Design & Pitch
Challenges in STEM

Teacher's Guide - Building Algorithms

DESIGN&PITCH CHALLENGE

INTRODUCTION AND WELCOME

Welcome to the Design & Pitch Challenges in STEM!

Whether this is your first time implementing a Design & Pitch Challenge or your ninth, we are excited to have you on our team of innovative practitioners who are bringing entrepreneurship and career readiness to the forefront of STEM.

In this document, you will find a variety of resources that will help you implement the Design & Pitch challenges with your students. These resources include:

1. an overview of the Design & Pitch (D&P) Process;
2. a list of Teacher Tips from the D&P team and other teachers who have used the challenges in their own classrooms;
3. a "Where's the Math?" document that outlines the standards and topics covered by each challenge;
4. a table of Implementation Models that outline what various timelines might look like for completing the challenges; and
5. a breakdown of each major step in the process in the context of the Building Algorithms challenge.

This guide is specifically designed around Building Algorithms, which is one of the nine D&P challenges designed for middle grades. The Building Algorithms challenge encourages students to build algorithms that use people's opinions to rate or rank something they care about and that can be the start of a successful business. While completing this challenge, students will encounter and develop understanding of mathematical topics like writing, evaluating, and interpreting algebraic expressions.

Our free materials can be accessed online at https://sites.ced.ncsu.edu/design-and-pitch/. If at any time you have a question about the materials or would like to discuss them in greater detail, feel free to reach out to the D&P team at design_pitch@ncsu.edu. We are here to help you in whatever way we can!

Thank you for your interest in the Design & Pitch Challenges in STEM!
The Design & Pitch Team

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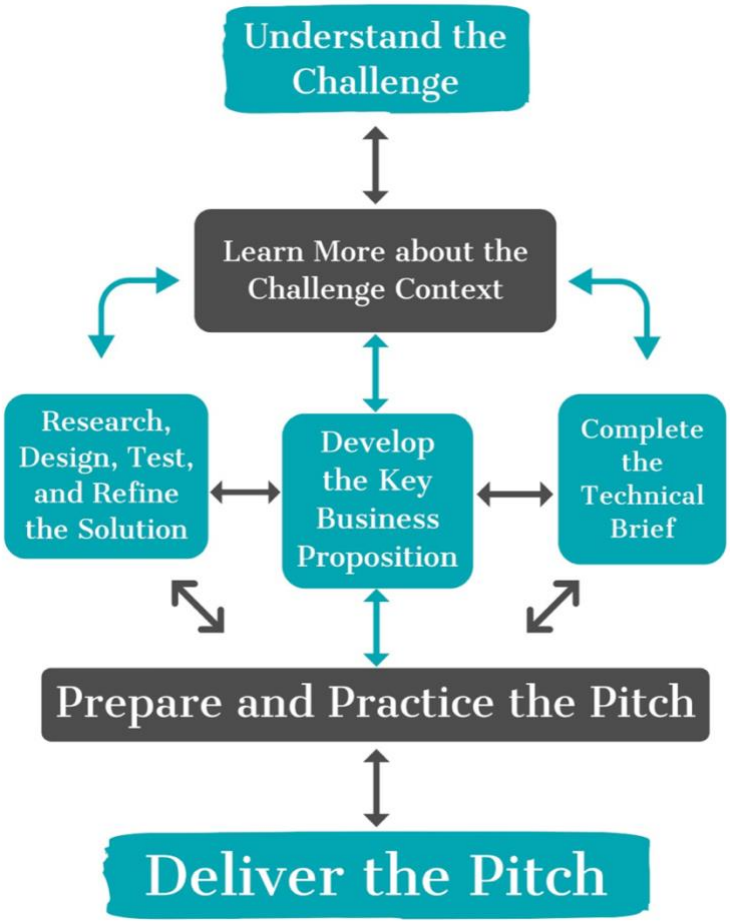
THE DESIGN & PITCH PROCESS

The Design & Pitch Process can be thought of as a flowchart, where the process begins at the top and flows bidirectionally from one step to the next. It flows bidirectionally because students are encouraged to work through the Challenges iteratively, meaning they should be revisiting previous parts of the process as they work toward their solution and the delivery of their pitch.

Throughout this Teacher's Guide, we will break down the steps of the D&P Process in the context of the Building Algorithms challenge. The pages that directly relate to one of the steps in the process will begin with headers that include 'THE PROCESS' and the name of the specific step. You can also find these pages labeled on the Table of Contents for your convenient navigation.



