

Unit 5: Big Data

Content Area: **Technology**
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Computer Science Principles

Department of Curriculum and Instruction



Belleville Public Schools

Curriculum Guide

**Computer Science Principles, Grades 9-12 High
School**

Big Data

Belleville Board of Education

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Unit Overview

Discover new knowledge through the use of large data sets.

Enduring Understanding

- Computers are used in an iterative and interactive way when processing digital information to gain insight and knowledge.
- Computing facilitates exploration and the discovery of connections in information.

- Transforming information can be effective in communicating knowledge gained from data.

Essential Questions

- How can computational models and simulations help generate new understanding and knowledge?
- Do considerations and trade-offs arise in the computational manipulation of data?

Exit Skills

- Assess the risks and benefits of drawing conclusions from patterns found in large data sets.
- Combine visuals, content knowledge, and interaction to create a dynamic infographic that clearly communicates discrete information about a data set.
- Differentiate usable and useful data from unusable data and useless data based on the characteristics of each.
- Extract structured information from unstructured data.
- Extract information from online sources, including structured and unstructured search engines, screen scrapers, and spiders.
- Examine features and functions of modern relational databases.
- Explore the use of data mining in the discovery of patterns in large data sets.
- Examine the use of cluster analysis and data classification in the processing of large data sets.
- Examine the causes and impact of data breaches involving sensitive personal data.

New Jersey Student Learning Standards (NJSL-S)

8.1 Educational Technology

8.1.12.A.1, 8.1.12.A.2, 8.1.12.D.1, 8.1.12.D.4, 8.1.12.E.1, 8.1.12.E.2, 8.1.12.F.1

8.2 Technology, Engineering, Design and Computational Thinking

8.2.12.A.1, 8.2.12.B.1, 8.2.12.C.2, 8.2.12.C.3

| | |
|---------------|--|
| TECH.8.1.12 | All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge. |
| TECH.8.1.12.A | Students demonstrate a sound understanding of technology concepts, systems and operations. |
| TECH.8.2.12 | All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment. |
| TECH.8.2.12.B | Knowledge and understanding of human, cultural and society values are fundamental when designing technology systems and products in the global society. |

| | |
|-------------------|---|
| TECH.8.2.12.C | The design process is a systematic approach to solving problems. |
| TECH.8.2.12.D | The designed world is the product of a design process that provides the means to convert resources into products and systems. |
| TECH.8.2.12.D.CS1 | Apply the design process. |
| TECH.8.1.12.F.CS4 | Use multiple processes and diverse perspectives to explore alternative solutions. |

Interdisciplinary Connections

- 21st century life and careers
- Technology
- Digital Literacy
- English Language Arts
- Reading
- Writing
- Speaking and Listening (communication skills)
- Mathematics
- Social science
- Science and the Engineering Practices

Career Ready Practices

- CRP4. Communicate clearly and effectively and with reason.
- CRP5. Consider the environmental, social and economic impacts of decisions.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP11. Use technology to enhance productivity.

Learning Objectives

Data Science:

- Relate the impact of computing to large-scale data processing.
- Discover the ways that patterns within large data sets can be used in a predictive manner.
- Assess the risks and benefits of drawing conclusions from patterns found in large data sets.
- Combine visuals, content knowledge, and interaction to create a dynamic infographic that clearly communicates discrete information about a data set.
- Differentiate usable and useful data from unusable data and useless data based on the characteristics of each.

Data Aggregation:

- Explore the purposes of processing tasks, including collection, knowledge extraction, and data storage.
- Identify multiple techniques for data collection, both on and off of the Internet.
- Extract structured information from unstructured data.
- Extract information from online sources, including structured and unstructured search engines, screen scrapers, and spiders.
- Examine features and functions of modern relational databases.

Data Analysis:

- Analyze the trade-off of utility and confidence in descriptive, predictive, and prescriptive data analysis.
- Investigate traditional statistical hypothesis testing and exploratory data analysis.
- Explore the use of data mining in the discovery of patterns in large data sets.
- Examine the use of cluster analysis and data classification in the processing of large data sets.

Global Impact:

- Debate the benefits and costs of large-scale data storage and data persistence on privacy and utility.
- Explore security risks and responsibilities assumed by companies that collect and store sensitive personal data.
- Examine the causes and impact of data breaches involving sensitive personal data.

