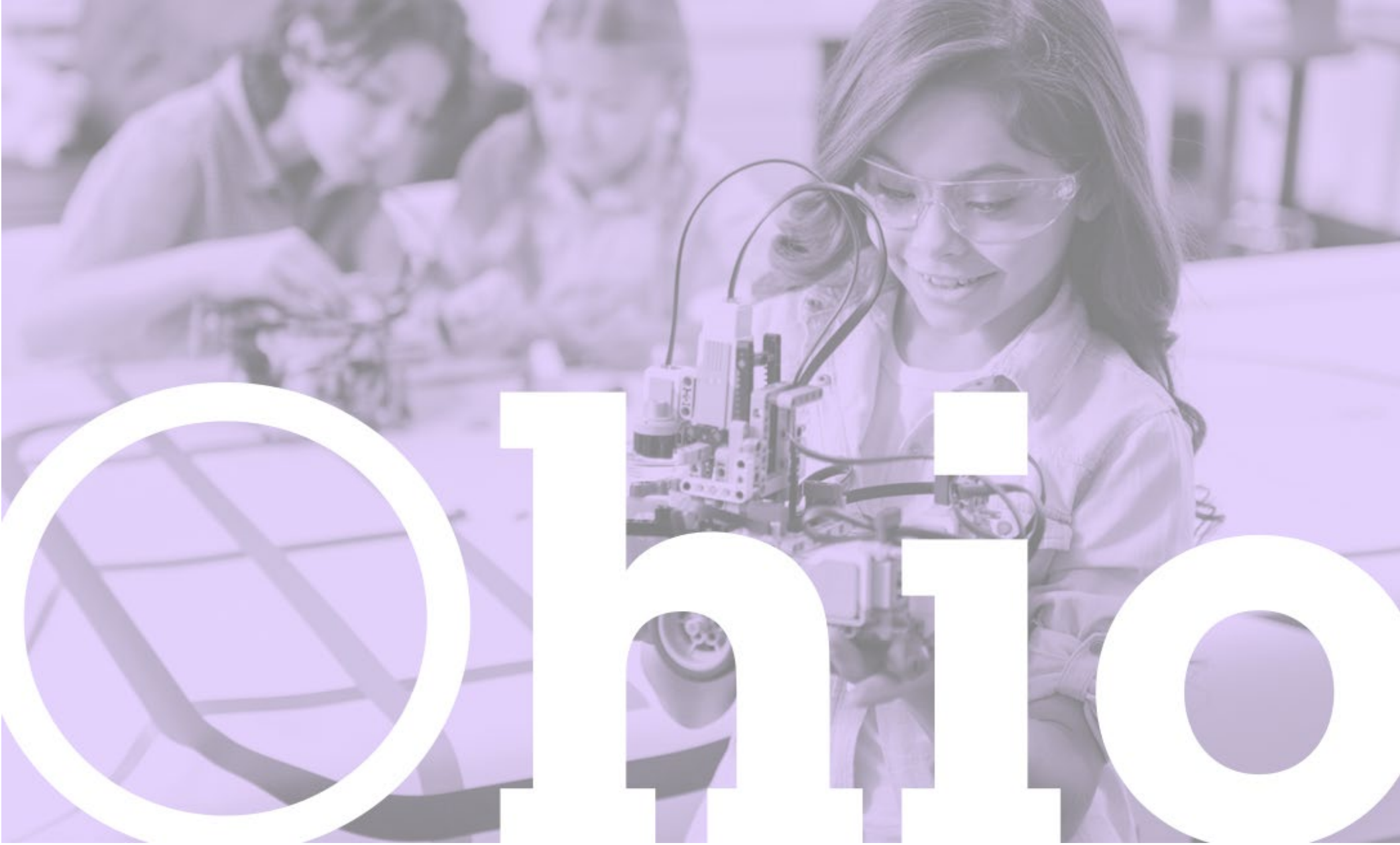


Ohio's Model Curriculum

Technology Grade K-12

ADOPTED JULY 2022

Ohio | Department of Education

TABLE OF CONTENTS

Introduction to Ohio's Model Curriculum for Technology

According to Ohio law, the State Board of Education adopted Ohio's Learning Standards for Technology for grades K-12 in April 2017. Just as Ohio Revised Code mandates the development of state standards, the law also requires the development of the model curriculum for those learning standards [ORC 3301.079 (B)(1)].

The 2022 Ohio Model Curriculum for Technology is the work of Ohio educators. Education professionals from across the state made up the advisory and working groups that drove the process to develop this model curriculum. This collaboration brought together representatives from K-12 and higher education, educational service centers, state technology agencies and associations; participants from urban, rural and suburban areas; and a range of educators, including curriculum directors, administrators, teachers, technology coordinators, technology coaches and library media specialists. Feedback on the draft of the model curriculum was received via an online survey available to the public. Comments received from the public and reviewed by the advisory group guided the working group's revisions to the draft model curriculum. This process produced a model curriculum that reflects best practices, the expertise of many Ohio educators and the varied perspectives of Ohio residents.

PURPOSE OF OHIO'S LEARNING STANDARDS AND MODEL CURRICULUM FOR TECHNOLOGY

All school districts, community schools and STEM schools may utilize the state standards and model curriculum [ORC 3301.079 (B)(3)]. Ohio's Learning Standards for Technology define what students need to know and be able to do to succeed in a technological world. The Model Curriculum for Technology is a tool that provides educators with information that clarifies the Learning Standards for Technology and sets the foundation for planning and developing instruction aligned to these standards. The model curriculum is not a full curriculum, nor is it mandated for use. It does not suggest pace, sequence or the amount of time teachers should spend on topics.

Ohio's Learning Standards and Model Curriculum for Technology:

- Balance knowledge, conceptual understanding and skill development.
- Address significant understandings that are the basis for students to make sound technological decisions.
- Focus on essential topics in technology.
- Represent a clear progression of content knowledge and skills.
- Complement and connect other content areas, offering students ways to apply the skills and content they are learning in the real world.

PHILOSOPHY OF OHIO'S LEARNING STANDARDS AND MODEL CURRICULUM FOR TECHNOLOGY

Ohio's Learning Standards and Model Curriculum for Technology incorporate the following overarching strands or categories 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
- **Society and Technology**: The interconnectedness of technology, self, society and the natural world, specifically addressing the ethical, legal, political and global impact of technology
- **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

These strands provide three lenses through which students consider and engage with technology. Together, they instill in students a broad, rich understanding of technology and its effective use and role in their world. Students develop an understanding of what it means to become a technologically literate citizen.

Each Child, Our Future

As proposed in Ohio's strategic plan for education, each child in Ohio is *challenged* to discover and learn, *prepared* to pursue a fulfilling post-high school path and *empowered* to become a resilient, lifelong learner who contributes to society.

The strategic plan also acknowledges a major education policy shift around technology. A student's ability to strategically use technology now is recognized as *foundational* and just as important as mathematics and English language arts, from which all other learning is built.

Four equal learning domains challenge, prepare and empower students for success beyond high school by giving them tools to become resilient, lifelong learners. Ohio's Learning Standards and Model Curriculum for Technology support each of these four domains:

- Foundational Knowledge and Skills
- Well-Rounded Content
- Leadership and Reasoning Skills
- Social-Emotional Learning

FOUNDATIONAL KNOWLEDGE AND SKILLS

Technology, along with literacy and numeracy, is identified in the strategic plan as a foundational skill. To be successful in Ohio's ever-changing economy, students must be equipped with foundational knowledge and skills that support lifelong learning. This includes being able to leverage technology to support and maximize learning. The Information and Communications Technology Strand emphasizes students identifying and using digital learning tools and resources to effectively accomplish defined goals and to locate, evaluate and use information to construct knowledge.

WELL-ROUNDED CONTENT

Beyond foundational skills and knowledge, students need opportunities to explore a broader range of subjects and disciplines. These explorations enable students to discover connections and relationships among ideas and concepts. All three Technology Standards Strands contain strong interdisciplinary connections with other content areas, promoting engagement with a wide array of subjects through application of technology knowledge and skills. Through these three strands, students examine topics such as those involving Science, Technology, Engineering and Mathematics (STEM). They make connections to other content areas as they investigate the ethical, legal, political and global impacts of technology. Students apply technology skills to access a range of information and use communication skills to share the knowledge they construct.

LEADERSHIP AND REASONING SKILLS

Future success will require students to exhibit both leadership and reasoning skills. These can include problem-solving, design thinking, creativity and data analytics. In the Design and Technology Strand, students begin in kindergarten to identify a problem and use an engineering design process to solve the problem. As they progress each year, their designs, products and evaluation processes become more sophisticated.

SOCIAL-EMOTIONAL LEARNING

Living as part of a community involves understanding the importance of social interaction and personal feelings. Social-emotional learning includes competencies like self-management, social awareness, collaboration, empathy, relationship skills and responsible decision-making. The Society and Technology Strand emphasizes communication and collaboration. This strand also addresses the impact technology and technology use can have on self and society. The Information and Communications Technology Strand also asks students to reflect on what it means to use technology responsibly.

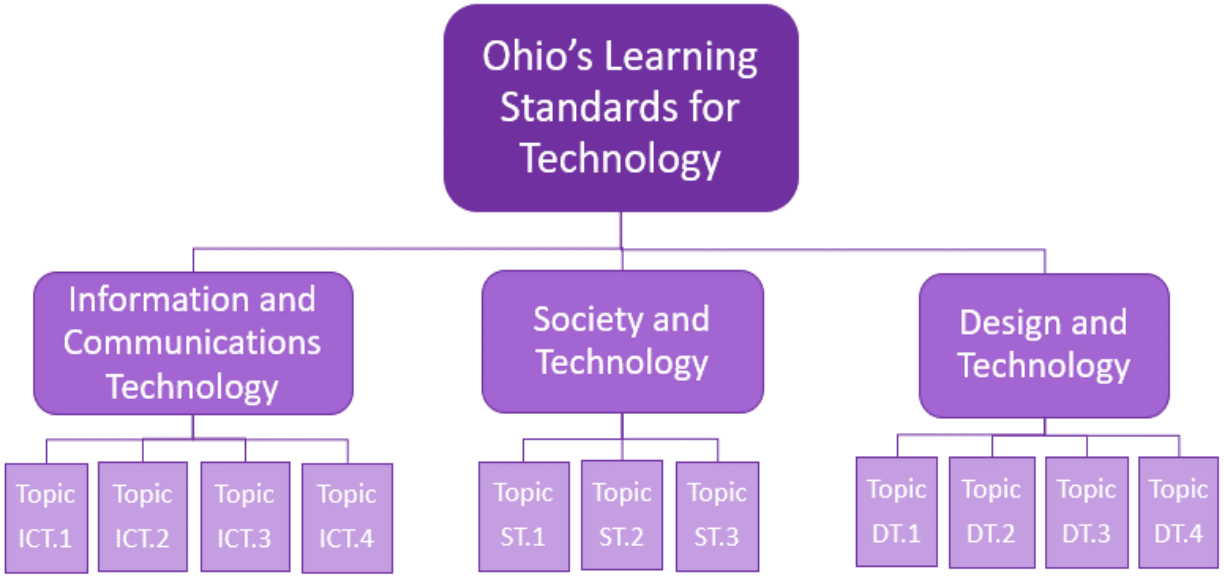
Organization of Ohio's Model Curriculum for Technology

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.

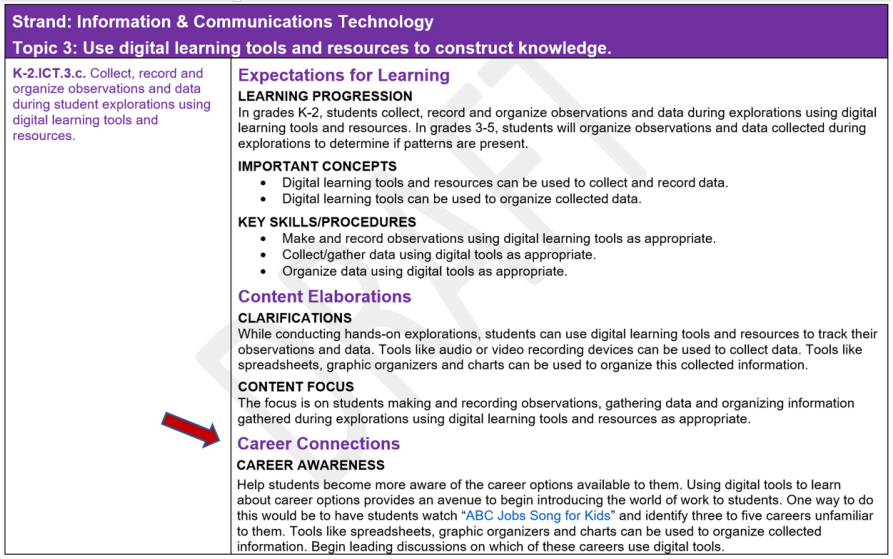
Ohio's Model Curriculum for Technology: Career Connections

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.

Kindergarten - Grade 2

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.

K-2.ICT.1.a. Develop basic skills for using digital learning tools and resources to accomplish a defined task.

Expectations for Learning

LEARNING PROGRESSION

In grades K-2, students develop basic skills for using digital learning tools and resources to accomplish a defined task. In grades 3-5, students will learn how to identify and use digital learning tools to support planning, implementing and reflecting upon a defined task.

IMPORTANT CONCEPTS

- When beginning a task, it is helpful to understand what digital learning tools are available and the functions offered within those learning tools.
- Learning the functions of different devices will help students properly care for the tools they select.

KEY SKILLS/PROCEDURES

- Demonstrate ways to take care of a digital learning tool.
- Use the functions of a learning tool to accomplish a defined task.

Content Elaborations

CLARIFICATIONS

Students use digital learning tools to accomplish tasks as they access information and communicate ideas. During use, they develop and practice basic skills. Learning tools can include computers, tablets and applications. Basic skills can include using a keyboard, a mouse (to click, click and drag, double-click and scroll) and learning software and applications. Students will be able to use these learning tools and skills to accomplish tasks such as word processing, research and problem-solving in a content area.

This also includes strategies to take care of and maintain digital tools properly.

CONTENT FOCUS

This content statement focuses on students using and learning to use digital learning tools and resources. Students gain these basic skills by participating in instructional activities to accomplish defined tasks.

Topic 1: Identify and use appropriate digital learning tools and resources to accomplish a defined task.	
K-2.ICT.1.b. With guidance, identify a goal and determine how digital learning tools can help accomplish that goal.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students with guidance identify goals and determine how digital learning tools can help them accomplish those goals. In grades 3-5, students will explain the use of selected digital learning tools and resources to support productivity and learning. **IMPORTANT CONCEPTS** • Digital learning tools can help students achieve their learning goals. **KEY SKILLS/PROCEDURES** • Identify a learning goal. • Determine how digital learning tools can help achieve the identified goal. • Select a digital tool or resource to support the goal. • Use the digital tool to make progress toward the learning goal. • Reflect on the process and effectiveness of the tool. **Content Elaborations** **CLARIFICATIONS** With guidance, students select learning goals, like decomposing numbers or increasing their vocabulary. They will select appropriate digital learning tools to help them accomplish their goals. For example, students could use embedded features in e-books like text-to-speech, dictionaries and highlighting tools to help them clarify the meaning of unknown words or phrases and increase their vocabularies. **CONTENT FOCUS** The focus is on each student identifying a goal, selecting a digital learning tool and using that tool to help them achieve the goal while explaining how it can help the student learn.

Topic 2: Use digital learning tools and resources to locate, evaluate and use information.	
K-2.ICT.2.a. Develop basic skills for locating information using digital learning tools and resources.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students develop basic skills for locating information using digital learning tools. In grades 3-5, students will expand on skills for locating information using digital tools and resources. **IMPORTANT CONCEPTS** • Information is organized in different ways digitally. • Search boxes can help locate specific information within a resource. **KEY SKILLS/PROCEDURES** • Select a resource or digital learning tool and use search strategies to find information. **Content Elaborations** **CLARIFICATIONS** Basic skills for locating information include using search boxes, selecting search terms, using navigational tools and following links. **CONTENT FOCUS** This content statement focuses on practicing effective search skills to access information.
K-2.ICT.2.b. Identify main ideas and details in information found with digital learning tools and resources.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students learn how to identify main ideas and details found with digital learning tools and resources. In grades 3-5, students will construct questions to broaden or narrow a topic. **IMPORTANT CONCEPTS** • The main idea and supporting details can be found in digital content. • Strategies used to identify main ideas and details for digital content may be different from those used for print content. **KEY SKILLS/PROCEDURES** • Identify the main idea and details found in digital resources. **Content Elaborations** **CLARIFICATIONS** Recognizing main ideas and details can be done using print and digital learning tools and resources. Some tools and features that may be available and useful are text-to-speech, translation, embedded word dictionary and highlighting. Some tasks that could support students' identification of main ideas and details

Topic 2: Use digital learning tools and resources to locate, evaluate and use information.	
	found in digital content are reading or research and modeling how to identify main ideas and details found with digital learning tools or resources. **CONTENT FOCUS** The focus is on students identifying main ideas and details in the information they find and use. Some strategies will be similar to those used for print-based materials, but digital materials require additional strategies.

Topic 3: Use digital learning tools and resources to construct knowledge.	
K-2.ICT.3.a. Develop basic skills for gathering and organizing information from multiple digital learning tools and resources to build knowledge.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students learn basic skills for gathering and organizing information from multiple digital learning tools and resources to build knowledge. In grades 3-5, students will gather, organize and summarize information from multiple digital learning tools and resources to build knowledge. **IMPORTANT CONCEPTS** • Digital learning tools and resources can provide content to develop a basic understanding of a concept. • Digital tools and resources can provide ways to help organize information. **KEY SKILLS/PROCEDURES** • Use various digital learning tools and resources to locate, collect and organize information. **Content Elaborations** **CLARIFICATIONS** Digital learning tools can be used to find information on a specific topic. Examples of these resources include databases, websites and electronic reference tools. This collected information then can be organized using digital learning tools like bulleted lists, slide presentations, mind maps and storyboards. **CONTENT FOCUS** This content statement focuses on providing experience with a variety of digital learning tools to identify correctly, collect and organize information.
K-2.ICT.3.b. Use visuals found in digital learning tools and resources to clarify and add to knowledge.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students use the visuals found in digital learning tools and resources to add knowledge. In grades 3-5, students will interpret visual information in digital learning tools and resources to add to knowledge. **IMPORTANT CONCEPTS** • Visual representations within a resource add deeper meaning and provide additional details to written text. **KEY SKILLS/PROCEDURES** • Use images or media from digital resources to expand knowledge of a topic.

Topic 3: Use digital learning tools and resources to construct knowledge.	
	Content Elaborations **CLARIFICATIONS** Digital learning tools have visual components that can be used to learn more about a topic. Pictures, graphs and data charts in digital tools and resources can help students gain a better understanding of information and add to their knowledge bases. **CONTENT FOCUS** The focus is on using visual representations from the gathered resources to add depth and clarity to the research topic.
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.

Topic 3: Use digital learning tools and resources to construct knowledge.	
	Career Connections **CAREER AWARENESS** Help students become more aware of the career options available to them. Students can use digital tools to learn about career options as an avenue to begin introducing the world of work to students. One way to do this would be to have students watch a video such as *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.
K-2.ICT.3.d. With guidance, create artifacts using digital learning tools and resources to demonstrate knowledge.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students create artifacts with guidance using digital learning tools and resources. In grades 3-5, students will create artifacts independently using digital learning tools and resources. **IMPORTANT CONCEPTS** • Digital learning tools can be used to create artifacts to demonstrate knowledge and understanding. • Artifacts are products that show competency and understanding of the subject matter. **KEY SKILLS/PROCEDURES** • With guidance, use digital learning tools to create a product or artifact that shows knowledge of a topic or mastery of a skill. **Content Elaborations** **CLARIFICATIONS** Digital learning tools can be used to create artifacts that are appropriate to use to share knowledge of content. Such digital tools include word processing, photography, slideshows and story creator software. **CONTENT FOCUS** The focus is on creating artifacts that align with content using digital learning tools and resources.

Topic 4: Use digital learning tools and resources to communicate and disseminate information to multiple audiences.	
K-2.ICT.4.a. With guidance, discuss and identify communication needs considering the task, situation and information to be shared.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students discuss and identify with guidance communication needs considering the task, situation and information to be shared. In grades 3-5, students will discuss and identify with guidance communication needs for a task considering the audience and content. **IMPORTANT CONCEPTS** • Creating a plan helps guide the next steps. • Identifying the needs, task and situation are important to consider when deciding what information to share. **KEY SKILLS/PROCEDURES** • Choose information to share in a specific situation. **Content Elaborations** **CLARIFICATIONS** People communicate ideas and information in a variety of ways. It is important to determine what ideas they want to share based on their identified goals or situations. This content statement is one of three content statements, K-2.ICT.4.a.-4.c., that together guide students in planning, producing and publishing an artifact. **CONTENT FOCUS** The focus of this content statement is on students deciding what information to communicate based on the task, needs and goals.
K-2.ICT.4.b. With guidance, use digital learning tools to add audio and/or visual media to clarify information.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students use digital learning tools with guidance to add audio and/or visual media to clarify information. In grades 3-5, students will select with guidance media formats appropriate to content and audience. **IMPORTANT CONCEPTS** • Using audio and video can enhance understanding of a given topic. **KEY SKILLS/PROCEDURES** • Include a variety of digital media, such as audio and video, to reinforce the presented information.

Topic 4: Use digital learning tools and resources to communicate and disseminate information to multiple audiences.	
	Content Elaborations **CLARIFICATIONS** A variety of digital resources can reinforce the information being presented. Depending on the publication's focus, including digital resources such as audio and video can reinforce what was learned. Examples can include incorporating music, spoken word or visual representations into a product. This content statement is one of three content statements, K-2.ICT.4.a.-4.c., that together guide students in planning, producing and publishing an artifact. **CONTENT FOCUS** The focus is on students determining what digital learning tools to use and what audio and/or visual media to add to clarify information.
K-2.ICT.4.c. With guidance, select appropriate digital learning tools and resources to produce and publish information.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students select digital learning tools and resources to publish information with guidance. In grades 3-5, students will select digital learning tools and resources to produce and publish information for a target audience. **IMPORTANT CONCEPTS** • Choosing an appropriate digital learning tool to convey information is important. **KEY SKILLS/PROCEDURES** • Select digital learning tools to convey information to an audience. • Plan and outline an appropriate way to present the published information. **Content Elaborations** **CLARIFICATIONS** With assistance from teachers, students will choose an appropriate media format to display the information presented. Digital learning tools like word documents, social media, poster creation software and cameras can be used to share information. This content statement is one of three content statements, K-2.ICT.4.a.-4.c., that together guide students in planning, producing and publishing an artifact.

Topic 4: Use digital learning tools and resources to communicate and disseminate information to multiple audiences.	
	CONTENT FOCUS The focus is on students selecting a digital learning tool and producing and publishing their work with guidance as needed.

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.

K-2.ST.1.a. Demonstrate appropriate and identify inappropriate uses of technology required to be a responsible user.

Expectations for Learning

LEARNING PROGRESSION

In grades K-2, students demonstrate appropriate uses of technology and identify inappropriate uses of technology. In grades 3-5, students will demonstrate appropriate uses of technology and explain the importance of responsible and ethical technology use.

IMPORTANT CONCEPTS

- There is an appropriate use of technology, and its advancement is based on its appropriate use and the needs and wants of its users.
- The inappropriate use of technology can diminish its effectiveness and purpose.

