Unit 4: Big Data and Privacy

Content Area: **Science**
Course(s):
Time Period: **MP2**
Length: **25 days**
Status: **Published**

NJSLS - Science

CS.9-12.8.1.12.CS.2	Model interactions between application software, system software, and hardware.
CS.9-12.8.1.12.CS.3	Compare the functions of application software, system software, and hardware.
CS.9-12.8.1.12.DA.1	Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.
CS.9-12.8.1.12.DA.5	Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.
CS.9-12.8.1.12.DA.6	Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process.
CS.9-12.8.1.12.IC.1	Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices.
CS.9-12.8.1.12.IC.3	Predict the potential impacts and implications of emerging technologies on larger social, economic, and political structures, using evidence from credible sources.
CS.9-12.8.1.12.NI.1	Evaluate the scalability and reliability of networks, by describing the relationship between routers, switches, servers, topology, and addressing.
CS.9-12.8.1.12.NI.4	Explain how decisions on methods to protect data are influenced by whether the data is at rest, in transit, or in use.

Rationale and Transfer Goals

The data-rich world we live in also introduces many complex questions related to public policy, law, ethics, and societal impact. In many ways, this unit acts as a unit on current events. There will likely be something related to big data, privacy, and security going on in the news at any point in. The major goals of the unit are 1) for students to develop a well-rounded and balanced view about data in the world around them and both the positive and negative effects of it and 2) to understand the basics of how and why modern encryption works.

Enduring Understandings

- Computing facilitates exploration and the discovery of connections in information.
- There are trade-offs when representing information as digital data.
- Algorithms can solve many but not all computational problems.
- Cybersecurity is an important concern for the Internet and the systems built on it.
- Computing enhances communication, interaction, and cognition.
- Compung has a global effect -- both beneficial and harmful -- on people and society.
- Computing innovations influence and are influenced by the economic, social, and cultural contexts in which they are designed and used.

Essential Questions

What opportunities do large data sets provide for solving problems and creating knowledge?

How is cybersecurity impacting the ever-increasing number of Internet users?

How does cryptography work?

Content - What will students know?

- Computing facilitates exploration and the discovery of connections in information.
- Computing enables innovation in nearly every field.
- An inventive process is aided by effective organization and selection of resources. Appropriate technologies and tools facilitate the accessing of information and enable the ability to evaluate the credibility of sources.
- Computing enables people to use creative development processes to create computational artifacts for creative expression or to solve a problem
- Computing enhances communication, interaction, and cognition.
- Computing innovations influence and are influenced by the economic, social, and cultural contexts in which they are designed and used.
- An investigative process is aided by the effective organization and selection of resources. Appropriate technologies and tools facilitate the accessing to information and enable the ability to evaluate the credibility of sources. ●
- There are trade-offs when representing information as digital data.
- Compung has a global effect -- both beneficial and harmful -- on people and society.
- Cybersecurity is an important concern for the internet and the systems built on it
- Models and simulations use abstraction to gerate new understanding and knowledge
- People use computer programs to process information to gain insight and knowledge.
- Algorithms can solve many but not all computational problems.
- Characteristics of the Internet influence the systems built on it.
- Creave development can be an essential process for creating computational artifacts.

Skills - What will students be able to do?

- Identify sources of data produced, used, and consumed by a web application.
- Given a tool that provides access to a large dataset, explain the kinds of problems such a tool could solve.
- Use a tool that provides access to “big data” and investigate its sources.
- Explain that new techniques are necessary to store, manage, transmit, and process data at the scale it is currently being produced.
- identify a suitable compound innovation for a research project.
- Identify reliable and authoritative sources of information about a computing innovation

