



TEACHER GUIDEBOOK

2026 - 2027

Table of Contents

Section Descriptions	4
Section 1: About the Junior STEM Challenge	5
The Frost Science Junior STEM Challenge.....	6
Junior STEM Challenge Student Timeline.....	7
Junior STEM Challenge Teacher Timeline.....	8
Junior STEM Challenge Theme	10
Junior STEM Challenge Prompts.....	11
Why Should You Participate in the Junior STEM Challenge?	12
Learning Labs and Outreaches	13
M-DCPS Teacher Benefits	14
Why Should Your Students Participate in the Junior STEM Challenge?	15
Teacher Expectations	16
Student Expectations.....	17
Junior STEM Challenge Agreement.....	18
Section 2: Student Activities	19
<i>Activity 0: I Care!</i>	<i>20</i>
<i>Activity 1: Let's Get Started</i>	<i>38</i>
<i>Activity 2: Dinosaur Drama.....</i>	<i>51</i>
<i>Activity 3: Out With the Old</i>	<i>96</i>
<i>Activity 4: Engineer That!</i>	<i>113</i>
<i>Multi-Purpose Activity: Mix-it-up.....</i>	<i>141</i>
Field Trips: Resources.....	149
Virtual Meet the Museum Scientist: Resources	158
Section 3: Teacher Resources.....	161
Junior STEM Challenge 2026-2027 Content Connections	162
Pacing Guides	173
Junior STEM Challenge Planning.....	177
Submission Procedures	181
Junior STEM Challenge Grading Rubric.....	182

Section 4: STEM Challenge Final Products	183
Models	184
Engineering Notebook	185
Presentation Displays	188
Evaluating Solutions	189
Judging Guidelines	191
Using Artificial Intelligence	195
Student Tips.....	197
Additional Resources	200



This icon indicates the
corresponding page number
in the Student Guidebook

Section Descriptions



Section 1

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

The Student Guidebook version of this section provides a less detailed timeline and does not include teacher-specific pages.



Section 2

Section 2 of the Teacher Guidebook contains Junior STEM Challenge activities along with their accompanying materials. This includes the required activity, *Activity 1: Let's Get Started*. Student activity sheets are also included for the optional field trip to Frost Science and virtual Meet the Museum Scientist opportunities.

The Student Guidebook version of this section only contains activity sheets for the Junior STEM Challenge activities, not including the field trip and virtual Meet the Museum Scientist opportunity activity sheets.



Section 3

Section 3 of the Teacher Guidebook includes additional materials to support teachers in integrating the Junior STEM Challenge into their curriculum and in guiding students through their Junior STEM Challenge projects. Along with the additional materials, Section 3 includes additional pages to use for planning.

The Student Guidebook does not contain any of the information in Section 3 of the Teacher Guidebook.



Section 4

Section 4 of the Teacher Guidebook contains information about Junior STEM Challenge final products, including guidelines for student models and displays. This section also contains tips and resources for students and teachers.



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 Junior STEM Challenge



Section 1 of the Teacher Guidebook includes an overview of the Junior STEM Challenge along with teacher and student benefits and expectations. Student benefits and expectations in Section 1 are also given to students in their Student Guidebook. The end of Section 1 also includes a copy of the Teacher Agreement.

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

—Albert Einstein



Frost Science Junior STEM Challenge

The Frost Science Junior STEM Challenge is a year-long science and engineering project for middle school students and teachers. In this challenge, students will use the engineering design process to create solutions to some of the problems scientists are trying to solve. These problems cover four different science disciplines: astronomy, marine science, paleontology, and health.

In the Junior STEM Challenge, groups of 2-4 students can pick one science discipline and problem to solve and create a solution, model, Engineering Notebook, display, and 5-minute presentation. Even if lots of students pick the same science discipline and problem, students have different skills, interests, and knowledge, and can come up with completely different solutions.

The theme and problems in the Junior STEM Challenge change every year. This means that students can participate in the Junior STEM Challenge every year in middle school. Once students graduate from middle school, they will be able to compete in the high school version of the competition, the STEM Challenge.

The Junior STEM Challenge has a two-step judging process. At the end of the school year, teachers will submit student projects online for judging. Students from the top scoring projects will then be invited to the STEM Challenge Expo where they will present their projects to judges in-person at Frost Science. Winning students will receive college scholarships that cover one year of college tuition.

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Junior STEM Challenge

Student Timeline

- 1 Get a Student Guidebook
- 2 Read over the Junior STEM Challenge
- 3 Do *Activity 1: Let's Get Started*
- 4 Research your science discipline
- 5 Pick one problem related to your science discipline
- 6 Brainstorm a solution to your problems
- 7 Adjust your solution using the Engineering Design Process
- 8 Create a model of at least part of your solution
- 9 Create a display, like a poster or slideshow
- 10 Turn in your project to your teacher
- 11 Your teacher takes pictures of your project and submits it online for judging
- 12 Top scoring projects will be invited to the STEM Challenge Expo at Frost Science to be judged in-person
- 13 Winners will be announced!

Junior STEM Challenge

Teacher Timeline

- 1 **Optional:** Complete *Activity 0: I Care!* with students
- 2 Provide your students with the student guidebook
- 3 Give students an overview of the Junior STEM Challenge
- 4 **Mandatory:** Complete *Activity 1: Let's Get Started* with students
 - As part of Activity 1, students will select their prompt and begin to plan their Junior STEM Challenge project
- 5 **Optional:** Complete *Activity 2: Dinosaur Drama* with students
- 6 Students research their prompt and create a list of resources
- 7 Students brainstorm a solution
- 8 **Optional:** Complete *Activity 3: Out with the Old* with students
- 9 Students refine their solution
- 10 **Optional:** Complete *Activity 5: Mix-it-up* with students
- 11 Students refine their solution
- 12 Students create a model of their solution
- 13 **Optional:** Complete *Activity 4: Engineer That!* with students
- 14 Students develop a 5-minute presentation for their projects
- 15 **Optional:** Complete *Activity 5: Mix-it-up* with students to refine their presentation

STEM Challenge Teacher Timeline

(continued)

16

Students create a display

17

Select strong student projects to submit for the first round of judging

18

Submit a digital copy of each selected project's display, model, and Engineering Notebook for round one of judging by April 3, 2027

- These submissions must include either digital files or clear photographs

19

Students that pass the first round of judging will receive invitations to present at the STEM Challenge Expo at Frost Science

20

Invited students, along with their teachers, arrive at the museum and set up their poster presentations and models for the second round of judging



2026 - 2027 Junior STEM Challenge Theme

The Junior STEM Challenge theme and prompts will change every year. The 2026-2027 Junior STEM Challenge theme is “Sustainable Energy Generation and Use” Teachers may assign a prompt or let students choose one of the prompts for the Junior STEM Challenge.

Sustainable Energy Generation and Use

Energy makes modern life possible, powering our homes, technologies, transportation systems, and more. However, a lot of energy generation methods and energy use have negative impacts. The future of sustainable energy will be shaped by the next generation of problem-solvers. This year’s Junior STEM Challenge encourages students to investigate, design, and innovate as they explore what the future of sustainable energy could look like.

Prompts for Junior STEM Challenge

Marine Science



There are many different ways that the ocean and its resources can be used to generate energy. However, accessing or generating energy can negatively impact marine ecosystems. Create a way to reduce or mitigate negative environmental impacts caused by energy production or create a more sustainable alternative to current energy generation methods in marine environments.

Astronomy



In space, access to Earth-based energy sources, like fossil fuels, is limited. Because of this, scientists are looking for new ways to study and use space-based energy sources as an alternative. Develop a way to expand our ability to observe, capture, or use energy in space.

Geology



Places that experience frequent tectonic activity can use the heat generated by the Earth's core to produce geothermal energy. However, not all places on Earth have access to this energy. Develop a way that places with less tectonic activity can gain access to geothermal energy. This can include new methods or more sustainable versions of current methods used for energy generation and transfer.

Health



Hospitals require constant energy to sustain vital support systems. Currently, hospitals primarily rely on generators in case of power shortages or emergencies. Create a way for hospitals to become more self-sustaining and off-the-grid in case of widespread or long-term power outages.

Why Should You Participate in the Junior STEM Challenge?

As part of the Junior STEM Challenge, teachers are eligible to receive a \$500 stipend. This stipend may be used to reimburse teachers for classroom materials or otherwise support them in facilitating the Junior STEM Challenge.

Teachers participating in the Junior STEM Challenge can reserve a field trip to Frost Science for 30 students and participate in virtual Meet the Museum Scientist opportunities at no cost. Frost Science field trips include self-guided tours through the museum and an optional STEM Challenge Learning Lab. The cost of buses will also be covered by Frost Science on a first-come, first-served basis. Purchasable add-ons for field trips include lunches, Frost Planetarium shows and non-STEM Challenge Learning Labs. Students and schools can provide their own lunches during field trips, or they can be purchased through Frost Science at \$10 per student. Likewise, planetarium shows and non-STEM Challenge Learning Labs (weekdays only) are available for an additional cost. Free STEM Challenge Learning Labs include the following:

Included Learning Lab Options (See [page 13](#) for descriptions)

- STEM Challenge Intro (Tier 1)
- STEM Challenge Starter (Tier 2)
- STEM Challenge Pro (Tier 3)

Purchasable Learning Lab Options

- Power of Hydration
- Earth Formations
- Squid Dissection

During virtual Meet the Museum Scientist opportunities, students will be able to meet with a scientist and learn about their field, job, and research. Students will then be able to ask the scientist questions about their career.

“Invest in our teachers, and our children will succeed.”

—Barack Obama

Learning Labs and Outreaches

STEM Challenge Learning Labs and Outreaches are free for all teachers and are available at three different Tiers. **Intro (Tier 1)** programs are designed for teachers who are not participating in the Junior STEM Challenge or STEM Challenge during the 2026-2027 school year or for participating teachers who would like a lesson focused on the Engineering Design Process. **Starter (Tier 2)** and **Pro (Tier 3)** programs are designed for teachers actively participating in the Junior STEM Challenge or STEM Challenge.

Intro (Tier 1): During an Intro program, students will learn about the Engineering Design Process by completing a hands-on 3D modeling activity.

Starter (Tier 2): During a Starter program, Frost Science educators will lead a hands-on version of Activity 1: Let's Get Started. This Learning Lab or outreach program can fulfill the requirement of teaching Activity 1: Let's Get Started as part of the Junior STEM Challenge.

Pro (Tier 3): During a Pro program, students will work on their Junior STEM Challenge projects under the guidance and supervision of Frost Science educators.

Register for a STEM Challenge Field Trip using the link or QR code below:

<https://forms.office.com/r/H7aVgBjv1F>



Register for a STEM Challenge Outreach using the link or QR code below:

<https://www.frostscience.org/outreach-reservations-form/>



M-DCPS Teacher Benefits

Teachers in Miami-Dade County Public Schools can receive additional benefits for participating in the Junior STEM Challenge. These teachers can receive STE(A)M Designation and credit for completing an in-school challenge.

To receive STE(A)M Designation, teachers must complete four engagements. These engagements include:

- Attending the professional learning experience on August 10, 2026.
- Scheduling and attending a field trip to Frost Science.
- Engaging with a virtual Meet the Museum Scientist opportunity.
- Scheduling and engaging with a STEM Challenge Outreach opportunity.
- Attending and participating in the STEM Challenge Expo.
- This engagement only counts for STE(A)M Designation if students are invited to the STEM Challenge Expo for the second round of judging.



Why Should Your Students Participate in the STEM Challenge?

The Junior STEM Challenge lets students explore what it means to be a scientist in a different way than a science fair. In a science fair, students have to write a hypothesis, do research, and collect data. Instead of this, the Junior STEM Challenge asks students to create solutions to real-world scientific problems.

The problems in the Junior STEM Challenge are real problems that scientists are trying to solve, and student solutions will be judged by real scientists.

Students in the Junior STEM Challenge will be judged in a two-step judging process. Student projects will be submitted by their teacher or mentor online for judging. Top scoring projects will then be invited to Frost Science for the STEM Challenge Expo, where students will present to judges in-person. Students that win 1st, 2nd, and 3rd place in the Junior STEM Challenge will receive a 1-year Florida University Plan scholarship through Florida Prepaid.

For winners to get their college scholarship from Florida Prepaid, they have to:

- 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 is missing one or more of the criteria listed above, Frost Science will work with the student to give them the value of the scholarship, which will be less than the cost of a 1-year Florida University Plan.

Florida University Plans from Florida Prepaid are for public Florida state universities but can also be used for private and out-of-state schools. When using these scholarships for private and out-of-state schools, the scholarship cost will be applied to student tuition. The scholarships will not cover 1-year of tuition like they would at a public Florida state university.

Teacher Expectations

Teach Activity 1: *Let's Get Started*

Participating teachers are expected to guide students through the Junior STEM Challenge as they brainstorm and create their solutions, construct a model of their solution, create an Engineering Notebook, and design a presentation. To begin, teachers will introduce students to the Junior STEM Challenge by teaching *Activity 1: Let's Get Started*. This activity is mandatory for all participating students and teachers as it introduces procedures that will help students complete the Junior STEM Challenge and guides students through starting their Junior STEM Challenge projects.

Teach or Encourage Students to Complete Remaining Activities

While only *Activity 1: Let's Get Started* is required, teaching activity 0 and activities 2-5 is highly recommended. These activities guide students through describing the importance of stakeholders, identifying reliable sources, applying the engineering design process, and creating strong presentations.

Guide Students to Project Completion

Teachers are also expected to allow students to come up with their own original solutions to the Junior STEM Challenge prompts. While teachers may provide guidance that directs students to pursue specific paths, they may not answer Junior STEM Challenge prompts for their students. Acceptable guidance by teachers includes helping students recognize that their solution may not be realistic, that their identified problem is too broad or difficult to address, that their presentation is missing key components, or providing other general feedback. Unacceptable guidance by teachers includes telling students how to solve their identified issue, telling students what part of their solution to model, or telling students to address a specific issue within their prompt. For example, while teachers may require students to address the marine science prompt, they may not tell students to focus on developing a solution that protects newly outplanted corals from predation.

Submit Top Student Projects

Teachers will submit their top student projects for the first round of judging. Teachers are expected to be unbiased in their selection of top student projects. All high-quality and complete student projects should be considered regardless of student performance in school. Exceptions to this rule include cases of severe disciplinary action. .

Student Expectations

Complete Activity 1: Let's Get Started

Students will start the Junior STEM Challenge by doing *Activity 1: Let's Get Started*. This activity walks students through a practice version of the Junior STEM Challenge.

Design a Solution

Creating a solution to one of the prompts is the first step in completing the Junior STEM Challenge. When students create their solution, they need to make sure that it is realistic and solves their Junior STEM Challenge prompt.

Use the Engineering Design Process

After students create their solutions, they should continue to make them better. Looking for problems with their solution and fixing those problems is a very important step in making a strong solution.

Create a Model and a Engineering Notebook

Once students feel like they have a strong solution, they should create a model of their solution. This model can be anything that shows at least part of their solution. While they create their model, students will take pictures or screenshots of their model as they go and save them for their Engineering Notebook. After they have finished their model, they should write at least one sentence for each of their pictures to show how they made their model over time.

Create a Display and Presentation

Students will then create a display and presentation for their solution and model. The display can be anything from a poster to a slideshow! Students should use their creativity, skills, and interests to make a display that they think works for their projects. Once students have a display, they can practice presenting their solutions. Presentations can only be 5 minutes long.

JUNIOR STEM CHALLENGE AGREEMENT

Purpose

This agreement defines the roles and responsibilities of teachers participating in the Junior STEM Challenge during the 2026-2027 academic year. This document is not a legally binding agreement or contract.

Agreements

As a participant, I:

1. Agree to participate in the Junior STEM Challenge with students during the 2026-2027 academic year.
2. Agree to receive the Junior STEM Challenge curriculum and implement *Activity 1: Let's Get Started* with participating students.
3. Agree to have students complete at least one Junior STEM Challenge project, producing a display and model that presents a solution to one of the four Junior STEM Challenge prompts.
4. Agree to digitally submit student projects to Frost Science by April 3, 2026.
5. Understand that I will receive a stipend of \$500 for attending the professional learning opportunity, teaching *Activity 1: Let's Get Started*, and submitting at least one student project. This stipend may be used as seen fit.
6. Understand that participation in the Junior STEM Challenge includes opportunities for a field trip to Frost Science, STEM Challenge Learning Labs and outreaches, and virtual Meet the Museum Scientist opportunities at no cost.
7. Understand that participation in the Junior STEM Challenge can be used to receive STE(A)M Designation through M-DCPS. Events include a professional learning opportunity on August 10, 2026, engagement with the field trip and Meet the Museum Scientist opportunities, STEM Challenge outreach opportunities, and attendance at the STEM Challenge Expo on May 1, 2027.
8. Understand that completion of the Junior STEM Challenge can be used to receive credit for completing an in-school challenge through M-DCPS. To receive credit for completing an in-school challenge, M-DCPS teachers must attend the professional learning opportunity on August 10, 2026 and teachers must submit Junior STEM Challenge projects by April 3, 2027.
9. Understand that receiving STE(A)M Designation and in-school challenge credit must be approved by M-DCPS and appropriate M-DCPS paperwork must be filled out by each school/teacher.

	Analisa Duran, Ph.D. Knight Vice President of Science Education Phillip and Patricia Frost Museum of Science
School Name	
Teacher Name	Signature
Date	
Signature	

Section 2

Overview of Provided Resources



This section provides an overview of each resource provided in Section 2 of the Teacher Guidebook. As a reminder, you are only required to teach *Activity 1: Let's Get Started*. Teachers are encouraged to use and modify any of the provided resources as needed.

Activities

The provided activities may be used to guide students through the Junior STEM Challenge. These activities contain procedural guidance and do not contain any content related to the Junior STEM Challenge prompts. The teacher guidebook contains activity plans and student activity sheets.

Field Trip Resources

For the optional field trips to Frost Science, teachers are provided with several scavenger hunts they can distribute to their students. These scavenger hunts guide students through exploring the museum and help students learn more about their Junior STEM Challenge prompts.

Virtual Meet the Museum Scientist Resources

Teachers are provided with a preparatory guide that can be distributed to their students for the optional virtual Meet the Museum Scientist opportunities. The guide helps students prepare questions that will give them a better understanding of the Junior STEM Challenge and what it means to be a scientist.

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

—Mae Jemison

Activity 0: I Care!

Overview

Students will learn about stakeholders and why engineers need to consider their stakeholders while making design decisions. To learn about what different stakeholders care about, students will play the card game “I Care!”

Objectives

By the end of this activity, students will be able to:

- Describe a stakeholder.
- Identify what different stakeholders care about.
- Understanding the role of stakeholders in engineering design projects.

Key Messages

- Stakeholders are the people or organizations that care about the implementation of a project, who need to be considered when creating any engineered design.
- Different stakeholders may have differing opinions on the same thing.
- During the Junior STEM challenge, students will need to identify and think about their stakeholders.

Time Needed: 35 minutes

Standards

NGSSS Gifted Learners Benchmarks

G.K12.2.2.2d, Questions and Inquiry - Accomplish: Use questions to situate personal interest and background within the inquiry.

G.K12.4.2.4b, Ethics - Understand: Use knowledge of recognized ethical standards of various stakeholders to formulate problem statements and solutions.

G.K12.5.2.2a, Diversity - Know: Identify in individuals the qualities of empathy and sensitivity to the ideas of others.

G.K12.5.3.2b, Communication - Understand: Show an awareness of the experiences, needs, and concerns of others in the communication process.

NGSSS Science Benchmarks

SC.8.N.4.1, Explain that science is one of the processes that can be used to inform decision making at the community, state, national, and international levels.

Background Information

Stakeholders

Stakeholders include any person or organization that cares about something. Usually, stakeholders are referenced when talking about the entities supporting a project. Stakeholders may either provide support for a project through funding or, if they are opposed to the project, may try to block the project. Stakeholders may try to block a project for many reasons but usually try to block projects that negatively impact them in some way. This could be through hurting the stakeholders financially, for example, using taxes to fund a project that does not benefit the stakeholders, through negatively impacting the stakeholders health, for example, by releasing pollutants, or by damaging the stakeholder’s surroundings, for example, by destroying a natural resource. To continue having support for their projects, engineers must make sure that the benefits of their projects outweigh any potential negative impacts.

Materials (per student)

- “I Care!” Instructions and Cards
- Computer
- Paper or Personal Whiteboards (Optional for Group Play)
- Pencil

Set-Up Procedure

1. Print or photocopy enough copies of the “I Care!” instructions for your students. Students will play the game, “I Care!” in partners or groups and each partner or group will need a copy of the instructions.
2. One copy of the card game has been provided with the Junior STEM Challenge curriculum. If students are sharing the cards, tell students to draw their “Stakeholder” card before passing the rest of the cards to the next group. Students can continue to pass the cards around the room while they play. Once all cards have been used, students can shuffle the cards and continue playing.
3. Open the PowerPoint.

Activity Procedures

INTRODUCTION: <i>This part of the activity will introduce students to the concept of a stakeholder and reveal their prior knowledge.</i>	
TIME REQUIRED: 10 minutes	
What the Teacher Does	Anticipated Student Behaviors/Responses
1. Tell students to sit with a partner or in a group. Note: For the game “I Care!,” there are separate instructions for both partner play and group play. To simplify the game instructions for students, all students should either be in partners or all students should be in groups of 3-6 players.	1. Students will sit with a partner or group.
2. Tell students that they will be learning about stakeholders in preparation for the Junior STEM Challenge, which they will be learning more about when they start the challenge in class.	2-3. Students will listen.
3. Tell students that a stakeholder is someone who cares about something that is happening. This could be because they are investors, they believe in it, or because it could affect them. For example, a teacher can be a stakeholder. The teacher might care that they have good curriculum, that students are learning and paying attention, that they have planning time, that they have funding for good classroom materials, and that they have good administration (principal, administrators, etc.). The teacher might also care about the local government shifting school zones and redistributing funds or about local crime rates that could impact their student’s safety. The things teachers care about is more than just what is happening in their classroom.	

4. Ask students the following questions: Q1: Who are some people in your community that are stakeholders? Q2: Is a stakeholder always a person? Who else could be a stakeholder? Select several students to share their answers to each question. If students are unable to answer question 1, provide students with the answer before asking question 2. Give the following example:	4. Selected students will answer each question. R1: <i>Student answers may vary. For example: My mom is a stakeholder in my community. She goes to every PTA meeting because she cares about what is happening in my school. My grandfather is also a stakeholder in my community. He donates to his church's soup kitchen because a soup kitchen helped him when he was in need and he believes other people deserve to have access to the same resource.</i> R2: A stakeholder could be a person, company, or organization.
5. Tell students that for each stakeholder you name, they will have to identify what the stakeholder might care about. Ask students to describe what each of the following stakeholders might care about: Small Bakery Owner Ballerina Grocery Store Firefighter Veterinarian Select students to share what each stakeholder cares about until students have provided the majority of each exemplar answer. Student answers may vary from the exemplars provided.	5. Selected students will share what they believe each stakeholder cares about. Small Bakery Owner: Sales, employees, oven quality, bread quality, marketing, competing bakeries, etc. Ballerina: Ballet company, instructor, classes, audience, performance hall, ballet shoes, health, etc. Grocery Store: Sales, employees, competing groceries, local markets, convenience stores, health department, etc. Firefighter: Citizens, police, Emergency Medical Technicians (EMTs), 911 operators, etc. Veterinarian: Pets, owners, drug manufacturers, labs, etc.

BODY OF THE ACTIVITY: In this part of the activity, students will play the game, “I Care!” to practice identifying what stakeholders may care about.

TIME REQUIRED: 20 minutes

What the Teacher Does	Anticipated Student Behaviors/Responses
1. Tell students that now that they understand a little bit about what stakeholders care about, they will be playing a game called, “I Care!” In this card game, students will ask questions to try and figure out the identity of a mystery Stakeholder.	1-3. Students will listen.
2. Explain the card game to students using one or both of the following instructions: Partners: One person will randomly draw a “Stakeholder” card without looking at it and will hold it up to their forehead. The other person will be the Assistant and has to help the Stakeholder guess what card they pulled. To do this, the Stakeholder can ask their Assistant up to 20 yes or no questions. The number of questions it takes for the Stakeholder to guess who they are will determine if their rank. Each player can then switch roles and play again. Groups: One person will draw a random “Stakeholder” card. They can look at this card but cannot show anyone else the card. The rest of the players will be Reporters. The Reporters can all ask the stakeholder one yes or no question. Once all of the Reporters have asked one question, they can each write their guess down on a piece of paper or a whiteboard. On the count of three, all of the Reporters will turn around their papers to show their guesses. If a Reporter guessed right, they get one point. If no one guessed correctly, then the Reporters will continue to ask a round of questions and make guesses until a Reporter guesses correctly and wins a point. The players can then rotate roles and play again. The player with the most points at the end of the game gets the title of Top Reporter.	
3. Tell students that there are 40 different “Stakeholder” cards and that they can reference the list of “Stakeholder” cards on the back of the instructions while playing the game.	
4. Tell students to take a few minutes to look over the list of “Stakeholder” cards in their instructions and ask questions. If students have questions about one of the “Stakeholder” cards listed, define the career or role for students.	4. Students will look over the list of “Stakeholder” cards and will ask questions about any careers or roles that they are unfamiliar with.

5. Give students about 20 minutes to play the game, “I Care!” As students play the game, circulate the classroom and listen to the types of questions students are asking. If students are asking questions like, “Does your card start with the letter...” redirect the students to ask questions about what the stakeholders care about.	5. Students will play the game, “I Care!” with a partner or in a group.
CONCLUSION: <i>In this part of the activity, students will reflect on what they learned about stakeholders from the card game, “I Care!” and will discuss why engineers care about their stakeholders when making engineering design decisions.</i>	
TIME REQUIRED: 5 minutes	
What the Teacher Does	Anticipated Student Behaviors/Responses
1. After about 20 minutes of gameplay, tell students to finish their current round of the game and stop playing. Ask the following questions or create your own questions that are tailored to the class curriculum or student interest: Q1: Were there things a stakeholder cared about that surprised you? If so, what were they? Q2: Do you think a fisher might care about healthy oceans AND catching as many fish as possible? Why? Q3: Which do you think fishers would find more important? Select several students to share their answers to each question.	1. Students will finish the round of the game they are playing and selected students will answer each question. R1: <i>Student answers will vary. For example: I was surprised to realize that zoos care about wild animals.</i> R2: The fisher would care about both because they need healthy oceans to catch fish, but they also want to maximize profit even though catching too many fish could hurt the oceans. R3: <i>Student answers will vary. For example: I think fishers would care more about catching as many fish as possible because their income is determined by the number of fish they catch.</i>
2. Tell students that the Junior STEM Challenge is an engineering design challenge that they will complete in class. Ask students the following questions: Q1: Stakeholders are an important part of STEM. Who do you think could be a stakeholder in STEM? Q2: Do you think engineers need to think about stakeholders? Why or why not? Q3: Why do you think that engineers have to think about stakeholders for every decision they make? Q4: What would happen if engineers did not think about the stakeholders when making each decision? Q5: If you are completing an engineering design challenge, why do you think it is important to know what a stakeholder is? Select several students to share their answers to each question.	2. Selected students will answer each question. R1: Stakeholders in STEM might include everyday people, workers in related STEM fields, and companies who may be working on or might be affected by the STEM project. R2: Engineers need to think about stakeholders because the stakeholders are who they should be designing for. The stakeholders may also be funding the project. R3: The stakeholders may be funding the project. Stakeholders also can oppose and try to block the project if the engineers make decisions they do not like. R4: If stakeholders do not like the decisions that are being made, they could pull funding or refuse to approve the project. R5: We will need to think about stakeholders while we complete the project because our project might impact more people than we think.

3. Tell students that as long as the benefits, or good parts, of a project are larger than the negatives, or problems caused, by the project, stakeholders will usually support engineering projects.	3-4. Students will listen.
4. Tell students that they will be starting the Junior STEM Challenge when they complete the next Junior STEM Challenge Activity, <i>Activity 1: Let's Get Started</i> . However, during the Junior STEM Challenge, they will need to think about stakeholders every step of the way.	

Notes/Considerations

Students should be allowed to ask clarifying questions at any time during the lesson.

If you have more than 40 minutes to complete this activity, give students more time to play the game, “I Care!”



I CARE!

SET UP

Shuffle the “Stakeholder” cards and place the deck face-down on the table.

GROUP RULES (3-6 Players)

1. One player will start as the **Stakeholder**. This player will draw one “Stakeholder” card and will keep it hidden from the remaining players. The remaining players will start as **Reporters**.
2. The **Reporters** will take turns asking the **Stakeholder** yes or no questions to try and identify the role on the “Stakeholder” card. Reporters may reference the list of **Stakeholder** roles in the game.
3. After every **Reporter** in the group has had a chance to ask one question, the **Reporters** will write their guesses on a piece of paper or a whiteboard. On the count of three, all **Reporters** will reveal their guesses.
4. If a **Reporter** correctly guesses the **Stakeholder** role, they get one point. If no one guesses the **Stakeholder** role, repeat steps 2-3 until a **Reporter** correctly guesses the **Stakeholder** role.
5. Rotate roles in the group and repeat steps 1-4. Play at least two rounds of the game or for as long as you have time. At the end of the game, the title of **Top Reporter** will be given to the player with the most points.

PARTNER RULES (2 Players)

1. One player will start as the **Stakeholder**. This player will draw one “Stakeholder” card without looking and hold it to their forehead. The second player will start as the **Assistant**.
2. The **Stakeholder** will ask their **Assistant** up to 20 yes or no questions to try and identify the role on their “Stakeholder” card. The **Stakeholder** may reference the list of **Stakeholder** roles in the game.
3. The number of questions it takes for the **Stakeholder** to identify their role will determine their rank:
 - **1-4 Questions:** Lead Investor
 - **5-8 Questions:** Shareholder
 - **9-12 Questions:** Owner
 - **13-16 Questions:** Manager
 - **16-20 Questions:** Employee
4. The **Stakeholder** and **Assistant** will switch roles and repeat steps 1-3. Play at least two rounds of the game or for as long as you have time.

TYPES OF QUESTIONS

To help identify the “Stakeholder” cards, players can ask questions. These questions can include variations of the following:

Does the Stakeholder care about...

Does the Stakeholder work with...

Would the Stakeholder be happy about...

Would the Stakeholder be upset about...



I CARE!

INSTRUCTIONS



I CARE!

STAKEHOLDER LIST



I CARE!

INSTRUCTIONS



COMMUNITY, CULTURE, AND SOCIETY

Citizen
Community Leader
Indigenous Community
Teacher
Student
Historian
Journalist
Influencer
Museum
Zoo or Aquarium



SCIENCE AND ENVIRONMENT

Marine Biologist
Oceanographer
Astronomer
Physicist
Chemist
Paleontologist
Archaeologist
Geologist
Ecologist
Astronaut



GOVERNMENT, LAW, AND PUBLIC SERVICE

Politician
Water Resource Manager
Urban Planner
Police
Lawyer



HEALTH

Doctor
Nurse
Hospital
Epidemiologist
Pharmacist



BUSINESS, ENGINEERING, AND TECHNOLOGY

Investor
Shareholder
Small Business Owner
Civil Engineer
Software Developer



AGRICULTURE AND NATURAL RESOURCES

Farmer
Rancher
Fisher
Forester
Park Ranger



I CARE!



I CARE!



I CARE!



I CARE!



I CARE!



I CARE!



I CARE!



I CARE!



I CARE!

Politician

A person that works in government and helps determine government policies and laws.

Cares: Laws, Politics, People



Government, Law, and Public Service

Water Resource Manager

A person that helps manage water resources, including drinking water and wastewater (sewage) treatment.

Cares: Clean water, Rivers, Sewage



Government, Law, and Public Service

Urban Planner

A person who plans city spaces, including neighborhoods, parks and roadways, among other urban areas.

Cares: Cities, Organization, Appearance



Government, Law, and Public Service

Police

A person who responds to emergencies and enforces the law.

Cares: Safety, Emergencies, Danger



Government, Law, and Public Service

Lawyer

A person who helps advise the people of their legal rights and helps present legal cases in court.

Cares: Law, Truth, Justice



Government, Law, and Public Service

Citizen

A person who lives in a city or town.

Cares: Community, Safety, Livability



Community, Culture, and Society

Community Leader

A person who serves their city or town and advocates for the well-being of the city or town's citizens.

Cares: Community, Safety, Opportunity



Community, Culture, and Society

Indigenous Community

The first group of people to live in an area, who are native, or indigenous, to the area.

Cares: Community, Safety, History



Community, Culture, and Society

Teacher

A person who teaches other individuals.

Cares: Students, Teaching, Learning



Community, Culture, and Society



I CARE!



I CARE!



I CARE!



I CARE!



I CARE!



I CARE!



I CARE!



I CARE!



I CARE!

Student

A person who learns and studies information while working towards a goal, like a grade or degree.

Cares: Learning, Studying, Recalling



Community, Culture, and Society

Historian

A person who studies history by looking at original documents.

Cares: History, Sources, Fact



Community, Culture, and Society

Journalist

A person who writes or edits for a news source.

Cares: News, Events, Reporting



Community, Culture, and Society

Influencer

A person who inspires other people to buy or use a product or to do certain activities.

Cares: People, Popularity, Followers



Community, Culture, and Society

Museum

An organization that displays historical, scientific, or art items and operates as a business for educational and preservation purposes.

Cares: Education, Exhibits, Artifacts



Community, Culture, and Society

Zoo or Aquarium

An organization that takes care of animals and operates as a business for educational and conservation purposes.

Cares: Animals, Conservation, Education



Community, Culture, and Society

Marine Biologist

A person who studies ocean life.

Cares: Ocean, Life, Research



Science and Environment

Oceanographer

A person who studies the ocean, from currents and tides to water chemistry and pollution.

Cares: Ocean, Water, Research



Science and Environment

Astronomer

A person who studies celestial bodies in space, including planets, stars, and galaxies.

Cares: Space, Stars, Planets



Science and Environment



I CARE!



I CARE!



I CARE!



I CARE!



I CARE!



I CARE!



I CARE!



I CARE!



I CARE!

Physicist

A person who studies how energy and matter interact.

Cares: Energy, Light, Objects



Science and Environment

Chemist

A person who studies the atomic structure of elements and molecules and how they interact.

Cares: Elements, Molecules, Reactions



Science and Environment

Paleontologist

A person who studies fossils to learn about ancient organisms and ancient Earth.

Cares: Fossils, Dinosaurs, Life



Science and Environment

Archaeologist

A person who studies the history of humans and human civilization through studying the objects and buildings humans left behind.

Cares: Artifacts, People, History



Science and Environment

Geologist

A person who studies rocks to learn about everything from Earth's history to the location of natural resources like fossil fuels.

Cares: Rocks, Earth, Resources



Science and Environment

Ecologist

A person that studies the relationship between living organisms and their relationship with their environment.

Cares: Life, Biodiversity, Ecosystems



Science and Environment

Astronaut

A person who travels into space.

Cares: Space, Safety, Exploration



Science and Environment

Doctor

A person who manages human health by caring for, diagnosing, and treating patients.

Cares: Health, Exam, Treatment



Health

Nurse

A person who cares for patients that need help and collects patient information to aid doctors.

Cares: Health, Care, Treatment



Health



I CARE!



I CARE!



I CARE!



I CARE!



I CARE!



I CARE!



I CARE!



I CARE!



I CARE!

Hospital

An organization that can provide more medical care than a health clinic or urgent care.

Cares: Health, Equipment, Care



Health

Epidemiologist

A person that studies diseases and disease control.

Cares: Health, Disease, Prevention



Health

Pharmacist

A person who prepares, measures, and distributes drugs, vaccines, and supplements in a pharmacy.

Cares: Health, Drugs, Safety



Health

Farmer

A person who uses land to grow lots of crops and sometimes raises livestock animals, like cows and chicken.

Cares: Animals, Product, Sales



Agriculture and Natural Resources

Rancher

A person who uses lots of land to raise herds of large livestock animals, like cows and sheep.

Cares: Plants, Product, Sales



Agriculture and Natural Resources

Fisher

A person who catches fish on a small or large scale.

Cares: Fish, Product, Sales



Agriculture and Natural Resources

Forester

A person who manages and cares for a forested area, making sure that trees are being grown at the same rate they are cut down.

Cares: Trees, Product, Environment



Agriculture and Natural Resources

Park Ranger

A person who manages, cares for, and protects a park.

Cares: Safety, Environment, Education



Agriculture and Natural Resources

Investor

A person who puts money into a business or business idea in exchange for something, like partial ownership of the company.

Cares: Money, Support, Planning



Business, Engineering, and Technology



I CARE!



I CARE!



I CARE!



I CARE!

Shareholder

A person who owns shares, or a small part of, a company.

Cares: Money, Ownership, Stocks



Business, Engineering, and Technology

Small Business Owner

A person who owns a company with less than 500 employees.

Cares: Money, Product, Quality



Business, Engineering, and Technology

Civil Engineer

A person that creates plans for public buildings, roads, bridges, and more.

Cares: Cities, Planning, Safety



Business, Engineering, and Technology

Software Developer

A person that creates programs used on computers, smartphones, tablets, and more.

Cares: Computers, Programs, Technology



Business, Engineering, and Technology

Activity 1: Let's Get Started

Overview

Students will learn more about the Junior STEM Challenge by completing a mini-challenge, designing a solution and creating a model and Engineering Notebook. Students will then discuss the differences and similarities between the Junior STEM Challenge and mini-challenge before reading the Junior STEM Challenge prompts and beginning their Junior STEM Challenge project.

Objectives

By the end of this activity, students will be able to:

- Describe the Junior STEM Challenge.
- identify the basic components of the Junior STEM Challenge.
- Find a group and identify their Junior STEM Challenge prompt.

Key Messages

- The Junior STEM Challenge is an engineering-design project that encourages participating students to design and model solutions to real-world issues.
- In the Junior STEM Challenge, students will select a Junior STEM Challenge prompt, research a topic, design a solution, create a digital or physical model, maintain an Engineering Notebook, and create a display.

Time Needed: 60 minutes

Standards

NGSSS Gifted Learners Benchmarks

- G.K12.4.1.1c, Problem Investigation-Perform: Use established criteria to focus the problem statement and generate solutions.
- G.K12.4.1.4b, Solution Finding - Understand: Establish and apply criteria for evaluation of solutions.
- G.K12.4.1.5b, Creative Thinking - Understand: Synthesize unique alternatives to solve a problem (originality).
- G.K12.4.1.5d, Creative Thinking - Accomplish: Evaluate and modify ideas and products to improve usefulness.
- G.K12.4.3.2d, Creative Methodology-Accomplish: Design original problem-solving models for use in specific situations.