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TEACHER CHECKLIST

General Suggested Materials: The following list is meant to serve as a helpful starting point. There may be items specific to each challenge in addition to those outlined below.

- ☐ Computers with internet access
  - The D&P Website: https://sites.ced.ncsu.edu/design-and-pitch/
- ☐ Presentation tools like PowerPoint, cameras, movie-making programs
- ☐ 2-3 judges (for the culminating event)

General Teacher Preparation:

- ***Become familiar with the challenge*** – Be sure you have walked yourself through the challenge, reading over the materials and the resources available to students.
- ***Collect materials*** – you might limit this to supplies you already have in the classroom or allow students to bring in materials from home to encourage creativity. After students brief themselves about the challenge, you might have students help describe the list of possible materials they might need, given any possible constraints like costs, size, etc.
- ***Confirm online access for students*** – Research is a primary component to the D&P Challenges, so students will need to have access to the internet. This can also be helpful in sharing documents and materials.
- ***Set a date for the "judging"*** – Be sure all of your judges can attend the competition!
- ***Prep your judges*** – Be sure to schedule a meeting with your judges ahead of time. During this meeting, have the judges watch the *Setting the Stage with Your Challenge Champion Video* and review the *Pitch Judging Sheet*.
- ***Consider what format the culminating activity will take*** – will this be a district-wide or school-wide competition, or will this be implemented in a classroom?

Tips from Other Teachers:

- ***Use the Challenges to teach 21st century skills*** – so many soft skills are built into the D&P Challenge Process, so be sure to use the process as a chance to teach presentation, organization, teamwork, and many other skills that students need to have to be successful in the 21st century
- ***Bring other teachers on board*** – depending on the challenge you and your students choose to tackle, you might consider working with another content teacher to cover more standards and increase the levels of engagement and learning

Questions?

The D&P Team is here to help! If you have questions, email us at design_pitch@ncsu.edu.

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BUILDING ALGORITHMS

What is Building Algorithms all about?

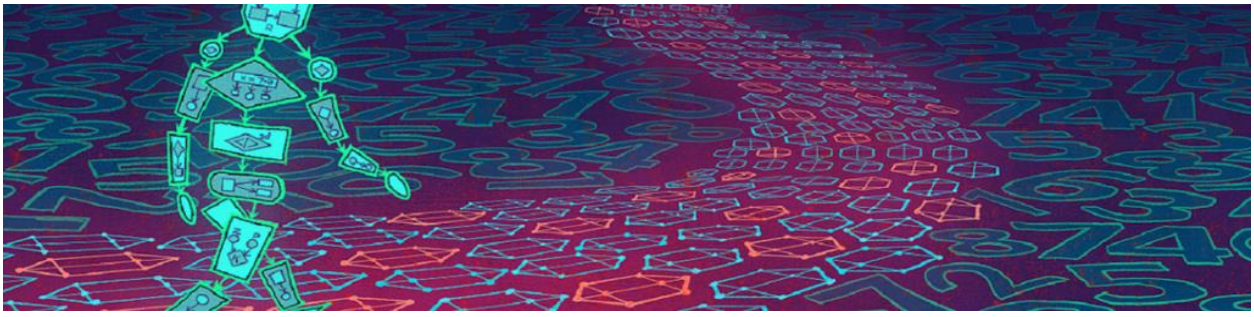
Algorithms influence everything from the content we consume to the places we choose to live. Although an algorithm is an objective process, the choices designers make in building an algorithm are not and often reflect their values and biases. In this challenge, students will experience the algorithm building process, through building spreadsheet ranking or rating algorithms. Along the way, they will need to assume an entrepreneurial mindset as they identify customers and define a business model that will make their algorithm actionable and sustainable.

In the Launch of the Building Algorithms challenge, students are introduced to Challenge Champion Cathy Yee, the founder and Chief Executive Officer (CEO) of Incluvie, a company that uses algorithms to rate movies according to how well they treat issues of representation. She explains to students what an algorithm is and how her company uses rating algorithms to solve a real-world and personally relevant problem: the lack of representation in Hollywood.

Along the way, Yee offers tips and suggestions for the students as they research possible solutions and begin building their prototype algorithms and designing their businesses. Several resources are provided to aid in students' research, but they are encouraged to reach beyond these resources to find the information they need.

