



STUDENT GUIDEBOOK

2025 - 2026

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This icon indicates a pause in the activity for class discussion.

Section Descriptions



Section 1

Section 1 of the Student Guidebook includes an overview of the STEM Challenge along with student benefits and expectations.



Section 2

Section 2 of the Student Guidebook contains STEM Challenge activity sheets. This includes the required activity, *Activity 1: Let's Get Started*. Your teacher may instruct you to complete activities 2-5 in class, as homework, or on your own.

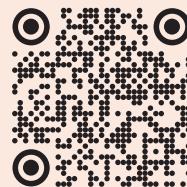


Section 3

Section 3 of the Student Guidebook contains information about STEM Challenge final products, including guidelines for student models and displays. This section also contains information about APA guidelines, tips, and additional resources.

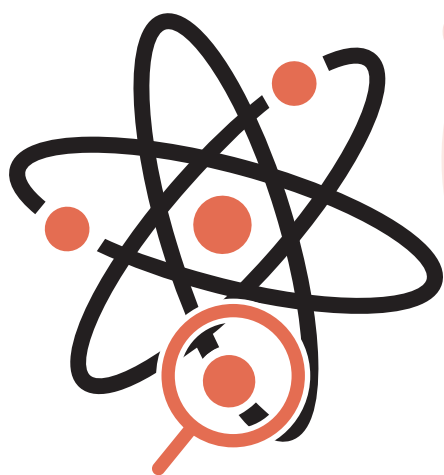
Resources: STEM Challenge Website

Additional resources can be found on the STEM Challenge website. Resources listed on the STEM Challenge website may be modified over time.



Section 1

About the STEM Challenge



*“Scientists investigate that which already is;
engineers create that which has never been.”*

—Albert Einstein

Frost Science STEM Challenge

The Frost Science STEM Challenge engages middle and high school students and teachers with a year-long STEM investigation. In this challenge, you will use the engineering design process to create new and innovative solutions to some of the problems scientists are currently trying to solve. These problems are based on each of Frost Science's four fields of study: astronomy, marine science, paleontology, and health.

Through this dynamic program, you can work in a group or individually to pick a problem, develop and model a solution, and present your work. Even though many students might be working on the same topic, these problems are broad, and you should use your unique interests, knowledge, and skillsets to derive your own creative solution.

The STEM Challenge is an ever-evolving challenge, with the overall program structure remaining constant but the theme and problems for students to solve changing each year. This gives you the opportunity to compete in the STEM Challenge across multiple years.

At the end of the 2025-2026 school year, teachers will submit student projects for the first round of judging. Then, finalists will be invited to present their projects at the STEM Challenge Expo. Students will be judged by experts and scientists in the fields of marine science, health, paleontology, astronomy and education. Winning groups and individuals will receive college scholarships covering up to four years of college. While only top performing students will be invited to present their projects at Frost Science, all STEM Challenge students are encouraged to come to the museum for the STEM Challenge Expo.

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STEM Challenge Timeline

- 1 Receive the Student Guidebook
- 2 Review the STEM Challenge
- 3 Complete *Activity 1: Let's Get Started*
- 4 Research the topic and create a list of reputable resources
- 5 Identify and list issues related to your prompt
- 6 Brainstorm your challenge/identified issues
- 7 Identify potential ideas/solutions
- 8 Select one idea/solution
- 9 Refine and finalize your idea/solution
- 10 Create a model of your solution that uses at least one physical component
- 11 Create a display
- 12 Turn in a digital copy or photographs of your presentation display, photographs of your model, and a copy of your history design file to your teacher
- 13 Your teacher submits projects for the first round of judging
- 14 Students that pass the first round of judging will receive invitations to the STEM Challenge Expo at Frost Science
- 15 Finalists will attend the STEM Challenge Expo for the final round of judging
- 16 Winners will be announced!

2025 - 2026 STEM Challenge Theme

The STEM Challenge prompts will change each year of the STEM Challenge and are based around a central theme. The 2025-2026 STEM Challenge theme is “Innovating with Technology to Advance Science.”

Innovating with Technology to Advance Science

Technology has become an increasingly prevalent part of everyday life. This year’s STEM Challenge theme prompts students to think about how emerging technologies can be used to advance science. As students think about the multitudinous uses of technology, they are encouraged to use emerging technologies to develop and model their solutions.

Emerging technologies in the context of the STEM Challenge can be defined as any technology that is currently in development, gaining new features, or being used in new ways. Students may use emerging technologies within their solutions or may begin developing their own emerging technology as part of the STEM Challenge.

Some current emerging technologies include:

- 3-Dimensional Modeling and Printing
- Artificial Intelligence
- Biotechnology
- Immersive Technologies
- Implantables
- Nanotechnology
- Robotics
- Wearables

2025 - 2026 STEM Challenge Prompts

In the STEM Challenge, you will be developing a solution to one of four prompts. These prompts are based on different scientific disciplines and are broad, allowing you to create a wide variety of different solutions. These prompts will change each year of the STEM Challenge and are based around the central theme.



Marine Science

Many agencies use technology to monitor and regulate marine activities. Design a solution that uses emerging technology to monitor or respond to human-led or naturally occurring marine activity.



Astronomy

As we continue to explore our universe, we need technology capable of supporting and entertaining astronauts in space and on other planets. Design a product or solution that uses emerging technology to fill at least one basic need for an astronaut in space.



Paleontology

Many fossils are located in hard-to-reach or remote environments and are only accessible seasonally. Design a solution that uses emerging technologies to find, access, extract, or preserve fossils more efficiently in extreme environments.



Health

Emerging technologies are being used to help recognize patterns in health data and diagnose and treat patients. However, these technologies are difficult to access and can be expensive or prone to errors. Design or improve upon a technology that accurately interprets health related data or makes healthcare more accessible and efficient.

Why Should You Participate in the STEM Challenge?

The STEM Challenge is unique in that it allows students to more fully and realistically explore what it means to be a scientist than a traditional science fair. In a traditional science fair, students write a hypothesis, design a research experiment to test their hypothesis, collect data, and draw conclusions from their data. Instead of taking this approach, the STEM Challenge asks you to engineer solutions to large-scale scientific problems.

By participating in the STEM Challenge, you will gain experience identifying specific issues, applying the engineering design process, and designing solutions to real-world problems. The problems presented in the STEM Challenge are also the same problems that many scientists are working to solve, and student-designed solutions will be judged by scientists in their respective fields. This means that you will be actively contributing to select scientific fields by engaging with these high-stakes issues.

Students participating in the STEM Challenge also can earn college scholarships. STEM Challenge projects will be evaluated in a rigorous two-stage judging process. The first round of judging will occur virtually, and the second round of judging will be held in-person at Frost Science. Top performing students can win the following scholarships through Florida Prepaid:

Individual Projects

- 1st Place – 4-year Florida University Plan
- 2nd Place – 3-year Florida University Plan
- 3rd Place – 2-year Florida University Plan
- Top Oral Presentation – 1-year Florida University Plan
- Top Model – 1-year Florida University Plan

Group Projects

- 1st Place – 3-year Florida University Plan
- 2nd Place – 2-year Florida University Plan
- 3rd Place – 2-year Florida University Plan
- Top Oral Presentation – 1-year Florida University Plan
- Top Model – 1-year Florida University Plan

Junior STEM Challenge Projects

(Middle School, Group Only)

- 1st Place – 1-year Florida University Plan
- 2nd Place – 1-year Florida University Plan
- 3rd Place – 1-year Florida University Plan

For winners to receive college scholarships through Florida Prepaid, they must:

- Have a valid Social Security Number
- Be less than 21 years of age
- Not have graduated high school
- Be a Florida resident for at least 1 year
- Be a U.S. citizen

If the winning student does not meet one of these criteria, Frost Science will work directly with the student to distribute the scholarship. Scholarships not distributed through Florida Prepaid will not qualify for the matched scholarship value and will be of lesser monetary value.

Florida University Plans distributed through Florida Prepaid are designed to be used at public Florida state universities but may be applied to tuition at private and out-of-state schools. When these scholarships are applied to private and out-of-state schools, their monetary value will be applied to student tuition, and will likely not cover the same portion of total educational cost that they would at a public Florida state university.

Student Expectations

Complete Activity 1: Let's Get Started

You will start the STEM Challenge by completing *Activity 1: Let's Get Started*. This activity guides you through an abbreviated, practice version of the STEM Challenge and recommends procedures that will be helpful when you begin your own STEM Challenge project.

Design a Realistic Solution

Designing a solution is an integral part of the STEM Challenge. In designing your solution, you should consider multiple options, evaluating each option for its ease of implementation and its probability of success. While you can design any solution you can imagine, you need to make sure that the solution is realistic and addresses your prompt.

Use the Engineering Design Process

As you design your solution, you should also refine it. Creating one solution without reflecting upon any potential flaws can lead to designing an unrealistic solution that is ineffective in addressing the prompt. Using the engineering design process to look for flaws within a solution, correcting the identified flaws, and repeating the process will help you design a strong solution.

Overcome Obstacles

As you design your solution and complete your STEM Challenge project, you will encounter obstacles along the way. These obstacles are a part of the engineering design process and the STEM Challenge. When you encounter these obstacles, you should look at them as learning opportunities and a way to improve your work. This experience can be difficult and frustrating, but persevering and addressing each obstacle as it comes is an important science and life skill. Sometimes, the best end products are created by overcoming the greatest challenges.