NGSSS Science Benchmarks

- SC.6.N.1.3, Explain the difference between an experiment and other types of scientific investigation, and explain the relative benefits and limitations of each.
- SC.6.N.2.3, Recognize that scientists who make contributions to scientific knowledge come from all kinds of backgrounds and possess varied talents, interests, and goals.
- SC.7.N.1.3, Distinguish between an experiment (which must involve the identification and control of variables) and other forms of scientific investigation and explain that not all scientific knowledge is derived from experimentation.
- SC.8.N.4.2, Explain how political, social, and economic concerns can affect science, and vice versa.

Background Information

Junior STEM Challenge

The Junior STEM Challenge is an inquiry-based and student-centered program designed and developed by the Phillip and Patricia Frost Museum of Science (Frost Science). In this program, students will investigate and design solutions for an identified real-world issue in one of four science disciplines: marine science, health, astronomy, and paleontology. First, students will select a discipline and prompt, then they will research their selected topic. During their investigation, students will identify real world issues associated with the prompt, brainstorm solutions to the issue, design and create a model of their solution, and prepare a presentation to be displayed at Frost Science at the STEM Challenge Expo.

STEM Challenge Prompts

Marine Science: There are many different ways that the ocean and its resources can be used to generate energy. However, accessing or generating energy can negatively impact marine ecosystems. Create a way to reduce or mitigate negative environmental impacts caused by energy production or create a more sustainable alternative to current energy generation methods in marine environments.

Astronomy: In space, access to Earth-based energy sources, like fossil fuels, is limited. Because of this, scientists are looking for new ways to study and use space-based energy sources as an alternative. Develop a way to expand our ability to observe, capture, or use energy in space.

Geology: Places that experience frequent tectonic activity can use the heat generated by the Earth's core to produce geothermal energy. However, not all places on Earth have access to this energy. Develop a way that places with less tectonic activity can gain access to geothermal energy. This can include new methods or more sustainable versions of current methods used for energy generation and transfer.

Health: Hospitals require constant energy to sustain vital support systems. Currently, hospitals primarily rely on generators in case of power shortages or emergencies. Create a way for hospitals to become more self-sustaining and off-the-grid in case of wide-spread or long-term power outages.

Materials (per student)

- Student Guidebooks
- Pencils
- Digital Model: One computer per group
- Physical Model: One set of materials per group
- Materials can include paper, cardboard, wire, pipe cleaners, tape, clay, etc.

Set-Up Procedure

1. **Digital Model:** Make sure that there are computers available for every group or partner to have one device. If students do not have personal devices, reserve a computer lab or computer cart. If students have personal devices, remind students one class day prior that they will need their computer on the following class day.
2. **Digital Model:** Create an educator Tinkercad account. Tinkercad will be used in the second half of this activity to provide students with a space to create and upload their projects. This is a free resource.
 - a. Create a class by going to 'Classes' and selecting 'Create a new class.' When creating your class, make sure to keep the setting in 'Safe Mode' so that no student designs are shared publicly.
3. **Physical Model:** Organize materials so that each partner or group can receive one set of materials. These materials will vary based on what is available and may be different from the materials suggested in the Materials section of the Activity Plan.
4. Set out student guidebooks to be distributed when directed to by the instructions.
5. Open PowerPoint.

Activity Procedures

INTRODUCTION: This part of the activity will introduce students to the Junior STEM Challenge and will introduce students to the theme of the mini-challenge.	
TIME REQUIRED: 10 minutes	
What the Teacher Does	Anticipated Student Behaviors/Responses
1. Tell students to sit with a partner or in a group of 3-4.	1. Students will sit with a partner or group. .
2. Introduce the Junior STEM Challenge as a fun, engineering challenge that students will be participating in this school year. Then distribute the Junior STEM Challenge Student Guidebook to all students.	2. Students will listen and receive their. Student Guidebook.
3. Ask students to print their name on the cover of their guidebook.	3. Students will follow instructions and will clearly and legibly write their names on the front of their guidebook.
4. Tell students that to get ready for the Junior STEM Challenge, they will be doing a mini-version of the challenge in class.	4. Students will listen.
5. Ask students the following questions: Q1: What are some examples of challenges? Give me at least one example of something that is a “challenge.” Q2: What might it mean to complete an engineering challenge? Select several students to share their answers to each question.	5. Selected students will answer each question. R1: Student answers may vary. For example: Some video games have challenges, or puzzles, you have to complete. The puzzles in Legend of Zelda games usually take me several tries. R2: An engineering challenge would be a challenge where people are given a hard problem to solve and will have to engineer a solution to that problem.
6. Tell students that in the Junior STEM Challenge they will have to make several different things: A solution to a Junior STEM Challenge problem A display, like a poster A digital or physical model of your solution An Engineering Notebook with pictures that shows you making your model, each with a short description	6-7. Students will listen.
7. Tell students that for their mini-challenge, they will be working to solve one problem: How do we make a building that can deal with one of the weather or natural disasters in Miami?	

8. Ask students to raise their hands and identify some of the different weather or natural disaster problems they may have experienced in Miami. If students are not in Miami or in Florida, ask them to think about the natural disasters they may experience in their home city or state. As students raise their hands, call on them to share their answers and write the responses in a central location that is easily visible. This could be a whiteboard, smartboard, large post-it, or another location.	8. Students will raise their hands to share some of the weather conditions and natural disasters that can be experienced in Miami. Students may draw on their personal experiences to answer the question.
9. Ask students the following questions: Q1: The problem was only about weather and natural disasters. Why were we able to give so many different answers? Select several students to share their answers.	9. Selected students will answer each question. R1: We were able to give so many different answers because the problem was really big and could have many different responses.
10. Tell students that just like the problem of weather and natural disasters, the problems in the Junior STEM Challenge are big and can go many different directions. This means that everyone can work on completely different projects.	10. Students will listen.

BODY OF THE ACTIVITY: *In this part of the activity, students will engage with a mini-challenge, designing a solution and creating a model and Engineering Notebook, before reflecting on the process in the next section of the activity.*

TIME REQUIRED: 45 minutes

What the Teacher Does	Anticipated Student Behaviors/Responses
1. Tell students that each group is going to try to solve the problem in a different way by focusing on different weather or natural disasters. If any of the weather phenomena or natural disasters below were identified by students, circle them on the whiteboard, smartboard, large post-it, or other location. Otherwise, add the weather phenomena or natural disaster to the easily visible location. Selected Weather and Natural Disasters: - Hurricanes - Sea Level Rise - Extreme Heat	1. Students will listen.
2. Tell students to open their guidebook to page 12 and assign each group one of the three problems. Tell students to read the information in their guidebook about their problem to prepare to design a building for the mini-challenge.	2. Students will open their guidebooks and turn to page 12. Once each partner pair or group has been assigned a weather phenomena or natural disaster, students will read the associated information in their guidebook.
3. Tell students that while this page of information has the basics, it does not have everything they might want to know.	3. Students will listen.

4. Tell students to write down at least five more things they would like to know about their problem in their Student Guidebook. These can be about the problem or about building design. If students are having trouble coming up with five topics, suggest that they write down five questions instead.	4. Students will work with their group to identify five more pieces of information or questions related to their topic.
5. If there is enough time in class, give students time to research the items on their list. Students can do their research using a personal device or computer. If students are doing research using their personal device or computer, lead a short discussion on AI with your students. Ask students the following questions: Q1: Do you think it is okay to use Artificial Intelligence (AI) to learn about your problem? Why or why not? Q2: Can you use AI as your only source? Why or why not? Select several students to share their answers to each question.	5. Selected students will answer each question. R1: It is okay to learn about AI to learn about your problem because it can do a good job summarizing information. R2: No, AI cannot be your only source. This is because AI can provide misinformation, so you need other sources to make sure you have the correct information.
6. Tell students that now that they have done the “research” part of their mini-challenge, they will begin to create their solution: a building that can deal with their problem. However, before they begin to design their building, they need to figure out who their stakeholders are. Q1: Why do we need to know who our stakeholders are when designing our buildings? Q2: Who are our stakeholders for these buildings? Select several students to share their answers to each question. After students have answered question 2, tell students to write their stakeholder in the blank space under “Stakeholders” in their guidebook.	6. Selected students will answer each question. R1: We need to know who our stakeholders are because they will be affected by our decisions. This could be positive or negative. R2: Student answers will vary. For example: Our stakeholders are residents of Miami, construction workers, landscaping companies, architecture firms, and climate scientists.
7. Tell students that now that they know their stakeholders, they should use the directions in their guidebook to brainstorm a building that can deal with their problem. In their brainstorming, students will need to identify the characteristics or parts their building will need and sketch their building. Give students approximately 10 minutes for this step.	7. Students will follow the directions in their guidebook to brainstorm and design a building that resists the weather or natural disaster they were assigned.
8. The next part of this activity can have students model their building design physically or digitally. Physical Model: If students creating their models physically, provide students with resources to build their models. These resources can be any items you have around your classroom, including paper, cardboard, wire, pipe cleaners, tape, clay, etc. Pass out one set of materials to each group or partner pair. Digital Model: If students are creating their models digitally, make sure that each group or partner pair has access to at least one computer. Tell students to navigate to tinkercad.com.	8. Students will receive their physical materials or grab a laptop to share with their small groups or partner. Students creating a digital model will navigate to tinkercad.com.

9. As they create their model, they will need to record what they are doing in their Engineering Notebook. Tell students that for the mini-challenge, they just need to write a few short sentences about what they are doing to build their model, including any problems they had to fix. For the real Junior STEM Challenge, students will also have to take pictures or screenshots of their model as they build it.	9. Students will listen.
10. Tell students that they have 15-20 minutes to create their physical or digital model while creating their Engineering Notebook. Digital Model: Students will need to 'Sign in' and enter the class code you received when you created your class during the set-up procedure. They will enter the class code in the space provided under the 'Students with Class Code' button.	10. Students will work in their groups or with their partner to create a model based on their sketch that uses the design considerations they identified while brainstorming.
11. After students have created their models, tell students to quickly present their model to the rest of the class. The presentations need to include the problem students were addressing and their design considerations. Presentations should only be 1-2 minutes.	11. Students will show and describe their model in front of the class.

CONCLUSION: *In this part of the activity, students will start the Junior STEM Challenge by forming groups and selecting a prompt.*

TIME REQUIRED: 5 minutes

What the Teacher Does	Anticipated Student Behaviors/Responses
1. Tell students that they will be following the same basic process when doing the Junior STEM Challenge. They will be picking a problem, doing research, identifying their stakeholders, designing a solution, creating a model and Engineering Notebook, and creating a display.	1. Students will listen.
2. Ask students the following questions: Q1: Why is it important to keep an Engineering Notebook? Q2: Why do you think I asked you to present your model? Q3: Does anyone have any questions about the Junior STEM Challenge process or any of the things you need to make for the STEM Challenge? Select several students to share their answers to questions 1-2. Answer all student questions for question 3.	2. Selected students will answer each question. R1: The Engineering Notebook shows our work process, that we have fixed our mistakes, and that we created the model ourselves. R2: We presented our model because we will have to present our projects during the Junior STEM Challenge. R3: Student questions will vary.
3. Tell students to turn to page 7 and read the Junior STEM Challenge theme and prompts quietly to themselves or select several students to read them out loud for the class. Students can either pick their prompt or be assigned a prompt. If students are required to work on one prompt, let them know at this time.	3. Selected students will read the Junior STEM Challenge theme and prompts out loud for the class.

4. Tell students to take another look at the prompts and ask students the following questions: Q1: Why do you think the Junior STEM Challenge problems are so big? Think back to the buildings you all designed during the mini-challenge. Select several students to share their answers to the question.	4. Selected students will answer the question. R1: The problems are big so we can make a lot of different solutions, just like how we all made different buildings even though we had the same problem for the mini-challenge.
5. Tell students to find a group of 2-4 and pick a prompt. While working with friends can be fun, students need to make sure that they can work well together. As a group, they should pick their favorite prompt or the prompt they find the most interesting for the Junior STEM Challenge project. Monitor group formation to make sure students form productive groups. To optionally facilitate group formation, assign one prompt to each corner of the room. Direct students to stand in the corner of the room assigned the prompt of their choice. Students should then form groups with other students that are standing in the same corner as them.	5. Students will find a group and pick a Junior STEM Challenge prompt.
6. If time allows, tell students to begin researching their prompt.	6. Students will begin their research.

Notes/Considerations

Students should be allowed to ask clarifying questions at any time during the lesson.

As any groups formed by students are set for the duration of the STEM Challenge, it is important to ensure that all group members can be productive and work as a team in their designated group. If you identify any groups that may be unproductive or have an elevated risk for conflict, you should adjust student groups.



What else would you like to know about your problem? These can be questions or topics.

Stakeholders: Who are the stakeholders for your project? Who are you designing your building for and who would care about your building?

Brainstorm: What should your building have?

**Brainstorm:** Draw your building

Engineering Notebook: Write down what you did to create your model, including what you did during each step of the process and any mistakes you made and later had to fix. For the Junior STEM Challenge, you will also have to take pictures or make screenshots of your model during each step.



Junior STEM Challenge Planner

AUGUST

SEPTEMBER

OCTOBER

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

OCTOBER

NOVEMBER

DECEMBER

JANUARY

MON	TUE	WED	THU	FRI
19	20	21	22	23
26	27	28	29	30
NOV. 2	3	4	5	6
9	10	11	12	13
16	17	18	19	20
23	24	25	26	27
30	DEC. 1	2	3	4
7	8	9	10	11
14	15	16	17	18
JAN. 4, 2027	5	6	7	8
11	12	13	14	15
Legal holiday	M-DCPS Teacher planning day, professional learning day or recess day.			

JANUARY

FEBRUARY

MARCH

MON	TUE	WED	THU	FRI
18	19	20	21	22
25	26	27	28	29
FEB.1	2	3	4	5
8	9	10	11	12
15	16	17	18	19
22	23	24	25	26
MAR. 1	2	3	4	5
8	9	10	11	12
15	16	17	18	19
22	23	24	25	26
29	30	31	APRIL 1	2
Project Submissions				
Legal holiday M-DCPS Teacher planning day, professional learning day or recess day.				



APRIL

MON	TUE	WED	THU	FRI
5	6	7	8	9
12	13	14	15	16
19	20	21	22	23
26	27	28	29	30

MAY

MAY 1	STEM CHALLENGE EXPO AT FROST SCIENCE			
Legal holiday	M-DCPS Teacher planning day, professional learning day or recess day.			

Dinosaur Drama: Activity 2

Overview

In this activity, students will solve a “Dinosaur Heist” by analyzing and synthesizing information from multiple sources. In the process, students will learn how to identify reputable sources and how to compile potentially conflicting information. After completing this activity, students will be able to identify reliable sources for their STEM Challenge.

Objectives

By the end of this activity, students will be able to:

- Define the terms reliable and unreliable.
- Describe the characteristics of reliable and unreliable sources.
- Identify reliable and unreliable sources.
- Read and synthesize information from multiple sources.

Key Messages

- Reliable sources will provide detailed information, present facts, clearly identify opinions, and be consistent.
- Unreliable sources often present opinions as facts, provide incorrect information, sensationalize content, and will have conflicting information.

Time Needed: 45 minutes

Standards

NGSSS Gifted Learners Benchmarks

G.K12.4.1.2a, Multiple Perspectives - Know: Acknowledge diverse viewpoints of a problem.

G.K12.4.1.2b, Multiple Perspectives - Understand: Compare and contrast multiple perspectives of a problem.

G.K12.4.2.3a, Critical Thinking-Know: Distinguish between fact and opinion in a variety of sources.

G.K12.4.2.3b, Critical Thinking - Understand: Recognize bias and value statements in a variety of media.

G.K12.4.3.1b, Evaluation - Understand: Analyze the impacts of existing knowledge and attitudes; identify personal assumptions and blind spots in approaching the problem.

G.K12.4.3.1c, Evaluation - Perform: Identify knowledge gaps and inconsistencies to challenge existing attitudes and beliefs.

G.K12.4.3.1d, Evaluation - Accomplish: Use multiple sources to affect change in generally accepted knowledge and attitudes.

Background Information

Reliable and Unreliable Sources

Sources can be split into two general categories: reliable and unreliable sources. Reliable sources are trustworthy and typically come from reputable organizations. Unreliable sources often present biased or unverified information as fact. When selecting sources for the Junior STEM Challenge or any other activity requiring research, students must be able to distinguish between reliable and unreliable sources for their information.

Reliable sources come from trustworthy organizations or experts who have a proven track record for providing accurate, unbiased information. These sources can also be recognized through their reliable grammar and spelling, citing their sources,

clearly identifying opinions, and providing consistent information.

Unreliable sources come from organizations without a proven track record or individuals without credentials. These sources can be recognized through unreliable grammar and spelling, not identifying the sources of their information, presenting opinions as facts, and providing vague or inconsistent information.

Synthesizing Information

While reliable sources provide accurate and consistent information, they still may provide different information or different perspectives on a topic. This information then needs to be compiled and synthesized into a broader understanding of the information presented.

In the Junior STEM Challenge, students will be referencing a wide variety of different sources and will need to take what they learn from each source to build their understanding of their problem and develop a solution. Without being able to recognize reliable sources and synthesize information, students will struggle to understand their prompt and develop realistic solutions that consider real-world constraints and data.

Materials (per student)

- Student Guidebook – 1 per student
- Pencil – 1 per student
- Green and Red Colored Pencils/Markers/Highlighters – 1 per group

Set-Up Procedure

1. Make sure that students have access to their student guidebooks.
2. Prepare a set of green and red color pencils or markers for each group.
3. Open PowerPoint.

Activity Procedures

INTRODUCTION: Students will discuss the importance of having reliable sources and will identify some of the common traits of “reliable” and “unreliable” sources.	
TIME REQUIRED: 8 minutes	
What the Teacher Does	Anticipated Student Behaviors/Responses
1. Tell students to sit with their Junior STEM Challenge groups and open their student guidebooks to the “Dinosaur Drama” student activity sheet on page 17 .	1. Students will sit with their group members for the Junior STEM Challenge and open their student guidebooks to the “Dinosaur Drama” student activity sheet.
2. Tell students that in the Junior STEM Challenge, it is important for groups to use reliable sources. Ask students the following questions: Q1: Imagine you are doing a school project about the planet Jupiter. What do you do to learn about the planet? Q2: How do you find these sources? Q3: Have you ever read two sources that said completely different things? Like one source says Jupiter is the third planet from the Sun and another source says Jupiter is the fifth planet from the Sun. Q4: If you have two sources that say completely different things, how do you figure out which source is telling the truth? Select several students to share their answers to each question.	2. Selected students will answer each question. R1: I use sources to get information about the planet Jupiter to make sure I have the right information. R2: I find sources by using key words in a search engine. Then, I look through the results to find sources that I think would give me the information I need. R3: Student answers may vary, but most students should say “yes.” R4: Student answers may vary. Example: I look at the sources to see which one is from a place I trust. I would trust information from websites like Britannica more than websites like Wikipedia.

3. Tell students that there are a few different ways to figure out if a source is “reliable” or “unreliable.” Tell students to create a list of “reliable” and “unreliable” traits in their Student Guidebook. These should be things that help students figure out if a source is “reliable” or “unreliable.” Give students 4 minutes to create their lists. As students make a list in their guidebooks, circulate the classroom to identify the most common responses.	3. Students will listen and create a list of “reliable” and “unreliable” traits for sources in their Student Guidebook. <table border="1" data-bbox="824 233 1468 806"> <thead> <tr> <th>Reliable Traits</th><th>Unreliable Traits</th></tr> </thead> <tbody> <tr> <td>Facts</td><td>Opinions</td></tr> <tr> <td>Proof (Says where they got the information)</td><td>No Proof</td></tr> <tr> <td>Trusted Source (Knows the name of the organization and that they do reliable work)</td><td>Untrusted Source (Knows the name of the organization and that they make things up)</td></tr> <tr> <td>No Bias (Tells both sides of the story, does not have a “reliable” or “unreliable” guy)</td><td>Biased (Only tells one side of the story)</td></tr> <tr> <td>Explains Information</td><td>Does Not Explain Information</td></tr> <tr> <td>Good Grammar and Spelling</td><td>Bad Grammar and Spelling</td></tr> </tbody> </table>	Reliable Traits	Unreliable Traits	Facts	Opinions	Proof (Says where they got the information)	No Proof	Trusted Source (Knows the name of the organization and that they do reliable work)	Untrusted Source (Knows the name of the organization and that they make things up)	No Bias (Tells both sides of the story, does not have a “reliable” or “unreliable” guy)	Biased (Only tells one side of the story)	Explains Information	Does Not Explain Information	Good Grammar and Spelling	Bad Grammar and Spelling
Reliable Traits	Unreliable Traits														
Facts	Opinions														
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Explains Information	Does Not Explain Information														
Good Grammar and Spelling	Bad Grammar and Spelling														
4. Ask students to share the traits they listed in their Student Guidebook. As students share each “reliable” and “unreliable” trait, write the traits in an easily visible location to create a cumulative list of all the traits identified by students. Encourage students to create “paired” traits. For example, if one student says that “reliable” sources always have facts, students should be able to identify that “unreliable” sources often share opinions as factual or true without providing supporting evidence. If students do discuss opinions, make sure that students do not frame opinions as a trait of an “unreliable” source, as opinions can still help provide much-needed perspectives on a topic. When discussing opinions, students must specifically identify that presenting “opinions as facts without supporting evidence” can be a trait of an “unreliable” source. As students create the cumulative list of “reliable” and “unreliable” traits, they should add any that they have not already identified to the list of traits in their guidebook.	4. Students will share and add onto the list of traits they created in their Student Guidebooks.														
5. Ask students the following questions: Q1: Can “reliable” sources ever have “unreliable” traits? Why? Q2: What about “unreliable” sources? Can “unreliable” sources ever have “reliable” traits? Why? Q3: Can a source be somewhere in between? Not “reliable,” but not “unreliable?” Q4: Why is it important to make sure you are only using “reliable” sources for the Junior STEM Challenge? What are the dangers of using a “unreliable” source? Select several students to share their answers to each question.	5. Selected students will answer each question. R1: “Reliable” sources should not have any “unreliable” traits. If a source has one “unreliable” trait, then additional sources need to be used to confirm information. R2: “Unreliable” sources might sometimes have “reliable” traits. The author of a “reliable” source might have made a mistake, or the author could have included “reliable” traits to confuse the reader. R3: Yes, a source can be somewhere between a “reliable” and “unreliable” source. Some parts of the source might be useful even if it is not a fully “reliable” source. R4: If we only use “reliable” sources, we know that our solution is built on reliable information and is more likely to work. If we use “unreliable” sources, our solution might be built on misinformation and the solution may not work.														

BODY OF THE ACTIVITY: *In this part of the activity, students will annotate several sources to solve a mystery, identifying each source as “reliable,” “mixed,” or “unreliable.”*

TIME REQUIRED: 30 minutes

What the Teacher Does	Anticipated Student Behaviors/Responses
1. Tell students that now that they know how to tell a “reliable” source from a “unreliable” source, they need to use what they have learned to solve a mystery. Recently, a <i>T. rex</i> was stolen as it was being moved from Montana to the “Ash Science Center” in Florida. Tell students that they have 8 different sources of information in their Student Guidebook. Each source will give them a different piece of the puzzle. To solve the mystery, they will have to work with their group to read each source, figure out if it is a “reliable” source, a “unreliable” source, or somewhere in-between, and use their critical thinking skills to figure out what happened! Note: While this is a fictional scenario, it is based on real challenges faced by paleontologists.	1-3. Students will listen and distribute the sources among their group members.
2. Tell students to split up the sources among their group members so that no one has to read all eight sources. Pass out red and green pencils/markers/highlighters to each group.	
3. Tell students to circle any “reliable” traits they notice in the sources in green and circle any “unreliable” traits they notice using red. Students should take notes and annotate as they go. Define the term annotation for students as notes that help explain something they notice in the text. Give students the following example of a simple annotation: They can circle opinions in red and label each of them as an “opinion.” Optional: Tell each group to create a timeline of the situation.	
4. Give students 20 minutes to read and annotate their sources. While students read and annotate their sources, they should talk with each other to share what they learned from their sources. Circulate the classroom as students read their sources and listen to student conversations. If students are talking about one of the “unreliable” or “mixed” sources as if they were a “reliable” source, remind students to look for “reliable” and “unreliable” traits in each source. Provide feedback as needed if you see a group coming to an incorrect conclusion.	4. Students will work with their group to read each source, circle and label “reliable” and “unreliable” traits and solve the mystery.
5. After students have had a chance to read all their sources and solve the mystery, tell students to place each source on the S to F tier list in their Student Guidebook, with S tier being very strong sources and F tier being weak sources. Tell students to take 2 minutes to rank their sources using the tier list.	5. Students will listen to the teacher and discuss each source in their group to determine their ranking in the tier list.

6. Have the class vote on each source one at a time. To do this, identify the source (e.g. Source 1, Source 2, etc.) and state each tier (e.g. S tier, A tier, etc.), asking students to raise their hands to vote.

If students do not all agree on the same tier for a source, ask students in each group to explain why they voted the way they did. Student answers may vary slightly, so discussions should focus on difference between high tiers (S and A tier), mid-tiers (B and C tier), and low tiers (D and F tier). For example, if all students agree that Source 1 is B or C tier and have identified most of the evidence contained in the Teacher Key, move on to the next source. If students think that Source 1 is tier A or tier D, continue discussions until all students identify Source one as tier B or C.

If all groups are missing a key piece of evidence identified in the Teacher Key for a source, share this piece of evidence with the class. Once every group has had a chance to explain their answer, hold a re-vote.

Source Key:

Source 1: Mid-tier (Tier B or C)

Source 2: Mid-tier (Tier B or C)

Source 3: High tier (Tier S or A)

Source 4: Low tier (Tier D or F)

Source 5: High tier (Tier S or A)

Source 6: High tier (Tier S or A)

Source 7: Mid-tier (Tier B or C)

Source 8: "Low tier (Tier D or F)

6. Students will vote on each source and explain their votes as needed.

7. Ask students the following questions:

Q1: What happened? Who stole the dinosaur?

Q2: Who were the stakeholders in this situation and why are they considered stakeholders?

Q3: What information were you able to learn from the mid-tier or low tier sources?

Q4: What's one mid-tier or low tier source that gave you very important information?

Q5: Social media is usually an unreliable source. Why?

Q6: Social media is often used to share opinions. Why can opinions be important?

Q7: Along with opinions, social media can also share information that would not be contained in a news article. What did you learn from social media and how was it used to help you solve the mystery?

Q8: What would the police need to do to make an arrest?

Select several students to share their answers to each question.

7. Selected students will answer each question.

R1: John McGuire stole the dinosaur. He already wanted to own the *T. rex* skull, but when he lost the lawsuit (if he won the lawsuit, the complete fossil would not have been shipped to Ash Science Center) and went bankrupt, it pushed him to steal the dinosaur and illegally sell it for money.

R2: The stakeholders were Ash Science Center, John McGuire, and Star Ranch as they all could claim ownership of part of the *T. rex*. ForgePoint Heavy Movers and Cedar Ridge Rest Stop could also be considered stakeholders after they were impacted by the theft of the *T. rex*.

R3: We learned about the relationships between some of the individuals, like the relationship between Star Ranch and John McGuire.

R4: *Student answers may vary, but students should identify social media in their answers.*

R5: Most of the posts on social media are opinions that are not backed up by a "reliable" source. Social media is great at spreading misinformation.

R6: The opinions shared on social media are often based on lived experience and can be used to learn about how a stakeholder may feel about a project, law, etc.

R7: The social media feed showed us that Star Ranch found their bull, so they no longer had a reason to be mad at Ash Science Center. Social media also showed that John McGuire was going bankrupt, but right after the fossil was stolen, he was no longer going bankrupt and had enough money for expensive cars and a new mansion.

R8: The police should look into where John McGuire suddenly got all his money!

CONCLUSION: In this part of the activity, students will practice summarizing information before working on finding sources for their Junior STEM Challenge projects.

TIME REQUIRED: 7 minutes

What the Teacher Does	Anticipated Student Behaviors/Responses
1. After students review their sources as a class, ask students to write a summary that describes what happened and who stole the fossil. This summary should include all of the information they learned from each source. This summary only needs to talk about the information related to John McGuire. A full and complete summary will include all of the following information: • Part of the <i>T. rex</i>'s cranium was found on John McGuire's land. • John McGuire agreed to let Ash Science Center keep the fossil so that he could get a tax break. • John McGuire changed his mind and decided he wanted the fossil and sued Ash Science Center to try and get ownership. • John McGuire lost the lawsuit. • John McGuire's business, Prairie Stacks, was struggling and he started to go bankrupt. • John McGuire dropped his pen while stealing the fossil. • John McGuire illegally sold the fossil. • John McGuire used the money to save his business, buy a fancy car, and build a new mansion. He posted all of this on social media. Circulate the classroom and review student summaries. As you read student summaries, look for any information or evidence that students may have skipped. If students are missing any information, ask students "how they know" or "what else did you learn from Source...?" Teachers may provide additional requirements for the summary, including length requirements, requiring paragraph format or bullet points, etc.	1. Students will work in their groups to summarize what happened using what they learned from each source.
2. Ask students the following questions: Q1: What is your biggest takeaway from what you learned today? Q2: What was the hardest part of figuring out if a source was "reliable" or "unreliable?" Were there any "unreliable" traits that you missed when looking at a source? Q3: How can you take what you learned and apply it to your Junior STEM Challenge project? Select several students to share their answers to each question.	2. Selected students will answer each question. R1: Student answers may vary. For example: It can be easy to accidentally accept opinions as facts when they come from a source that looks official. R2: Student answers may vary. For example: It was easy to miss some of the grammar problems, like where <i>T. rex</i> was not italicized. R3: It is extremely important to go through and make sure that we are reading our sources carefully so that we are only using "reliable" sources. Some "unreliable" sources look reliable unless you pay very close attention.

3. Tell students to go back to the list of traits they created at the beginning of the activity and add any additional reliable and unreliable traits they noticed during the activity. Tell students that they should use this list of traits as a checklist when finding “reliable” sources for their Junior STEM Challenge project. Circulate the room and look at student answers. Share student additions with the rest of the class.	3. Students will add traits to their checklist.
4. If students have started their research: Tell students that now that they know more about how to identify “reliable” sources, they should look at all the sources they are using for the Junior STEM Challenge. If they have any sources that are “unreliable” or “mixed,” they should find a new source. If students have not started their research: Tell students that now that they know more about how to identify “reliable” sources, they should begin to look for “reliable” sources for their Junior STEM Challenge project. Remind students that for everything they present as part of their background information, they should have a source. Also, if they have any questions about whether a source is reliable or unreliable, they should look and see if the source is giving them facts or opinions. If they still are not sure, you can always ask for help.	4. Students will work on finding sources for the Junior STEM Challenge projects.

Notes/Considerations

Students should be allowed to ask clarifying questions at any time during the lesson.

This optional activity can be taught in part or in full to adjust for different class lengths. If the activity is too long for a designated class period, the activity can be taught in several sections over the course of a few class periods.

If you have more than 45 minutes to complete this activity, give students more time to annotate each source.

Activity 2

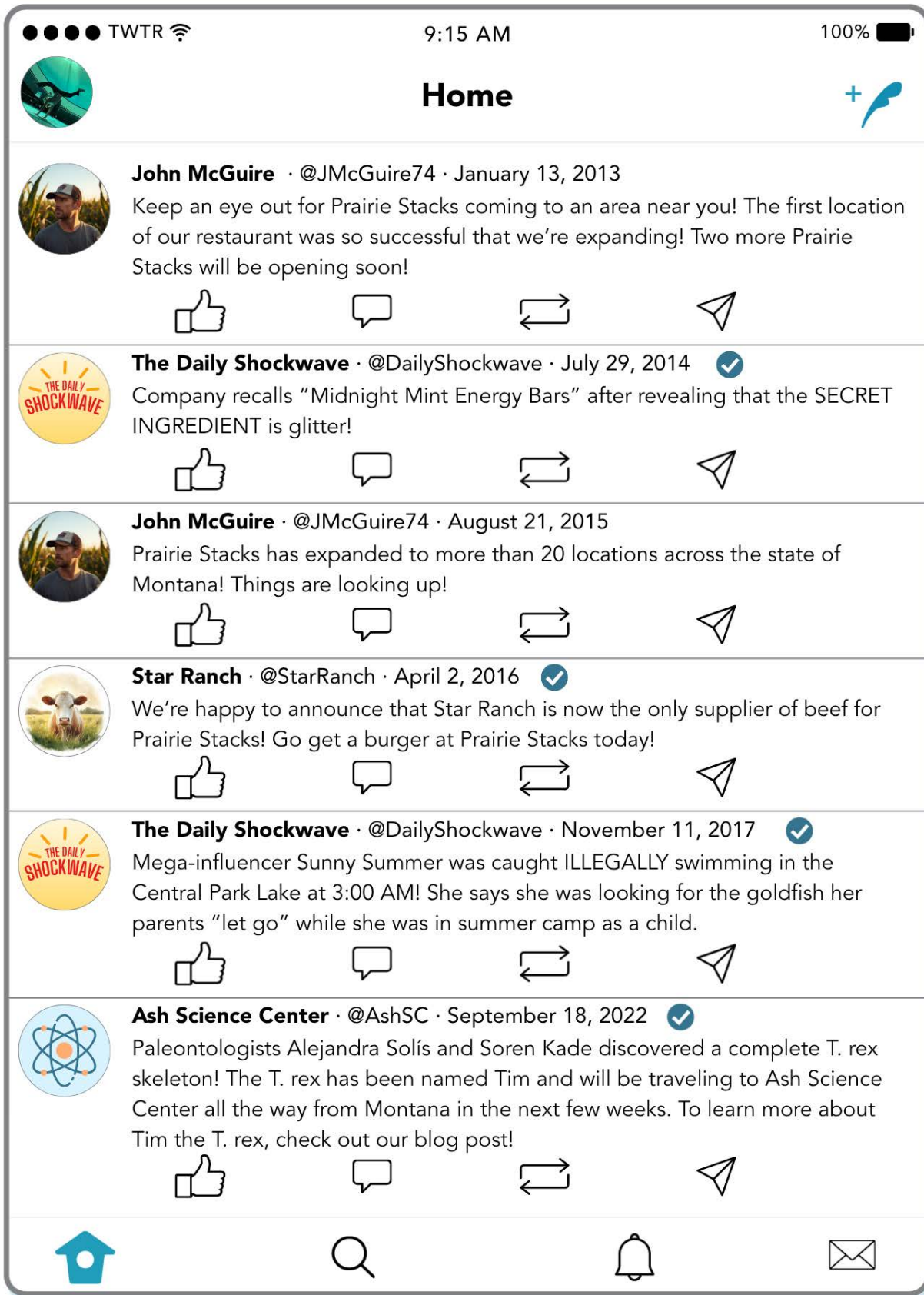
Dinosaur Drama

Create a list of traits that you can use to help identify a “reliable” and “unreliable” source using the table. At the end of the activity, you will add onto this list. Use this list as a checklist when looking for sources for your Junior STEM Challenge.

