Challenge 4: There Is an App for Class

Design Challenge Overview

Key Question

How do individuals generate ideas for apps?

Problem

The term "app" is short for "application," a special type of software program that allows a user to do something on their smart television, smart watch, smartphone, computer, or tablet. The number of apps available to users is expanding at a rapid rate, and app technology often pushes the limits of current technology. Consumers spent more than $100 billion in app downloads in 2018 and are predicted to spend in excess of $150 billion by the year 2022 (Statista, 2020). This has led companies that host platforms where users can download apps to establish strict guidelines in order to maintain integrity of both their platform and community environment. App designers often use these guidelines to guide their work when developing an app.

When an individual has an idea for an app, they may submit the idea to one of the many app-hosting sites on the Internet. The submission process begins by having the developer fill out an app specification sheet designed to explain and fully develop the idea including the app's purpose, intended audience, and plans for development. The app's specification sheet has become an integral tool in the app planning process for all entrepreneurs, regardless of their age or experience.

In recent years, software programs have become available for creating apps that do not require developers to know programming languages. In fact, there are even companies that will create the app based on the design specification sheet.

This challenge focuses on idea generation rather than app creation.

Design Challenge Task

You have been hired as an entry-level software developer on a software development team by Apps for Education, LLC. Upper management specifically requests that you and your team submit an app proposal to solve a problem that many high school students face when understanding or accessing content in the science or career and technical education (CTE) classroom.

Criteria and Constraints Key

After analyzing the **Design Challenge Card**, students should identify the following criteria and constraints. Use the facilitation questions in the Teacher Guide to help support students as necessary.

Criteria

1. Teams must identify and propose an app.
2. Teams must complete the app specification sheet.
3. Teams must communicate the intended customer interface.
4. Teams must communicate their design for the user experience.
5. Teams must define the app's audience.

Constraints

1. The app must be based on a problem students encounter in a science or CTE classroom.
2. The app must be related to content in the science or CTE classroom.

Career Focus

Programming and Software Developer

Course Alignment

✓ This challenge can be used in any course or class.

Teacher Notes

In this challenge, students will use their experiences in the science or CTE class to develop an idea for an app to assist students in learning and to better access content in the classroom. As with the real world, we cannot anticipate who will have the next great idea for an app or what it will be, but we do not want to limit students and their ideas. You may add an additional constraint for students by having them focus on a specific TEKS or content that traditionally or historically is challenging for students. You may do this by providing student-friendly versions of TEKS and letting them form teams to investigate. We provided suggestions in the TEKS connection portion of this lesson. This challenge includes a strong career connection. The United States is not producing enough computer programmers to satisfy the 1 million plus jobs that require computer programming. Within those statistics, women and minorities make up an even smaller percentage of computer programmers (Committee on STEM Education, 2018). Developing a design for an app is an introductory computer science task that can lead to a career in computer science (Google Inc. and Gallup Inc., 2016).

The product that should be produced in this challenge is a completed app specification sheet, which is a form of a prototype. The prototype should include a sketch of the home page as it would look on a device, a flow chart, or other detailed instructions that may include coding. Students are not required to develop a working app. They are required to do the thinking necessary to start the design process for a unique app. Through research, students may discover how to create and design apps. If the app idea already exists, they should try to figure out a small change they can make so that their app stands out or solves a problem that the other app does not solve.

In the science classroom, apps may assist with several process skills. This could include measurements, calculations, procedures, content clarifications, and simulations. As students plan and start developing their applications, they should get feedback from other peer groups. Students may begin by brainstorming items or concepts in the class they struggled with or that have traditionally been difficult for students.

Students may think that they need coding skills to develop an app. In reality, there are many different websites to assist with app development. The following are the general steps app developers follow.

1. Determine the purpose of the app.
2. Define the intended audience.
3. Determine the problem the app will solve, including what the app will do and how it will meet the audience's needs.
4. Plan the plan. What steps should the app do to accomplish the task?
5. Design and test the app.
6. Redesign and fix the app where necessary.