Create a Model and Presentation

You must also create a model and a display that showcases your solution. While there are criteria for what the models and displays must include, there is not a required format for either the model or display. You should use your creativity, skills, and interests to create your model and display. While many displays will take the form of a poster, you should not be afraid to branch out and explore other display options.

Section 2

Student Activity Sheets



“Never be limited by other people’s imagination; never limit others because of your own limited imagination.”

—Mae Jemison

Activity 1: Let's Get Started

STEM Challenge Practice

About Electronic Waste

Electronic waste, or e-waste, refers to any discarded electronic devices and equipment.

Electronics can be discarded for a variety of reasons but are usually thrown away because they have been replaced, have become outdated, or have broken.

While the types of items that are classified as e-waste vary, many of these items include computer components.

- The main categories of e-waste, ranked by their global volume from highest to lowest, are as follows:
 1. Small everyday electronics like toaster or electric toothbrushes
 2. Large appliances like electric stoves or washing machines
 3. Cooling and heating units like refrigerators and air conditioners
 4. Display screens like televisions or computer monitors
 5. Lighting devices like LED light bulbs or fluorescent lights
 6. Communication devices like smartphones and laptops
- Other categories of e-waste include medical devices, electric tools, toys, sports equipment, monitoring devices, batteries, cables and wires, and photovoltaic panels (solar panels).

Rapid technological progress and brief product lifespans leads to high volumes of e-waste.

E-waste contains valuable materials like gold and copper, but it also includes hazardous metals and chemicals including lead, mercury, cadmium, chromium, beryllium, and flame retardants.

Harmful Impacts of E-Waste

- E-waste can leach hazardous metals and chemicals into the environment, where they can contaminate soil and groundwater.
- Improper recycling of e-waste through burning and acid baths can release hazardous metals and chemicals into the air where they can negatively impact human health.
- Exposure to hazardous metals and chemicals released by e-waste can cause neurological damage, respiratory problems, and an increased risk of cancer.

Sources:

Children's Environmental Health Collaborative (n.d.). *E-waste* | Children's Environmental Health Collaborative. Unicef.

Retrieved July 11, 2025, from <https://ceh.unicef.org/spotlight-risk/e-waste>

Environmental Protection Agency (EPA) (n.d.). *Cleaning Up Electronic Waste (E-Waste)*. US EPA. Retrieved July 11, 2025,

from <https://www.epa.gov/international-cooperation/cleaning-electronic-waste-e-waste>

World Health Organization (WHO) (2024, October 1). *Electronic waste (e-waste)*. WHO. Retrieved July 11, 2025, from

[https://www.who.int/news-room/fact-sheets/detail/electronic-waste-\(e-waste\)](https://www.who.int/news-room/fact-sheets/detail/electronic-waste-(e-waste))

Activity 1

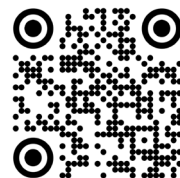
Let's Get Started

STEM Challenge Pre-Participation Survey

Instructions: Complete the STEM Challenge Pre-Participation Survey. To access this survey, use the survey QR code or URL. Make sure you click “Submit” at the bottom of the survey and receive a confirmation message before closing the window.

Pre-Participation Survey:

<https://forms.office.com/r/QAJzC0DvGb>



STEM Challenge Practice

Instructions: Using the prompt provided in Activity 1, independently answer the questions below to identify issues and potential solutions.

Prompt:

1. Identify at least five problems or issues that address the prompt. Be specific.

2. Brainstorm at least one solution for each of the problems you identified.

3. What problem/solution is the most practical and best addresses the prompt? Does this solution already exist? If so, how can you improve it to better address this issue?

4. How can this solution be implemented? Be as detailed as possible.

5. Who is responsible for implementing solutions for this issue? In other words, who are your stakeholders?

6. Describe the design of a physical or digital model that represents or demonstrates this solution. Models may include fully functional devices, scaled/miniature replicas of the solution, 3-dimensional models, or sections of code. If you are struggling to design a model, go back and take a closer look at the problem/solution you selected.

7. How would this model help explain or demonstrate your solution? What would this model add to a presentation about your solution?

Practice Debrief

Instructions: Independently answer the questions below to reflect on the STEM Challenge Practice provided in Activity 1.

1. What was the most challenging part of creating a solution for the provided prompt? Why?

2. Why is it important to brainstorm more than one issue and solution associated with the prompt?

3. What are the advantages of brainstorming more than one solution for each issue?

4. What is the importance of explaining every detail behind the implementation of your solution?
Why is it important to be as specific as possible?

5. Why is it important to consider your stakeholders?



6. In this activity, you were asked to describe how you would model your solution to the provided prompt. What difficulties did you encounter in designing this model?

7. What challenges would you expect to encounter in creating the model you designed? Think of the time, materials, tools, and software required to create your model.



[illegible][illegible]

STEM Challenge Preparation

Instructions: Independently answer the questions and follow the directions below to prepare for the STEM Challenge.

1. Review the 2025-2026 STEM Challenge prompts. Which prompt interests you the most? Why?

2. You can work individually or in a group for the STEM Challenge. What are the advantages and disadvantages of working in a group? What are the advantages and disadvantages of working alone?

3. What does your workload look like this year? How much time do you have to dedicate to this project?



4. Identify whether you would like to work individually or in a group. If you want to work in a group, find your group members now. Groups should be no larger than 4 students.

5. Select one prompt to complete for this year's STEM Challenge. If working in a group, make sure all group members agree with the prompt selection.

6. In your guidebook, turn to page 45 to propose a project timeline, record group member names, and optionally delegate tasks amongst group members.

Activity 2: Sound Sources

Instructions: Answer the questions below to learn how to identify reliable sources.

Reliable Source (Examples):	Unreliable Source (Examples):
1. Justification: 	1. Justification:
2. Justification: 	2. Justification:
3. Justification: 	3. Justification:

Reliable vs. Unreliable Sources

Refer to the STEM Challenge resource page and click the items named “Unreliable Source” and “Reliable Source.” Alternatively, use the URLs or QR codes found below.

Unreliable Source:

<https://en.wikipedia.org/wiki/Dolphin>



Reliable Source:

<https://www.fisheries.noaa.gov/dolphins-porpoises>



1. How can you tell which source is reliable and which source is unreliable? What sets the reliable source apart from the unreliable source?

2. What does it mean if something is reliable?

3. What is the importance of using reliable sources in your STEM Challenge?



4. Reliable sources should remain unbiased. Imagine that you are researching the relationship between screen-time and mental health and find two articles of interest. One article is written by a psychologist and published in a medical journal, whereas the second article is written by a video game company and published on the company website. What does it mean if a source is biased? Which article might be biased? How can you tell?



Primary, Secondary and Tertiary Sources

Refer to the STEM Challenge resource page and click the items named, “Primary Source,” “Secondary Source,” and “Tertiary Source.” Alternatively, use the URLs or QR codes found below.

Primary Source:

<https://journals.biologists.com/jeb/article/226/22/jeb245845/334721/Passive-electroreception-in-bottlenose-dolphins>



Secondary Source:

<https://www.sciencenews.org/article/bottlenosed-dolphins-sense-electric-fields-hunt-prey>



Tertiary Source:

<https://seaworld.org/animals/all-about/bottlenose-dolphin/senses/>



5. Look at each of the provided sources and take note of any differences. Why might we designate sources as primary, secondary or tertiary sources? What do you think these designations might mean?

6. We often consider primary and secondary sources to be reliable sources. Why might we not consider tertiary sources reliable?



Understanding Scientific Articles

7. What type of source are scientific articles? Why?

8. What are the advantages of using scientific articles in your project?

9. What must a scientific experiment do to be considered reliable and scientifically accurate?

10. Can scientific articles be biased? If so, what might a biased scientific article look like?

11. How could a reliable, unbiased scientific article provide misinformation?

12. What can you do to make sure that your sources, including any scientific articles, are providing accurate information?



Searching for Scientific Articles

13. What kind of search query might you use to find scientific articles for your project?

14. Using your search query, look at the titles of each study to find one you think would provide helpful information. Looking at this article, what is the purpose of the abstract?

15. After reading the abstract, there are two other sections of the research paper that are important to read. What sections do you think you may need to read to understand the study? Explain your answer.

16. In what situation would you sit down to read the remaining sections of the research paper?



Activity 3: Iterative Ideas

Instructions: Answer the questions below to identify how the engineering design process helps develop innovative solutions.

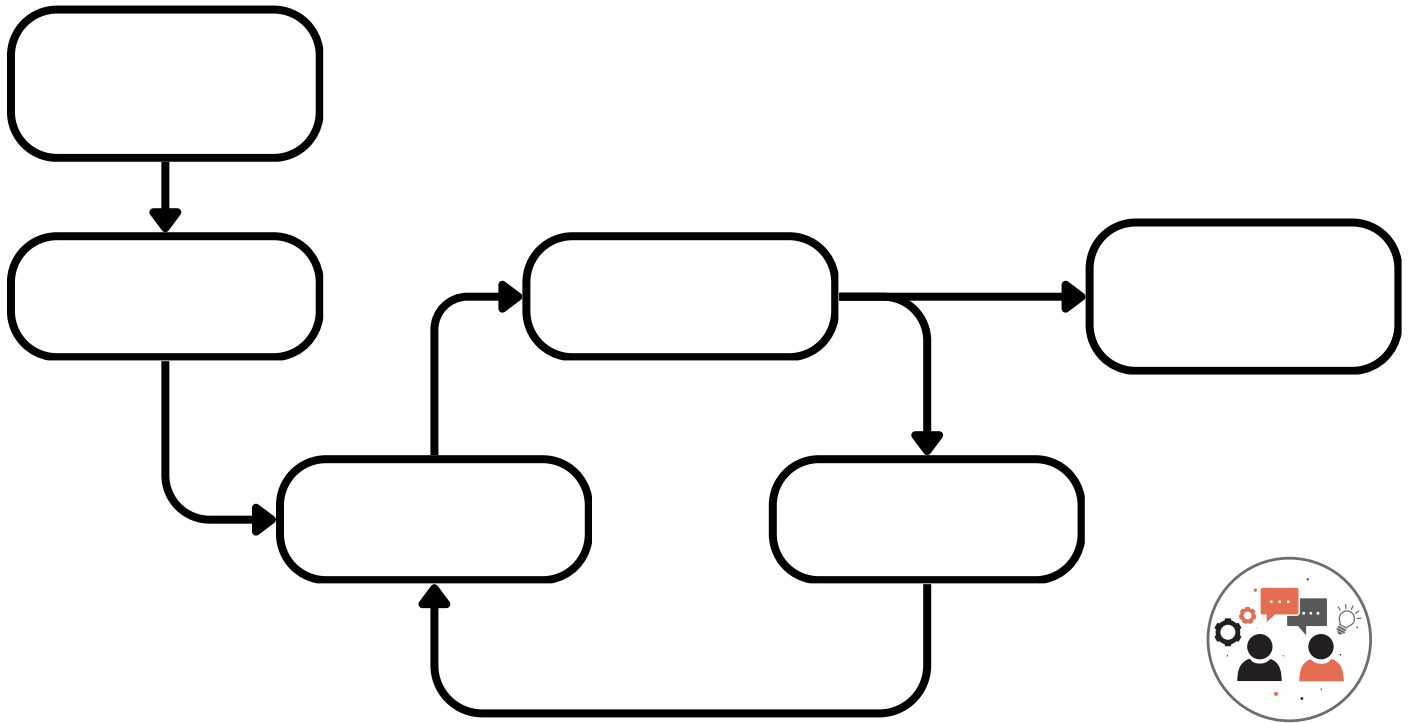
1. Innovation is the process of creating something new and unexpected. Why is it important to be innovative in the STEM Challenge?

2. Think back to a time in your life when you had creative freedom and came up with a new innovative idea. Describe this experience.

3. How do you use sources to figure out if your solution is new and innovative?



Instructions: Record the engineering design process steps in the chart below.



4. How does the engineering design process facilitate innovation?

5. What does it mean to make multiple iterations of something? Why is it important?



6. What part of the engineering design process are you currently on? If applicable, how many times have you been through the engineering design process?

7. Why is the engineering design process often collaborative?

8. How can a one-person project be made collaborative?

9. How will you collaborate effectively?

10. At what point do you decide you are done iterating on your solution? In theory, the engineering design process never ends.



Activity 4: Pitch Your Point

Instructions: Think about the STEM Challenge as you answer the questions below to learn about developing a pitch for your presentation.

Investor vs. Entrepreneur

Scenario 1: Reusable straw

Made of stainless steel

Includes a reusable straw and carrying bag

Production cost: \$3 per straw/bag

Minimum quantity produced: 100

Selling price: \$10 per straw/bag

Scenario 2: New phone manufacturer

Made of a wide variety of materials

Includes a “roll-up” phone and phone charger

Production cost: \$300 per phone and charger

Minimum quantity produced: 100

Selling price: \$1,000 per phone and charger



Why Argue

1. Making an argument means that you are communicating evidence or reasons in support of an idea. Why would you make an argument?

2. What is the relationship between an argument and a pitch?

3. What will you have to pitch/argue in your final presentation?

4. Who is your audience and why is it important that they are presented with a strong pitch/argument?



Strong pitches/arguments include ethos, logos, and pathos.**Ethos:** An appeal to credibility**Logos:** An appeal to logic**Pathos:** An appeal to emotion

5. Refer to the STEM Challenge resource page and click the item named, “Example Pitch/Argument.” Alternatively, use the URL or QR code below. Watch the video and identify how ethos can be used in a pitch/argument to change how a statement is interpreted.



Pepsi Commercial: <https://www.youtube.com/watch?v=I9jlc7E52m0>

6. How can you use your identified issue and solution to evoke an emotional response in your audience (pathos)?

7. What is the relationship between a strong pitch/argument and evidence (logos)?

8. What appeal is the most important in a scientific presentation? Why?



9. Think back to a time when you heard an argument that did not use any _____.
Was it a strong or convincing argument? Why or why not? Be specific.



Building Evidence

1. What did you have to consider when designing a realistic solution?

Notes:



2. How can we use our design considerations as evidence in our argument?

Notes:



3. Why do we need to be specific in our evidence?

Notes:



4. What is the most convincing/important piece of evidence for your pitch/argument?
This is your selling point.

5. Why might it be important to have a selling point?

6. How can you organize your evidence and use your selling point in a pitch/argument that fits naturally in your presentation?

7. When should you give your pitch/argument in your presentation?



8. Think back to a time you heard someone argue something they did not believe in. How could you tell they did not believe in their own argument?

9. Is confidence an appeal to ethos, logos, or pathos? Why?



Multi-Purpose Activity: Mix-it-up!

Instructions: Answer the questions below about constructive criticism to prepare for today's activity.

1. What is constructive criticism? How is it different from criticism?

2. Give an example of constructive criticism and criticism. How might these sound?



Section 3

Student Resources



“Knowing is the key to caring, and with caring there is hope that people will be motivated to take positive actions. They might not care even if they know, but they can’t care if they are unaware.”

—Sylvia Earle

STEM Challenge Planning

Instructions: Use this activity sheet to plan your STEM Challenge project.

Name(s):

Selected Prompt:

1. Are you working in a group or individually? If you are working in a group, who are your group members?

2. Begin planning your STEM Challenge by listing each procedural task you would like to complete. For example, you may include “Finish Solution Draft 1” or “Finalize model.” If you are working in a group, your group can optionally assign tasks to group members.

3. Use the planner to record due dates for the STEM Challenge. Each page directly corresponds to one Quarter of the M-DCPS 2025-2026 school year, excluding December 23 – January 3. Along with any due dates for the STEM Challenge, try to schedule each procedural task you listed in response to question 2.

STEM Challenge Planner

AUGUST

SEPTEMBER

OCTOBER

MON	TUE	WED	THU	FRI
11 	12 	13 	14	15
18	19	20	21	22
25	26	27	28	29
SEPT. 1	2	3	4	5
8	9	10	11	12
15	16	17	18	19
22	23 	24	25	26
29	30	OCT. 1	2 	3
6	7	8	9	10
13	14	15	16	17
Legal holiday		 M-DCPS Teacher planning day, professional learning day or recess day.		

OCTOBER

NOVEMBER

DECEMBER

JANUARY

MON	TUE	WED	THU	FRI
20	21	22	23	24
27	28	29	30	31
NOV. 3	4	5	6	7
10	11	12	13	14
17	18	19	20	21
24	25	26	27	28
DEC. 1	2	3	4	5
8	9	10	11	12
15	16	17	18	19
JAN. 5, 2025	6	7	8	9
12	13	14	15	16
Legal holiday		M-DCPS Teacher planning day, professional learning day or recess day.		

JANUARY

FEBRUARY

MARCH

MON	TUE	WED	THU	FRI
19	20	21	22	23
26	27	28	29	30
FEB. 2	3	4	5	6
9	10	11	12	13
16	17	18	19	20
23	24	25	26	27
MAR. 2	3	4	5	6
9	10	11	12	13
16	17	18	19	20
23	24	25	26	27
30	31	April 1	2	3
Legal holiday	M-DCPS Teacher planning day, professional learning day or recess day.			

APRIL

MON	TUE	WED	THU	FRI
6	7	8	9	10
13 	14	15	16	17
SATURDAY, APRIL 18				
STEM CHALLENGE EXPO AT FROST SCIENCE				
20	21	22	23	24
 Legal holiday		 M-DCPS Teacher planning day, professional learning day or recess day.		

Technology Terminology

There are a wide variety of emerging technologies that may be used in the 2025-2026 STEM Challenge. While not an exhaustive list, these technologies include:

3-Dimensional (3D) Modeling: 3D models are designed or sculpted using 3D modeling software. These models occupy three planes and have a depth, width, and height.

3-Dimensional (3D) Printing: 3D models can be sliced using 3D printing software to create thin, printable layers. The 3D printer can then print each layer of the 3D model using plastic or resin.

Artificial Intelligence (AI): AI is a technology that allows computer systems to perform actions or tasks that would typically be performed by humans. To perform these tasks, AI pulls from provided data.

Machine Learning: Machine Learning is a type of AI that can analyze data to identify trends and predict results. As the Machine Learning AI is provided with more data, it can 'learn' and the processes it uses to make predictions will change.

Biotechnology: Biotechnology uses or simulates biological processes or structures. Processes are often used to create a product while structures are often integrated into the product structure.

Immersive Technologies: Immersive technologies simulate virtual elements that users can perceive as real.

Augmented Reality (AR): Augmented reality overlays virtual elements with physical elements in the real world. Users can interact with these virtual elements.

Mixed Reality (MR): Mixed reality integrates virtual elements into the physical environment of the real world. The virtual elements are fully interactive and can respond to changes in the physical environment.

Virtual Reality (VR): Virtual reality allows users to view and interact with an immersive virtual world.

Implantables: Implantables, or implantable devices, are any type of technology that is implanted directly into the body and include items like pacemakers and cochlear implants.

Nanotechnology: Nanotechnology is the modification of matter on the atomic and molecular level. These modifications result in altering existing, or creating new, materials or substances. **Robotics:** Robotics is the field of science responsible for designing, building, and programming machines capable of complex actions.

Wearables: Wearables, or wearable devices, includes any type of technology that can be worn as an accessory or embedded in a clothing item. Wearables are diverse and include technologies used to monitor health data, make calls, and track locations.

Scientists use a variety of different terms and tools when planning, designing, or creating different technological products. The following terms can be used to help understand technologies:

Application Software (Apps): Application software includes all computer programs used to perform specific tasks.

Block-based coding: Block-based coding, or block coding, is a type of visual code used to program different technologies. Unlike programming languages, block-based code uses blocks of text pre-programmed with code. These blocks can be modified, moved, and rearranged to indicate the order of or the relationship between tasks. While block-based coding can be used to program computers, actions are limited by the type of available blocks.

Programming Languages: Programming languages describe the language used to code, or write instructions for, different technologies. Different programming languages have different syntax, or code structures, and may be used for different purposes. Three of the most common programming languages are:

C++: C++ is a general-purpose programming language that is frequently used to code computer systems and software. C++ is considered an advanced programming language.

JavaScript: JavaScript is a general-purpose programming language that is primarily used to code web-based software and websites.

Python: Python is a general-purpose programming language that is frequently used to code computer software and artificial intelligence. Python is often considered the best programming language for beginners.

Hardware: Hardware includes all physical components of a computer or related technology.

Open-source: The term open-source indicates that all users can use, modify, and redistribute the software or code. Users can use open-source software and code for any personal or commercial purpose.

Rendering: Rendering is the final process in developing computer generated 2-Dimensional or 3-Dimensional visuals. During this process, additional detail is added to the visual to indicate textures and light sources. This may include adding shadows and highlights to objects.

Software: Software includes all programs and code used by a computer or related technology.

User Experience (UX): User experience describes how people feel when interacting with a product. Successful technological products provide a positive user experience.

User Interface (UI): User's interact with technology using the user interface. This includes any user-facing dialogue boxes, buttons, or controls.

APA Format

American Psychological Association (APA) formatting is commonly used to cite scientific reviews and articles. Students must use APA formatting when citing sources, and in-text citations must be included within all STEM Challenge products, including STEM Challenge presentations. In-text citations identify information obtained from another source, helping you avoid plagiarism. Information obtained from other sources should be paraphrased and should not appear in quotes. Each in-text citation must have a corresponding citation in the references section on your STEM Challenge display.

While there are a variety of websites that can automatically produce citations for students, they do not produce in-text citations. In-text citations should be written as follows:

In-Text Citations	
No author	(Title of Source, Year)
One author	(Last name of Author, Year)
Two authors	(Last name of Author 1 & Last name of Author 2, Year)
More than one author	(Last name Author 1 et al., Year)
If citing multiple works	(In-text citation 1; In-text citation 2)

If students must use a direct quote, the page number of the quotation should be included at the end of the in-text citation in the following format: p. #

Most of the cited works used in the STEM Challenge will be websites. These websites can be cited as follows:

- Last name, F. M. (Year, Month Date). *Title of page*. Site name. URL

While many scientific articles may be found online, they use a different APA citation format than websites. Scientific articles can be cited as follows:

- Last name, F. M. (Year). Title of article. *Journal name*, volume number (issue number), pages. URL

For scientific articles, Google Scholar or the scientific journal may already provide a citation in APA format.

If one of the components, such as the author's middle name or the date published, are missing from the source material, they may be omitted from the in-text citations and the citation listed in the references section. Every in-text citation should have a corresponding citation listed in the references section. Citations listed in the references section should be listed in alphabetical order.

Non-website or scientific article sources use different APA citations formats. For referencing other sources, such as books or videos, students can reference apa.org or use an online citation generator. If using an online citation generator, students must always check that the format is set correctly and double check the citation for any potential errors.

Models

As part of the STEM Challenge, you must produce a partial or full model of your solution that includes at least one physical or digital component. Purchased materials do not count as a component of the model unless they have been modified. For example, you could purchase, modify, and use a radio-controlled car as part of your model, but you may not use the radio-controlled car as purchased without modifying it in any way.

The model should be clearly and accurately described in your presentation and should not need a verbal explanation when placed alongside your display. The model may use labels for additional descriptions as needed. For example, a section of code could be placed alongside a description of its intended purpose. Because the code is clearly labelled in the display, it would not need a verbal explanation to be understood.

In addition to the model's ability to embody the solution, the model should also be well constructed. For physical models, this means that the model should not have any rough edges or parts and must not pose a safety hazard. For digital models, this means that rendered models should display clearly and accurately, while functional models should perform reliably without major bugs or errors.

All models must be accompanied by a Design History File.

Examples of Acceptable Models	Examples of Unacceptable Models
Blueprints of a robot with a student-made robot arm	Blueprints of a robot with no physical or digital component
Student-made or modified scale model of a robot that is 1/24 the size of the proposed product	Purchased 1/24 scale model of a robot that has not been modified
Student-made robot arm with labels that can be understood by a viewer without a verbal explanation	Student-made, unlabeled robot arm that needs an additional explanation to be understood by a viewer
Purchased robot arm that runs using a student-made or modified code	Purchased robot arm that runs using a pre-built code that has not been modified by students
Student-made robot arm that matches the robot as described in the display	Student-made robot arm that is different from the robot as described in the display
3D model of a robot with a good mesh	3D model of a robot that has mesh distortions
Code for a robot that has no syntax errors	Code for a robot that has a lot of syntax errors and bugs

The above examples of acceptable and unacceptable models are not meant to be all-inclusive. Use your creativity when creating a model of your solution. If your model is understood when placed alongside other project components, does not need a verbal explanation, and contains a physical or digital component that has been modified in some way, it meets the criteria of a STEM Challenge model.

Design History Files

Each model created for the STEM Challenge must have an accompanying Design History File (DHF). DHFs are used to document the design of a product from start to finish and identify each iteration of the product as it is refined by the engineering design process.

For the purposes of the STEM Challenge, DHFs will be fairly simple and will be used by judges to assess physical and digital models.

Design History File Requirements
Any files or notes used to develop the model - DHFs may include code and 3D model files. - Not all notes regarding the solution need to be included, only notes related to model development.
Sketches, pictures, or screenshots of the model during the design process - For digital models, including code and 3D models, this includes several screenshots of the digital file during its development. - Pictures of 3D models being printed are only necessary to record printing errors as these may require adjusting the model or print settings.
Pictures or screenshots of any problems encountered during the design process - Pictures or screenshots showing problems must be included in the DHF. These are very important as fixing problems is a key part of the engineering design process. - Pictures may display broken models, components that did not work as intended, and more. - Screenshots may include error messages for digital models.
Each sketch, picture, screenshot, file, or notes must be accompanied by a short description - Descriptions must explain what was done to create the model or what changes were made to the model. - Descriptions should include reasoning for each design choice or modification.
DHFs can be saved as any file type Presentations are a recommended format for saving a DHF. Each sketch, picture, or screenshot can be placed along with their associated description on a separate slide.

Design History File: Example

The descriptions provided for each picture, screenshot, sketch, etc. will vary. The following example DHF descriptions are for a hypothetical color pencil-sorting robot. Please note that for the purposes of the STEM Challenge, the code or 3-Dimensional models would count as a digital model and likewise, the physical robot would count as a physical model. This example is intended to demonstrate a DHF for multiple model types.

Example 1: Digital 3D Model and Physical Robot Model

The 3D model and the physical robot model count as two separate models. Students would only need to submit one of these to fulfill the model requirement. This example details the production of both models.

[Sketch of robot with measurements]

This sketch shows the initial design for a color pencil sorter. This initial design includes a base for stability and a robotic arm. The end of the robotic arm is equipped with a small camera and a gripper. The robotic arm has two joints and can rotate on the base. Measurements for each component are included in the sketch.

[Screenshot of 3D modeling software]

This screenshot shows the basic shapes used to create each part of our robot. These shapes have not been fully designed.

[Screenshot of 3D modeling software]

This screenshot shows each part of our robot mid-design. The shapes have been merged to create each individual component.

[Photo of robot parts]

This photo shows the test print of our robot components. The parts fit together, but some parts had a really tight fit. This would prevent the robot from being able to move its arm joint.

[Screenshot of 3D modeling software]

This screenshot shows how we resized each of our robot components so that they have a loose, but still snug, fit.

[Photo of robot parts and wiring]

This photo shows the robotic arm under construction. You can see our wiring and where we attached the robotic arm to the base.

Example 2: Physical Robot Model and Digital Code

The physical robot model and the code count as two separate models. Students would only need to submit one of these to fulfill the model requirement. This example details the production of both models.

[Copy of code, 4 pages]

This is the first draft of our code. The code takes inputs from the camera and interprets them using “If-then” statements. Based on what colors the camera sees, the robot will move the color pencils until they create a ROYGBV gradient.

[Screenshot of code, 5 lines of code are highlighted]

The robotic arm did not work using the first draft of our code. This screenshot shows how we modified the code to make sure the input from the camera was being received by the robot’s computer.

[Photo of robot dropping a pencil and a screenshot of code with 1 line of code highlighted]

This photo shows a color pencil falling out of the gripper and the screenshot shows how we adjusted the code to increase the strength of the gripper.

[Photo of sorted color pencils]

This photo shows the results of our first test. The robot did not correctly sort the color pencils into ROYGBV order as it had difficulty sorting the darker shades of blue and violet.

[Photo of LED wiring]

This photo shows the installation of LED lights near the camera. These lights will help the camera differentiate between the darker shades of blue and violet.

[Photo of sorted color pencils]

This photo shows the results of our second test. The robot did a better job sorting the color pencils into ROYGBV order, but it still struggled with the darker shades of blue and violet.

[Screenshot of code, 3 lines of code are highlighted]

This screenshot shows how we increased the saturation of our camera input by adding three lines of code.

[Photo of sorted color pencils]

This photo shows the results of our third test. The robot was able to successfully sort the color pencils into ROYGBV order.

Presentation Displays

You must create a display for your STEM Challenge project presentation. These displays must identify the chosen prompt, provide background information, identify a solvable issue related to the prompt, describe a solution, identify the solution's design considerations and list the sources used to develop the project. If you would like additional information about what your display should include, they should refer to the Project Completion Judging Rubric found on [page 63](#). The display must also be used to support, not replace, oral presentations and should look polished. The display's design must be purposeful and should contain no grammatical or spelling errors.

For the first round of judging, displays must be submitted digitally as photos, videos, or another file type. Projects that pass the first round of judging must also have a display that can be presented in-person at the STEM Challenge Expo. You may modify your display between the first and second round of judging and should make sure that your display format lends itself to both digital submissions and in-person oral presentations. Students with video displays or other display formats are responsible for all equipment needed to give their presentations if they are invited to the STEM Challenge Expo.

While each STEM Challenge display must contain specific components and must act as a supporting element for oral presentations, a specific display design or structure is not required. In other words, you are encouraged to use your creativity in designing your display. As posters provide an easy way to organize and present information, they are a simple display type to use for the STEM Challenge, although other displays are still acceptable!

Posters and other written materials can be designed digitally. Canva is a free program that makes graphic design easy. To design a tri-fold poster in Canva, click "Create a Design" in the upper right corner of the website, select "Custom Size" from the drop-down menu, and set the width to 48 inches and height to 36 inches. To set up the panels on the tri-fold poster in Canva, add a "square" element to the document, resize the square to fill half of the poster, and center it to the middle of the document. Students can then design their tri-fold poster by adding additional elements to their page using the same procedure. The diagram on the next page provides an example layout for a tri-fold poster display as made in Canva.

Selected Prompt Background Information Tell us about information related to your prompt and problem/issue. Page Size: 8.5X11 inches Additional Information Page Size: 8.5X8.5 inches Problem/Issue Identify your problem/issue. Why did you choose this problem/issue? Page Size: 8.5X11 inches	Presentation Title Student Name(s) Design What is your solution? How does it address the problem/issue? What does it look like? Page Size: 11X5 inches Solution How is your solution new and innovative? Page Size: 11X5 inches Impact Will your solution partially or fully fix the problem/issue? How effective is your solution? Page Size: 11X6 inches Design Considerations Materials What materials are you using in your solution? How and why are you using these materials? Page Size: 7x11 inches Cost How much does your solution cost to implement and maintain? Page Size: 7x11 inches Additional Considerations What else did you have to consider when designing your solution? Page Size: 7x11 inches	Solution Implementation Stakeholders Who are your stakeholders? How are they invested in helping solve the problem/issue? Page Size: 8.5X8.5 inches Implementation Procedure How can your solution be implemented? What is the implementation timeline? Page Size: 8.5X11 inches Sources List all of your sources in APA format. Page Size: 8.5X11 inches
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Evaluating Solutions

The following questions are designed to help you evaluate and review your solution. Use these questions during each step of the engineering design process. Use your responses to help guide you in revising your solution.

Does your solution involve implementing a new technology or updating a system already in place?

The theme of the 2025-2026 STEM Challenge is “Innovating with Technology to Advance Science.” If your solution does not involve an emerging technology, revise your solution.

Does your solution address the theme of the STEM Challenge and one of the four prompts?

The connection between your solution and the STEM Challenge theme and prompts should be easily identifiable. If your solution does not clearly address the marine science, astronomy, paleontology, or health prompt, revise your solution.

Does your solution have an engineered design?

The STEM Challenge is an engineering design challenge. If your solution involves social implementations and does not involve an engineered design, revise your solution.

If you do not know if your solution has an engineered design, ask the following questions:

- **Is your solution testable?** If so, it is probably an engineered design.
- **Does your solution involve people or marketing?** If so, it may not be an engineered design. Revise your solution.
- **Can your solution be measured objectively, independent of people and their thoughts or feelings?** If so, it is probably an engineered design.
- **Can you model your solution?** This model can be either digital or physical. If you cannot model your solution, it may not be an engineered design. Revise your solution.

How well does your solution solve your identified issue?

Not all solutions have to completely fix an issue. Some of the most innovative solutions may only reduce the impact of an issue. If your solution does not noticeably reduce the impact of your issue, revise your solution.

Is your solution innovative? Is your solution something new, or has it been done before? If it has been done before, is it better than the current solution being used to solve your issue?

While there may be multiple ways to reduce the impact of your issue, your solution should require less resources or produce different results from the current solutions already in place. If your solution does not, revise your solution.

What problems might be caused by the implementation of your solution?

No solution is completely risk-free. If the problems caused by the implementation of your solution are bigger than the issue your solution is designed to solve, revise your solution. Problems caused by implementing your solution may include human health, data safety, or environmental safety issues.

How well does your solution work? Is your solution reliable?

Your solution should work to reduce the issue the majority of the time. If your solution is not consistently effective, revise your solution.

Is your solution replicable? Could it be manufactured or otherwise reproduced?

If your solution only works for one extremely-specific situation and is not replicable, revise your solution.

Have you revised or changed any of your solution?

Make sure you are using the engineering design process to improve your solution. Keep in mind that it is highly unlikely that a solution created for the STEM Challenge will be perfect. Look for areas to revise your solution.

Do you have evidence that your solution will work? What is your evidence?

If possible, use data from reliable sources, like scientific articles, to support your solution. If you have no evidence your solution will work, either find evidence or revise your solution. Your evidence should be as specific as possible and you should always cite your sources.

What might prevent you from implementing your solution? Is it primarily cost, or are there other factors?

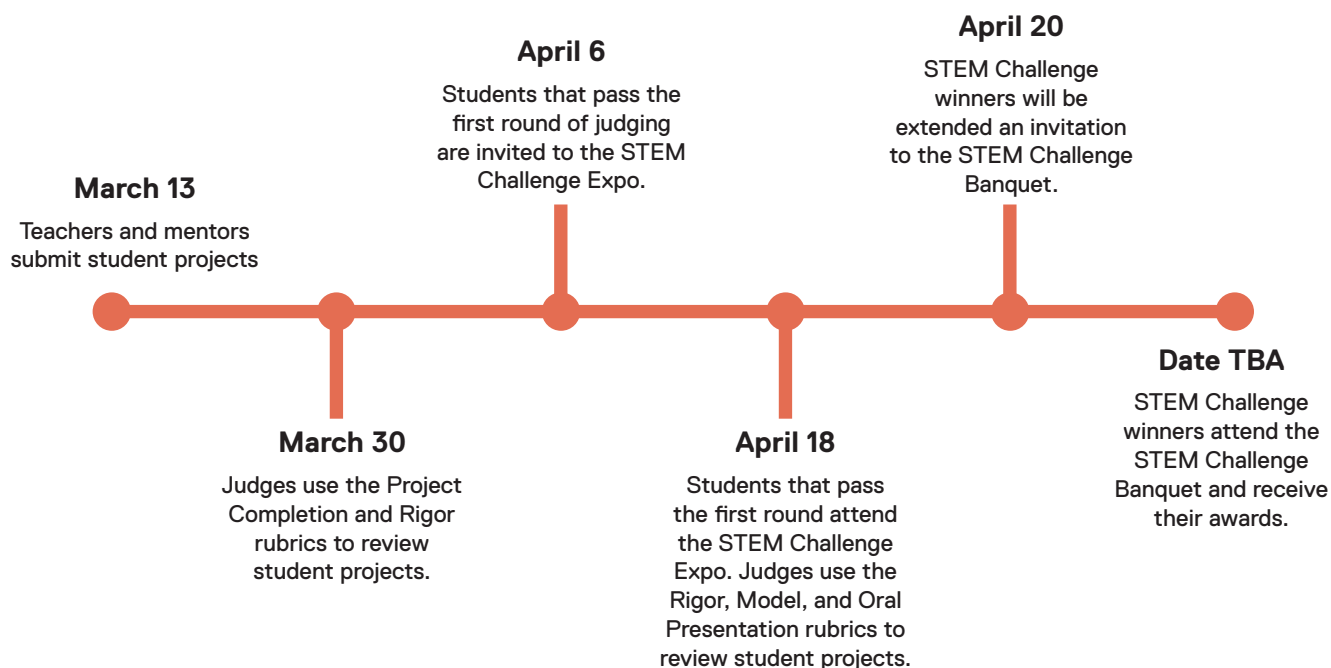
Make sure you address any major real-world constraints. These may include:

- Cost of implementation
- Cost of maintenance
- Stakeholders who may be against solution's implementation
- Laws and regulations

If you have not addressed real world constraints, revise your solution.