- Synthesize information taken from multiple online sources to create a cohesive description of a computing innovation
- Explain how data drives a specific innovation, both in writing and visually.
- Explain privacy concerns that arise through the mass collection of data
- Use online search tools to find and connect information about a person or topic of interest.
- Explain how multiple sources of data can be combined to uncover new knowledge or information
- Analyze the personal privacy and security concerns that arise with any use of computational systems.
- Explain how and why personal data is exchanged for the use of free software
- Explain some of the privacy and economic tradeoffs involved in the collection and use of personal data.
- Describe the ways and reasons organizations collect information about individuals.
- Read and critically evaluate a data privacy policy.
- Explain why encryption is an important need for everyday life on the Internet.
- Crack a message encrypted with a Caesar cipher using a Caesar Cipher Widget
- Crack a message encrypted with random substation using Frequency Analysis
- Explain the weaknesses and security flaws of substation ciphers
- Explain the relationship between cryptographic keys and passwords.
- Explain in broad terms what makes a key difficult to “crack.”
- Reason about strong vs. weak passwords using a tool that shows password strength.
- Understand that exponential growth is related to an encryption algorithm’s strength.
- Explain how and why the Vigenère cipher is a stronger form of encryption than a plain substation.
- Explain the properties that make for a good key when using the Vigenère Cipher.
- Explain what the modulo operation does and how it operates as a "one-way" function
- Follow an asymmetric encryption algorithm to encrypt a numerical message using the Public Key Crypto widget.
- Explain the difference between symmetric and asymmetric encryption
- Describe the basic process of encrypting data using public key encryption
- Explain the benefits of public key cryptography
- Explain the characteristics of a phishing attack
- Explain how a DDoS attack works
- Describe how one computer virus works
- Research and describe a cyber attack found in the news
- Reason about the threats posed by, and methods of recourse for, various types of cyber attacks
- Identify reliable and authoritative sources of information about company information.
- Synthesize information taken from multiple online sources to create a cohesive description of a company innovation.
- Idenfy an artifact that clarifies an aspect of a computing topic not easily captured in writing
- Explain both the beneficial and harmful effects related to a modern social dilemma in computing

Activities - How will we teach the content and skills?

- Unplugged Acvies
- Concept Invention
- Widget - Text Compression
- Group Problem Solving
- Reinforcement

- Research
- Individual and Group Discovery
- External Tools
- Exploraon
- Performance Task
- Presentation

Evidence/Assessments - How will we know what students have learned?

- What is a Caesar cipher?
- What problems exist with encryption schemes such as the Vigenère cipher, even when strong encryption keys are used?
- Companies and organizations commonly require users to change their passwords frequently. Websites have password length and complexity requirements. Is it better to change your password frequently or to have a longer password? What level of security is appropriate to require of end users? Does this change, depending on the context (for example, employee or customer)?
- In symmetric encryption, t(more are welcome) why asymmetric encryption is useful.
- IN the cups and beans activity, what is the public key? What is the private key? What is the unencrypted and encrypted message?
- What are some other examples of one-way functions? Can you think of a one-way function in real life?
- Using your name and the name of a friend, describe the process of sending your friend a message using public key cryptography. Your explanation should include the terms: Public Key, Private Key, Encrypt(ion), Decrypt(ion)
- Explain what the module operation does. You may use the analogy of a clock in your answer if you like.
- Why is a modulo a one-way function?
- Describe to a person who knows nothing about encryption why public key encryption is hard to crack.

Spiraling for Mastery

Content or Skill for this Unit	Spiral Focus from Previous Unit	Instructional Activity
• The design and use of computing technologies and artifacts can improve, worsen, or maintain inequitable access to information and opportunities. • Many aspects of society, especially careers, have been affected by the degree of communication afforded by computing. The	• Advancements in computer technology change people's everyday activities. Society is faced with tradeoffs due to the increasing globalization and automation that computing brings. • People can organize and engage around issues and topics of interest through various communication	• What is Big Data? • Identifying People With Data • The Cost of Free

increased connectivity between people in different cultures and different career fields has changed the nature and content of many careers. • Laws govern many aspects of competition, such as privacy, data, property, information, and identity. These laws can have beneficial and harmful effects, such as expanding or delaying advancements in computing and protecting or infringing upon people's rights. International differences in laws and ethics have implications for computing.	platforms enabled by computing, such as social networks and media outlets. These interactions allow issues to be examined using multiple viewpoints from a diverse audience. • There are tradeoffs between allowing information to be public and keeping information private and secure. People can be tricked into revealing personal information when more public information is available about them online.	

Key Resources

Unit 4 - Code.org Computer Science Principles Curriculum

Caesar Cipher - Encryption

Widget - Public Key Crypto

Career Readiness, Life Literacies, & Key Skills

CAEP.9.2.12.C.7	Examine the professional, legal, and ethical responsibilities for both employers and employees in the global workplace.
TECH.9.4.12.CI	Creativity and Innovation
TECH.9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a). Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed.