4- Computer Systems, Networks and the Impact of Computing

Content Area: **Technology**
Course(s):
Time Period: **Marking Period 3**
Length: **13 blocks**
Status: **Published**

Course Description & Instructional Notes

Exam Weighting: 32-41% (applies to student Create task required for the AP Exam, which is also in the next unit)

The Internet is a network that most students use on a regular basis to look up information, to socialize with friends, and in many cases to complete their school work. In this big idea, students will learn how computer systems and networks, primarily the Internet, work. Students will learn about how information is transmitted on the Internet and about the safeguards that have been put in place to keep this system from breaking down. In addition, students will learn the effect that dividing tasks across multiple computing devices can have on the speed at which processes can occur.

The creation of computer programs can have extensive impacts, some unintended, on societies, economies, and cultures. In this big idea, students explore these effects, the legal and ethical concerns that come with programs, and the responsibilities of programmers. When using computing innovations and transmitting information via the Internet, students should be aware of the risk of sharing personal identifiable information about themselves, such as their age or address, and actively take steps to keep this information safe.

Prior Knowledge

none

Instructional Notes

Building Computational Thinking Practices:

Some programs are so large or complex that they end up taking a long time to run, making them impractical to use. In order to minimize this runtime, the individual processes that comprise a program can be run on multiple processors simultaneously. Programmers need to evaluate the options of running these processes sequentially or in parallel across multiple processors to optimize the solution time. When introducing students to distributed processes, use real-world examples, such as dividing up household chores or passing back classroom papers.

To create more stable access to the Internet, additional connections and routers can be added. Redundant routing options help ensure that the Internet is more reliable and stable. To determine where additional

connections and routers need to be added to the systems, evaluation of existing infrastructure is beneficial. Using kinesthetic learning techniques to simulate the connections and routers in a system can help students make this abstract idea more concrete. As student understanding increases, propose problems for the students to solve, such as broken connections or the need to expand the system to include newly added routers or devices.

Computing innovations and programs are often developed in teams. A good, collaborative team starts with a group that is made up of people from different backgrounds, genders, ages, and races so that the perspectives of all potential users are being represented. By creating diverse groups where each person's opinion is considered, we help avoid unintentional bias and potential negative effects, such as contributing to the digital divide, that can creep into innovations.

Investigating the impact of existing computing innovations can help students avoid unintentional negative effects of their own innovations. Consumers should be aware of the impact that a new computing innovation might have before beginning to use it, as well as what data are being gathered and how the product owner intends to use those data. While students may find it relatively easy to describe how the gathering of data would impact them, it is sometimes more difficult for students to understand the impacts that computing innovations and the gathering of personal data might have on people who are different from them, or on society as a whole. As students investigate computing innovations, provide opportunities for students to learn from others' perspectives by allowing time for viewpoints and potential impacts to be shared during a group discussion, like a debate.

Preparing for the AP Exam:

On the end-of-course exam, students will be presented with scenarios for how information could be passed via the Internet along with illustrations of interconnected computers in given networks. Students will be asked to select which choice best explains how information is passed through these networks from one computing device to another or how designing systems to include redundancy helps make them fault-tolerant. To aid in understanding these diagrams, students should be encouraged to use the Marking the Text strategy (see page 133). They can mark the diagrams with the information provided to ensure they have an accurate visual and can then match that visual to the explanations provided.

Students will be asked to complete three investigations into computing innovations during the school year. Through these investigations, students will look at the data the computing innovation uses to complete its task; any data privacy, security, or storage concerns that might be associated with the innovation; and beneficial and harmful effects the computing innovation might have on society, the economy, or culture.

On the end-of-course exam, students will be presented with a passage about a computing innovation and will be asked a series of questions about data and the effects of the computing innovation. While the computing innovations that need to be investigated are not specified in the curricular requirement, students will benefit from investigating a large range of computing innovations.

Technology Integration

Computer Science naturally integrates technology on a daily basis.

Enduring Understandings

Computer systems and networks facilitate the transfer of data.
Parallel and distributed computing leverage multiple computers to more quickly solve complex problems or process large data sets.
While computing innovations are typically designed to achieve a specific purpose, they may have unintended consequences.
The use of computing innovations may involve risks to personal safety and identity.

Essential Questions

Why are long text messages sometimes delivered out of order?
When an Internet service outage occurs in a different part of your town or city, how are you still able to access the Internet?
What are the benefits of dividing tasks among group members?
Is there a point where adding another group member would not make completing the task faster? Why?