Judging Guidelines

Submitted student projects are subject to two separate rounds of judging. The first round of judging will occur virtually, with judges scoring digital submissions of each STEM Challenge project using the Project Completion and Rigor rubrics. The judges will then meet to discuss student projects and select which projects will be invited to the STEM Challenge Expo at Frost Science. For projects that are invited to the STEM Challenge Expo, judges will watch student presentations in person, scoring each project using the 1) Rigor, 2) Oral Presentation, and 3) Model rubrics. After watching student presentations, judges will meet to discuss student scores and will determine Individual, Group, and Junior STEM Challenge winners.



Judging rubrics should be used to self-evaluate STEM Challenge projects and may be used to identify areas for improvement. When using a rubric to self-evaluate a STEM Challenge project, students should first read the section of the rubric labeled “Excellent.” Students should aim to fulfill the qualifications of an “Excellent” project. If a student sees that their project most likely falls into the “Satisfactory” or “Room to Improve” categories, they should try to modify their project until it meets the “Excellent” project criteria.

Frost Science STEM Challenge Rubric for Assessing Project Completion: Digital Submissions

Criteria	Room to Improve (0-3)	Satisfactory (4-6)	Excellent (7-10)	Score (0-10)
IDENTIFICATION OF PROMPT/BACKGROUND INFORMATION	The prompt is not present on the student display. A) Students do not provide background knowledge about their prompt on their display. OR B) Students provide inaccurate background information on their display.	A) The prompt is not easily identifiable when observing their display. OR B) Students do not clearly state the prompt on their display. Students provide background knowledge about their prompt on their display. The background knowledge is mostly accurate.	Students clearly state the prompt on their display. Students provide background knowledge about their prompt on their display. The background knowledge is accurate.	
IDENTIFIED ISSUE	A) Students identify a current issue, but the issue's relevance to the prompt is unclear. OR B) Students do not focus on one identifiable issue related to their prompt and instead attempt to address the prompt in its entirety.	A) Students identify a current issue that is tangentially related to the prompt. OR B) Students focus on one aspect of their prompt, but the issue is not specific or manageable.	Students focus on one specific and manageable issue.	
APPLIED ENGINEERING DESIGN PRINCIPLES Engineering Design Principles: • Functionality • Safety • Reliability • Manufacturability	Students do not design their solution to account for real world constraints. Students do not address cost or ease of implementation. The solution does not utilize modern technologies.	A) Students design their solution to account for real world constraints. Students address cost or ease of implementation. The solution does not utilize modern technologies. OR B) Students do not design their solution to account for real world constraints. Students do not address cost or ease of implementation. The solution utilizes modern technologies.	Students design their solution to account for real world constraints, including cost and ease of implementation. The solution utilizes modern technologies.	

Frost Science STEM Challenge Rubric for Assessing Project Completion: Digital Submissions (continued)

Criteria	Room to Improve (0-3)	Satisfactory (4-6)	Excellent (7-10)	Score (0-10)
DEVELOPED SOLUTION	A) Students did not develop a solution to their identified issue. <u>OR</u> B) Students developed a solution to their identified issue, but the solution is unrealistic or would have no impact on the identified issue.	Students developed a solution to their identified issue. This solution is clearly described and would solve or reduce the impact of the identified issue but is not practical or implementable.	Students developed a solution to their identified issue. This solution is clearly described, is practical, and students describe how the solution could be implemented to solve or reduce the impact of the identified issue.	
MODEL OF SOLUTION	A) Students have not modeled their solution. <u>OR</u> B) Students have modeled their solution, but it does not contain a physical or digital component. <u>OR</u> C) The model is not easily understood. The model may or may not maximize the use of an emerging technology.	A) The model is not easily understood but contains a physical or digital component that has been constructed to partially or fully model the solution. <u>OR</u> B) The model is easily understood when placed alongside the display. The model may or may not maximize the use of an emerging technology.	The model is easily understood when placed alongside the display and contains either physical or digital components. These physical or digital components have been constructed to partially or fully model the solution. The model maximizes the use of an emerging technology.	
SOURCES	A) Students have listed and utilized 0-2 reputable sources. <u>OR</u> B) Students have listed 0-5+ sources, but none of the sources are reputable.	A) Students have listed and utilized 5+ sources. Some of these sources are not reputable. <u>OR</u> B) Students have listed 3-4 reputable sources.	Students have listed and utilized 5+ reputable sources.	
APA FORMATTING Junior STEM Challenge projects will not be judged on their use of in-text citations but will be judged on their use of APA format within their references section.	The in-text citations do not match the sources. Some citations and sources are not in APA format.	A) The in-text citations do not match the sources. All citations and sources are in APA format. <u>OR</u> B) All in-text citations have an accompanying source in the references section. Some citations and sources are not in APA format.	All in-text citations have an accompanying source in the references section. All citations and sources are in APA format.	

Frost Science STEM Challenge Rubric for Assessing Project Completion: Digital Submissions (continued)

Criteria	Room to Improve (0-3)	Satisfactory (4-6)	Excellent (7-10)	Score (0-10)
CONTENT	There are grammatical or spelling errors. Each section of content may or may not build upon one another to create a cohesive presentation. Some content feels extraneous or unnecessary and is not relevant to the problem or identified solution.	1) There are a few grammatical or spelling errors. All content is connected, with each section of content building upon one another to create a cohesive presentation. No content feels extraneous or unnecessary. <u>OR</u> 2) There are no grammatical or spelling errors. Content is connected, with each section of content building upon one another to create a cohesive presentation. Some content feels extraneous or unnecessary and is not relevant to the problem or identified solution.	There are no grammatical or spelling errors. All content is connected, with each section of content building upon one another to create a cohesive presentation. No content feels extraneous or unnecessary.	
DISPLAY	The display looks rushed or thrown together.	The display looks polished but is not arranged logically.	The display is arranged logically and is easy to follow. The display looks polished.	
PROJECT COMPONENTS	Student presentation covers 0-2 project components.	Student presentation covers 3-4 project components.	Student presentation covers all 5 project components: • Prompt • Background Information • Issue • Solution with model • Sources	
Overall Score:				/100

Frost Science STEM Challenge Rubric for Assessing Rigor: Digital Submissions and In-Person Judging

Criteria	Room to Improve (0-3)	Satisfactory (4-6)	Excellent (7-10)	Score (0-10)
IDEATION AND ITERATION PROCESS / ENGINEERING DESIGN	Students do not explain what challenges they encountered when designing a solution and do not explain how they designed their solution.	Students explain what challenges they encountered when designing a solution but did not explain how they adjusted their solution to account for each challenge. Students do not explain each step in their iteration process.	Students explain what challenges they encountered when designing a solution and identify how they adjusted their solution to account for each challenge. Students explain each step in their iteration process.	
EVIDENCE	Students do not explain why their solution is viable.	Students explain why their solution is viable, but do not use specific pieces of evidence.	Students explain why their solution is viable using specific pieces of evidence. This evidence may be scientific, experiential, or anecdotal.	
SOLUTION	A) The solution is specific to the identified issue but is not new or innovative. The solution is already being implemented by another party OR B) The solution is not specific to the identified issue.	The solution is specific to the identified issue. Students use current techniques and practices within their solution, but they are not being used to achieve a different result. The solution has been used elsewhere.	The solution is specific to the identified issue and is new and innovative. Students may use current techniques and practices within their solution, but these techniques and practices must be used to achieve a different result.	
USE OF MODERN TECHNOLOGY	A) Students identify and utilize modern technology in their solutions. Students do not explain the advantages of using this technology and are not specific in identifying any materials or equipment used. OR B) Students do not identify or utilize modern technology in their solutions.	A) Students identify and utilize modern technology in their solutions. Students explain the advantages of using this technology but are not specific in identifying any materials or equipment used. OR B) Students identify and utilize modern technology in their solutions. Students are specific in identifying any materials or equipment used but do not explain the advantages of using this technology. For example, non-specific modern technology may include composite, plastic, chemicals, drones, 3D printers, etc.	Students identify and utilize modern technology in their solutions. Students are specific in identifying any materials or equipment used and explain the advantages of using this technology. For example, specific modern technology may include cellulose-based composite (a plastic substitute), High-Density Polyethylene (a type of plastic), 95% ethanol, fixed-wing drones, fused deposition modeling (a type of 3D printing), etc.	

