Motivating Students Mathematically

Thru

Entrepreneurial Design Competitions

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Design & Pitch Challenges in STEM at
NC STATE UNIVERSITY

Project Staff, Partners, and Support

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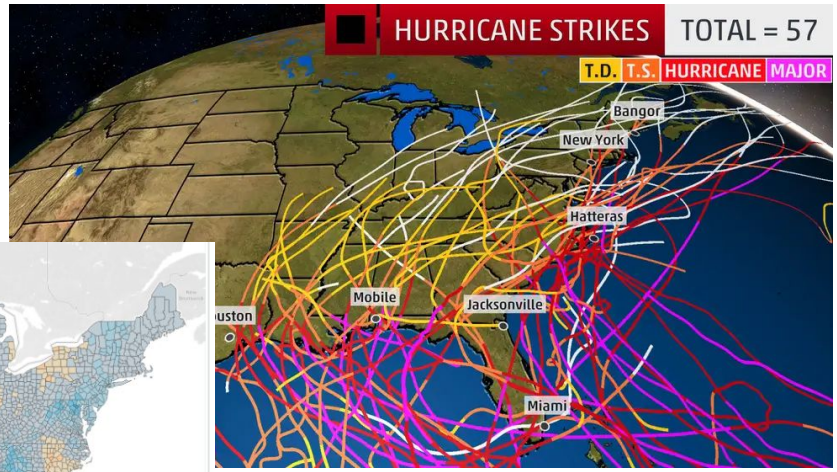
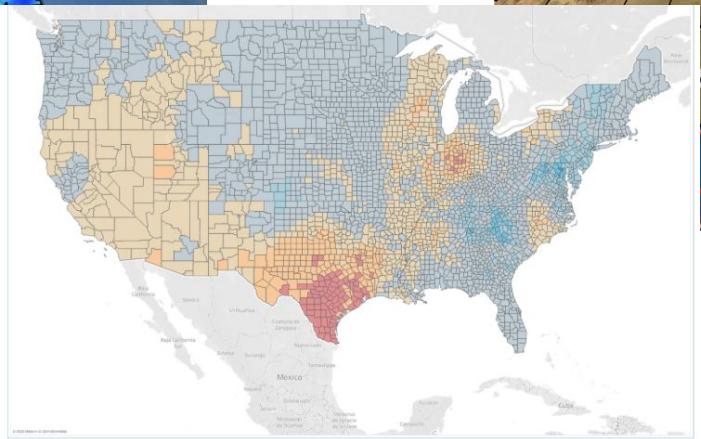
Why do we need

Entrepreneurship?