Reliable Traits		Unreliable Traits	
☐		☐	
☐		☐	
☐		☐	
☐		☐	
☐		☐	
☐		☐	
☐		☐	
☐		☐	
☐		☐	

After reading all eight sources, rank the sources in the tier list below:

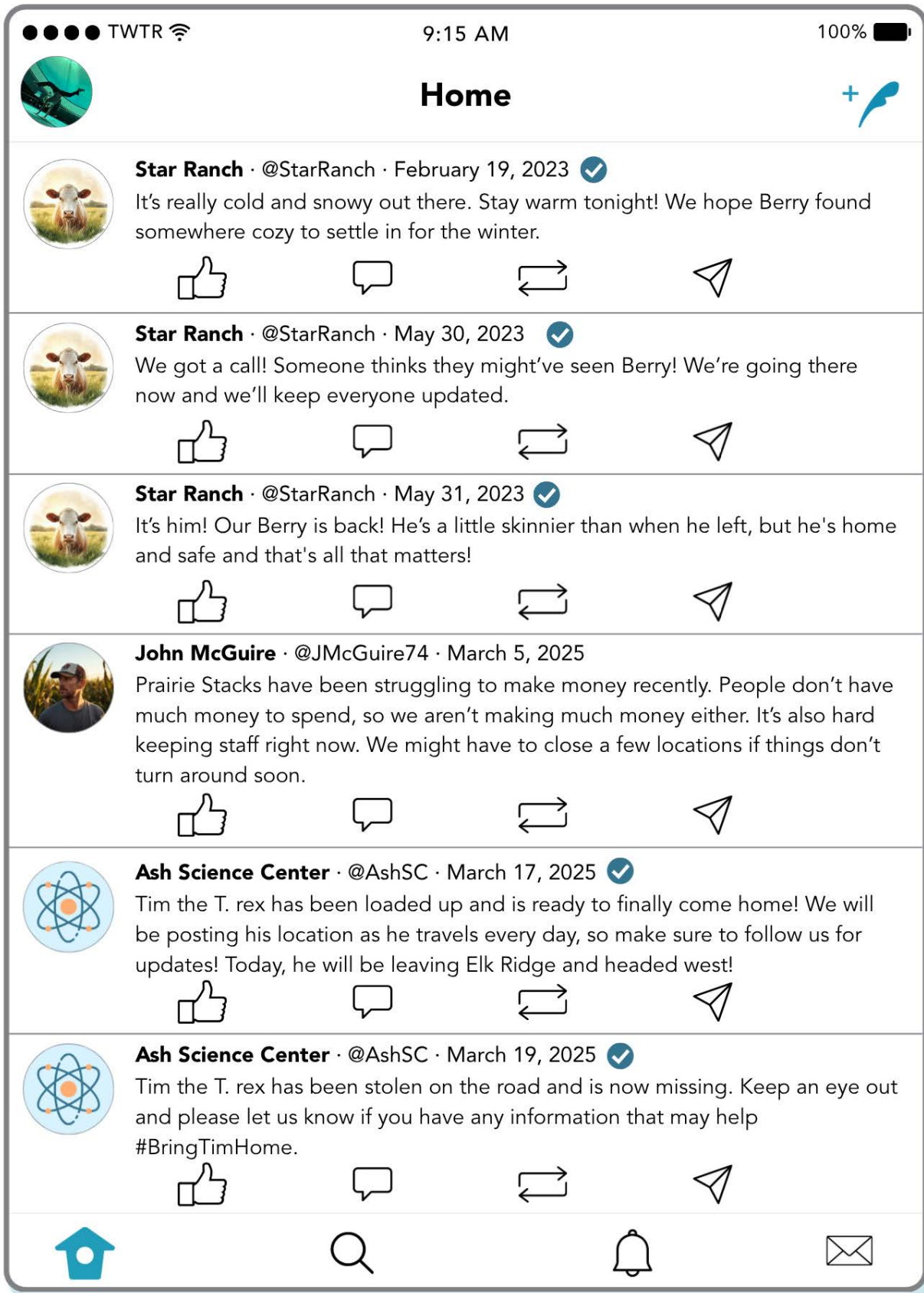
Tier		Sources
	S	
	A	
	B	
	C	
	D	
	F	



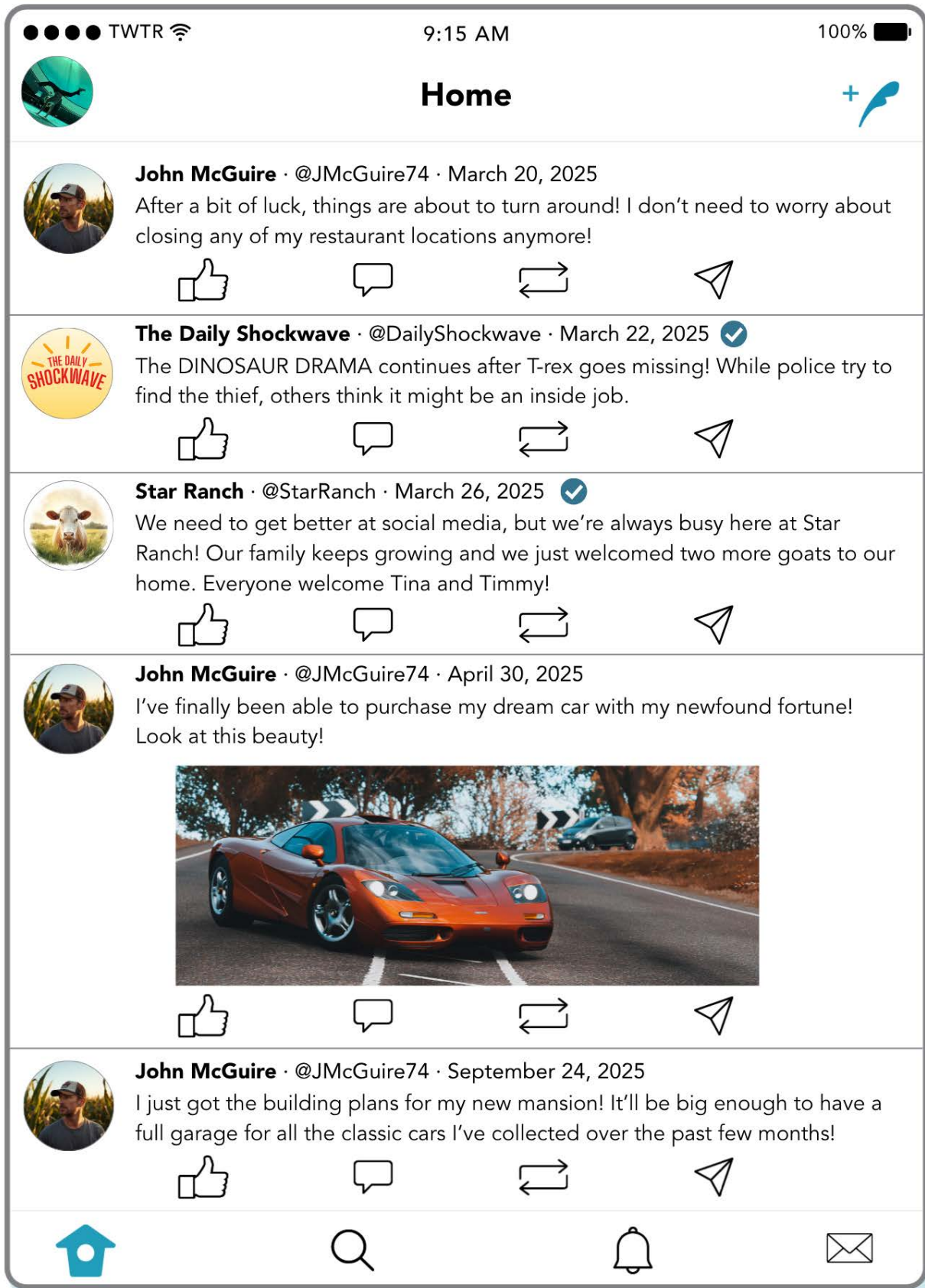
Source 1



Source 1



Source 1



Source 1



KTRK 8 – Trail Rock News Network



Aired March 18, 2025 - 10:30 AM MT

THIS IS A TRANSCRIPT. THE TEXT COPY MAY CHANGE.

[10:30:00]

EMILY CHEN, NEWS ANCHOR, KTRK 8: Breaking news, live from Elk Ridge. A whole dinosaur has gone missing after being stolen late last night. I am here with Bill Rutford from ForgePoint Heavy Movers and Samantha Hill from Cedar Ridge Rest Stop, the scene of the crime. Bill, what happened?

BILL RUTFORD, TRUCK DRIVER, FORGEPOINT HEAVY MOVERS: ForgePoint was in charge of moving the dinosaur from Elk Ridge to Sunnyside Harbor in Florida. We parked at Cedar Ridge for the night and when we woke up this morning and checked our trucks, we noticed that the back of the trucks were all open.

CHEN: And the dinosaur was gone?

RUTFORD: And the dinosaur was gone.

CHEN: How do you think the back of the trucks were opened?

RUTFORD: We had pretty big locks on our trucks. The locks were cut.

CHEN: What did you do when you noticed?

RUTFORD: We panicked. We weren't sure what to do because we've seen nothing like this before. That thing was huge and heavy and was in over ten parts. My truck had four and one of them was over a ton.

[10:35:00]

CHEN: And Samantha, you're the manager at Cedar Ridge Rest Stop. Were the cameras at Cedar Ridge able to catch anything?

Source 2



KTRK 8 – Trail Rock News Network



SAMANTHA HILL, MANAGER, CEDAR RIDGE REST STOP: No, they weren't. The trucks were in the back of our parking lot --

RUTFORD: In the spots set aside for big trucks --

HILL: And there isn't much light back there. Plus, the back of the lot is far from the cameras and the back of the trucks were facing away from the rest stop, so even if the cameras could see that part of the parking lot the trucks would've blocked the view.

CHEN: Why do you think someone would have done this? Why steal a dinosaur?

RUTFORD: I don't know, but they must've planned it. The locks were cut by someone who knew what they were doing. They didn't leave anything behind either.

HILL: They did damage some of our property though. The highway's nearby, but they had to go over our grass to get to the back of the trucks. They must've used heavy equipment because the grass is all torn up.

CHEN: That's unfortunate. Looks like the thief caused problems for everyone, from ForgePoint Heavy Movers to Cedar Ridge Rest Stop. Up next, we'll be speaking with the paleontologist responsible for finding the dinosaur. Stay tuned.

(COMMERCIAL BREAK)

[10:45:00]

CHEN: We have Alejandra Solís on the line from Ash Science Center. She's the person who found the dinosaur. Alejandra, why do you think someone would do this?

Source 2



KTRK 8 – Trail Rock News Network



ALEJANDRA SOLÍS, CURATOR OF PALEONTOLOGY, ASH SCIENCE CENTER: Believe it or not, but people try to steal dinosaurs all the time. This is just the first time it's happened to us. People steal dinosaurs for lots of reasons, but the most common one is probably easy to guess --

CHEN: Money?

SOLÍS: Yep, it's money. And the nicer the dinosaur the more money someone would be able to get for it when they sell it illegally. It's hard to do that in the U.S., so lots of people end up trying to smuggle dinosaurs out of the country before selling them. You can imagine for a whole T. rex, people would be able to get a lot of money by selling it.

[10:50:00]

CHEN: How much would the T. rex be worth?

SOLÍS: We haven't prepared the T. rex yet, so it's still covered in rock so it's hard to give an exact amount, but if everything looks good, it should be worth several million dollars. Whole T. rex skeletons have been sold from 5 to over 30 million dollars before on auction.

CHEN: Wow! That's a lot of money! Hopefully they find the dino before it gets sold.

SOLÍS: Yes, it would be much harder to find our T. rex once it's been sold. Fossils in private collections can be really hard to find and track.

CHEN: Then let's keep our fingers crossed. Thank you for talking with us today, Alejandra. We'll be right back for more morning news after this quick break.

Source 2



ELK RIDGE POLICE DEPARTMENT REPORT

Case No.:

3	4	6	6	3	7	2	6	2
---	---	---	---	---	---	---	---	---

 Date:

0	3
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 /

1	8
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 /

2	0	2	5
---	---	---	---

Reporting Officer: Jane Sorenson

Time:

0	6
---	---

 :

0	9
---	---

^{AM}
PM

Detail of Event:

Location: [REDACTED] US-2, Chester, MT 59522

Incident Type: Property/vehicle damage, Theft

Describe the incident: A Tyrannosaurus rex being carried by three Freightliners was stolen sometime during between the hours of 10:26 PM and 06:09 AM on the night of 03/17/2025. The locks on each container were cut. Truck 1 was carrying 4 pieces, truck 2 was carrying 6 pieces, and truck 3 was carrying 5 pieces of the dinosaur. The grass behind the trucks had tracks that looked like they belonged to heavy machinery.

Injuries and Damages:

Were there any injuries? ☐ Yes ☒ No

Were there any damages? ☒ Yes ☐ No

Describe the injuries or damages: The locks on the back of the Freightliners were broken and can no longer be used. The grass and some nearby bushes on Cedar Ridge Rest Stop's property were torn up. Broken pieces of plaster were found near the back of the Freightliners where the dinosaur was broken was stolen.

Witnesses:

Were there any witnesses? ☒ Yes ☐ No

List the witnesses names and contact information:

ForgePoint Heavy Movers Drivers: Bill Rutford, (406) [REDACTED] - [REDACTED], Caleb Henderson, (406) [REDACTED] - [REDACTED],

Molly Whitaker, (406) [REDACTED] - [REDACTED]

Cedar Ridge Rest Stop Manager: Samathana Hill, (406) [REDACTED] - [REDACTED]

Actions Taken:

I talked with the witnesses from ForgePoint Heavy Movers to figure out what was stolen from the Freightliners and the manager from Cedar Ridge Rest Stop to learn about damages to the property. I put the cut locks in evidence bags and dusted the handles on the back of each container for fingerprints. I picked up the pieces of plaster found near the Freightliners put it in a second evidence bags. A pen engraved with "JM" was found 100 yards away in the grass and was placed in an evidence bag. The pen may or may not be related to the theft.

Source 3



LOCAL CRIME SPORTS CULTURE CELEBRITIES



Dinosaur 'Stolen' on the Road Raises Questions

March 2025 · By Leroy Wood



A tyrannosaurus rex went missing in Montana right after leaving for Ash Science Center. This is just the latest problem for the dinosaur, which has been in the middle of several legal battles over the last three years. The lawsuits were all settled peacefully, so what could have happened to the dinosaur? One insider thinks that the thief might be the shipping company.

ForgePoint Heavy Movers was hired by Ash Science Center to move the dinosaur all the way from Montana to Florida. After driving only a few miles, the truckers stopped at Cedar Ridge Rest Stop for the night. The truckers all parked in the very back of the parking lot with the back of their trucks near the busy highway. This area of the parking lot was also far from all the streetlamps, making it very dark, and was in a blind spot for Cedar Ridge Rest Stop's security cameras. In the middle of the night, the locks on each truck were smashed and the dinosaur was stolen.

Source 4



Our insider said that they had seen the truckers arguing earlier in the day after dropping part of the dinosaur while putting it into one of the trucks. While the container holding the dinosaur looked fine, it's hard to know if the fossil broke when it fell. Now, with the dinosaur missing and no way to check for damage, ForgePoint Heavy Movers can't get in trouble.

One staff member at Cedar Ridge Rest Stop said, **"We've had problems with ForgePoint before. The truckers always come in here and cause problems and I've caught them several times trying to take food, like granola bars and stuff, from the lobby without paying. I wouldn't be surprised if they tried to take other things too."**

While ForgePoint Heavy Movers has a reason to steal the dinosaur, police still do not know how the dinosaur was stolen or where the dinosaur is now. With such a big dinosaur, the biggest tyrannosaurus rex ever found in the United States, it can't stay missing forever. Hopefully, the missing dinosaur will be found soon.

ForgePoint Heavy Movers did not answer when asked to comment.

Source 4



Blog / Science News

ALL TOPICS HEALTH ENVIRONMENT ANIMALS SPACE GOVERNMENT

Meet Ash Science Center's Newest Team Member, Tim the T. rex

September 18, 2022

By Marcellus Reed, Collections Manager



Paleontologists from Ash Science Center just made the discovery of a lifetime! On their current paleontology trip to Elk Ridge, Montana, Alejandra Solís, Curator of Paleontology, and Soren Kade, Fossil Preparator, found a complete *Tyrannosaurus rex* fossil.

Finding a complete fossil does not happen every day and makes this find a big deal! Complete skeletons can teach us a lot about dinosaurs, where they lived, what they ate, and more. The more complete a fossil is, the more paleontologists are usually able to learn.

Source 5



After the fossil was uncovered by Solís and Kade, they dug a trench around the fossil and covered the fossil and matrix, the rock and dirt around the fossil, with burlap and plaster. Eventually, they dug all the way under the fossil, wrapping the whole fossil in a burlap and plaster jacket. The *Tyrannosaurus rex*, who they named “Tim,” was put in 15 jackets. Most of these jackets were small, weighing only about half a ton (~1,100 pounds). The largest fossilized bones needed to be put in biggest jackets, so Tim’s skull and hips were both put in jackets that weighed over one ton (~2,000 pounds). These jackets will protect Tim as it travels from Montana to Ash Science Center in Florida. The journey is over 4,023 kilometers (2,500 miles) and the jackets will be carried in three trucks.

Once Tim arrives at Ash Science Center, all of the jackets will be taken to storage and will be added to collections. After the paperwork is done and the Collections Manager, Marcellus Reed, has finished adding the jackets to collections, Reed will work with Solís and Kade to take one jacket from collections to the fossil preparation lab in Ash Science Center. Once the jacket is taken to the fossil preparation lab, the jacket will be opened and Kade will begin to uncover the rest of the fossil. Kade will then use chemicals to protect the fossil and help the fossil stay together. Hopefully, with the right chemicals and enough luck, Tim will one day be able to stand on his own.

Follow Ash Science Center’s social media to keep up to date on Tim’s progress as he travels from Elk Ridge, Montana to Sunnyside Harbor, Florida!



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November 11, 2022

The Continental Times

U.S. WORLD BUSINESS ARTS LIFESTYLE OPINION VIDEO AUDIO GAMES COOKING WIRECUTTER

Lawsuits Filed after Dinosaur Discovery

Two lawsuits have been filed against Ash Science Museum after they found a complete *Tyrannosaurus rex* fossil in Montana

By Jasper J. Thornwell

November 11, 2022, 11:11 AM EST | GIFT THIS ARTICLE

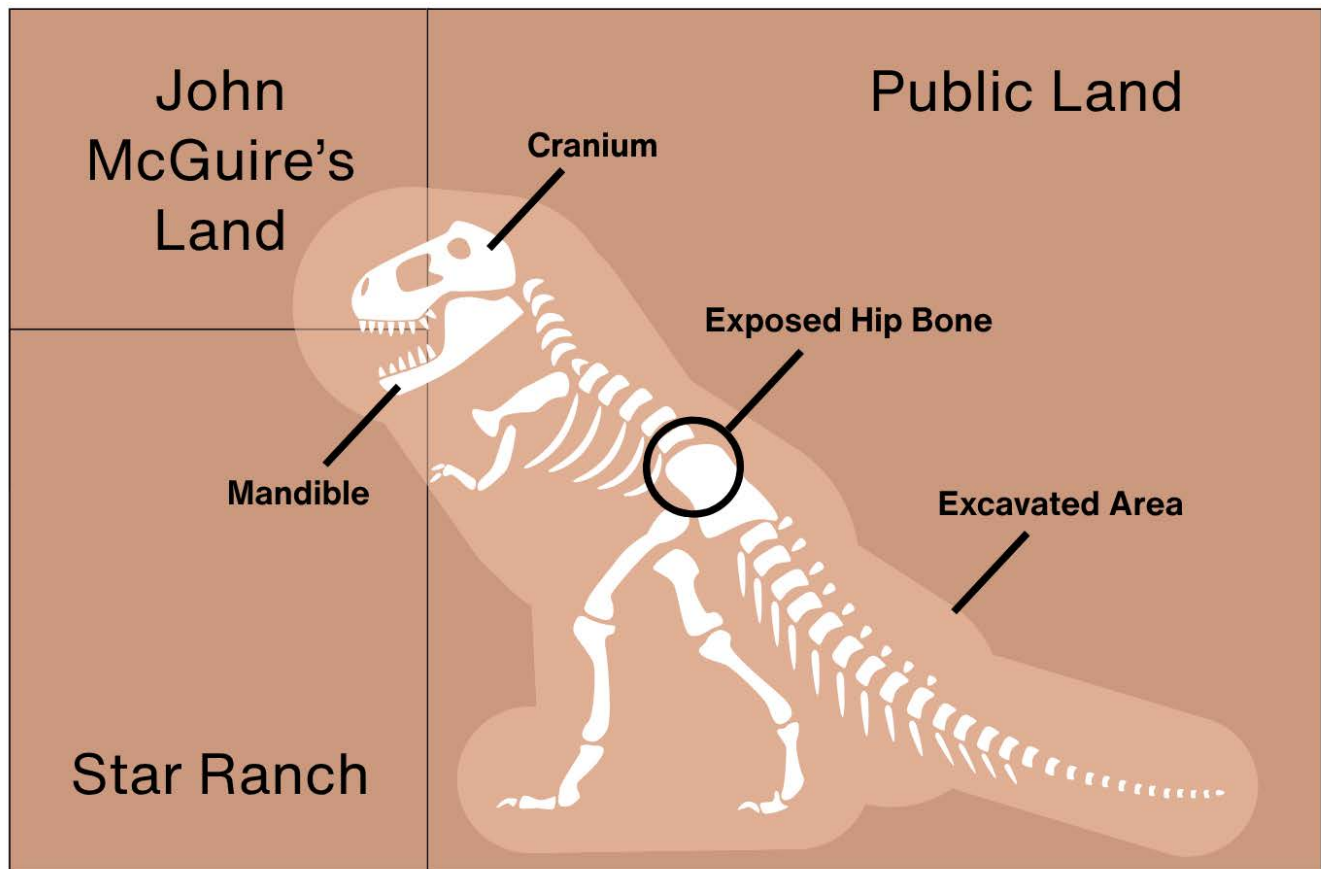


Diagram courtesy of Lawsuit Art, Inc.

Vertebrate fossils found on public land can only be removed by permit holders and fossils found on private land do not require a permit and belong to the landowners. So, what happens when a fossil is found on more than one property?

This is exactly what happened when paleontologists from Ash Science Center went on their last trip to Elk Ridge, Montana. While looking for fossils in a remote area 40 miles outside of town, they found part of a dinosaur hip bone sticking out of the soil.

Source 6



Usually when paleontologists find fossils, they only find parts and pieces of the dinosaur. Finding a complete skeleton is very rare. However, as the paleontologists continued to look at and uncover the fossil, they realized that what they were working on was a complete *Tyrannosaurus rex* skeleton. The problem came when they realized that only part of the skull was on public land.

The skull was located on three different properties, split between the public land, land owned by Star Ranch, and land owned by John McGuire. In this case, the large bones that form the top and the bottom of the skull were both located on two properties. The top of the skull, the cranium, was found on public land and on McGuire's property and the bottom of the skull, the mandible or jaw, was found on public land and on Star Ranch. As soon as Ash Science Center saw that some of the *Tyrannosaurus rex* skeleton was on private property, they talked with Star Ranch and McGuire. Star Ranch and McGuire agreed to donate the part of the fossils on their land to get a tax break. The fossils were then removed by paleontologists from Ash Science Center.

During the removal, Ash Science Center damaged Star Ranch's fences, causing them to lose their prize-winning bull, who was able to escape. Star Ranch is now suing Ash Science Center for the cost of damage to their fenceline and for lost profit caused by the loss of their bull. The escaped bull has not yet been found.

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Anyone can read the comments, but you must be a subscriber or logged in with a registered account to contribute. If you do not have a registered account, you can sign up for one below (it's free).

[LOG IN](#)[SIGN UP](#)**Source 6**



AI Overview

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Ash Science Center was sued by two parties over the excavation and ownership of the fossil. [The Continental Times](#)

How the robbery happened

The drivers transporting the fossil pulled into Cedar Ridge Rest Stop for the night to get some sleep. [KTRK 8](#)

All trucks were parked in the back of the Cedar Ridge Rest Stop parking lot overnight. The locks on each truck were broken. [The Daily Shockwave](#)

What was stolen

Over ten plaster jackets containing a *Tyrannosaurus rex* fossil. [KTRK 8](#)

Each plaster jacket weighed at least half a ton. [Ash Science Center](#)

Investigation and aftermath

Police on the scene found evidence of tampering with the locks on the truck. The locks were cut off of the vehicles. The police also found broken plaster from the stolen dinosaurs. [Elk Ridge Police Department](#)

Ask anything



Source 7



Fossil Collections

Posts

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Page

Notes



Alejandra Solís Wednesday 8:13 AM

AS

Bad news guys...

Soren Kade Wednesday 8:15 AM

SK

What's up?

Alejandra Solís Wednesday 8:16 AM

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Someone robbed our trucks. Tim is gone.

Marcellus Reed Wednesday 8:16 AM

MR

WHAT??

Soren Kade Wednesday 8:17 AM

SK

Who could've done that?

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I have no idea. We didn't have cameras on our trucks. I didn't think anyone would steal it.

Marcellus Reed Wednesday 8:19 AM

MR

Yeah, that dino was HEAVY!!! Wasn't the skull alone over a ton? How could they steal the whole dinosaur?

Source 8



Soren Kade Wednesday 8:21 AM

SK

I bet it was Star Ranch. The owner was really mad that we had to take down his fence to get the rest of the skull. One of his cows even got out! He kept yelling about how the cow was his prize-winning bull and that he lost thousands of dollars because of us.

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It could've been John too. He also wasn't happy about us shipping Tim back here for research.

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Idk. I don't want to point fingers if we don't have any proof.

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Those two have been nothing but trouble for the past few years. They slowed EVERYTHING down.

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Honestly, if they hadn't caused such a mess, Tim would've been here by now.

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And I would've started preparing Tim! Think of all the things we could've already learned! We would be getting ready to publish new research papers at this point!

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Guys, calm down. I'm just as upset as you are, but being mad isn't going to help them find Tim quicker. Let's just wait and see what they can find.

Source 8



Marcellus Reed Wednesday 8:34 AM

MR

You're right. Sorry, I'm just frustrated.

Soren Kade Wednesday 8:36 AM

SK

Me too. Sorry guys. I was just really excited to start working on this fossil. It's such a rare opportunity.

Alejandra Solís Wednesday 8:37 AM

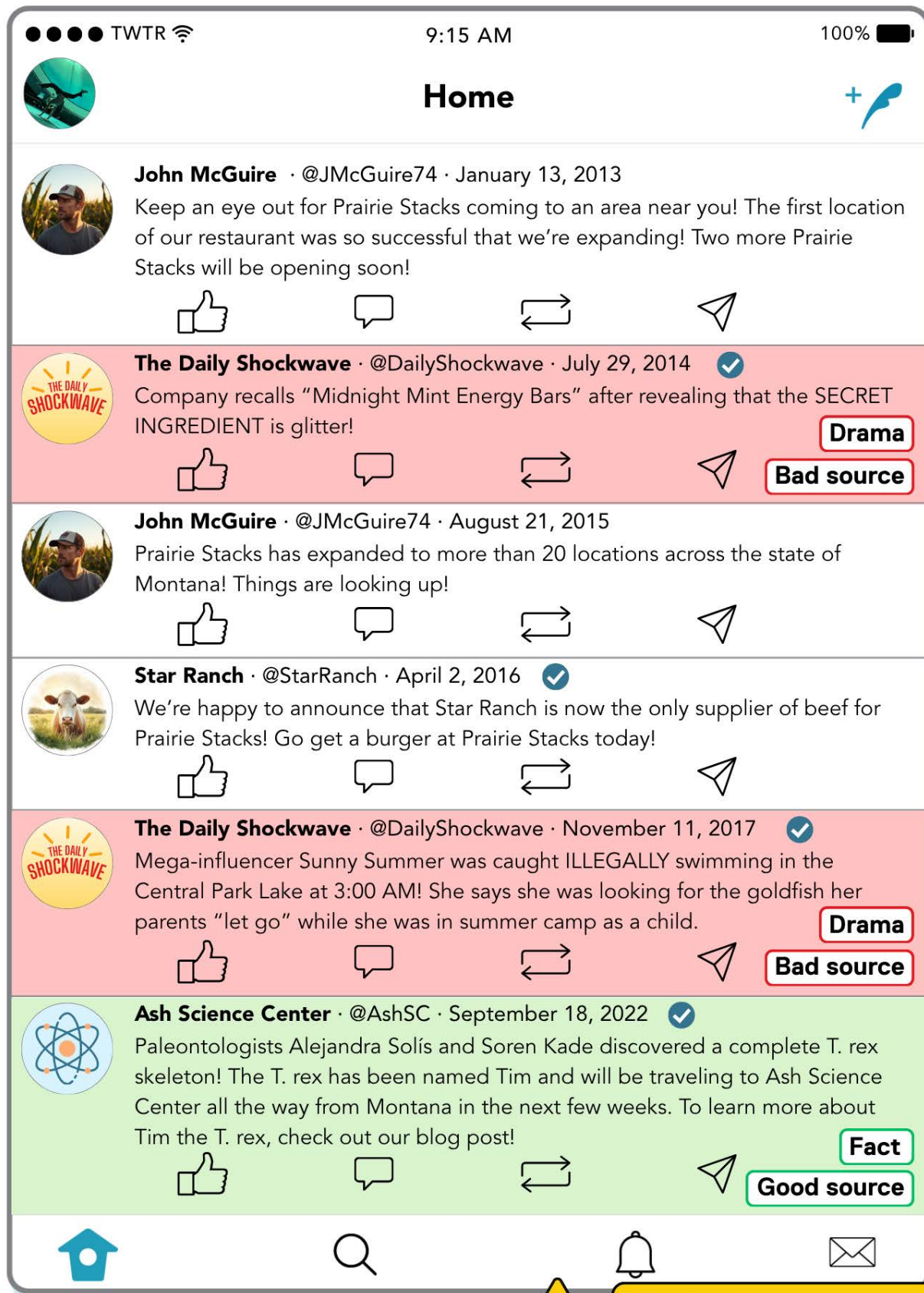
AS

We're in this together. It's a huge fossil, so it can't have gone too far. I'm sure they'll find it soon. We've just gotta hang in there. Plus, there isn't too much we can do from Florida. I'll let you know as soon as I hear anything new.

Type a message

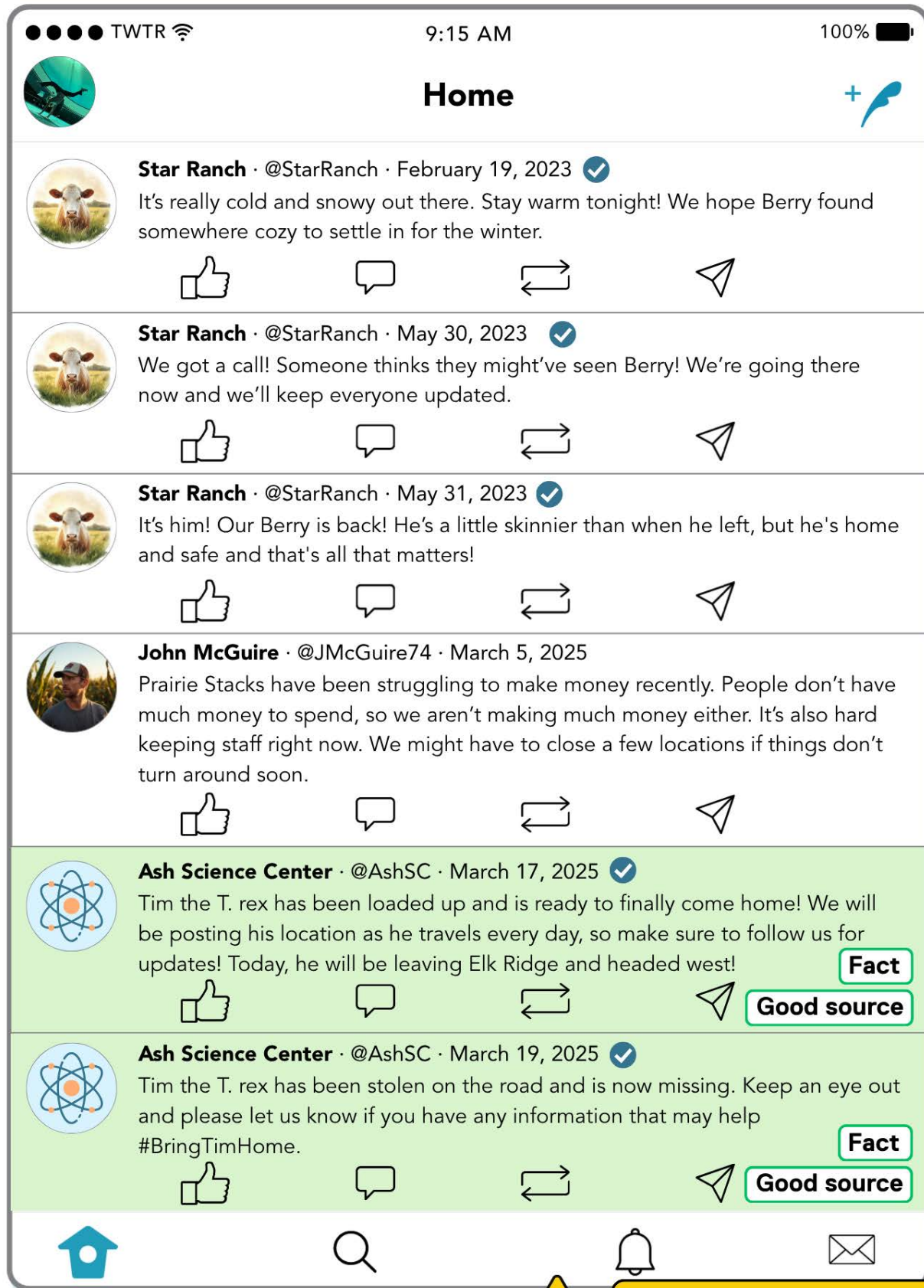


Source 8

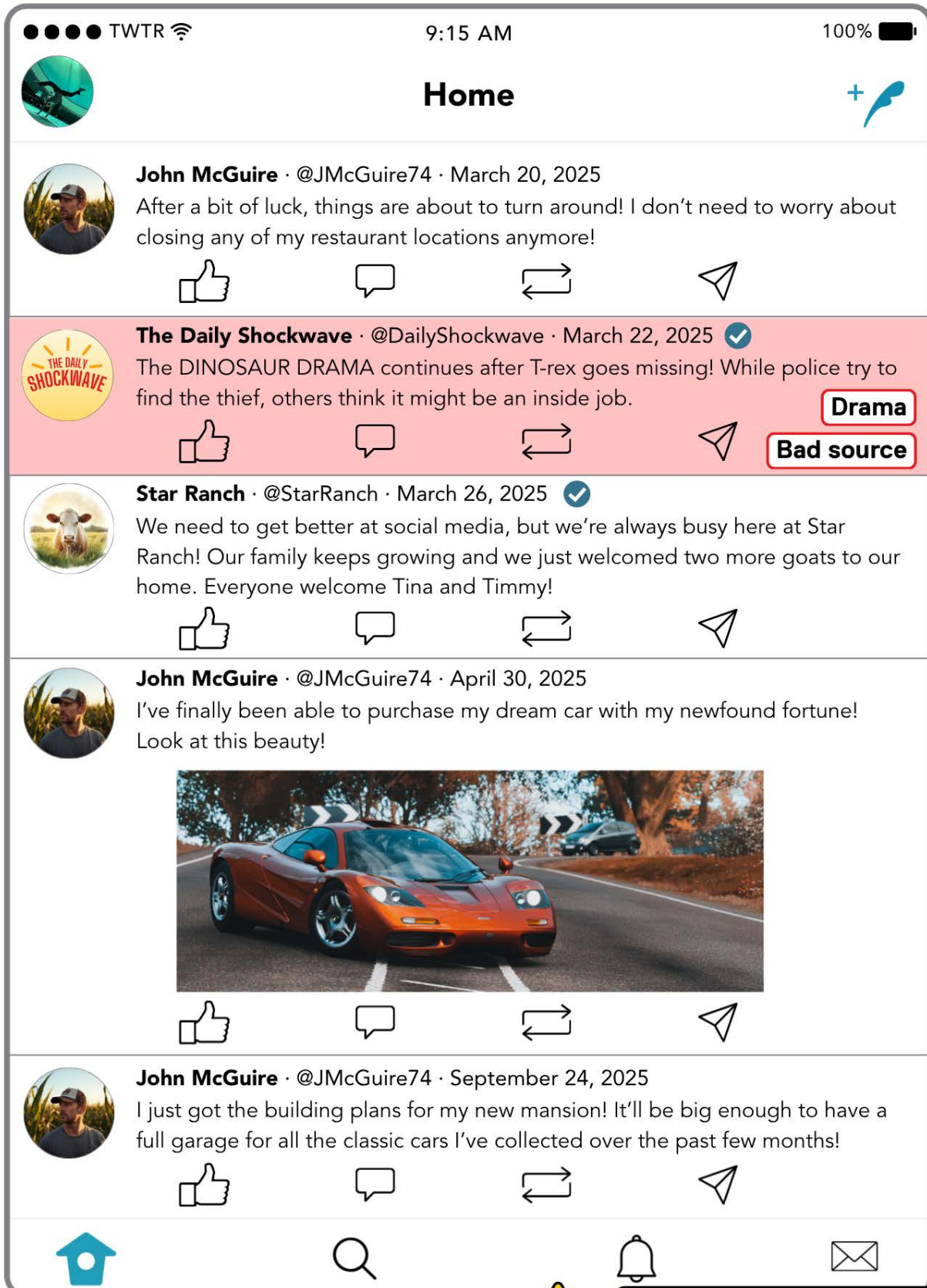


Teacher Copy: Source 1

**Teacher Copy: Source 1**



Teacher Copy: Source 1

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KTRK 8 – Trail Rock News Network



Aired March 18, 2025 - 10:30 AM MT

THIS IS A TRANSCRIPT. THE TEXT COPY MAY CHANGE.

[10:30:00]

EMILY CHEN, NEWS ANCHOR, KTRK 8: Breaking news, live from Elk Ridge. A whole dinosaur has gone missing after being stolen late last night. I am here with Bill Rutford from ForgePoint Heavy Movers and Samantha Hill from Cedar Ridge Rest Stop, the scene of the crime. Bill, what happened?

BILL RUTFORD, TRUCK DRIVER, FORGEPOINT HEAVY MOVERS: ForgePoint was in charge of moving the dinosaur from Elk Ridge to Sunnyside Harbor in Florida. We parked at Cedar Ridge for the night and when we woke up this morning and checked our trucks, we noticed that the back of the trucks were all open. **Fact**

CHEN: And the dinosaur was gone?

RUTFORD: And the dinosaur was gone.

CHEN: How do you think the back of the trucks were opened?

RUTFORD: We had pretty big locks on our trucks. The locks were cut.

Fact

CHEN: What did you do when you noticed?

RUTFORD: We panicked. We weren't sure what to do because we've seen nothing like this before. That thing was huge and heavy and was in over ten parts. My truck had four and one of them was over a ton.

Fact

[10:35:00]

CHEN: And Samantha, you're the manager at Cedar Ridge Rest Stop. Were the cameras at Cedar Ridge able to catch anything?



Teacher Copy: Source 2

KTRK 8 – Trail Rock News Network



SAMANTHA HILL, MANAGER, CEDAR RIDGE REST STOP: No, they weren't. The trucks were in the back of our parking lot --

RUTFORD: In the spots set aside for big trucks --

HILL: And there isn't much light back there. Plus, the back of the lot is far from the cameras and the back of the trucks were facing away from the rest stop, so even if the cameras could see that part of the parking lot the trucks would've blocked the view. **Fact**

CHEN: Why do you think someone would have done this? Why steal a dinosaur?

RUTFORD: I don't know, but they must've planned it. The locks were cut by someone who knew what they were doing. They didn't leave anything behind either. **Opinion**

HILL: They did damage some of our property though **Fact** the highway's nearby, but they had to go over our grass to get to the back of the trucks. They must've used heavy equipment because the grass is all torn up. **Opinion**

CHEN: That's unfortunate. Looks like the thief caused problems for everyone, from ForgePoint Heavy Movers to Cedar Ridge Rest Stop. Up next, we'll be speaking with the paleontologist responsible for finding the dinosaur. Stay tuned.

(COMMERCIAL BREAK)

[10:45:00]

CHEN: We have Alejandra Solís on the line from Ash Science Center. She's the person who found the dinosaur. Alejandra, why do you think someone would do this?



Teacher Copy: Source 2

KTRK 8 – Trail Rock News Network



ALEJANDRA SOLÍS, CURATOR OF PALEONTOLOGY, ASH SCIENCE CENTER:

it or not, but people try to steal dinosaurs all the time. This is just the first time it's happened to us. People steal dinosaurs for lots of reasons, but the most common one is probably easy to guess --

Fact

CHEN: Money?

SOLÍS: Yep, it's money. And the nicer the dinosaur the more money someone would be able to get for it when they sell it illegally. It's hard to do that in the U.S., so lots of people end up trying to smuggle dinosaurs out of the country before selling them. You can imagine for a whole T. rex, people would be able to get a lot of money by selling it.

Fact

[10:50:00]

CHEN: How much would the T. rex be worth?

SOLÍS: We haven't prepared the T. rex yet, so it's still covered in rock so it's hard to give an exact amount. **Opinion** if everything looks good, it should be worth several million dollars. Whole T. rex skeletons have been sold from 5 to over 30 million dollars before on auction.

Fact

CHEN: Wow! That's a lot of money! Hopefully they find the dino before it gets sold.

SOLÍS: Yes, it would be much harder to find our T. rex once it's been sold. Fossils in private collections can be really hard to find and track.

Fact

CHEN: Then let's keep our fingers crossed. Thank you for talking with us today, Alejandra. We'll be right back for more morning news after this quick break.