Many computational thinking skills may be helpful as students take on this task. The first skill is decomposition. Decomposition is the act of breaking tasks down into smaller tasks. The second skill is pattern recognition. This includes determining whether there is something that is asked for over and over that can be included in the program for the app. The next skill is abstraction which refers to filtering out important information and ignoring what is not important. Finally, students should create an algorithm, which is a detailed set of instructions to solve the task. These processes are similar to science processes standards and may be presented in either form but are integral to the task.

A note about career connections

Make sure to emphasize career connections in this design challenge utilizing the **Career Profile** at a time of your choosing. The teacher guide provides instructions for introducing this **Career Profile** during the LAUNCH phase. However you could make the career connection during the PLAN phase when students explore roles and responsibilities or as a reflection at the end of the challenge. This challenge requires the same skills as a software developer and software engineer. Additionally, this challenge includes opportunities to develop STEM skills, investigate career tracks, and become aware of high school and college courses that are necessary to have success in this career. In STEM careers across the board, there are equity concerns for underrepresented populations including women and people of color (Committee on STEM Education, 2018). Consider contacting a counselor or CTE teacher to speak to students about additional opportunities. When possible, invite a software designer or engineer on-site one day to work with students.

Vocabulary

Academic	Career		
Align to student topic selected for your course. Consider having students choose from a selection of specific knowledge and skills to provide focus for the related vocabulary.	abstraction	decomposition	pattern recognition
	algorithm	interface	Software Developer
	app specification sheet	landing page	wireframe
	application (app)	mock-ups	

Materials

For the teacher

- access to collaboration with a computer science teacher

For the challenge

- provide images or outlines of various smartphones, tablets, smart televisions, and other devices that use apps

For each team/student

- access to smart device, such as tablet, computer, or smart phone or other device
- art supplies (colored pencils, markers, etc.)
- chart paper
- Internet access
- paper (various types and sizes)

Advance Preparation

- (Optional) Select specific TEKS for students to focus on. You will determine academic vocabulary and those will be shared with students along with career vocabulary.
- (Optional) Research campus policies for student surveys. The test process for the app is to conduct surveys to determine if the apps are useful and necessary.

Suggested Time Frame: Approximately three 45-minute class periods

The amount of time needed for this challenge may vary depending on your students' research skills and findings.

Suggested Days	Challenge Phase	Planned Time (minutes)	Checkpoint
Day 1	LAUNCH ASK IMAGINE PLAN • understand challenge • research existing apps • brainstorm		
Day 2	• sketch and plan independently • reach team consensus on final design CREATE/TEST/IMPROVE • build and test prototypes • informally share with other teams • revise designs		
Day 3	• revisions continue as needed COMMUNICATE • blind judging and survey (Students from different class periods will complete this.) • presentation (Teams may present via recorded video.) • Peer Review Reflection		
	TOTAL		

Standards Correlations

The following TEKS are ideas for content teachers.

TEXAS ESSENTIAL KNOWLEDGE AND SKILLS (TEKS) FOR SCIENCE CONNECTIONS

AQUATIC SCIENCE

(10)(A) The student is expected to classify different aquatic organisms using tools such as dichotomous keys.

ASTRONOMY

(7)(A) The student is expected to observe and record data about lunar phases and use that information to model the Sun, Earth, and Moon system.

BIOLOGY

(6)(F) The student is expected to predict possible outcomes of various genetic combinations such as monohybrid crosses, dihybrid crosses, and non-Mendelian inheritance.

CHEMISTRY

(8)(G) The student is expected to perform stoichiometric calculations, including determination of mass and gas volume relationships between reactants and products and percent yield.

EARTH AND SPACE SCIENCE

(5)(C) The student is expected to contrast the characteristics of comets, asteroids, and meteoroids and their positions in the solar system, including the orbital regions of the terrestrial planets, the asteroid belt, gas giants, Kuiper Belt, and Oort Cloud.