KEY SKILLS/PROCEDURES

- Demonstrate the appropriate use of different types of technology.
- Recognize the inappropriate uses of technology and associated consequences.

Content Elaborations

CLARIFICATIONS

Based on technology encompassing knowledge, artifacts, infrastructure, tools, materials, processes and products modified from the natural environment, students appropriately utilize technology in a way that demonstrates responsibility while identifying irresponsible uses. Examples should move beyond digital devices with screens (such as tablets, phones and computers) to include other types of technology.

For example, a stop sign is an example of technology because it is infrastructure. The appropriate use of a stop sign is to regulate and control traffic. At the same time, an inappropriate use could be defacing the stop sign, which would hinder traffic regulation.

CONTENT FOCUS

This content statement focuses on students demonstrating appropriate uses of all types of technology.

Topic 1: Demonstrate an understanding of technology's impact on the advancement of humanity – economically, environmentally and ethically.	
K-2.ST.1.b. Identify positive and negative impacts one's use of technology can have on oneself and one's family.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students identify positive and negative impacts their use of technology can have on themselves and their families. In grades 3-5, students will identify positive and negative impacts their use of technology can have on their communities. **IMPORTANT CONCEPTS** • The use of technology can positively and negatively impact the family and self. **KEY SKILLS/PROCEDURES** • List ways one and one's family use technology. • Determine positive and negative impacts of technology use on oneself and one's family. **Content Elaborations** **CLARIFICATIONS** Based on technology encompassing knowledge, artifacts, infrastructure, tools, materials, processes or products modified from the natural environment, students understand ways that technology can positively or negatively affect the needs and wants of their families. Students can discuss their use of technology and its impact on their families economically, environmentally and ethically. For example, a stove can make cooking dinner easier and faster. However, if it were left on and unattended, it could use too much electricity or cause a fire. Tablets, phones or other devices provide entertainment and access to information. Yet too much time spent interacting with a device on one's own can result in less time for family activities. **CONTENT FOCUS** The focus is on students' self-evaluation of their use of technology and its impacts on their lives.

Topic 2: Analyze the impact of communication and collaboration in both digital and physical environments.	
K-2.ST.2.a. Communicate and collaborate using several digital methods.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students communicate and collaborate using several digital methods. In grades 3-5, students will create plans and select collaboration and/or communication tools to complete a given task. **IMPORTANT CONCEPTS** • Communication and collaboration skills including, but not limited to, speaking and listening are important in everyday life to make connections and contributions. **KEY SKILLS/PROCEDURES** • Communicate and collaborate using various digital tools within digital and physical spaces. **Content Elaborations** **CLARIFICATIONS** Communicate in a variety of ways and use digital tools for collaborative conversations. Teachers may provide multiple ways for students to communicate. Communication and collaboration can occur within a physical or digital environment. For example, students can use digital tools to engage in teamwork, participate in online discussions (such as those about an image or artwork), develop a blog post, talk with experts through video chats and use audio recordings to share their thinking. **CONTENT FOCUS** This content statement focuses on effective communication and collaboration in person or with digital tools in individual or peer group settings. **Career Connections** **CAREER AWARENESS** With guidance, students work together to determine a professional in the community to invite to a video chat the class is hosting. The class's career interests can be used to determine which professionals to video chat. Students use digital tools to collaborate on their selections and are prepared to ask the professional questions in a variety of ways during the video meeting. Students determine together their questions for the professional ahead of time using digital tools. Teachers can identify ways for students to interact with the professional during the video meeting (for example, using polling software and meeting functions such as the chat and hand raising).

Topic 2: Analyze the impact of communication and collaboration in both digital and physical environments.	
K-2.ST.2.b. Identify positive and negative ways of collaborating in digital and physical environments.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students identify positive and negative ways of collaborating in digital and physical environments. In grades 3-5, students will exercise digital etiquette when communicating and collaborating. **IMPORTANT CONCEPTS** • Communicating and collaborating within a digital space can impact a physical environment. • Communicating and collaborating within a physical environment can impact a digital space. • Types of communication and collaboration can change depending on the digital learning tool being used. **KEY SKILLS/PROCEDURES** • Identify ways to communicate and collaborate digitally. • Identify ways to communicate and collaborate in physical environments. • Identify ways that interactions can be positive or negative. **Content Elaborations** **CLARIFICATIONS** When collaborating and communicating within different digital and physical spaces, there are positive and negative ways of interacting. Examples of digital spaces include texting, video games, online conferencing, video chats, learning platforms, social media, image sharing, educational apps with sharing features and creation environments. Students can have discussions to identify these digital spaces and connect how they interact in digital spaces with how they interact in the physical environment. **CONTENT FOCUS** Students recognize there are positive and negative impacts of collaborating and communicating within digital and physical environments.

Topic 2: Analyze the impact of communication and collaboration in both digital and physical environments.	
K-2.ST.2.c. Investigate how technology does (or does not) impact the way(s) one's family communicates.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students investigate how technology impacts the ways families communicate. In grades 3-5, students will identify the positive and negative impacts the use of technology can have on relationships, communities and themselves. **IMPORTANT CONCEPTS** • There are different types of technology used to communicate. • Types of technology used to communicate can impact the family in various ways. **KEY SKILLS/PROCEDURES** • Investigate different types of technology used to communicate. • Investigate how using different technologies to communicate impact the family. **Content Elaborations** **CLARIFICATIONS** Explore and explain different types of technology (knowledge, artifacts, infrastructure, tools, materials, processes and products) used to communicate. Examples can include a family calendar with a practice time so pick up is on time, a note in a lunch box that would make one feel good, a chore chart to help organize daily household tasks, a behavior chart to track good choices to earn a reward and a video chat to communicate with others. **CONTENT FOCUS** The focus is on the impact technology has on communication within the family.

Topic 3: Explain how technology, society and the individual impact one another.	
K-2.ST.3.a. State the advantages and disadvantages of technology in one's life.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students state the advantages and disadvantages of technology in their lives. In grades 3-5, students will describe the advantages and disadvantages of using technology to understand the relationship between technology, society and the individual. **IMPORTANT CONCEPTS** • There are advantages and disadvantages to every piece of technology. **KEY SKILLS/PROCEDURES** • Communicate the benefits and drawbacks to different forms of technology. **Content Elaborations** **CLARIFICATIONS** Explain benefits or drawbacks in the ways students use technology (knowledge, artifacts, infrastructure, tools, materials, processes and products) day-to-day. For example, students could discuss watching television and the advantages (such as entertainment or education) and disadvantages (such as less time to talk to family or play outside). **CONTENT FOCUS** This content statement focuses on students examining their current usage of technology and its impacts on them in positive or negative ways.
K-2.ST.3.b. Identify examples of how technology innovations/ inventions can have multiple applications.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students identify examples of how technology innovations/inventions can have multiple applications. In grades 3-5, students will demonstrate how technology innovations/inventions can have multiple applications. **IMPORTANT CONCEPTS** • Technological innovations and inventions have set purposes but can be used in multiple ways. **KEY SKILLS/PROCEDURES** • Communicate multiple ways a technology innovation or invention can be used. • Give an example of how technology was created to address a specific want or need. • Give an example of how technology can meet other wants or needs beyond its original application.

Topic 3: Explain how technology, society and the individual impact one another.	
	Content Elaborations **CLARIFICATIONS** Technology is something someone made to meet a need or want. Examine a technology innovation or invention and determine different uses for that technology. Critically and creatively think about different ways and purposes it can be used. For example, students use the internet to do research, but they also can use it to play games. Adults can use the internet to both shop and find jobs. Invention is the process of turning ideas and imagination into devices and systems. Innovation is the process of modifying an existing system or system element(s) to improve it. These are ways to develop ideas for different technologies. These two definitions and the distinction between the processes are not introduced until grades 6-8 but are mentioned here to encourage discussion. **CONTENT FOCUS** The focus is on identifying the different ways technology innovations and inventions can be used. There are multiple ways to use technology in addition to its original design.
K-2.ST.3.c. Identify how the use of technology affects self and others in various ways.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students identify how the use of technology impacts themselves and others in various ways. In grades 3-5, students will identify and discuss how the use of technology affects themselves and others in various ways. **IMPORTANT CONCEPTS** • There are direct and indirect effects of using a technology on users and non-users. **KEY SKILLS/PROCEDURES** • Describe how using a technology impacts the technology user. • Describe how the use of a technology impacts others. **Content Elaborations** **CLARIFICATIONS** Technology (knowledge, artifacts, infrastructure, tools, materials, processes and products) impacts the user and non-user directly and indirectly.

Topic 3: Explain how technology, society and the individual impact one another.	
	An example could be packing a lunch using an insulated lunch box. It impacts the lunch line, temperature of the food and environment depending on the disposal of the materials used to pack the lunch. **CONTENT FOCUS** The focus is on how the use of a technology affects the user and non-user.
K-2.ST.3.d. Define and discuss digital identity and digital footprints.	## Expectations for Learning **LEARNING PROGRESSION** In grades K-2, students define and discuss digital identities and digital footprints. In grades 3-5, students will identify components of their digital identities and digital footprints. **IMPORTANT CONCEPTS** • Determine appropriate information that can be shared publicly, which becomes part of one's digital identity. • A digital footprint (also called a digital tattoo) is created by personal information provided by the user or others that is published publicly. **KEY SKILLS/PROCEDURES** • Explain which types of personal information are acceptable to share publicly. • Explain how a digital footprint is created and that it is permanent. ## Content Elaborations **CLARIFICATIONS** Digital identity is affected by the information that is shared about someone online. This information could be shared by an individual or about an individual. For students in this grade band, their parents may be contributing more to their digital footprints or tattoos than the students are at this time. Only appropriate information should be shared as part of their digital footprints. Students at this age need to learn what information should be kept private and what information can be safely shared. Examples of information to keep private could include students' lunch numbers, phone numbers, home addresses and practice times or locations. Some students (such as students in foster care or students with parents in divorce or custody situations) may need to be more careful about sharing information than others. **CONTENT FOCUS** The focus is on students examining what information is private and should not be shared freely with others. Information shared publicly in a digital format is shared permanently and part of one's digital footprint.

Topic 3: Explain how technology, society and the individual impact one another.	
K-2.ST.3.e. Provide examples of how rules for respecting others' belongings apply to digital content and information.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students develop the idea that people not only own things but also ideas and content. In grades 3-5, students will discuss the rules and laws for digital content and information. **IMPORTANT CONCEPTS** • Individuals create digital content and information. • Digital content must be respected, and credit must be given if used. **KEY SKILLS/PROCEDURES** • Explain how to give credit and respect digital content and information. **Content Elaborations** **CLARIFICATIONS** Ideas and digital creations are personal property and cannot be used by others without permission. People need to respect and give credit to the creator of an idea or text. Examples of digital content and information can include stories, pictures, songs and videos. For example, students understand that a backpack or jacket belongs to another student. If someone used or took the jacket without permission, feelings could be hurt and rules might be broken. As they do with physical property (such as a jacket or backpack), students also need to respect digital and intellectual property (such as pictures, ideas and videos) and follow those rules. **CONTENT FOCUS** The focus is on the idea that people are owners of digital content, similar to a physical document or object.

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.

K-2.DT.1.a. Identify and discuss differences between the human-designed world and the natural world.

Expectations for Learning

LEARNING PROGRESSION

In grades K-2, students identify and distinguish between the natural and human-designed world and describe how technology can be used to meet needs and wants. In grades 3-5, students will determine how human-designed items extend human capabilities to meet needs and wants.

IMPORTANT CONCEPTS

- Technology within the human-created world is created to meet specific purposes.
- Objects in the natural world exist without human interference.

KEY SKILLS/PROCEDURES

- Identify objects in the natural world and objects humans created to meet specific purposes.
- Compare and contrast objects from the natural world with objects created by humans to meet specific purposes.

Content Elaborations

CLARIFICATIONS

As students observe their environments, they notice things in the natural world (such as rivers, sticks, trees, plants and rocks) and things people create for specific purposes (such as pencil sharpeners, pens, tablets, buildings and highways).

For example, students could look at naturally occurring shelters (such as caves, anthills and tunnels) in comparison to human-made structures (such as houses, tents and yurts).

Items in the natural world often are used as raw materials when people build and create things. People also make tools to help them get jobs done. These tools and materials are called resources and tie into K-2.DT.1.d.

CONTENT FOCUS

This content statement focuses on students identifying what is human-designed and what is of the natural world. This could include identifying items around the room and outside the school.

Topic 1: Define and describe technology, including its core concepts of systems, resources, requirements, processes, controls, optimization and trade-offs.	
K-2.DT.1.b. Describe technology as something someone made to meet a want or need.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students describe how technology meets a need or want. In grades 3-5, students will demonstrate how applying human knowledge using tools and machines can extend human capabilities to meet needs and wants. **IMPORTANT CONCEPTS** • Technology is created to meet a need. • Technology is created to meet a want. **KEY SKILLS/PROCEDURES** • Define technology as something someone made to meet a want or a need. • Describe how technology satisfies a specific want or need. **Content Elaborations** **CLARIFICATIONS** Technology is created to solve human problems to meet a need or a want. Technology includes knowledge, artifacts, infrastructure, tools, materials, processes and products. For example, shoes can satisfy both a need and a want. People need shoes to protect their feet from cold temperatures and sharp objects. People may want a specific kind of shoe because of its style, color, pattern or material. **CONTENT FOCUS** The focus is on describing ways various technologies meet wants or needs. For example, students could identify a want or a need and then discuss how technology has helped meet the want or need.

Topic 1: Define and describe technology, including its core concepts of systems, resources, requirements, processes, controls, optimization and trade-offs.	
K-2.DT.1.c. Explain that systems have parts or components that work together to accomplish a goal.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students explain that systems have parts or components that work together to accomplish a goal. In grades 3-5, students will explain how controls in a system can use information to cause the system to change. **IMPORTANT CONCEPTS** • A system works best when its parts work together to accomplish a goal. • A system is incomplete when the parts do not work together to accomplish the goal. A missing, misused or broken part will lead to an incomplete system. (For example, a broken cord will not charge a device and missing cafeteria trays will impact the lunch line.) **KEY SKILLS/PROCEDURES** • Explain how components of a system work together to make the system complete. • Explain what happens when components of a system are not working together and the system is incomplete. **Content Elaborations** **CLARIFICATIONS** Various systems throughout the classroom and building can be identified and explored. This should include how parts or components of systems work together to complete a task, as well as what happens to the system when it is not working (that is, incomplete). For example, a printer and a computer work together as a system to produce a printed page. If the system is not working and the printer does not print, a part of the system could be the cause of the incomplete task. Other examples of systems within a classroom or school could include a fire drill or purchasing lunch in the cafeteria. **CONTENT FOCUS** The focus is to identify and explore how parts or components of a system work together to accomplish a goal and explain how parts play a role in working and non-working systems.

Topic 1: Define and describe technology, including its core concepts of systems, resources, requirements, processes, controls, optimization and trade-offs.	
K-2.DT.1.d. Give examples of how resources such as tools and materials are things that help people get a job done.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students give examples of how resources such as tools and materials are things that help people get jobs done. In grades 3-5, students will demonstrate how applying human knowledge using tools and machines extends human capabilities to meet needs and wants. **IMPORTANT CONCEPTS** • Tools help people complete jobs. • Materials are modified or combined to create products. • Resources include people, tools and materials. **KEY SKILLS/PROCEDURES** • Describe how tools, as a resource, help people complete their jobs. • Describe how materials are used as resources. • Identify resources that help people get their jobs done. **Content Elaborations** **CLARIFICATIONS** Help students connect everyday resources they use at home and school (for example, a comb, broom, water, paper, ruler or pencil) and how the items are used to achieve given tasks. Various resources help people in the community (such as police officers, construction workers, firefighters, teachers or students) get their jobs done. For example, students can use tools like pencils, paper and computers to communicate with people. When people build houses, they use materials like gravel, bricks and wood. People use tools like trucks and cranes to move building tools and materials from one place to another. Materials like stone can be found in the natural world and then modified to be used in buildings, such as granite counters, marble floors and limestone blocks, or combined with other materials to create a product. For example, gravel, sand and cement are combined to make concrete. This concept can tie into K-2.DT.1.a. by relating tools and materials to the differences between the natural and human-designed world. **CONTENT FOCUS** The focus is on explaining how people use different resources to complete jobs. Tools, materials and people are examples of resources.

Topic 2: Identify a problem and use an engineering design process to solve the problem.	
K-2.DT.2.a. Observe and describe details of an object's design.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students observe and describe the details of an object's design. In grades 3-5, students will critique the needs and opportunities for designing solutions. **IMPORTANT CONCEPTS** • The design of an object corresponds with its purpose and can impact how it is used. **KEY SKILLS/PROCEDURES** • Observe the characteristics of an object's design. • Describe the parts of an object's design and how they function to accomplish a goal. **Content Elaborations** **CLARIFICATIONS** Discussing familiar objects, like a chain or pair of glasses, can help connect student observations to the function, purpose and effectiveness of an object's design. Students can observe and describe the details noticed on objects found in the classroom, at home and in the community and on objects students create themselves. For example, when observing the design of a backpack, students could notice the details of a zipper. They could then discuss and describe the function of the zipper on the backpack. Additionally, the adjustable shoulder straps, storage compartments, weight, durability and features added to enhance aesthetics could be observed and described. **CONTENT FOCUS** This content statement focuses on observing and describing an object's design and how the details or parts of the design accomplish a goal or complete a function.
K-2.DT.2.b. Demonstrate the ability to follow a simple design process: identify a problem, think about ways to solve the problem, develop possible solutions and share and evaluate solutions with others.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students learn what a design process is and apply a simplified design process to solve a problem. In grades 3-5, students will plan and implement a design process to solve a problem, adding steps to test and redesign their solutions. **IMPORTANT CONCEPTS** • A design process is continuous and helps organize thinking.

Topic 2: Identify a problem and use an engineering design process to solve the problem.	
	KEY SKILLS/PROCEDURES • Follow a design process to create a solution to a problem. ## Content Elaborations **CLARIFICATIONS** A design process is a tool to help students organize their thinking. It is a continuous process that is cyclical by nature. Students can use a simple design process to solve a problem. Beginning with a question can encourage students to consider their schools and communities and help them identify relevant problems to solve. Students take the lead in thinking about many ways to solve the problems they identified, and then they develop, create and/or build possible solutions to the problems. Audiences for the evaluation of the possible solutions to the student-identified problems will depend on the problems themselves. Students may be sharing and evaluating their solutions with peers from their classroom, other schools in their districts or other districts, parents or other members in their communities. Initially, this could be a shared or guided process, eventually evolving into a small group or independent experience. For example, after identifying a problem that mice are in a school, students could follow a design process to create innovative solutions to trapping the mice in nonlethal ways. **CONTENT FOCUS** The focus is on using a design process and building a simple design to solve an identified problem. ## Career Connections **CAREER AWARENESS** Once students have experience brainstorming solutions to problems using the design process, conduct a classroom discussion on the various general industries and occupations involved in the creation and implementation of the solution(s). For example, once students have created innovative solutions to trapping the mice in nonlethal ways, discuss what industries and occupations would be involved in making the solution a reality. Who designs the traps and makes the traps? Who delivers the traps? Who could take the mice once they are trapped?

Topic 2: Identify a problem and use an engineering design process to solve the problem.	
K-2.DT.2.c. Explain that a design process is a plan to find solutions to problems.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students learn what a design process is, apply a simplified design process to solve a problem and learn that a design process is a plan to find solutions to problems. In grades 3-5, students will plan and implement a design process to solve a problem, adding steps to test and redesign their solutions. **IMPORTANT CONCEPTS** • A design process is continuous and can produce multiple solutions. • A design process can be used as a plan to find solutions to problems. **KEY SKILLS/PROCEDURES** • Describe a design process as a plan to solve a problem. • List steps in a design process and explain how the steps help to find solutions. **Content Elaborations** **CLARIFICATIONS** Describing a design process helps develop an understanding of how problems are solved. Students can describe how a design process can be used as a plan to solve a problem by revisiting design projects they have completed. As they return to the processes they used, they can determine how the components of their processes formed plans that helped them solve their problems. In content statement K-2.DT.2.b., a simple design process includes the following steps: identify a problem, think about ways to solve the problem, develop possible solutions and, with others, share and evaluate solutions. Help students see how each of the steps together form a plan that moves them toward solving problems. Students can be encouraged to determine how seeking multiple solutions or improving their designs based on feedback could strengthen their solutions. Additional concepts that could be addressed include how to provide valuable feedback and how to evaluate feedback from others. **CONTENT FOCUS** The focus is on how a design process, one that is cyclical and continuous, can be used as a plan to generate multiple solutions to solve a problem.

Topic 2: Identify a problem and use an engineering design process to solve the problem.	
K-2.DT.2.d. Demonstrate that there are many possible solutions to a design problem.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students learn what a design process is and apply a simplified design process to solve a problem. In grades 3-5, students will plan and implement a design process to solve a problem and communicate their ideas and decisions. **IMPORTANT CONCEPTS** • There are multiple ways to solve a problem. • Feedback is important when improving designs. **KEY SKILLS/PROCEDURES** • Identify multiple solutions to a given problem. • Communicate feedback to peers to help improve designs. **Content Elaborations** **CLARIFICATIONS** There are many possible solutions to a design problem. Multiple solutions to a problem should be identified and developed. For instance, developing a humane mouse trap, described in the Clarification for K-2.DT.2.b., could have many design solutions. Evaluation of the solutions can be offered after developing evaluation criteria. Additional concepts that could be addressed include how to provide valuable feedback and how to evaluate feedback from others. Students can be encouraged to make improvements to their designs based on feedback. **CONTENT FOCUS** The focus is on creating many different solutions to the same problem.
K-2.DT.2.e. Communicate design plans and solutions using drawings and descriptive language.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students learn what a design process is and communicate design plans and solutions as they apply a simplified design process to solve a problem. In grades 3-5, students will plan and implement a design process to solve a problem and communicate their ideas and decisions. **IMPORTANT CONCEPTS** • Design plans and solutions can be communicated through drawings and descriptive language. **KEY SKILLS/PROCEDURES** • Share design plans that include drawings and descriptive language.

Topic 2: Identify a problem and use an engineering design process to solve the problem.	
	Content Elaborations **CLARIFICATIONS** Communicating plans and solutions is an important step in a design plan. Students should be able to share their plans and solutions in writing or verbally using descriptive language and drawings that show their designs and solutions. Students could include sketches, words, images, end products or models, symbols, text, spreadsheets, tables or slideshows. Recording audio may be helpful as students describe plans using descriptive language. Using digital tools may aid students in creating or capturing drawings (for example, taking digital pictures of paper drawings or creating a design plan in 2D or 3D). **CONTENT FOCUS** The focus is on students communicating their plans and solutions.

Topic 3: Demonstrate that solutions to complex problems require collaboration, interdisciplinary understanding and systems thinking.	
K-2.DT.3.a. Describe how different technologies are used in various fields.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students describe how different technologies are used in various fields. In grades 3-5, students will make connections between technology and other fields of study and how different disciplines combine their skills in the design and production of a product. **IMPORTANT CONCEPTS** • Varying technologies are used in occupations to help complete or perform a job. **KEY SKILLS/PROCEDURES** • List technologies for selected occupations. **Content Elaborations** **CLARIFICATIONS** People in the community (such as police, firefighters, teachers and students) use technology in their occupations. Students can identify multiple fields of employment and the technologies used by those roles. **CONTENT FOCUS** This content statement focuses on students describing how different occupations and different industries use different technologies.
K-2.DT.3.b. Work as a team to identify possible problems to solve and their potential technological solutions.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students work as a team to identify problems to solve and their solutions. In grades 3-5, students will design products and explain how knowledge and skills from different disciplines were combined in the design and production. **IMPORTANT CONCEPTS** • Working collaboratively allows for identifying and solving technical problems. • Working collaboratively generates more ideas and solutions for tasks and problems. **KEY SKILLS/PROCEDURES** • Collaboratively work in groups to identify problems and potential solutions.