Why might my students find this challenge interesting?

Building Algorithms was designed to encourage creativity and personalization for students. This challenge requires students to build rating or ranking algorithms, but they should be encouraged to select a context (what they are rating/ranking) and a set of input variables that reflect their interests and values. We have seen teams build algorithms relating to a range of contexts, including Historically Black Colleges and Universities (HBCUs), horse racing tracks, and YouTube channels. The mathematical goal for this challenge is to get students to write, evaluate, and interpret algebraic expressions, which they do through spreadsheet formulas. As such, any context that allows students to consider and evaluate a list of items using a common set of characteristics is likely to work.



DESIGN&PITCH CHALLENGE

WHERE'S THE MATH?

Each challenge has been carefully designed to align to the Common Core State Standards for Mathematics (CCSS-M). To make your job easier, we have compiled a brief overview of each challenge, including a summary of mathematical topics and a list of CCSS-M standards covered within each one. We categorize each standard as either a standard we intend for students to encounter or an additional standard students might encounter. The **standards we intend for students to encounter** are standards we anticipate will be covered by solutions that meet the requirements of the challenge. The **additional standards that students might encounter** are standards that students could uncover as they are digging into their solutions but are not the focus of the challenge.

Our team has created several overview documents to help you get a quick glance at all nine challenges. The Challenge Matrix, pictured below, provides you with a one-page reference sheet that includes the Challenge Image, Title, Description, Champion, and Mathematical Topics. The Standards Alignment document enumerates the concepts most likely to come out during the challenge for each of the D&P challenges. These documents are all available on the Teacher Resources page of the D&P website.

Design and Pitch: Challenges in STEM
Overview of Challenges

Challenge Image	Challenge Title	Description	Challenge Champion	Mathematical Topics
	Operation Lifeline	During natural disasters, delivering essential supplies like water, food, and medicine becomes a race against time. This challenge becomes even harder when the supplies have to be kept cold the whole time so that they don't spoil. In this Design & Pitch Challenge, you will find a workable solution for this important problem.	Kris Ludwig Scientist at the United States Geological Survey	3-D Figures; Proportional Reasoning
	Power Me Up	Gas-powered vehicles release harmful greenhouse gases and rely on a natural resource that will someday be gone. As a result, more and more people are buying electric vehicles. More electric vehicles means there is a need for more electric vehicle charging stations. This is an opportunity for savvy entrepreneurs. In this Design & Pitch Challenge, you will plan design a company that builds charging stations for electric vehicles.	Kristin Vicari Senior Chemical Engineer at Tesla	Analyzing Data; Proportional Reasoning
	Keep It Real	Smartphones are everywhere. They make so many things easier. We can get a ride, order a pizza, and connect with people across the world with a single tap of the screen. But what happens when smartphones get in the way of communication? In this Design & Pitch Challenge, you will design a way to help people put down their phones and connect, face-to-face.	Cardell Patillo Executive Director of Mile High Kids	Collecting, Analyzing, and Representing Data
	Building Algorithms	In today's internet world, data on people's opinions are highly prized. One way to understand those opinions is to ask people to complete surveys. Researchers then create formulas, or algorithms, that analyze their survey responses in an automated process. Many successful businesses are built around algorithms. Your challenge is to build an algorithm that uses people's opinions to rate or rank something you care about and that can be the start of a successful business.	Cathy Yee CEO & Founder of Incluvie	Equations and Inequalities; Percentages
	Prototype to Profit	Being an entrepreneur is about finding problems and turning them into opportunities. It's about inventing new solutions that create value for customers and using those solutions to make money, because even the best ideas need funding to succeed. At the heart of making money is finding the right business model type. The right business model type can be the difference between success and failure for an idea. And, sometimes, the business model type itself is the solution.	Tyler Maloney Materials Science Engineer & Entrepreneur	Representing and Solving Linear Functions
	Erase Food Waste	The way food looks is one indicator of whether it is safe to eat. But in the United States, we take this idea too far. Most grocery stores and restaurants won't offer produce to their customers that isn't perfectly shaped and colored, even if it is perfectly safe to eat. This results in a lot of food waste. In this Design & Pitch Challenge, you will design a food-related business that uses a sliding price scale to reduce food waste.	Oscar Ekponimo Founder & CEO of Chowberry	Percentages; Data Collection and Analysis
	Fix It: Design for Community Impact	In every community, there are problems that need solving or things that need improving. The most effective solutions are ones that meet the needs and desires of the community. If you pay attention and ask questions, you will notice what people want and what they need. Entrepreneurs don't wait on the sidelines for others to do the work. They jump in and use their energy and passion to make change happen. What can you fix in your community?	Gitanjali Rao Inventor & STEM Promoter	Proportions; Transformations; 3-D Figures
	Flashy Fashion	Technology can now be integrated into clothes, bags, and wearable devices for both self-expression and health & safety applications. Designers' creativity is shining in fashion shows, and tools like LEDs are now accessible enough that anyone can learn to make wearable technology. How will your design light up the world?	Kelsy Dominick Designer & CEO of DiDomenico Design	Coordinate Plane; Transformations; Domain and Range
	Pollution Solution	Plastic is a big environmental problem. The world is becoming overwhelmed by plastic waste, especially plastic containers that hold consumer products. Can you imagine a solution to replace plastics that does not cause as much harm to the environment?	Clifford Okoth Owino Founder & CEO of Chemolex	3-D Figures; Data Collection and Analysis

