

Unit 2: Digital Information *October-November*

Targeted Standards: [K12 Computer Science Standards](#)

- Computing Systems - Devices, Troubleshooting
- Networks and the Internet - Network Communication and Organization
- Data and Analysis - Collection, Storage, Visualization and Transformation, Inference and Models
- Impacts of Computing - Culture, Social Interactions, Safety, Law, and Ethics

(also reference [CSTA K-12 Computer Science Standards](#))

Rationale and Transfer Goals:

This unit further explores the ways that digital information is encoded, represented and manipulated. In this unit students will use a variety of tools including Code.org widgets and external data manipulation and visualization tools (such as Excel or Google Sheets).

Enduring Understandings:

- Creative development can be an essential process for creating computational artifacts.
- Computing can extend traditional forms of human expression and experience.
- A variety of abstractions built upon binary sequences can be used to represent all digital data.
- There are trade offs when representing information as digital data.
- Computing can extend traditional forms of human expression and experience.
- People use computer programs to process information to gain insight and knowledge.
- Computing facilitates exploration and the discovery of connections in information.
- There are trade offs when representing information as digital data.
- Computing enhances communication, interaction, and cognition.
- Computing has a global affect -- both beneficial and harmful -- on people and society.

Essential Questions:

- Are the ways in which digital information is encoded more laws of nature or man made?
- What kinds of limitations does the binary encoding of information impose on what can be represented inside a computer?
- How accurately can human experience and perception be captured or reflected in digital information?
- What is the relationship between data, information and knowledge?
- What are the best ways to find, see, and extract meaningful trends and patterns from raw data?
- Where and how does human bias affect the collection, processing and interpretation of data?

Content/Objectives		Instructional Actions	
Content <i>What students will know</i>	Skills <i>What students will be able to do</i>	Activities/Strategies <i>How we teach content and skills</i>	Evidence (Assessments) <i>How we know students have learned</i>
<ul style="list-style-type: none"> • A variety of abstractions built upon binary sequences can be used to represent all digital data. • There are trade offs when representing information as digital data. • Multiple levels of abstraction are used to write programs or create other computational artifacts • People use computer programs to process information to gain insight and knowledge. • Algorithms can solve many but not all computational problems. 	<ul style="list-style-type: none"> • Use appropriate terminology when describing the size of digital files. • Identify and compare the size of familiar digital media. • Solve small word problems that require reasoning about file sizes. • Collaborate with a peer to find a solution to a text compression problem using the Text Compression Widget (lossless compression scheme). • Explain why the optimal amount of compression is 	<ul style="list-style-type: none"> • Research • Widget - Text Compression • Individual and Group Discovery • Widget - Pixelation • Concept Invention • Individual Creation • Performance TAsk • Unplugged Activities • External Tools • Presentation • Class Discussion • Analyzing Artifacts • Group Discovery • Class Discussion • Individual Skill Building • Tutorial • Collaborative Artifact Creation 	<ul style="list-style-type: none"> • If you send the compressed poem, would your friend will be able to read it? Why is the dictionary important? • Why do you want to compress anything? What's the point? • For a piece of text, what is a "good" amount of compression? Is there a way to know when you've compressed it the most? Explain how you would know, or why you can't know. • What would happen if we didn't include width and height bits in our protocol? Assume your