Teacher Copy: Source 2



ELK RIDGE POLICE DEPARTMENT REPORT

Case No.:

3	4	6	6	3	7	2	6	2
---	---	---	---	---	---	---	---	---

 Date:

0	3
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 /

1	8
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 /

2	0	2	5
---	---	---	---

Reporting Officer: Jane Sorenson Time:

0	6
---	---

 :

0	9
---	---

^{AM} PM

Detail of Event:

Location: [REDACTED] US-2, Chester, MT 59522

Incident Type: Property/vehicle damage, Theft

Describe the incident: A Tyrannosaurus rex being carried by three Freightliners was stolen sometime during between the hours of 10:26 PM and 06:09 AM on the night of 03/17/2025. The locks on each container were cut. Truck 1 was carrying 4 pieces, truck 2 was carrying 6 pieces, and truck 3 was carrying 5 pieces of the dinosaur. The grass behind the trucks had tracks that looked like they belonged to heavy machinery.

Injuries and Damages:

Were there any injuries? ☐ Yes ☒ No

Were there any damages? ☒ Yes ☐ No

Describe the injuries or damages: The locks on the back of the Freightliners were broken and can no longer be used. The grass and some nearby bushes on Cedar Ridge Rest Stop's property were torn up. Broken pieces of plaster were found near the back of the Freightliners where the dinosaur was broken was stolen.

Witnesses:

Were there any witnesses? ☒ Yes ☐ No

List the witnesses names and contact information:

ForgePoint Heavy Movers Drivers: Bill Rufford, (406) [REDACTED] - [REDACTED], Caleb Henderson, (406) [REDACTED] - [REDACTED],

Molly Whitaker, (406) [REDACTED] - [REDACTED]

Cedar Ridge Rest Stop Manager: Samathana Hill, (406) [REDACTED] - [REDACTED]

Actions Taken:

I talked with the witnesses from ForgePoint Heavy Movers to figure out what was stolen from the Freightliners and the manager from Cedar Ridge Rest Stop to learn about damages to the property. I put the cut locks in evidence bags and dusted the handles on the back of each container for fingerprints. I picked up the pieces of plaster found near the Freightliners put it in a second evidence bags. A pen engraved with "JM" was found 100 yards away in the grass and was placed in an evidence bag. The pen may or may not be related to the theft.

All facts



Teacher Copy: Source 3



LOCAL CRIME SPORTS CULTURE CELEBRITIES



Dinosaur 'Stolen' on the Road Raises Questions

March 2025 · By Leroy Wood



Not italics

A *tyrannosaurus rex* went missing in Montana right after leaving for Ash Science Center. This is just the latest problem for the dinosaur, which has been in the middle of several legal battles over the last three years. The lawsuits were all settled peacefully, so what could have happened to the dinosaur? One insider thinks that the thief might be the shipping company.

Opinion

ForgePoint Heavy Movers was hired by Ash Science Center to move the dinosaur all the way from Montana to Florida. After driving only a few miles, the truckers stopped at Cedar Ridge Rest Stop for the night. The truckers all parked in the very back of the parking lot with the back of their trucks near the busy highway. This area of the parking lot was also far from all the streetlamps, making it very dark, and was in a blind spot for Cedar Ridge Rest Stop's security cameras. **Fact** middle of the night, the locks on each truck were smashed and the dinosaur was stolen.

Wrong

Teacher Copy: Source 4



Our insider said that they had seen the truckers arguing earlier in the day after dropping part of the dinosaur while putting it into one of the trucks. While the container holding the dinosaur looked fine, it's hard to know if the fossil broke when it fell. Now, with the dinosaur missing and no way to check for damage, ForgePoint Heavy Movers can't get in trouble. **Opinion**

One staff member at Cedar Ridge Rest Stop said, **"We've had problems with ForgePoint before. The truckers always come in here and cause problems and I've caught them several times trying to take food, like granola bars and stuff, from the lobby without paying. I wouldn't be surprised if they tried to take other things too."** **Drama**

While ForgePoint Heavy Movers has a reason to steal the dinosaur, police still do not know how the **Opinion** was stolen or where the dinosaur is now. With such a big dinosaur, the biggest tyrannosaurus rex ever found in the United States, it can't stay missing forever. **Not italics** missing dinosaur will be found soon.

ForgePoint Heavy Movers did not answer when asked to comment.

Teacher Copy: Source 4



Blog / Science News

ALL TOPICS HEALTH ENVIRONMENT ANIMALS SPACE GOVERNMENT

Meet Ash Science Center's Newest Team Member, Tim the T. rex

September 18, 2022

By Marcellus Reed, Collections Manager



Paleontologists from Ash Science Center just made the discovery of a lifetime! On their current paleontology trip to Elk Ridge, Montana, Alejandra Solís, Curator of Paleontology, and Soren Kade, Fossil Preparator, found a complete *Tyrannosaurus rex* fossil.

Italics

Finding a complete fossil does not happen every day and makes this find a big deal! Complete skeletons can teach us a lot about dinosaurs, where they lived, what they ate, and more. The more complete a fossil is, the more paleontologists are usually able to learn.

Fact



Teacher Copy: Source 5

After the fossil was uncovered by Solís and Kade, they dug a trench around the fossil and covered the fossil and matrix, the rock and dirt around the fossil, with burlap and plaster. Eventually, they dug all the way under the fossil, wrapping the whole fossil in a burlap and plaster jacket. The *Tyrannosaurus rex*, who they named "Tim," was put in 15 jackets. Most of these jackets were small, weighing only about half a ton (~1,100 pounds). The largest fossilized bones needed to be put in biggest jackets, so Tim's skull and hips were both put in jackets that weighed over one ton (~2,000 pounds). These jackets will protect Tim as it travels from Montana to Ash Science Center in Florida. The journey is over 4,023 kilometers (2,500 miles) and the jackets will be carried in three trucks.

Once Tim arrives at Ash Science Center, all of the jackets will be taken to storage and will be added to collections. After the paperwork is done and the Collections Manager, Marcellus Reed, has finished adding the jackets to collections, Reed will work with Solís and Kade to take one jacket from collections to the fossil preparation lab in Ash Science Center. Once the jacket is taken to the fossil preparation lab, the jacket will be opened and Kade will begin to uncover the rest of the fossil. Kade will then use chemicals to protect the fossil and help the fossil stay together. Hopefully, with the right chemicals and enough luck, Tim will one day be able to stand on his own.

Fact

Follow Ash Science Center's social media to keep up to date on Tim's progress as he travels from Elk Ridge, Montana to Sunnyside Harbor, Florida!



[Subscribe to our monthly newsletter](#)

**Teacher Copy: Source 5**



November 11, 2022

The Continental Times

U.S. WORLD BUSINESS ARTS LIFESTYLE OPINION VIDEO AUDIO GAMES COOKING WIRECUTTER

Lawsuits Filed after Dinosaur Discovery

Two lawsuits have been filed against Ash Science Museum after they found a complete *Tyrannosaurus rex* fossil in Montana

By Jasper J. Thornwell

November 11, 2022, 11:11 AM EST | GIFT THIS ARTICLE

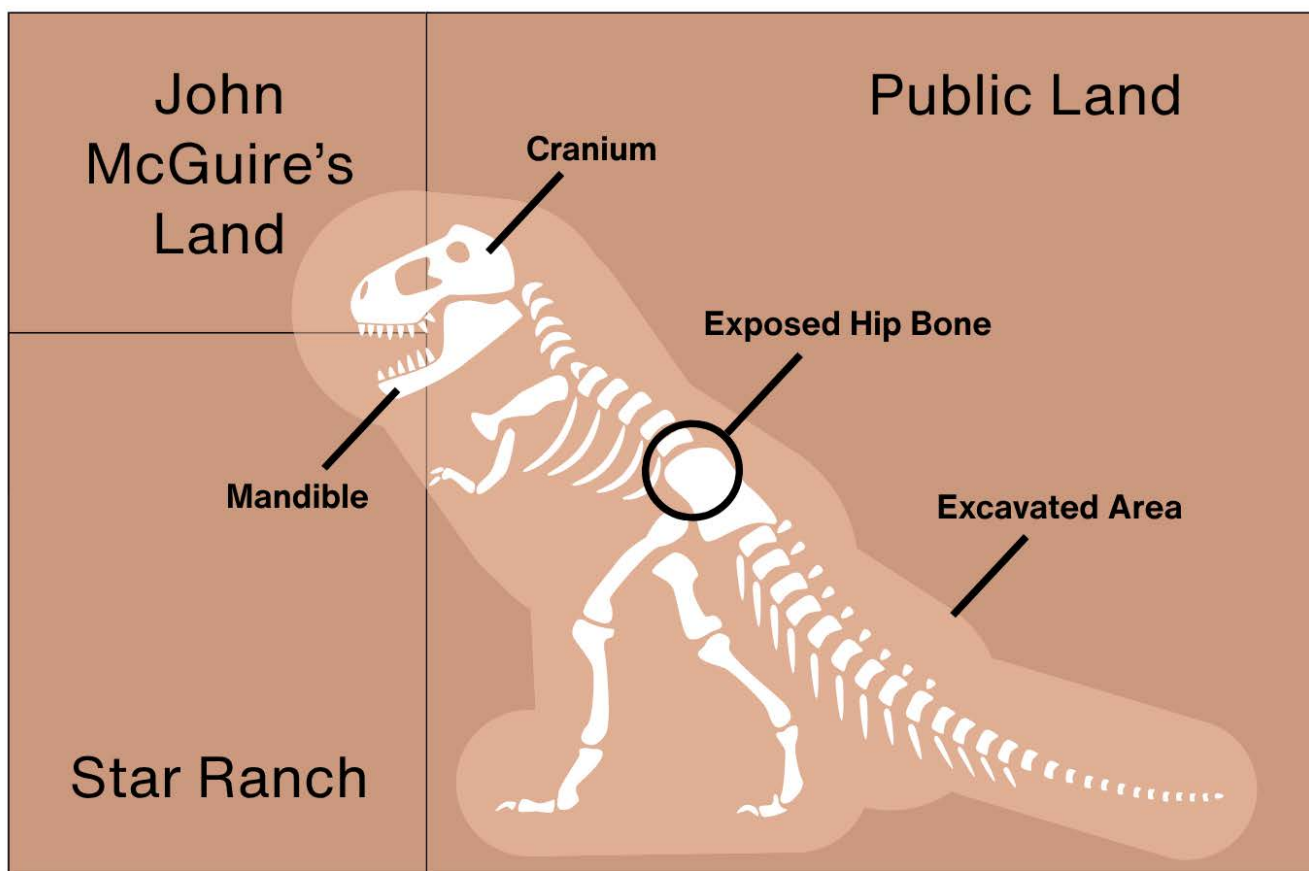
Italics

Diagram courtesy of Lawsuit Art, Inc.

Vertebrate fossils found on public land can only be removed by permit holders and fossils found on private land do not require a permit and belong to the landowners. So, what happens when a fossil is found on more than one property?

This is exactly what happened when paleontologists from Ash Science Center went on their last trip to Elk Ridge, Montana. While looking for fossils in a remote area 40 miles outside of town, they found part of a dinosaur hip bone sticking out of the soil.

**Teacher Copy: Source 6**

Usually when paleontologists find fossils, they only find parts and pieces of the dinosaur. Finding a complete skeleton is very rare. However, as the paleontologists continued to look at and uncover the fossil, they realized that what they were working on was a complete *Tyrannosaurus rex* skeleton. The problem came when they realized that only part of the skull was on public land.

Italics**Fact**

The skull was located on three different properties, split between the public land, land owned by Star Ranch, and land owned by John McGuire. In this case, the large bones that form the top and the bottom of the skull were both located on two properties. The top of the skull, the cranium, was found on public land and on McGuire's property and the bottom of the skull, the mandible or jaw, was found on public land and on Star Ranch. As soon as Ash Science Center saw that some of the *Tyrannosaurus rex* **Italics** as on private property, they talked with Star Ranch and McGuire. Star Ranch and McGuire agreed to donate the part of the fossils on their land to get a tax break. The fossils were then removed by paleontologists from Ash Science Center.

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During the removal, Ash Science Center damaged Star Ranch's fences, causing them to lose their prize-winning bull, who was able to escape. Star Ranch is now suing Ash Science Center for the cost of damage to their fenceline and for lost profit caused by the loss of their bull. The escaped bull has not yet been found.

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LOG IN**SIGN UP****Teacher Copy: Source 6**



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The drivers transporting the fossil pulled into Cedar Ridge Rest Stop for the night to get some sleep. [KTRK 8](#) **Mixed source**

All trucks were parked in the back of the Cedar Ridge Rest Stop overnight. The locks on each truck were broken. [The Daily Shockwave](#) **Bad source**

Wrong

What was stolen

Over ten plaster jackets containing a Tyrannosaurus rex fossil. [KTRK 8](#) **Mixed source**

Each plaster jacket weighed at least half a ton. [Ash Science Center](#) **Good source**

Investigation and aftermath

Police on the scene found evidence of tampering with the locks on the truck. The locks were cut off of the vehicles. The police also found broken plaster from the stolen dinosaurs. [Elk Ridge Police Department](#) **Good source**

Ask anything

**Teacher Copy: Source 7**



Fossil Collections

Posts

Shared

Page

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**Teacher Copy: Source 7**

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Teacher Copy: Source 7

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Type a message



Teacher Copy: Source 7

Out with the Old: Activity 3

Overview

Students will brainstorm the steps of the engineering design process before practicing the redesign step of the engineering design process by creating multiple versions of a common item. As students redesign, they will create and reflect upon a Scale Drawing, Digital Model, or Physical Model of their item. Students will then identify how their practice redesigning a common item can be translated to their Junior STEM Challenge projects.

Objectives

By the end of this activity, students will be able to:

- Define the steps of the engineering design process.
- Identify that using the engineering design process results in multiple versions of an idea or solution.

Key Messages

- The engineering design process generally consists of the following steps: Identify a real world problem → Plan a solution → Prototype your solution → Test your solution → Redesign your solution → Communicate your solution.
- The engineering design process is cyclical and has no clear end point.
- Using the engineering design process results in multiple versions of the same idea or solution.

Time Needed: 50+ minutes

Standards

NGSSS Gifted Learners Benchmarks

G.K12.4.1.5d, Creative Thinking - Accomplish: Evaluate and modify ideas and products to improve usefulness.

G.K12.7.2.3a, Praxis-Know: Generate multiple solutions to a given problem.

Background Information

Engineering Design

Engineers use the engineering design process to develop innovative solutions, procedures, and products. The exact steps to the process can vary slightly depending on who is applying it, but it always follows the same general pattern. The process starts by defining or identifying problems, then moves through a cycle of creating or designing solutions, modeling or testing solutions, and evaluating the solution to improve on it. This process almost always results in multiple iterations of the same solution, with each iteration producing a better solution to the original problem. In other words, the engineering design process encourages constant improvement upon solutions or ideas.

Materials (per student)

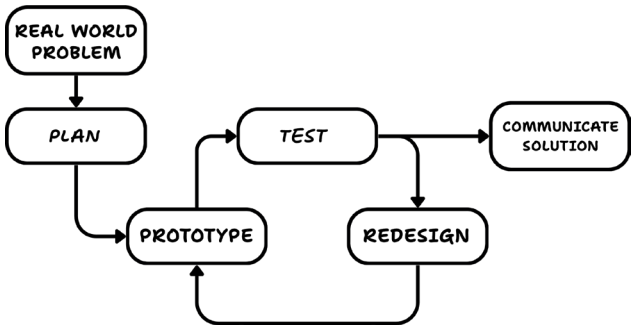
- Student Guidebook
- Sticky Notes
- Pencil
- One computer per group
- Paper
- **Conceptual Drawing:** Ruler, protractor (optional), and math compass (optional)
- **Physical Model:** One set of materials per group
 - Materials can include paper, cardboard, wire, pipe cleaners, tape, clay, tape, glue, etc.

Set-Up Procedure

1. Make sure that students have access to their Student Guidebooks.
2. Make sure that there are computers available for every group or partner to have one device. If students do not have personal devices, reserve a computer lab or computer cart. If students have personal devices, remind students one class day prior that they will need their computer on the following class day.
3. **Digital Model:** Create an educator Tinkercad account if you have not already. Tinkercad will be used at the start of this activity to provide students with a space to create and upload their projects. This is a free resource.
4. If this is your first time using Tinkercad in class, go to 'Classes' and selecting 'Create a new class.' When creating your class, make sure to keep the setting in 'Safe Mode' so that no student designs are shared publicly.
5. **Physical Model:** Organize materials so that each partner or group can receive one set of materials. These materials will vary based on what is available and may be different from the materials suggested in the Materials section of the Activity Plan.
6. Open PowerPoint.

Activity Procedures

INTRODUCTION: This part of the activity will introduce students to the engineering design process.	
TIME REQUIRED: 10 minutes	
What the Teacher Does	Anticipated Student Behaviors/Responses
1. Tell students to sit with their Junior STEM Challenge groups. NOTE: If you assign step 2 of the activity as homework, complete step 1 when starting the activity in class.	1. Students will sit with their group members for the Junior STEM Challenge.
2. Select one object for students to design in class. This may be a bubble wand, fidget device, or another comparable item. Tell students to draw, or design, the item on a blank piece of paper. Tell students that they are designing this item for "Junior STEM Challenge practice." Students can create this item in class during the same class period, or it can be assigned as homework or completed in class the day before. If students design the item in class, they will work with their Junior STEM Challenge groups. If students design their item as homework, they will work independently.	2. Students will design an item in groups in class or individually as homework.
3. After students have designed their items, start this activity by asking students the following questions: Q1: What did you do to design your item? Q2: Do you think your design is finished? Why or why not? Q3: Do you think that scientists and engineers are done solving a problem as soon as they come up with their first idea? Why or why not? Q4: Can you think of at least one solution, item, or product that scientists and engineers have kept working on over time? Select several students to share their answers to each question.	3. Selected students will answer each question. R1: Student answers will vary. R2: Our design is not finished yet because it still has a lot of room for improvement. R3: Scientists and engineers are not done once they come up with an idea because they need to build, test, and improve their design several times before they are 'done.' R4: Student answers will vary. For example: Engineers have kept improving cellphones over time. They did not stop at the first iPhone or android phone. Instead, they kept making new, better versions.

4. Tell students that during the Junior STEM Challenge, the first idea they come up with will not be perfect and will still need more work. Engineers and scientists use the engineering design process to make their ideas better and better over time.	4. Students will listen.
5. Give each group of students a stack of sticky notes. Tell students to work with their group to brainstorm the steps engineers may use in their engineering design process. Remind students that they have already completed some of these steps during this activity and other Junior STEM Challenge activities. The first step of the engineering design process is “identify a problem” and the last step is “share their idea.” Groups should try to come up with 2-8 more steps (for a total of 4-10 steps) of the engineering design process, writing each step on a separate sticky note. As students brainstorm additional steps to the engineering design process, circulate the classroom and make sure that students have written “identify a problem” and “share their idea” on two separate sticky notes.	5. Students will work with their Junior STEM Challenge group to brainstorm the steps of the engineering design process, writing each step on a separate sticky note.
6. Once students have recorded each step on their sticky notes, tell students to organize the sticky notes into their engineering design process. If students want to, they can draw arrows on additional sticky notes to help show the direction of the engineering design process. As students organize each step into the engineering design process, take note if it looks linear or cyclical.	6. Students will organize the steps on their sticky notes into a logical engineering design flow.
7. Once students have organized their sticky notes, write or project the following engineering design process on the board. As you read out each step of the process, tell students to raise their hands if they included that step on their sticky notes.  <pre> graph TD A[REAL WORLD PROBLEM] --> B[PLAN] B --> C[PROTOTYPE] C --> D[TEST] D --> E[COMMUNICATE SOLUTION] D --> F[REDESIGN] F --> C </pre>	7. Students will listen to each step of the engineering design process and each group will raise their hands when they hear a step of the process that they included on their sticky notes.
8. Tell students to open their Student Guidebooks to the “Out with the Old” student activity sheet on page 36 and record each step of the engineering design process.	8. Students will open their student guidebooks to the “Out with the Old” student activity sheet and will write down each step of the engineering design process in the space provided.

9. Tell students that the engineering design process varies from place to place, so while the engineering design process we are using for the Junior STEM Challenge follows these steps, the process in other places may include some of the other steps they included on their sticky notes. As students organize each step into a design process, take note if the design looks linear or cyclical.	9. Students will listen.
10. Ask students the following questions: Q1: Besides the steps, what else do you notice about this process? How is it shaped? Q2: Why do you think this process is a cycle and not a straight line? Select several students to share their answers to each question.	10. Selected students will answer each question. R1: The process is a cycle that can repeat over and over again. R2: The process is a cycle because there will ways to improve on an idea and make it better.
11. Tell students that like they talked about earlier, scientists and engineers keep working on their ideas over time, even if their idea is being used already. There is not a clear end to the engineering design process, just a place where people choose to share their idea with others. Also, even if scientists and engineers stop working on an idea, other people can pick up where they left off, continuing the engineering design process.	11. Students will listen.
BODY OF THE ACTIVITY: <i>In this part of the activity, students will identify how they can implement the engineering design process in the STEM Challenge and will practice iterating upon an idea.</i>	
TIME REQUIRED: 30 minutes	
What the Teacher Does	Anticipated Student Behaviors/Responses
1. Tell students that to practice the engineering design process, they will be working on the item that they designed at the start of this activity. This item is going to be their “prototype.” Students should pull out the paper where they designed their item and label it “Version 1.” If students designed their item as homework, tell each Junior STEM Challenge group to identify one of their items to use for the rest of the activity. While each group must pick one item, students can add elements from the rest of their items during their first redesign.	1. Students will listen and label their design, “Version 1.”

2. Ask students the following questions: Q1: A prototype is an early version of an item that we can test to see if it works. Is your item a prototype we can test? Why or why not? Q2: What do we have in place of the prototype for the Junior STEM Challenge? Q3: What is the next step of the engineering design process? Q4: Do you think you will be able to test your item during this activity and test your solution during the Junior STEM Challenge? Q5: If we cannot test our item or solution, what else can we do to make sure our item works? Select several students to share their answers to each question.	2. Selected students will answer each question. R1: Our item is not a prototype because it is not a physical item we can test. R2: We have a model instead of a prototype. R3: The next step of the engineering design process is testing our prototype, item, or solution. R4: No, we will not be able to and do not need to test our items and solutions. R5: Instead of testing our item or solution, we can look for information that shows our item or solution can work. This could be research articles or examples of previous items and solutions that worked.
3. Tell students to use their computers to look up other ways that creators have designed similar items. As students look at each item, they should look for what works and identify any design characteristics that are similar between the items. Tell students to record these elements in the designated spot in their Student Guidebook. Give students at least 5 minutes for this part of the activity.	3. Students will look at the designs of similar items, recording their observations in the table in their Student Guidebook.
4. Ask students the following questions: Q1: Why do you think these items all share the same characteristics? Q2: If these items all share several characteristics, why do they look different? Q3: How can you use some of the same characteristics, but still make your design unique? Keep in mind that you might not use all the same characteristics and that is okay. You could have created a something that works better! Select several students to share their answers to each question.	4. Selected students will answer each question: R1: They share these characteristics because these characteristics help the items work. The characteristics may also make the items cheaper or look nicer than alternative designs. R2: <i>Student answers will vary.</i> For example: The items look different because they were made for different people or groups or because people would not buy them if they all looked the same. R3: <i>Student answers will vary.</i>
5. Tell students to use the space following the table in their guidebook to describe how they can add some of the characteristics they think would be helpful into their design while still keeping their design unique. Give students at least 5 minutes to develop an implementation plan.	5. Students will develop a plan to implement some of the observed characteristics into their design.
6. Tell students to take the changes they described and draw an updated version of their design on a new sheet of paper. They should label this new design, "Version 2."	6. Students will draw a new version of their design on a new sheet of paper. Students will label this design, "Version 2."

7. Students will only have time to create one of the following final products in class: the Scale Drawing (step 7a), Digital Model (step 7b), or Physical Model (step 7c). Creating a Scale Drawing is more challenging than creating a digital or physical model, so it is only recommended for advanced 7th grade classes and 8th grade classes.

If students are creating a digital (7b) or physical (7c) model in class, tell students that they will not be using the Scale Drawing section of the activity in their Student Guidebook. Students only need to use this section if they are completing step 7a.

Optionally, students can create additional final products in the following class period or can be directed to create additional final products as homework. If students are creating more than one type of final product, students should be completing the final products in alphabetical order (e.g. a digital model [step 7b] before a physical model [step 7c]).

Give students 20 minutes for this part of the activity

7a. Scale Drawing: Tell students to create a scale drawing of their item. Define “scale” for students by telling them that scale drawings are proportional to the real, or final version of the item. For example, maps are “scaled.” On a map, there is usually a little scale in the corner that shows whether 1 millimeter, 1 centimeter, or 1 inch on the map represents 1 mile, 10 kilometers, or another distance. If the scale is 1 centimeter to 1 mile, students could measure the distance between each point on the map using a ruler and calculate the real distance between each location. So, if they measured 2.4 centimeters on the map, they would know that the locations are 2.4 miles away from each other.

Show students an example of a scale image by either drawing one on the board or projecting a map with a scale. Tell students that they can either scale down their item (making it look smaller so that it can all fit on a piece of paper) or scale up their item (making it larger to show more detail).

Give each group a ruler, blank paper, a protractor (optional), and a math compass (optional). Tell students to use the information in their guidebook to create their scale drawing. First, they will need to figure out the size of each part of their item in centimeters. From there, they can calculate the total size of their item and figure out how much they want to scale their item. Their item should be scaled up or down so that it can fit on a blank sheet of paper. Students can then calculate new, scaled dimensions for each part of their item and draw their item on a new piece of paper. Students must write the scale they are using in the corner of the paper.

As students create their scale drawings, circulate the room to make sure that students follow each of the steps in their guidebook and are making accurate calculations.

7a. Students will listen before creating scale drawings of their item. To create the scale drawings of their items, students will identify the dimensions of each part of their item, will identify a scale that works for their item, will calculate the scaled dimensions, and will use a ruler and other available items to draw their items to scale.

7b. Digital Model: Tell students to navigate to tinkercad.com on their computers and ‘Sign in’ by entering the class code under the ‘Students with Class Code’ button. This is the class code you received when you created your class. Help students join the class. Once students have joined the class, tell students to “Create” a new 3D Design. In this new design, they should create a 3D model of their item. Optionally, if students have created a Scale Drawing of their item, tell students to complete the following steps in Tinkercad so that they can create their item in the same scale as their drawing: • Click the “Settings” button in the bottom right of the screen and to change the units from • “1:1 (millimeters)” to “1:10 (centimeters)” • While still in the “Settings,” change the Width to 20 and the Length to 25 • Close “Settings” • Click the dropdown next to “Snap Grid” and change it to 0.1 cm • Use the measurements from your Scale Drawing (step 6 in the Scale Drawing instructions) to create your item	7b. Students will login to their Tinkercad class and create a 3D model of their item. If students have already created a Scale Drawing of their item, they will make their Digital Model to scale.
7c. Physical Model: Tell students to create a physical model of their item. This model does not have to be functional but should resemble their item. Distribute one set of materials to each student group to create a Physical Model. If there are extra materials, place them a central location for easy student access and identify this location for students Optionally, if students have created a Scale Drawing of their item, tell students to use the measurements from their Scale Drawing (step 6 in the Scale Drawing instructions) to create their Physical Model. If students are using their Scale Drawing as a reference, make sure all students have access to a ruler.	7c. Students will create a Physical Model of their item. If students have already created a Scale Drawing of their item, they will make their Physical Model to scale.

CONCLUSION: *In this part of the activity, students will continue to iterate upon their idea and will describe how the engineering design process can be used to improve their Junior STEM Challenge solutions.*

TIME REQUIRED: 10 minutes

What the Teacher Does	Anticipated Student Behaviors/Responses
1. After students have created their Scale Drawing, Digital Model, or Physical Model, ask students the following questions: Q1: Why is it important that you looked over your item a few times before creating your Scale Drawing/Digital Model/Physical Model? Q2: Can you still improve on your version 2 design? Why or why not? Q3: Did your version 2 design look the same as your Scale Drawing/Digital Model/Physical Model? Why or why not? Q4: Was there anything you would change about your design after making your Scale Drawing/Digital Model/Physical Model? Why or why not? Select several students to share their answers to each question.	1. Selected students will answer each question: R1: Student answers will vary. For example: It takes a lot more effort, time, and materials to create a Scale Drawing/Digital Model/Physical Model than it does to create an initial design. By revising a few times before making the Scale Drawing/Digital Model/Physical Model, we can make sure we are putting our effort into making something that we feel good about. R2: We can still improve on our version 2 design because there are still places where things might not work the way we want them to. Our item is also not super unique, so we need to keep working on it so that it stands out from similar items. R3: Student answers will vary. For example: Our version 2 design looked slightly different from our Scale Drawing/Digital Model/Physical Model because the measurements and size of some of our components changed. R4: Student answers will vary. For example: We would want to change the size of a few parts of our design so that they fit together better.
2. Tell students to take 5 minutes to revise their design one last time on a new sheet of paper. These revisions should reflect any changes they made for their Scale Drawing/Digital Model/Physical Model and want to keep. If there are any changes that students made that they do not like, they can revert those parts of their design back to a previous version. Tell students to label this paper, "Version 3."	2. Students will listen and update the design of their item, labeling it, "Version 3."
3. Ask students the following questions: Q1: Can you still improve your version 3 design? Why or why not? Q2: Did creating a Scale Drawing/Digital Model/Physical Model teach you anything about your design? How did it help? Q3: Why do you think we spent class practicing the redesign step of the engineering design process? How could this practice be helpful for the Junior STEM Challenge? Select several students to share their answers to each question.	3. Selected students will answer each question: R1: <i>Student answers will vary. For example: We can still improve our version 3 design. If we have time, we would want to model it again to see if our changes made our item better. We may want to model and redesign the item a few more times before we are completely happy with it.</i> R2: <i>Student answers will vary. For example: When we created our Scale Drawing/Digital Model/Physical Model we noticed a few design flaws that would have kept our item from working. It also left us with a few questions about how some components were attached to each other. This helped us figure out some things we might need to change.</i> R3: Redesigning our item or solution is an important part of the engineering design process. By practicing the redesign step, we are practicing analyzing our item or solution and looking for things that could be fixed or otherwise improved. Doing this in the Junior STEM Challenge will help us make our solutions even better.

4. Tell students that in their Junior STEM Challenge projects, they will need to redesign their solutions several times. They may need to redesign it after learning something new about their problem, after modeling their problem, or after receiving feedback. While some of the changes they make might be small, other changes may be a bit larger and may take more time. In some cases, students might even come up with a completely new solution. It can be frustrating, but it is a very normal part of the process!	4. Students will listen.
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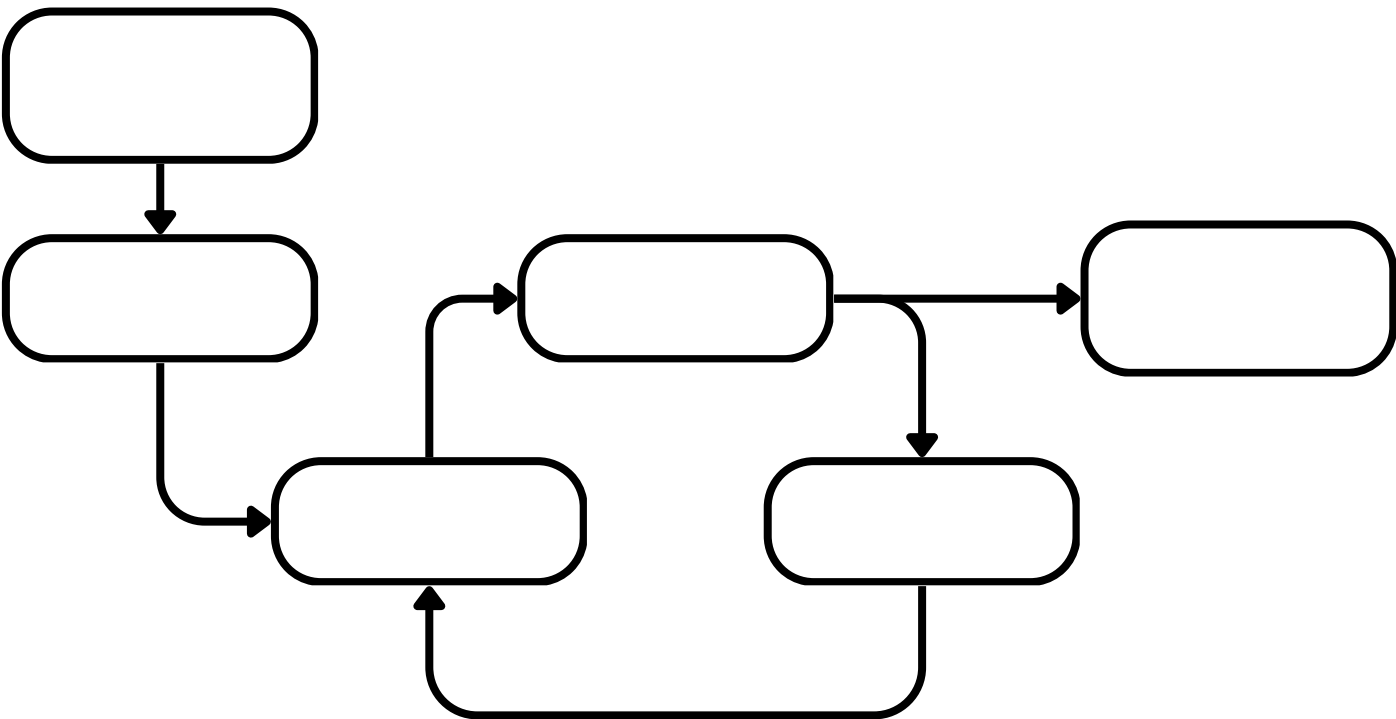
Notes/Considerations

Students should be allowed to ask clarifying questions at any time during the lesson.

Students will only be completing one final product in class: a Scale Drawing, a Digital Model, or a Physical Model. Use the final product best suited for your class time, available materials, and grade level. The Scale Drawing is more difficult than creating either model type, so it is recommended for advanced 7th graders and 8th graders. The Scale Drawing can also be adapted for use with graph paper. In this adaptation, students can sketch their design on the graph paper, with each square representing 1 unit. To scale up their drawing, students can divide or multiply the number of units by a whole number and draw their item on another piece of graph paper using the new proportions.

This optional activity can be completed entirely in-class or can be completed in-class with portions assigned as homework to suit different class styles and lengths.

Activity 3: Out with the Old



Use your computer to look up similar items online and record the design characteristics you notice in the table below:

Describe the Characteristic	What Does This Characteristic Do?	Does Your Prototype Include This Characteristic?

How can you implement some or all of these characteristics into your design while still keeping the design unique and different from the items you saw online?

Use the guide below to create either a Scale Drawing, a Digital Model, or a Physical Model.



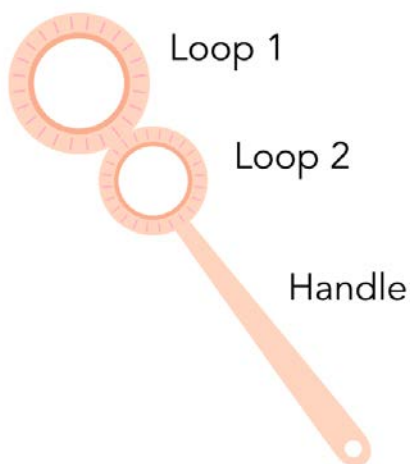
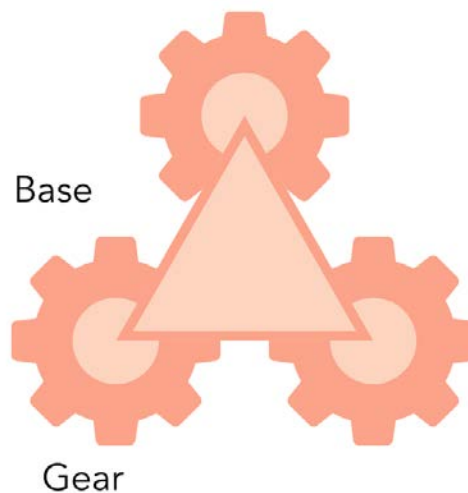
Scale Drawing

Use the table to record your measurements as you follow steps 1-7, listed below.

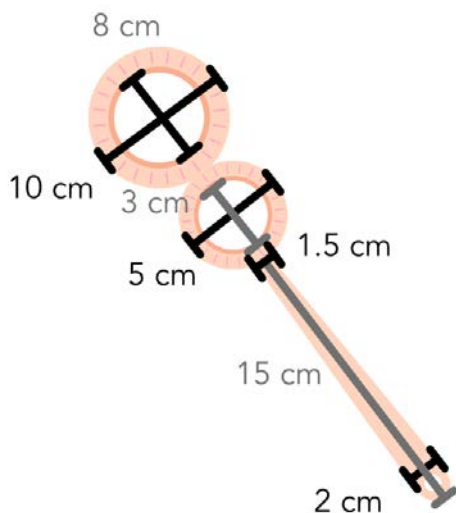
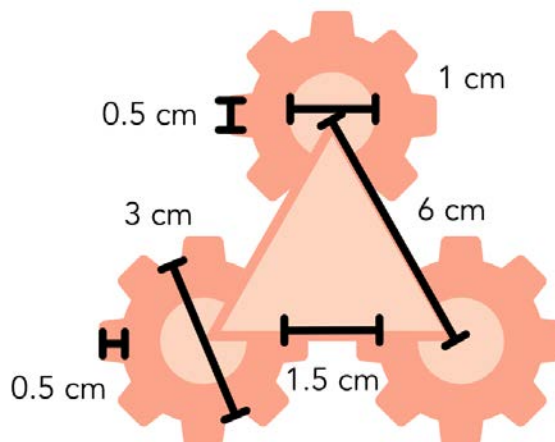
1	2	3
		Scale: _____
Item Component	Measurements	Scaled Measurements (Measurement×Scale)
Example A: Handle	Length: 15 Top Width: 1.5 Bottom Width: 2	Length: 11.25 Top Width: 1.125 Bottom Width: 1.5
Example B: Gear	Outer Hole Diameter: 3 Inner Hole Diameter: 1 Tooth Width: 0.5 Tooth Height: 0.5	Outer Hole Diameter: 4.5 Inner Hole Diameter: 1.5 Tooth Width: 0.75 Tooth Height: 0.75



1. Name each part of your item and write them in section A of the table. These are your Item Components.

EXAMPLE AEXAMPLE B

2. With your group, identify how long and wide you want each Item Component to be. You can have more than one measurement for each Item Component. All sizes should be measured in centimeters. Record the sizes of each item in section B of the table.