Suggested Activities & Best Practices

Exploration and Research:

- Investigate a computing innovation that has had a significant impact on society, economy, or culture.
- Produce a computational artifact that describes the intended purpose and function of the computing innovation and demonstrates how it fulfills that purpose.
- Document the development process, tools, and techniques used in creating the computational artifact.
- Analyze the beneficial and harmful effects of the computing innovation on society, economy, or culture.
- Identify and discuss how the computing innovation consumes, produces, and/or transforms data and address concerns about data storage, data privacy, or data security..
- Design, research, and create a computational artifact.

Creative Development:

- Design, implement, and test a program that solves a problem of personal interest to the student.
- Summarize, describe, and reflect on the development process of the program.
- Create a video demonstrating the use and functionality of the program.

Evidence of Student Learning - Checking for Understanding (CFU)

- Minor exercises and short formative assessments addressing specific unit topics and objectives
 - Formally assessed, multiple-choice test addressing unit objectives (single- and multiple- select questions) in preparation for advanced placement exam
 - Rubric-assessed, individual and/or collaborative unit project demonstrating mastery of unit objectives
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- Admit Tickets
 - Anticipation Guide
 - Common benchmarks
 - Compare & Contrast
 - Create a Multimedia Poster

- Define
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer
- Illustration
- Journals
- KWL Chart
- Newspaper Headline
- Outline
- Question Stems
- Quickwrite
- Quizzes
- Red Light, Green Light
- Self- assessments
- Socratic Seminar
- Study Guide
- Teacher Observation Checklist
- Think, Pair, Share
- Think, Write, Pair, Share
- Top 10 List
- Unit tests

Primary Resources & Materials

Online Edhesive Computer Science Program.

Ancillary Resources

General Resources:

- Computers and Internet Access
- AP Central at Collegeboard.org
- Massive Open Online Course
- Code.org

- Multimedia Applications Tools
- Abelson, H., Ledeen, K., and Lewis, H. R. Blown to Bits: your life, liberty, and happiness after the digital explosion. Upper Saddle River, N.J.: Addison-Wesley, 2008.

AP Approved Programming Resources:

(may choose one or more)

- Alice - This 3-D modeling environment allows students to create and animate 3-D worlds. This environment lends itself well to creating stories and games.
- App Inventor - This open-source Web application allows students to create their own applications on mobile devices. App Lab - This is a programming environment for creating web applications with JavaScript. It allows students to develop programs and toggle back and forth between block-based and text-based programming modes.
- EarSketch - This browser-based application allows students to create their own music using either JavaScript or Python. Greenfoot - This Java IDE is designed for use in education to create two-dimensional graphic applications, such as simulations and interactive games.
- Java - There are several IDEs that can be used to write in Java. The Java language allows students to create and solve problems that vary widely in difficulty.
- JavaScript - This language is commonly used to create interactive effects within Web browsers.
- Lego Mindstorms NXT - This product integrates programming with Lego bricks and sensors to create and program robots. The instructions are assembled by linking together function blocks.
- Processing - This programming language was initially created to serve as a software sketchbook, and it can be used to teach programming using a visual context.
- Python - This language has the benefit of readability that might be helpful to new programmers.
- Scratch - This blocks-based programming language allows students to build scripts to run animations. This product can be downloaded and installed on a computer or run in the browser.
- Snap! - This Scratch-style programming language is block-based and allows users to define new primitives in JavaScript. Users can read and write information from the Internet using server-defined APIs and make mobile applications.
- Swift - This programming language is designed for use with iOS, OS X, tvOS and watchOS. This environment allows students to create their own Apple apps and includes interactive environments that allow students to see the effects of changes or additions to code as they type.

Design and Development Process:

- “What Is the Software Development Life Cycle?” Official Blog Airbrake Bug Tracker. <https://airbrake.io/blog/insight/what-is-the-software-development-life-cycle>
- “Engineering Design Process.” [https://www.teachengineering.org/ engrdesignprocess.php](https://www.teachengineering.org/engrdesignprocess.php)
- “The Engineering Design Process.” <http://www.eie.org/overview/engineeringdesign-process>
Mohammed, Nabil, Ali Munassar, and A. Govardhan.

- “A Comparison Between Five Models of Software Engineering.” IJCSI International Journal of Computer Science 7.5 (2010): 94-101. Open Source:
- “What Is Open Source?” Opensource.com. <https://opensource.com/resources/whatopen-source>
- Open Source Initiative. <http://opensource.org/>

Technology Infusion

Computer Science is essentially technologically infused.

Alignment to 21st Century Skills & Technology

The core content areas include:

- English Language Arts;
- Mathematics;
- Science and Scientific Inquiry (Next Generation);
- Social Studies, including American History, World History, Geography, Government and Civics, and Economics;
- World languages;
- Technology;
- Visual and Performing Arts.

