society as a whole. For example, in the turn of the 20th century, the vacuum tube was invented to convert AC electricity to DC. It was later discovered this same technology also could be used to electronically amplify sound and later to store information digitally. The technological concepts that enabled this storing of information still apply to today's computer chips. **CONTENT FOCUS** The focus is on students explaining how an invention or innovation created for a particular purpose in one technological field can be used in other fields of technology for the same purpose or different, unintended purposes. Students explain how a technology can be repurposed, modified and redesigned through using a design process.

<table>
<tr><th colspan="2">Topic 3: Demonstrate that solutions to complex problems require collaboration, interdisciplinary understanding and systems thinking.</th></tr>
<tr><td>6-8.DT.3.c. Evaluate the effectiveness of the group's collaboration during the engineering design process and the contribution of the varying roles.</td><td>
<h2>Expectations for Learning</h2>
LEARNING PROGRESSION
In grades 3-5, students described how people from different disciplines combined their skills in the design and production of a product. In grades 6-8, students evaluate the effectiveness of the group's collaboration during an engineering design process and the contribution of varying roles. In grades 9-12, students will evaluate a technological problem that has benefited from a multidisciplinary approach.

IMPORTANT CONCEPTS
• Feedback addressing group collaboration is critical during an engineering design process.
• Every role has an impact on the effectiveness of group collaboration.
• A group can adjust its collaboration based on feedback.

KEY SKILLS/PROCEDURES
• Constructively critique the contribution of each role within a collaboration.
• Discuss how each role contributes to an engineering design process.
<h2>Content Elaborations</h2>
CLARIFICATIONS
Evaluation of varying roles is important to determine the effectiveness of group collaboration and the contribution of different roles during an engineering design process.

CONTENT FOCUS
The focus is on students evaluating the effectiveness of their group's collaboration, providing feedback to one another based on roles and responsibilities.
</td></tr>
<tr><td>6-8.DT.3.d. Give examples of how changes in one part of a system can impact other parts of that system.</td><td>
<h2>Expectations for Learning</h2>
LEARNING PROGRESSION
In grades 3-5, students designed a product with multiple components and described how the components interact to form a system. In grades 6-8, students give examples of how changes in one part of a system can impact other parts of that system. In grades 9-12, students will analyze the interactions within systems and between systems.

IMPORTANT CONCEPTS
• Each part of a system affects the whole system.
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Topic 3: Demonstrate that solutions to complex problems require collaboration, interdisciplinary understanding and systems thinking.	
	KEY SKILLS/PROCEDURES • Analyze the components of a system and their impact on the whole system. **Content Elaborations** **CLARIFICATIONS** A change in one part of a system can affect other parts of the system. For example, when using an assembly line to create a product, any change to the components of the end product will require adjusting, changing or reconfiguring the components of the assembly line (such as to the equipment used to assemble the end product). Changes in one part of a system can impact that system positively or negatively. Returning to the example of an assembly line, if the equipment used in one stage of the assembly line is not operating efficiently, production can be impacted negatively (such as the creation of bottlenecks in the assembly line). When working with systems, even small changes to system components need to be considered. **CONTENT FOCUS** The focus is on explaining how a change in one part of a system would impact the overall function or output of that system.
6-8.DT.3.e. Deconstruct a system into its component parts and describe how they interrelate.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students designed a product with multiple components and described how the components interact to form a system. In grades 6-8, students deconstruct a system into its component parts and describe how they interrelate. In grades 9-12, students will analyze the interactions within systems and between systems. Students also will apply systems thinking to solve a complex problem. **IMPORTANT CONCEPTS** • Every system can be broken down into its interrelated components. • Each individual component within a system has a specific function that supports the unique purpose of that system. **KEY SKILLS/PROCEDURES** • Deconstruct a system and identify its component parts. • Explain how each part of a system relates to one another and affects the system as a whole.

Topic 3: Demonstrate that solutions to complex problems require collaboration, interdisciplinary understanding and systems thinking.	
	Content Elaborations **CLARIFICATIONS** Every system is made up of multiple components that, together, create a whole system. For example, a bicycle is a system that includes parts, such as wheels, pedals, brakes and gears. Each individual component has a specific function and when they are combined, they create a system that has a unique purpose. **CONTENT FOCUS** The focus is on analyzing a system by identifying its component parts, their individual functions and how these individual components interrelate to support the function of the entire system.