Frost Science STEM Challenge Rubric for Assessing Rigor: Digital Submissions and In-Person Judging (continued)

Criteria	Room to Improve (0-3)	Satisfactory (4-6)	Excellent (7-10)	Score (0-10)
INNOVATION / ENTHUSIASM	The solution is not new or innovative. Students do not present their ideas with enthusiasm and do not try to convince the audience that their solution is amazing.	A) The solution is not new or innovative. Students present their ideas with enthusiasm and try to convince the audience that their solution is amazing. OR B) The solution is new or innovative. The solution may be a completely new or unique solution or may be an unexpected iteration of a current innovation or solution. Students do not present their ideas with enthusiasm and do not try to convince the audience that their solution is amazing.	The solution is new or innovative. The solution may be a completely new or unique solution or may be an unexpected iteration of a current innovation or solution. Students present their ideas with enthusiasm and try to convince the audience that their solution is amazing.	
Overall Score:				/50

Frost Science STEM Challenge Rubric for Oral Presentations: In-Person Judging

Criteria	Room to Improve (0-3)	Satisfactory (4-6)	Excellent (7-10)	Score (0-10)
INTRODUCTION	Students do not introduce themselves. Students do not state the prompt.	A) Students do not introduce themselves. Students clearly state the prompt at the beginning of their presentation. <u>OR</u> B) Students introduce themselves. Students do not clearly state the prompt.	Students introduce themselves. Students clearly state the prompt at the beginning of their presentation. The introduction includes an attention grabber and utilizes ethos, logos, and/or pathos.	
BACKGROUND INFORMATION/ISSUE CONNECTIONS	Students do not provide background knowledge about their prompt and do not identify one specific issue.	Students provide background knowledge about their prompt. The background knowledge does not provide all the information needed to introduce their identified issue.	Students provide background knowledge about their prompt. The background knowledge provides the information needed to seamlessly introduce their identified issue.	
DEVELOPED SOLUTION	A) Students do not explain their solution. <u>OR</u> B) Students explain their solution, but do not explain how it solves the identified issue or how it accounts for real world constraints.	A) Students explain how their solution solves the identified issue, but do not explain how the solution accounts for real world constraints. <u>OR</u> B) Students do not explain how their solution solves the identified issue. Students do explain how the solution accounts for real world constraints.	Students explain how their solution solves the identified issue and how the solution accounts for real world constraints, including cost and ease of implementation.	
MODEL OF SOLUTION	Students do not explain how the model represents or shows their solution.	Students partially explain how the model represents or shows their solution. The purpose of parts of the model remains unclear even after student explanation.	Students fully explain how the model represents or shows their solution.	
PRESENTATION	Students do not maintain eye contact with their audience and frequently read off their display. At the end of the presentation, students may or may not invite their audience to ask questions.	Students do not maintain eye contact with their audience and may occasionally read off their display. At the end of the presentation, students may or may not invite their audience to ask questions.	Students maintain eye contact with their audience and do not read off their display. At the end of the presentation, students invite their audience to ask questions.	
Overall Score:				/50

Frost Science STEM Challenge Rubric for Models: In-Person Judging

Criteria	Room to Improve (0-3)	Satisfactory (4-6)	Excellent (7-10)	Score (0-10)
DESIGN HISTORY FILE	A) There is no physical or digital component. OR B) The model is not accompanied by a Design History File.	A) The model is accompanied by a Design History File. The Design History File has records of the model at each stage of development but does not contain any descriptions. OR B) The Design History File has descriptions of the model's development but does not have any record of the model during each developmental stage. The Design History File may or may not show the planning, prototyping, testing (where applicable), and redesigning steps of the engineering design process.	The model is accompanied by a Design History File. The Design History File has records of the model at each stage of development. These pictures are accompanied by brief descriptions about the model's initial construction and any modifications made during the engineering design process. The Design History File clearly shows the planning, prototyping, testing (where applicable), and redesigning steps of the engineering design process.	
RELEVANCE/DESIGN	A) There is no physical or digital component. OR B) The model varies from the solution's description. There are differences in material or structure. These differences are not identified and affect the degree to which the model embodies the solution.	A) The model varies slightly from the solution's description. There are differences in material or structure. These differences are not identified, but they do not affect the degree to which the model embodies the solution. OR B) The model varies slightly from the solution's description. There are differences in material or structure. These differences are clearly identified, but they affect the degree to which the model embodies the solution.	The model does not differ from the solution's description. If there are any differences in material or structure, these differences are clearly identified and do not affect the degree to which the model embodies the solution.	
CLARITY	A) There is no physical or digital component. OR B) The components of the model are not identifiable or easily understood based on the description of the solution and any provided labels. The model cannot be understood without a verbal explanation.	Some components of the model are easily identifiable, but other components are not identifiable or easily understood based on the description of the solution and any provided labels. The model cannot be fully understood without a verbal explanation.	All components of the model are easily identifiable based on the description of the solution and any provided labels. The model can be understood without a verbal explanation.	

Frost Science STEM Challenge Rubric for Models: In-Person Judging (continued)

Criteria	Room to Improve (0-3)	Satisfactory (4-6)	Excellent (7-10)	Score (0-10)
STRUCTURE	A) There is no physical or digital component. OR B) The model presents a safety hazard. OR C) The physical component of the model is an item that can be purchased online or in-store. It has not been modified in any way and is not a custom component.	The model contains components that have been altered or made to model the specific solution. The model has some loose parts or rough edges. The model presents no safety hazards.	The model contains multiple physical components that have been altered or made to model the specific solution. The model has no loose parts or rough edges. The model presents no safety hazards.	
WOW FACTOR! While this criterion is more subjective, the ability for a model to leave a lasting impression is important in assessing a model's quality. The "Wow Factor!" often reflects the time and care taken to create the model.	A) There is no physical or digital component OR B) The model does not catch the judges attention or interest through its design or function.	The model catches the judges interest through its design or function and leaves a positive impression. While impressive, the model does not leave the judges thinking, "Wow!"	The model catches the judges attention and interest through its design or function, leaves a positive impression, and leaves the judges thinking, "Wow!"	
Note: If a physical model broke in transit, students should have made a clear attempt to repair the model. Accidental breaks should not influence scores. Models that have visible repairs and have been identified as broken by students will be judged as if they are fully intact.				
Overall Score:				/50

Using Artificial Intelligence

About Artificial Intelligence

Artificial intelligence (AI) is becoming increasingly common in schools and the workplace. While AI can be used as a tool in the STEM Challenge, it should not be used in place of student work. AI may also only be used in the STEM Challenge if AI use is allowed under school policy and is permitted by the teacher facilitating the STEM Challenge.

How to Use Artificial Intelligence

As AI becomes more common, AI misuse is also becoming more common. When choosing to use AI for a STEM Challenge project or other work, make sure to follow proper protocol for using AI. AI should be treated as a tool to create content, not as a replacement for work, and all AI generated content must be checked. AI programs draw information from a variety of sources. This means that even the best AI may provide unreliable or biased information. Because of this, AI is better used to generate and refine ideas, find sources, and sort through information than it is to write content or tell you how to create a display or model.

If using AI for the STEM Challenge, do not rely on AI to generate STEM Challenge solutions. AI draw from information that is already available and are not capable of coming up with an original solution. However, AI can be used to learn about the solutions already being used to address the issues presented in the STEM Challenge. Remember, AI is just a tool and cannot replace creative thought.

Tips for using AI (OpenAI, 2023)*:

1. **Be Specific:** To use AI effectively, you should provide clear and specific prompts to get accurate and relevant responses.
2. **Use AI to Verify Information:** Ask AI to provide sources and cross-reference its responses with reliable, authoritative websites.
3. **Use AI to Learn About a New Topic:** Ask AI detailed questions on the topic you are interested in and request explanations or summaries to gain a better understanding of the topic.
4. **Use AI to Find Related Topics:** Ask AI to suggest topics or concepts related to your area of interest or initial query.

Good vs. Bad Artificial Intelligence

There are a wide range of AI programs that can be used online for free to generate text, art, code, and more. However, not all AI programs are created equally. While programs like Adobe Firefly and Canva can be used to generate AI art and images, some AI art programs generate art or images using copywritten source material as a base without permission from the original artist. AI programs like this are currently under scrutiny and should not be used for the STEM Challenge.

If you choose to use AI for any part of the STEM Challenge, make sure it is a reputable AI program. Some reputable and common AI programs include (Perplexity AI, 2022)**:

- **Adobe Firefly:** “Adobe’s family of generative AI models that can create images, text, videos and other content from natural language prompts and inputs.”
- **Canva:** “A graphic design platform that utilizes AI capabilities like text-to-image generation to help users create visuals like social media posts, presentations, and more.”
- **ChatGPT:** “An advanced language model developed by OpenAI that can engage in human-like conversations and assist with a wide range of tasks like writing, analysis, and coding.”
- **Gemini:** “Google DeepMind’s family of multimodal AI models designed to understand and generate text, images, code, and other content.”
- **Perplexity:** “A conversational AI search engine that generates natural language answers to queries by summarizing information from web sources and providing inline citations.”

Citing Artificial Intelligence

Whenever you use AI, you must cite the AI you used as a source. Like with any source, failure to cite AI can be considered plagiarism. AI citations in APA format should be written as follows:

Author. (Date). *Name* (Version) [Type of Artificial Intelligence]. URL

For example, ChatGPT may be cited as follows:

OpenAI. (2023). *ChatGPT* (April 29, 2024 version) [Large language model]. <https://chatgpt.com/>

If using the above citation to cite ChatGPT in a STEM Challenge project, make sure to update the version date or number. To find the version you are using, click the small question mark in the bottom right corner of ChatGPT and select “Release notes.” This will open a new page with the most recent version date listed at the top.