21st Century Skills/Interdisciplinary Themes

The **21st Century/Interdisciplinary Themes** that will be incorporated into this unit.

- Communication and Collaboration
- Creativity and Innovation
- Critical thinking and Problem Solving
- ICT (Information, Communications and Technology) Literacy
- Information Literacy
- Life and Career Skills

- Media Literacy

21st Century Skills

21st century life and careers

Technology

Digital Literacy

English Language Arts

Reading

Writing

Speaking and Listening (communication skills)

Mathematics

Social science

Science and the Engineering Practices

Career Ready Practices

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.

CRP6. Demonstrate creativity and innovation.

CRP7. Employ valid and reliable research strategies.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

CRP11. Use technology to enhance productivity.

- Civic Literacy
- Environmental Literacy
- Financial, Economic, Business and Entrepreneurial Literacy
- Global Awareness
- Health Literacy

Differentiation

- Project Based Learning
- Highlighting key vocabulary.
- Additional testing time.
- Using paired/cooperative learning.
- Using hands-on learning.
- Making curricular and personal connections.
- Developing oral, reading, and writing skills.
- Using graphic organizer and/note taking guides
- Use of technology for class
- Use of scaffolding and tiered assessments
- Other differentiation based on IEP and 504 accommodations

Intervention Strategies

- Project Based Learning
- Highlighting key vocabulary.
- Additional testing time.
- Using paired/cooperative learning.
- Using hands-on learning.
- Making curricular and personal connections.
- Developing oral, reading, and writing skills.
- Using graphic organizer and/note taking guides
- Use of technology for class
- Use of scaffolding and tiered assessments

- Other differentiation based on IEP and 504 accommodations
- allowing students to correct errors (looking for understanding)
- teaching key aspects of a topic. Eliminate nonessential information
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning
- allowing students to select from given choices
- allowing the use of note cards or open-book during testing
- collaborating (general education teacher and specialist) to modify vocabulary, omit or modify items to reflect objectives for the student, eliminate sections of the test, and determine how the grade will be determined prior to giving the test.
- decreasing the amount of work presented or required
- having peers take notes or providing a copy of the teacher's notes
- marking students' correct and acceptable work, not the mistakes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using authentic assessments with real-life problem-solving
- using true/false, matching, or fill in the blank tests in lieu of essay tests
- using videos, illustrations, pictures, and drawings to explain or clarify

Special Education Learning

- Project Based Learning
 - Highlighting key vocabulary.
 - Additional testing time.
 - Using paired/cooperative learning.
 - Using hands-on learning.
 - Making curricular and personal connections.
 - Developing oral, reading, and writing skills.
 - Using graphic organizer and/note taking guides
 - Use of technology for class
 - Use of scaffolding and tiered assessments
 - Other differentiation based on IEP and 504 accommodations
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- printed copy of board work/notes provided
 - additional time for skill mastery
 - assistive technology

- behavior management plan
- Center-Based Instruction
- check work frequently for understanding
- computer or electronic device utilizes
- extended time on tests/ quizzes
- have student repeat directions to check for understanding
- highlighted text visual presentation
- modified assignment format
- modified test content
- modified test format
- modified test length
- multiple test sessions
- multi-sensory presentation
- preferential seating
- preview of content, concepts, and vocabulary
- reduced/shortened reading assignments
- Reduced/shortened written assignments
- secure attention before giving instruction/directions
- shortened assignments
- student working with an assigned partner
- teacher initiated weekly assignment sheet
- Use open book, study guides, test prototypes

English Language Learning (ELL)

- Project Based Learning
- Highlighting key vocabulary.
- Additional testing time.
- Using paired/cooperative learning.
- Using hands-on learning.
- Making curricular and personal connections.
- Developing oral, reading, and writing skills.
- Using graphic organizer and/note taking guides
- Use of technology for class
- Use of scaffolding and tiered assessments
- Other differentiation based on IEP and 504 accommodations

- teaching key aspects of a topic. Eliminate nonessential information
- using videos, illustrations, pictures, and drawings to explain or clarify
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning;
- allowing students to correct errors (looking for understanding)
- allowing the use of note cards or open-book during testing
- decreasing the amount of work presented or required
- having peers take notes or providing a copy of the teacher's notes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using computer word processing spell check and grammar check features
- using true/false, matching, or fill in the blank tests in lieu of essay tests

Sample Lesson