Topic 3: Demonstrate that solutions to complex problems require collaboration, interdisciplinary understanding and systems thinking.	
	Content Elaborations **CLARIFICATIONS** A team approach to solving technical problems is more effective than an individual approach. Students can discuss what characteristics exist within a well-functioning team. Students identify possible problems and work in collaborative teams using a design process to develop possible solutions. Groups can include whole group, small collaborative groups or pairs or triads. **CONTENT FOCUS** The focus is on students practicing working collaboratively to solve a problem.

Topic 4: Evaluate designs using functional, aesthetic and creative elements.	
K-2.DT.4.a. Identify and discuss the use of aesthetics in everyday objects.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students identify and discuss the use of aesthetics in everyday objects. In grades 3-5, students will apply criteria developed with guidance to evaluate new or improved products for functional, aesthetic and creative elements. **IMPORTANT CONCEPTS** • The design of objects includes properties that help it function. • Aesthetic properties do not help an object function. • Aesthetic elements, like how an object looks, feels or sounds, increase the appeal of an object. **KEY SKILLS/PROCEDURES** • Identify the aesthetic design properties of an object. • Describe how the aesthetic properties of an object may or may not play a role in the object's function. **Content Elaborations** **CLARIFICATIONS** The aesthetic element considers the product's appeal, including visual, audio and tactile. An object's color, size or material(s) may or may not play a role in the purpose of the object's function. Discuss everyday objects with students, identify the use of aesthetics and the objects' uses in relation to their appearances. During the discussion, students may question why an object looks a certain way and if parts of the appearance have a functional purpose or are for aesthetic purposes only. **CONTENT FOCUS** This content statement focuses on students engaging in discussions about the appearance and aesthetic properties of everyday objects.
K-2.DT.4.b. Identify and discuss functional aspects of everyday objects.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students identify and discuss functional aspects of everyday objects. In grades 3-5, students will apply criteria developed with guidance to evaluate new or improved products for functional, aesthetic and creative elements. **IMPORTANT CONCEPTS** • Everyday objects have functions and purposes.

Topic 4: Evaluate designs using functional, aesthetic and creative elements.	
	KEY SKILLS/PROCEDURES • Identify the functions and uses of everyday items. **Content Elaborations** **CLARIFICATIONS** The functional element considers if the product fulfills the intended purpose. Discuss everyday objects with students and identify the intended purposes of the objects. Since students will be looking at following the design process and creating their own products and solutions to given or identified problems, examining the function of an item as it relates to its design is important to give them a reference point. **CONTENT FOCUS** The focus is on looking at objects that students interact with every day and discovering how an object's design helps it function.
K-2.DT.4.c. Identify and discuss examples of creativity found in everyday objects.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students identify and discuss examples of creativity found in everyday objects. In grades 3-5, students will apply criteria developed with guidance to evaluate new or improved products for functional, aesthetic and creative elements. **IMPORTANT CONCEPTS** • Everyday objects can be designed creatively. **KEY SKILLS/PROCEDURES** • Give examples of creativity in the design and use of everyday items. **Content Elaborations** **CLARIFICATIONS** The creative element considers the uniqueness of how the product fulfills its intended purpose. Discuss everyday objects with students and identify the intended purposes of objects. Then, students can discuss if each object met its purpose in a unique way. An example can be found in classroom organization and storage. Some teachers may use plastic cups or recycled food containers to store markers and crayons. These items might be designed for other purposes, but teachers may find they make excellent storage containers too.

<table>
<tr><th colspan="2">Topic 4: Evaluate designs using functional, aesthetic and creative elements.</th></tr>
<tr><td></td><td>CONTENT FOCUS
The focus is on students using common, everyday objects in creative ways and identifying how designers used creative ideas in creating these objects.</td></tr>
<tr><td>K-2.DT.4.d. Discuss and give examples of how changes in design can be used to strengthen or improve a product.</td><td><h2>Expectations for Learning</h2>LEARNING PROGRESSION
In grades K-2, students discuss and give examples of how changes in design can be used to strengthen or improve a product. In grades 3-5, students will examine a familiar product or process and suggest improvements to its design.
IMPORTANT CONCEPTS
Changes in the design of a product can strengthen or improve it.
KEY SKILLS/PROCEDURES
Provide constructive feedback to help improve or strengthen a design.
Give examples of ways to improve or strengthen a design.
<h2>Content Elaborations</h2>CLARIFICATIONS
Students will engage in discussions and provide examples of how they can improve a design to make a better product. Through learning how to give valuable feedback, students can think about what works within a given design and problem-solve any glitches or errors. As part of a design process, students identify any issues and develop ways to improve the design. Students also provide constructive feedback and specific examples.
CONTENT FOCUS
The focus is to increase the problem-solving discourse in the classroom around the design process and ways improvements can be made to designs.</td></tr>
</table>

Grades 3-5

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.

3-5.ICT.1.a. With guidance, identify and use digital learning tools or resources to support planning, implementing and reflecting upon a defined task.

Expectations for Learning

LEARNING PROGRESSION

In grades K-2, students developed basic skills for using digital learning tools and resources to accomplish a defined task. In grades 3-5, students identify and use digital learning tools or resources with guidance to support planning, implementing and reflecting upon a defined task. In grades 6-8, students will independently select and use digital learning tools to support planning, implementing and reflecting upon a defined task.

IMPORTANT CONCEPTS

- It is important that an appropriate digital learning tool or resource is chosen for a defined task.
- Digital learning tools can help humans.
- It is important to consider multiple tools because of the wide variety of functions tools may possess.

KEY SKILLS/PROCEDURES

- Apply features of different digital learning tools to determine an appropriate digital tool to complete a defined task.

Content Elaborations

CLARIFICATIONS

Students should understand there may be more than one tool or resource to complete a certain task. They need to be guided to identify, choose and use a variety of digital learning tools to plan, implement and reflect on a task.

For example, when planning a task that requires text, such as writing a letter, students could use a tool that has word processing capabilities (such as spellcheck, thesaurus and speech-to-text) to support planning, implementation and reflection. Speech-to-text features can allow students to concentrate on their ideas, as the tool captures their ideas, and can be particularly helpful in planning or reflecting upon a task. Students can use spellcheck, dictionary or thesaurus capabilities when refining their writing. Journals or blog posts are additional tools that could allow for reflection on a task.

Topic 1: Identify and use appropriate digital learning tools and resources to accomplish a defined task.	
	CONTENT FOCUS This content statement focuses on providing a variety of resources or digital learning tools and guiding students to choose one that they feel is appropriate.
3-5.ICT.1.b. Explain the use of selected digital learning tools and resources to support productivity and learning.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students learned how to identify a learning goal and determine how digital learning tools could help accomplish that goal with guidance. In grades 3-5, students explain the use of selected digital learning tools and resources to support productivity and learning. In grades 6-8, students will learn how to evaluate digital learning tools and resources to support learning and productivity. **IMPORTANT CONCEPTS** • It is important to be able to describe why a digital learning tool or resource was chosen. • Choosing the right digital tool for the task helps humans complete a project with efficiency. **KEY SKILLS/PROCEDURES** • Justify why a digital learning tool was chosen to complete a task and how the selected tool or resource supports productivity and learning. **Content Elaborations** **CLARIFICATIONS** Students should be able to identify specific tools or resources that could be used to support their own productivity and learning. They should be able to elaborate on their reasons for choosing the specific tools or resources (such as a digital portfolio, word processing, data entry and databases, presentations and digital libraries like INFOhio). For example, a digital portfolio would help productivity by collecting and organizing student artifacts. **CONTENT FOCUS** The focus is on the student explaining his or her choice of a digital learning tool or resource used to complete a task. The explanation should focus on how the selected tool or resource supports the student's productivity and learning.

Topic 2: Use digital learning tools and resources to locate, evaluate and use information.	
3-5.ICT.2.a. Identify questions related to a topic of interest to broaden or narrow the topic as needed.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students learned how to identify main ideas and details within digital resources. In grades 3-5, students construct questions to broaden or narrow a topic. In grades 6-8, students will learn advanced search techniques to locate information. **IMPORTANT CONCEPTS** • When thinking about a topic to explore, sometimes it is necessary to ask questions to expand or limit the topic. • Asking questions about a topic helps narrow the focus. **KEY SKILLS/PROCEDURES** • Compose and revise questions to narrow or broaden a topic of interest for exploration. **Content Elaborations** **CLARIFICATIONS** As students consider ideas for further exploration, they will construct and ask a number of questions to make the overarching research question more or less specific. **CONTENT FOCUS** This content statement focuses on the students revising their questions to broaden or narrow the results of their searches. This process should be used to provide more focus to the students' research.
3-5.ICT.2.b. Use appropriate search techniques to locate needed information using digital learning tools and resources.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students developed basic skills for locating information using digital learning tools and resources. In grades 3-5, students learn appropriate search techniques needed to locate information. In grades 6-8, students will learn advanced search techniques to locate information. **IMPORTANT CONCEPTS** • Specific search terms can lead to locating needed information more effectively. **KEY SKILLS/PROCEDURES** • Demonstrate appropriate search techniques to obtain appropriate information using a digital learning tool or resource.

Topic 2: Use digital learning tools and resources to locate, evaluate and use information.	
	Content Elaborations **CLARIFICATIONS** Students will enter specific language when using search engines, online databases, digital card catalogues and websites to find information. For example, students can use keywords from a question to conduct research rather than utilizing the entire question word for word. Students can use phrases in quotation marks or qualifiers like AND and "+" (Boolean Logic) to refine their searches as they locate information. Search techniques also are addressed in Ohio's Model Curriculum for Computer Science beginning in fourth grade. **CONTENT FOCUS** The focus is on students selecting and using appropriate digital search techniques for their situations or tasks. They may need to narrow or expand their results.
3-5.ICT.2.c. Use multiple criteria developed with guidance to differentiate between relevant and irrelevant information found with digital learning tools and resources.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students identified main ideas and details found with digital learning tools and resources. In grades 3-5, students use multiple criteria developed with guidance to differentiate between relevant and irrelevant information found with digital learning tools and resources. In grades 6-8, students will use criteria to evaluate the validity of information found with digital learning tools and resources. **IMPORTANT CONCEPTS** • It is important to analyze search results and the information found for relevance. **KEY SKILLS/PROCEDURES** • Develop criteria with guidance for determining the relevance of information. • Using developed criteria, differentiate between relevant and irrelevant information found with digital learning tools and resources. • Justify the importance of analyzing search results for relevancy or irrelevancy using developed criteria. **Content Elaborations** **CLARIFICATIONS** With guidance, students create a set of criteria that provide a process for determining the relevance of information found by using digital learning tools and resources (for example, search engines, news websites, apps and digital libraries such as INFOhio).

Topic 2: Use digital learning tools and resources to locate, evaluate and use information.	
	Possible criteria could include the publication date (depending on the topic) and whether the information located meets the needs of the defined task. **CONTENT FOCUS** The focus is on helping students form criteria for determining the relevancy of information and using the criteria they have developed to differentiate between relevant and irrelevant information found using digital learning tools or resources.
3-5.ICT.2.d. Explain basic ideas of plagiarism and copyright.	## Expectations for Learning **LEARNING PROGRESSION** In grades K-2, students developed the idea that people not only own things, but ideas and content as well. In grades 3-5, students learn basic ideas of plagiarism and copyright. In grades 6-8, students will apply principles of copyright, use digital citation tools and use strategies to avoid plagiarism. **IMPORTANT CONCEPTS** • Copyright law protects creators of information. • Plagiarism is when one claims others' work or ideas as one's own. • It is important to give credit to the work of others. • There are consequences when people plagiarize or break copyright laws. **KEY SKILLS/PROCEDURES** • Explain the importance of following copyright laws and avoiding plagiarism. • Explain possible consequences that could occur if people plagiarize or break copyright laws. ## Content Elaborations **CLARIFICATIONS** Students need to understand the legality of taking someone else's work and claiming it as theirs. Students should be aware of the consequences of plagiarism and copyright issues so they can appropriately research and communicate ideas. **CONTENT FOCUS** The focus is on students identifying the consequences of using someone else's work as their own.

Topic 2: Use digital learning tools and resources to locate, evaluate and use information.	
3-5.ICT.2.e. Use digital citation tools to cite sources with appropriate guidance.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students developed the idea that people not only own things, but ideas and content as well. In grades 3-5, students use digital citation tools to cite sources with guidance. In grades 6-8, students will apply principles of copyright, use digital citation tools and use strategies to avoid plagiarism. **IMPORTANT CONCEPTS** • There are digital learning tools to help one cite where one obtained information. **KEY SKILLS/PROCEDURES** • Use digital citation tools to cite sources using proper formatting. **Content Elaborations** **CLARIFICATIONS** Given the understanding of plagiarism and copyright, students need to be shown and then use a citation tool to cite the content and resources they utilized to gather information. **CONTENT FOCUS** The focus is on adequately documenting where students obtained their information and images and inputting the source documentation via digital learning tools.

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

3-5.ICT.3.a. Gather, organize and summarize information from multiple digital learning tools and resources to build knowledge of a topic.

Expectations for Learning

LEARNING PROGRESSION

In grades K-2, students learned basic skills for gathering and organizing information from multiple digital sources. In grades 3-5, students gather, organize and summarize information from multiple digital sources. In grades 6-8, students will analyze and integrate textual, visual and quantitative information from multiple digital learning tools and resources.

IMPORTANT CONCEPTS

- Digital learning tools (such as apps and e-books) and resources (like databases and online encyclopedias) can contain information for building knowledge of a topic.
- Digital tools and resources can be useful when organizing and summarizing information from multiple sources.
- Knowledge of a topic that includes adequate summaries can provide a deeper understanding of a topic.
- Creating a visual representation of knowledge can locate gaps in information to key questions.

KEY SKILLS/PROCEDURES

- Select digital learning tools and resources to organize and summarize information from multiple sources.
- Determine an organizational method to gather and summarize information from multiple digital resources.
- Build knowledge of a topic by summarizing information across multiple sources.

Content Elaborations

CLARIFICATIONS

Information is everywhere. Being able to gather, organize and summarize information from multiple locations to build knowledge is a valuable skill for students to learn. When gathering information on a topic, students should use more than one digital learning tool or resource. Free e-books are available at public and school libraries and through INFOhio.

Students may be accessing information from digital learning tools like apps and e-books or resources like videos, databases and online encyclopedias as they learn more about their world. Digital tools resembling sticky notes or bulletin boards can help students organize the information they gather.

Using an organizational method or strategy, students need to record information gathered and summarized from more than one digital learning tool or resource to answer questions about a topic and organize the information to create a complete repository of knowledge about a topic.

Topic 3: Use digital learning tools and resources to construct knowledge.	
	CONTENT FOCUS This content statement focuses on the student evaluating digital learning tools and resources then selecting those that contain the content needed to increase their knowledge of the topic of interest. Students also can evaluate digital tools and resources to select and use those that aid in organizing and summarizing information.
3-5.ICT.3.b. Interpret images, diagrams, maps, graphs, infographics, videos, animations, interactives, etc., in digital learning tools and resources to clarify and add to knowledge.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students used the visuals found in digital learning tools and resources to add knowledge. In grades 3-5, students interpret visual information in digital learning tools to add to knowledge. In grades 6-8, students will analyze and integrate textual, visual and quantitative information from multiple digital learning tools and resources. **IMPORTANT CONCEPTS** • Visual resources can be used to better understand information. • Information can be communicated visually. • Visual representations provide additional details and information to assist with the interpretation of written text. • People can use digital learning tools and resources to add information to and interpret visual resources. **KEY SKILLS/PROCEDURES** • Interpret visual representations or resources to clarify or add new knowledge of a topic. • Deduce information, interpret data and communicate information visually. **Content Elaborations** **CLARIFICATIONS** Gleaning information from visual resources, such as pictures, graphs, data charts and visual advertisements, in digital learning tools and resources can help students gain a better understanding of information and add to their knowledge base. To understand the information found in these visual resources, students need to deduce information, interpret data and communicate information. Visual resources may be found in digital tools like e-books and apps or in resources like online videos, encyclopedias or databases. Free e-books are available at public and school libraries and through INFOhio. Students need to communicate what they learned from information in a visual resource as well as be able to represent information visually. Students can use digital tools to assist when interpreting visual resources.

Topic 3: Use digital learning tools and resources to construct knowledge.	
	Drawing apps can add labels or text to an image to show important aspects or features. Students can show understanding by using presentation software to add a voice-over explanation to images. For example, given a visual advertisement, students should be able to determine the company and its product. **CONTENT FOCUS** The focus is on students interpreting visual resources to add additional information or clarify existing knowledge.
3-5.ICT.3.c. Organize observations and data collected during student explorations to determine if patterns are present.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students used digital learning tools to collect, record and organize observations and data during exploration. In grades 3-5, students organize observations and data collected during student explorations to determine if patterns are present. In grades 6-8, students will analyze data collected or retrieved from a variety of digital learning tools and resources to determine if patterns or trends are present. **IMPORTANT CONCEPTS** • Digital learning tools and resources can be used to collect data. • Digital tools can be used to organize data and observations. • Once information is collected, data and observations need to be organized to determine if patterns are present. • Identified patterns can provide clarifying information about knowledge of a topic. **KEY SKILLS/PROCEDURES** • Make observations and collect and assemble data to determine if patterns are present. **Content Elaborations** **CLARIFICATIONS** Databases containing primary sources (such as records of events as they are first described) and secondary sources (such as records written after the events have taken place by people who were not present at the events) can be sources of content for students to explore and make observations. Mind maps are one tool students can use to organize their observations, look for common themes, determine if patterns are present or see if there are changes over time.

Topic 3: Use digital learning tools and resources to construct knowledge.	
	Digital notebooks, journals or portfolios can be used to collect observations and data during students' scientific investigations. They can use survey tools or forms to create and collect information and use tables, spreadsheets, graphs and charts to visually depict patterns in the data they collect. Allow time for students to critically examine and construct notes during explorations to determine if patterns are present. **CONTENT FOCUS** The focus is on students determining if patterns exist in the data collected during student observations and then identifying those patterns to determine if the patterns relate to or add to their knowledge of a topic. ## Career Connections **CAREER AWARENESS** Using a video library such as *Kids Work*, have students record whether or not the career video they have watched is something they would enjoy doing. Ask students to record this information for multiple careers. Consider having students film their own "reaction videos" to the career videos. Have students record their thoughts and then use the class data to determine if there is a pattern in the careers that students would and would not enjoy. Teachers can identify outliers in the data and communicate positive aspects of those career options as well. Students choose a digital method to communicate patterns in class career interests overall.
3-5.ICT.3.d. Create artifacts using digital learning tools and resources to demonstrate knowledge.	## Expectations for Learning **LEARNING PROGRESSION** In grades K-2, students created artifacts with guidance using digital learning tools and resources to demonstrate knowledge. In grades 3-12, students will 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 use digital learning tools and resources to create products that communicate knowledge. **KEY SKILLS/PROCEDURES** • Construct digital artifacts to demonstrate knowledge. • Create an artifact using digital learning tools and resources.

Topic 3: Use digital learning tools and resources to construct knowledge.	
	Content Elaborations **CLARIFICATIONS** Digital learning tools and resources can provide content for students to incorporate into the artifacts and products they create to demonstrate their content knowledge. These tools and resources also can be used as students build, develop and create the artifacts. Artifacts could include videos, annotated images, graphs or charts, video games, diagrams or pictures with a voice-over explanation or any demonstration of student knowledge. For example, students can create visual brochures using the research they conducted on their chosen countries in social studies class. Students could create their own ABC-style e-books to demonstrate their knowledge of producers, consumers and decomposers using appropriate English language arts conventions while using other ABC-style books as anchor texts. Students could take pictures using digital cameras or create their own artwork drawings (or in collaboration with the fine arts teacher) to add original artwork to their e-books. **CONTENT FOCUS** The focus is on students using digital learning tools and resources to create products that demonstrate their knowledge.

Topic 4: Use digital learning tools and resources to communicate and disseminate information to multiple audiences.	
3-5.ICT.4.a. With guidance, discuss and identify communication needs considering goals, audience and content.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students discussed and identified communication needs with guidance considering their tasks, information and situations. In grades 3-5, students discuss and identify communication needs for a task considering their goals, audience and content with guidance. In grades 6-8, students will independently identify communication needs, considering goals, audience and content using digital learning tools and resources. **IMPORTANT CONCEPTS** • Identifying communication needs is a first step in making a plan to publish information. • There are many details to consider to provide the appropriate information to meet the desired outcome and delivery for a specific audience. **KEY SKILLS/PROCEDURES** • Determine the communication goals (such as to inform parents, share student work, demonstrate content knowledge or call to action). • Determine the content to include in the communication to meet a certain goal (for example, text, videos, pictures and audio). • Consider the audience as it relates to the goals (such as students, parents, teachers, community members and visitors to a district website). **Content Elaborations** **CLARIFICATIONS** Digital learning tools can be used to communicate ideas and information to audiences. Before disseminating information to an audience, students need to identify their communication goals, consider the content they want to share and determine the audience. Students should think about the purpose of various products, such as digital flyers, podcasts and websites. With help from teachers and peers, students will identify their communication needs and begin to form a plan to produce and publish information. This content statement is one of four content statements, 3-5.ICT.4.a.-4.d., that together guide students in planning, producing and publishing an artifact. *Note: Ohio's Learning Standards for English Language Arts introduce the consideration of "audience" in the Production and Distribution Writing Strand beginning in grade 4.*
	CONTENT FOCUS

Topic 4: Use digital learning tools and resources to communicate and disseminate information to multiple audiences.	
	This content statement focuses on students identifying communication needs that consider student goals and the content to be shared for a selected audience.
3-5.ICT.4.b. With guidance, select media formats appropriate to content and audience.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students used digital learning tools with guidance to add audio and/or visual media to clarify information. In grades 3-5, students select with guidance media formats appropriate to the content and audience. In grades 6-8, students will independently select and use a variety of media formats to communicate information to a target audience. **IMPORTANT CONCEPTS** • It is important to select media formats that are appropriate and provide necessary details of the content. • Knowing which media format to use for audiences is an important part of meeting the audience's need. **KEY SKILLS/PROCEDURES** • Determine which media formats to use for specific content types and audiences. **Content Elaborations** **CLARIFICATIONS** Communication can occur in person or online, in real time or asynchronously, between individuals, groups or worldwide. Selecting the media format that will be used to communicate and disseminate information depends on both its content and audience. Students consider the audience's needs and how information would best be presented (such as through a podcast, audio/video, graphic design, an interactive presentation or blog that can be presented to peers, educators, the local community, the administration or global audiences). For example, a third grade class could collaboratively create an e-book including text, pictures of drawings or diagrams, audio explanations and graphs to explain how they had different approaches in solving the same math problem. An audio/visual presentation may be best for an audience of elderly adults rather than just a podcast. Another option could be for students to use graphic design and interactive presentations for younger students still learning to read. Students select media formats and continue to create their plans to produce and publish information. This content statement is one of four content statements, 3-5.ICT.4.a.-4.d., that together guide students in planning, producing and publishing an artifact.