EXAMPLE AEXAMPLE B



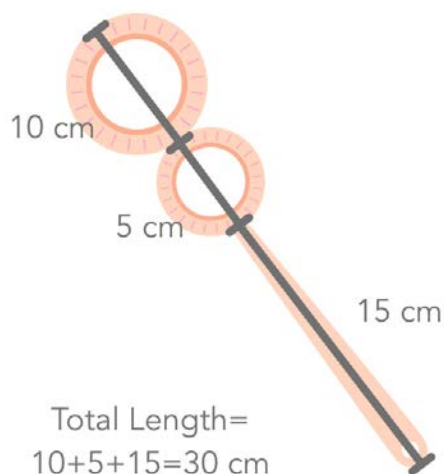
3. Look at your updated design and add up the size of each Item Component to find your Total Length and Total Width. For example, if you are making a bubble wand, you would add together the length of the handle and the loop.

For some designs, you may only need one measurement.

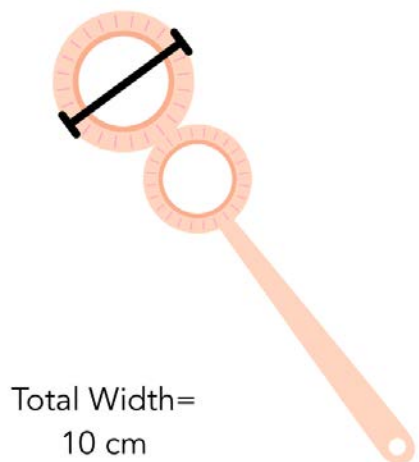
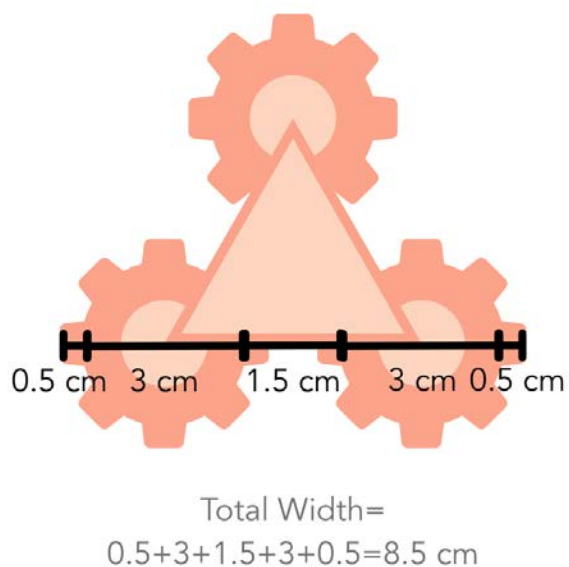
Total Length = _____ centimeters

Total Width = _____ centimeters

EXAMPLE A



EXAMPLE B





4. Your drawing needs to fill a ~25×20 centimeter area (this is slightly smaller than a blank sheet of paper). Multiply your Total Length and Total Width by different fractions to find the scale that makes your item fill a 25×20 centimeter area.

If you need to make your item smaller by scaling it down, multiply your Total Length and Total Width by fractions less than 1.

Example A (Scaled Down/Smaller):

Scale	Total Length	Total Width
1/2	$30 * 1/2 = 15$	$10 * 1/2 = 5$
3/4	$30 * 3/4 = 22.5$	$10 * 3/4 = 7.5$
1/1	$30 * 1/1 = 30$	$10 * 1/1 = 10$

A scale of 3/4 will make the item fill up most of the paper (22.5 out of 25 centimeters). The scale of this drawing would be 3:4 because it is 3/4 the size of the original item.

If you need to make your item look larger by scaling it up, multiply your Total Length and Total Width by fractions greater than 1.

Example B (Scaled Up/Larger):

Scale	Total Width
4/1	$8.5 * 3/2 = 12.75$
5/1	$8.5 * 2/1 = 17$
6/1	$8.5 * 5/2 = 21.25$

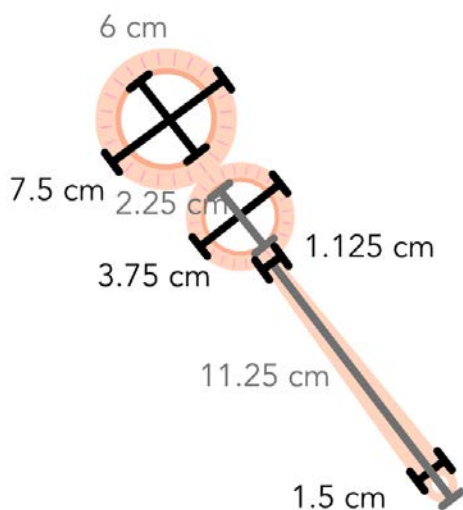
A scale of 5/1 will make this item fill up most of the paper (17 out of 25 centimeters). The scale of this item would be called 5:1 because it is 5 times bigger than the original item.

5. Write your scale in the space below:

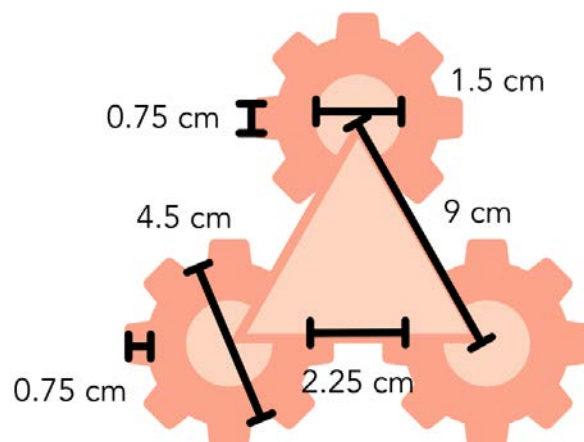
_____:

6. Multiply the measurements for each Item Component by your scale (e.g. 3/4, 5/1, etc.). When you draw each Item Component in your scale drawing, they should be this new, scaled size.

EXAMPLE A

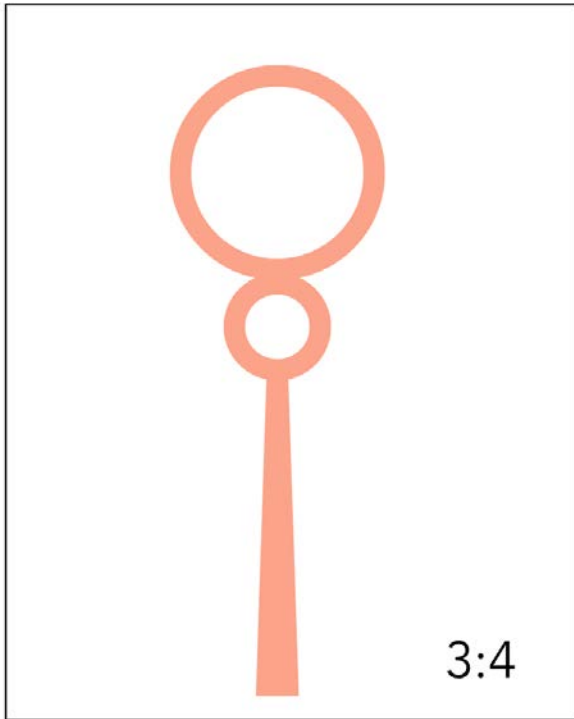


EXAMPLE B

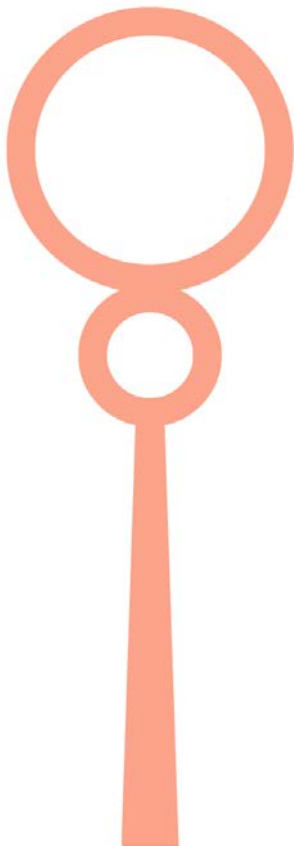
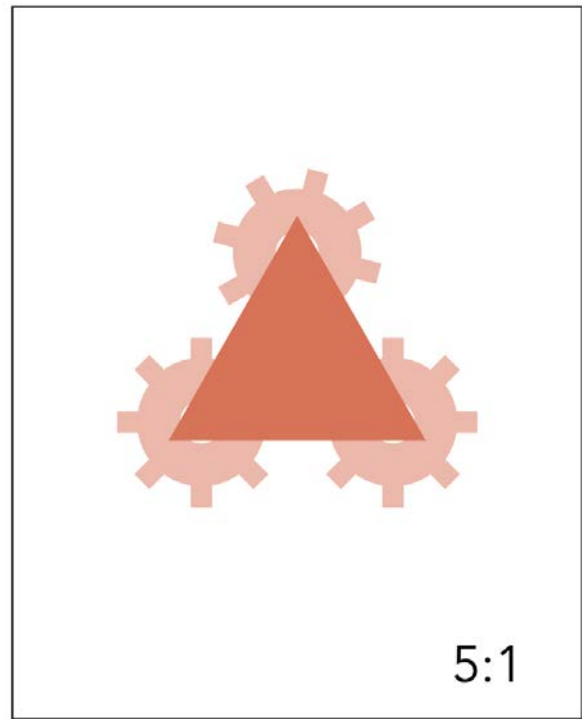




7. Use a ruler to create your scale drawing on the next page!
Make sure to write your scale (e.g. 3:4, 5:1, etc.) in the corner of the page.

EXAMPLE A

**ACTUAL
SIZE**

EXAMPLE B

**ACTUAL
SIZE**





Scale
_____:

Engineer That!: Activity 4

Overview

Students will learn how to use ethos, logos, and pathos to create a strong presentation. Using this knowledge, students will use logos and pathos while practicing their presentation skills by playing the card game “Engineer That!” Students will finish this activity by reflecting on how the skills they practiced can be used for their Junior STEM Challenge projects.

Objectives

By the end of this activity, students will be able to:

- Identify the importance of being detailed when presenting a solution or idea.
- Evaluate the importance of utilizing ethos, logos, and pathos in a presentation.
- Apply logos and pathos to give a detailed, convincing presentation.

Key Messages

- Strong arguments use ethos, logos, and pathos.
- Ethos explains why the audience should listen to the presenter.
- Pathos explains why the audience should care about what is being presented.
- Logos uses sources or other information to prove why the information being presented is true.
- Junior STEM Challenge presentations should use logos to give a detailed explanation of their solution and how it works and should use pathos to explain why the audience, including the judges, should care about their problem and solution.

Time Needed: 50 minutes

Standards

B.E.S.T. Standards: English Language Arts

ELA.6.C.2.1, Present information orally, in a logical sequence, using nonverbal cues, appropriate volume, clear pronunciation, and appropriate pacing.

ELA.7.C.2.1, Present information orally, in a logical sequence, emphasizing key points that support the central idea.

ELA.8.C.2.1, Present information orally, in a logical sequence, supporting the central idea with credible evidence.

NGSSS Gifted Learners Benchmarks

G.K12.5.3.2d, Communication-Accomplish: Analyze and synthesize the presentation skills necessary to communicate ideas, information, concerns, and solutions to a project goal.

G.K12.7.1.4d, Problem Solving-Accomplish: Address critics with prepared, defensible arguments that effectively defend solutions.

Background Information

Ethos, Logos, and Pathos

Strong presentations appeal to the audience using a mixture of ethos, an appeal to credibility; logos, an appeal to logic; and pathos, an appeal to emotion. Using each of these three factors strategically can engage the audience and motivate them to support the implementation of the idea or solution.

In a strong presentation, a presenter will use ethos, an appeal to credibility, by establishing themselves as an expert on the subject at hand and/or as a trustworthy or reliable source. As the students in the Junior STEM Challenge are not experts, students must focus on presenting their solution with confidence and professionalism.

Presenters should use logos, an appeal to logic, throughout the presentation. Providing lots of well-reasoned details can also help a presenter establish their credibility. As students present their background information and solutions, they should try to be as detailed as possible to convince the judges that their solution would work to solve their problem.

Finally, pathos, an appeal to emotion, helps connect the presenters with their audience. Students can use pathos to convince their audience to care about the problem they are addressing.

While using ethos, logos, and pathos is important in students' presentations, the focus of the presentation should be logos and pathos.

Materials (per student)

- Student Guidebook
- “Engineer That!” Instructions and Cards
- Pencil

Set-Up Procedure

1. Make sure that students have access to their student guidebooks.
2. Print or photocopy enough copies of the “Engineer That!” instructions for your students. Students will play the game, “Engineer That!” in groups or in a tournament. If they play in groups, each group will need a copy of the instructions.
3. “Engineer That!” Tournament: Create a tournament bracket for students before starting this activity. This tournament bracket can be written on the board or placed in another easily accessible location. Each student should be placed on the outside of the bracket and each pair of students should be labeled with a group number. If there is an odd number of students, they can start during Round 2 of the tournament.
4. “Engineer That!” Groups: One copy of the card game has been provided with the Junior STEM Challenge curriculum. Print out additional copies of the card game on cardstock or encourage students to take turns with the cards while playing the game. If students are taking turns with the cards, tell students to draw their “Problem” and “Solution” cards before passing the rest of the cards to the next group. Students can continue to pass the cards around the room while they play. Once all cards have been used, students can shuffle the cards and continue playing.
5. Open PowerPoint.

Activity Procedures

INTRODUCTION: <i>In this part of the activity, students will identify how they feel about giving presentations and learn how ethos, logos, and pathos can be used to create a strong presentation.</i>	
TIME REQUIRED: 10 minutes	
What the Teacher Does	Anticipated Student Behaviors/Responses
1. Tell students to sit with their Junior STEM Challenge groups and open their student guidebooks to the “Engineer That!” student activity sheet on page 44 .	1. Students will sit with their group members for the Junior STEM Challenge and open their student guidebooks to the “Engineer That!” student activity sheet.
2. Ask students the following questions: Q1: How do you feel when you have to present something to other people? Q2: Do you think all presentations are the same? Why or why not? Q3: What are some different kinds of presentations? Select several students to share their answers to each question.	2. Selected students will answer each question. R1: Student answers may vary. R2: Not all presentations will be the same. That’s because different presentations are designed to do different things. R3: Student answers may vary. Example: Presentations are used to teach information, share work, share data, or convince someone to do something.
3. Tell students that while the first round of judging in the Junior STEM Challenge is online, top student projects will be invited to the STEM Challenge Expo to present in-person. This means that everyone needs to practice their presentation skills in case they are invited to the STEM Challenge Expo!	3. Students will listen.
4. Ask students the following questions: Q1: How do you think presenting to judges is different from presenting to your teacher and classmates? Q2: What are some ways you can make your presentation stronger? Q3: Why is it important to know how to make a strong presentation for the Junior STEM Challenge? Select several students to share their answers to each question.	4. Selected students will answer each question. R1: Student answers may vary. For example: Presenting to judges is going to be scarier than presenting to my teacher and classmates because I do not know them and they will be comparing my project to others. R2: By understanding our stakeholders and our background information and sources, we can make a stronger presentation that clearly explains our points and uses evidence to support our solution. It will also help us answer the judge’s questions. R3: Student answers may vary. For example: The judges for the Junior STEM Challenge are our stakeholders, and we need to use our knowledge of our background information and our sources to convince the judges that our project should win the Junior STEM Challenge. Having a strong presentation for the judges increases our chances of winning.
5. Tell students that good presentations include three things: Ethos, logos, and pathos. Ethos explains why the audience should listen to the presenter. Pathos explains why the audience should care about what is being presented. Logos uses sources or other information to prove why the information being presented is true.	5. Students will listen.

BODY: In this section of the activity, students will play the card game “Engineer That!” to practice their presentation skills.

TIME REQUIRED: 30 minutes

What the Teacher Does	Anticipated Student Behaviors/Responses
1. Tell students that today, they will be playing a card game called, “Engineer That!” to practice our presentation skills. In this card game, students will either be an Engineer or a Judge. The Judge(s) will draw a random “Problem” card, and the Engineers will draw three “Solution” cards. Engineers will then have to use at least one of their “Solution” cards and explain to the Judge(s) how their “Solution” fixes the “Problem.” The Engineers can add whatever they want to their “Solution” and can get as creative as they want. Everyone will take turns playing as an Engineer or a Judge. If students are playing in <i>Competition Mode</i>, the Engineer that the Judge(s) think has a better presentation can earn a point and can keep the “Problem” card. In <i>Competition Mode</i>, the player with the most points at the end of the game gets the title of Best Presenter.	1. Students will listen.
2. Demonstrate the card game for students by asking for a student to volunteer to be a Judge. Tell the Judge to draw one random “Problem” card and share the card with the class. After the Judge shares the problem, draw three “Solution” cards and read them to the class. Pick a “Solution” and explain how the “Solution” fixes the “Problem.” In the example presentation, be as detailed and convincing as possible to set a strong example for students. The presentation should also address students directly, telling them why they should care about the “problem.”	2. Students will watch the demonstration. One student will volunteer to be a Judge during the demonstration.
3. Ask students the following questions: Q1: How did I use logos in my presentation? Q2: How did I use pathos in my presentation? Q3: Do you think it would make sense to use ethos in my presentation? Q4: If the Judge(s) vote for the Engineer that did the best job presenting their “Solution,” what do the Engineers need to do in their presentation? Select several students to share their answers to each question.	3. Selected students will answer each question. R1-2: <i>Student answers may vary.</i> R3: With how short the presentation was, it would not have made sense to include ethos because including the facts (logos) and the reasons why people should care (pathos) are more important for making a good presentation. R4: The Engineers need to give a detailed explanation of how their solution fixes the problem.

4. Tell students to look at the example presentations in their guidebook and put them in order from “Weak” to “Strong” presentations. Problem: Lost Hiker Solution: Map with Live Data Example 1: Satellites look for movement on the mountain that could be the lost hiker and puts the location of each movement on the map. People can go to each location to look for the hiker. Example 2: The hiker has a tracker that shows up on the map. Example 3: Rescuers use a map that updates with trail cam activity to go look for the hiker. Example 4: An AI uses satellites with thermal cameras to make a heat map of the trail where the hiker disappeared. AI identifies any odd “hot spots” on the map and sends the coordinates to the rescue team.	4. Students will organize the examples from “Weak” to “Strong” in their Student Guidebook. Exemplar Order: <table data-bbox="852 367 1125 499"> <tr> <td>Weakest</td><td>Example 2</td></tr> <tr> <td>↕</td><td>Example 3</td></tr> <tr> <td></td><td>Example 1</td></tr> <tr> <td>Strongest</td><td>Example 4</td></tr> </table>	Weakest	Example 2	↕	Example 3		Example 1	Strongest	Example 4
Weakest	Example 2								
↕	Example 3								
	Example 1								
Strongest	Example 4								
5. Tell students to either find a group of at least 3 people to play the game in <i>Competition Mode</i> or <i>Collaboration Mode</i> or tell students that they will be having a class tournament. Circulate the room to make sure students are giving strong presentations. Periodically remind students playing in <i>Competition Mode</i> to vote for the best presentation, not the easiest solution. If you see students give short presentations, encourage judges to ask questions about how it would work. Feel free to act as a Judge when passing through groups by discussing student explanations with the other Judges. Note: Additional instructions to help facilitate group or tournament gameplay can be found in the Activity Notes/ Considerations.	5. Students will play the card game “Engineer That!”								
CONCLUSION: <i>In this part of the activity, students will reflect on how the presentation skills they practiced using during the card game “Engineer That!” can apply to the Junior STEM Challenge and their future careers.</i>									
TIME REQUIRED: 10 minutes									
What the Teacher Does	Anticipated Student Behaviors/Responses								
1. After students have finished playing “Engineer That!,” ask the following questions: Q1: Was it easy or hard to convince the Judges that you had a good solution? Why? Q2: It helped to have a good “Solution” card, but was the “Solution” card the only thing that determined whether you got a point? Q3: What else helped you get a point? Select several students to share their answers to each question.	1. Selected students will answer each question. R1: <i>Student answers may vary.</i> R2: No, having a good “Solution” card did not mean we would always get the point. R3: The way the solution was explained helped make a big difference in how much the Judges liked it. The more creative and detailed we were, the more the Judges wanted to give us a point.								

2. Tell students to remember that students that pass the first round of judging will be invited to present their Junior STEM Challenge projects at the STEM Challenge Expo.	2. Students will listen.
3. Ask students the following questions: Q1: The Junior STEM Challenge is very different from a card game. How can you use the skills you practiced playing “Engineer That!” to present your Junior STEM Challenge projects? Q2: Why do you think it’s important that we practiced these skills now? Select several students to share their answers to each question.	3. Selected students will answer each question. R1: Just like how we needed to explain our “Solution” cards in detail and explain why the Judge(s) should care, we will need to explain our Junior STEM Challenge solution in the same way. R2: It is important to practice our presentation skills now so that we are ready to present in case we are invited to STEM Challenge Expo. If we wait until we know whether we are invited to the Expo, we will not have much time to practice.
4. Tell students that having good presentation skills is good for the Junior STEM Challenge, but it’s also important in life. Lots of different jobs require good presentation skills, including scientists, teachers, politicians, and salespeople.	4. Students will listen.
5. Ask students the following question: Q1: How can you take the skills you practiced in this game and use them in your life? Select several students to share their answers to the question.	5. Selected students will answer the question. R1: <i>Student answers may vary. Example: I can use these skills to give better presentations in class or convince my parents to let me play certain video games.</i>

Notes/Considerations

Students should be allowed to ask clarifying questions at any time during the lesson.

This optional activity can be taught in part or in full to adjust for different class lengths. If the activity is too long for a designated class period, class discussions can be omitted, or the activity can be taught in several sections over the course of a few class periods. If discussions are omitted, the answers to each question should be reviewed for students.

If you need to provide additional guidance for students about how to play the game, use the following instructions:

“Engineer That!” Group Gameplay: Help facilitate group gameplay by giving students the following instructions:

- Shuffle your “Problem” cards and “Solution” cards.
- Two people in your group will start as the **Engineers**. If you aren’t an **Engineer**, you will be a **Judge**.
- **Judges**, draw one random “Problem” card for your group and read it to the **Engineers**.
- **Engineers**, draw three random “Solution” cards. Read your cards and pick the “Solution” cards you think you can use to fix the “Problem.” You have to use at least one of your cards. Put any cards you won’t be using into a discard pile.
- If your group is playing in *Competition Mode*, **Engineers** will give separate presentations, each explaining to the **Judges** how their “Solution” cards fix the “Problem.” The **Judges** will give a point to the **Engineer** that gave the best presentation.
- If your group is playing in *Collaborative Mode*, **Engineers** will work together to present a solution to the **Judges**. The **Judges** will then either approve or disapprove of the solution. If the **Judges** think the solution would work, place the “Problem” card in an “Approved” pile. If the **Judges** do not think

the solution would work, place the “Problem” card in a “Disapproved” pile.

- Get creative with it! Maybe your drone shoots missiles, you have a nano-bot army, or your 3D printer prints titanium. You can add as much to your “Solution” as you want – it doesn’t have to be super realistic. Remember, your goal isn’t to have the perfect solution, but to practice your presentation skills. Try to be convincing! And **Judges**, you can ask the **Engineers** any questions you have about their solution.
- Once both **Engineers** have presented their “Solution” and Judges have had a chance to ask questions, the **Judges** can give the **Engineer** with the better presentation a point and the “Problem” card.
- Rotate roles in your group and do it again.
- If your group is playing in *Competition Mode*, once you’re done with X rounds or at X:XX, the person with the most points in your group will get to be the **Best Presenter**.
- If your group is playing in *Collaboration Mode*, once you’ve solved 10 problems, count how many “Problem” cards are in the “Approved” pile. If you have 10 approved cards, you are Masters! If you have 7, 8 or 9 cards, you’re
- 7-9 Cards: Teachers
- 5-6 Cards: Apprentices
- 2-4 Cards: Students
- 1 Card: Newbies

“Engineer That!” Tournament: Help facilitate the tournament using the following instructions:

- Look at the bracket and find the other students with your group number. Move to stand with your group.
- If you’re on the left side of the bracket, you will start as **Engineers**. If you’re on the right side of the bracket, you will start as **Judges**.
- Shuffle your “Problem” cards and “Solution” cards.
- **Judges**, draw one random “Problem” card for your group and read it to the **Engineers**.
- **Engineers**, draw three random “Solution” cards. Read your cards and pick the “Solution” you think is the best for the “Problem.” Put the two cards you won’t be using into a discard pile.
- **Engineers**, explain to the **Judges** how your “Solution” fixes the “Problem.” Get creative with it! Maybe your drone shoots missiles, you have a nano-bot army, or your 3D printer prints titanium. You can add as much to your “Solution” as you want – it doesn’t have to be super realistic. Remember, your goal isn’t to have the perfect solution, but to practice your presentation skills. Try to be convincing! And **Judges**, you can ask the **Engineers** any questions you have about their solution.
- Now that both **Engineers** have presented their “Solution” and **Judges** have had a chance to ask questions, the **Judges** can give the **Engineer** with the better presentation a point and the “Problem” card.
- Switch roles and do it again. If you’re on the left side of the bracket, you’re now a **Judge**. If you’re on the right side of the bracket, you’re now an **Engineer**.
- Now that we’re done with the first round of the tournament, the left and right side of the bracket should find the group next to them on the tournament bracket. Group 1 on the left should find Group 2 on the left, Group 3 on the left should find Group 4 on the left, etc. Keep going and combining groups until you’re left with the **Best Presenter**!



Activity 4: Engineer That!

Look at the Problem and Solution listed below and read each example presentation. These presentations explain how the solution fixes the problem. Put each presentation in order from the “Weakest” presentation to the “Strongest” presentation.

Problem: Lost Hiker

Solution: Map with Live Data

Example 1: Satellites look for movement on the mountain that could be the lost hiker and puts the location of each movement on the map. People can go to each location to look for the hiker.

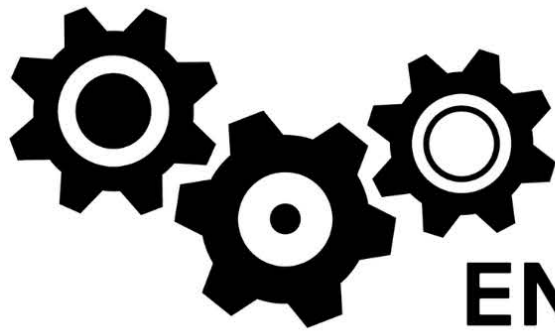
Example 2: The hiker has a tracker that shows up on the map.

Example 3: Rescuers use a map that updates with trail cam activity to go look for the hiker.

Example 4: An AI uses satellites with thermal cameras to make a heat map of the trail where the hiker disappeared. AI identifies any odd “hot spots” on the map and sends the coordinates to the rescue team.

Weakest ← → Strongest

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ENGINEER THAT!

SET UP

Shuffle the “Problem” cards and shuffle the “Solution” cards, placing both decks face-down on the table.

Judging a Solution

Judges should look for the **Engineer** that has the best presentation, not the **Engineer** with the easiest “Solution.”

Judges should look for the following:

- Explanation makes sense
- Explanation is detailed
- **Engineer** sounds excited
- **Engineer** sounds confident
- **Engineer** is creative
- **Engineer** can answer questions

Presenting a Solution

- Engineers can add additional information to their “Solution” card. For example, the “Problem” of a “Lost Hiker” could have a “Solution” card for a “Map with Live Data.”
- The **Engineer** could say that Artificial Intelligence uses a live satellite heat map to locate the lost hiker. While the card was not “Artificial Intelligence” or “Thermal Imaging Camera,” the explanation used a “Map with Live Data.”

Judges can ask the presenting Engineers questions and Engineers can argue against each other to explain why their opponent’s “Solution” would not work.

Get creative! Have your 3D printer print glass, a fan blow sleeping gas, teleport inside the giant monster, or use super-strong magnets to stop the alien invasion!

Group Rules (3+ Players)

1. Two players will start as **Engineers** and the rest of the players will be **Judges**.
2. The **Judges** will draw one random “Problem” card and read it to the group.
3. The **Engineers** will each draw three random “Solution” cards. **Engineers** can place any cards they do not want into the discard pile.
4. The **Engineers** will explain how their “Solution” cards can be used to fix the “Problem.” **Judges** can ask the **Engineers** questions.
 - *Competition Mode:* **Engineers** compete to give the best presentation. The **Judges** will pick the **Engineer** who had the best presentation to earn one point and keep the “Problem” card.
 - *Collaborative Mode:* The **Engineers** work together to present their solution to the **Judges**. The **Judges** will either approve or disapprove of the solution based on the **Engineers** presentation. Place the “Problem” card in an “Approved” or “Disapproved” pile.

Rotate roles in the group and repeat steps 3-7.

- *Competition Mode:* Play at least two rounds of the game or for as long as you have time. At the end of the game, the title of **Best Presenter** will be given to the player with the most points.
- *Collaboration Mode:* Solve 10 “Problem” cards and count the number of cards in the “Approved” pile.
 - **10 Cards:** Masters
 - **7-9 Cards:** Teachers
 - **5-6 Cards:** Apprentices
 - **2-4 Cards:** Students
 - **1 Card:** Newbies



ENGINEER THAT!

INSTRUCTIONS



ENGINEER THAT!

INSTRUCTIONS

Tournament Rules (3+ Players)

1. Play as one large group. Create a Tournament Bracket with the names of everyone who will be playing the game. The Tournament Bracket should be put somewhere where everyone can see it.
2. All players will have a chance to be **Judges** and **Engineers** during the tournament.
3. The left side of the bracket will start as **Engineers** and the right side of the bracket will start as **Judges**.
4. Each pair of **Judges** will randomly pick one "Problem" card and will read it to a pair of **Engineers**.
5. Each **Engineer** will then draw three random "Solution" cards and will pick one card to keep, putting their other two cards into the discard pile.
6. The **Engineers** will each explain how their "Solution" card fixes the "Problem." **Judges** can ask each **Engineer** questions.
7. Once both **Engineers** have had a chance to present their "Solution," the **Judges** will pick the **Engineer** who had the best presentation to move forward in the tournament. The players will then update the Tournament Bracket by writing the name of the winning **Engineer** in the next bracket.
8. The players will then switch roles so that the players on left side of the bracket are **Judges** and the players on the right side of the bracket are **Engineers**. Repeat steps 4-7.
9. Once the first round of the tournament has been completed, players will combine groups for the second level of the bracket and repeat steps 3-8.
10. The last **Engineer** standing gets the title of **Best Presenter**.

Example Tournament Bracket



Map with
Live Data



ENGINEER THAT!

Artificial
Intelligence



ENGINEER THAT!

Remote-
Controlled
Robot



ENGINEER THAT!

Drones



ENGINEER THAT!

Nano-
Robot



ENGINEER THAT!

Autonomous
Vehicle



ENGINEER THAT!

Wearable
Power Suit



ENGINEER THAT!

Virtual or
Augmented
Reality

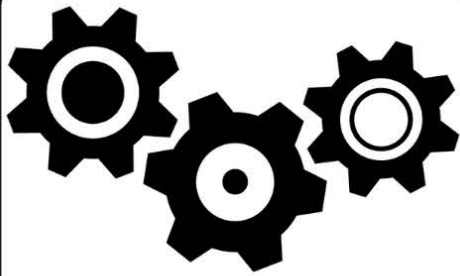


ENGINEER THAT!

Smart
Sensors



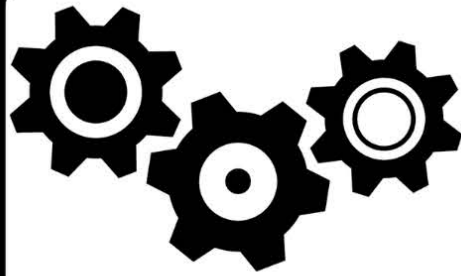
ENGINEER THAT!



**ENGINEER
THAT!**



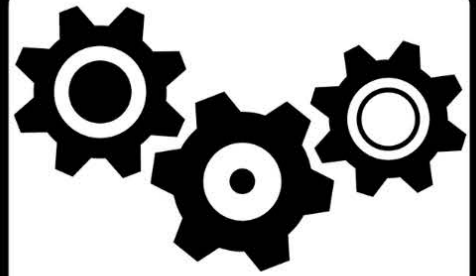
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**ENGINEER
THAT!**



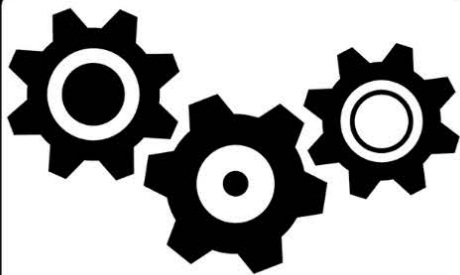
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**ENGINEER
THAT!**



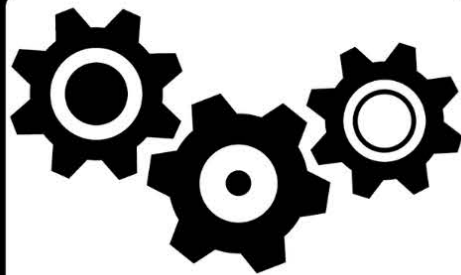
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**ENGINEER
THAT!**



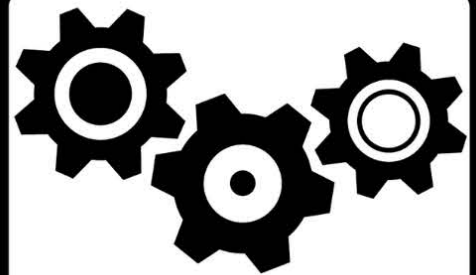
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**ENGINEER
THAT!**



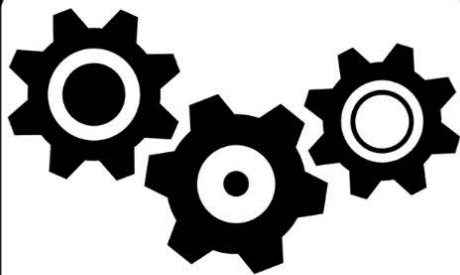
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**ENGINEER
THAT!**



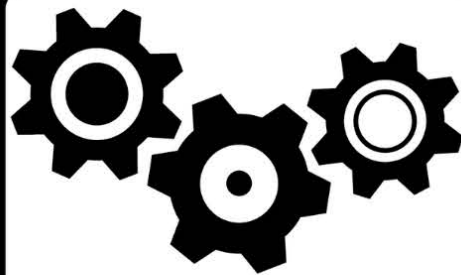
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**ENGINEER
THAT!**



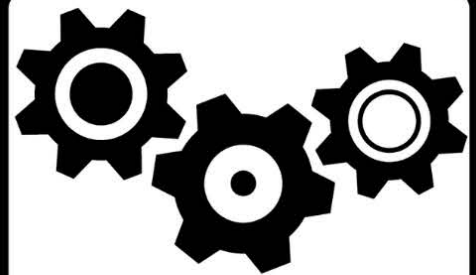
SOLUTION



**ENGINEER
THAT!**



SOLUTION



**ENGINEER
THAT!**



SOLUTION

Motion-
Activated
Cameras



ENGINEER THAT!

Tracking
Device



ENGINEER THAT!

Water
Cannon



ENGINEER THAT!

Ultra-
Strong
Superglue



ENGINEER THAT!

Supersonic
Speaker



ENGINEER THAT!

Motion
Sensor



ENGINEER THAT!

Super-
Strong
Magnets



ENGINEER THAT!

3D
Printer

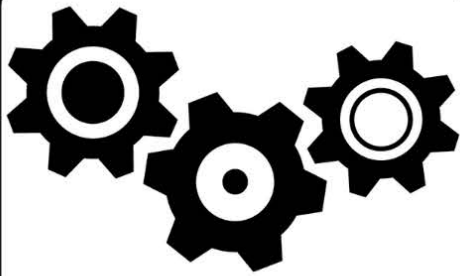


ENGINEER THAT!

X-Ray
Goggles



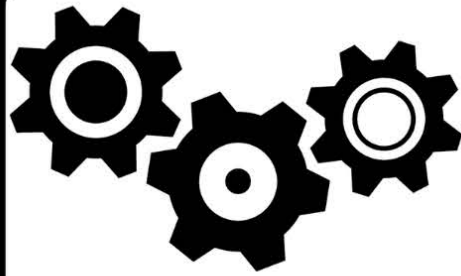
ENGINEER THAT!



**ENGINEER
THAT!**



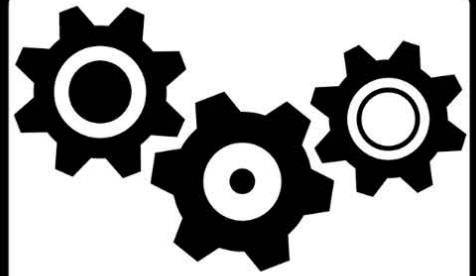
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**ENGINEER
THAT!**



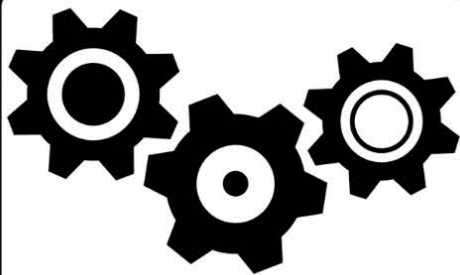
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**ENGINEER
THAT!**



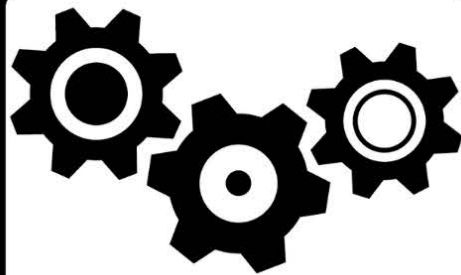
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**ENGINEER
THAT!**



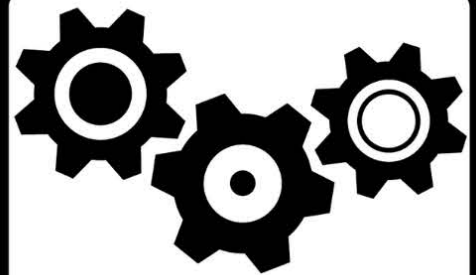
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**ENGINEER
THAT!**



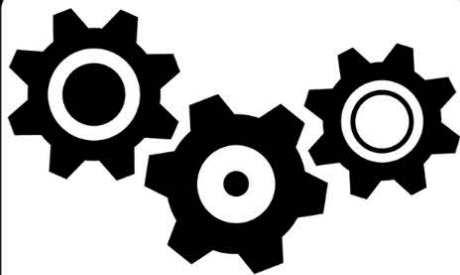
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**ENGINEER
THAT!**



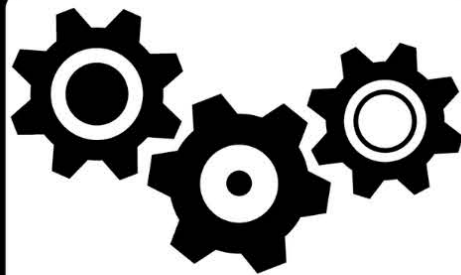
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**ENGINEER
THAT!**



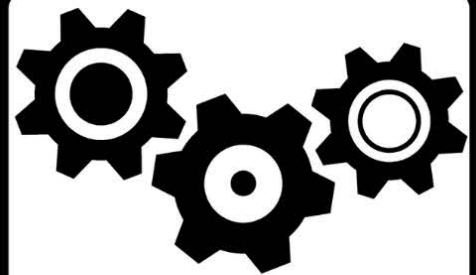
SOLUTION



**ENGINEER
THAT!**



SOLUTION



**ENGINEER
THAT!**



SOLUTION

Teleportation
Device



ENGINEER THAT!