Summary
In Building Algorithms, students will engage with a functional approach to learning about algebraic expressions. They will need to learn and apply spreadsheet language and syntax to prototype their algorithms. In doing so, students will develop a deeper understanding of the **meaning of a variable** and will learn to **write, evaluate, and interpret the structure of algebraic expressions**.

Standards
In building their solutions, students are likely to engage with the following mathematical standards.

Standards We Intend for Students to Encounter

- Algebra
  - Representing and Manipulating Algebraic Expressions
    - Translate an algorithm into an algebraic expression. 6.EE.A.2.A
    - Simplify algebraic expressions. 6.EE.A.2.B

Additional Standards Students Might Encounter

- Algebra
  - Create and solve equations and inequalities. 7.EE.B.4
- Number Sense and Computation
  - Understand and use percentages to apply weight to responses. 6.RP.A.3.C, 7.RP.A.3

Opportunities for Math in the Challenge
After deciding on their context (what it is they want to rate/rank) and categories/variables (what they will base their ratings/rankings on) for their algorithms, students will need to build a prototype using a generalizable spreadsheet formula. To do this, students will need to write a spreadsheet formula and automatically apply it across multiple cells and rows. As they work to automate their spreadsheet formulas, students come to see the **variables** (i.e., cell names) as representing a range of possible values instead of one single value. Additionally, the spreadsheet tool, in requiring users to explicitly define operations (e.g., multiplication), helps draw students' attention to the **meaning of coefficients in expressions**. Finally, encouraging students to prototype their algorithms with real examples and to reflect on their accuracy will support students to **interpret the structure of algebraic expressions** and the relationships between that structure and the ratings/rankings produced by the algorithm.

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MATH RESOURCES AND TECH TOOLS

Math Resources - Workshops

One way to help students achieve the intended math goals for a challenge is to have small group workshops with your students. These workshops allow you to instruct and remediate on targeted math concepts as needed. You can run workshops with select students, a single team, multiple teams, or the whole class depending on the needs of your students. For example, in Building Algorithms, you may find that you need to help your students work through the spreadsheet resource to better understand how to write spreadsheet formulas or to connect those spreadsheet formulas to generalized algebraic expressions. These are things that can be addressed using a workshop model. By pulling a small group of students together for a workshop on using the spreadsheet resource, you will be able to address individual needs while situating the math in the context of students' specific solutions.

Tech Tools

Each of the D&P Challenges includes a Tech Tool that is designed to help students develop a deeper understanding of the mathematical content embedded in the Challenge. For Building Algorithms, the tech tool is the Building Algorithms Spreadsheet resource. This is an interactive spreadsheet that teaches students about algorithms and how to write spreadsheet formulas by walking them through several examples of rating and ranking algorithms. When students open the link to the spreadsheet resource, they will be prompted to create a copy of the Google Sheets spreadsheet. If you do not have access to Google, you can also download the spreadsheet as an Excel file. In this case, it will be important that students have a way to save their work, whether on a personal computer or flash drive. You can access the Building Algorithms Spreadsheet resource through a few places on our website. There are links at the bottom of the Launch page and the Prepare page, and it is also featured on the Tech Tools section of the website.