Topic 4: Use digital learning tools and resources to communicate and disseminate information to multiple audiences.	
	Note: Ohio's Learning Standards for English Language Arts introduce the consideration of "audience" in the Production and Distribution Writing Strand beginning in grade 4. **CONTENT FOCUS** The focus is on students selecting media formats after considering the content they are sharing and their audience while keeping in mind the differences between and uses of different media formats.
3-5.ICT.4.c. Evaluate the features of digital learning tools and resources based on the characteristics of a specific audience.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students selected appropriate digital learning tools and resources to produce and publish information with guidance. In grades 3-5, students evaluate the features of digital learning tools and resources based on the characteristics of a specific audience. In grades 6-8, students will discuss and identify ways to communicate and disseminate information so that users with varied needs can access information. Students also will evaluate the effectiveness of a digital tool to communicate information with multiple audiences. **IMPORTANT CONCEPTS** • Not all digital resources meet the needs of the audience. • Some digital learning tools have features that better communicate certain content to specific groups of people. • Evaluating different digital tools is an important part of decision-making to ensure communication is effective and engaging. **KEY SKILLS/PROCEDURES** • Identify characteristics of an intended audience to consider when evaluating digital learning tools and resources (for example, language spoken and accessibility needs). • Determine the features of different digital learning tools and resources to provide better communication support to a particular audience.
	Content Elaborations **CLARIFICATIONS**

Topic 4: Use digital learning tools and resources to communicate and disseminate information to multiple audiences.	
	After students have selected the media format and specific audience, they need to consider what features the digital learning tools and resources they want to use will need to have. Will they need photo editing tools? Will they need to record audio or video? Where will the publication be shared and who will be able to access it? Students determine criteria, evaluate different options, then select appropriate digital tools and resources to disseminate information to that audience. Students need to understand their audience, what they want to communicate and the most effective tool to do so. The evaluation and selection of digital tools and resources continue the plan students create to produce and publish information. This content statement is one of four content statements, 3-5.ICT.4.a.-4.d., that together guide students in planning, producing and publishing an artifact. *Note: Ohio's Learning Standards for English Language Arts introduce the consideration of "audience" in the Production and Distribution Writing Strand beginning in grade 4.* **CONTENT FOCUS** The focus is on comparing the features of digital learning tools to meet the needs of a specific audience, such as the ability to edit content, alter display settings, use audio description or have access to subtitle features for presentation software.
3-5.ICT.4.d. Produce and publish information appropriate for a target audience using digital learning tools and resources.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students selected digital learning tools and resources to publish information with guidance. In grades 3-5, students produce and publish information appropriate for a target audience using digital learning tools and resources. In grades 6-8, students will publish information and evaluate the effectiveness of a digital tool to communicate information with multiple audiences. **IMPORTANT CONCEPTS** • Producing and publishing information requires a plan. • Digital learning tools can be used to produce content and present information to many different audiences. • It is important to choose a medium to present information clearly.
	KEY SKILLS/PROCEDURES • Produce content that meets communication goals.

Topic 4: Use digital learning tools and resources to communicate and disseminate information to multiple audiences.	
	• Produce content in a format using digital learning tools that meet the audience's need. • Publish the information, communication or publication. **Content Elaborations** **CLARIFICATIONS** Students use the information gathered in understanding who their audience is to make important decisions, such as how formal or informal they can make their presentation. Using digital learning tools and resources, they can disseminate information to their target audience. For example, students presenting to educators should not use texting language and emojis. This content statement is one of four content statements, 3-5.ICT.4.a.-4.d., that together guide students in planning, producing and publishing an artifact. *Note: Ohio's Learning Standards for English Language Arts introduce the consideration of "audience" in the Production and Distribution Writing Strand beginning in grade 4.* **CONTENT FOCUS** The focus is on students using selected digital learning tools and resources to produce and publish information with consideration to their target audience.

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.

3-5.ST.1.a. Demonstrate appropriate use of technology and explain the importance of responsible and ethical technology use.

Expectations for Learning

LEARNING PROGRESSION

In grades K-2, students demonstrated appropriate uses of technology and identified inappropriate uses of technology as part of being a responsible technology user. In grades 3-5, students demonstrate appropriate uses of technology and explain the importance of responsible and ethical technology use. In grades 6-8, students will advocate for and exhibit ethical, legal and responsible practices when utilizing technology.

IMPORTANT CONCEPTS

- Technology should be used in a way that does not harm or impact others negatively.
- Technology should be used in a positive and ethical way to research, create and communicate.

KEY SKILLS/PROCEDURES

- Define the phrase "appropriate use of technology."
- Demonstrate examples of appropriate and responsible uses of technology.
- Communicate examples of inappropriate, unethical or irresponsible uses of technology.

Content Elaborations

CLARIFICATIONS

Technology should be used responsibly. Technology includes processes, ideas, infrastructure, products, materials, tools and knowledge.

Giving credit to creators of content is an important part of ethical technology use. For example, when using a picture of a tornado for a report, students find the content owner or creator of the photo and properly credit that photo within the report.

An example of an inappropriate use of technology could be putting a second rider on a bicycle built for one person. This can be dangerous for the riders and also can break the bicycle.

CONTENT FOCUS

This content statement focuses on the appropriate use of technology and understanding why it is important to use technology responsibly and ethically. Students apply their understanding by demonstrating appropriate use and providing examples of responsible uses of technology.

Topic 1: Demonstrate an understanding of technology's impact on the advancement of humanity – economically, environmentally and ethically.	
3-5.ST.1.b. Identify positive and negative impacts one's use of personal technology and technology systems (e.g., agriculture, transportation, energy generation, water treatment) can have on one's community.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students identified positive and negative impacts their use of technology can have on themselves and their families. In grades 3-5, students identify positive and negative impacts their use of technology can have on their communities. In grades 6-8, students will explore advantages and disadvantages of widespread use, accessibility and reliance on technology in the world. **IMPORTANT CONCEPTS** • While technology and technology systems may help humans do their work more easily, there may be positive and negative outcomes. • What people do impacts more than just themselves. Their actions can affect their local communities. **KEY SKILLS/PROCEDURES** • Identify positive and negative impacts of one's use of technologies and systems on one's community. **Content Elaborations** **CLARIFICATIONS** Given a technological device or system, students should be able to identify the positive and negative impacts on the community. Students should consider the unintended consequences of technological advancement. An example of this would be students identifying that agriculture produces food for communities, both near and far. However, runoff from animal manure or pesticides used could pollute area streams. Students also could investigate how farming has changed throughout history and how those changes could have impacted the farmers and their communities. Students could consider how the transition from using horses and steel plows to today's tractors and combines may have altered factors such as the speed, cost and productivity of farming. Another example would be how cellphones offer quick, easy access to information and communication but also can distract users from important tasks like driving their cars. Thinking beyond oneself is an important skill in becoming a good global citizen. Students should consider how technology has the potential to help or hurt individuals in their daily lives (for example, in terms of the community, economics, the environment and family dynamics).

Topic 1: Demonstrate an understanding of technology's impact on the advancement of humanity – economically, environmentally and ethically.	
	CONTENT FOCUS The focus is on the positive and negative impacts one's use of technology has on one's community. Students should be able to identify these effects on a given situation, understanding that what one does impacts more than just oneself.
3-5.ST.1.c. Describe legal and responsible practices when utilizing technology.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students were introduced to responsible technology usage. In grades 3-5, students explain how to use technology legally and responsibly. In grades 6-8, students will advocate and exhibit ethical, legal and responsible technology use and further investigate how these practices apply to creating and using digital technologies. **IMPORTANT CONCEPTS** • Technology can be used in ways that can result in negative and positive consequences. • One should use technology in ways that are legal and responsible. **KEY SKILLS/PROCEDURES** • Describe real-life examples of technology use – the positive and negative impacts – and how they relate to responsible technology practices. • Describe real-life examples of technology use – the positive and negative impacts – and how they relate to legal technology practices. **Content Elaborations** **CLARIFICATIONS** Technology should be used in responsible and legal ways. Remember that technology includes processes, ideas, infrastructure, products, materials, tools and knowledge, so the scenarios and practices students describe can include examples of many types of technology. For example, students can discuss responsible uses of digital cameras, including asking people's permission before taking their pictures and showing them the picture to make sure they approve of the image. However, taking a picture of a test and posting it to social media is not a responsible use. Sending inappropriate pictures through digital communication tools can be illegal. Another example considers ways people obtain rare earth minerals and other resources for use in the production of technology. Students could examine how the local people and environment are or are not protected (economically, ethically or environmentally, as grade-level appropriate).

Topic 1: Demonstrate an understanding of technology's impact on the advancement of humanity – economically, environmentally and ethically.	
	CONTENT FOCUS Use real-life examples regarding how the use of technology has impacted our environmental, social, economic and personal issues (for example, legal repercussions) in both positive and negative ways.

Topic 2: Analyze the impact of communication and collaboration in both digital and physical environments.	
3-5.ST.2.a. Create a plan and select collaboration and/or communication tools to complete a given task.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students demonstrated their understanding of digital tools when used collaboratively. Students also communicated using a variety of digital methods. In grades 3-5, students create plans and select collaboration and/or communication tools to complete a given task. In grades 6-8, students will critique specific instances of how technology has impacted access to information, communications and collaboration. **IMPORTANT CONCEPTS** • Creating a plan helps determine what steps are required and which tools are needed to complete a task. • Digital tools can enhance communication and collaboration efforts. • Developing criteria based on the task requirements and then using those criteria to select digital communication and collaboration tools results in a better match between tool and task. **KEY SKILLS/PROCEDURES** • Develop a plan for completing a given task using the specifications of that task. • Produce criteria to select and use a tool for collaboration and communication to complete a given task. **Content Elaborations** **CLARIFICATIONS** Students determine the specifications of a given task and create a plan to complete the task. This includes a focus on using tools to communicate and collaborate in digital and physical spaces. When communicating and/or collaborating, students develop criteria for selecting appropriate tools. The criteria students develop need to address communication goals, content and audience. For example: • Are students sending text, pictures, videos or files that are very large? • Do students need to communicate in real time or will asynchronous communication work? • If real-time communication is needed, will voice-only work or do they need video too? • Will they need to simultaneously see someone's slideshow using a shared desktop or use tools like a shared whiteboard to draw on the slides?

Topic 2: Analyze the impact of communication and collaboration in both digital and physical environments.	
	Collaboration could include working as an in-class group on a task or could involve working with others outside of their class meeting time (for example, a different class with the same teacher) or outside of their building (such as a different building in the district or with peers in a different district, city or state). Students also may be collaborating with content experts like scientists, city planners, museum staff, university partners, state agencies or other resources. **CONTENT FOCUS** This content statement focuses on students creating a plan based on the specifications of the task and then determining and selecting appropriate tools for communication and collaboration. ## Career Connections **CAREER AWARENESS** Students work in small groups to identify and plan a "career awareness interview" with a professional in their community. Consider professionals who represent diverse groups and populations when inviting professionals to share their work experiences with students. Work with the student groups to help them develop and finalize plans for how they will conduct their interviews. Student plans can outline: • What methods students within a group will use to communicate during the interview planning process, including the digital tools necessary; • Which tools will be necessary for securing the interview with the professional; • What materials and digital tools are needed to conduct the interview with the professional; and • How group members will evaluate and summarize the interview they conducted. Conduct a classroom discussion on the digital tools used throughout the planning and implementing of the interviews. Students reflect on which tools were most effective for the particular tasks performed.
3-5.ST.2.b. Exercise digital etiquette when communicating and collaborating.	## Expectations for Learning **LEARNING PROGRESSION** In grades K-2, students understood positive and negative ways to interact with their peers in digital and physical environments. In grades 3-5, students practice positive behaviors while communicating and collaborating with their peers. In grades 6-8, students will explain how technology can have both positive and negative impacts on personal, professional and community relationships. Students also will apply digital etiquette appropriate to varying contexts, reflecting on the impact of their actions in both digital and physical environments.

Topic 2: Analyze the impact of communication and collaboration in both digital and physical environments.	
	IMPORTANT CONCEPTS • There are appropriate ways to communicate and collaborate in both digital and physical environments. **KEY SKILLS/PROCEDURES** • Demonstrate appropriate digital etiquette when collaborating and communicating with others. **Content Elaborations** **CLARIFICATIONS** Many students need to know the difference between casual communication and communication used in more formal settings such as academia and business (for example, knowing when it is appropriate to use emoticons). Also, students need a clear understanding of expectations for working as a member of a team; this is true in digital and physical environments. **CONTENT FOCUS** Teachers demonstrate, guide and assist students in the practice of appropriate behavior while students actively communicate and collaborate with each other in digital and physical environments.
3-5.ST.2.c. Identify the positive and negative impact the use of technology can have on relationships, communities and self.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students investigated how technology impacts the ways families communicate. In grades 3-5, students identify both the positive and negative impacts of technology use on relationships, communities and self. In grades 6-8, students will explain how technology can have both positive and negative impacts on personal, professional and community relationships. Students also will investigate how social media impacts society and the digital identities of individuals and organizations. **IMPORTANT CONCEPTS** • Technology has both positive and negative impacts on communication and collaboration within and among communities. • Technology can have both positive and negative impacts on communication and collaboration in relationships. • Technology can have both positive and negative impacts on communication and collaboration that have consequences to oneself.

Topic 2: Analyze the impact of communication and collaboration in both digital and physical environments.	
	KEY SKILLS/PROCEDURES • Identify how the use of technology when communicating and/or collaborating can have both positive and negative impacts on relationships, communities (such as neighborhoods, churches and schools) and individuals. **Content Elaborations** **CLARIFICATIONS** Technology provides convenient and immediate access to information, communication and collaboration tools, as well as the ability to interact with individuals around the world. Although many benefits can be derived from these technological advancements, students should be aware of the potential negative consequences. Consider providing activities that will elicit an understanding of methods of communication and collaboration and how pictures and words can be used to help or hurt. Cyberbullying would be considered one possible negative impact. The ability to video chat with grandparents across the country or world could be a positive result of technological advancement. **CONTENT FOCUS** The focus is on student exploration of examples of how technology has and can impact relationships, both positively and negatively.

Topic 3: Explain how technology, society and the individual impact one another.	
3-5.ST.3.a. Describe the advantages and disadvantages of technology (past, present, future) to understand the relationship between technology, society and the individual.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students recognized the benefits and drawbacks of technology in their lives. In grades 3-5, students describe the advantages and disadvantages of technology to understand the relationship between technology, society and the individual. In grades 6-8, students will discuss how the development and use of technology has influenced societal issues and how society and the individual impact the development of new technologies. **IMPORTANT CONCEPTS** • There are technological advancements that positively and negatively impact society and the individual. • Society and individuals impact technology, both positively and negatively. **KEY SKILLS/PROCEDURES** • Identify and explain the positive and negative impacts technological advancements can have on society and individuals. • Identify and explain how societies and individuals impact technology, both positively and negatively. **Content Elaborations** **CLARIFICATIONS** Students may understand there are processes of turning ideas into objects (for example, a pair of glasses) but do not always associate those with technology. Students need to recognize there are technologies (knowledge, artifacts, infrastructure, tools, materials, processes and products) that were developed in the past that were revised and improved for a present need or want. These innovations could then take on other forms in the future. Students should be able to identify disadvantages or advantages of technologies on themselves and society. An example could be primary source documents that showcase the changes in roads over the span of 200 years. Students could analyze data showing changes in wildlife in surrounding areas during the same time. **CONTENT FOCUS** This content statement focuses on students identifying technological inventions or innovations and the different advantages or disadvantages of a technology on society and individuals, as well as how society impacts that technology.

Topic 3: Explain how technology, society and the individual impact one another.	
3-5.ST.3.b. Demonstrate how technology innovations/inventions can have multiple applications.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students identified how technology innovations/inventions can have multiple applications. In grades 3-5, students demonstrate how technology innovations/inventions can have multiple applications. In grades 6-8, students will analyze how technological innovations and inventions can have multiple applications, both intended and unintended. **IMPORTANT CONCEPTS** • Inventions and innovations are not singular in use. • Technology can be used in a variety of ways. **KEY SKILLS/PROCEDURES** • Demonstrate a variety of ways a technology invention or innovation can be applied for other purposes. **Content Elaborations** **CLARIFICATIONS** Students often see technological inventions or innovations in isolation. They need to be able to view those technologies in relation to their other possible functions. They also need to understand the process of turning ideas into devices and systems (an invention) and modifying existing systems for improvement (an innovation). For example, Velcro™ is used by astronauts in space suits who have limited dexterity due to their bulky gloves. Velcro™ also is used on shoes for individuals with limited dexterity, such as young children and older adults. **CONTENT FOCUS** The focus is on students recognizing that inventions and innovations can have more than one purpose. Encourage students to think creatively about how a technology could be used in another way or for another purpose.

Topic 3: Explain how technology, society and the individual impact one another.	
3-5.ST.3.c. Identify and discuss how the use of technology affects self and others in various ways.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students identified how technology use impacts self and others in a variety of ways. In grades 3-5, students identify and discuss how the use of technology can impact themselves and others. In grades 6-8, students will identify how technological innovations and inventions can have multiple applications, both intended and unintended. Students also will continue their examination of the relationship between technology, society and the individual in terms of the influence of technology development on societal issues and impacts of the individual on technology development. **IMPORTANT CONCEPTS** • Personal use of technology can have impacts on self and others. • Using technology can affect people's behaviors, actions or feelings in positive, negative or neutral ways. **KEY SKILLS/PROCEDURES** • Describe the ways personal technology affects self and others. • Identify how the use of knowledge, artifacts, infrastructure, tools, materials, processes and products can impact people. **Content Elaborations** **CLARIFICATIONS** Students use technology daily and often do not realize how their own personal use of technology can impact themselves and others. Students need to be able to identify how the use of technology (knowledge, artifacts, infrastructure, tools, materials, processes and products) affects themselves and others. For example, the invention of the light bulb has allowed people to work longer hours by extending the day. Light bulbs produce more light than candles and could extend the day beyond daylight hours more effectively than candles did. This also can have an effect on people's sleeping habits. Instead of waking up when the sun rises and going to bed when it sets, people are able to wake earlier and stay up later. **CONTENT FOCUS** The focus is on students identifying that what they do while using technology can help or harm themselves and others. As students use technology, they need to consider the possible impacts of that technology.

Topic 3: Explain how technology, society and the individual impact one another.	
3-5.ST.3.d. Identify the components of one's digital identity and one's digital footprint.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students defined the term digital identity and digital footprint and they discussed what information is appropriate to share as part of their digital footprints. In grades 3-5, students identify components that make up their own digital identities and digital footprints. In grades 6-8, students will manage components of their digital identities and digital footprints. **IMPORTANT CONCEPTS** • All users of technology have digital identities and digital footprints (also called digital tattoos). • Components of one's digital identity include personal identifiers (for example, birthdate and addresses) created by online behaviors (such as when an adult creates an online account). • Components of one's digital footprint include online activities, actions and communications. • Permanency of information (students' digital footprints) allows words and actions to be accessed at any time, in any location and can follow individuals through their entire lives. • Words and actions can impact our world in both positive and negative ways when using technology to communicate. **KEY SKILLS/PROCEDURES** • Identify how the use of technology can affect a digital identity and footprint over time. • Explain how information communicated using digital tools can be permanent and publicly available. **Content Elaborations** **CLARIFICATIONS** Students may think that what they do online will disappear and not impact others, not realizing that their posts can cause complications for themselves or others in the future. Students may not realize which parts of their digital activities will stay online and which parts will be anonymous. **CONTENT FOCUS** The focus is on students knowing what parts of their online presence will remain online and be searchable in the future. They also should be able to recognize that their own content could have an extended effect on others who are associated with that online content.

Topic 3: Explain how technology, society and the individual impact one another.	
3-5.ST.3.e. Identify and discuss laws and rules that apply to digital content and information.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students developed the idea that people not only own things but ideas and content as well. In grades 3-5, students discuss basic rules and laws that protect someone's ownership of ideas and content found online. They also discuss basic rules and laws that ensure equitable access to digital content. In grades 6-8, students will evaluate revisions to laws, rules and polices as society responds to technological advancements (for example, revisions to laws that address ownership involving online ideas and content). **IMPORTANT CONCEPTS** • All digital content has an owner who deserves credit for that content. • There are legal guidelines on how digital content and information should be utilized and how to provide equitable access to this content. • Rules and laws that govern digital content and information should be followed. **KEY SKILLS/PROCEDURES** • Describe legal guidelines that govern digital content and information. **Content Elaborations** **CLARIFICATIONS** Laws and rules regarding digital content and information exist for different reasons. Those appropriate for this grade band are the following: 1) to protect ownership of ideas and digital content, and 2) to ensure equitable access to digital content. As students use digital content, it becomes even more important to understand these laws and rules (such as those relating to accessibility, intellectual property rights, copyright law, Creative Commons guidelines, fair use guidelines and open source). Engage students in discussions as they identify what digital content they may use, how they may use it and how the content should be cited or attributed. These laws and rules also have a direct impact on what students decide to use when creating their own digital content. They can identify the proper type of content and which laws or guidelines apply to that content. Students should be able to discuss the similarities and differences between the types of laws and guidelines governing the use of digital content and information. **CONTENT FOCUS** The focus is on understanding and adherence to the basic rules and laws about digital content. This includes accessibility, intellectual property and copyright.

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.

3-5.DT.1.a. Demonstrate how applying human knowledge using tools and machines extends human capabilities to meet our needs and wants.

Expectations for Learning

LEARNING PROGRESSION

In grades K-2, students distinguished between natural and human-designed items and learned that technology is something someone made to meet needs and wants. In grades 3-5, students demonstrate how applying knowledge using tools and machines extends human capabilities to design products that meet their needs and wants. In grades 6-8, students will 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.

IMPORTANT CONCEPTS

- People have the ability to apply knowledge through their use of tools and machines.

KEY SKILLS/PROCEDURES

- Demonstrate how using tools and machines extends capabilities to meet needs and wants.

Content Elaborations

CLARIFICATIONS

Throughout human history, there is evidence of technology in the form of tools and primitive machinery being used to solve problems to meet basic human needs and wants. As time progresses, technologies continue to change and improve to increase human efficiency and solve problems. As knowledge grows, humans design more tools and machines to expand capabilities and meet both needs and wants.

Building and using tools and machines allows humans to work smarter, faster and stronger, helping to satisfy needs and wants. For example, using a hammer to drive a nail into wood requires less effort and makes it faster to fasten structural parts together when building a shelter.

CONTENT FOCUS

This content statement focuses on how humans use their knowledge to create tools that expand their capabilities. Students need to have hands-on experiences using tools and machines. Through these hands-on experiences, they can build an understanding of how applying knowledge through the use of tools and machines is able to extend human capabilities to meet needs and wants.

Topic 1: Define and describe technology, including its core concepts of systems, resources, requirements, processes, controls, optimization and trade-offs.	
3-5.DT.1.b. Give examples of how requirements for a product can limit the design possibilities for that product.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students gave examples of how resources such as tools or materials help people get a job done. In grades 3-5, students give examples of how requirements for a product can limit the design possibilities for that product. In grades 6-8, students will define and categorize the requirements of a design as either criteria or constraints. **IMPORTANT CONCEPTS** • Requirements of a project create limitations on the design. **KEY SKILLS/PROCEDURES** • Discuss how limitations impact the design possibilities for a product. • Give examples of how requirements for a product can limit design. **Content Elaborations** **CLARIFICATIONS** During a design process, there may be times when limiting factors, such as funding shortages, time requirements or improper materials, may limit the design of the product. It may be necessary to change a design to accommodate a limiting factor even though some benefits are lost. Students need to be given limitations in the midst of a design challenge so they may experience how possibilities can change as a result of the requirements or limitations. For example, when designing a house, students would consider using materials that are appropriate and readily available in a given region. **CONTENT FOCUS** The focus is on helping students understand how to incorporate requirements for a product within a design process when designing products or solving problems.
3-5.DT.1.c. Describe a process as a series of actions and how it is used to produce a result.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students explained that systems have parts or components that work together to accomplish a goal. In grades 3-5, students describe a process as a series of actions and how it is used to produce a result. In grades 6-8, students will define and categorize the requirements of a design as either criteria or constraints and explain how optimization is a process of making a product as fully functional and effective as possible.