Force
Field



ENGINEER THAT!

Jetpack



ENGINEER THAT!

Cooling
Fan



ENGINEER THAT!

Titanium
Net



ENGINEER THAT!

Satellites



ENGINEER THAT!

Unbreakable
Tape



ENGINEER THAT!

Thermal
Imaging
Camera

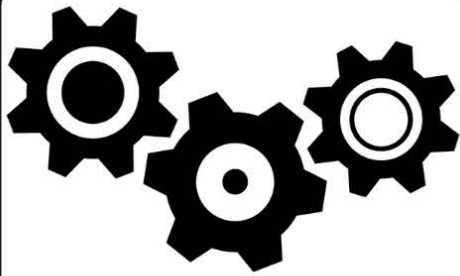


ENGINEER THAT!

Night
Vision
Camera



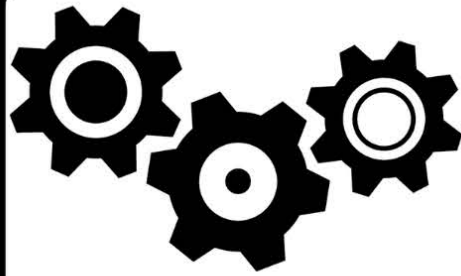
ENGINEER THAT!



**ENGINEER
THAT!**



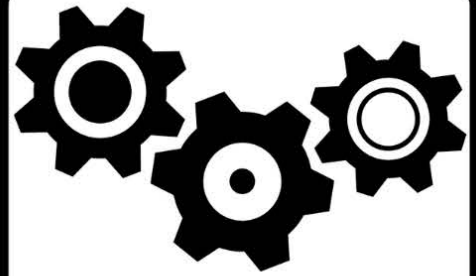
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THAT!**



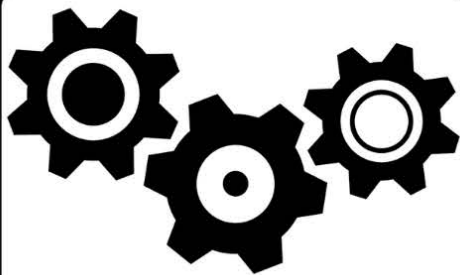
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**ENGINEER
THAT!**



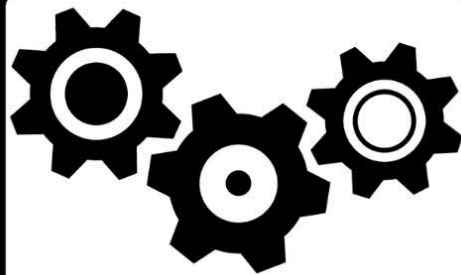
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**ENGINEER
THAT!**



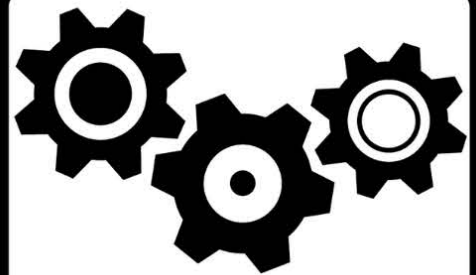
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**ENGINEER
THAT!**



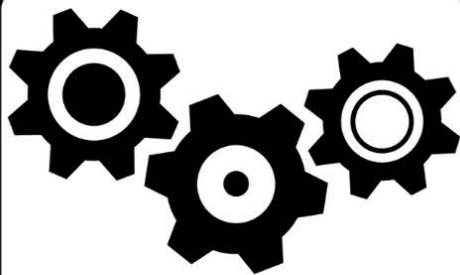
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**ENGINEER
THAT!**



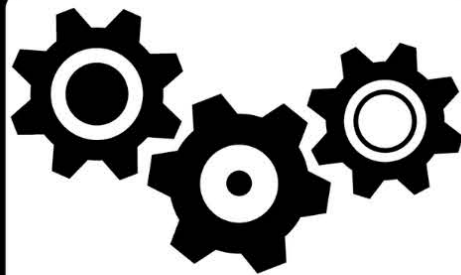
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**ENGINEER
THAT!**



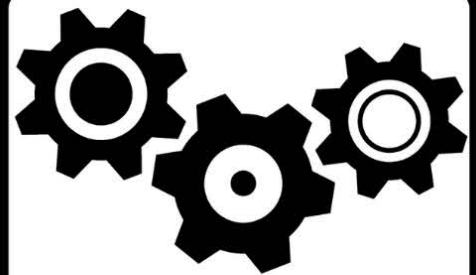
SOLUTION



**ENGINEER
THAT!**



SOLUTION



**ENGINEER
THAT!**



SOLUTION

Flamethrower



ENGINEER THAT!

Weather
Controller



ENGINEER THAT!

Smart
Glasses



ENGINEER THAT!

Hoverboard



ENGINEER THAT!

Hologram
Projector



ENGINEER THAT!

Giant
Suction
Cup



ENGINEER THAT!

Drill



ENGINEER THAT!

Ice Ray

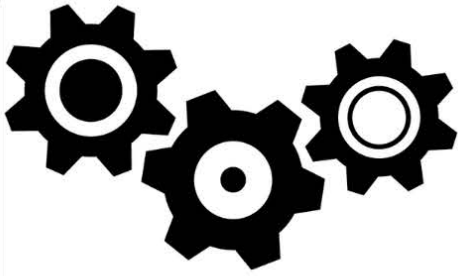


ENGINEER THAT!

Laser
Beam



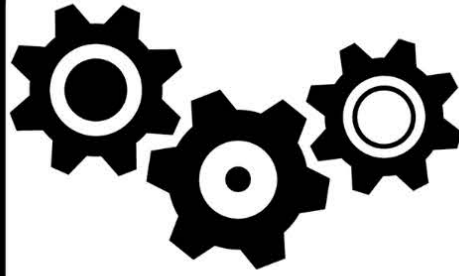
ENGINEER THAT!



**ENGINEER
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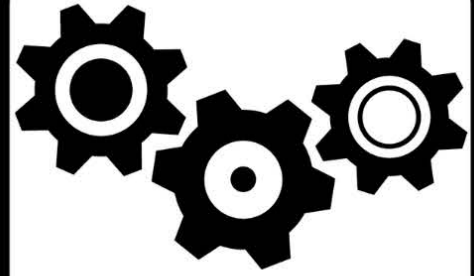
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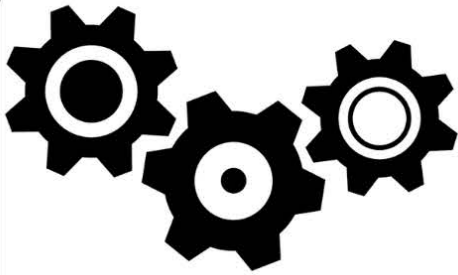
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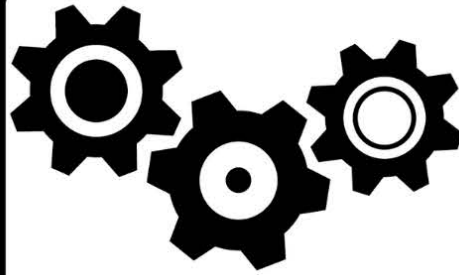
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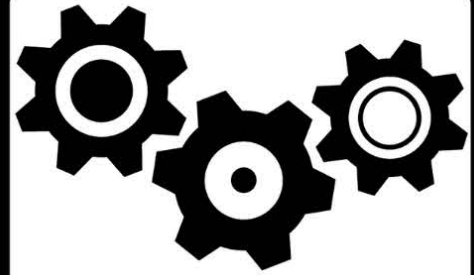
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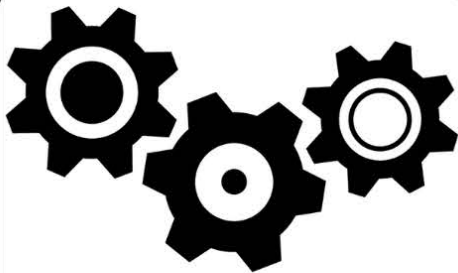
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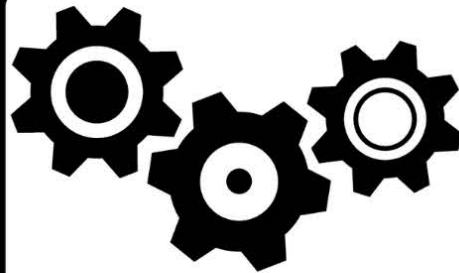
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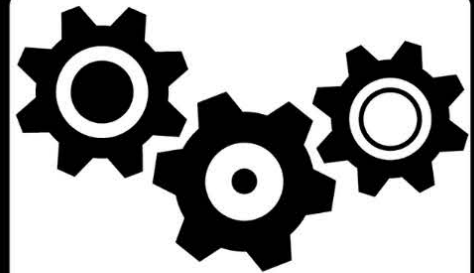
SOLUTION



**ENGINEER
THAT!**



SOLUTION



**ENGINEER
THAT!**



SOLUTION

Universal Remote



ENGINEER THAT!

Rocket



ENGINEER THAT!

Universal Translator



ENGINEER THAT!

Shield



ENGINEER THAT!

Phone a Friend

Pick someone, real or
imaginary, to call for help



ENGINEER THAT!

Zero Gravity Ray



ENGINEER THAT!

Animal Sidekick

Pick an animal



ENGINEER THAT!

Infinite Material

Pick one material

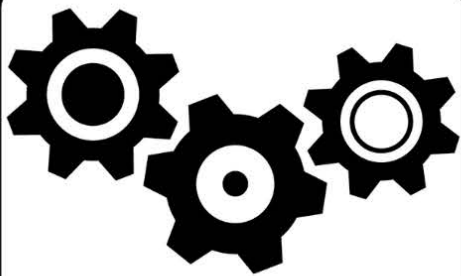


ENGINEER THAT!

Wild Card! Make your own solution



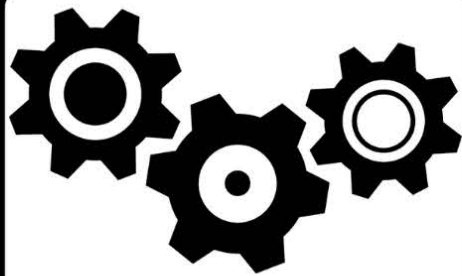
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THAT!**



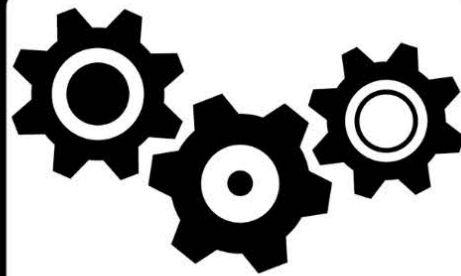
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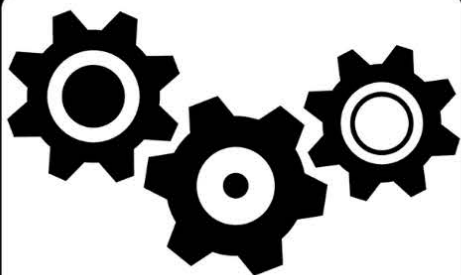
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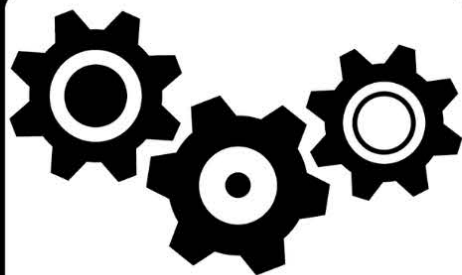
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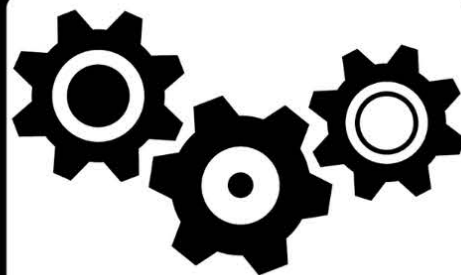
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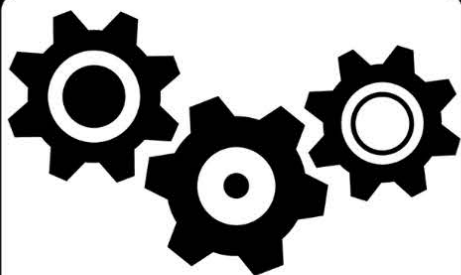
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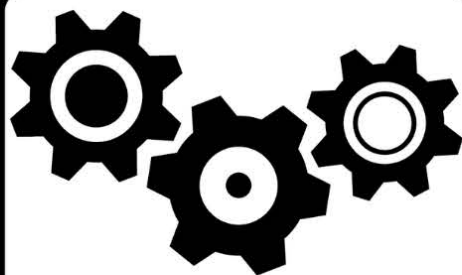
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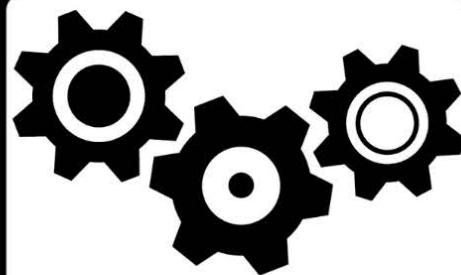
SOLUTION



**ENGINEER
THAT!**



SOLUTION



**ENGINEER
THAT!**



SOLUTION

Uncontrolled
Wildfire



ENGINEER THAT!

Polluted
Water
Supply



ENGINEER THAT!

Lost
Hiker



ENGINEER THAT!

Shoplifting
Outbreak



ENGINEER THAT!

Breaking
Bridge



ENGINEER THAT!

Ocean
Plastic
Pollution



ENGINEER THAT!

Drought
on a Farm



ENGINEER THAT!

Sorting
Recycled
Items

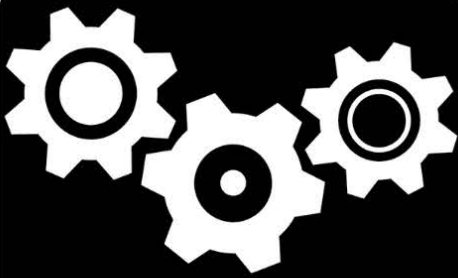


ENGINEER THAT!

Air
Pollution



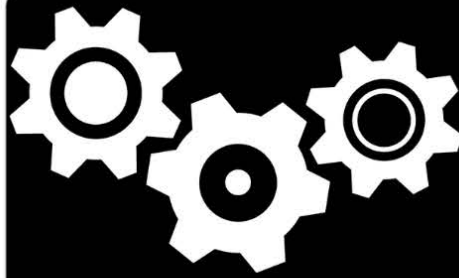
ENGINEER THAT!



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THAT!**



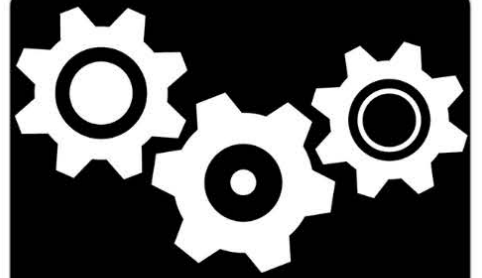
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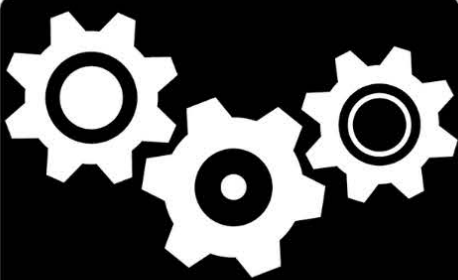
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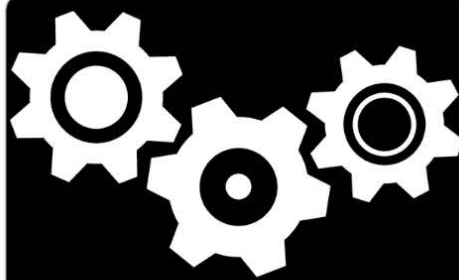
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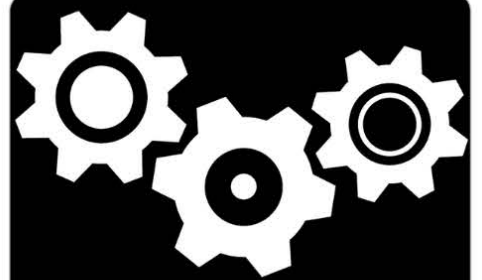
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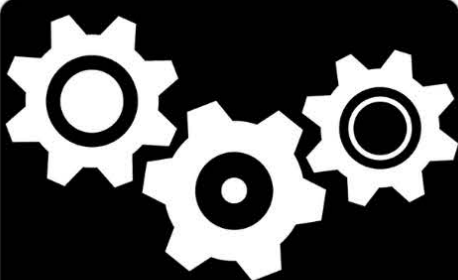
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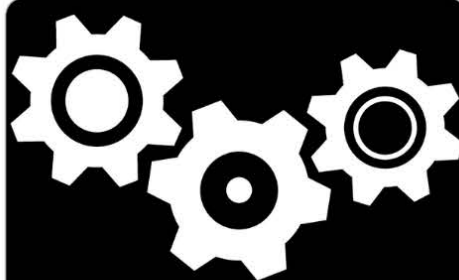
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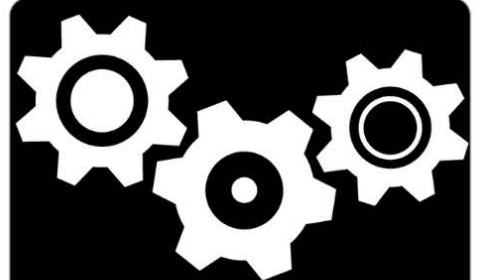
PROBLEM



**ENGINEER
THAT!**



PROBLEM



**ENGINEER
THAT!**



PROBLEM

Lots of
Traffic



ENGINEER THAT!

Flooding



ENGINEER THAT!

Food
Waste



ENGINEER THAT!

Lost
Packages



ENGINEER THAT!

Large
Sinkhole



ENGINEER THAT!

Broken
Rollercoaster



ENGINEER THAT!

Space Station
Air Leak



ENGINEER THAT!

Potholes

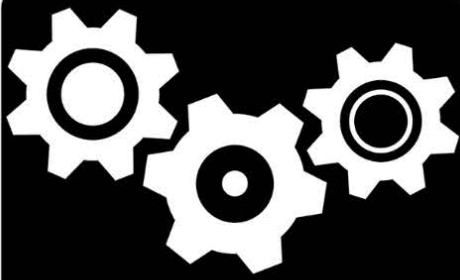


ENGINEER THAT!

City
Power
Outage



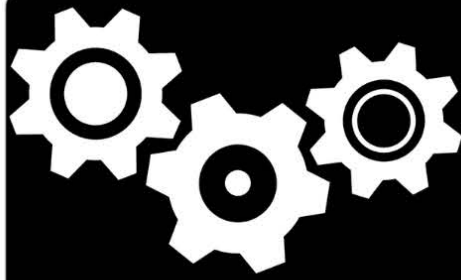
ENGINEER THAT!



**ENGINEER
THAT!**



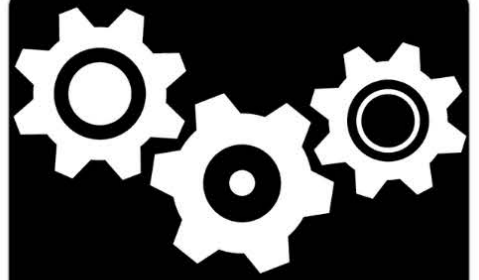
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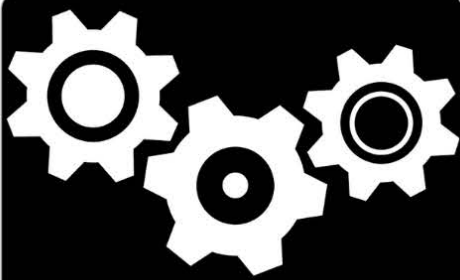
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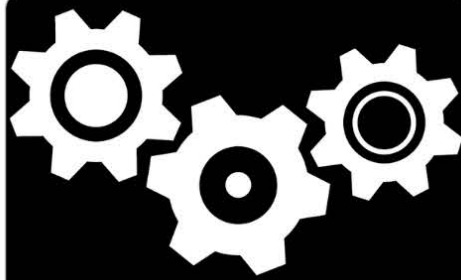
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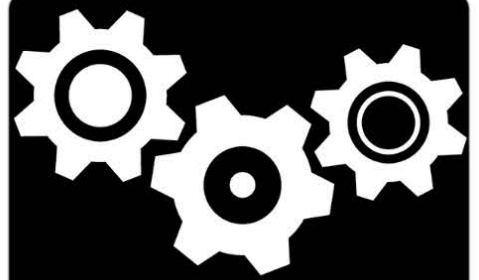
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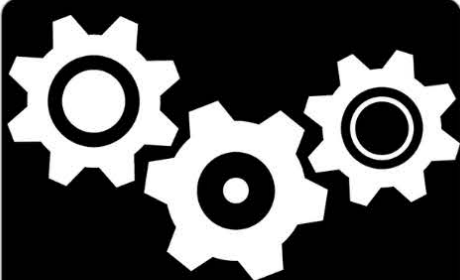
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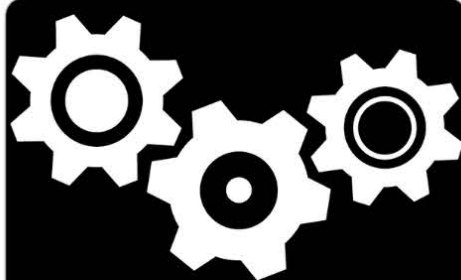
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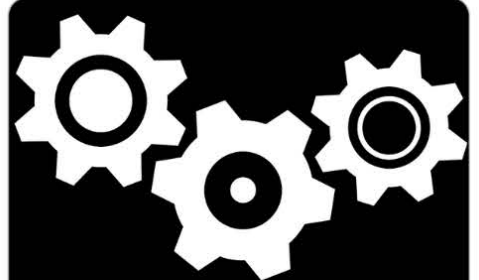
PROBLEM



**ENGINEER
THAT!**



PROBLEM



**ENGINEER
THAT!**



PROBLEM

Swarm of
Mosquitoes



ENGINEER THAT!

Giant
Monster



ENGINEER THAT!

Tsunami



ENGINEER THAT!

Sinking
Ship



ENGINEER THAT!

Alien
Invasion



ENGINEER THAT!

Robot
Takeover



ENGINEER THAT!

The Sun
Explodes



ENGINEER THAT!

Spaceship
Pulled Toward
Blackhole

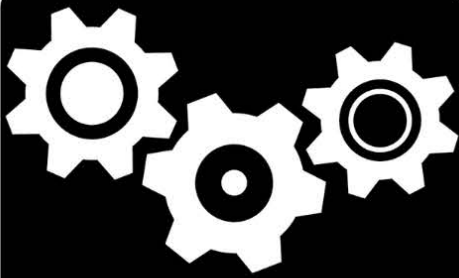


ENGINEER THAT!

Zombie
Apocalypse



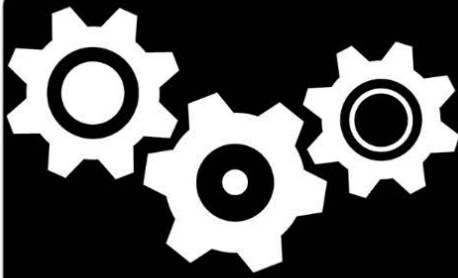
ENGINEER THAT!



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THAT!**



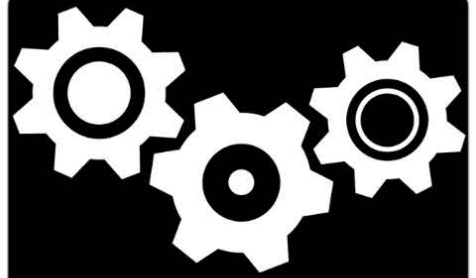
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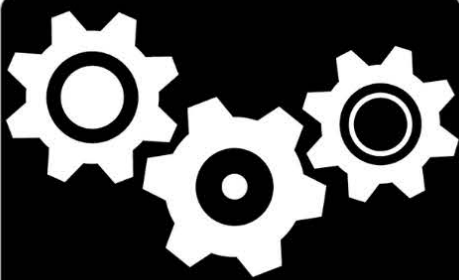
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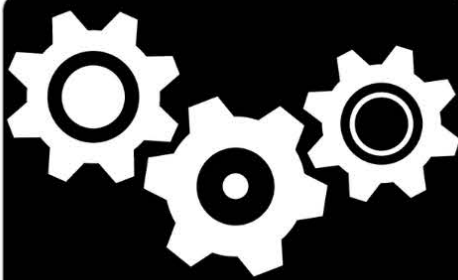
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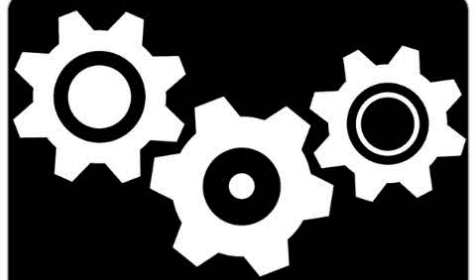
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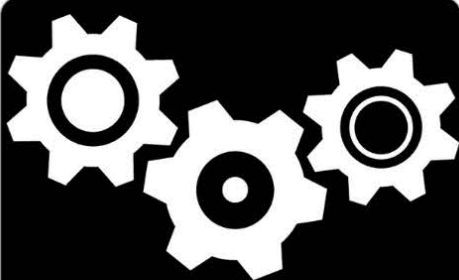
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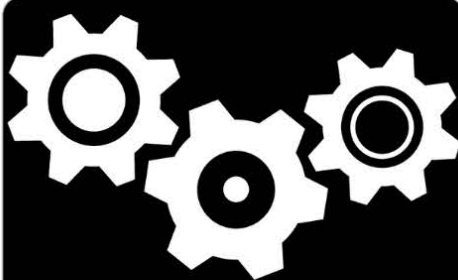
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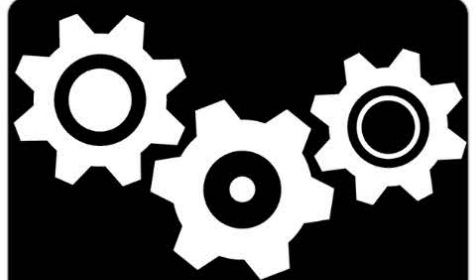
PROBLEM



**ENGINEER
THAT!**



PROBLEM



**ENGINEER
THAT!**



PROBLEM

Earthquake



ENGINEER THAT!

Tornado
Outbreak



ENGINEER THAT!

Wild Card!

Make your own
problem



ENGINEER THAT!



**ENGINEER
THAT!**



PROBLEM



**ENGINEER
THAT!**



PROBLEM



**ENGINEER
THAT!**



PROBLEM

Mix-it-up: Multipurpose Activity

Overview

Students will create outlines for their solution or presentation. Students will then present their outline to other students, get feedback, and adjust their outlines as needed.

This activity can be used one or two times during the Junior STEM Challenge. The “Mix-it-up” activity can be used to help students refine both their solutions and their presentations.

Objectives

By the end of this activity, students will be able to:

- Identify what they need to include in their solution or presentation.
- Define constructive criticism.
- Give and receive constructive criticism.
- Refine their solution or presentation.

Key Messages

- Constructive criticism is a type of feedback where people point out how something could be made better. The criticism is nice and helpful.
- Destructive criticism is a type of feedback where people say something is bad. The criticism is mean and not helpful.
- Junior STEM Challenge solutions need to include how the solution is made, what the solution is made of, and how much the solution costs.
- Junior STEM Challenge presentations need to explain why people should want to use the solution. The presentation should have explain why the solution would work and why the solution is better than other solutions.
- Strong presentations use evidence.

Time Needed: 30+ minutes

Standards

NGSSS Gifted Learners Benchmarks

G.K12.4.1.5c, Creative Thinking - Perform: Elaborate ideas through collaborative processes with colleagues.

G.K12.4.3.3d, Communication - Accomplish: Advocate convincingly to diverse audiences using sophisticated techniques (oral, written, technological) appropriate to the field and audience.

NGSSS Science Benchmarks

SC.6.N.1.5, Recognize that science involves creativity, not just in designing experiments, but also in creating explanations that fit evidence.

SC.6.N.2.2, Explain that scientific knowledge is durable because it is open to change as new evidence or interpretations are encountered.

SC.7.N.1.6, Explain that empirical evidence is the cumulative body of observations of a natural phenomenon on which scientific explanations are based.

SC.8.N.4.1, Explain that science is one of the processes that can be used to inform decision making at the community, state, national, and international levels.

SC.8.N.4.2, Explain how political, social, and economic concerns can affect science, and vice versa.

Background Information

Types of Criticism

While many types of criticism exist, criticism can usually be categorized as either constructive or destructive. The main way to differentiate between constructive and destructive criticism is to identify the intent behind it.

Destructive criticism points out problems in a product without providing any actionable feedback. Destructive criticism can be recognized by its vague identification of any problems in the product. For example, instead of stating, “The solution presented did not identify what specific materials were being used,” the criticism may be, “The solution is bad” or, “The materials aren’t good enough.” Providing vague feedback ensures that the problem is not identified and cannot be addressed or fixed and provides no suggestions on how to rectify the issue. Finally, destructive criticism also includes criticism aimed at the creator instead of the product.

Constructive criticism, on the other hand, aims to identify both the problems or areas for improvement in a product and provides suggestions on how to fix them. While constructive and destructive criticism can both point out and identify the same problem, the difference lies in how the flaw is addressed. For example, while destructive criticism may state, “This solution’s risk is bad,” constructive criticism of the same problem may state, “The solution has a high financial risk. You should explain why this risk is worth taking.” While neither type of criticism fixed the problem, the constructive criticism provided a suggested direction that can be taken to solve the problem.

Materials (per student)

- Student Guidebook
- Solution or Presentation Checklist – 5 (per Junior STEM Challenge project)
- Pencil

Set-Up Procedure

1. Make sure that students have access to their student guidebooks and their in-progress Junior STEM Challenge projects.
2. Let students know that they should have a draft of their solution or presentation ready for class in the days leading up to of the “Mix-it-up” activity. Make sure students know that they will be presenting their draft to each other for feedback, but that they will not have to present in front of the entire class.
3. The checklists needed for this activity are not in the Student Guidebook. Print several copies of the desired solution or presentation checklist for each group. This way each group can receive feedback several times.
4. Open PowerPoint.

Activity Procedures

INTRODUCTION: In this part of the activity, students will discuss the importance of receiving constructive criticism from their peers.	
TIME REQUIRED: 8 minutes	
What the Teacher Does	Anticipated Student Behaviors/Responses
1. Tell students to sit with their Junior STEM Challenge groups and open their student guidebooks to the “Mix-it-up” student activity sheet on page 45 .	1. Students will sit with their group members for the Junior STEM Challenge and open their student guidebooks to the “Mix-it-up” student activity sheet.
2. Ask students to answer the questions on their activity sheet. If you have already used the “Mix-it-up” activity, you may review student answers and skip steps 3-6 in the “Introduction” of the activity. As students record their answers in their Student Guidebooks, circulate the classroom looking for specificity. Encourage students with vague answers to go back and narrow down their responses.	2. Students will answer or review questions 1-2 on their activity sheet. Q1: For each piece of feedback below, label it as “constructive criticism (CC),” which is helpful criticism, or “destructive criticism (DC),” which is unhelpful criticism. You look bad and so I couldn’t pay attention to your project. A: DC Your project is bad. A: DC I can’t tell what your model is showing. You should add labels. A: CC Your solution won’t work. A: DC I don’t understand how your solution works. Can you give me more details? A: CC I would be able to pay attention to your presentation more if you stopped looking at your phone. A: CC Q2: What do you think constructive criticism means? A: Student answers may vary. For example: I think constructive criticism is feedback that helps someone improve something they are working on. Q3: How is constructive criticism different from other kinds of criticism? A: Constructive criticism is helpful while other types of criticism can be mean and point out problems without helping the person make things better.
3. Select several students to share their answers.	3. Selected students will share their answers.
4. Tell students that today they will be giving each other feedback on their Junior STEM Challenge solution or presentation.	4. Students will listen.
5. Ask students to talk with their group about why it is important that they only use constructive criticism when giving feedback to each other today. Students should discuss the importance of constructive criticism for at least 2 minutes.	5. Students will talk in their groups about why they should use constructive criticism when giving feedback.
6. Ask each group to share what they discussed.	6. Groups will share what they discussed.

RECEIVING FEEDBACK: *In this part of the activity, students will identify the components they need to address in their solution or presentation before presenting it to their peers to receive constructive feedback.*

TIME REQUIRED: 22 minutes

What the Teacher Does	Anticipated Student Behaviors/Responses
1. Pass out either the solution or presentation checklist to each student group and tell students to take a minute to read over the checklist to learn what they need to have a strong solution or presentation. Let students know that they might not have everything on their checklist. This is okay because they are still working on making their solution or presentation. They can always add anything that they are missing later.	1. Students will read over the checklist.
2. Tell students that they will be giving each other feedback using this checklist.	2. Students will listen.
3. Ask students the following question: Q1: What do you think is the point of this activity? Select several students to share their answers to the question.	3. Selected students will share their answers. R1: The point of this activity is to get feedback that we can use to make our Junior STEM Challenge project better.
4. Tell students to use what they have so far to create an outline that covers each of the items on their checklist. They will use this outline to present their solution or presentation to other groups. Tell students that if they do not have something that is on their checklist, they draft their ideas in their outline. Give students at least 5 minutes to create their outline. Make sure students know that the outline should contain brief statements and not complete sentences. These should be bullet points. As students draft an outline, circulate the classroom. If students are writing complete sentences, remind students that their outlines should be short statements. When they are presenting their outline to another group for feedback, they should not their outline word-for-word. The outline should only be used to help them remember what they need to talk about.	4. Students will create an outline that contains the main points of their solution or presentation.
5. Tell students to practice presenting their outline with their group. Suggest that groups use this time to figure out which students in their group will be presenting each part of their outline. As students practice, circulate the classroom to provide general feedback.	5. Students will practice presenting their outline.

6. Tell students to find another group. Once they find another group, each group should take turns presenting their outline to each other. As one group presents, the other group should take notes and check items off the checklist. Remind students that the goal of this activity is to give each other constructive criticism to help them improve their Junior STEM Challenge projects. If needed, students can partner with more than one group.	6. Students will listen.
7. Tell students that each presentation should only take about 5 minutes. Set a 5-minute timer and tell students to begin their first presentation. As students present, circulate the classroom to provide general feedback. Do not interrupt student presentations and only provide general feedback when there is a natural pause in the presentation.	7. Students will either present their outline or review the other group's presentation, checking items off the checklist.
8. After the timer goes off, tell students to take 3 minutes to talk with their group. The presenting group should talk about the things they want to improve, and the reviewing group should finish filling out and adding any additional notes to the checklist. Set a 3-minute timer.	8. Reviewing students will review the checklist items and add notes. Presenting students will discuss how they want to improve their presentation.
9. Tell students to switch roles and repeat the review process. The students that just presented will now review the presentation of their partnered group.	9. Students will switch roles and repeat steps 7-8.
10. Once both groups have presented, tell students to trade their checklists and read each other's feedback.	10. Students will trade checklists and read their feedback.
11. Tell students to ask each other any questions they have about the feedback they received.	11. Students will ask their reviewers questions about the feedback they received.
CONCLUSION: In this part of the activity, students will utilize the feedback they received to refine their solution or presentation.	
TIME REQUIRED: 0-30 minutes* *The feedback process can repeat as long as time allows	
What the Teacher Does	Anticipated Student Behaviors/Responses
1. Tell students to go back and add onto their outlines using the feedback they received, get a new checklist, find a new group, and repeat the feedback process. Students should continue the process of presenting and giving feedback for as long as time allows.	1. Students will refine their outlines, get a new checklist, find a new group, and repeat the feedback process.

Notes/Considerations

Students should be allowed to ask clarifying questions at any time during the lesson.

If students need additional time to "Mix-it-up," you can optionally give students extra checklists to take home. These checklists can be given to family or friends outside of class to receive extra feedback on their solution or presentation. This can either be optional for students or given to students as a homework assignment.

Reviewer Name(s):_____

STEM Challenge: Pitch Checklist and Feedback Form

Presenter Name(s):_____

Reviewer Name(s):_____

Pitch Checklist		
✓	Item Addressed	Notes
	Explains the Problem	
	Explains Why the Audience and Stakeholders Should Care (Pathos)	
	Explains the Solution	
	Explains the Solution Materials	
	Explains What the Solution Costs	
	Explains Problems with the Solution (Expensive, Ugly, Only Fixes Part of the Problem, etc.)	
	Explains Why it Would Work Using Sources (Logos)	
	Sounds Confident in Solution (Ethos)	

Additional Notes:

Activity 5: Mix-it-up

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

1. For each piece of feedback below, label it as “constructive criticism (CC),” which is helpful criticism, or “destructive criticism (DC),” which is unhelpful criticism.

Feedback	Feedback Type (CC or DC)
You look bad and so I couldn’t pay attention to your project.	
Your project is bad.	
I can’t tell what your model is showing. You should add labels.	
Your solution won’t work.	
I don’t understand how your solution works. Can you give me more details?	
I would be able to pay attention to your presentation more if you stopped looking at your phone.	

2. What do you think constructive criticism means?

3. How is constructive criticism different from other kinds of criticism?





Field Trips: Resources

As part of the Junior STEM Challenge, teachers may reserve a field trip to Frost Science. This field trip includes a self-guided tour of the museum and an optional STEM Challenge Learning Lab. To help guide students in their exploration of the museum, teachers may optionally provide Junior STEM Challenge scavenger hunts. These scavenger hunts must be printed by the teacher prior to arrival at the museum; Frost Science will not provide copies on-site.