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IMPLEMENTATION MODELS

Ways to Use D&P

Design & Pitch challenges can be used in a variety of ways - as core or supplemental materials and in both in-school and out-of-school settings (e.g., after-school clubs, summer camps, Boys & Girls Clubs). There is no “right” way to implement the challenges. Instead, we encourage you to think about how D&P can best fit into your classroom. The D&P team offers professional development opportunities to help teachers dive into the materials in a fun, collaborative setting, and we are happy to meet one-on-one with any teacher who is interested in using the challenges.

Classroom Implementation

For your pacing purposes, we have broken the D&P Process into 6 sessions, which can be found on the next page. You will also find a “Session 0” that can be helpful for those teachers and students experiencing Design & Pitch for the first time. Each of these sessions assumes students will have a 45-minute class period in which to work. For longer or shorter class periods, consider adapting the sessions to meet your needs.

In the past, we have seen teachers complete multiple challenges in a semester, implementing some challenges over consecutive days and completing others a couple days per week for a couple months. The goal is to fit D&P into your schedule rather than try to squeeze the diverse needs of your students into a regimented box.

Including the Community

D&P challenges are also well positioned to provide opportunities for schools to connect with and engage family members, community members, local businesses, and/or town governments. Local STEM professionals or other members of the community with expertise in areas relevant to each challenge can serve as mentors throughout the design process, offering feedback on prototypes and business plans, and may be recruited to judge final projects.

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DESCRIPTION OF SESSIONS

Session 0
If it is your first time using Design & Pitch Materials, a day introducing the ideas may be advisable. Introduce the idea of D&P, what it means to be an entrepreneur, and what a pitch competition is.
Students discuss the Entrepreneurial Wheel and the D&P Process flowchart (see p. 4).
Briefly discuss the various aspects of the D&P Challenges (e.g., Challenge Statement, Key Business Proposition, Tech Brief, Pitch).

Session 1
Launch: Introduce Challenge (video and Challenge Statement); form teams of 3-4 students.
Prepare: Students begin exploring and researching, including Helpful Resources on the Prepare page of the website. Students brainstorm ideas and sketch initial solution.
Engage: Review things students should submit by the end of the Challenge (which can be found on the Engage page) at this time.

Session 2
Engage: Students review Business Models and begin working on Key Business Proposition (KBP).
Students discuss initial thoughts about their business model and what their customers and/or users want.
Students revise product in light of business model and KBP.

Session 3
Engage: Introduce Technical Brief and Technical Brief Grading Rubric.
Students conduct further research and design prototype.

Session 4
Engage/Persuade: Students review How to Build a Pitch and Pitch Judging resources.
Students build initial pitch deck.
If able, students conduct tests on their prototypes and make final revisions.
Teams continue working on Technical Briefs.

Session 5
Engage: Students discuss and finalize KBP.
Engage/Persuade: Students present pitch to practice judges for feedback. Students analyze feedback and revise their pitches, solutions, and business propositions.
Teams revise and complete Technical Brief and Pitch.

Session 6
Students pitch their solutions to a panel of judges (possible investors).
Students hand in Technical Briefs.
Winner(s) announced.
Optional: Awards / Celebration

Launch

Once you have selected and prepared for a challenge, it is time to launch the challenge with your students. Each challenge includes a Challenge Statement video, in which the Challenge Champion (each challenge has a unique Champion to guide the students through the Launch and Prepare sections) establishes the context or problem and formally issues the challenge. In the video for Building Algorithms, Incluvie founder and CEO Cathy Yee briefly explains what an algorithm is, as well as how her company uses algorithms to address an important and socially relevant problem.

Summary and Scenario

Following the Challenge Statement video is a Summary and Scenario section, where the challenge is briefly summarized for the students. This section also begins to explore the significance of the issue so as to convince students that this problem deserves their attention. In the Building Algorithms challenge, for example, students are prompted to consider contentious debates, such whether LeBron James is a better basketball player than Michael Jordan or whether Chinese food is better than TexMex, to get them to start thinking about the considerations that often inform our evaluations. For example, some might argue that a player's win-loss record in NBA championships is more important than the number of NBA championships a player wins. These early discussions are the types of things students will need to consider in identifying input variables for their algorithms.