Topic 1: Define and describe technology, including its core concepts of systems, resources, requirements, processes, controls, optimization and trade-offs.	
	IMPORTANT CONCEPTS • A process is a series of actions leading to a result. • Processes and products serve different purposes. Processes are what and how tools are used to make a product. A product is a result that serves to meet a need or want. **KEY SKILLS/PROCEDURES** • Explain the actions used to create a specific result. ## Content Elaborations **CLARIFICATIONS** In grades K-2, students learned that technology was something someone made to meet a need or want. People often think of technology as an object or device, but it also can be a process used to produce a result, which can be a product. Students should be able to explain a series of steps or actions and how it could be used to produce a result. For example, the process of lining up for lunch has a number of actions, with a result of students moving quickly and quietly from chairs and tables to a line at the door. **CONTENT FOCUS** The focus is on breaking down a process into the necessary steps or actions to accomplish the given task.
3-5.DT.1.d. Identify and describe examples of technology products and processes.	## Expectations for Learning **LEARNING PROGRESSION** In grades K-2, students defined technology as something someone made to meet needs or wants. In grades 3-5, students identify a technology product and technology process and describe how they satisfy needs or wants. In grades 6-8, students will explore and document how technology can impact efficiency, as well as analyze how tools, materials and processes are used to alter the natural and human-designed worlds. **IMPORTANT CONCEPTS** • Technology is a product or process that is created to meet a want or a need. **KEY SKILLS/PROCEDURES** • Describe a technology product and a technology process and how they meet needs or wants.

Topic 1: Define and describe technology, including its core concepts of systems, resources, requirements, processes, controls, optimization and trade-offs.	
	Content Elaborations **CLARIFICATIONS** Technology is anything that modifies the natural environment to meet a need or a want. Technology includes knowledge (for example, the proper tool use), products (for example, sliced bread), processes (such as lining up for lunch; or scanning items at a self-checkout, getting the total, paying, and getting change and the receipt), infrastructure (for example, the freeway system) and materials (for example, plastic, Velcro™ and rubber). **CONTENT FOCUS** The focus is on describing examples of technology products and processes and how they satisfy wants or needs.
3-5.DT.1.e. Explain how controls use information to cause systems to change, like a home thermostat turning on the heat based on the low temperature of a room.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students learned that systems have components that work together to accomplish a goal. In grades 3-5, students explain how controls use information to cause systems to change. In grades 6-8, students will learn how technology can impact efficiency and how optimization makes a product as fully functional and effective as possible. Controls can help optimize products. **IMPORTANT CONCEPTS** • System controls use provided information to communicate if/then (cause and effect) commands to produce a result. **KEY SKILLS/PROCEDURES** • Determine the effect of a given cause. • Create an if/then script or process. (For example, if the temperature in the room falls, then the heat turns on.) **Content Elaborations** **CLARIFICATIONS** Systems have parts or components that work together to accomplish a goal. Controls use the information provided by the components to cause changes in the system. In grades K-2, students were introduced to the concept of systems (parts or components that work together to accomplish a goal). In the content statement example, the thermostat is the control. It sends information (such as turn off or turn on) to other parts of the heating system. The thermostat temperature sensor measures the temperature of

Topic 1: Define and describe technology, including its core concepts of systems, resources, requirements, processes, controls, optimization and trade-offs.	
	the air in the room. If it is below a certain temperature, it sends the signal to turn the heater on. When the temperature sensor measures the temperature of the air again and the air is at the maximum temperature setting, the signal is sent to turn off the heater. Another example could be a motion-activated kitchen faucet. If the sensor "sees" motion, the faucet will turn on. **CONTENT FOCUS** The focus is on how system controls use the information provided to determine the changes that should be made to the system.

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

3-5.DT.2.a. Critique needs and opportunities for designing solutions.

Expectations for Learning

LEARNING PROGRESSION

In grades K-2, students learned what a design process was and applied a simplified design process to solve a problem. In grades 3-5, students plan and implement a design process to solve a problem, which includes a focus on the process of identifying a problem to solve. In grades 6-8, students will apply a complete design process to solve a problem, including research and consideration of criteria and constraints.

IMPORTANT CONCEPTS

- When identifying problems, it is important to identify the needs and opportunities to be able to create efficient and effective solutions.

KEY SKILLS/PROCEDURES

- Identify a problem to solve, thoroughly explaining the problem.
- Identify any limits given to the problem that will need to be considered in the solution.

Content Elaborations

CLARIFICATIONS

Identify classroom problems or school problems that could be solved using a design process. Analyze a problem and determine possible needs for a solution. Students may be able to find problems to solve by looking for ways to design seating, classroom processes that need to be refined or looking to overall school or community problems.

Erosion control or algae growth in an aquarium or pond may be ideas that could be seen on school grounds or in the community and have connections to grade-level science and social studies content.

Other opportunities for designing solutions can be found in novels students are reading in other content area studies. Are the characters facing problems that students could help the characters solve? Could they find solutions on behalf of a character in a story they already are reading?

As students work to identify a problem, they must ask themselves questions about the needs and opportunities that exist for designing a solution. Is there already a solution for this problem? If so, can they improve on the solution? If there is not a solution, what do they need to do to solve the problem?

CONTENT FOCUS

This content statement focuses on students identifying problems to solve. (This will tie into the next content statement of using a design process to solve problems.)

Career Connections

Topic 2: Identify a problem and use an engineering design process to solve the problem.	
	CAREER AWARENESS Using the identified problem and potential solutions, students discuss what careers exist that are aligned to the solutions they have identified. Are there people who implement these solutions or solve these problems? Invite professionals from one of the career fields discussed to speak with the class about their jobs and the steps they took to prepare for their careers. Have a class discussion on how careers are continually changing based on new solutions people find to existing problems, especially in the technology field.
3-5.DT.2.b. Plan and implement a design process: identify a problem, think about ways to solve the problem, develop possible solutions, test and evaluate solution(s), present a possible solution and redesign to improve the solution.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students learned what a design process was and applied a simplified design process to solve a problem. In grades 3-5, students plan and implement a design process to solve a problem. In grades 6-8, students will apply a complete design process to solve a problem. **IMPORTANT CONCEPTS** • A design process can help solve many problems. • Using a design process helps keep thinking systematic and focused. **KEY SKILLS/PROCEDURES** • Explain the problems a design solution (product or process) solves. • Identify a problem. • Generate solutions to the problem. • Test and evaluate solutions. • Present a possible solution. • Redesign to improve the solution based on testing, evaluation and feedback. **Content Elaborations** **CLARIFICATIONS** A design process is continuous and cyclical by nature. Using the problems and ideas created in 3-5.DT.2.a., students can use a design process cycle to plan and implement possible solutions.
	Collaborating in small groups to identify and solve problems may be helpful. Encourage students to think

Topic 2: Identify a problem and use an engineering design process to solve the problem.	
	about different ways to solve the problems. The first few times students experience a design process, more instruction may be needed. As students become more familiar with the process, they can become more independent. Drawing sketches and then building models out of blocks, recyclables or craft supplies can help students test, redesign and improve their solutions. Building 2D or 3D models using digital blocks or other tools may be helpful as well. **CONTENT FOCUS** The focus is on using steps of a design process and the importance of evaluating the role each of these steps plays within the entire nonlinear cycle.
3-5.DT.2.c. Generate, develop and communicate design ideas and decisions using appropriate terms and graphical representations.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students learned what a design process was and applied a simplified design process to solve a problem. In grades 3-5, students plan and implement a design process to solve a problem, which includes a focus on communicating their ideas and decisions. In grades 6-8, students will apply a complete design process to solve a problem, including considering multiple factors to justify design decisions. **IMPORTANT CONCEPTS** • Once a problem has been identified and solutions have been considered, the design ideas can be shared. **KEY SKILLS/PROCEDURES** • Communicate design ideas using appropriate terms and graphical representation. **Content Elaborations** **CLARIFICATIONS** As students continue through a design process to solve a problem, they need to generate many ideas and decide which of these alternatives to further develop. Using grade-level appropriate terms, they need to record and communicate their ideas and the decisions they made. Graphical representations could include sketches, drawings, pictures with a recorded voice explanation, diagrams with labels and videos. Students could also use 2D or 3D sketches or mock-up models.

Topic 2: Identify a problem and use an engineering design process to solve the problem.	
	CONTENT FOCUS The focus is on communicating design ideas and decisions. Students could use a variety of tools to present information and create a representation of their design solutions.

Topic 3: Demonstrate that solutions to complex problems require collaboration, interdisciplinary understanding and systems thinking.	
3-5.DT.3.a. Design a product with multiple components and describe how the components interact to form a system.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students learned that systems have components that work together to accomplish a goal. In grades 3-5, students produce a product with multiple components and describe the interaction between these components. In grades 6-8, students will understand how changing one component will impact that system. Students will deconstruct a system into its component parts and describe how they interrelate. **IMPORTANT CONCEPTS** • Systems include a variety of components. • Components within a system interact (work together) to make a product work. • People use a design process to integrate components in the design of a system or product. **KEY SKILLS/PROCEDURES** • Communicate examples of system components and identify components of the system. • Describe the interaction between a product's components, including ways the parts of that system impact or are impacted by its other parts. • Design a product that contains multiple components. **Content Elaborations** **CLARIFICATIONS** In grades K-2, students learned systems have parts or components that work together to accomplish a goal. Before designing their own product, students may find it helpful to look at other products and see how the components work together to make the product function. Products could be built physically or using online models and simulations. Products could contain simple circuits such as a light bulb powered by a battery. Toy cars could be used to investigate speed. These projects could integrate fourth and fifth grade-level science content. **CONTENT FOCUS** This content statement focuses on the interaction of the components that comprise a system.

Topic 3: Demonstrate that solutions to complex problems require collaboration, interdisciplinary understanding and systems thinking.	
3-5.DT.3.b. Explore and document connections between technology and other fields of study.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students described how technologies are used in different fields. In grades 3-5, students explore connections between technology and other fields of study. In grades 6-8, students will learn how inventions and innovations in one field can transfer into other fields of technology. **IMPORTANT CONCEPTS** • Technology can be used in a variety of ways across many disciplines affecting multiple facets of society. • Multiple disciplines affect the development of technology. **KEY SKILLS/PROCEDURES** • Discuss how various disciplines utilize the same technology. • Identify ways a given piece of technology can be used in many different fields. **Content Elaborations** **CLARIFICATIONS** Identifying different technologies (knowledge, artifacts, products, processes, infrastructure, tools and materials) can help students relate how a technology could impact multiple disciplines and also is impacted by multiple disciplines. For example, lenses are used in telescopes, microscopes, reading glasses, contact lenses and cameras. The same basic technology of a lens is used to help people see things that are large but far away and see things that are close but small. The field of medicine also has influenced the development of lens technology itself as advances in contact lenses have been made to meet the wants or needs of patients. **CONTENT FOCUS** The focus is on examples of how knowledge and skills from multiple disciplines can contribute to design solutions and how a technology can impact multiple disciplines.
3-5.DT.3.c. Identify a product and describe how people from different disciplines combined their skills in the design and production of the product.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students worked as a team to identify possible problems to solve and potential technological solutions to these problems. In grades 3-5, students describe how people from different disciplines apply their knowledge and skills as they collaborate to design a product. In grades 6-8, students will collaborate to

Topic 3: Demonstrate that solutions to complex problems require collaboration, interdisciplinary understanding and systems thinking.	
	solve a problem as an interdisciplinary team. Students will evaluate the effectiveness of the group's collaboration during a design process and the contribution of the various roles. **IMPORTANT CONCEPTS** • Products are designed and produced by people in various disciplines. **KEY SKILLS/PROCEDURES** • Explain how people from different disciplines create a single product. **Content Elaborations** **CLARIFICATIONS** Identify that a product requires the integration of different ideas from multiple disciplines and a variety of backgrounds to create the end product. People in each discipline bring different knowledge and skills together when they collaborate to solve a problem to meet a need or want. For example, a robotic vacuum incorporates parts and functions from many disciplines. Robotics, vacuum and radio/wireless technologies and more need to work together to make the robotic vacuum function properly. **CONTENT FOCUS** The focus is on the collaboration between individuals knowledgeable in their disciplines to create an end product.

Topic 4: Evaluate designs using functional, aesthetic and creative elements.	
3-5.DT.4.a. Use criteria developed with guidance to evaluate a new or improved product for its functional, aesthetic and creative elements.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students identified and discussed the aesthetics, functional aspects and creativity of everyday objects. In grades 3-5, students develop criteria with guidance and apply these criteria to evaluate a product for its functional, aesthetic and creative elements. In grades 6-8, students will examine the progression of a product to identify how the functional, aesthetic and creative elements were applied. They also will apply the design principle "form follows function" to develop a product. **IMPORTANT CONCEPTS** • Criteria, whether given or created, can be used to evaluate a product. • Designers emphasize some or all of the functional, aesthetic and creative elements in their designs. Resources impact the importance of each element. **KEY SKILLS/PROCEDURES** • Create with guidance a list of criteria that could be used to improve a product. • Evaluate a product against a set of criteria. **Content Elaborations** **CLARIFICATIONS** Students critique a product using a collaboratively developed set of criteria. The functional element considers if the product fulfills the intended purpose. The aesthetic element considers the appeal of the product, including visual, audio and tactile. The creative element considers the uniqueness of the way the product fulfills the intended purpose. Suggestions for evaluation could include a rubric, checklist or grading sheets for students to use as they evaluate functional, aesthetic and creative elements. For example, a chair can be evaluated to see if it is functional (Does it support an individual's weight? Does it tip over easily?) and aesthetically pleasing (What materials are used? Is it pleasing to look at or touch?). For the creativity element, the chair can be evaluated to see if it performs the function of a chair but in a new or unusual way (for example, shaped like a shoe or hanging from the ceiling). **CONTENT FOCUS** This content statement focuses on having students develop criteria for evaluating a product design based on functional, creative and aesthetic elements. Students then apply these criteria to complete the evaluation of a product.

Topic 4: Evaluate designs using functional, aesthetic and creative elements.	
3-5.DT.4.b. Examine a familiar product or process and suggest improvements to its design.	**Expectations for Learning** **LEARNING PROGRESSION** In grades K-2, students discussed and gave examples of how changes in design can be used to strengthen or improve a product. In grades 3-5, students examine, evaluate and suggest improvements to a product. In grades 6-8, students will analyze environments or products that are applications of universal or inclusive design and examine how designs can be improved to better meet the needs of all users. They also will apply the design principle "form follows function" to develop a product. **IMPORTANT CONCEPTS** • Products and processes can be analyzed and evaluated to make improvements. **KEY SKILLS/PROCEDURES** • Evaluate a product and process to make it better. **Content Elaborations** **CLARIFICATIONS** Products and processes are everywhere in a student's world. In this grade band, students are introduced to a process as a series of actions and learn that a process can be used to produce a result. Classrooms and schools have many processes that could be examined, such as lining up for recess or handing in homework. Each classroom might have a different series of steps to line up for recess, but the result of those processes still could be a group of children moving from one room and ending up outside. Students take an existing product (such as a classroom chair or desk) or process and look for ways to make it better. For example, students could evaluate the current process for the end-of-day dismissal pattern and suggest a more efficient design. **CONTENT FOCUS** The focus is on how to improve a product or process.

Grades 6-8

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.

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

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.
6-8.ICT.4.d. Evaluate the effectiveness of a digital tool to	**Expectations for Learning**

Topic 4: Use digital learning tools and resources to communicate and disseminate information to multiple audiences.	
communicate information with multiple audiences.	**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. Transportation technology increases the spread of diseases, both in their geographical reach and the

Topic 1: Demonstrate an understanding of technology's impact on the advancement of humanity – economically, environmentally and ethically.	
	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 idea of fair use principles and usage rights and continue to build on their understanding of intellectual

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

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

CONTENT FOCUS

Topic 3: Explain how technology, society and the individual impact one another.	
	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.
6-8.DT.1.d. Explain how optimization is the process of	**Expectations for Learning**

Topic 1: Define and describe technology, including its core concepts of systems, resources, requirements, processes, controls, optimization and trade-offs.	
making a product as fully functional and effective as possible.	**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.
6-8.DT.1.e. Describe how trade-offs involve a choice of one quality over another.	## Expectations for Learning **LEARNING PROGRESSION**

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

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

Topic 3: Demonstrate that solutions to complex problems require collaboration, interdisciplinary understanding and systems thinking.	
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.	**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 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. **Content Elaborations** **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.
6-8.DT.3.d. Give examples of how changes in one part of a system can impact other parts of that system.	**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 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.

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.

Grades 9-12

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.

9-12.ICT.1.a. Develop strategies for using digital learning tools and resources to plan, implement and reflect upon a complex task.

Expectations for Learning

LEARNING PROGRESSION

In grades 6-8, students selected and used digital learning tools or resources to support planning, implementing and reflecting upon a defined task. In grades 9-12, students learn how to develop strategies for using digital learning tools and resources to plan, implement and reflect on complex tasks.

IMPORTANT CONCEPTS

- Depending on the task, digital tools and resources have varying benefits and limitations.
- Effectively selecting digital learning tools and resources for a task takes strategic planning and evaluation.
- Developing strategies for using digital tools and resources helps make planning, implementing and reflecting on tasks more effective.

KEY SKILLS/PROCEDURES

- Analyze a task to select appropriate digital learning tools and resources to support the task.
- Establish a plan to strategically use digital tools and resources to effectively plan, implement and reflect on a complex task.

Content Elaborations

CLARIFICATIONS

By developing strategies for using digital learning tools and resources, students can more effectively plan, implement and reflect upon complex tasks both individually and in groups. This could include strategically using digital tools for time and project management, collaboration, peer feedback and revision. Before selecting digital tools, students should carefully consider the task to determine which features of digital tools they will need.

For example, in English language arts, students may create digital storybooks to teach grammar to younger students. For this project, students must consider which digital tools and resources will help them plan the sequence of their stories, create their graphics, share their work with peers or other learners to gain feedback and revise their work. Beyond the strategic selection of digital tools and resources, students develop strategies for using these tools and resources. For example, in the project above, students may

Topic 1: Identify and use appropriate digital learning tools and resources to accomplish a defined task.	
	use strategies that involve saving and keeping track of different versions of their work. When sharing their work with others, students may develop strategies for collecting this feedback and for monitoring what feedback has been received, responded to and resolved. **CONTENT FOCUS** This content statement focuses on students strategically selecting and using digital learning tools and resources to support the processes of planning, implementing and reflecting on complex tasks.
9-12.ICT.1.b. Based on project-specific requirements, develop criteria to select digital learning tools and resources to support the concurrent management of multiple projects.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students developed criteria for selecting digital learning tools and resources to accomplish a defined task. In grades 9-12, students develop criteria based on project-specific requirements to select digital learning tools and resources to support the concurrent management of multiple projects. **IMPORTANT CONCEPTS** • Project requirements and constraints impact the criteria used for selecting digital learning tools and resources that will effectively support the concurrent management of multiple projects or project components. • Collaboration often is required while working on projects. • The ability to manage multiple projects or multiple aspects of a project is a requirement for most professional environments. **KEY SKILLS/PROCEDURES** • Analyze project requirements and constraints across multiple projects or components of a project that affect the selection of digital learning tools and resources. • Develop criteria for selecting project management and productivity tools. **Content Elaborations** **CLARIFICATIONS** Constraints and project requirements, such as timelines, access, workload, group requirements or project goals, can affect the criteria used for the selection of digital learning tools and resources. As students identify the tasks in each project, or in each component of a single project, they need to review project management and productivity tools to identify the features needed to support successful project completion. Students may find that concurrent management of multiple projects or components within a project requires coordinating the use of more than one tool. For example, students may be asked to complete a project in social studies to identify, share and solve a social issue in their local community. They would need the

Topic 1: Identify and use appropriate digital learning tools and resources to accomplish a defined task.	
	ability to select the proper digital tools to collaborate with one another to assign tasks, schedule multiple timelines, manage workloads across components of the project and organize information. **CONTENT FOCUS** The focus is on students developing criteria and purposefully selecting digital learning tools and resources that aid them in aspects of managing multiple projects or multiple aspects of one project concurrently (such as time, people, tasks and documents).
9-12.ICT.1.c. Analyze and evaluate the ease of use and effectiveness of available features of selected digital learning tools and resources.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students evaluated digital learning tools and resources to support learning and productivity. In grades 9-12, students analyze and evaluate the ease of use and effectiveness of available features of selected digital learning tools and resources. **IMPORTANT CONCEPTS** • It is important to understand the benefits and limitations of a particular digital learning tool or resource for completing a task. • Two tools or resources may have the same or similar features, but one may be easier to use than another. • Not every user uses a tool or resource in the same way or finds the same tools and resources beneficial. **KEY SKILLS/PROCEDURES** • Identify the function and features of digital learning tools and resources. • Compare the features of various digital tools and resources used to perform specified functions to make determinations concerning their ease of use and effectiveness. **Content Elaborations** **CLARIFICATIONS** Digital learning tools and resources can be evaluated for their effectiveness and ease of use. Exploring the various features of tools and resources, how they meet pre-established criteria and how well they support the task at hand will allow students to independently select digital tools and resources suited for future tasks and individual needs. How well a digital tool works in combination with other digital tools needed for a project is another factor that may impact tool selection. Evaluating digital tools and resources in terms of their ease of use and effectiveness can become a common practice that enhances how effectively students are able to complete projects. For example, in an

Topic 1: Identify and use appropriate digital learning tools and resources to accomplish a defined task.	
	assignment in which students are asked to document and reflect on a science experiment, students could evaluate the effectiveness of the digital tools used for documentation and the features available in and missing from these tools to improve the documentation of future experiments. **CONTENT FOCUS** The focus is on students evaluating the ease of use and effectiveness of features available in digital learning tools and resources.

Topic 2: Use digital learning tools and resources to locate, evaluate and use information.	
9-12.ICT.2.a. Use advanced search and filtering techniques to locate needed information using digital learning tools and resources.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students used advanced search techniques to locate information using digital learning tools and resources. In grades 9-12, students use advanced search and filtering techniques to locate information using digital learning tools and resources. **IMPORTANT CONCEPTS** • Advanced search and filtering techniques produce results more relevant to the information need. • Utilizing a variety of search and filtering techniques when searching a scholarly database provides access to credible sources of information. • Some search techniques are more useful than others for specific search purposes. **KEY SKILLS/PROCEDURES** • Identify and use advanced search and filtering techniques. • Evaluate search and filtering techniques and digital learning tools and resources that will be most useful for gathering specific information. **Content Elaborations** **CLARIFICATIONS** By using advanced search and filtering techniques (such as Boolean, proximity and nested searches), targeted information can be located online in a more efficient method. For example, students in a science class can use filtering techniques to help them find information about the emergence and growth of an invasive fish species in their local area. By narrowing the time period they search, students may see a greater impact of the growth of this species. Students may use advanced search techniques to track the presence of this fish species in nearby areas, excluding particular areas that do not have an impact on the growth of the species within their local area. By using more effective search and filtering techniques to locate information, students will be able to efficiently evaluate information and integrate this information into their projects and assignments. **CONTENT FOCUS** This content statement focuses on selecting and using advanced search and filtering techniques that will assist in locating information and resources that are beneficial to completing a given task in an efficient manner.