**The tips for this section of the Guidebook were partially generated using AI. ChatGPT was given the following prompt, “How can you use ChatGPT to _____? Answer in one sentence.” This prompt was repeated for each of the tips provided. ChatGPT responses were then edited and refined.*

***The definitions for each of the recommended AI programs were generated using Perplexity and remain unedited.*

Sources:

OpenAI. (2023). *ChatGPT* (April 29, 2024 version) [Large language model]. <https://chatgpt.com/>

Perplexity AI. (2022). [Large language model]. Perplexity AI, Inc. <https://www.perplexity.ai>

Student Tips

The STEM Challenge is just that—a challenge. While completing the STEM Challenge, many students will encounter obstacles. When you encounter these obstacles, you may reference this page for tips on how to overcome them.

Feeling Stuck: How to Take a Break

If you feel stuck at any point during your STEM Challenge, take a break! During your break, try not to scroll social media or do any other activities that may give you information overload. Instead, find a part of your STEM Challenge project that you want to work on. This could be sketching part of your solution, doing additional research, or designing your presentation display. Your priority should be to do something productive and at least somewhat enjoyable; by doing this, you can actively reduce your stress levels and prepare yourself to jump back into the original task (“Taking Breaks,” 2024).

Feeling Frustrated: Finding Sources

If you are struggling to find reliable sources related to your prompt, check open-source websites. While open-source websites like Wikipedia should not be used as sources for your STEM Challenge project, they can be used to find reliable sources. First, search for your topic on the open-source website and look for information that may be relevant to your topic, issue, or solution, writing down any key terms you might be able to use in future searches. While on the open-source website, find the sources section and look for sources relevant to your topic. Some of these sources may be reliable sources you can use for your STEM Challenge project.

Feeling Rushed: Deadlines

During the STEM Challenge, you or your teacher may set deadlines for project tasks. While deadlines can be necessary for you to complete the STEM Challenge, they can also cause a lot of stress. If you feel stressed about meeting a deadline, break your task down into several smaller components. Identify how long it will take you to complete each component and focus on completing each component one at a time. Your goal should be completion, not perfection. Once you have completed each component, you can take any remaining time before the deadline to refine your product.

If you are unable to meet a deadline and the deadline was set by you or your group, adjust the deadline accordingly. Keep in mind that if you move a deadline by a considerable amount of time, you may struggle to meet any following deadlines. Always look forward and plan ahead. If you are unable to meet a deadline and the deadline was set by your teacher, be proactive and communicate your concerns with your teacher to explain why you are unable to meet the deadline and identify a time and date by which you believe you can finish the task. Work with your teacher to discuss your options.

Feeling Overwhelmed: Too Many Options

During the STEM Challenge, you may experience choice overload. Choice overload happens when you feel like you have too many options and struggle to make a decision. For your model and presentation, you can make whatever you want, but you have a set of guidelines to follow and have examples to use for inspiration. There is no shame in using the examples set within your Student Guidebook. If you are ever overwhelmed when designing your solution, learn more about your topic, list all your solution ideas, and pick one solution to focus on for your project. Once you have picked a solution,

do not look back or reconsider your selection. Going back and changing your mind repeatedly, reselecting your solution each time, can make you doubt yourself. You picked a solution, stick with it. Remember, you can still adjust your selected solution as you go—that is part of the engineering design process and part of the STEM Challenge (Chernev et al., 2015; Pilat & Krastev).

Feeling Exhausted: It's Too Hard

The STEM Challenge is not intended to be an easy project. There may be times where you feel exhausted and feel like the project is too hard and never-ending. When this happens, take a break and look at how much you have already accomplished. Remind yourself that everyone goes at their own pace and that the challenges you are facing are the same challenges scientists face everyday. It is okay to struggle. Keep in mind that no one expects your solution to fully solve your identified issue—if finding a perfect solution were that easy, scientists would have already done it.

Other Tips

Do not procrastinate: Not procrastinating is easier said than done. If you struggle with procrastination, there are a variety of tips and tricks you can use to avoid waiting until the last minute. For example, you can set one or several completion goals for your project or project components. These completion goals should be set a few days or a week before the project deadline. Tell someone you know, either a friend or family member, about your completion goals and ask them to hold you accountable or give you reminders. If you keep up with your completion goals, you will finish before your deadline and still have time to touch up your work.

List all your sources: Keep a list of all the sources you think might be relevant to your topic, even if you do not currently need them. It is much easier to remove an unused source from your list than it is to find a specific source you discarded.

Limit work time: Try to maintain a school-life balance. Like any project, the STEM Challenge can be as big or as small as you make it. Try to set STEM Challenge specific work times and only work on the STEM Challenge during these designated time periods. When these time periods are over, stop working on the STEM Challenge. The exception to this rule is when you have an upcoming deadline.

Take care of yourself: Like all work, you need to take care of yourself while completing the STEM Challenge. If you are struggling with any part of the STEM Challenge or with work or life outside of the STEM Challenge, confide in a peer or a mentor. This could be a friend, a teacher, a family member, or a counselor. Remember, while the STEM Challenge and school are important, you are more important. You need to prioritize your own mental and physical wellbeing.

Sources:

- Chernev, A., Böckenholt, U., & Goodman, J. (2015). Choice overload: A conceptual review and meta-analysis. *Journal of Consumer Psychology*, 25(2), 333-358.
- Pilat, D., & Krastev, S. (n.d.). *Choice Overload Bias*. The Decision Lab. <https://thedecisionlab.com/biases/choice-overload-bias>
- Saunders, E. G. (2016, May 11). *If you dread deadlines, you're thinking about them all wrong*. Harvard Business Review. <https://hbr.org/2016/03/if-you-dread-deadlines-youre-thinking-about-them-all-wrong>
- The University of North Carolina at Chapel Hill. (2024, February 19). *Taking Breaks*. The Learning Center. <https://learningcenter.unc.edu/tips-and-tools/taking-breaks/#:~:text=For%20this%20reason%2C%20while%20it,studying%20can%20even%20improve%20recall!>

Additional Resources

Free Resources

While some software and classes can be expensive or otherwise difficult to access, there are many high-quality free alternatives.

Frost Science

<https://www.frostscience.org/>



Frost Science will print 3D models for students participating in the STEM Challenge. These models will be printed on a small scale, and model files must be sent to Frost Science 2 months prior to the necessary in-hand date. If you are interested in printing your STEM Challenge models for free, please send your STL files to education@frostscience.org.

AutoDesk

<https://www.autodesk.com/education/home#students>



The AutoDesk Suite provides a wide variety of different software that range from simple 3D modeling to infrastructure design. Software provided in the AutoDesk suite are free for students with a valid school email address.

Tinkercad (Beginner)

<https://www.tinkercad.com/>



Tinkercad is a web-based AutoDesk software that allows users to create 3D models, circuits, and code. The circuits are compatible with Arduino and Micro:Bit and utilize block and Python coding. Tinkercad cannot be used to design circuits compatible with Raspberry Pi. Tinkercad is considered an easy-to-use software.

Blender (Advanced)

<https://www.blender.org/>



Blender is a 3D creation suite that has more capabilities than other 3D modeling software, like Tinkercad, and can create styled and photo-realistic 3D models, animations, simulations, and more. Because Blender has a lot of tools and settings, it also has a steep learning curve.

GitHub (Intermediate-Advanced)

<https://github.com/education/students>



GitHub is a platform where developers can create, store, manage, and share their code with other users. Like with any online download, code used for the STEM Challenge should only come from reliable sources to avoid encountering malware. The source for any code from GitHub used in a STEM Challenge project should be cited.

Google Earth Studio (Beginner-Intermediate)

<https://www.google.com/earth/studio/>



Google Earth Studio is an online software that can be used to create animations and Virtual Reality scenes. Google Earth Studio utilizes Google Earth satellite and Street View imagery along with 3D building models.

KIRI Engine (Beginner)

<https://www.kiriengine.app/>



KIRI Engine allows users to scan objects using their phone to create 3D models. The 3D models generated by KIRI Engine can then be exported and imported into other 3D modeling software, where the file can be edited.

QGIS (Intermediate-Advanced)

<https://qgis.org/>



QGIS is a geographic information system (GIS) software. As a GIS software, QGIS allows users to analyze, display, and map location data. Uses for GIS maps include displaying weather data, identifying flood zones, monitoring deforestation, and urban planning.

Teachable Machine (Beginner)

<https://teachablemachine.withgoogle.com/>



Teachable Machine is a machine learning AI program. Users provide images and sounds to the Teachable Machine, and the AI will learn how to identify and categorize the provided media. The Teachable Machine can be exported and used in conjunction with coding.

Unreal Engine (Advanced)

<https://www.unrealengine.com/>



Unreal Engine is a 3D graphics computer game engine. While this software is primarily used to create video games, it is also used to create simulations, VR/AR/MR, video, and more. Knowing C++ is advantageous when using the program.

Visual Studio Code (VSCode) (Intermediate-Advanced)

<https://code.visualstudio.com/>



VSCode is an environment where users can write, debug, test, and compile code. VSCode requires a basic understanding of at least one programming language.

Online Courses (Beginner-Advanced)

Students can take free and paid courses that address a wide range of different topics, including coding, artificial intelligence, machine learning, and more.

Corsera

<https://www.coursera.org/>



Code Academy

<https://www.codecademy.com/>



Resources: STEM Challenge Website

<https://www.frostscience.org/frost-science-stem-challenge/>

Additional resources can be found on the STEM Challenge website. Resources listed on the STEM Challenge website may be modified over time.



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