<ul style="list-style-type: none"> • Creative development can be an essential process for creating computational artifacts. • Computing enables people to use creative development processes to create computational artifacts for creative expression or to solve a problem. • Computing can extend traditional forms of human expression and experience. • Models and simulations use abstraction to generate new understanding and knowledge. • Computing facilitates exploration and the discovery of connections in information. • Computing has a global affect -- both beneficial and harmful -- on people and society. • Computing innovations influence and are influenced by the economic, social, and 	<p>impossible or “hard” to identify.</p> <ul style="list-style-type: none"> • Explain some factors that make compression challenging. • Develop a strategy (heuristic algorithm) for compressing text. • Describe the purpose and rationale for lossless compression. • Explain how images are encoded with pixel data. • Describe a pixel as an element of a digital image. • Encode a B&W image in binary representing both the pixel data (intensity) and metadata (width, height). • Create the necessary metadata to represent the width and height of a digital image, using a computational tool. • Explain why image width and height are metadata for a digital image. • Use the Pixelation Tool to encode small color 	<ul style="list-style-type: none"> • Writing • Analyzing • Group Skill Building • Artifact Creation • Performance Task 	<p>friend just sent you 32 bits of pixel data (just the 0s and 1s for black and white pixels). Could you recover the original image? If so, how?</p> <ul style="list-style-type: none"> • How many bits (or bytes) are required to encode an image that is 25 pixels wide and 50 pixels tall, if you encode it with 24 bits per pixel? • Imagine that you have an image that is too dark or too bright. Describe how you would alter the RGB settings to brighten or darken it. Give an example. • Consider the following statement from the CS Principles course framework: 7.4.1C The global distribution of computing resources raises issues of equity, access, and power. Briefly describe one of these issues that you learned about in the lesson and how it affects your life or the lives of people you
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<p>cultural contexts in which they are designed and used.</p> <ul style="list-style-type: none"> • Computing enhances communication, interaction, and cognition. 	<p>images with varying bits-per-pixel settings.</p> <ul style="list-style-type: none"> • Explain the color encoding scheme for digital images. • Use the Pixelation Tool to encode an image of the student's design. • Explain the benefits of using hexadecimal numbers for representing long streams of bits. • Explain the difference between lossy and lossless compression. • Identify common computer file types and whether they are compressed or not, and whether compression is lossy or lossless. • Read a technical article on the web and sift its contents for targeted information. • Break a complex piece of information down into its component parts such that it could be represented on a computer. 		<p>know. Keep your response to about 100 words (about 3-5 sentences).</p> <ul style="list-style-type: none"> • Show students a visualization and have them analyze it, using the table of characteristics of good/bad visualizations to justify their opinion. • Describe the development process of discovering your data story and creating a visualization. Describe the difficulties and/or opportunities you encountered along the way, and describe the collaborative process between you and your partner.
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	<ul style="list-style-type: none">● Choose appropriate binary encodings for specific pieces of information and justify those choices.● Develop a hypothesis about student behavior over time, based on a small sample of data.● Describe sources of data appropriate for performing computations.● Use Google Trends to identify and explore connections and patterns within a data visualization.● Accurately describe what a data visualization of a trend is showing.● Provide plausible explanations of trends and patterns observed within a data visualization.● Define the digital divide as the variation in access or use of technology by various demographic characteristics.		
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	<ul style="list-style-type: none">● Identify assumptions made when drawing conclusions from data and data visualizations● Identify an effective data visualization and give justification.● Collaborate to investigate and evaluate a data visualization.● Suggest an appropriate visualization for some data.● Evaluate a data visualization for effectiveness of communication.● Identify a poor data visualization and give justification.● Select the appropriate type of data visualization to discover trends and patterns within a dataset.● Create a bar, line, and scatter chart from a dataset using a computational tool.● Use the settings of a data visualization tool to manipulate and refine the		
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	<p>features of a data visualization.</p> <ul style="list-style-type: none">● Collaboratively investigate a dataset.● Create a visualization (chart) from provided data.● Identify possible trends or connections in a data set by creating visualizations of it.● Accurately communicate about a visualization of their own creation.● Filter and sort a dataset using a spreadsheet tool.● Identify and correct invalid values in a dataset with the aid of computational tools● Justify the need to clean data prior to analyzing it with computational tools.● Create a pivot table with at least one aggregation and one calculation when given a set of data.● Describe the benefits a summary table has over a raw dataset.		
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	<ul style="list-style-type: none"> ● Collaboratively investigate a dataset by creating summary tables. ● Explain the meaning of a summary table they created. ● Create summaries of a dataset using a pivot table. ● Manipulate and clean data in order to prepare it for analysis. ● Explain the process used to create a visualization. ● Design a visualization that clearly presents a trend, pattern, or relationship within a dataset. ● Create visualizations of a dataset in order to discover trends and patterns. ● Draw conclusions from the contents of a data visualization. 		
<p><u>Spiraling for Mastery</u> Where does this unit spiral back to other units from this or previous years in order to ensure that students retain mastery of what they've learned?</p>			
Content or Skill for this Unit	Spiral Focus from Previous Unit	Instructional Activity	

<ul style="list-style-type: none"> ● Computing devices are often integrated with other systems, including biological, mechanical, and social systems. These devices can share data with one another. The usability, dependability, security, and accessibility of these devices, and the systems they are integrated with, are important considerations in their design as they evolve. ● Troubleshooting complex problems involves the use of multiple sources when researching, evaluating, and implementing potential solutions. Troubleshooting also relies on experience, such as when people recognize that a problem is similar to one they have seen before or adapt solutions that have worked in the past. 	<ul style="list-style-type: none"> ● The interaction between humans and computing devices presents advantages, disadvantages, and unintended consequences. The study of human–computer interaction can improve the design of devices and extend the abilities of humans. ● Comprehensive troubleshooting requires knowledge of how computing devices and components work and interact. A systematic process will identify the source of a problem, whether within a device or in a larger system of connected devices. 	<ul style="list-style-type: none"> ● Encoding B&W Images ● Lossy Compression and File Formats
<p>21st Century Skills: What are the 21st Century Skills that are a part of this unit, and where are they experienced?</p> <ul style="list-style-type: none"> ● Global awareness ● Creativity and Innovation ● Critical Thinking and Problem Solving ● Communication and Collaboration ● Information Literacy ● Flexibility and Adaptability ● Initiative and Self Direction <p>These skills are experienced throughout unplugged and plugged activities that will involve individual, group, and whole class discussion.</p>		



Key resources: What are the resources that are essential for this unit (may also be listed in “Activities/Strategies”)?

- [Unit 2 - Code.org Computer Science Principles Curriculum](#)
- [Widget - Text Compression](#)
- [Widget - Color Pixelation](#)