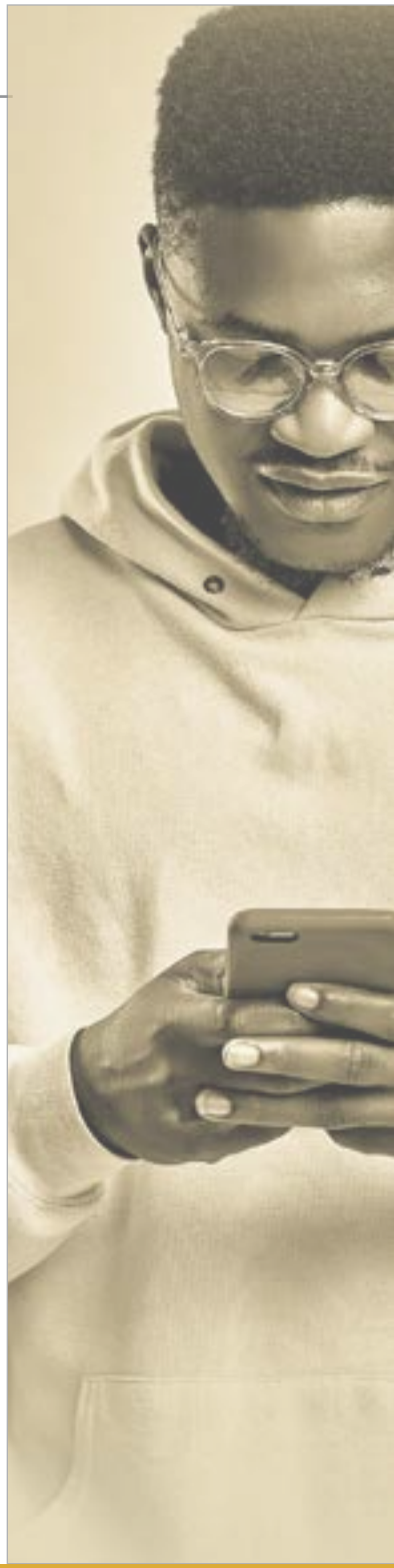
INTEGRATED PHYSICS AND CHEMISTRY

(6)(D) The student is expected to relate the placement of an element on the Periodic Table to its physical and chemical behavior, including bonding and classification.

PHYSICS

(5)(E) The student is expected to characterize materials as conductors or insulators based on their electric properties.

Teacher Guide



LAUNCH

To kick off this challenge, consider asking students to share their favorite app that they use regularly on their phones, tablets, or computers. Take one of the apps suggested and explore the facilitation questions below. If possible, facilitate a similar discussion using a design specification sheet for an existing app. After presenting the apps, distribute the **Career Profile** for software development. Facilitate a discussion of the qualifications and responsibilities of Software Developers. Consider equity when discussing the career.

FACILITATION QUESTIONS:

- What makes you want to search for a specific app and download it?
- How do apps assist or makes things easier for you?
- What problem do you think the app solves? How did they know it was a problem?
- Who is the ideal user of the app?
- What information do you think the app developers collected before trying to develop the app?
- If the creator determines that an app already exists, what would the app developer's next step be?
- What does a software developer do?

ENGINEERING DESIGN PROCESS (EDP) pages 84–89

Engineering Design Process

ASK

- Divide the class into teams of 3–4 students.
- Assign each team a place to work.
- Distribute the **Design Challenge Card** to each team.
- Distribute the **App Design Specification Sheet**.
- Distribute the **ASK: Design Challenge Think Pad**.
- Facilitate a class discussion about the **ASK: Design Challenge Think Pad** to capture ideas and ensure students understand the challenge.

Students should identify the criteria and constraints below. Use the facilitation questions to help support students as necessary.

CRITERIA AND CONSTRAINTS KEY

Criteria

1. Teams must identify and propose an app.
2. Teams must complete the app specification sheet.
3. Teams must communicate the intended customer interface.
4. Teams must communicate their design for the user experience.
5. Teams must define the app's audience.

Constraints

1. The app must be based on a problem students encounter in a science or CTE classroom.
2. The app must be related to content in the science or CTE classroom.

FACILITATION QUESTIONS:

- What are the criteria for this challenge?
- What are the constraints?
- What do you know about app development?
- How do you create an app?
- What apps exist for students who are struggling in a science or CTE class?
- What are some things you notice about the app specification sheet? What stands out to you?
- How will the app specification sheet be helpful when developing your app?

SENTENCE STEMS:

- I think that . . .
- One idea that I have is . . .
- My interpretation of the criteria and constraints is . . .
- Another example is . . .