What app or computer software do you use most often and would have a hard time going without? How does this software solve a problem for you or benefit you?
Are innovators responsible for the harmful effects of their computing innovations, even if those effects were unintentional? Why or why not?
What data are generated by smartphones, and what are they being used for?

Student Learning Objectives

Students will be able to…

- Explain how computing devices work together in a network.
- Explain how the Internet works.
- Explain how data are sent through the Internet via packets.
- Describe the differences between the Internet and the World Wide Web.
- For fault-tolerant systems, like the Internet: Describe the benefits of fault tolerance, explain how a given system is fault-tolerant, and identify vulnerabilities to failure in a system.
- For sequential, parallel, and distributed computing: Compare problem solutions and determine the efficiency of solutions.
- Describe benefits and challenges of parallel and distributed computing.
- Explain how an effect of a computing innovation can be both beneficial and harmful.
- Explain how a computing innovation can have an impact beyond its intended purpose.
- Describe issues that contribute to the digital divide.
- Explain how bias exists in computing innovations.
- Explain how people participate in problem-solving processes at scale.
- Explain how the use of computing can raise legal and ethical concerns.
- Describe the risks to privacy from collecting and storing personal data on a computer system.
- Explain how computing resources can be protected and can be misused.
- Explain how unauthorized access to computing resources is gained.

Vocabulary & Learning Experiences

Essential Academic Vocabulary: computing device, computer network, path, routing, bandwidth, communication protocol, dynamic, scalability, data stream, packets, TCP, IP, UDP, HTTP, fault tolerance, redundancy, sequential computing, parallel computing, distributed computing, digital divide, bias, crowdsourcing, citizen science, intellectual property, creative commons, open source, open access, Personally Identifiable Information (PIIs), multifactor identification, encryption, symmetric key encryption, public key encryption, digital certificates, computer viruses, malware, phishing, keylogging, rogue access point

Planned Learning Experiences

Journaling

Ask students to read about the Internet and packet switching in Blown to Bits. Pose several prompts related to the Internet, such as the following, and have students add their answers to their journals:

How is the Internet like the US Post Office?

Explain the difference between circuit switching and packet switching.

Ask students to use what they learned from reading to make a drawing showing how they think an email travels from one place to another.

Predict and compare

When introducing parallel and distributed computing, present students with a set of processes and several distributed models. Ask students to compare the models and predict which one is the most efficient, least efficient, or equivalent to other models in the set. Then show students how to determine the efficiency of each model to check if their predictions were correct.

Marking the text

Provide students with an article that highlights both beneficial and harmful effects of a specific computing innovation, and have them mark which effects are beneficial and which are harmful. For each effect the students mark as harmful, have them add notes about whether they think these effects should have been anticipated in advance. For each effect the students mark as beneficial, have the students make notes indicating if they think these benefits were intended or unintended.

Kinesthetic learning

In small groups, have students create and act out a play or a scene involving privacy and security risks,

especially when it comes to personally identifiable information (PII) and the impact of collecting such data. Sample topics might include not recognizing a phishing email, being careless with passwords, downloading a virus accidentally, or not being aware of a search history being kept on a computer. Students could extend their play to include best practices or ways to stay safer when using computing innovations.

Resources

CodeHS

Code.org

MobileCSP

Google Classroom

AP Classroom

Assessments

Formative

Quizzes embedded in CodeHS Modules and Code Review

Reflection: Unintended Effects

Students consider the WWW, targeted advertising and machine learning and data mining as examples of computing innovations. They also learn that responsible programmers try to consider the unintended ways their computing innovations can

be used and the potential beneficial and harmful effects of these new uses although it may not be possible for a programmer to consider all the ways a computing innovation can be used.

They then consider Pokemon Go (from the previous video) or research another innovation that had unintended effects. Students answer in their reflections:

1. What were the intended effects and what were the unintended effects?

2. Explain beneficial and harmful effects of at least one other computing innovation on society, economy, or

culture.

Packets and Protocols: The Story of the Internet

In their own words, students tell the story of downloading an image from a website on the internet. They tell the story step by step of how their computer finds the relevant server, requests information from the server, and receives it.

Students are required to include distinctions between the internet and the World Wide Web, such as:

- The World Wide Web is a system of linked pages, programs, and files.
- HTTP is a protocol used by the World Wide Web.
- The World Wide Web uses the Internet.