Topic 4: Evaluate designs using functional, aesthetic and creative elements.	
6-8.DT.4.a Examine the progression of a product to identify how the functional, aesthetic and creative elements were applied.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students used criteria developed with guidance to evaluate a new or improved product for its functional, aesthetic and creative elements. In grades 6-8, students examine the progression of a product to identify how the functional, aesthetic and creative elements were applied. In grades 9-12, students will interpret data/information related to product testing to determine revisions and modifications to a design's function and aesthetics. **IMPORTANT CONCEPTS** • Functional, aesthetic and creative elements are applied in the design of products. • Functional, aesthetic and creative elements are each applied in different ways when designing products. **KEY SKILLS/PROCEDURES** • Identify and explain how functional, aesthetic and creative elements were applied during the design of a product. **Content Elaborations** **CLARIFICATIONS** By examining the progression of a product's design, students can identify how functional, aesthetic and creative elements were used in its development. Functional elements are applied through design choices that enable a product to achieve its given purpose. Aesthetic elements are applied through design choices that make a product appealing to the senses of a given audience (sight, sound, taste, touch or smell). Creative elements are applied through design choices that make a product unique in design. **CONTENT FOCUS** This content statement focuses on the process of deconstructing the iterative development of a product's design to identify how the individual functional, aesthetic and creative elements were applied.

Topic 4: Evaluate designs using functional, aesthetic and creative elements.	
6-8.DT.4.b. Analyze environments or products that are examples of the application of the principles of universal or inclusive design.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students examined a familiar product or process and suggested improvements to its design. In grades 6-8, students analyze environments or products that are examples of the application of the principles of universal or inclusive design. In grades 9-12, students will critically evaluate a design solution at multiple points of the design process. They will consider design requirements and adjust processes and outcomes as needed. **IMPORTANT CONCEPTS** • A well-designed product or environment can be accessed and used by a diverse population. • Applying the principles of universal and inclusive design requires considering the needs of diverse users from the start of the design process. • Equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, and size and space for approach and use are principles to consider when applying universal design. • Inclusive design focuses on the diversity and uniqueness of each individual user, as well as the range of disabilities for which access needs to be developed. **KEY SKILLS/PROCEDURES** • Explain how a given product or environment demonstrates the principles of universal or inclusive design. • Identify universal or inclusive design principles that were considered during the development of a specific product or environment. • Identify universal or inclusive design principles to consider during the development of a specific product or environment to provide suggestions for improvements. **Content Elaborations** **CLARIFICATIONS** The purpose of universal and inclusive design is that a product or environment should be accessible to and usable by as many people as possible within a diverse population without the need for adaptation or specialized design. To design a product or an environment that can be used effectively by a diverse group of people, it is necessary to consider upfront their varying needs in terms of characteristics such as ability, experience, age and language. For example, ensuring that every citizen can participate in the voting process requires taking into consideration from the start the diverse needs of voters. Does the polling location provide access to those who are differently abled? Does the technology in the voting booth support visually impaired voters? Principles for students to consider as they apply universal and inclusive design

Topic 4: Evaluate designs using functional, aesthetic and creative elements.	
	include equitable use, flexibility in use, simple and intuitive use, perceptible information, low physical effort, tolerance for error and size and space for approach and use. **CONTENT FOCUS** The focus is on investigating how specific products or environments demonstrate the principles of universal or inclusive design.
6-8.DT.4.c. Apply the design principle "form follows function" to develop a product.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 3-5, students used criteria developed with guidance to evaluate a new or improved product for its functional, aesthetic and creative elements. Students also examined a familiar product or process and suggested improvements to its design. In grades 6-8, students apply the design principle "form follows function" to develop a product. In grades 9-12, students will evaluate a design solution at multiple points of a design process. They will interpret data/information related to product testing to determine modifications to a design's function and aesthetics. They also will explain the interrelationships between technology, creativity and innovation. **IMPORTANT CONCEPTS** • Products are designed and created out of a want or need. • "Form follows function" states that the elements used in the design and creation of a product (such as shape, color, line and texture) serve the intended purpose or function of that product. **KEY SKILLS/PROCEDURES** • Identify key design elements (such as shape, color, line and texture) that contribute to the development of a product in terms of the product's form or function. • Explain how the form of a given product is directly related to the desired function of that product. • Develop a product taking into consideration how its purpose or function determines design choices related to its shape or form. **Content Elaborations** **CLARIFICATIONS** "Form follows function" is a principle that states the shape or form that a product takes should be chosen based on its intended purpose or function. This principle can easily be applied to many facets of the designed world, including art, architecture, manufacturing and city planning. Consider that skyscrapers are designed to house large numbers of people in a small footprint and their form is based on this functionality. In some cases, there are architectural

Topic 4: Evaluate designs using functional, aesthetic and creative elements.	
	elements added, such as reflective glass or unique roof elements, to make the structure look more aesthetically pleasing. **CONTENT FOCUS** The focus is on students applying the principle of "form follows function" as they design a product. Students define the intended purpose or function of the product and consider the relationship between the product's form and function. Students determine how the product's function determines its form.