Teacher Guide

Engineering Design Process

IMAGINE

- Provide access to research materials such as the Internet, experts, artifacts, books, and magazines.
- When necessary, define vocabulary and model techniques for research and notetaking.
- Describe the test process to students.
- After they have finished their research, distribute the **IMAGINE: Window Panes** document to each student. Instruct students to use this graphic organizer to jot down up to nine ideas about their design. Encourage students to value all ideas, to capture as many ideas as they can, to go wild, and to think unconventionally. Students can sketch, draw, or write. They are to record their ideas, build on them, and combine them.
- To wrap up the individual brainstorming session, instruct students to select and circle the top two ideas they want to share with their team. They will need to be ready to communicate and justify their choice using one of the following sentence stems:
  - The idea I'm most excited about is . . . because . . .
  - The idea which is most likely to succeed is . . . because . . .
  - Based on my research and understanding, I think we should . . .
  - The most difficult tasks in this class are . . .
  - The goal of the app is . . .
  - To appeal to the user, I think we should . . .
- Many students will try to find solutions before they fully define the problem. They need to specify a problem and audience before leaving this phase. Consider requiring students submit this portion of the app specification chart before brainstorming solutions.

Note: *Allow students to observe and explore apps at this time to support their brainstorming.*

SUGGESTED RESEARCH TOPICS:

- things to consider when developing an app
- questions to ask before designing an app
- steps to follow when creating an app
- how to build your first app

FACILITATION QUESTIONS:

- What is the content connection in the science or CTE classroom? What specific problem are you trying to solve?
- How do you know that students face this problem? What data do you have to support your decision?
- Do apps that solve this problem already exist? If so, how is your app unique?
- Who is your audience? Why do they need the app?

Engineering Design Process

PLAN

- Distribute and explain the **PLAN: Decision-Making Matrix** to each team to assist them in evaluating possible solutions against the criteria.
- Instruct students to share their top two ideas using the sentence stems on the **IMAGINE: Window Panes** document for team evaluation. Share the following sentence stems as an additional scaffold as needed.
    - I think my team could solve this problem by . . .
    - My idea for solving this problem is . . .
    - Based on my research and understanding, I think we should . . .
- Observe teams to assess and provide feedback on their collaboration, creativity, critical thinking, and communication skills.
- For the purpose of using time efficiently, suggest that teams equally divide and individually assign the tasks for this challenge.
- Provide each team an **App Specification Sheet** to capture their final design and plan.
- Provide feedback to student teams on their final design and plan.
- Assist teams in managing roles and help team members understand their responsibilities within the challenge.

SUGGESTED ROLES:

- Project Manager
- Quality Control Manager
- Creative Design Manager (Note: In this challenge, the Creative Design Manager supervises the look and feel of the app and is in charge of the interface and home screen.)
- Information Specialist
- Safety Manager

SENTENCE STEMS:

- Our app will solve the problem of . . . by . . .
- We will need the following materials . . .
- Our audience would like/not like this because . . .
- The steps we will take are . . .
- Our role assignments are . . .
- Our app will need to do the following . . .
- This idea will be used to complete the _____ section of the **App Specification Sheet**.

Teacher Guide

Engineering Design Process

CREATE/TEST/IMPROVE

- Assist with project management by calling certain team members to give a status update. In addition, provide a specific time when all teams must submit their **App Specification Sheet**.
- Remember not to take over the design process.
- Observe teams to assess and provide feedback on their collaboration, creativity, critical thinking, communication skills, and application of content knowledge.
- Listen for and encourage the use of key academic and career vocabulary.
- Provide time and space for students to give and receive feedback for improvement.
- Facilitate student reflection on their design process using facilitation questions below.
- Review concepts that may help students improve their designs, specifically the content TEKS for your class.
- When necessary, modify or reintroduce problem.

FACILITATION QUESTIONS:

- Why is that significant? Explain your reasoning.
- What are the advantages and disadvantages of _____?
- When might _____ be most useful and why?
- What might happen if you combine _____ and _____?
- What are the most important parts or features of your app?
- Are there planned times when members of your team give progress updates and ask questions?
- What criteria can you use to assess?
- Is the task broken into sections so all can work at the same time?
- How are you ensuring you meet deadlines?