As you launch the challenge with your students, you might consider introducing additional examples that pique student interest and draw their attention to the key components of an algorithm: input information, output information, and a process of using the input information to generate output information. These examples could include companies like Yelp, which utilizes user input to generate restaurant ratings. Consider using a current debate that your students are passionate about (e.g., LeBron James vs. Michael Jordan) to help them recognize the importance of establishing agreed upon input information for an algorithm. The goal here is to tailor this section of the challenge to your students' interests and grab their attention; this is the time to bring out your teacher 'hook!'

Challenge Statement

The final piece of the Launch is the Challenge Statement itself. This document outlines the challenge and describes the areas that should be addressed by the students' products/solutions and businesses. While the students are encouraged to be innovative in their solutions, the following criteria are laid out to get students to interact with the targeted math topics. The Challenge Statement for Building Algorithms explains that the students are to **build an algorithm**

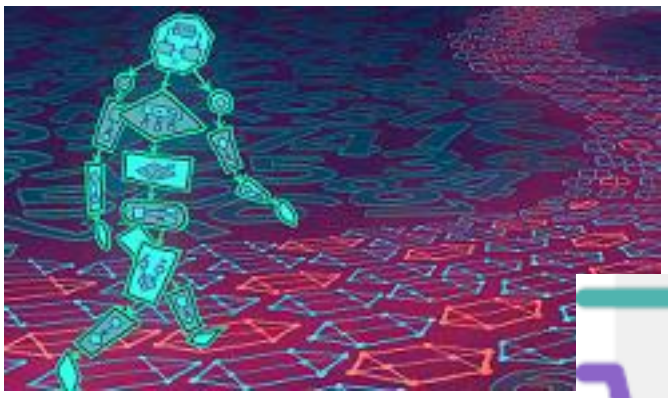
that uses people's opinions to rate or rank something they care about and that can be the start of a successful business. It also states that their solution must:

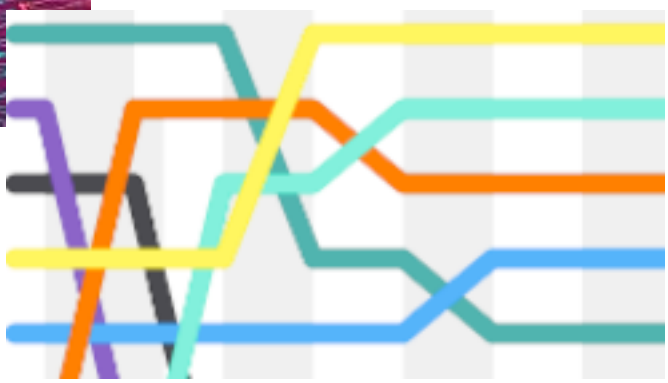
1. Allow users to put in data and automatically rate or rank the thing they care about.
2. Include weighted categories*.
3. Be transparent (Users should know how their algorithm works and be able to test it).
4. Include a way to make money.

* Weighted Categories: Algorithms often assign "weights" to categories depending on how important they are to the builder of the algorithm. For example, suppose you were building an algorithm to decide where to live when you graduate from college. You might care more about the average temperature of the city than the size of the city. You can use weights so that average temperature has a larger impact on the ranking than population. Explore the interactive spreadsheet Building an Algorithm Worksheet to see examples of algorithms that use weighted categories.

Brainstorming

As you introduce the challenge to your students, it is important to allow them to brainstorm along the way. They might be thinking about issues they find important or possible solutions. They might be thinking of business strategies or about the final pitch. They might be thinking about questions they have or things they will need to know along the way. As such, they might need help organizing their thoughts, and brainstorming as a class or small group can help them do this. If students have already been organized into groups, you can have them record their brainstorming somewhere that will be accessible for all group members; if you are brainstorming as a class, you might consider recording ideas on a poster board or bulletin board so the class can refer back to their original thoughts later.





Prepare

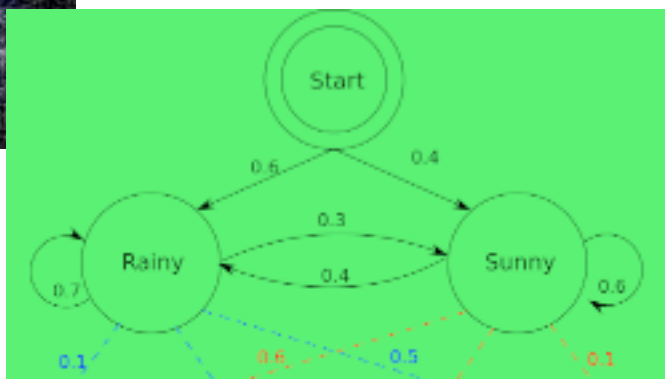
In this part of the challenge, students will conduct the research necessary to design and market their product. In order to facilitate this part of the challenge, we have included several tools on the Prepare section of the website.