Solving Problems in Real Time





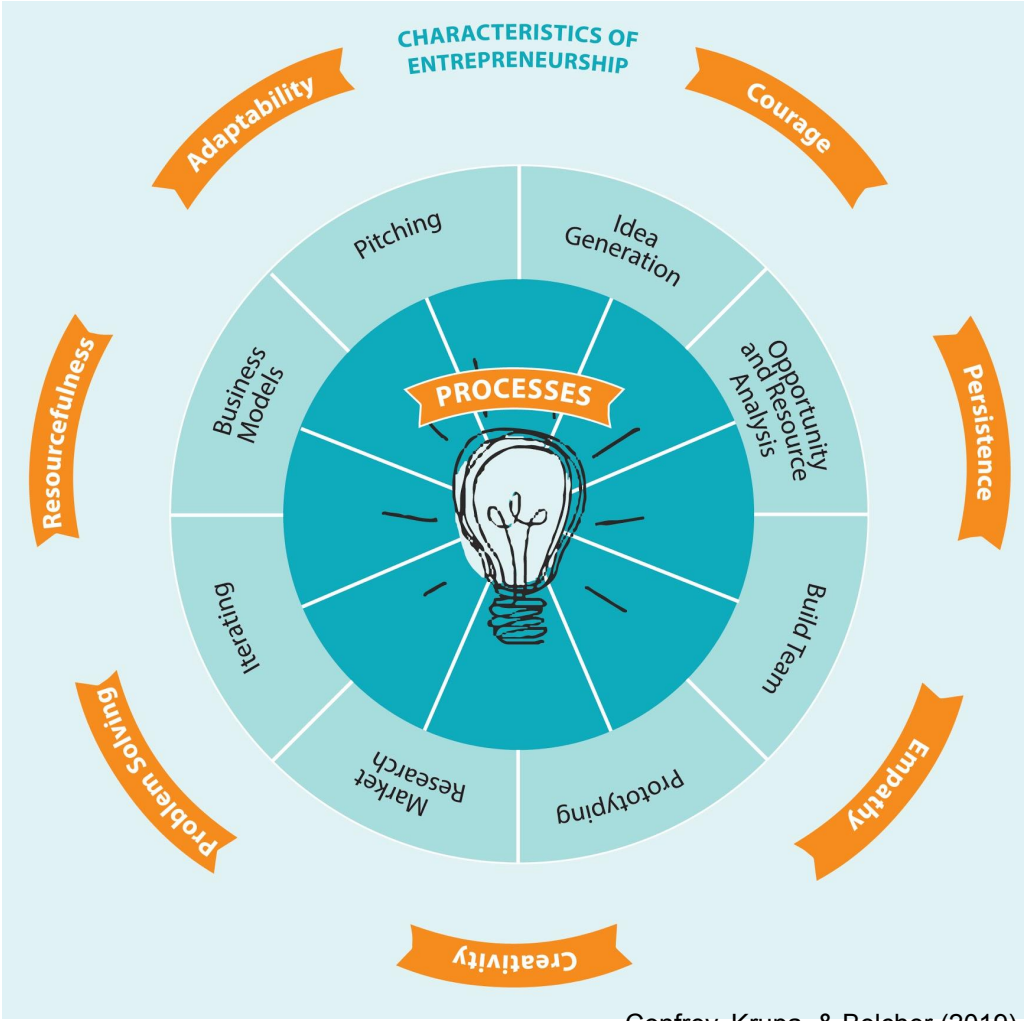
June 17 — We see higher than expected levels of illness transmission in several areas which we now see are experiencing a large surge in COVID-19 cases, including Texas, South Carolina, Arizona, Southern California.

Why Entrepreneurship?

- Seeking Out Diversity
- Finding Opportunities
- Identifying Resources
- Defining and Solving Problems
- Acting on Solutions
- Making the Economy Work for You

What does it Mean to be an Entrepreneur

Entrepreneurial Framework



Confrey, Krupa, & Belcher (2019)

What is

Design & Pitch?

Follow me to the D&P Website!

Goals of the Projec

- Use entrepren
- Devel
  - Motiva arning of w STEM conter pecially math

In response to the COVID-19 pandemic:

Design & Pitch

has gone

VIRTUAL!

The Challenges

9 Challenges

- Span a variety of topics
- Allow for students to explore own interests
- Aligned to middle school math standards

Operation Lifeline

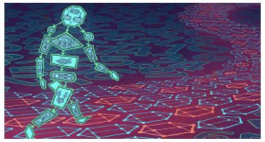
When disaster strikes, emergency response is crucial. How will you get essential refrigerated medical supplies to patients and facilities? →

Power Me Up

Gas-powered vehicles damage the environment, and more people are buying electric vehicles. However, charging stations are few and far between. Bring (electric) power to the people! →

Keep It Real

Smartphones are everywhere, and they make many things much easier... but sometimes they make good face-to-face conversations harder! How can you help people put down their phones and connect IRL? →



Building Algorithms

In today's internet world, data on people's opinions are highly prized. One way to figure out those opinions is to ask people to complete surveys where they rate or rank their favorites. Researchers create formulas that analyze those answers in an automated process. That process is called an algorithm. Algorithms are everywhere. →

Prototype to Profit

Being an entrepreneur is about finding problems and turning them into opportunities. Taking advantage of those opportunities requires understanding the situation and choosing the right approach, or business model. The right business model can be the difference between success and failure for an entrepreneur. →

Erase Food Waste

Catalog-perfect produce isn't the only kind that tastes delicious. 30-50% of food grown in the U.S. gets thrown away, and weird-looking vegetables are often the first to go. But ugly food tastes great! How can you erase food waste? →

