Title: Promising Portals	Targeted Grade: Lexile: 900L - 1100L
Author(s):	Time Expectancy: 120 min Depth of Knowledge (DOK 1, 2, or 3): 2-3

Computer Science Learning Objectives: Student will:

- be able to describe the significance of the ENIAC computer in the context of World War II and the role that necessity played in its development, using at least three specific historical details.
    - **Standard:** CCSS-ELA: W.7.1 (Write arguments to support claims with clear reasons and relevant evidence)
    - **Domain:** Knowledge and Understanding
    - **Assessment:** Individual; Informal assessment through reflective writing in Part II.

- create a Scratch project that accurately represents different potential future paths, incorporating at least two sprites and three different backdrops, while demonstrating their understanding of basic coding principles.
    - **Standard:** CSTA 2-AP-11 (Create clearly named variables that represent different data types and perform operations on their values)
    - **Domain:** Application and Creativity
    - **Assessment:** Small Group or Individual; Formal assessment based on the completed Scratch project in Part III.

- explain how collaboration and diverse contributions were essential to the development of ENIAC, citing the specific roles of the women programmers involved.
    - **Standard:** ISTE 1.4 Innovative Designer (Students use a variety of technologies within a design process to identify and solve problems)
    - **Domain:** Analysis and Evaluation
    - **Assessment:** Large Group; Informal assessment through class discussion and participation during the introduction and body of the lesson.

Concepts/Keywords: ENIAC, World War II, necessity, innovation, computing, programming, relays, vacuum tubes, women programmers, Scratch, animation, coding, binary arithmetic, technological advancement, collaboration, problem-solving, digital history, reflection, future aspirations, project-based learning.

K-12 CSTA Identifier(s)	**Standard(s)** *and Descriptive Statement(s)*
2-AP-11	Create clearly named variables that represent different data types and perform operations on their values.
2-AP-17	Systematically test and refine programs using a range of test cases.
K-12 Computer Framework(s)	**Practice # and Statement(s)**
P6.1 [Core Practice]	Develop and refine computational artifacts iteratively, using systematic testing and debugging.

P7.2 [Core Practice]	Communicate about technology using design sketches, models, and presentations.
ISTE Standards	Standard(s)/Statement(s)
1.4 Innovative Designer 1.6 Creative Communicator	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. Write arguments to support claims with clear reasons and relevant evidence.
Additional Content Standard #(s)	Standard(s)/Statement(s)
NGSS: MS-ETS1-1 CCSS-ELA: ELA: W.7.1	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. Write arguments to support claims with clear reasons and relevant evidence.
State (or International) Standard(s): (TBD and identified by location of instructor utilizing lesson).	
References	K-12 CSTA Standards: Computer Science Teachers Association (2017). *CSTA K–12 Computer Science Standards, Revised 2017.* Retrieved from https://csteachers.org/k12standards/. K-12 Computer Science Framework: https://k12cs.org/wp-content/uploads/2016/09/K%E2%80%9312-Computer-Science-Framework.pdf Next Generation Science Standards: https://www.nextgenscience.org/standards/standards Common Core State Standards for ELA: http://www.thecorestandards.org/ELA-Literacy/ ISTE Standards: https://www.iste.org/standards/for-students Bloom's Digital Taxonomy Verbs: https://libguides.bc.edu/c.php?g=628962&p=4506921
Lesson Resources/Folder Access (Link)	

Overview:

Part I: "Necessity is the Mother of Invention" and ENIAC's Development

In this lesson, students explore the concept that "necessity is the mother of invention," particularly in the context of technological advancements during 1933-1941. The lesson examines the role of necessity in driving innovation, using the example of the ENIAC (Electronic Numerical Integrator and Computer). Students are prompted to think about how pressing needs during World War II led to the development of early computers. The ENIAC, developed to aid in ballistic calculations, was a major technological achievement, involving contributions from women programmers who were pivotal in its operation. This part of the lesson helps students understand the historical context and significance of ENIAC in the evolution of computing.

Part II: Ambition Mission

In this reflective activity, students are asked to think about their future aspirations and career goals. After learning about the contributions of women in the development of ENIAC, students are prompted to write a paragraph envisioning their own career path ten years from now. This activity encourages students to think critically about their ambitions, and how they might contribute to technological or other fields in the future. The goal is to inspire students to consider the impact they can have on the world, just as the women who programmed ENIAC did without realizing the full importance of their work at the time.

Part III: Admire, Aspire, and Acquire in Scratch

In this creative activity, students use Scratch to design an animation that reflects their future aspirations. They create sprites representing their current and future selves and design a backdrop featuring three doors, each leading to a different future path. This project encourages students to think about decision-making and how different choices can lead to different outcomes. The lesson integrates coding skills with personal reflection, allowing students to express their thoughts on their future through a creative and interactive medium. This activity is designed to foster both technical skills in programming and critical thinking about personal development.