Tips From Your Challenge Champion

At the top of the Prepare page, you will find a brief biography of the Challenge Champion, followed by a Background video from this expert. In Building Algorithms, Cathy Yee takes students on a deeper dive into her background and how her company uses algorithms to address the problem of poor representation in Hollywood.

Helpful Resources on Algorithms

Below the Background video, we have included several resources that students might find helpful as they learn more about algorithms and existing solutions. These resources include articles, websites, and a spreadsheet resource. The spreadsheet resource is especially important in this challenge as it gives students a tool with which to build a prototype algorithm, while also teaching them what an algorithm is and how to write generalizable spreadsheet formulas using the correct language and syntax. This is where the bulk of the learning relating to algebraic expressions and variables happens.



Prototyping

Once students are familiar with the requirements and context of the challenge, it is time for them to begin working on their solution. This is a great opportunity to check in with students as they work. Ask them to explain their entrepreneurial solution and follow up with questions that drive back at the challenge criteria. For example, when checking in on students, consider asking what variables they are using to calculate their rating/ranking. These questions position students as experts while also driving them to consider the meaning and structure of algebraic expressions.

Research

Depending on the ideas your students develop, they may need to go beyond the resources provided to understand what their solution might require. For example, your students might want to use a more complex spreadsheet formula than what is described in the Building Algorithms Spreadsheet Resource. That is wonderful, and we encourage students to be as inventive as possible! It might require them to do some additional digging, though, and this is where they can begin that research.

Design

Once students understand what their solution will require, they are ready to begin designing their solution. In Building Algorithms, this will involve using a spreadsheet tool, such as Excel or Google Sheets. Because many students will be unfamiliar both with algorithms and with writing spreadsheet formulas, we have provided the Building Algorithms Spreadsheet Resource to learn more about algorithms and how to build them in a spreadsheet. This resource can be found at the bottom of the Launch page, on the Prepare page, and on the Tech Tools page of the website.

Test and Refine

The brilliance of entrepreneurship is that designs that don't work are viewed as learning opportunities. As students test their initial algorithms, they might find that something went wrong. Maybe they discovered that their algorithm is assigning too high a rating or ranking to something they know should be rated lower. For our young entrepreneurs, this is a chance to take a step back, re-evaluate, and refine their algorithm. This is a good time to encourage your students to revisit (or take a first look at) the helpful resources on the Launch page. It might take several attempts before they find something that works, and that is okay.

As a teacher, you have a lot of flexibility in how you run this part of the challenge. Some teachers have groups pair up to share their ideas and give feedback. Other teachers have done this as a whole class discussion. This is a great time to practice informal presentation skills and giving constructive feedback.

DESIGN&PITCH CHALLENGE

THE PROCESS
Develop the Key Business Proposition

Developing a Business
The Design & Pitch Challenges are a great way to get students to think creatively about real-world issues, but they are also about building a viable business. As such, one part of the D&P Challenges that students must consider is the Key Business Proposition.

Business Models
One of the first questions students must answer about their business is how their solution is going to create value, which includes identifying a business model so that you can reach your target customers. We have provided a list of common business models for students to consider. This list is not comprehensive; students are welcome to research and select a business model that is not on this list.

Key Business Proposition
Once students have decided on the model for their business, they can begin working on the Key Business Proposition. This document is designed to get students thinking about a variety of business-related questions, including the following:

- Who are your customers and/or users? What do they want out of a solution?
- Why do they need your design more than someone else's?
- How does your solution enhance what customers like about their situation and fix what they dislike?

We find that students often lose sight of the customer through the process of designing their solution, and the Key Business Proposition can be used to remind them of the ultimate goal: design a product *to help* someone or some community. This is another opportunity to drive the students back to the targeted math goals. Asking questions like "How did you decide what variables to use in your algorithm?"; "What will the ratings/rankings look like to users?"; and "What will you do to help users trust your ratings/rankings?" is a great way for students to think about both the math and the needs of their customers. You might also encourage students to think about their own experiences with similar algorithms as they begin to justify what customers want or need.