Topic 2: Use digital learning tools and resources to locate, evaluate and use information.	
9-12.ICT.2.b. Independently construct an evaluative process for information sources chosen for a learning task.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students used multiple criteria to evaluate the validity of the information found with digital learning tools and resources. In grades 9-12, students independently construct an evaluative process for information sources. **IMPORTANT CONCEPTS** • A variety of criteria and strategies are used to evaluate the credibility of a source, including those that are predetermined and self-determined. **KEY SKILLS/PROCEDURES** • Independently create a process for evaluating information from a chosen source using criteria and strategies that are self-determined in addition to those that are predetermined. • Reflect upon the process developed to evaluate source credibility to determine if changes are needed to improve this process. • Select credible information as a result of the evaluation process constructed. **Content Elaborations** **CLARIFICATIONS** Information literacy criteria, such as timeliness, relevancy, bias, authority, accuracy and purpose can be a part of a process that students construct to evaluate information sources. Students can further strengthen the evaluative process by considering areas where their evaluation of sources may fall short and then incorporating additional questions to target these areas. Students may identify additional evaluation criteria or strategies that are specific to the topics they are investigating. As part of constructing an evaluative process, students can determine how they will document the process they use and organize their findings. **CONTENT FOCUS** The focus is on students independently constructing an evaluative process for information sources.
9-12.ICT.2.c. Analyze the complexities and discrepancies found in digital information to make informed decisions.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students used multiple criteria to evaluate the validity of the information found with digital learning tools and resources. In grades 9-12, students analyze the complexities and discrepancies found in digital information to make informed decisions.

Topic 2: Use digital learning tools and resources to locate, evaluate and use information.	
	IMPORTANT CONCEPTS • Digital information may have discrepancies and complexities that need to be identified and understood. • Complexities and discrepancies found in digital information can be identified and analyzed by comparing information across multiple sources. **KEY SKILLS/PROCEDURES** • Compare and contrast digital information from multiple sources to identify similarities and differences in information, determine credibility and relevance and construct an informed understanding of a topic. • Distinguish between discrepancies in information due to inconsistencies or inaccuracies and differences in information due to the complexity of a topic. **Content Elaborations** **CLARIFICATIONS** By analyzing the various information found through digital learning tools, students can make informed decisions about what information is credible, relevant and useful to their work. Through this analysis, students can identify discrepancies between information sources by comparing and contrasting similar information across, for example, different sponsors, authors and media. Students can examine complexities in digital information that can be created by the range and breadth of information available and variety of perspectives represented across information sources (such as organizational websites that may have a particular mission or research interest). In the case of these complexities, differences in information may be found across sources that are each credible. Students can analyze such complexities as they identify gaps in information and synthesize information to develop a more informed understanding upon which to base decisions. This content statement is a natural progression from content statement 9-12.ICT.2.b. that involves students in independently constructing a process for evaluating the credibility of information sources. **CONTENT FOCUS** The focus is to develop students' abilities to make informed decisions when working with information that contains complexities and discrepancies and determining what information is credible, relevant and useful to completing the task at hand.

Topic 2: Use digital learning tools and resources to locate, evaluate and use information.	
9-12.ICT.2.d. 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.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students applied principles of copyright, used digital citation tools and used strategies to avoid plagiarism. In grades 9-12, students 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** • Online sources have different usage rights. The specific usage rights for each source must be examined and followed. • Copyright laws, including those for digital materials, need to be understood and followed. • It is important to understand what constitutes plagiarism and how to avoid plagiarism. **KEY SKILLS/PROCEDURES** • Identify the usage rights of a given digital source. • Apply principles of copyright. • Avoid plagiarism by utilizing strategies and digital citation tools to credit sources for information used. **Content Elaborations** **CLARIFICATIONS** Multiple strategies are necessary to avoid copyright infringement and plagiarism. When using the work of others, students should use copyright best practices, such as determining and adhering to permitted uses of content and seeking permission from copyright holders when needed. They may need to conduct an analysis of the four fair use factors (purpose, amount, nature and effect). Students can avoid plagiarism by systematically keeping track of information sources and taking advantage of digital citation tools to properly cite sources. **CONTENT FOCUS** The focus is on the importance of following copyright law and providing documentation of all content, including digital resources and tools. When students use the work of others and create content of their own, they will have the necessary knowledge to apply copyright principles and use strategies and digital citation tools to properly cite sources and avoid plagiarism.

Topic 3: Use digital learning tools and resources to construct knowledge.	
9-12.ICT.3.a. Synthesize textual, visual and quantitative research and data (e.g., images, diagrams, maps, graphs, infographics, videos, animations, interactives) from a variety of digital learning tools and resources.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students analyzed and integrated textual, visual and quantitative information from multiple digital learning tools and resources. In grades 9-12, students synthesize textual, visual and quantitative research and data from a variety of digital learning tools and resources. **IMPORTANT CONCEPTS** • It may be required to integrate different types of information (textual, visual and quantitative) from multiple resources to achieve a specific purpose or task. **KEY SKILLS/PROCEDURES** • Synthesize textual, visual and quantitative information from a variety of digital learning tools and resources to achieve a specific task or purpose. **Content Elaborations** **CLARIFICATIONS** Textual, visual and quantitative information each bring a different layer of information to a topic or concept. As students synthesize these different forms of information, they build a more complete understanding. Students can use digital learning tools to synthesize evidence and construct knowledge from different types of information they locate using digital tools and resources, including research and data pulled from images, maps, graphs, infographics and videos. For example, students in a health class researching trends in teen use of tobacco products and possible influences will likely draw upon a variety of textual, visual and quantitative information resources that they will need to synthesize to determine how these pieces of information connect to form a coherent understanding. They may use a database tool to analyze online datasets that provide percentages of current teen smokers. Students can use visualization tools to see their data displayed in different formats (such as an interactive map that displays percentages by region or a line graph that shows how these percentages change across years). In addition, advertisements for tobacco products and for anti-smoking campaigns may serve as resources for examining possible factors in teen smoking. **CONTENT FOCUS** This content statement focuses on students constructing knowledge through synthesizing different types of information found from a variety of digital learning tools and resources.

Topic 3: Use digital learning tools and resources to construct knowledge.	
9-12.ICT.3.b. Analyze relationships and forecast outcomes using data collected by students or retrieved from a variety of digital learning tools and resources.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students analyzed data collected or retrieved from a variety of digital learning tools and resources to determine if patterns or trends were present. In grades 9-12, students analyze relationships and forecast outcomes using data collected by students or retrieved from a variety of digital learning tools and resources. **IMPORTANT CONCEPTS** • Digital learning tools can support data collection and analysis by helping to organize observations and look for trends or patterns to determine relationships. • Data can be collected or retrieved from digital sources and analyzed to determine if relationships are present. • Relationships found when analyzing data can be used to make predictions. **KEY SKILLS/PROCEDURES** • Use digital learning tools and resources to assist in data collection, organization and analysis. • Analyze data, collected on one's own or retrieved from a variety of digital sources, to determine if relationships are present. • Make predictions based on relationships found in analyzed data. **Content Elaborations** **CLARIFICATIONS** Data analysis can be more impactful for students when they have the opportunity to examine data they gathered through explorations. Digital learning tools can support data collection by helping students organize their observations or data entries. These digital tools can support data analysis by helping students look for trends or patterns to determine relationships. Students also can construct knowledge using data gathered from a variety of credible online sources of information. Students can interpret the data gathered and make forecasts or predictions of outcomes based on their analysis. For example, students in a social studies class can make predictions about the outcome of a local election based on data gathered from online voting trends over past elections. Students in math or science class can gather data on the distance a model car can travel over a set time, analyze relationships between variables of speed, distance and time and then predict outcomes when factors like ramp height or ramp surface are changed. After testing the new factors, the predicted results and actual results can be compared for further analysis.
	CONTENT FOCUS

Topic 3: Use digital learning tools and resources to construct knowledge.	
	The focus is on students analyzing data they collected or retrieved from various digital learning tools and resources to determine if relationships are present to make predictions. **Career Connections** **CAREER PLANNING** Through Career Connections provided in earlier grades, students were exposed to various digital tools to facilitate career awareness and exploration while performing data analysis to identify career interests. Data analytics exist across many career fields. Using student-identified career interests, students now use digital tools to explore how different careers use formal and informal data to determine relationships and forecast outcomes. Students then select an occupation and develop one or more career plans using OhioMeansJobs K-12. (Students must first create an account on the OhioMeansJobs K-12 website to develop a career plan using this link.) Teachers can consider aiding students in academic course selection based on career interests. For example, if a student is interested in data visualization tools, the student can consider a data analytics math course like *Data Science Foundations*.
9-12.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** • Digital learning tools and resources can be used to create and develop original content that demonstrates knowledge of a concept or topic. **KEY SKILLS/PROCEDURES** • Determine what type of artifact can be used to effectively demonstrate the knowledge that has been constructed of a topic or concept. • Use digital learning tools and resources to create an artifact consisting of original content that demonstrates knowledge constructed of a topic or concept.

Topic 3: Use digital learning tools and resources to construct knowledge.	
	Content Elaborations **CLARIFICATIONS** Students can provide evidence of their learning through creating artifacts (such as videos, annotated images, graphs, charts, video games and diagrams) using digital learning tools and resources. Creating their own content through such artifacts demonstrates the knowledge they have constructed about a concept or topic. For example, students could create a visual brochure using the research they conducted on a chosen country in a world language class. Or students could create a children's e-book to demonstrate knowledge of a science concept using appropriate English language arts conventions while using other ABC-style books as anchor texts. Students could take pictures using digital cameras or create their own artwork (or in collaboration with the fine arts teacher) to add original artwork to the ABC-style e-book. To demonstrate knowledge gained from the health research project described in 9-12.ICT.3.a., students could construct an infographic that displays the key relationships found in the analyzed data. This content statement is a natural progression from content statements 9-12.ICT.3.a. and 9-12.ICT.3.b. that involve students in analyzing and synthesizing information and data. **CONTENT FOCUS** The focus is on students creating digital artifacts that demonstrate their knowledge through the effective use of digital learning tools and resources.

Topic 4: Use digital learning tools and resources to communicate and disseminate information to multiple audiences.	
9-12.ICT.4.a. Use digital learning tools and resources to identify communication needs considering goals, audience, content, access to tools or devices, timing of communication (e.g., time zones), etc.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students used digital learning tools and resources to identify communication needs considering goals, audience and content. In grades 9-12, students use digital learning tools and resources to identify communication needs considering goals, audience, content, access to tools or devices and additional factors. **IMPORTANT CONCEPTS** • Communication needs vary based on a number of factors (for example, goals, audience, content, access to tools or devices). • To effectively communicate and disseminate information to multiple audiences it is necessary to first identify communication needs. • Digital learning tools and resources can be used to gather information about communication needs. **KEY SKILLS/PROCEDURES** • Identify communication needs using digital learning tools and resources. **Content Elaborations** **CLARIFICATIONS** The first step in developing a plan to share digital information is to identify communication needs. By considering multiple factors (such as plan goals, audience characteristics, access to tools and timing), students are able to begin building the foundation of a plan to communicate and disseminate information to multiple audiences. After identifying communication needs, students continue to develop their communication plans in content statement 9-12.ICT.4.b. Students may use digital tools like survey or poll tools to identify communication needs (such as audience members' spoken language(s), content familiarity, accessibility needs and availability) and to assist in planning. **CONTENT FOCUS** This content statement focuses on students using digital learning tools and resources to identify communication needs for various tasks based on a variety of criteria, such as plan goals, the intended audience, content to be shared and tools and devices accessible at that time.

Topic 4: Use digital learning tools and resources to communicate and disseminate information to multiple audiences.	
9-12.ICT.4.b. Based on communication needs, develop, implement and evaluate a communication plan to disseminate information to multiple audiences.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students selected and used a variety of media formats to communicate to a target audience and evaluated the effectiveness of a digital tool to communicate information to multiple audiences. In grades 9-12, students develop, implement and evaluate a communication plan to disseminate information to multiple audiences that is based on communication needs. **IMPORTANT CONCEPTS** • When developing a communication plan for sharing digital information with a variety of audiences, the content, audience and specific task goals and characteristics guide the construction of the plan. • Some digital tools are more effective than others for addressing a variety of audiences. • It is important to evaluate the effectiveness of a communication plan to identify components that can be improved for future implementations. **KEY SKILLS/PROCEDURES** • Create a communication plan for sharing information digitally based on identified communication needs that consider audience, content, goals, access, timing and other task specifics. • Select online communication tools that are appropriate for specific audiences, content and tasks. • Develop a strategy for how to best use online communication tools to communicate and disseminate information to multiple audiences. • Evaluate a communication plan to identify areas for improvement. **Content Elaborations** **CLARIFICATIONS** By first analyzing communication needs, students can create and implement plans for sharing digital information with a variety of audiences. Taking communication needs into consideration, students can develop plans that incorporate appropriate online communication tools that will allow them to best convey information to targeted audiences. They can lay out other details within their plans, such as when different communications will take place based on timelines and availability. Students can consider the criteria they will use to evaluate their communication plans and to assess and improve their plans for use in the future. For example, students could be asked to develop and implement communication plans in which they identify what segments of their community are affected by a particular community problem, how they will communicate with team members in another school to develop solutions to the problem and how they will share solutions with impacted members in their community.
	CONTENT FOCUS

Topic 4: Use digital learning tools and resources to communicate and disseminate information to multiple audiences.	
	The focus is on developing, implementing and evaluating a communication plan that meets identified communication needs that must be considered to communicate and disseminate information to multiple audiences.
9-12.ICT.4.c. Integrate accessibility principles to effectively communicate to, and meet the needs of, multiple audiences.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students discussed and identified ways to communicate and disseminate information so that users with varied needs could access information. In grades 9-12, students integrate accessibility principles to effectively communicate to, and meet the needs of, multiple audiences. **IMPORTANT CONCEPTS** • It is necessary to integrate accessibility principles when communicating and disseminating information to make all digital communications as accessible as possible. • Making content accessible to different audiences requires first considering the communication needs of these audiences. • The accessibility features available vary for each digital communication tool. **KEY SKILLS/PROCEDURES** • Consider the communication needs of different audiences in terms of accessibility principles. • Use accessibility features that allow for optimal communication of all information to the largest possible audience. **Content Elaborations** **CLARIFICATIONS** Identifying the communication needs of different audiences from the start and taking into consideration their varied needs, abilities and preferences is necessary to make content accessible to a variety of audiences and to reach the broadest possible audience. Students engage in the upfront planning necessary for integrating accessibility principles as they view the information to be communicated from the multiple perspectives of their audiences and ask themselves questions such as, “Is this information understandable?” and “Can audience members perceive or take in this information?” By integrating accessibility principles (such as universal or inclusive design) and features into the way students create and share their content, students will be able to communicate and disseminate information to a variety of audiences. For example, including closed captioning for a video or choosing a digital tool with speech-to-text compatibility would provide access to a wider audience by supporting people who are hard of hearing or

Topic 4: Use digital learning tools and resources to communicate and disseminate information to multiple audiences.	
	non-native language speakers. Students could create accessible documents to share learning with audiences outside of the classroom by providing alternative text to describe images and using text displayed in fonts and colors perceivable by people with visual impairments. **CONTENT FOCUS** The focus is on integrating accessibility principles and features to make digital content accessible to people with varying needs, abilities and preferences.
9-12.ICT.4.d. Use digital learning tools to represent and model complex systems of information to a target audience.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students evaluated the effectiveness of a digital tool to communicate information with multiple audiences. In grades 9-12, students use digital learning tools to represent and model complex systems of information to a target audience. **IMPORTANT CONCEPTS** • Digital learning tools enable complex systems of information to be represented and modeled in a format that can be more easily comprehended by a target audience. **KEY SKILLS/PROCEDURES** • Consider the system of information to be shared and the characteristics of a target audience. Evaluate digital learning tools to determine appropriate tools to represent and model this complex system of information to the target audience. • Create a digital representation that models a complex system of information that meets the needs of a target audience. **Content Elaborations** **CLARIFICATIONS** Representing and modeling complex systems of information can engage students in discerning patterns and relationships in data that can involve large datasets and multiple factors or components. Certain digital learning tools (such as data visualization tools and simulations) have the capability to make patterns, relationships and interactions between the multiple elements of a complex system more clearly seen and comprehended. By utilizing these capabilities, students can communicate complex systems of information to a target audience more effectively. For example, students could communicate factors affecting the weather during a hurricane (such as wind speed, wind direction and temperature) using a simulation or interactive real-time map. In math, students could use pivot tables within spreadsheets to look at various aspects of complex data. How students would

Topic 4: Use digital learning tools and resources to communicate and disseminate information to multiple audiences.	
	use digital tools to communicate this information would depend on their target audience. Are students modeling a complex system for middle school students or a visiting scientist? This content statement forms a natural progression from the content statements in Topic 3 of this strand that engage students in using digital learning tools to construct knowledge, analyze information and synthesize information and data. **CONTENT FOCUS** The focus is on using digital learning tools to organize information into a representation that makes a complex system of information and the models of patterns, relationships and interactions within this system more comprehensible to a target audience.

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.

9-12.ST.1.a. Interpret, and practice, ethical considerations and legal requirements involved in the creation and use of digital technologies.

Expectations for Learning

LEARNING PROGRESSION

In grades 6-8, students advocated and exhibited ethical, legal and responsible practices when utilizing technology. Students also reviewed and demonstrated ethical considerations and legal requirements involved in creating artifacts using digital technologies. In grades 9-12, students interpret and practice ethical considerations and legal requirements involved in creating artifacts using digital technologies.

IMPORTANT CONCEPTS

- It is important to understand the rights associated with the ownership of intellectual property.
- The ethical responsibilities and legal requirements for using digital artifacts involve both determining usage rights and giving appropriate credit to the holder of the rights to that work.
- It is critical to understand the difference between copyright infringement, plagiarism and piracy and how this applies to the creation and use of digital artifacts. (For example, certain uses of digital technology can constitute piracy and plagiarism, even when credit is given.)
- Ethical considerations and laws surrounding the creation and use of digital artifacts may need to be reevaluated due to advancements in technology.

KEY SKILLS/PROCEDURES

- Protect intellectual property rights of self and others.
- Appropriately credit sources of all media types that can be used when creating digital artifacts.
- Interpret and apply the laws associated with the creation and use of digital artifacts, identifying legal and illegal uses.
- Determine ethical and unethical behavior related to the creation and use of digital artifacts, explaining one's reasoning.

Content Elaborations

CLARIFICATIONS

When using digital technologies to create artifacts (such as digital images, online video, source code and apps), it is important to recognize the ethical and legal concerns that should be considered. This includes intellectual property, plagiarism, piracy, copyright infringement and, in general, showing respect for the work and rights of others.

Topic 1: Demonstrate an understanding of technology's impact on the advancement of humanity – economically, environmentally and ethically.	
	When creating any digital artifact, students must determine usage rights and provide appropriate credit for the work they use. Students' creation of their own work can involve applying Creative Commons licenses and participating in open educational resources. Students can contrast the benefits of using, creating and sharing digital artifacts with the potential risks. **CONTENT FOCUS** This content statement focuses on students interpreting and applying laws pertaining to their creation and use of a range of digital artifacts. Students also must weigh ethical considerations that may be involved. Responsible, legal and ethical use of another's work (such as source code, designs or images) and of digital technologies when creating artifacts is emphasized.
9-12.ST.1.b. Debate the advantages and disadvantages of widespread use, accessibility and reliance on technology in one's world, in the workplace and in global society.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students explored the advantages and disadvantages of widespread use, accessibility and reliance on technology in one's world. In grades 9-12, students debate the advantages and disadvantages of widespread use, accessibility and reliance on technology in one's world, the workplace and global society. **IMPORTANT CONCEPTS** • The widespread use of a technology can have both advantages and disadvantages on one's world, the workplace and global society. • There are potential positives and negatives both in being immersed in technology and being unplugged. • Inequities in access to technology can have implications for one's world, the workplace and global society. • Ethical decision-making is needed in weighing the positive and negative consequences of a technology.
	KEY SKILLS/PROCEDURES

Topic 1: Demonstrate an understanding of technology's impact on the advancement of humanity – economically, environmentally and ethically.	
	• Consider different perspectives concerning the positive and negative impacts of widespread use of technology, comparing the advantages and disadvantages of technology use in terms of one's world, the workplace and global society. • Provide examples of how access to technology can affect an individual, the workplace and global society. **Content Elaborations** **CLARIFICATIONS** Students research and debate the advantages and disadvantages of widespread technology use in areas such as environmental resources, agriculture, medicine and transportation. Students consider disadvantages that reliance on technology can bring, such as impacts on interpersonal skills when changing from face-to-face to remote forms of communication, technology addiction, reliance on electricity and connectivity, risks to data privacy and cybersecurity threats. When considering advantages and disadvantages stemming from technology use, inequities that exist between populations who do and do not have access to technology must be considered, as in those reflected by the digital divide. Students could watch a documentary, view a popular film or read a fictional story in which technology plays an important role in the plot or character development. Students then could debate the positive or negative impacts of this technology and consider these impacts in terms of a technology in their own world. **CONTENT FOCUS** The focus is on students weighing the positive and negative impacts of widespread use, accessibility and reliance on technology. Individuals, organizations and cultures balance the tension between an innovation's potential positive and negative consequences. Students debate these advantages and disadvantages. As digital citizens, they discuss balancing the adoption of a technology with mitigating potential negative consequences, while taking into account the diverse population of those impacted.
9-12.ST.1.c. Select a technology and analyze its global impact across multiple disciplines.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students analyzed an environmental concern and investigated technology solutions to that problem. In grades 9-12, students select a technology and analyze its global impact across multiple disciplines.

Topic 1: Demonstrate an understanding of technology's impact on the advancement of humanity – economically, environmentally and ethically.	
	IMPORTANT CONCEPTS • Technological impacts can be felt at the individual, local, national or global level in a wide variety of contexts over time. • Technological impacts can extend across multiple disciplines. **KEY SKILLS/PROCEDURES** • Trace the evolution of a technology over time. Analyze and explain its consequences, considering geographic scope. • Analyze and explain how a specific technology has affected more than one discipline or field (such as agriculture, medicine and transportation). **Content Elaborations** **CLARIFICATIONS** Technological impacts can extend over time, across geographic areas and across disciplines. Students identify a technology and analyze the nature of its impact on people and society in a variety of ways, such as economically, environmentally and ethically. Students could look to current events to find technologies to examine. For example, rare earth minerals located in China are needed to manufacture many technological products, including mobile phones, medical equipment, electric cars and solar panels. Students could research the impact of a technology whose production is reliant on the import of critical resources from China, analyzing this impact in terms of the disciplines or fields affected and global reach. Students could create a digital product that would effectively illustrate findings, such as the short- and long-term global impact of the production of that technology. **CONTENT FOCUS** The focus is on students analyzing the impact of a specific technology over time and across geographic areas. Students analyze these impacts in terms of their reach across multiple disciplines.

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

9-12.ST.2.a. Demonstrate and advocate effective collaboration strategies and techniques using technology.