Engineering Design Process

COMMUNICATE

- Facilitate the presentation and testing process.
- Accept and expect failure; failure is an opportunity to learn and improve.
- Distribute the **COMMUNICATE: Peer Review Rubric**.
- Ask questions to help students think critically about the successes and failures of their design.
- Facilitate student reflection on their design process.
- Feedback: Allow time for students to ask questions of each other, reflect, note, and communicate their observations. Facilitate the use of the rubric.

TEST PROCESS:

1. Teacher will conduct market research by surveying classes.
    a. Distribute app specification sheets to student teams in different class periods. In order to use time efficiently, consider having each team member read an app specification sheet and describe the app to team members for team voting.
    b. Omit team names and information that may allow other students to identify team members.
    c. Have teams indicate if they would download this app based on their need and information provided.
    d. Collect the information and provide a summarized table by class period.
2. In addition, have teams conduct a quick search to confirm that the app does not already exist in the same format.

Note: *You may find examples of market research surveys on the Internet to use with your students. It is recommended that you review the examples prior to using them in your classroom to verify their appropriateness.*

FACILITATION QUESTIONS:

- As you worked through the EDP, what changes did you make and why?
- Is there another app that does the same thing as yours? If so, what sets your app apart?
- What problem are you solving with your app? How will your app make solving the problem easier?
- How did you define your audience?
- Does this app work for all users? If it does not, how would you describe the ideal user?

Teacher Guide

Engineering Design Process

COMMUNICATE continued

SENTENCE STEMS:

- I observed . . .
- The part(s) that work(s) is/are . . .
- The part(s) that did not work is/are . . .
- When we tested, we learned . . .
- We know we were successful because . . .
- When we observed other presentations, we learned . . .

EXTENSION ACTIVITY:

- Once all teams have presented, allow the class to consider all presentations and use information to make one final design. Students would analyze different aspects of each team's final design, come together as a class, and engineer one final design.

DESIGN Challenge Card

Challenge 4: There Is an App for Class

Key Question

How do individuals generate ideas for apps?

Problem

The term "app" is short for "application," a special type of software program that allows the user to do something on their smart television, smart watch, smartphone, computer, or tablet. The number of apps available to users is expanding at a rapid rate, and app technology often pushes the limits of current technology. Consumers spent more than $100 billion in app downloads in 2018 and are predicted to spend in excess of $150 billion by the year 2022 (Statista, 2020). This has led companies that host platforms where users can download apps to establish strict guidelines in order to maintain integrity of both their platform and community environment. App designers often use these guidelines to guide their work when developing an app.

When an individual has an idea for an app, they may submit the idea to one of the many app-hosting sites on the Internet. The submission process begins by having the developer fill out an app specification sheet designed to explain and fully develop the idea including the app's purpose, intended audience, and plans for development. The app's specification sheet has become an integral tool in the app planning process for all entrepreneurs, regardless of their age or experience.

There are many software programs available for creating apps that do not require developers to know programming languages. In fact, there are even companies that will create the app based on the design specification sheet.

This challenge focuses on idea generation rather than app creation.

Design Challenge

You have been hired as an entry-level software developer on a software development team by Apps for Education, LLC. Upper management specifically requests that you and your team submit an app proposal to solve a problem that many high school students face when understanding or accessing content in the science or career and technical education (CTE) classroom.

The app must be useful to a wide variety of students, and you must conduct research to define your audience. To progress to app development, the app must meet all criteria on the app specification sheet: meet a need of the specific audience the app is written for; accomplish a task unique to the science or CTE classroom; and have an interface that makes the user experience pleasant. The manner in which the interface is communicated may include a sketch of the landing page as it would look on a device, a flow chart, or other detailed method that may or may not include coding. Entry-level developers are responsible for reviewing specifications, providing technical designs, and completing app specification sheets for Apps for Education, LLC.

CAREER PROFILE: Programming and Software Developer

In this challenge, you have been hired as an entry-level **software developer**. Software developers **analyze** user needs and then **engineer, design,** and **test** software. This may include upgrading existing programs.

The possibilities for employment are endless and include careers in

- Computer Services
- Finance
- Insurance
- Publishing
- Manufacturing

To pursue a career in **software development,** the following courses may be offered at your high school campus. Ask about certifications you can obtain while in high school.