Fix It: Design for Community Impact

In every community, there are problems that need solving or things that need improving. What can you fix in your community? →

Flashy Fashion

People are always looking for the newest trends, and wearable technology is the next big thing! What kind of flashy fashion can you design? →

Pollution Solution

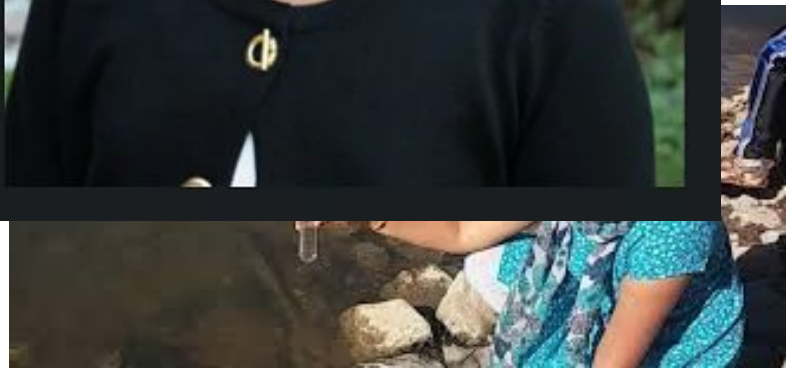
The world is becoming overwhelmed by plastic waste. Can you imagine a solution to replace plastics that does not cause as much harm to the environment? →