Summative

Computer Systems, Networks, and Impact of Computing Unit Assessments on CodeHS

Practice PT: The Effects of the Internet

Students provide evidence of the extensive knowledge they have developed about a chosen Internet-based innovation and its impact(s). Students include citations, as applicable, within their written responses. Within their computational artifact, students explain at least one beneficial effect and at least one harmful effect the Internet-based innovation has had, or has the potential to have, on society, economy, or culture. They also identify data privacy, security, or storage concerns for the computing innovation.

AP CSP Explore Task Practice on CodeHS

NJSLS Standards

NJSLS Standards Copied and Pasted as well as linked.

NJSLS Computer Science and Design Thinking

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas
9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice
9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving
9.4.12.DC.1: Explain the beneficial and harmful effects that intellectual property laws can have on the creation and sharing of content
9.4.12.DC.2: Compare and contrast international differences in copyright laws and ethics.
9.4.12.DC.3: Evaluate the social and economic implications of privacy in the context of safety, law, or ethics

9.4.12.DC.4: Explain the privacy concerns related to the collection of data (e.g., cookies) and generation of data through automated processes that may not be evident to users
9.4.12.DC.7: Evaluate the influence of digital communities on the nature, content and responsibilities of careers, and other aspects of society
9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task
9.4.12.TL.3: Analyze the effectiveness of the process and quality of collaborative environments.
9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem

Additional NJSLS Standards

NJSLS Standards Copied and Pasted as well as linked.

Interdisciplinary Connections

NJSLS Career Readiness, Life Literacies, and Key Skills

From CLKS:

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas
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NJSLS Companion Standards Grades 9-12 (Reading & Writing in Science & Technical Subjects)

Modifications/Accommodations

GENERAL CONSIDERATIONS FOR DIVERSE LEARNERS

English Language Learners

- Personal glossary
- Text-to-speech
- Extended time
- Simplified / verbal instructions
- Frequent breaks

WIDA Can Do Descriptors for Grade 9-12

WIDA Essential Actions Handbook

FABRIC Paradigm

Wall Township ESL Grading Protocol

*Use WIDA Can Do Descriptors in coordination with Student Language Portraits (SLPs).

Students Receiving Special Education Services

- Small group/One to one
- Additional time
- Review of directions
- Student restates information
- Space for movement or breaks
- Extra visual and verbal cues and prompts
- Preferential seating
- Follow a routine/schedule
- Rest breaks
- Verbal and visual cues regarding directions and staying on task
- Checklists
- Immediate feedback

Students receiving Special Education programming have specific goals and objectives, as well as accommodations and modifications outlined within their Individualized Education Plans (IEP) due to an identified disability and/or diagnosis. In addition to exposure to the general education curriculum, instruction is differentiated based upon the student's needs. The IEP acts as a supplemental curriculum guide inclusive of instructional strategies that

Advanced Learners

- Use of high level academic vocabulary/texts
- Problem-based learning
- Pre assess to condense curriculum
- Interest-based research
- Authentic problem-solving
- Homogeneous grouping opportunities

Knowledge and Skill Standards in Gifted Education for All Teachers

Pre-K-Grade 12 Gifted Programming Standards

Gifted Programming Glossary of Terms

Students with 504 Plan

Teachers are responsible for implementing

support each learner.

designated services and strategies identified on a student's 504 Plan.

Considerations for Special Education Students 6-12

National Center on Universal Design for Learning - About UDL

UDL Checklist

UDL Key Terms

At Risk Learners / Differentiation Strategies

Alternative Assessments

Choice Boards

Games and Tournaments

Group Investigations

Learning Contracts

Leveled Rubrics

Literature Circles

Multiple Texts

Personal Agendas

Homogeneous Grouping

Independent Research & Projects

Multiple Intelligence Options

Project-Based Learning

Varied Supplemental Activities

Varied Journal Prompts

Tiered Activities/Assignments

Tiered Products

Graphic Organizers

Choice of Activities

Mini-Workshops to Reteach or Extend

Think-Pair-Share by readiness or interest

Use of Collaboration of Various Activities

Jigsaw

Think-Tac-Toe

Cubing Activities

Exploration by Interest

Flexible Grouping

Goal-Setting with Students

Homework Options

Open-Ended Activities

Varied Product Choices

Stations/Centers

Work Alone/Together