Rationale/Background:

The purpose of this lesson is to engage students in understanding the historical significance of technological advancements and the role of necessity in driving innovation, particularly during critical periods such as World War II. By examining the development of ENIAC and the contributions of the women who programmed it, students will gain insight into the origins of modern computing and the importance of collaboration and problem-solving in technological progress. This lesson is designed to connect these historical concepts to students' personal aspirations, encouraging them to think critically about their future roles in technology and innovation.

The students are familiar with basic computing concepts and have some background knowledge of World War II and its impact on technological development. This lesson builds on that prior knowledge by introducing more complex ideas such as the role of necessity in invention and the early history of computing. Additionally, students have been exposed to basic programming through previous lessons in Scratch, allowing them to apply their coding skills in a creative project that reflects their understanding of the lesson's themes. The diverse backgrounds of students in the classroom will enrich the discussion and creative activities, as they bring different perspectives to the historical and personal implications of technological innovation.

Teacher (Required) Materials/Resources:

Whole-Group Materials: (as the instructor sees fit)

- **Projector/Screen:** To display the ENIAC video clip and relevant lesson content for all students.

- **Computer with Internet Access:** To access the "Timeline of Computer History" from the Computer History Museum website.
- **Whiteboard/Markers:** For the instructor to note key points during discussions and summarize important concepts from the lesson.
- **Handouts:** Copies of the lesson's historical context, including information about ENIAC and the women who programmed it, for reference during discussions.

Small Collaborative Group Materials:

- **Laptops/Tablets with Internet Access:** Each group will need a device to access Scratch (scratch.mit.edu) for the project in Part III.
- **Shared Scratch Accounts (if needed):** Group login credentials for students to work collaboratively on their Scratch projects.
- **Poster Paper/Markers:** For groups to brainstorm and plan their Scratch animations, including designing their future scenarios and the doors that represent different paths.

Individual Student Materials:

- **Personal Laptops/Tablets (if available):** For students to work individually on the reflection activity in Part II or to independently explore the Timeline of Computer History.
- **Writing Utensils and Notebooks:** For students to complete the reflective writing task in Part II, where they describe their future aspirations.
- **Scratch Accounts:** Individual login credentials for students to create their own sprites and backdrops if they are working individually on Part III.
- **Paper and Pencil:** For drafting their project ideas and sketching out their Scratch animation plan before creating it digitally.

These materials are organized to facilitate different phases of the lesson, ensuring that all students have the resources they need whether they are participating in whole-group instruction, small group collaboration, or individual tasks.

Student Materials:

Individual Student Materials:

- **Personal Laptops/Tablets (if available):** For students to work individually on the reflection activity in Part II or to independently explore the Timeline of Computer History.
- **Writing Utensils and Notebooks:** For students to complete the reflective writing task in Part II, where they describe their future aspirations.
- **Scratch Accounts:** Individual login credentials for students to create their own sprites and backdrops if they are working individually on Part III.
- **Paper and Pencil:** For drafting their project ideas and sketching out their Scratch animation plan before creating it digitally.

Guided Practice/Instructor Procedures:

A) Introduction and Motivation:

1. Means of assessing prior knowledge:
   Begin by asking students what they know about World War II and its impact on technology. Have a

brief discussion on the role of necessity in driving innovation, prompting students to share examples they are aware of. This will assess their prior knowledge and set the context for the lesson.

2. Motivational strategy:
   Introduce the lesson by showing a short, attention-grabbing video clip about the development of ENIAC and its significance. Highlight how the women who programmed ENIAC played a crucial role in a project that changed the world. This will motivate students by connecting historical achievements with their potential future contributions.
3. Strategy for activating prior knowledge:
   Connect the topic to students' previous experiences with basic programming in Scratch. Ask them how coding and problem-solving have been important in their projects. Relate these experiences to the challenges faced by the ENIAC programmers during World War II.
4. Lesson purpose (as appropriate):
   The purpose of this lesson is to explore how historical necessity led to groundbreaking technological advancements, specifically focusing on the development of the ENIAC computer and its programmers' contributions. Students will also reflect on their own future aspirations and how they can impact the world.