Each scavenger hunt is related to one of the Junior STEM Challenge prompts. Students should receive the scavenger hunt associated with the prompt they are addressing in their Junior STEM Challenge project. Each question in the scavenger hunts helps students identify how their prompts are related to the theme. The scavenger hunts also provide basic guidance on where in the museum students should look to find answers to their questions.

“The best museums and museum exhibits about science or technology give you the feeling that, hey, this is interesting, but maybe I could do something here, too.”

– Paul Allen

Frost Science Scavenger Hunt: Marine Science

Instructions: As you explore the museum, answer the questions below to learn more about the relationship between sustainable energy and marine science.

1. **The Dive:** Find the exhibit labeled, “ReeFL.” Tidal power uses the rise and fall of the ocean tides to generate electricity but must be built along coastlines. How might this type of power generation affect coral reefs?
2. **The Dive:** Find the display labeled, “Sea Turtles.” Submarine cables carry the electricity generated from offshore windfarms to land. All electrical conductors, like these cables, generate electric and magnetic fields. Why might this affect sea turtle migrations? How could this affect their nesting behaviors?
3. **Power of Science:** Find the display labeled, “Power of Science.” Where do coral settle and why should this information be considered when designing offshore energy infrastructure?

Frost Science Scavenger Hunt: Marine Science

Instructions: As you explore the museum, answer the questions below to learn more about the relationship between sustainable energy and marine science.

1. **The Dive:** Find the exhibit labeled, “ReeFL.” Tidal power uses the rise and fall of the ocean tides to generate electricity but must be built along coastlines. How might this type of power generation affect coral reefs?

Construction of this type of energy infrastructure could cause water quality issues, negatively impacting species sensitive to changes in water chemistry, like corals

2. **The Dive:** Find the display labeled, “Sea Turtles.” Submarine cables carry the electricity generated from offshore windfarms to land. All electrical conductors, like these cables, generate electric and magnetic fields. Why might this affect sea turtle migrations? How could this affect their nesting behaviors?

Sea turtles can detect electromagnetic fields generated by the Earth. They can return to the nests they hatched by detecting that locations specific electromagnetic signature. If that is disrupted by nearby offshore windfarms, they avoid those beaches or even become confused and not be able to locate their nesting beaches.

3. **Power of Science:** Find the display labeled, “Power of Science.” Where do coral settle and why should this information be considered when designing offshore energy infrastructure?

Coral larvae settle on structures that most closely match the spectral signature, or color, of the corals preferred algae. When designing energy infrastructure, making the portion of the infrastructure in the water match the color of the most common corals in the area may help promote coral growth and create an artificial coral reef.

Frost Science Scavenger Hunt: Astronomy

Instructions: As you explore the museum, answer the questions below to learn more about the relationship between sustainable energy and astronomy.

1. ***Feathers to the Stars:*** Find the display labeled, “Stellar Beginnings & Endings.” What type of light does the James Webb telescope utilize to explore the universe, and how might this type of telescope help scientists search for new sources of energy in space?
2. ***Power of Science:*** Find and watch the video titled, “Looking for Lunar Water.” How are scientists hoping to utilize water ice they find below the lunar surface? How could this help revolutionize space travel?
3. ***The Sun Spot (Roof):*** Find the display labeled, “Feel the Heat.” What type of energy is emitted by the Sun and what portion of this energy has the highest amount of energy? What about the lowest? Why is this important to know when capturing energy in space?

Frost Science Scavenger Hunt: Astronomy

Instructions: As you explore the museum, answer the questions below to learn more about the relationship between sustainable energy and astronomy.

1. **Feathers to the Stars:** Find the display labeled, “Stellar Beginnings & Endings.” What type of light does the James Webb telescope utilize to explore the universe, and how might this type of telescope help scientists search for new sources of energy in space?

The James Webb telescope uses infrared light to explore the universe, which allows it to be able to see through clouds of gas and dust. This could make it possible to observe previously hidden objects in space.

2. **Power of Science:** Find and watch the video titled, “Looking for Lunar Water.” How are scientists hoping to utilize water ice they find below the lunar surface? How could this help revolutionize space travel?

Scientists are hoping to mine water ice to create rocket fuel. This could allow astronauts to use the Moon as a jumping off point to explore further into space than if they were to leave from Earth.

3. **The Sun Spot (Roof):** Find the display labeled, “Feel the Heat.”

- a. What type of energy is emitted by the Sun and what portion of this energy has the highest amount of energy?

The Sun emits radiation. The radiation with the highest amount of energy are gamma rays.

- b. What type of energy has the lowest amount of energy?

The radiation with the lowest amount of energy are radio waves.

- c. Why is it important to know about energy levels in space?

This is important to know when capturing energy in space because by expanding the range of wavelengths used to generate solar energy to shorter frequencies, we can capture more energy.

Frost Science Scavenger Hunt: Geology

Instructions: As you explore the museum, answer the questions below to learn more about the relationship between sustainable energy and geology.

1. **The Dig:** Observe the fossil preparation laboratory. What is Laurasia and what areas of Laurasia do you think would have active volcanic activity?
2. **The Dig:** Look at the exhibits in The Dig. What tools do paleontologists use to excavate fossils? How do you think heavy machinery, like the drills used to access geothermal energy, may impact fossils?
3. **The Dig:** Observe the fossil preparation laboratory and look for two replica skulls in the back of the room. These skulls are replicas of ancient animals found in the La Brea Tar Pits in California. These tar pits often form in areas with tectonic activity, where lower layers of the Earth's crust are closer to the surface. Despite this, these areas are not suitable for geothermal energy generation. Use what you know about plate boundaries to hypothesize why these areas are not good for geothermal energy.

Frost Science Scavenger Hunt: Geology

Instructions: As you explore the museum, answer the questions below to learn more about the relationship between sustainable energy and geology.

1. **The Dig:** Observe the fossil preparation laboratory. What is Laurasia and what areas of Laurasia do you think would have active volcanic activity?

Laurasia is an ancient continent composed of North America, Europe, and Asia. The middle of this continent, where the plates border Europe, would have a lot of volcanic activity.

2. **The Dig:** Look at the exhibits in The Dig. What tools do paleontologists use to excavate fossils? How do you think heavy machinery, like the drills used to access geothermal energy, may impact fossils?

Paleontologists use a wide variety of tools to access fossils, including rock hammers, chisels, awls, brushes, and brooms. Because fossils are very fragile, heavy machinery like drills could destroy the fossil. Even if the drills are not used on top of the fossil, the vibrations created by the drill could damage any fossils in the surrounding area.

3. **The Dig:** Observe the fossil preparation laboratory and look for two replica skulls in the back of the room. These skulls are replicas of ancient animals found in the La Brea Tar Pits in California. These tar pits often form in areas with tectonic activity, where lower layers of the Earth's crust are closer to the surface. Despite this, these areas are not suitable for geothermal energy generation. Use what you know about plate boundaries to hypothesize why these areas are not good for geothermal energy.

While it is easier to access lower layers of the Earth's crust in these areas, having tectonic activity does not always mean that the area is suitable for geothermal energy. The plate boundary in this part of California, a transform boundary, does not result in a lot of volcanic activity and is much cooler than other types of plate boundaries, like convergent and divergent boundaries.

Frost Science Scavenger Hunt: Health

Instructions: As you explore the museum, answer the questions below to learn more about the relationship between sustainable energy and health.

1. **The Sun Spot (Roof):** Find the display labeled, “Smart Delivery of Energy.” How might smart grid technology help keep hospitals operational during widespread or long-term power outages?
2. **The Sun Spot (Roof):** Find the display labeled, “Renewable Solutions.” Hospitals can receive power from sun and wind energy, but what are the limitations of this type of energy and how can hospitals overcome these limitations?
3. **MeLab Level 3:** Find the “High-tech Medicine” videos and watch one video of your choice. Does this technology rely on a constant power supply? If so, how could a disruption in power impact the use of this technology?

Frost Science Scavenger Hunt: Health

Instructions: As you explore the museum, answer the questions below to learn more about the relationship between sustainable energy and health.

1. **The Sun Spot (Roof):** Find the display labeled, “Smart Delivery of Energy.” How might smart grid technology help keep hospitals operational during widespread or long-term power outages?

Smart grid technology can very quickly identify problems within a power grid and could divert power stored from solar energy to hospitals to keep them operational.

2. **The Sun Spot (Roof):** Find the display labeled, “Renewable Solutions.” Hospitals can receive power from sun and wind energy, but what are the limitations of this type of energy and how can hospitals overcome these limitations?

Solar and wind energy availability is based on weather conditions and cloudy, still days would not generate much energy. However, hospitals can use batteries to store any excess energy created from wind and solar energy to use during these cloudy, still days.

3. **MeLab Level 3:** Find the “High-tech Medicine” videos and watch one video of your choice. Does this technology rely on a constant power supply? If so, how could a disruption in power impact the use of this technology?

There are four video topics: robotic surgery, 3D-printed medical models, interventional radiology, and awake craniotomy. In the 3D-printed medical model video, it talks about how doctors use medical scans to create 3D models. A disruption in power could disrupt the medical scan. Fortunately, this would not have any significant impacts as the scan could be repeated after power has been restored.



Virtual Meet the Museum Scientist: Resources

As part of the Junior STEM Challenge, teachers may participate in virtual Meet the Museum Scientist opportunities with Frost Science. During Meet the Museum Scientist opportunities, students will have a chance to learn about a scientist and their research. Students will also be able to ask this scientist questions. They should spend time prior to Meet the Museum Scientist opportunities to draft questions that may aid them in their Junior STEM Challenge projects. To help students with this, the Meet the Museum Scientist worksheet can be completed by students before the virtual meeting. This worksheet can be assigned to students to complete during class or may be assigned as homework.

“Research is to see what everybody else has seen, and to think what nobody else has thought.”

– Albert Szent-Györgyi



Virtual Meet the Museum Scientist

Instructions: Answer the questions below to get ready for a Meet the Museum Scientist opportunity. As you answer each question, think about questions that might help you with your Junior STEM Challenge project.

1. Write 3 questions for the scientist about how they got into their field. This could be about their first science job, their college degree, etc.
2. Write 3 questions for the scientist about how they teach people about hard scientific topics.
3. Why is it important to learn how to teach people about scientific topics as a student in the Junior STEM Challenge? How can you use what you learn in your project?

Virtual Meet the Museum Scientist

Instructions: You will be able to talk with a scientist, learning about them and their research. Answer the questions below to get ready to Meet the Museum Scientist. As you answer each question, think about questions that might help you with your Junior STEM Challenge project.

1. Write 3 questions for the scientist about how they got into their field. This could be about their first science job, their college degree, etc.

Student answers may vary. Example question: What college did you go to and what did you study?

2. Write 3 questions for the scientist about how they teach people about hard scientific topics.

Student answers may vary. Example question: How can you explain complicated science topics to non-scientists?

3. Why is it important to learn how to teach people about scientific topics as a student in the Junior STEM Challenge? How can you use what you learn in your project?

Student answers may vary. Example: In the Junior STEM Challenge, I will need to explain my solution to my teacher, parents, and judges. If I can't explain why my solution works, it will be hard for people to understand my solution. I can use what I learn from the scientist to help me figure out how I want to present my solution.

Section 3



Teacher Resources

The Teacher Guidebook provides a wide variety of resources to help teachers integrate the Junior STEM Challenge into their curriculum and assist in guiding students through their Junior STEM Challenge projects. This section provides an overview of each resource provided in Section 3 of the Teacher Guidebook. These resources are optional and provided to reduce the stress and workload of implementing the Junior STEM Challenge on teachers. Teachers are encouraged to use and modify any of the provided resources as needed.

Content Connections

Teachers are provided with content connections between Junior STEM Challenge activities and prompts and Next Generation Sunshine State Standards. These can be used to help show students how the Junior STEM Challenge is related to their class.

Pacing Guides

The pacing guides provided within this guidebook include pacing guides for semester-long and year-long Junior STEM Challenge projects.

Planning Space

Teachers can use the provided planning space in Section 3 to schedule Junior STEM Challenge activities and in-class due dates.

Final Product

Section 3 also includes recommendations for how to submit and evaluate student projects. As part of this, a suggested rubric is provided. This rubric can be optionally used to assess student work after they have completed their Junior STEM Challenge projects. Teachers can also adapt the Judging Rubrics to assess final products.

“What you do makes a difference, and you have to decide what kind of difference you want to make.”

– Jane Goodall

Junior STEM Challenge 2026-2027 Content Connections

The Junior STEM Challenge Teacher Guidebook provides recommended content connections for each of the four Junior STEM Challenge prompts. These content connections are specific to the 2026-2027 prompts which reflect this year's theme of "Sustainable Energy Generation and Use."

Next Generation Sunshine State standards are paired with either a Junior STEM Challenge activity or prompt. To identify which standard is associated with each activity or prompt, refer to the activity number in the "Associated Activity" or colored letters in the "Associated Prompts" column. The marine science prompt is denoted by **M** or ●, the health prompt by **H** or ●, the geology prompt by **G** or ●, and the astronomy prompt by **A** or ●.

The content connections provided here may include examples, data, or other information relevant to a prompt and to the identified course topic/standard. Teachers are welcome to use the content connections in class to underscore how class content is relevant to students' Junior STEM Challenge projects.

Sixth Grade: Science Standards			
Associated Prompts: Marine science, geology			
Physical Science			
NGSSS Standard	Associated Prompts	Justification	Potential Connectors
Big Idea 11: Energy Transfer and Transformations			
SC.6.P.11.1 Explore the Law of Conservation of Energy by differentiating between potential and kinetic energy. Identify situations where kinetic energy is transformed into potential energy and vice versa.		The ocean has tides that move with kinetic energy. When the tidalwater is held back by a dam, this energy is converted into potential energy. As water is released and flows through the dam, the potential energy can be converted to kinetic energy and used to turn a turbine and generate electricity.	Ask students to engineer a way to use the kinetic energy of tidalwater for energy generation. To help students, tell students that a “wheel,” or turbine is often used to generate electricity and should be included in their design.
Earth and Space Science			
NGSSS Standard	Associated Prompts	Justification	Potential Connectors
Big Idea 7: Earth Systems and Patterns			
SC.6.E.7.1 Differentiate among radiation, conduction, and convection, the three mechanisms by which heat is transferred through Earth's system.		Heat from the Earth's core travels to the surface using conduction and convection. The Earth's core generates a lot of heat, making super-hot liquid rock. This rock is lighter and rises towards Earth's surface by creating convection currents. This heat energy can also travel through the solid rock above the liquid rock, using conduction. For geothermal energy, scientists and engineers drill through the Earth's crust to access this heat energy, create steam, turn turbines, and generate electricity.	Ask students to identify what types of heat transfer are used to carry the heat of Earth's core to a geothermal power plant.
Nature of Science			
NGSSS Standard	Associated Activities	Justification	
Big Idea 1: The Practice of Science			
SC.6.N.1.3 Explain the difference between an experiment and other types of scientific investigation, and explain the relative benefits and limitations of each.	Activity 1	During Activity 1: Let's Get Started, students will work through a STEM Challenge practice project. As part of this practice, students will learn about engineering design.	
SC.6.N.1.4 Discuss, compare, and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation.	Activity 5	During Activity 5: Mix-it-up, students will present their Junior STEM Challenge project to their peers in order to receive feedback on their solutions. As students share their solutions, they will observe how their solutions differ even when both groups have addressed the same Junior STEM Challenge prompt.	

NGSSS Standard	Associated Activities	Justification
Big Idea 2: The Characteristics of Scientific Knowledge		
SC.6.N.2.3 Recognize that scientists who make contributions to scientific knowledge come from all kinds of backgrounds and possess varied talents, interests, and goals.	Activity 0	During <i>Activity 0: I Care!</i> , students will consider the backgrounds and knowledge of different types of stakeholders and how these differences can influence stakeholder interests and goals.
Big Idea 3: The Role of Theories, Laws, Hypotheses, and Models		
SC.6.N.3.4 Identify the role of models in the context of the sixth grade science benchmarks.	Activity 3	During <i>Activity 3: Out with the Old</i> , students will create scale drawings, digital models, or physical models.

Sixth Grade English Language Arts Standards			
Reading			
B.E.S.T. Standard	Associated Activities	Justification	
Standard 2: Reading Information Text			
ELA.6.R.2.3 Analyze authors' purpose(s) in multiple accounts of the same event or topic.	Activity 2	During Activity 2: <i>Dinosaur Drama</i> , students read and analyze multiple accounts of a dinosaur robbery to deduce what happened and identify the thief.	
Standard 3: Reading Across Genres			
ELA.6.R.3.2 Paraphrase content from grade-level texts.	Activity 2	During Activity 2: <i>Dinosaur Drama</i> , students have to summarize and paraphrase the information contained in multiple sources.	
Communication			
B.E.S.T. Standard	Associated Activities	Justification	
Standard 1: Communicating Through Writing			
ELA.6.C.1.3 Write and support a claim using logical reasoning, relevant evidence from sources, elaboration, and a logical organizational structure with varied transitions.	Activity 2	During Activity 2: <i>Dinosaur Drama</i> , students must determine who stole the dinosaur by providing evidence from each source and summarizing the series of events leading up to the theft. During this process, students must use logical reasoning.	
ELA.6.C.1.4 Write expository texts to explain and/or analyze information from multiple sources, using a logical organizational structure, relevant elaboration, and varied transitions.			
ELA.6.C.1.5 Improve writing by planning, revising, and editing, considering feedback from adults and peers.	Activity 5	During Activity 5: <i>Mix-it-up</i> , students will present their initial solution or presentation to their peers for feedback. Students will then use the feedback they receive to improve upon their solution or presentation.	
Standard 2: Communicating Orally			
ELA.6.C.2.1 Present information orally, in a logical sequence, using nonverbal cues, appropriate volume, clear pronunciation, and appropriate pacing.	Activity 4	During Activity 4: <i>Engineer That!</i> , students will practice their presentation skills with their peers while playing a card game. In the game, students will have to use their presentation skills to explain how a random solution solves a random problem.	

			
Seventh Grade: Science Standards			
Associated Prompts: Marine science, health, geology, astronomy			
Life Science			
NGSSS Standard	Associated Prompts	Justification	Potential Connectors
Big Idea 15: Diversity and Evolution of Living Organisms			
SC.7.L.15.3 Explore the scientific theory of evolution by relating how the inability of a species to adapt within a changing environment may contribute to the extinction of that species.		When we build large wind farms or drill for fossil fuels in marine environments, we change these environments. Human-made changes are much quicker than most natural changes and if a species cannot adapt to these changes, it will negatively impact the species population and could lead to extinction.	Ask students to describe how building a large structure in the ocean might affect marine species.
Big Idea 16: Heredity and Reproduction			
SC.7.L.16.4 Recognize and explore the impact of biotechnology (cloning, genetic engineering, artificial selection) on the individual, society and the environment.		Modern hospitals use biotechnology to treat patients, but this equipment often requires a lot of electricity. If the power goes out, it can become life-threatening for patients relying on treatments that utilize biotechnology. Reducing the amount of energy needed by biotechnology or finding alternative power sources for hospitals that are not tied to the power grid are beneficial for long-term power-outages.	Ask students to identify at least one biotechnology used in a hospital and explain why it needs a constant power supply.
Big Idea 17: Interdependence			
SC.7.L.17.3 Describe and investigate various limiting factors in the local ecosystem and their impact on native populations, including food, shelter, water, space, disease, parasitism, predation, and nesting sites.		Limiting factors are things that keep a species population from growing too big. For example, space can be a limiting factor, especially for organisms that require a lot of space to survive. Building wind farms or drilling for fossil fuels in marine environments can alter limiting factors. To continue the example, it can potentially reduce the amount of available space for larger organisms and increase the amount of available space for some smaller organisms. This in turn can affect their population sizes.	Ask students to explain how building a wind farm could change the "limiting factors" for barnacles or small fish.
Physical Science			
NGSSS Standard	Associated Prompts	Justification	Potential Connectors
Big Idea 10: Forms of Energy			
SC.7.P.10.2 Observe and explain that light can be reflected, refracted, and/or absorbed.		Light can be reflected, refracted or "bent," or absorbed by different materials. Light also has mass in the form of photons. This means that photons can reflect or "bounce" off a material and transfer their kinetic energy to that material. Solar sails use this reflection of light to move through space.	Ask students why solar sails are made of shiny materials instead of dark materials.
Big Idea 11: Energy Transfer and Transformations			
SC.7.P.11.1 Recognize that adding heat to or removing heat from a system may result in a temperature change and possibly a change of state.		To produce geothermal energy, scientists and engineers use heat from the Earth's core to boil water and produce steam. This steam can turn a turbine to generate electricity.	Ask students to describe how the Earth's core can be used to turn water into steam.

NGSSS Standard	Associated Prompts	Justification	Potential Connectors
SC.7.P.11.2 Investigate and describe the transformation of energy from one form to another.		The kinetic energy carried by molecules in the air as wind can be used to turn a turbine to create electricity.	Give students a printed picture of each energy generation method. Ask students to trace the “flow of energy” through the picture, starting with the source of the energy (wind, water, etc.) and ending with electricity.
		The kinetic energy carried by water during tides can be stored potential energy when it is blocked by a sluice gate. This potential energy can later be released as kinetic energy, where it can be used to turn a turbine to create electricity.	
		Fossil fuels, which can be extracted from the ocean, release energy through a chemical reaction that occurs when they are burned. This can be used to boil water, creating steam that can turn a turbine and create electricity.	
		ospitals are required to have emergency power systems to generate electricity in case of a power outage. Typically, they use generators to burn fossil fuels. Burning fossil fuels releases energy through a chemical reaction that occurs when they are burned. This can be used to spin an alternator and create electricity.	Ask students to explain why having “stored chemical energy” is good for emergency situations and is especially important for hospitals.
		Hospitals can also store energy from solar panels for electricity. These solar panels use the kinetic energy from photons to break electrons off their atoms and create electricity. This electricity can be stored in batteries.	
		Spacecraft need energy to travel through space. Typically, this energy is created through burning fuels made of fossil fuels and releasing the energy contained in their chemical bonds. When these fuels are burned, the chemical bond breaks and releases kinetic energy, which can be used to propel the spacecraft.	
SC.7.P.11.4 Observe and describe that heat flows in predictable ways, moving from warmer objects to cooler ones until they reach the same temperature.		Once in space, spacecraft typically use solar panels to create electricity. These solar panels use the kinetic energy from photons to break electrons off their atoms and create electricity.	Ask students to discuss why a spacecraft might need to use different sources of energy when launching and when navigating space.
		Solar sails absorb the kinetic energy of photons when they reflect off the sail to move through space.	
		For geothermal energy, heat from the Earth’s core travels to the surface, creates steam, turns turbines, and generates electricity. While the heat is carried by rock and water during this process, it transforms into kinetic energy when it turns the turbine and creates electricity.	
		Heat always moves from warmer to cooler areas. In places where the Earth’s crust is thin, heat can move from the Earth’s core towards the surface. Scientists and engineers can then use this heat to boil water, producing steam. This steam can then be used to turn a turbine and generate electricity.	Ask students to explain why heat flows from the Earth’s core toward the surface.
Earth and Space Science			
NGSSS Standard	Associated Prompts	Justification	Potential Connectors
SC.7.E.6.1 Describe the layers of the solid Earth, including the lithosphere, the hot convecting mantle, and the dense metallic liquid and solid cores.		Big Idea 6: Earth Structures	
		Earth has a crust (the lithosphere), a hot mantle, and a super-hot core. Geothermal energy relies on the heat produced by the Earth’s core that gets trapped in the mantle to produce electricity. Geothermal energy is best produced in areas where the crust is thin.	Ask students to draw a cross-section of the Earth and label each layer with their appropriate name and relative temperature.

NGSSS Standard	Associated Prompts	Justification	Potential Connectors
SC.7.E.6.6 Identify the impact that humans have had on Earth, such as deforestation, urbanization, desertification, erosion, air and water quality, changing the flow of water.		To access marine resources, environmental quality is often negatively impacted. It can change how sediment erodes and is deposited, it can introduce pollutants, and it can destroy habitats.	Ask students to identify one way we could collect energy from the ocean that does not negatively impact marine ecosystems.
Nature of Science			
NGSSS Standard	Associated Activities	Justification	
Big Idea 1: The Practice of Science			
SC.7.N.1.3 Distinguish between an experiment (which must involve the identification and control of variables) and other forms of scientific investigation and explain that not all scientific knowledge is derived from experimentation.	Activity 1	During <i>Activity 1: Let's Get Started</i> , students will work through a STEM Challenge practice project. As part of this practice, students will learn about engineering design.	
Big Idea 3: The Role of Theories, Laws, Hypotheses, and Models			
SC.7.N.3.2 Identify the benefits and limitations of the use of scientific models.	Activity 3	During <i>Activity 3: Out with the Old</i> , students will create scale drawings, digital models, or physical models and will reflect on how each model type can be used to represent a solution or idea.	

Seventh Grade English Language Arts Standards			
Reading			
B.E.S.T. Standard	Associated Activities	Justification	
Standard 3: Reading Across Genres			
ELA.7.R.3.2 Paraphrase content from grade-level texts.	Activity 2	During <i>Activity 2: Dinosaur Drama</i> , students have to summarize and paraphrase the information contained in multiple sources.	
Communication			
B.E.S.T. Standard	Associated Activities	Justification	
Standard 1: Communicating Through Writing			
ELA.7.C.1.3 Write and support a claim using logical reasoning, relevant evidence from sources, elaboration, a logical organizational structure with varied transitions, and acknowledging at least one counterclaim.	Activity 4	During <i>Activity 4: Engineer That!</i> , students must use logical reasoning to convince their peers that their randomly selected solution would be able to solve their randomly selected problem. As students present their solutions, students may use counterclaims against their opponent or may acknowledge counterclaims to bolster their own solution.	
ELA.7.C.1.4 Write expository texts to explain and analyze information from multiple sources, using relevant supporting details and a logical organizational pattern.	Activity 2	During <i>Activity 2: Dinosaur Drama</i> , students must determine who stole the dinosaur by providing evidence from each source and summarizing the series of events leading up to the theft. During this process, students must use logical reasoning.	
ELA.7.C.1.5 Improve writing by planning, revising, and editing, considering feedback from adults and peers.	Activity 5	During <i>Activity 5: Mix-it-up</i> , students will present their initial solution or presentation to their peers for feedback. Students will then use the feedback they receive to improve upon their solution or presentation.	
Standard 2: Communicating Orally			
ELA.7.C.2.1 Present information orally, in a logical sequence, emphasizing key points that support the central idea.	Activity 4	During <i>Activity 4: Engineer That!</i> , students will practice their oral presentation skills, presenting a randomly selected solution to a randomly selected problem. To earn points, students must give a strong presentation with several key points that support their solution.	

Eighth Grade: Science Standards							
Associated Prompts: Marine science, health, geology, astronomy							
Physical Science							
NGSSS Standard	Associated Prompts	Justification	Potential Connectors				
Big Idea 8: Properties of Matter							
SC.8.P.8.4 Classify and compare substances on the basis of characteristic physical properties that can be demonstrated or measured; for example, density, thermal or electrical conductivity, solubility, magnetic properties, melting and boiling points, and know that these properties are independent of the amount of the sample.		Materials used in producing energy in marine environments must be resistant to corrosion.	Ask students what physical properties might be important when designing energy systems for marine environments.				
		When choosing materials for hospital backup power systems, engineers need to make sure that the components are able to handle load without overheating. If materials were to overheat, the backup power systems could fail and put people's lives at risk.	Tell students that batteries are often used to store excess solar power and that this is sometimes used as a backup for hospitals during power outages. Ask students to explain why a battery's physical properties are just as important as the battery's capacity and size.				
		While energy is prevalent in space and is needed for long-term space exploration, energy can also be hazardous. Spacecraft are designed to be lightweight, durable, and dense enough to block harmful radiation in space. Heavy ships require more energy to launch than ships made of lighter materials.	Tell students that space is full of energy in the form of both light and radiation. Ask students to explain why spacecraft are made out of dense materials.				
		In geothermal energy, materials used for drilling into the Earth must have very high melting points and thermal conductivity. Temperatures when drilling can reach over 400°F or 200°C.	Ask students to explain why the drills used to create geothermal energy wells are made out of materials with high melting points.				
Earth and Space Science							
NGSSS Standard	Associated Prompts	Justification	Potential Connectors				
Big Idea 5: Earth in Space and Time							
SC.8.E.5.2 Recognize that the universe contains many billions of galaxies and that each galaxy contains many billions of stars.		The universe contains billions of galaxies, each with billions of stars. Because there are stars throughout the universe, light energy can be used almost everywhere in space to power spacecraft with solar panels or to propel spacecraft with solar sails.					
SC.8.E.5.10 Assess how technology is essential to science for such purposes as access to outer space and other remote locations, sample collection, measurement, data collection and storage, computation, and communication of information.		We cannot study energy in deep space without advanced technology. Lots of space-based energy sources, like radiation, require advanced sensors or cameras to be observed. Other space-based energy sources may be found on the surface of or underground on celestial bodies. To find these energy sources, technology like	Ask students to identify one type of energy that is available throughout the universe.				

NGSSS Standard	Associated Prompts	Justification	Potential Connectors
SC.8.E.5.11 Identify and compare characteristics of the electromagnetic spectrum such as wavelength, frequency, use, and hazards and recognize its application to an understanding of planetary images and satellite photographs.		Visible light is just one part of the electromagnetic spectrum. By studying different wavelengths of light, including radio waves, microwaves, infrared light, ultraviolet light, x-rays, and gamma rays, scientists can observe and study energy and radiation in space. This can help scientists locate potential space-based energy sources.	Ask students to label a diagram of the electromagnetic spectrum and identify what wavelengths of light are typically used for energy production on Earth.
Nature of Science			
NGSSS Standard	Associated Activities	Justification	
Big Idea 2: The Characteristics of Scientific Knowledge			
SC.8.N.2.1 Distinguish between scientific and pseudoscientific ideas.	Activity 2	During <i>Activity 2: Dinosaur Drama</i> , students will use their critical thinking skills to determine which sources provide factual information and which sources provide misinformation. As part of this, students should be able to identify what sources use the proper scientific nomenclature for a T. rex.	
Big Idea 3: The Role of Theories, Laws, Hypotheses, and Models			
SC.8.N.3.1 Select models useful in relating the results of their own investigations.	Activity 3	During <i>Activity 3: Out with the Old</i> , students will create scale drawings, digital models, or physical models. Creating these models can help students determine what models or supplemental materials may help illustrate their STEM Challenge solutions.	
Big Idea 4: Science and Society			
SC.8.N.4.1 Explain that science is one of the processes that can be used to inform decision making at the community, state, national, and international levels.	Activity 0	During <i>Activity 0: I Care!</i> , students will consider how different types of stakeholders, including community members and politicians, can inform scientific decision-making at local and community levels.	
SC.8.N.4.2 Explain how political, social, and economic concerns can affect science, and vice versa.			

			
Eighth Grade English Language Arts Standards			
Reading			
B.E.S.T. Standard	Associated Activities	Justification	
Standard 3: Reading Across Genres			
ELA.8.R.3.2 Paraphrase content from grade-level texts.	Activity 2	During Activity 2: <i>Dinosaur Drama</i> , students have to summarize and paraphrase the information contained in multiple sources.	
Communication			
B.E.S.T. Standard	Associated Activities	Justification	
Standard 1: Communicating Through Writing			
ELA.8.C.1.3 Write to argue a position, supporting at least one claim and rebutting at least one counterclaim with logical reasoning, credible evidence from sources, elaboration, and using a logical organizational structure.	Activity 4	During Activity 4: <i>Engineer That!</i> , students must use logical reasoning to convince their peers that their randomly selected solution would be able to solve their randomly selected problem. As students present their solutions, students may use counterclaims against their opponent or may acknowledge counterclaims to bolster their own solution.	
ELA.8.C.1.4 Write expository texts to explain and analyze information from multiple sources, using relevant supporting details, logical organization, and varied purposeful transitions.	Activity 2	During Activity 2: <i>Dinosaur Drama</i> , students must determine who stole the dinosaur by providing evidence from each source and summarizing the series of events leading up to the theft. During this process, students must use logical reasoning.	
ELA.8.C.1.5 Improve writing by planning, editing, considering feedback from adults and peers, and revising for clarity and cohesiveness.	Activity 5	During Activity 5: <i>Mix-it-up</i> , students will present their initial solution or presentation to their peers for feedback. Students will then use the feedback they receive to improve upon their solution or presentation.	
Standard 2: Communicating Orally			
ELA.8.C.2.1 Present information orally, in a logical sequence, supporting the central idea with credible evidence.	Activity 4	During Activity 4: <i>Engineer That!</i> , students will practice their oral presentation skills, presenting a randomly selected solution to a randomly selected problem. To earn points, students must give a strong presentation with several key points that support their solution.	

Pacing Guides

Junior STEM Challenge activity pacing guides provide suggested pacing for both year-long and semester-long Junior STEM Challenge Projects. For semester-long Junior STEM Challenge projects, the project should be taught during the second semester. These pacing guides are only meant to provide suggested pacing and are not intended to represent every possible pacing structure.

All pacing guides include recommendations for when to teach each Junior STEM Challenge activity. While *Activity 1: Let's Get Started* is the only required activity, utilizing all Junior STEM Challenge activities is recommended to guide and support students in their Junior STEM Challenge projects. Each activity is referred to in the pacing guide by number with “I Care!” denoted by **Activity 0**, “Let’s Get Started” denoted by **Activity 1**, “Dinosaur Drama” denoted by **Activity 2**, “Out with the Old” denoted by **Activity 3**, “Engineer That!” denoted by **Activity 4**, and “Mix-it-up” denoted by **Activity 5**. Along with recommended pacing for Activities, each pacing guide also includes recommended blocks for students to work on their Junior STEM Challenge in class. These block periods include suggested student focuses and may be used in addition to student worktime outside of class.

Year-Long Pacing Guides

YEAR-LONG PACING GUIDE: Version 1					19+ Blocks
Use this pacing guide if you have a flexible class schedule and can afford to use ~4 weeks of class time for the Junior STEM Challenge. This pacing guide prioritizes the completion of final products before the fourth quarter. Final products are due on April 3, 2027. During the fourth quarter, students will focus on developing their presentation.					
1st Quarter	2nd Quarter	3rd Quarter	4th Quarter		
Focus: Getting Started	Focus: Solution Development	Focus: Model and Display Construction	Focus: Presentation Development		
5 Blocks	6 Blocks	5 Blocks	3 Blocks		
Activity 0 1 Block Activity 1 1 Block (Required) Initial Research 1 Block Activity 2 1 Block Research/Gather Information 1+ Block	Solution Development 2+ Blocks Activity 3 1 Block Solution Iteration 1+ Block Activity 5: Solution Review 1 Block Solution Iteration 1+ Block	Model Development 1+ Block Model Construction 1+ Block Activity 4 1 Block Display Design 1+ Block Display Construction 1+ Block	Pitch/Presentation Development 1+ Block Activity 5: Presentation Review 1 Block Refine Presentation 1+ Block		
Quarter Goal: Students will learn about stakeholders, select a prompt, and gather information related to their prompt.	Quarter Goal: Students will design a solution for their prompt before learning each step in the engineering design process, receiving feedback on their solution, and utilizing the engineering design process to iterate upon their solution.	Quarter Goal: Students will develop and construct a model of their designed solution before learning about the components of a strong presentation. Students will design and construct their Junior STEM Challenge display.	Quarter Goal: Students will develop, receive feedback on, and refine a presentation for their Junior STEM Challenge project.		

YEAR-LONG PACING GUIDE: Version 2 (Condensed)					16+ Blocks
Use this pacing guide if you have a flexible class schedule and can afford to use ~3 weeks of class time for the Junior STEM Challenge. This pacing guide prioritizes solution development and completion of final products before the fourth quarter. Final products are due on April 3, 2027. During the fourth quarter, students will focus on developing their presentation. This pacing guide provides less class time for students to work on their models and displays.					
1st Quarter	2nd Quarter	3rd Quarter	4th Quarter		
Focus: Getting Started and Solution Development	Focus: Solution Development	Focus: Model and Display Construction	Focus: Presentation Development		
5 Blocks	5 Blocks	3 Blocks	3 Blocks		
Activity 0 1 Block Activity 1 1 Block (Required) Activity 2 1 Block Research/Gather Information 1+ Block Preliminary Solution Development 1+ Block	Continued Solution Development 1+ Blocks Activity 3 1 Block Solution Iteration 1+ Block Activity 5: Solution Review 1 Block Solution Iteration 1+ Block	Model Development and Construction 1+ Block Activity 4 1 Block Display Design and Construction 1+ Block	Presentation Development 1+ Block Activity 5: Presentation Review 1 Block Refine Presentation 1+ Block		
Quarter Goal: Students will learn about stakeholders, select a prompt, gather information related to their prompt, and begin to draft their solution.	Quarter Goal: Students will continue to design a solution for their prompt before learning each step in the engineering design process, receiving feedback on their solution, and iterating upon their idea to finalize their solution.	Quarter Goal: Students will develop and construct a model of their designed solution before learning about the components of a strong presentation. Students will design and construct their Junior STEM Challenge display.	Quarter Goal: Students will develop, receive feedback on, and refine a presentation for their Junior STEM Challenge project.		

YEAR-LONG PACING GUIDE: Version 3 (Excluding Activity 5)					14+ Blocks
Use this pacing guide if you have a flexible class schedule and can afford to use ~3 weeks of class time for the Junior STEM Challenge. This pacing guide prioritizes solution development and completion of final products before the fourth quarter. Final products are due on April 3, 2027. During the fourth quarter, students will focus on developing their presentation. This pacing guide omits Activity 5: Mix-it-up.					
1st Quarter	2nd Quarter	3rd Quarter	4th Quarter		
Focus: Getting Started	Focus: Solution Development	Focus: Model and Display Construction	Focus: Presentation Development		
4 Blocks	4 Blocks	4 Blocks	2 Blocks		
Activity 0 1 Block Activity 1 1 Block (Required) Activity 2 1 Block Research/Gather Information 1+ Block	Solution Development 2+ Blocks Activity 3 1 Block Solution Iteration 1+ Block	Model Development 1+ Block Model Construction 1+ Block Display Design 1+ Block Display Construction 1+ Block	Activity 4 1 Block Presentation Development 1+ Block		
Quarter Goal: Students will learn about stakeholders, select a prompt and gather information related to their prompt.	Quarter Goal: Students will design a solution for their prompt before learning each step in the engineering design process, iterating upon and finalizing their solution.	Quarter Goal: Students will develop and construct a model of their designed solution and will design and construct their Junior STEM Challenge display.	Quarter Goal: Students will learn about the components of a strong presentation before developing a presentation for their Junior STEM Challenge project.		