Expectations for Learning

LEARNING PROGRESSION

In grades 6-8, students critiqued specific instances of how technology impacts access to information, communications and collaboration. In grades 9-12, students demonstrate and advocate effective collaboration strategies and techniques using technology.

IMPORTANT CONCEPTS

- Effective collaboration requires meaningful communication and communicating with respect.
- Effective collaboration strategies and techniques can vary depending on the technology tools being used, situation, task and users.
- Modeling effective collaboration strategies and techniques can encourage others to collaborate more effectively.

KEY SKILLS/PROCEDURES

- Select and use technology tools in combination with collaboration strategies and techniques to support collaboration within a particular task.
- Reflect on the effectiveness of the collaboration strategies and techniques used with particular technology tools for a collaborative task.
- Model effective collaboration in online discussions, group work and peer feedback.

Content Elaborations

CLARIFICATIONS

Students can demonstrate effective collaboration strategies and techniques using technology when, for example, they co-create using cloud computing (such as co-authoring documents or co-producing audio, video and music); share perspectives using discussion boards and blogs; conduct virtual meetings using video conferencing, chat tools and interactive whiteboards; and solve problems together using interactive tools that involve immersive environments (such as virtual worlds).

Students can learn which technology tools and strategies are useful for a particular collaboration given the situation, task and users. Tools and strategies used to collaborate with a co-author on a shared document may differ from those used to discuss design solutions with a larger group.

When collaborating, students can compare the advantages and disadvantages of using different strategies and techniques in combination with various technology tools. This enables them to advocate for those combinations of strategies and tools that would be effective for collaborating within a particular context. For example, students could work on a collaborative project using various online tools to share documents

Topic 2: Analyze the impact of communication and collaboration in both digital and physical environments.	
	and provide feedback. They could then rate the usefulness of the strategies and tools they used for their collaboration. **CONTENT FOCUS** This content statement focuses on how to appropriately and effectively collaborate in a digital environment. Students practice behaviors that promote productivity and collaboration. Certain technology tools are more effective than others, depending on the situation, task or users; one tool often does not meet all needs. ## Career Connections **CAREER PLANNING** Using the OhioMeansJobs.com K12 "Big Interview" tool, students work in small groups to use technology to conduct mock job interviews. Students electronically collaborate to evaluate and provide feedback to each other on their techniques and ability to effectively communicate both in their mock interview videos and when collecting peer feedback. (Select "Visit Interview Practice Center" to access the "Big Interview" tool.)
9-12.ST.2.b. Describe and demonstrate professionalism and civility in communications and collaborative environments.	## Expectations for Learning **LEARNING PROGRESSION** In grades 6-8, students explained how the use of technology can have both positive and negative impacts on personal, professional and community relationships. Students also applied appropriate interactions and digital etiquette in varying contexts, reflecting on potential impacts in both digital and physical environments. In grades 9-12, students describe and demonstrate professionalism and civility while communicating and collaborating in all environments. **IMPORTANT CONCEPTS** • Effective and professional communication and collaboration are based on respectful, civil behavior and practices. • Nonverbal communication (for example, tone of voice and facial expressions) can be lost in digital environments. There are ways to express some aspects of nonverbal communication in digital environments (such as strategic use of punctuation marks and capital letters). • Professionalism includes tone, grammar, appropriateness and respectful communication.

Topic 2: Analyze the impact of communication and collaboration in both digital and physical environments.	
	KEY SKILLS/PROCEDURES • In digital and physical environments, use appropriate words, tone and nonverbal signals to engage in professional and civil communication and collaboration. • Determine instances of communication and collaboration that are and are not professional and civil based on behavior. • Explain how personal communication choices can affect professional standing. **Content Elaborations** **CLARIFICATIONS** Students apply appropriate etiquette demonstrating professionalism and civility within a variety of digital environments (such as social media, email, learning management systems and videoconferencing), as well as in physical environments. Students convey thoughts productively and constructively by practicing to think critically about the way they will respond and evaluate their responses before posting or publishing (such as when peer editing, using discussion boards and providing feedback). Students demonstrate professionalism and civility for academic work and career readiness. For example, students could be given or create scenarios in which digital communication would be necessary (such as when taking an online course, facilitating a webinar or participating in a virtual meeting). They could establish rules for communicating within this digital scenario and create sample interactions. **CONTENT FOCUS** The focus is on students describing and demonstrating effective and professional communication and collaboration, based on respectful, civil behavior and practices. Behavior in both physical and digital environments can have social and professional consequences. Students identify how critically thinking about and evaluating their responses contribute to the way they communicate and collaborate.
9-12.ST.2.c. Analyze how social media impacts society, individuals and organizations.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students investigated how social media impacts society and the digital identities of individuals and organizations. In grades 9-12, students analyze how social media impacts society, individuals and organizations. **IMPORTANT CONCEPTS** • Social media tools have unique features and processes for sharing (such as hashtags and mentions) as compared to other traditional or web tools. These tools can influence social media's potential impact on society, individuals and organizations. • Social media memberships tie users' accounts to their digital footprints.

Topic 2: Analyze the impact of communication and collaboration in both digital and physical environments.	
	• Individuals and organizations may have different or conflicting interests for using social media (such as an individual's desire to share personal life events versus a business' goal to mine data and advertise). • Participation in a network includes membership (either named or anonymous) that can have both positive and negative consequences (such as being able to access useful resources, yet unknowingly sharing private information). **KEY SKILLS/PROCEDURES** • Explain ways that social media tools can be used to exert an influence on society, individuals and organizations. • Explain how participation in a social media network can have consequences for privacy. • Compare and contrast the goals of an individual user or organization to the goals of the social media platform. **Content Elaborations** **CLARIFICATIONS** Students analyze the positive and negative impact that social media usage can have on society, individuals and organizations. Positive impacts might include providing an efficient platform for collaboration, networking, public relations, market research and job searches. Potentially negative impacts could be infringement on privacy, intentional or unintentional spreading of false information, cyberbullying and reduced productivity. For example, students could analyze specific current events discussed on social media or sample social media accounts, such as accounts of politicians, news agencies, celebrities and influencers, for impact on culture and public opinion or policy. **CONTENT FOCUS** The focus is on examining how social media tools impact society, individuals and organizations, resulting in both positive and negative consequences. Users participating in social media automatically are joining a network of individuals and organizations in a fast-paced, media-rich environment. Social media posts often have an impact on larger public events, policy and opinion.

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

9-12.ST.2.d. Manage and adjust appropriate interactions and digital etiquette in varying contexts, in digital, physical and cultural environments.

Expectations for Learning

LEARNING PROGRESSION

In grades 6-8, students applied appropriate interactions and digital etiquette in varying contexts and reflected on potential impacts in both digital and physical environments. In grades 9-12, students manage and adjust appropriate interactions and digital etiquette in varying contexts, in digital, physical and cultural environments.

IMPORTANT CONCEPTS

- Social norms that guide interaction can vary across different physical and digital contexts.
- Cultures hold their own social norms that guide appropriate interaction; what is considered appropriate etiquette in physical and digital environments can vary from culture to culture and differ from one's own.
- Interactions in digital environments may be less formal but still have certain norms for communication that users are expected to follow.
- Nonverbal cues (such as emojis) exist in communications that take place in digital environments and can impact interactions.

KEY SKILLS/PROCEDURES

- Identify specific behaviors related to digital etiquette.
- Identify specific behaviors involving appropriate interaction and digital etiquette that vary across contexts in physical, digital and cultural environments.
- Contrast behaviors that are acceptable in digital environments (such as social media, chats and texts) with those acceptable in more traditional forms of communication (such as business communication).
- Adjust ways of interacting and digital etiquette behaviors according to the situation.

Content Elaborations

CLARIFICATIONS

Students identify how different contexts may require making adjustments to etiquette behavior and the way they interact. They learn to manage and adjust their interactions based on differences they identify in what is considered appropriate interaction in varying contexts (such as digital and physical environments, formal and informal settings or different groups of internet users). In addition, students must recognize differences that exist in social conventions across cultures to engage effectively in the global environment found online, modifying their behaviors accordingly.

For example, students could participate in role-play scenarios in various contexts, adjusting their digital communication in each. Or students could analyze a variety of examples of digital interactions to identify

Topic 2: Analyze the impact of communication and collaboration in both digital and physical environments.	
	appropriate and inappropriate interactions given different audiences (such as parents, teachers, the principal, a public official or peers). Students also could examine topics that might include diversity and inclusion principles, cultural competency and racial bias education. **CONTENT FOCUS** The focus is on students being able to adjust their interactions and digital etiquette according to the social conventions appropriate in varying contexts. Digital communication norms may differ from more traditional methods for communication. For example, the conventions of a business letter or legal document differ from those acceptable for email, chat or text messages. Productive interactions require an awareness and sensitivity to individuals' cultural norms.

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

9-12.ST.3.a. Debate how demand for technology and innovation have reshaped the social, cultural, political and/or economic landscape, citing references and examples.

Expectations for Learning

LEARNING PROGRESSION

In grades 6-8, students discussed and defined how the development and use of technology has influenced societal issues. In grades 9-12, students debate how demand for technology and innovation have reshaped the social, cultural, political and/or economic landscape, citing references and examples.

IMPORTANT CONCEPTS

- Social, cultural, political and economic aspects of society can each create demand for technology and innovation to varying degrees.
- All areas of life can be impacted by the demand for technology and innovation.

KEY SKILLS/PROCEDURES

- Identify a technology or innovation that has impacted people and communities as an example of how demand for technological development can reshape societal landscapes (social, cultural, political and/or economic).
- Analyze the relationship between demand for a technology or an innovation and different aspects of society (social, cultural, political and/or economic), examining the nature of this demand and its impact on these different societal landscapes.
- Using evidence gained through research and analysis, debate an issue involving demand for a technology or innovation and its societal impact (such as weighing the pros and cons of social media considering its ability to respond to the public's demand for content and influence society).

Content Elaborations

CLARIFICATIONS

Societal demand can drive the development of a technology or an innovation. These technological developments can then, in turn, impact society. Students explain how demand for a technology or an innovation has impacted social, cultural, political or economic landscapes over time. Narrowing their focus, students find factual references to support their claims.

For example, demand for better transportation technology impacted people's settlement patterns over time. The shapes of some cities changed because of connection (or lack thereof) to downtown. Rail connections were constructed before road connections. Consequently, cities that had rail connections to their downtowns changed more quickly than those that did not. Having cars and roads allowed other more sparsely populated areas to later fill in. Similarly, technology, such as railroads and other methods of travel, enabled people to settle in areas farther away, establishing suburban areas and settlements in rural areas.

Demand can be created for technology development through businesses' need to offer goods and services that consumers need or want in order to make a profit. Development of an innovation provides a means for

Topic 3: Explain how technology, society and the individual impact one another.	
	businesses to offer goods and services that have a competitive edge (such as certain smartphone features and the integration of smartphones with cars and homes). Government can serve as a means through which society promotes or restricts technologies (such as nuclear power plants and stem cell research). Innovation can stem from intervention and assistance by government, enabling large-scale implementations of technological advances like railroad, air travel and space travel. **CONTENT FOCUS** This content statement focuses on students examining the ways that demand for technological development and aspects of society interrelate, laying the groundwork for a debate of issues involving this demand and its societal impact. Students analyze the demands that are created for a technology or an innovation and how this demand for technological development has changed the social, cultural, political and/or economic landscape. Students build evidence for their findings using references and examples from their research and analysis.
9-12.ST.3.b. Discuss how technological innovation has resulted when ideas, knowledge or skills have been shared across multiple fields.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students explained how new technology development is driven by factors such as commercialization, creative/inventive thinking and cultural/historical influence. They also analyzed how technological innovations can have multiple applications, both intended and unintended. In grades 9-12, students discuss how the sharing of ideas, knowledge and skills across multiple fields has resulted in technological innovation. **IMPORTANT CONCEPTS** • When technology is developed, resources, ideas, knowledge and skills often are shared across areas and fields to maximize innovation. • A technological innovation can spread to other fields where it can be adopted and adapted. **KEY SKILLS/PROCEDURES** • Describe examples of innovations that have been developed through the contribution of ideas, knowledge and skills from multiple fields and identify the contributions of each field. • Describe examples where the application of technological innovations has spread across multiple fields. **Content Elaborations** **CLARIFICATIONS**

Topic 3: Explain how technology, society and the individual impact one another.	
	Technological innovation can span multiple fields, benefiting from input, resources, support and development efforts from multiple sources. For example, developing the GPS (Global Positioning System) satellite network required knowledge and skills from multiple fields. Companies involved in the communication industry were needed to create the technology, including the satellites, that make GPS possible. The aviation industry was needed to build the rockets that put the GPS satellites into orbit. Innovations in technology can spread to multiple fields where they can be adopted and adapted. While GPS technology originally was developed for military use, it now is used in a variety of industries, including in agriculture for the navigation of combines and consumer products like watches, mobile devices or home automation systems. **CONTENT FOCUS** The focus is on students studying specific examples of technological innovations to discuss how these technological developments are a result of shared ideas, knowledge and skills from multiple fields.
9-12.ST.3.c. Forecast the need to review, adapt and innovate laws and policies applied to copyrights, patents, trademarks and speech.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students evaluated current and past revisions to laws, rules and policies as society responds to technological advancements. In grades 9-12, students forecast the need to review, adapt and innovate laws and policies applied to copyrights, patents, trademarks and speech. **IMPORTANT CONCEPTS** • Technology advancements may dictate laws and policies to be developed that were not necessary in the past. • Ongoing review of current laws and policies are necessary due to areas of rapid technological advancement in today's world and the need for laws and policies to be able to respond to these advancements.
	KEY SKILLS/PROCEDURES

Topic 3: Explain how technology, society and the individual impact one another.	
	• Review and discuss how laws and policies involving copyrights, patents, trademarks and speech apply as new technologies are developed; consider previous revisions due to technological advancements and future implications of these advancements. • Identify laws and policies involving copyrights, patents, trademarks and speech that need to be created, adapted or removed because they no longer apply due to the development of new technologies. **Content Elaborations** **CLARIFICATIONS** As innovations occur, laws and policies must be reviewed to ensure they respond to technological advancements. For example, with the advent of new ways to share content, from the printing press to the development of streaming technology (like Spotify™, YouTube™ and Netflix™), changes in law have had to follow, such as those involving copyright law. Students can investigate these changes in law and the kinds of cases courts have heard involving new technologies. Through reviewing laws and policies, they can be evaluated to determine where adaptations as well as new laws and policies will be needed. Forecasting this need would be ongoing and interpretive. Predictions can be informed by previous law and policy revisions that concerned past innovations. Students can access past court cases involving new technologies to see what issues were presented and how these cases were resolved. They also can access a case currently being reviewed by the Supreme Court and predict how this case might be resolved. After the court renders its decision, students can determine how their predictions aligned with the court's rulings and opinions. Students also can consider future implications of a technological development to inform their forecasts. **CONTENT FOCUS** The focus is on students interpreting current copyright, patent, trademark and speech laws and policies as they pertain to technological advancements. Students forecast the need for adaptations to be made to current laws and policies and for creating new laws and policies.
9-12.ST.3.d. Predict changes in society and intentional and unintentional consequences resulting from continued technological progress and defend the rationale within a given context.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students analyzed how technological innovations and inventions can have multiple applications, both intended and unintended. In grades 9-12, students predict changes in society and intentional and unintentional consequences resulting from continued technological progress and defend the rationale within a given context. **IMPORTANT CONCEPTS**

Topic 3: Explain how technology, society and the individual impact one another.	
	• When considering societal changes that may result from continued technological progress, intentional and unintentional consequences of that technology need to be taken into account. • Societal changes resulting from technological progress may differ from one culture to another or from one location to another. • The understanding of a technology's impact on society may change as additional information is gained and perceptions of the impact change over time. **KEY SKILLS/PROCEDURES** • Identify older and newer developments of a technology that has shown continued progress and identify their societal impacts. • Analyze how intentional and unintentional consequences resulting from technological developments occur within society. • Use a rationale to defend a prediction of societal changes resulting from a technology's continued progress. Consider intentional and unintentional consequences of that technology (past, present and future) when developing this rationale. ## Content Elaborations **CLARIFICATIONS** Technological progress results in both intentional and unintentional consequences. Both types of consequences must be considered to predict the impact of continued technological progress on society. The automobile provides an example of how societal impacts changed with continued technological progress. When the automobile was first introduced, people predicted it would never last. It was not reliable. Laws were enacted reducing the amount of road that automobiles could use and speeds were limited to travel no faster than horses to reduce accidents. However, as technology involving transportation progressed and roads were paved, automobiles were permitted to travel at higher speeds because they could do so safely. Automobiles became a more reliable and prevalent mode of transportation. The use of GPS technology to tag photos with precise location information illustrates how intentional and unintentional consequences may exert their impacts as a result of technological progress. GPS photo-tagging has enabled people to find the exact location where a photograph was taken. This has brought larger crowds to previously unknown locations, which has provided broader access to beautiful scenery. However, the presence of large crowds has negatively impacted some delicate ecosystems.
	CONTENT FOCUS

Topic 3: Explain how technology, society and the individual impact one another.	
	The focus is on students analyzing and then predicting how society changes, both in intentional and unintentional ways, as a result of continued technological progress. Students evaluate the impact of those predicted changes. They defend their predictions, providing a rationale.
9-12.ST.3.e. Analyze and influence one's digital identity and digital footprint while considering past, present and future implications.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students managed components of their digital identities and digital footprints. In grades 9-12, students analyze and influence their digital identities and digital footprints while considering past, present and future implications. **IMPORTANT CONCEPTS** • Digital content is almost impossible to permanently delete. • Perceptions are subjective. Criteria for evaluating one's digital identity and footprint (also called digital tattoo) are subject to interpretation. • Strategies and techniques can be used to influence one's digital identity and footprint. **KEY SKILLS/PROCEDURES** • Identify and use criteria to evaluate one's digital identity and digital footprint. • Explain the positive and negative implications one's digital identity and digital footprint can have on one's present and future. • Apply steps to enhance, edit or create digital identities and digital footprints to have a positive impact moving forward; consider the impacts one's identity and footprint have had in the past and implications for the present and future. **Content Elaborations** **CLARIFICATIONS** As students analyze and take steps to influence their digital identities and footprints or tattoos, they need to understand how this digital information can have an impact on someone's life in the present and future. Allow students to acknowledge the impact of their identities and footprints on their past and present lives and potentially on their futures. Then, provide them with techniques to edit, enhance and create digital identities and digital footprints that, moving forward, would be of benefit to them.

Topic 3: Explain how technology, society and the individual impact one another.	
	For example, students could conduct evaluations of their own digital identities and footprints based on predetermined criteria. Students could conduct peer evaluations, discussing their findings and efforts that could be made to improve their identities and footprints. Students also could create identities that could be used in new environments, such as in college, career or business settings, that would have a positive impact on their future. **CONTENT FOCUS** The focus is on students evaluating and improving their digital identities and digital footprints. Students consider impacts their identities and footprints have had in the past and implications for the present and future.

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.

9-12.DT.1.a. Explore and document how systems theory includes the concepts of system dynamics, systems thinking and computational thinking.

Expectations for Learning

LEARNING PROGRESSION

In grades 6-8, students documented how technology can impact efficiency and analyzed how tools and processes can alter the natural and human-designed worlds. Students also examined how components of a system interrelate and how changes in one part of a system can impact other parts of that system. In grades 9-12, students explore and document how systems theory includes the concepts of system dynamics, systems thinking and computational thinking.

IMPORTANT CONCEPTS

- Design problems exist in multiple systems.
- Systems thinking provides multiple tools for solving problems that take into consideration the interaction between systems and between the components within a system.
- System dynamics enables modeling solutions, taking into account the interaction between systems and between the components within a system over time.
- Computational thinking provides tools to analyze and quantify a problem (such as the requirements for an effective solution).

KEY SKILLS/PROCEDURES

- Determine the systems that need to be considered to solve a problem.
- Explain the interaction between systems and their possible impacts on a solution when using a design process to create, modify or optimize a technology.
- Considering the systems that impact a problem, explain how computational thinking can be used to solve that problem (such as determining the quantifiable elements of the problem and recognizing patterns).

Content Elaborations

CLARIFICATIONS

Systems theory is the study of how systems interact. Systems thinking, system dynamics and computational thinking, all aspects of systems theory, provide tools and methods for understanding and solving complex problems. Applying systems thinking when designing a solution promotes viewing a problem in its entirety, examining how components interact within a system and systems interact with each

Topic 1: Define and describe technology, including its core concepts of systems, resources, requirements, processes, controls, optimization and trade-offs.	
	other. System dynamics enables examining the way systems interact when designing a solution, modeling the behavior of interrelated systems as they change over time. Computational thinking provides tools to quantify and analyze a problem (such as breaking complex problems into simpler problems). In the example below, systems thinking, system dynamics and computational thinking all come into play in the efficient management of a farm. A systems thinking approach is needed because a farm functions as a system made up of subsystems designed to perform tasks (such as planting, cultivating and harvesting crops). Subsystems respond to input from other subsystems, such as when changes in seasonal temperatures and rainfall affect harvesting schedules. System dynamics help farmers understand the behavior of and interaction between these changing subsystems. Many processes used by these subsystems (like determining an irrigation schedule) are created computationally by breaking down a problem into simpler problems, using mathematics to express relationships, analyzing needs and creating step-by-step solutions. **CONTENT FOCUS** This content statement focuses on understanding how systems thinking, system dynamics and computational thinking can be used to help understand complex problems and design solutions to these problems.
9-12.DT.1.b. Discuss how a design process builds on the core concepts of technology, including the relationship between systems.	## Expectations for Learning **LEARNING PROGRESSION** In grades 6-8, students continued to build on their understanding of the core concepts of technology. They analyzed how tools, materials and processes are used to alter the natural and human-designed worlds. Students also examined how requirements, trade-offs and optimization interrelate within a design process. In grades 9-12, students discuss how a design process builds on the core concepts of technology, including the relationship between systems. **IMPORTANT CONCEPTS** • Having an innovative and inventive mindset is vital to a design process. • The core concepts of technology are interrelated within a design process. Their relationship needs to be considered to optimize a design process. • Iterative processes used to improve design solutions take into consideration whether the systems and subsystems involved are functioning optimally. • Many technological advances are developed by changing open loop systems into closed loop systems, enabling systems to be controlled autonomously. This results in more responsive and efficient systems.

Topic 1: Define and describe technology, including its core concepts of systems, resources, requirements, processes, controls, optimization and trade-offs.	
	KEY SKILLS/PROCEDURES • Reverse engineer and describe the systems used in a product. • Using the core concepts of technology, defend the design choices made to solve a problem. • Describe how invention, innovation and iteration were incorporated in a design process used. • Describe technological advancements that are examples of converting open loop systems to closed loop systems. **Content Elaborations** **CLARIFICATIONS** Technological design is an iterative process to develop and optimize human-made products or processes. Generally, a design process is a plan to find solutions to problems. The core concepts of technology are interrelated within this process. When developers engage in a design process, they view these core concepts as a whole, not individually. They consider the interactions between requirements, processes and controls to determine trade-offs that can result in optimal design solutions. Tools, machines, processes and materials all involve systems (such as logistics, capital and labor) that influence a design process and the resulting solution. Designing new products often occurs by taking existing designs and making improvements (redesign). One area to consider involves the operation of open loop systems. Open loop systems require operator input to make changes to the system. In contrast, a closed loop system can run more efficiently because it can respond to information from the system and take action based on this feedback. (For example, feedback from a thermostat that is a part of a closed loop system can automatically cause the system to turn on the heat when the temperature is too cold; an open loop system would require a person to intervene to raise the temperature.) **CONTENT FOCUS** The focus is on the interaction between the core concepts of technology within a design process, ranging from the interaction between two materials (such as whether to use wood or metal for a structure) to the interaction between systems (for example, how transportation and regulations impact a design).