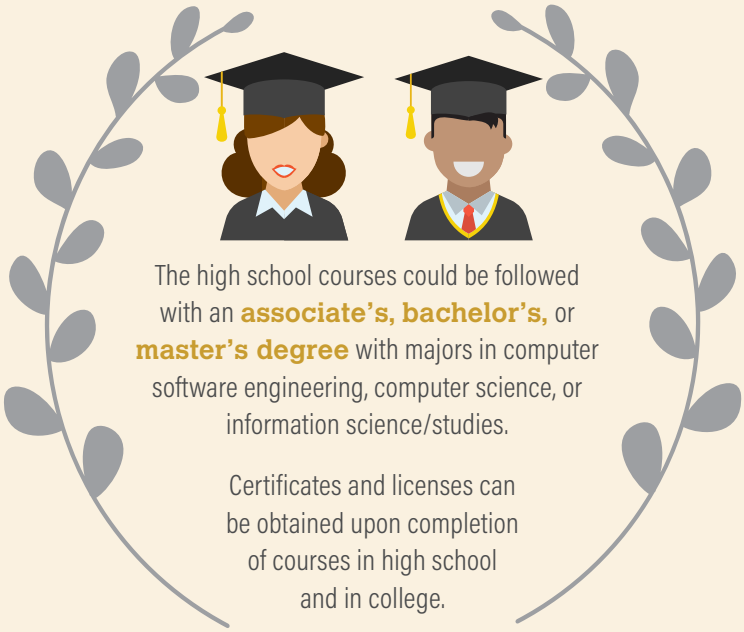
HIGH SCHOOL COURSES

LEVEL 1
Fundamentals of Computer Science

LEVEL 2
AP Computer Science Principles
Computer Science I

LEVEL 3
AP Computer Science A
Computer Science II
Introduction to C# Programming Applications
Mobile App Development

LEVEL 4
Computer Science II
Practicum in STEM
Career Preparation I
Practicum of AV Production
Practicum in Information Technology



The high school courses could be followed with an **associate's, bachelor's,** or **master's degree** with majors in computer software engineering, computer science, or information science/studies.

Certificates and licenses can be obtained upon completion of courses in high school and in college.

Areas to highlight on your résumé that are consistent with skills used in this challenge:

❑ Knowledge of computer science concepts	❑ Equity in app design
❑ Creativity	❑ Self-starter
❑ Innovation experience	❑ Resourcefulness
❑ Evaluation of solutions	❑ Meet deadlines
❑ Identify and solve problems	❑ Communication with team members
❑ Independent learning	❑ Communication with customers

References:

U.S. Bureau of Labor Statistics. (2020, September 1). *Software developers: Summary.* In Occupational Outlook Handbook. Retrieved from https://www.bls.gov/ooh/computer-and-information-technology/software-developers.htm

Texas Education Agency. (2020, July). *Statewide program of study: Programming and software development; STEM career cluster.* Retrieved from https://tea.texas.gov/Sites/default/files/Programming-ProgramOfStudy2020.pdf

App Specification Sheet

Team Details

Team Name
Team Members
Class Period

Background

What roles will individuals play on the team? What experience do team members have with apps? Please list at least five STEM skills that your team members used during this challenge.

1.

2.

3.

4.

5.

Purpose

Describe your app idea. What problem are you trying to solve? What specific knowledge from your science or CTE class did you include in your app? Tell us your vision for the app.

App Specification Sheet

Audience

How did you determine your target audience? Who is your target audience? How did your team address your audience's needs throughout the challenge?

Data and Platforms

Which devices will the app work on? What data will you collect from users? How can data be used in multiple places? What information did you decide to ignore because it was not relevant to the process?

App Algorithm

What do you want your app to do? Please list as many steps as possible as to how the app will work.

App Specification Sheet

App Landing Page Design

Include a sketch of a landing page as it would look on device(s).

Designs/Wireframes

You may include a flowchart or use another method that may or may not include coding to communicate app design. You may wish to include algorithms here.

App Specification Sheet

Timeline and Cost

What time of the school year would this app need to be ready for launch? Will this app be free? If you plan to charge for the app, please specify how much each user will pay.

Criteria

List the essential functions the app will perform. Make sure each criteria is addressed.

Additional Information

Include any additional information that we may not have asked for. How does your app set itself apart from other educational apps?