YEAR-LONG PACING GUIDE: Version 4 (Excluding Activity 0 and Activity 5)					10+ Blocks
Use this pacing guide if you have a flexible class schedule and can afford to use ~2 weeks of class time for the Junior STEM Challenge. This pacing guide prioritizes solution development and completion of final products before the fourth quarter. Final products are due on April 3, 2027. During the fourth quarter, students will focus on developing their presentation. This pacing guide provides less class time for students to work on their models and displays and omits Activity 0: I Care! and Activity 5: Mix-it-up.					
1st Quarter	2nd Quarter	3rd Quarter	4th Quarter		
Focus: Getting Started	Focus: Solution Development	Focus: Model and Display Construction	Focus: Presentation Development		
3 Blocks	3 Blocks	2 Blocks	2 Blocks		
Activity 1 1 Block (Required) Activity 2 1 Block Research/Gather Information 1+ Block	Solution Development 2+ Blocks Activity 3 1 Block Solution Iteration 1+ Block	Model Development and Construction 1+ Block Display Design and Construction 1+ Block	Activity 4 1 Block Presentation Development 1+ Block		
Quarter Goal: Students will select a prompt and gather information related to their prompt.	Quarter Goal: Students will design a solution for their prompt before learning each step in the engineering design process and iterating upon and finalizing their solution.	Quarter Goal: Students will develop and construct a model of their designed solution and will design and construct their Junior STEM Challenge display.	Quarter Goal: Students will learn about the components of a strong presentation before developing a presentation for their Junior STEM Challenge project.		

Semester-Long Pacing Guides

SEMESTER-LONG PACING GUIDE: Version 1 (Condensed)		15+ Blocks
Use this pacing guide if you have a flexible class schedule and can afford to use ~3 weeks of class time for the Junior STEM Challenge. This pacing guide prioritizes research and solution development and completion of final products during the third quarter. Final products are due on April 3, 2027. During the fourth quarter, students will focus on developing their presentation. This pacing guide provides less class time for students to develop their solution and work on their models and displays.		
2nd or 3rd Quarter	3rd or 4th Quarter	
Focus: Getting Started, Solution Development, and Model and Display Construction	Focus: Presentation Development	
11 Blocks	4 Blocks	
Activity 0 1 Block Activity 1 1 Block (Required) Activity 2 1 Block Research/Gather Information 1+ Block Solution Development 1+ Block Activity 3 1 Block Solution Iteration 1+ Block Activity 5: Solution Review 1 Block Model Development and Construction 1+ Block Display Design and Construction 1+ Block	Activity 4 1 Block Presentation Development 1+ Block Activity 5: Presentation Review 1 Block Refine Presentation 1+ Block	
Quarter Goal: Students will learn about stakeholders, select a prompt, gather information related to their prompt, design a solution for their prompt, learn each step in the engineering design process, receive feedback on their solution, and iterate upon and finalize their solution. Students will then develop and construct a model of their designed solution and design and construct their Junior STEM Challenge display.	Quarter Goal: Students will learn about the components of a strong presentation before they develop, receive feedback on, and refine a presentation for their Junior STEM Challenge project.	

SEMESTER-LONG PACING GUIDE: Version 2 (Excluding Activity 0 and Activity 5)		11+ Blocks
Use this pacing guide if you have a flexible class schedule and can afford to use ~2 weeks of class time for the Junior STEM Challenge. This pacing guide prioritizes research and solution development and completion of final products during the third quarter. Final products are due on April 3, 2027. During the fourth quarter, students will focus on developing their presentation. This pacing guide provides less class time for students to develop their solution and work on their models and displays and omits Activity 0: I Care! and Activity 5: Mix-it-up.		
2nd or 3rd Quarter	3rd or 4th Quarter	
Focus: Getting Started, Solution Development, and Model and Display Construction	Focus: Presentation Development	
9 Blocks	2 Blocks	
Activity 1 1 Block (Required) Activity 2 1 Block Research/Gather Information 1+ Block Solution Development 1+ Block Activity 3 1 Block Solution Iteration 1+ Block Model Development and Construction 1+ Block Display Design and Construction 1+ Block	Activity 4 1 Block Presentation Development 1+ Block	
Quarter Goal: Students will select a prompt, gather information related to their prompt, design a solution for their prompt, learn each step in the engineering design process, and iterate upon and finalize their solution. Students will then develop and construct a model of their designed solution and design and construct their Junior STEM Challenge display.	Quarter Goal: Students will learn about the components of a strong presentation before developing a presentation for their Junior STEM Challenge project.	

Junior STEM Challenge Planning

This planner can be used along with the pacing guides to schedule each Junior STEM Challenge activity and can be used to record due dates for student work, field trips to Frost Science, and Meet the Museum Scientist opportunities. Each page directly corresponds to one quarter of the M-DCPS 2026-2027 school year, excluding December 21 – January 1.

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

OCTOBER

NOVEMBER

DECEMBER

JANUARY

MON	TUE	WED	THU	FRI
19	20	21	22	23
26	27	28	29	30
NOV. 2	3 	4	5	6
9	10	11	12	13
16	17	18	19	20
23 	24 	25 	26	27 
30	DEC. 1	2	3	4
7	8	9	10	11
14	15	16	17	18 
JAN. 4, 2027	5	6	7	8
11	12	13	14	15 
Legal holiday		 M-DCPS Teacher planning day, professional learning day or recess day.		

JANUARY

FEBRUARY

MARCH

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

MARCH

APRIL

MAY

MON	TUE	WED	THU	FRI
29 	30	31	APR. 1	2
5	6	7	8	9
12	13	14	15	16
19	20	21	22	23
26	27	28	29	30
SATURDAY, MAY 1, 2027				
				
EXPO AT FROST SCIENCE				
Legal holiday		 M-DCPS Teacher planning day, professional learning day or recess day.		

Submission Procedures

While all students can participate in the Junior STEM Challenge, only select student projects will be judged as part of the Junior STEM Challenge. Due to the size of the Junior STEM Challenge, teachers will be asked to select their top student projects for entry into the first round of judging. Teachers may be limited to several submissions per class, program, or extracurricular activity and may use their discretion in selecting which projects to submit.

When selecting top student projects to submit for the Junior STEM Challenge, avoid bias. Top student projects should only be selected based on the quality of student solutions, presentations, models, and Engineering Notebooks as these will be the aspects evaluated during the first round of judging. All student projects should be considered for submission to the Junior STEM Challenge if they are complete and high-quality. Complete and high-quality student projects should not be discarded from consideration based on student performance in class or school or based on student attendance.

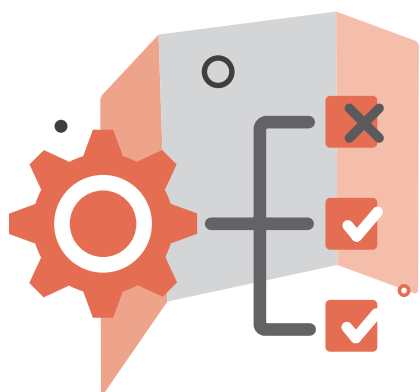
Selected student projects will be photographed or otherwise digitized by the students or their teacher before being submitted via an online portal. In these digital files, student and school names should be hidden to avoid any potential bias during the judging process. After all submissions have been judged, teachers will receive notification of whether any of their submitted student projects have passed the first round of judging. Students that have passed the first round of judging will be asked to attend the STEM Challenge Expo, where they will be judged in-person at Frost Science.

Additional information regarding project submissions will be provided to teachers closer to the STEM Challenge Expo.

Junior STEM Challenge Grading Rubric

Teachers can assess student progress and projects at their discretion. The following rubric may be optionally used to assess student projects at the end of the Junior STEM Challenge.

Criteria	Room to Improve (0-3)	Satisfactory (4-6)	Excellent (7-10)
Problem	Students do not pick problem related to their prompt.	Students pick a problem related to their prompt, but the problem is too big to be solved with one solution.	Students pick one small problem related to their prompt that could be solved with one solution.
Background Information	Students do not have any background information on their display.	Students have background information about their prompt on their display. The background information is partially correct.	Students have background information about their prompt on their display. All of the background information is accurate.
Solution	Students did not create a solution, describe their solution, or design a solution related to their problem.	Students created and described a solution for their problem. The solution is not well planned out, parts of the solution are confusing, and it is hard to tell if the solution could help fix their problem. The solution may or may not work.	Students created and described a solution for their problem. This solution is clearly explained and students identify how the solution could be used to help fix their problem.
Engineering Design	Students do not explain how they came up with their solution.	Students explain how they came up with their solution, but do not describe any problems they found with their solution or describe how they fixed these problems.	Students explain how they came up with their solution. Students describe the problems they had with their solution and how they fixed these problems.
Model	Students did not make a model.	Students made a model of their solution. The model is hard to understand and does not look like any part of the solution.	Students made a model of their solution. The model is easy to understand and looks like at least part of the solution.
Sources	Students have 0-2 sources in their references section. Only some of the sources are trustworthy.	Students have listed 3-4 sources in their references section. Some or all of the sources are trustworthy.	Students have listed 5+ sources in their references section. All of the sources are trustworthy.
Content	There are lots of grammatical or spelling errors.	There are a few grammatical or spelling errors.	There are no grammatical or spelling errors.
Display	The display is not organized and looks messy and thrown together.	The display looks well done but is not organized.	The display looks well done and is organized.
Engineering Notebook	Students did not take any pictures of their model as it was being created.	1) The Engineering Notebook has 3+ pictures of the model as it was being created. The pictures do not have any explanations. OR 2) The Engineering Notebook has 1-2 pictures of the model as it was being created. Each picture has a 1-2 sentence explanation.	The Engineering Notebook has 3+ pictures of the model as it was being created. Each picture has a 1-2 sentence explanation.
Teamwork	Students do not work well together and rushed to finish their project. Students did not share the workload and one student did most of the project on their own.	Students did not share the workload evenly, and at least one student did not work on any of the project. The students finished their project on time without rushing.	Students evenly shared the workload and did not rush to finish their project.
			Overall Score: _____/100



Section 4

Final Products

Section 4 of the Teacher Guidebooks contains information about how Junior STEM Challenge projects will be evaluated along with additional tips and resources for students. This includes descriptions and examples of final products and judging rubrics. This section also provides additional information about using Artificial Intelligence (AI), tips for students, and additional resources. While all materials in Section 4 were written for students and can be found in Section 3 of the Student Guidebook, they may also be beneficial for teachers.

Reviewing the section about AI is highly recommended. While the use of AI in student work is controversial, it is also becoming increasingly common and difficult to identify. If possible, teachers should encourage responsible AI use with their students. By allowing responsible AI use, teachers can monitor and provide feedback on how students use this technology. Teachers that do not allow AI use in the Junior STEM Challenge project should be aware that their students may still use AI without proper guidance and that their students will be competing with other students who were allowed to use AI for their projects.

“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

Models

In the Junior STEM Challenge, students will have to create a model of their solution. This model can be anything that shows part of their solution or their whole solution. The model can also be physically made or made on a computer.

Students cannot buy their model and must create it on their own. If students buy something for their model, they must change it in some way. For example, if a student buys a toy car, they must change or add something onto the toy car. They cannot use the toy car as their model without making any changes.

When the model is placed next to a display, people should be able to figure out how the model shows the solution. People should not need students to explain the model to understand it. To help people understand the model without an explanation, students can use labels. For example, if students wrote code for their model, they would need to write a one to two sentence explanation to go with the code. This is because most people looking at the model would have trouble understanding what the code does without a description.

Students must create a Engineering Notebook to go with their model.

Examples of Acceptable Models	Examples of Unacceptable Models
A robot arm next to a sketch of a robot	Only a sketch of a robot
A small version of a robot	A small robot bought from the store
A robot arm with labels that explain what it does	A robot arm with no labels
A robot arm bought from the store that runs using code created by students	A robot arm bought from the store that runs using code students downloaded online
3D model of a robot	3D model of a robot that is distorted and glitched
Code for a robot with a short description that explains what it does	Code for a robot that has no description

The examples listed above do not include every type of model. Students should use their creativity when creating their model. As long as their model makes sense when placed next to their display and has not been bought from the store, it meets the requirements of a Junior STEM Challenge model.

Engineering Notebook

All Junior STEM Challenge models must have a Engineering Notebook. The Engineering Notebook should show how students created, fixed, and improved their model. Engineering Notebooks can be a journal or slideshow with pictures or screenshots of the model over time. Each time students add to or change their model, they should take a picture or screenshot for their Engineering Notebook.

Engineering Notebookss in the Junior STEM Challenge are simple and will be used by judges reviewing student models.

What to include in a Engineering Notebook

Notes used to plan the model

Sketches used to plan the model

Pictures or screenshots of the model as it was being built

Pictures or screenshots of any changes made to the model

Pictures or screenshots of problems with the model

Pictures or screenshots showing problems, or error messages, are very important for your Engineering Notebook

- Pictures or screenshots of your problems can help show the judges how you fixed your problems or made your model better!

One to two sentence descriptions

- Everything in your Engineering Notebook must have a short description explaining what the notes, sketches, pictures, or screenshots show.

Engineering Notebook: Examples

Look over the Engineering Notebook examples below. These Engineering Notebooks are for a color pencil-sorting robot. Example 1 is for code, Example 2 is for a 3D model, and Example 3 is for a physical model.

Example 1: Code

[Screenshot of code downloaded online]

We downloaded this code from GitHub to start creating code for our color pencil-sorting robot.

[Screenshot of code, first line highlighted]

We changed the first line of code so that our robot uses a camera to look for different colors.

[Screenshot of code, hex code is highlighted]

The hex code is highlighted in this screenshot. Hex is used to code for different colors, so we added hex codes for each color: red, orange, yellow, green, blue, and violet.

[Screenshot of code, last 3 lines highlighted]

We changed the end of the code so that the robot knows to grab, move, and place one color pencil at a time until they are in ROYGBV order.

[Screenshot of error message]

There is a problem with the last three lines of code.

[Screenshot of code, last 7 lines highlighted]

We split the end of the code into six steps. Step 1 is to look for red color pencils and move them to the left. Step 2 is to look for orange color pencils and move them to the right of the red color pencils. Step 3 is to look for and move yellow color pencils, Step 4 is to look for and move green color pencils, Step 5 is for blue color pencils, and Step 6 is for violet color pencils.

Example 2: 3D Model

[Sketch of robot]

This sketch shows a color pencil-sorting robot. The robot has a camera to look for color pencils and a robotic arm to pick up and move the color pencils.

[Screenshot of 3D model]

We added a cube, a cylinder, and a sphere to make the base of our robot. The sphere represents the robot's camera.

[Screenshot of 3D model]

We merged the basic shapes to make the base of our robot.

Example 2: 3D Model (Cont.)

[Screenshot of 3D model]

We added the basic shapes for the robot's arm.

[Screenshot of 3D model]

We merged the basic shapes for the robot's arm.

[Screenshot of 3D model]

We realized that the robot arm needs to be able to move left and right, so we added another sphere to the bottom of the robot's arm. The robot's arm can use this sphere to move up, down, left, and right.

Example 3: Physical Model

[Sketch of robot]

This sketch shows a color pencil-sorting robot. The robot has a camera to look for color pencils and a robotic arm to pick up and move the color pencils.

[Picture of cardboard]

We drew the shapes we need for our robot on cardboard. Each piece is labeled

[Picture of cardboard shapes]

We cut out each piece of cardboard for the base of our robot.

[Picture of cardboard 'cube']

We taped the pieces of cardboard together and one side of the robot's base is bigger than the other side. We will have to cut some of the cardboard shapes again.

[Picture of cardboard cube]

We cut a new piece of cardboard for the base of our robot. The base is now the right size.

[Picture of cardboard shapes]

We cut out the rest of the cardboard shapes for our robot's arm.

[Picture of cardboard robot]

We taped the pieces of cardboard together to make the robot's arm and attached it to the base.

[Picture of cardboard robot]

We painted the cardboard robot and labeled each part of the robot.

Presentation Displays

Students have to make a display for their Junior STEM Challenge project. Students should be creative with their display and can make a poster, slideshow, or anything else they imagine!

Even though displays can be any format, they all must:

- Have a title
- Have student names
- Have the prompt
- Have background information
- Describe the problem
- Describe the solution and how it works
- Show the Engineering Notebook
- List sources in the references section

If students want more information about what they should have in their display, they should look at the Project Completion Judging Rubric found on **page X** in the Teacher Guidebook and **page 60** in the Student Guidebook.

For step one of judging, teachers will submit digital copies of student displays as photos, videos, or other file types. Students that pass the first round of judging will have to bring their display in-person to Frost Science for the STEM Challenge Expo. If students do not have a poster and instead have a slideshow, video, or another type of digital display, they will have to bring their own computer and computer charger to the STEM Challenge Expo.

Posters are one of the easiest displays students can make and can even be created online using free programs like Canva. Students can use the template linked below to help create a poster layout for a 48×26-inch tri-fold poster. Students will need a Canva account to access this template. After designing their poster in Canva, Pages 3-13 can be printed on standard US Letter (8.5×11-inch) paper.

Canva Display Template: <https://tinyurl.com/3wm8zc6p>





Evaluating Solutions

The following questions are designed to help students evaluate and review their solution. Students can use these questions during each step of the engineering design process, using their responses to help guide them through revising their solutions.

Does your solution talk about sustainable energy?

The theme of the 2026-2027 Junior STEM Challenge is “Sustainable Energy Generation and Use.” If your problem or solution does not talk about sustainable energy, you need to change your problem and solution.

Does your solution talk about one of the four prompts?

Your solution needs to talk about one of the four prompts of the Junior STEM Challenge. It should be easy to tell which prompt your project, and your solution, are about. If it is not easy to see which prompt your solution is about (marine science, astronomy, paleontology, or health), change your solution.

Is your solution engineered? Remember that the Junior STEM Challenge is an engineering design competition.

Your solution must be something that can be physically built or made. It cannot be a solution that is all about people. For example, if your solution has people making and installing a device, it is engineered and is a good solution for the Junior STEM Challenge. If your solution has people volunteering to do an ocean cleanup or share flyers, it is not engineered and is not a good solution for the Junior STEM Challenge.

If you do not know if your solution is engineered, ask the questions below:

- ♦ **If you had enough money and time, could you build and test your solution?** If you could, it is probably engineered!
- ♦ **Does your solution need people to help fix the problem?** If so, it may not be engineered. Change your solution.
- ♦ **Can you measure if your solution works?** This could be with a ruler, scale, counter, etc. If so, it is probably engineered.
- ♦ **Can you make a model for your solution?** If you cannot model your solution, it may not be engineered. Change your solution.

Does your solution fix your problem?

Your solution does not have to fix your whole problem, but it should fix at least part of your problem or make your problem better. If your solution does not fix any of your problem, change your solution.



Is your solution something new, or has it been done before? If it has been done before, is your solution any better at solving your problem?

Your solution should be able to fix your problem more, or in a different way, than the solutions scientists and engineers are already using to fix your problem. If your solution is not any better than current solutions, change your solution.

Does your solution cause any problems?

No solution is perfect, so think about the problems your solution might cause. Maybe your solution is expensive, uses materials that are bad for the environment, takes up a lot of space, or could accidentally hurt people. If your solution causes more problems than it fixes, change your solution.

Have you already changed your solution?

Remember, the Junior STEM Challenge is an engineering design competition. Engineers use the engineering design process to change their solutions over and over again. If you have not changed any of your solution, go look at your solution again. Change part of your solution to make it better.

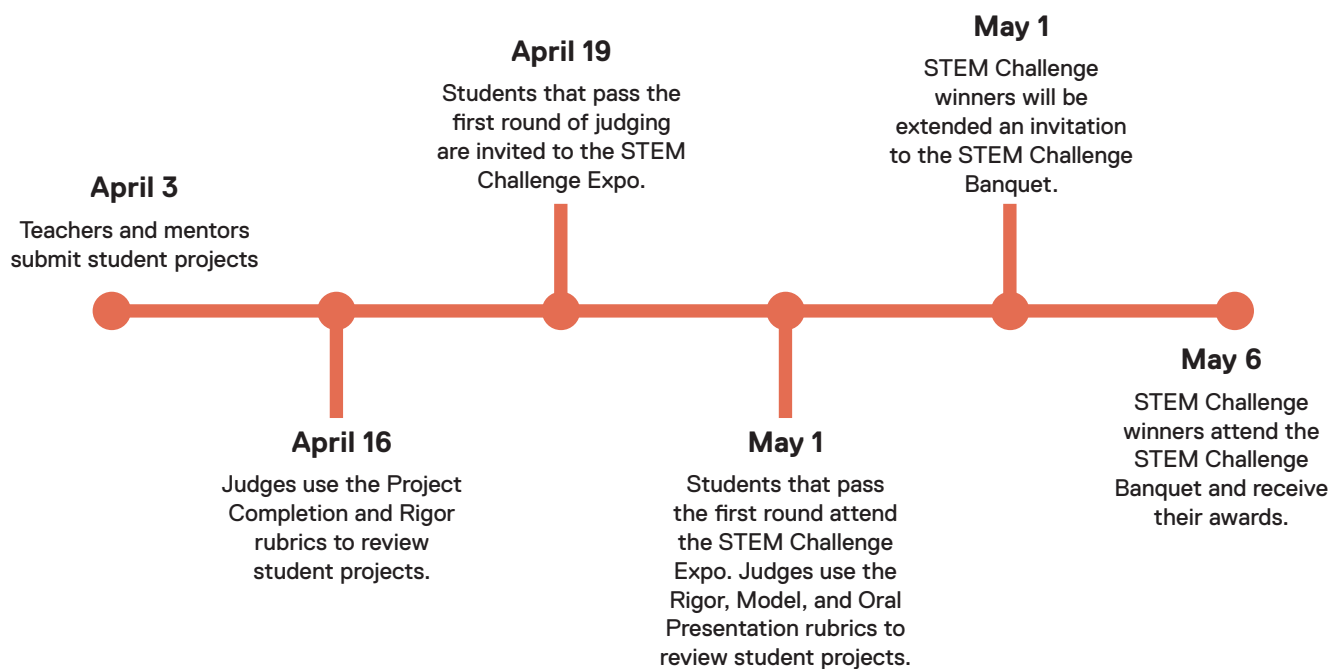
Judging Guidelines

Teachers will submit Junior STEM Challenge projects online as pictures or other file types. Judges can then review and score each project as part of a two-step judging process. First, judges will score the projects online 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.

Students that are invited to the STEM Challenge Expo will get notes from the judges and can fix any problem the judges noticed. Students can keep working on their projects until the morning of the STEM Challenge Expo.

Invited students will go to the STEM Challenge Expo in person on May 1, 2027 to present their project. Junior STEM Challenge students will then give judges a 5 minute-presentation on their project. The judges will be using the Rigor rubric to evaluate student projects. Groups of judges will come by each project several times to listen to student presentations and judge them using the Rigor rubric.

After all judges have listened to student presentations, they will meet to discuss student scores and pick 1st, 2nd, and 3rd place Junior STEM Challenge winners.



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

Criteria	Starting (0-3)	Growing (4-6)	Pro (7-10)	Score (0-10)
TITLE AND PROMPT	The project does not have a title and the prompt is not written on the display.	The project has a title, but it is not creative. For example, the title of the project might just be, "Astronomy" or "Paleontology." The prompt may or may not be written on the display.	The project has a creative title and the prompt is written on the display.	
PROBLEM	Students do not pick problem related to their prompt.	Students pick a problem related to their prompt, but the problem is too big to be solved with one solution.	Students pick one small problem related to their prompt that could be solved with one solution.	
BACKGROUND INFORMATION	Students do not have any background information on their display.	Students have background information about their prompt on their display. The background information is partially correct.	Students have background information about their prompt on their display. All of the background information is correct.	
SOLUTION: DESCRIPTION	Students did not create a solution for their problem or students did not describe their solution.	Students created and described a solution for their problem. Parts of the solution are confusing and it is hard to tell if the solution could help fix their problem.	Students created and described a solution for their problem. This solution is clearly explained and students identify how the solution could be used to help fix their problem.	
SOLUTION: SET UP	Students do not describe how the solution is set up or installed.	Students describe when, where, and how the solution is set up or installed, but do not describe the set up or installation plans in detail.	Students describe when, where, and how the solution is set up or installed. As part of their plans, students describe a set up or installation timeline.	
SOLUTION: COST	The display does not talk about how much the solution costs.	The display talks about how much the solution costs, but the costs are missing material cost, set-up cost, or worker cost.	The display talks about how much the solution costs and includes material cost, set-up cost, and worker cost.	



Criteria	Starting (0-3)	Growing (4-6)	Pro (7-10)	Score (0-10)
MODEL	Students did not make a model.	Students made a model of their solution. The model is hard to understand and does not look like any part of the solution.	Students made a model of their solution. The model is easy to understand and looks like at least part of the solution.	
SOURCES	Students have 0-2 sources in their references section. Only some of the sources are trustworthy.	Students have listed 3-4 sources in their references section. Some or all of the sources are trustworthy.	Students have listed 5+ sources in their references section. All of the sources are trustworthy.	
CONTENT	There are lots of grammatical or spelling errors.	There are a few grammatical or spelling errors.	There are no grammatical or spelling errors.	
DISPLAY	The display is not organized and looks messy and thrown together.	The display looks well done but is not organized.	The display looks well done and is organized.	
Overall Score:				/100



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

Criteria	Starting (0-3)	Growing (4-6)	Pro (7-10)	Score (0-10)
ENGINEERING DESIGN	Students do not explain how they came up with their solution.	Students explain how they came up with their solution, but do not describe any problems they found with their solution or describe how they fixed these problems.	Students explain how they came up with their solution. Students describe the problems they had with their solution and how they fixed these problems.	
SOLUTION: PROOF	Students do not explain why their solution would work.	Students explain why their solution would work, but do not share any data, examples of how similar solutions worked, or other information to help explain why their solution would work.	Students share data, examples of how similar solutions worked, or other information to help explain why their solution would work.	
SOLUTION: NEW	The solution is not a new solution, or the solution does not work to fix the problem.	The solution is new but does not fix the problem much more than other solutions.	The solution is new and fixes the problem much better than any of the other solutions that are being used to fix the problem.	
MATERIALS AND TECHNOLOGY	Students do not identify the materials or types of technology they used in their solution.	Students identify the materials or types of technology the used in their solution, but are not specific. Example 1: Plastic instead of Polyvinyl Chloride (PVC) Example 2: Artificial intelligence (AI) instead of predictive AI Example 3: Drones instead of fixed-wing drones	Students identify the materials or types of technology the used in their solution. Students are specific when identifying each component. Example 1: The solution uses a cellulose-based composite (a plant-based plastic substitute) Example 2: The solution uses stereolithography (3D printing that works using resin and ultraviolet light) Example 3: The solution uses 95% ethanol (a type of alcohol)	
ENTHUSIASM	The presentation and/or display does not show off the solution and project. The solution and project do not look strong.	The presentation and/or display shows off the solution and project. The solution and project are strong, but the students and/or display could do more to convince the viewer that their solution would work.	The presentation and/or display shows off the solution and project. The solution and project are strong and the students and/or display makes the viewer believe that the solution would work.	
Overall Score:				/100



Using Artificial Intelligence

About Artificial Intelligence

Artificial intelligence (AI) is a technology that helps computers learn over time. AI can be used to collect information, guess results, and create stories, pictures, and more. While AI is a great tool, it is important that we use AI the right way.

How to Use Artificial Intelligence

To use AI the right way, you need to make sure you are not using AI to do all the work for you. Everything that AI makes needs to be double checked because AI pulls information from lots of different places. This means that even the best AI can get things wrong and give you bad information. Because of this, you should only use AI to help you brainstorm ideas and find information, not write things for you or tell you how to create your solution for the Junior STEM Challenge. Even if you are just using AI to brainstorm ideas and find information, you will still need to double check the information it gives you to make sure it is correct.

If you are using AI for the Junior STEM Challenge, you cannot use AI to create your solution. AI can only tell you what we already know. This means that it can only tell you what scientists and engineers are already doing to fix the problems in the Junior STEM Challenge and cannot come up with any new ideas. While we cannot use AI to come up with a new solution, we can use AI to figure out what scientists and engineers are already doing to fix these problems. This can give you a good starting place for the Junior STEM Challenge. Remember, AI is a tool and cannot come up with new, creative solutions.

How to use AI (OpenAI, 2025)*:

Step 1: Figure out what you want the AI to help you with.

Step 2: Write your prompt. Use the following prompt examples to help create prompts for the Junior STEM Challenge:

Example 1: Describe what tools scientists have designed to... in the last 5 years.

Example 2: Identify five problems associated with...

Step 3: Add information to your prompt so that the AI understands exactly what you want. This can be your audience, how you want it formatted (a paragraph, a list, etc.), and more.

Example 1: Provide your response in a bulleted list with at least one reliable resource supporting each bullet.

Example 2: Provide your response in paragraph format.

Step 4: Read the response and make sure it matches what you asked for.

Step 5: If the answer does not make sense, go back and fix your prompt.

Step 6: If you fixed your prompt, try your new prompt to see if it gives you a better response.

Step 7: If the answer still does not make sense, repeat steps 5-6 until you get a better response.

Step 8: Review the final response to make sure it is correct and makes sense before using it for schoolwork or projects.

Checking Artificial Intelligence Responses

Reviewing AI responses to make sure that the information it gives you is correct is one of the most important steps when using AI. We all know that AI can pull information from bad sources, but it can also completely make sources up! When using AI to give you information about a topic, always ask AI to give you its sources. Once it gives you the sources, you need to go check out the website yourself. AI will try to make up sources that sound perfect! If you do not check the AI responses and read the sources yourself, it can be very easy to use information that may not be true.

Good vs. Bad Artificial Intelligence

There are a lot of different free AI tools that can be used to collect information, guess results, and create stories, pictures, and more. Not all AI tools are good at the same thing, so you should decide what you want to create before picking your AI tool. Be super careful when using AI to make pictures. Some AI tools create pictures using art without the artist's permission. Because of this, a lot of AI tools are being sued by the artists who have had their work stolen. Each of the AI tools listed below are safe to use, but students in M-DCPS should only use Gemini (Gemini, 2025)**:

- **Gemini:** This tool answers questions and helps you think of new ideas. It makes written answers, summaries, fun stories, and helpful plans.
- **ChatGPT:** This is a computer program that can write about anything you ask it to do. It makes stories, emails, poems, and helpful facts.
- **Perplexity:** This tool finds information on the internet and then gives you a clear summary, showing where the facts came from. It makes quick facts and easy-to-read summaries of research.
- **Canva (Magic Studio):** This design tool uses AI to help you create great-looking pictures quickly. It makes posters, drawings, presentations, and images created from text.
- **Adobe Firefly:** This is a creative tool where you type what you want, and the AI makes it into an image or helps you fix photos fast. It makes new digital art, picture edits, and quick illustrations.

Citing Artificial Intelligence

Whenever you use AI, you have to add the AI you used as a source even if you did not copy exactly what the AI said. If you pull any information from AI, you will have to list it as a source just like anything else.

**The tips for this section of the Guidebook were created using ChatGPT. ChatGPT was given the prompt, "Create a 'how to' guide for AI designed for middle school students. This guide should be listed as a series of steps (Step 1, Step 2, etc.) and should be no longer than 8 steps. Each step should be 1-2 sentences. The guide should cover building a specific prompt, refining the prompt (if needed), and checking the results generated by the AI." The ChatGPT response was then edited.*

***The definitions for each AI tool was created using Gemini. Gemini was given the prompt, "Create a 1-2 sentence descriptor of each AI tool. Each description should be written for a 6-8 grade audience and should identify the types of products each AI tool can produce." Gemini was given a few more prompts to help the answers make more sense. Responses remain unedited.*

Sources:

OpenAI. (2025). ChatGPT (GPT-5.1) [Large language model]. <https://chatgpt.com/>

Google. (2025). Gemini (2.5 Flash) [Large language model]. <https://gemini.google.com>

Student Tips

The Junior STEM Challenge was not made to be easy. Whenever you feel like you are struggling with the STEM Challenge, turn to this page for some tips and tricks.

How to Take a Break

Do not forget to take breaks while working on the Junior STEM Challenge! When taking breaks, try to switch project tasks and keep using your brain. For example, if you are working on your solution, maybe you can use your break to sketch your model, organize your sources, or work on another part of your project. If you scroll social media or play a video game during your break, your brain will have a harder time getting back to work. By using your break to work on another part of your project, you can feel productive, get work done, reduce your stress, and make it easier to go back to your original task (“Taking Breaks,” 2024).

Finding Sources

If you are having trouble finding good sources for your project, you can use websites like Wikipedia. While you cannot use Wikipedia as a source for your Junior STEM Challenge project, you can use it to get ideas or find other good sources. The bottom of each Wikipedia page has a list of sources at the bottom. You can look through these sources to see if any are good sources that you can use for your Junior STEM Challenge project.

Too Many Options

In the Junior STEM Challenge, you can pick any problem, solution, display, and model that you want. This can give you choice overload, which happens when you have so many options you cannot decide what to do.

If you have trouble picking your problem or solution, you should learn more about your topic, list all your ideas, and pick one problem and solution that everyone in your group likes. Even if you are not sure about your solution, remember that you can still change things as you go—that is part of the engineering design process and part of the Junior STEM Challenge (Chernev et al., 2015; Pilat & Krastev).

If you have trouble picking your model and display, you should read the examples in your Student Guidebook. It is one hundred percent okay to make something similar to these examples.

It’s Too Hard

The Junior STEM Challenge is not easy. There might be times when you feel like finishing your project is impossible. When this happens, take a break and look at how much you have already done. Remember that the problems you are trying to solve are the same problems that scientists and engineers are still trying to solve. It makes sense that if scientists and engineers find it hard, you will too! Also, remember that your solution does not have to fix your entire problem. As long as your solution makes the problem a little bit better, it is a great solution for the Junior STEM Challenge.



Due Dates

During the Junior STEM Challenge, your teacher might give you due dates for different parts of your project. While due dates can help you finish your project on time, they can also be stressful. If a due date stresses you out, make a list of everything you have to do before your due date. Then, work on finishing each item on your list one at a time. Do not worry about making everything perfect – just worry about getting them finished. Once they are all done, you can always use whatever time you have left to make them better.

If you know that no matter what you do you will not be able to meet a due date, talk to your teacher ahead of time. Do not wait until the day it is due. When talking to your teacher, you need to be honest and explain why you do not think you will be able to meet the due date. During this conversation, give your teacher a new due date that you think you will be able to meet. You can then talk with your teacher to figure out what works for both of you. Use the following example to see how you can have this conversation with your teacher:

The due date is in three days and you go up to your teacher before or after class.

“Hi. I know that my group’s model is due in three days, but we don’t think we will be able to meet that due date.”

“I didn’t manage my time well and I didn’t realize I have two more projects due this week. One of the projects is for my English class and it’s a big part of my grade, so I need to finish it first. The rest of my group can keep working on the model, but I have some of the things they need to finish it.”

“Could we have one more day to finish the model? We can all meet after school on the due date and can bring the model in the next morning at the start of school.”

“If we can’t have one more day, I understand, but is there anything else I can do? I want to make sure that my mistake doesn’t hurt my group’s project grade.”

You can have a similar conversation with your teacher for any due date and for any problem. While the example conversation is for a student who did not keep track of their assignments, you can have the same conversation about other problems and emergencies. If you do have an emergency that is making you miss a due date, you may need to give your teacher proof of the emergency. Always try to talk to your teacher as soon as you realize you might not be able to meet a due date and remember that your teacher can always say no to your request for more time. Your teacher is also more likely to say no if you wait until the last second to ask them, if you are always asking them for more time, or if you always turn in your assignments late.

Other Tips

Do not procrastinate: It sounds easy, but it can be hard to not procrastinate on your project! If you know that you procrastinate on a lot of assignments, use these tips and tricks to help you get work done. Set one or more mini-due dates before your due date for class. Then, tell a teacher, friend, or family member about your new mini-due dates and ask them to make sure you are finishing your work before each mini-due date. For example, you can set one or several completion goals for your project or project components. If you finish your work before each mini-due date, you will finish everything before the real due date and will still have time to go back and make things better. This works even if you procrastinate on your work before each mini-due date!

Keep every source: Write down every source that talks about your problem, even if you do not need them right now. You can always throw away the sources you did not need at the end of your project. If you throw away the sources you think you do not need early, you might have trouble finding them again if you need them later.

Do a little at a time: Try to work on the Junior STEM Challenge a few times a week or little bit every day. If you spread out the work, you will not have to do a ton of work right before each due date.

Take care of yourself: Like with all schoolwork, you need to take care of yourself during the Junior STEM Challenge. If you are having trouble with the Junior STEM Challenge, tell your teacher. Remember, even though the Junior STEM Challenge and school are important, you are more important.

Sources:

Chernev, A., Böckenholt, U., & Goodman, J. (2015). Choice overload: A conceptual review and meta-analysis. *Journal of Consumer Psychology*, 25(2), 333-358.

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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

Sustainable Energy Data



Data Bank, Sustainable Energy for All

<https://databank.worldbank.org/source/sustainable-energy-for-all/preview/on>

The Data Bank can be used to see the sustainable energy consumption of different countries around the world. This data can be filtered by year.



Geospatial Energy Mapper

<https://gem.anl.gov/>

The Geospatial Energy Mapper (GEM) website can be used to generate maps of the United States that show sustainable energy potential and current energy infrastructure locations.



International Energy Agency

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

The International Energy Agency (IEA) website contains global data on different energy generation methods. This data is displayed across the site in different reports and graphs.



Our World in Data, Renewable Energy

<https://ourworldindata.org/renewable-energy>

Our World in Data has visualizations for different datasets related to sustainable energy consumption. The visualizations can be viewed as tables, maps, line graphs, bar graphs, and area graphs and the data can be adjusted to view sustainable energy consumption over time.



United States Energy Information Administration, Renewable & Alternative Fuels

<https://www.eia.gov/renewable/>

The United States Energy Information Administration (EIA) website contains data for different energy production methods across the United States. These datasets are often broken down by state. Many data sets are viewable only as tables. The Hourly Electric Grid Monitor shows the energy draw of each power company across the US in real time.

Model Resources

While some modeling software can be expensive or otherwise difficult to access, there are many high-quality free alternatives. As a reminder, creating a digital 3D model is not required for the STEM Challenge as models may include any physical or digital project component that represents the project solution.



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

<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

<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.



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.

This image shows a full page of blank white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page, providing a template for writing or drawing. There are no margins, text, or other markings on the page.

[illegible]



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