Technical Brief

The Technical Brief, or "Tech Brief," gives students the opportunity to reflect on the D&P process and their solutions and connects directly to the targeted math concepts. As such, it can be completed along the way or after the final pitch and provides you the opportunity for small group instruction as needed. Some of the questions ask students to identify strengths they noticed and challenges they overcame along the way, so you might want to encourage students to be thinking about these items as they are working on their solution.

There are seven parts to the Tech Brief, which are outlined below. The first six parts are common to all nine D&P Challenges, though Part 1 often asks students how their solution works within the context of the specific challenge. Part 7, however, is challenge specific and drives students to think about the math behind their solutions.

Part 1. Briefly describe your solution and how it solves the problem or challenge you identified.
Part 2. Describe the mathematics, science, and engineering you researched to design your product. Include links to websites or other resources you used.
Part 3. Describe the decisions you made to choose your design and the challenge you had to overcome.
Part 4. How did developing your Key Business Proposition and related Business Models Type affect your process?
Part 5. Your final solution probably looked different from your original idea. Describe the process for how you developed your idea from start to finish.
Part 6. How well do you think your solution will work under real-world conditions? Explain your reasoning.
Part 7. Fully describe your Building Algorithms solution based on the questions below.
1. What does your algorithm do?
2. How does your algorithm work?
3. How will your company make money?
4. What are the limitations of your algorithm?

Grading Rubric

Teachers often ask us how they can assign a grade to the D&P Challenges. While there are many ways you might choose to assign a numeric or letter grade to your students' work, we provide a rubric for the Tech Brief to help you assess the mathematical content behind each solution. Each rubric is designed to align to Part 7 of the Tech Brief and is unique for each challenge. In keeping with the entrepreneurial spirit, criteria are rated as "Getting Started," "Improving," "Good," or "Excellent" in order to encourage students to keep working hard.

Prepare and Practice the Pitch

Once your students have designed and refined their solutions, it is time for them to pitch their ideas to the investors. As students begin to build their pitch deck (i.e., the slides they will use to present their solutions to the judges), it will be useful for them to review two resources that can be found on the Engage and Persuade pages of the website: How to Build a Pitch, which walks students through the components of a successful business pitch; and the Pitch Judging Sheet – a score sheet that judges will use to evaluate each of the solutions and choose a winning team.

On the Persuade page, students also have access to three example pitch decks from existing companies (Air BnB, YouTube, and Podozi). These are meant to serve as idea-generating examples, not templates, for the students to use to understand what a pitch *can* look like and how important elements can be incorporated into a winning pitch. Once students have developed their initial pitch decks, they should practice the pitch before delivering it to investors. This can take a variety of forms, including having teams pitch to one another, to the whole class, or to a single individual (e.g., teacher, administrator, or community member). This is a time for the students to receive critical feedback so they can develop their ideas more completely before the final pitch.

Deliver the Pitch

Presenting the pitch is one of the most exciting parts of the competition for students (and teachers). All of the hard work each student has put in up to this point culminates in this persuasive presentation. As a standard rule, students only have five minutes to pitch their solution to the panel of judges (more on the judges below), though you, as a teacher, have control over how long students have to present. The suggested five minutes encourages students to be succinct and helps them to become effective communicators. In addition to overall winners, we encourage you to assign superlatives to all teams, such as awarding Best Business Design, Most Creative Solution, Best Pitch or Most Engaging Pitch, Overall Best Solution.

Preparing a Panel of Judges

Students love the opportunity to share their work with people external to the classroom. In the past, we have seen panels of principals, parents, community members, college professors, and other experts from the field. For Building Algorithms, you might consider members of your community who have experience working as computer programmers or in fields that use statistics. To help your judges prepare for their role, provide them with some background info, such as a link to the challenge website, and the Pitch Judging Sheet ahead of time so that they can understand what they are going to be judging. As for grading the pitch, some teachers use the Pitch Judging Sheet to assign a grade, some develop their own method for scoring the pitch, and still others choose not to assign a grade to this part of the Challenge. We encourage you to think about what works best for your classroom and assessment practices.

This teacher's guide was created by the Design & Pitch team, a group of mathematics education researchers in the Department of STEM Education at North Carolina State University. The D&P materials were created in partnership with Scaling Up Digital Design Studies (SUDDS), Exploring Mathematics Curricula Creatively (EMC^2), and JASON Learning.