B) Lesson Body:

1. A sequence of the experiences used to develop the lesson:
   - Begin with a discussion on "necessity is the mother of invention" and how this concept applied to World War II technology.
   - Present information on ENIAC and the women who programmed it, emphasizing the significance of their work.
   - Have students watch a video clip about ENIAC.
   - Engage students in a reflective writing activity where they envision their future careers (Part II).
   - Guide students in using Scratch to create an animation representing different future paths (Part III).
2. A means of assessing concurrent achievement:
   - Monitor student participation during discussions to ensure understanding.
   - Review students' reflective writing for Part II to gauge their engagement with the lesson's themes.
   - Evaluate the Scratch projects in Part III for creativity, effort, and the application of coding skills.
3. A list of the higher-level questions needed to teach this lesson:
   - How did the challenges of World War II drive technological innovation?
   - What role did the women programmers of ENIAC play in the history of computing?
   - How can understanding the past inspire us to shape the future?
   - In what ways does necessity continue to drive innovation today?
4. A plan for students who need adapted/modified instructional plans; that is, students needing re-teaching and students needing enrichment:
   - For students needing re-teaching: Provide additional background reading on World War II and early computing. Offer one-on-one guidance during the Scratch project to help them understand coding concepts.
   - For students needing enrichment: Encourage these students to research other key figures in computing history and present their findings to the class. They can also extend their Scratch project by adding more complex features or creating a more detailed animation.

5. Sufficient details so that a peer could teach the lesson without further instructions:
   The lesson plan includes a clear sequence of activities starting with an assessment of prior knowledge, followed by an engaging introduction, a detailed exploration of the ENIAC and its historical context, a reflective writing activity, and a creative coding project. Each section is designed to build on the previous one, ensuring a coherent and engaging learning experience.
6. Opportunities for independent practice and extensions for high-level learners:
   High-level learners can work independently on extended Scratch projects, exploring more advanced coding techniques. They can also be tasked with creating a presentation on how the lessons learned from ENIAC can be applied to solving current global challenges.

C) Lesson Closure:

1. Application of knowledge learned to a new situation to prove that students understand beyond the knowledge level:
   Have students discuss how the lessons from ENIAC's development could apply to modern technological challenges, such as climate change or healthcare. This discussion will help them apply the historical concepts to contemporary issues.

2. Review of main concepts through a summary statement, student participation restatement of purpose of the lesson, or quick review of the main concepts:
   End the lesson with a quick review, asking students to summarize what they learned about ENIAC and its significance. Reinforce the idea that necessity drives innovation and how this concept has shaped both past and future technological advancements.

Student Misconceptions:

1. **Technology Develops in Isolation:**
   Students may mistakenly believe that technological advancements like ENIAC occurred in isolation without influence from broader societal needs. It's important to emphasize that the development of ENIAC was driven by the urgent needs of World War II, illustrating how societal pressures often spur technological innovation.

2. **Only Engineers and Scientists Contributed to Early Computers:**
   Some students might assume that only men or engineers and scientists were responsible for the development of early computers like ENIAC. This lesson challenges that misconception by highlighting the critical contributions of the women programmers who played a pivotal role in making ENIAC operational.

3. **Historical Technology Was Ineffective or Primitive:**
   Students may undervalue the effectiveness of early computing technology, viewing it as primitive by today’s standards. Clarify that while ENIAC and similar machines were much slower and less powerful than modern computers, they were groundbreaking for their time and laid the foundation for all subsequent advancements in computing.

4. **Necessity Always Leads to Positive Outcomes:**
   Students might develop the misconception that all innovations driven by necessity are beneficial or have purely positive outcomes. It’s important to discuss that while necessity often drives innovation,

the outcomes can be complex, sometimes leading to unintended consequences or ethical dilemmas, as seen with technologies developed during wartime.

5. **Coding Is a Solitary Activity:**
   Given the focus on individual or small group Scratch projects, students might think that coding is primarily a solitary task. Reinforce that coding and technology development are often highly collaborative efforts, involving teams of people with diverse skills and backgrounds, just as the ENIAC project did.

6. **Historical Contributions Are Fully Recognized:**
   Students may assume that all contributions to significant historical achievements, such as the programming of ENIAC, have been widely recognized. Discuss the reality that many contributions, particularly by women and minority groups, were historically overlooked or underappreciated, and how this is being rectified today.

Addressing these misconceptions during the lesson will help students develop a more accurate and nuanced understanding of the history of technology and the collaborative, complex nature of innovation.

Reading Selection: *N/A*

Assessment:

A) Student assessment (by instructor):

Informal Assessment:

Formal Assessment:

B) Instructor Self and Student Evaluation: The instructor is encouraged to complete the following as the lesson is being carried out or reflected after the lesson is completed.

Three Strengths of This Lesson:

1) _____
2) _____
3) _____

Three Elements/Areas for Improvement:

1) _____
2) _____
3) _____

Identification of students (**using initials, not names**) who were not successful in meeting the stated objectives: _____

_____

How shortcomings will be addressed prior to starting next session:

_____

_____

_____

Scope and Sequence:

Look-Ahead: *Provide a list of preparations to make for the next lesson. This can be written as a bulleted or numbered list, or written in paragraph form.*