Topic 2: Identify a problem and use an engineering design process to solve the problem.	
9-12.DT.2.a. Evaluate a design solution using conceptual, physical, digital and mathematical models at various intervals of a design process in order to check for proper design and note areas where improvements are needed (e.g., check the design solutions against criteria and constraints).	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students applied a complete design process to solve an identified individual or community problem. They considered multiple factors, including criteria and constraints, to justify design decisions. In grades 9-12, students implement, document and present a design process as applied to a particular product, process or problem. At various intervals of a design process, they use conceptual, physical, digital and mathematical models to evaluate a design solution, checking for proper design and noting areas that need improvement (such as checking the design solutions against criteria and constraints). **IMPORTANT CONCEPTS** • It is important to evaluate the definition of a design problem to ensure the resulting solution will address user needs and wants and meet design constraints and requirements. • Design solutions should be checked at various intervals of a design process to ensure they are following the criteria and constraints. • Conceptual, physical, digital and mathematical models can be used to evaluate the effectiveness of a design solution. **KEY SKILLS/PROCEDURES** • Define a design problem, identifying user needs and wants and design criteria and constraints. • Evaluate a problem's definition to ensure the identified user needs and wants, criteria and constraints will result in a design solution that addresses the problem or scenario. • Use conceptual, physical, digital and mathematical models to gain the feedback needed to evaluate the effectiveness of a design solution. • Assess and refine design solutions at various intervals based on the results gained through the use of conceptual, physical, digital and mathematical models. **Content Elaborations** **CLARIFICATIONS** During a design process, it is important to have multiple checkpoints to ensure consideration of criteria, constraints and design requirements and to verify proper design. Developers use conceptual, physical, digital and mathematical models to evaluate their design solutions, considering past solutions to problems where applicable. They document their results and note areas for improvement.
	CONTENT FOCUS

Topic 2: Identify a problem and use an engineering design process to solve the problem.	
	This content statement focuses on students evaluating design solutions at different intervals during a design process using conceptual, physical, digital and mathematical models. Students use this information to identify areas for improvement and make needed adjustments to their design solutions.
9-12.DT.2.b. Implement, document and present a design process as applied to a particular product, process or problem.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students applied a complete design process to solve an identified individual or community problem. In grades 9-12, students implement, document and present a design process as applied to a particular product, process or problem. They use an evaluation process that includes the use of models to check for proper design and note areas where improvements are needed. **IMPORTANT CONCEPTS** • A design process, including alternative solutions, needs to be documented to provide an ongoing record that tracks the progression of a solution from its initial to final stages. • A design process is fluid. • Documentation of a design process should reflect the iterative thought process involved. **KEY SKILLS/PROCEDURES** • Explain the iterative process involved in a design process, focusing on how one idea can lead to another. • Describe the adjustments made during a design process used to develop a particular solution. • Document a design process to provide an ongoing record of a solution's development (such as initial ideas, sketches, tests conducted, data collected, decisions made and results of these decisions). • Present a design solution to a chosen audience structured by the design process used to develop that solution. Use documentation of this design process as a resource. **Content Elaborations** **CLARIFICATIONS** As designers engage in a design process to develop a solution, they can build important records of their work by documenting the processes they use to create their solutions. By keeping a record of the nonlinear, iterative process implemented, a designer can track the progression from initial ideas to a finished design. This record makes clear the decisions made during the process and the results of those decisions. Documentation includes information such as ideas, observations, sketches, test procedures, data collected and the role this data plays in decisions made during the design process.

Topic 2: Identify a problem and use an engineering design process to solve the problem.	
	When developing a solution to a problem, designers often need to present their findings to other stakeholders. Clear and detailed documentation of the processes they have used to design their solutions provides information needed for these presentations. Useful methods for documenting a design process include using an engineering notebook, journal, blog, website or portfolio to structure the ongoing recording of this process. **CONTENT FOCUS** The focus is on students documenting the design processes they use as they develop solutions for a particular product, process or problem. Students present the design processes they applied to develop their solutions using their ongoing records of these processes as a resource.

Topic 3: Demonstrate that solutions to complex problems require collaboration, interdisciplinary understanding and systems thinking.	
9-12.DT.3.a. Evaluate a technological problem that has benefited from a multidisciplinary approach.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students collaborated to solve problems as interdisciplinary teams, modeling different roles and functions. In grades 9-12, students evaluate a technological problem that has benefited from a multidisciplinary approach. **IMPORTANT CONCEPTS** • Design solutions can be evaluated and improved through collaboration between multiple disciplines when considering problems and their solutions. • A multidisciplinary approach to problems and their solutions helps ensure relevant perspectives, knowledge and skills are applied to a design solution. **KEY SKILLS/PROCEDURES** • Determine the disciplines that contribute to the solution of a given problem. • Identify the knowledge and skills from each discipline that contribute to the solution of a given problem. • Explain and evaluate the contribution of each discipline that is applied to the solution of a given problem. **Content Elaborations** **CLARIFICATIONS** Approaching problems through multidisciplinary lenses brings different knowledge, skills and perspectives to developing solutions. For example, to provide internet connectivity to all people, internet service providers must consider factors, including distance from areas with existing connectivity, terrain, governmental regulations, environmental impact and return on investment. This requires people with knowledge and skills from multiple disciplines or fields, such as information technology, civil engineering, business and environmental science. **CONTENT FOCUS** This content statement focuses on students analyzing a problem from the perspectives of multiple disciplines and evaluating how each discipline contributed to the effectiveness of the solution.

Topic 3: Demonstrate that solutions to complex problems require collaboration, interdisciplinary understanding and systems thinking.	
9-12.DT.3.b. Locate and evaluate past predictions about the development of technology.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students explained ways that invention and innovation within one field can transfer into other fields of technology. In grades 9-12, students locate and evaluate past predictions about the development of technology. **IMPORTANT CONCEPTS** • People have been making predictions about the development of technology with varying degrees of accuracy throughout history. • The accuracy of predictions can depend on interactions between and within systems (such as the accuracy of a prediction about a product's success depending on how that product's development and marketing take into account consumers' wants and needs). • Studying and evaluating past predictions about the development of a technology can inform future development decisions. **KEY SKILLS/PROCEDURES** • Identify past technological trends and predictions. • Identify interdisciplinary understandings that impacted the development of a past technology. • Identify interactions between and within systems that impacted the development of a past technology. • Compare predicted and actual results concerning a technological development. • Analyze the factors that contributed to the accuracy of predictions made about a technological development. **Content Elaborations** **CLARIFICATIONS** Throughout history, technological implementations have benefited from past predictions about future needs. Evaluations of past predictions about technology development are based on historical records, evidence of implementation, attempts, successes and failures. Research may be required to identify past technological developments, their successes and failures. Examining past predictions about the development of a technology and the reasons why they were or were not accurate can inform future development decisions. For example, Google Glass smart glasses, initially developed as a prototype for early adopters, were marketed to the public following the initial release to early adopters. However, Google's expectation that Google Glass would have wider public appeal was never realized due to consumer concerns about privacy, cost and other issues. The initial promotion for public use

Topic 3: Demonstrate that solutions to complex problems require collaboration, interdisciplinary understanding and systems thinking.	
	of the glasses shifted to the workplace, with later versions of the glasses used in specific work settings, such as factories and the medical field. **CONTENT FOCUS** The focus is on evaluating predictions made about a technology's development and use, using historical research on the implementation of that technology. This includes researching predictions, patterns of adoption and non-adoption and impacts, both past and present. Students also consider future implications for technology development.
9-12.DT.3.c. Describe techniques for making decisions about the future development of technology.	## Expectations for Learning **LEARNING PROGRESSION** In grades 6-8, students examined factors that drive new technology development, such as commercialization, creative/inventive thinking and cultural/historical influence. In grades 9-12, students describe techniques for making decisions about the future development of technology. **IMPORTANT CONCEPTS** • It is necessary to determine the criteria that will guide decision-making about future technological development and the relative importance of these criteria. • Criteria used to make decisions involving future technological developments include social, environmental, economic, political, safety and cultural considerations. • Knowledge gained from different disciplines often is applied when assessing decision-making criteria. • Developers apply techniques (such as the use of matrices) to make decisions about future technological development. **KEY SKILLS/PROCEDURES** • Identify criteria that can be used to make decisions about the future development of a technology and the relative importance of these criteria. • Deconstruct a decision-making process, including the criteria weighed when making a decision. • Describe how decision-making techniques (such as the use of matrices) can be applied to guide future development of a technology. • Identify current research and development being used to make decisions about future technological developments.

Topic 3: Demonstrate that solutions to complex problems require collaboration, interdisciplinary understanding and systems thinking.	
	Content Elaborations **CLARIFICATIONS** Several criteria affect decision-making processes when considering technology development and adoption. Technology development stems from needs or wants in areas where improvements can be realized. Criteria to take into account when making decisions about the when, how, where and what of technology development include social, environmental, economic, political, safety and cultural considerations. Using decision-making matrices to rank various solutions and consider decision points is one technique that can be used to guide future technological development. For example, students might use this technique to weigh costs and benefits or pros and cons for different solutions to make decisions about the development of a technology. **CONTENT FOCUS** The focus is on students understanding how techniques can be used to guide decisions about the future development of technology. This includes criteria that could be considered as part of the decision-making process and their relative importance.
9-12.DT.3.d. Analyze the interactions within systems and between systems.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students gave examples of how changes in one part of a system can impact other parts of that system. Students also deconstructed a system into its component parts and described how they interrelate. In grades 9-12, students analyze the interactions within systems and between systems. **IMPORTANT CONCEPTS** • The components within a system interact with each other to produce a desired outcome. • Systems can have an effect on other systems, interacting to produce a desired outcome. **KEY SKILLS/PROCEDURES** • Deconstruct a system by explaining the functions of its components and how their interaction affects the desired outcome. • Identify and describe a system that interacts with other systems, explaining how the interaction between systems affects the desired outcome.
	Content Elaborations

Topic 3: Demonstrate that solutions to complex problems require collaboration, interdisciplinary understanding and systems thinking.	
	CLARIFICATIONS Systems are made up of multiple components organized to achieve a common goal. Components within a system can interact internally with other components in that system. Systems also can interact with each other to achieve a desired outcome. Data and feedback are used to optimize performance. For example, an automobile features several systems that collect data. A central computer collects data from all the systems to optimize the performance of the vehicle, such as braking performance and crash avoidance. Typically, the braking system is controlled by the driver. However, systems involving the brakes and collision sensors can interact to improve car safety using feedback from these sensors. As sensors monitor for objects in the car's path, brakes are activated when sensor feedback indicates danger of a collision. **CONTENT FOCUS** Students choose systems to analyze, focusing on how the interactions among system components and between systems affect achieving a desired outcome.
9-12.DT.3.e. Apply systems thinking to solve a complex problem.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students deconstructed a system into its component parts and described how they interrelate. In grades 9-12, students apply systems thinking to solve a complex problem. **IMPORTANT CONCEPTS** • Interactions between or within systems can be the cause of complex problems. • Systems thinking can be used with a design process to solve a complex problem. • One's understanding of the interactions within and between systems (systems, subsystems and system components) can impact the solution developed for a complex problem. • An efficient method for analyzing a complex problem is to break it down into simpler problems.
	KEY SKILLS/PROCEDURES

Topic 3: Demonstrate that solutions to complex problems require collaboration, interdisciplinary understanding and systems thinking.	
	• Identify the systems, subsystems and system components that impact a complex problem. • Analyze how interactions between systems, subsystems and system components impact a complex problem and its solutions. • Design multiple solutions to a complex problem taking into consideration the interactions identified between systems, subsystems and system components. • Evaluate solutions to a complex problem in terms of how they will affect and be affected by other systems. **Content Elaborations** **CLARIFICATIONS** Complex problems do not exist within an isolated environment or system. Solving such problems requires applying a systems-thinking approach and considering influences across interrelated systems. Systems thinking can be used with a design process to solve a complex problem. For example, a decrease in fuel economy from a vehicle could be caused by one of many subsystems that help to control the engine/fuel system. **CONTENT FOCUS** The focus is on solving a complex problem by breaking it down into simpler problems and determining the systems, subsystems and parts that impact the problem.

Topic 4: Evaluate designs using functional, aesthetic and creative elements.	
9-12.DT.4.a. Evaluate project/product solutions and communicate observations of the entire design process results.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students examined the progression of a product to identify how the functional, aesthetic and creative elements were applied. In grades 9-12, students evaluate project/product solutions and communicate observations of the entire design process results. Students also determine revisions and modifications to a design's function and aesthetics based on data/information related to product testing. **IMPORTANT CONCEPTS** • Evaluation of a project or product solution should describe what aspects of the solution are effective and what aspects need improvement. • Solutions should be evaluated at key points over the course of a design process, recording results and observations to show progress made toward project or product goals. **KEY SKILLS/PROCEDURES** • Evaluate functional, aesthetic and creative elements for quality during a design process. • Evaluate examples of products in relation to application of the principles and elements of design. • Communicate and display evaluation results and solutions and discuss observations made over the course of a design process. **Content Elaborations** **CLARIFICATIONS** As students develop project or product solutions, they must examine their ideas to make sure they meet design requirements. Their evaluation must include consideration of the functionality of the design. Does the design achieve its given purpose? Students evaluate the aesthetic appeal of the design using the design principles (balance, rhythm, proportion, unity and emphasis) and elements (line, shape, form, color, texture, space and value). Students must evaluate how creative elements are applied through design choices. Using a design portfolio, students can communicate evaluation results and observations they record throughout the process of solution development. Artifacts such as sketches, pictures, video and other visual representations of their projects need to be included in the portfolio to document progress. **CONTENT FOCUS** This content statement focuses on students evaluating a design solution in terms of its functionality, aesthetic appeal and creativity and documenting the progression of the solution over the course of the entire design process. Students then communicate their observations of process results.

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

9-12.DT.4.b. Interpret data/information related to product testing to determine revisions and modifications to a design's function and aesthetics.

Expectations for Learning

LEARNING PROGRESSION

In grades 6-8, students examined the progression of a product to identify how the functional, aesthetic and creative elements were applied. Students also applied the design principle "form follows function" to develop a product. In grades 9-12, students interpret data/information related to product testing to determine revisions and modifications to a design's function and aesthetics.

IMPORTANT CONCEPTS

- A design solution must be usable and based on current methods and materials, with thought given to future technologies to leave open the possibility of finding new solutions.
- Determining the balance of functionality and aesthetics is important to creating a successful design and guides revisions and modifications made to a design.
- There are processes and procedures for testing the functionality and aesthetics of products.
- Product designs may be modified in terms of functionality and aesthetics based on results of product testing.

KEY SKILLS/PROCEDURES

- Interpret product testing data in terms of design criteria concerning functionality and aesthetics.
- Analyze multimodal representations of product testing data (such as charts, diagrams and testing for acoustics or noise).
- Determine revisions and modifications needed in terms of functionality and aesthetics based on product testing.
- Assess revisions and modifications in relation to functionality and aesthetics.

Content Elaborations

CLARIFICATIONS

Concern with functionality when developing a product is a critical component of testing and evaluation. The aesthetic appeal of a product design can affect user satisfaction with the human-built world and also must be considered.

Results from product testing provide crucial information that guides revisions and modifications to a product's functional and aesthetic design. When interpreting test data concerning the functionality of a product design, students consider efficiency, sustainability, affordability (cost benefit analysis), simplicity and usability. Can the product be used, maintained or fixed easily? Students consider design principles (balance, rhythm, proportion, unity and emphasis) and elements (line, shape, form, color, texture, space and value) when evaluating aesthetic appeal.

Topic 4: Evaluate designs using functional, aesthetic and creative elements.	
	Developers weigh the relative importance of the functional and aesthetic elements of a product's design. Some products may be designed primarily for functionality. However, concern with only functionality may leave consumers dissatisfied with the lack of aesthetic appeal. Developers may consider questions such as, "Can a product be made more aesthetically pleasing while not sacrificing functionality?" Students can construct rubrics or checklists using design criteria concerning functionality and aesthetics. They can use these tools to guide their interpretations of testing data and the revisions and modifications they make to product designs. Students can study the changes to models of products over time, discussing revisions and modifications in terms of the functional and aesthetic elements. **CONTENT FOCUS** The focus is on students evaluating selected products in terms of functionality and aesthetics using data gained from testing. Students interpret this data to make revisions and modifications to the product's design.
9-12.DT.4.c. Critically evaluate a design solution at multiple points of a design process. Consider design requirements and adjust processes and outcomes as needed.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students examined the progression of a product to identify how the functional, aesthetic and creative elements were applied. Students considered design requirements to justify decisions when developing solutions to problems. In grades 9-12, students critically evaluate a design solution at multiple points of a design process. They consider design requirements and adjust processes and outcomes as needed. **IMPORTANT CONCEPTS** • Design outcomes and processes are adjusted and refined as solutions are developed. • Evaluating a design at multiple points during development can result in a more efficient process, enabling adjustments to be made throughout this process. • When evaluating a design solution, it is important to consider the design from perspectives that were not previously considered. **KEY SKILLS/PROCEDURES** • Determine what information is critical to the success of a design solution and the evaluations that are needed to capture this information. • Determine evaluation points during the design process timeline. • Analyze and interpret evaluation results, including feedback and product testing data. • Determine adjustments to design processes and outcomes based on design requirements, such as criteria and constraints.

Topic 4: Evaluate designs using functional, aesthetic and creative elements.	
	Content Elaborations **CLARIFICATIONS** Evaluating a design solution at multiple points during a design process allows developers to adjust this process to achieve optimal outcomes. By verifying design requirements at these points, adjustments can be made as needed. Evaluation of a design solution can include considering data and feedback from various sources (such as end-user input, research of existing sources of data or running tests and simulations). A critical aspect of conducting these evaluations is determining when would be the most advantageous points for evaluations to take place during the process. It can be useful to revisit past design solutions for ideas that can be applied to a current project, as well as future designs. Doing so can promote viewing the solution from a perspective that has not been considered and uncovering new ways of thinking about or approaching the design. Students evaluate solutions as a part of their own design projects. They also can consider examples of product design specifications and view these designs in various phases of the design process. Students can analyze changes in the product designs in terms of needs and desires concerning design outcomes. **CONTENT FOCUS** The focus is on students evaluating their design solutions and interpreting the results. These results determine what changes are needed in processes and outcomes based on design requirements. Evaluation occurs at critical points during development, with adjustments made before final products or design solutions are implemented. **Career Connections** **CAREER PLANNING** Students work with their community to identify real-world problems to solve. Consider having students work with the district's Business Advisory Council to hear about the real issues businesses face. Students can bring these issues back to the classroom to develop solutions through implementing the design process with evaluations of the process along the way. Students can work closely with representatives of the community to test their designs and, using an iterative design process, refine their solutions based on feedback. Consider how this type of opportunity may lead to an internship or other work-based learning opportunity for students.

Topic 4: Evaluate designs using functional, aesthetic and creative elements.	
9-12.DT.4.d. Explain the interrelationship between technology, creativity and innovation.	**Expectations for Learning** **LEARNING PROGRESSION** In grades 6-8, students examined the progression of a product to identify how the functional, aesthetic and creative elements were applied, including principles of universal design and "form follows function." In grades 9-12, students explain the interrelationship between technology, creativity and innovation. **IMPORTANT CONCEPTS** • Evaluation of a design solution takes into account appearance, user experience, form, function, innovation and creativity. • Common, everyday items (such as whiteboards, pencils, desks, cell phones and computers) have undergone a process of design and redesign that applied innovation and creative invention, making earlier designs less desirable. • Continuous improvement is an iterative process of redesigning and creating more functional and aesthetically pleasing products. This process should be ongoing, occurring throughout the course of development. **KEY SKILLS/PROCEDURES** • Assess the role innovation and creativity play in technological progress. • Identify and discuss improvements to items that have undergone iterations of redesign by examining the functional, aesthetic and creative elements (such as a common item that has undergone many iterations or a completed design that has undergone iterations). **Content Elaborations** **CLARIFICATIONS** The flexible, iterative nature of a design process provides the opportunity for creative and innovative thinking to be applied during the development of a technology. Technological change is a function of this thinking, with creativity and innovation seen in improvements to functionality and aesthetics. Design solutions need to be evaluated in terms of how well they meet design requirements (aspects such as form, function, appearance, user experience, innovation and creativity). Developers weigh the relative importance of functional and aesthetic elements of a product's design. Determining this balance is important to creating a successful design. Companies develop technological advances based on perceived and discovered needs in the market. Those needs are based on people's desires for functional, creative and aesthetic elements. **CONTENT FOCUS** Students evaluate solutions or products in terms of how well they meet the design requirements (aspects such as user experience, form, function, appearance, innovation and creativity).

Acknowledgements

Emily Armour
College of Wooster

Karen Ayers
Mt. Healthy City Schools

Cheryle Basinger
Ashland University

Joe Bedingfield
Willard City Schools

Jeff Beine
Malone University

Laura Brown
North Fork Local Schools

Cathie Cooper
INFOhio

Britton Devier
Willard City Schools

Tad Douce
Ohio Technology & Engineering Educators Association (OTEEA)

Marcie Ebright
Akron Public Schools

Amy Estepp
Franklin City Schools

Karen Fiedler
Columbus City Schools

Amanda Frasure
Vinton County Local Schools

Theresa Fredericka
iNFOhio

Jennifer Fry
Westerville City Schools

Angela Greene
Tecumseh Local Schools

Sara Hager
Grandview Heights Schools

Katie Hudson
Hilliard City Schools

Andreas Johansson
Streetsboro City Schools

Bob Keep
Big Walnut Local Schools

Barbara Kenney
West Clermont School District

Jennifer Keyes
Centerville City Schools

John Kramer
North Central Ohio Educational Service Center

Brian Lien
Butler Tech

Rosina Matthies
Clark-Shawnee Local Schools

Jennifer McGraner
Pickerington Local School District

Kathleen McMahon
Catholic Diocese of Columbus

Cynthia Meisel
Reynoldsburg City Schools

Lindsay Miesmer
Massillon City Schools

Scott Miller
Wooster City Schools

Chelsea Moyer
EHOVE Career Center

Shelly Mumaw
Ottoville Local School District

Melissa Munro
Cuyahoga Valley Career Center

Stephanie Nuber
Springfield City School District

Amy Palermo
WOSU Public Media/Instructional Technology Integration Partnership (ITIP)

Mark Pohlman
Hilliard City Schools

Paul Post
The Ohio State University

Caitlin Reggie
South-Western City School District

Jeffrey Rhodes
North Royalton City Schools

Amber Richardson
North Union Local Schools

David Rouch
Ohio Northern University

Dawn Schiavone
Oregon City Schools

Sarah Schroeder
University of Cincinnati

Rosemary Sirmans
Cincinnati Public Schools

Leslie Slaven
Lakota Local School District

Melissa Solema
Euclid City Schools

Kevin Spooner
Lakewood City Schools

Daniel Stitzel
Streetsboro City Schools

Nathan Tharp
East Muskingum Local Schools

Elizabeth Wallick

Teresa Walton
Greenon Local Schools

Dona Weber
Euclid City Schools

Julie Williams
Conneaut Area City Schools

Katherine Wirthlin
Westerville City Schools

Brandi Young
Ohio Educational Library Media Association (OELMA)/South-Western City School District

Rachel Young
Valley STEM + ME2 Academy