Challenge Champions and Mentors

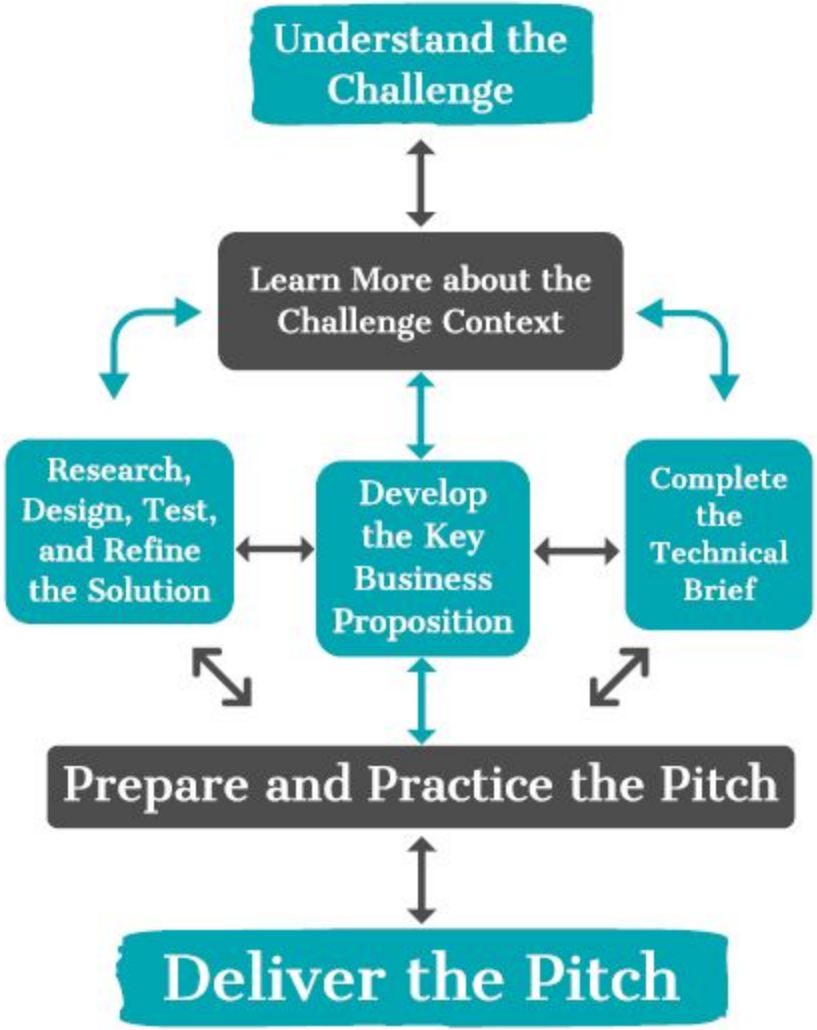
Challenge Image	Challenge Title	Challenge Champion	Champion Credentials and Accolades
	Operation Lifeline	 **Kris Ludwig** Scientist United States Geological Survey	A Natural Hazards specialist, Kris has co-led responses to volcano eruptions and hurricane relief efforts, including recovery from Hurricane Sandy. She has also led conversations and exercises on climate change, Zika virus, and several other topics. She holds degrees from Stanford (B.S. Earth Systems) and the University of Washington (Ph.D. Oceanography).
	Power Me Up	 **Kristin Vicari** Senior Chemical Engineer Tesla	Kristin currently works for Tesla as a Senior Chemical Engineer. Prior to her appointment at Tesla in 2017, Kristin worked as a PhD researcher at M.I.T. in Cambridge, MA, where she invented an organic, rechargeable battery. Kristin holds degrees from Northwestern University (B.S. Chemical Engineering) and M.I.T. (M.S. Chemical Engineering Practice, Ph.D. Chemical Engineering).
	Keep It Real	 **Cardell Patillo** Executive Director Mile High Kids	Along with his work with Mile High Kids, which currently administers the Head Start grant for the City of Virginia Beach, Cardell also serves on the school board for the Portsmouth Public Schools. He is a gifted communicator, and in 2013, he published a book entitled "How to Love Your Child Through A Divorce." He also founded the Cardell Patillo Leadership Academy for mentoring young men.
	Building Algorithms	 **Cathy Yee** CEO & Founder Incluvie	Before founding Inlcuvie, Cathy worked as an Engineering Project Manager for Johnson & Johnson, where she worked on teams across the globe as a teacher and trainer. She has also worked with Boston Scientific and Amgen. Cathy holds degrees from the University of Connecticut (B.S. Biomedical Engineering) and the University of Southern California (M.S. Biomedical Engineering).
	Prototype to Profit	 **Tyler Maloney** Materials Science Engineer & Entrepreneur	Prior to beginning his MBA studies at Stanford, Tyler served on the board of directors for InterAct of Wake, a service organization dedicated to assisting victims of domestic violence and sexual assault. Tyler was part of a team of undergraduate students at North Carolina State University (B.S. Materials Science and Engineering) that developed a nail polish that detects the presence of date rape drugs.
	Erase Food Waste	 **Oscar Ekponimo** Founder & CEO Chowberry	Oscar has been named in Time Magazine's 10 Next Generation Leaders, the BBC's Top 10 Innovators of 2018, and Quartz Media's Top 30 African Innovators in 2017 for his work in erasing food waste. His passion for integrating STEAM into everyday life is seen in his work as the Executive Director of Gallery of Code. He holds a degree in computer science from the University of Calabar.
	Fix It: Design for Community Impact	 **Gitanjali Rao** Inventor & STEM Promoter	Gitanjali took the world by storm in 2017 when she won the Discovery Education 3M Young Scientist Challenge at the age of 12. Her winning invention, *Tethys*, uses a 9-volt battery and carbon nanotubes to detect the presence of lead in water. This project was inspired by the crisis over clean drinking water in Flint, MI. Gitanjali has given three TEDx talks and has been awarded numerous prizes for her work.
	Flashy Fashion	 **Kelsy Dominick** Designer & CEO of DiDomenico Design	Fashion has always been about breaking the mold, and Kelsy is passionate about going where no man – or woman – has gone before. Kelsy's global travels have inspired her to create unique fashions, including her line of gowns that incorporate LED technologies. Her creativity has taken her to New York Fashion Week, the Cannes Film Festival, and an underwater photo shoot in Aruba.
	Pollution Solution	 **Clifford Okoth Owino** Founder & CEO of Chemolex	Chemolex is a company based in Kenya that strives to provide clean and affordable energy to the communities of East Africa. Clifford founded this company that patented its biofuel production technology that produces clean energy from the water hyacinth. Both he and the company are dedicated to reducing carbon emissions through creative, STEM-based solutions.

“I think being a scientist is like being a superhero, because superheroes save people, and want to do what is best for their society – scientists do the same exact thing."

Gitanjali Rao, TIME's Kid of the Year



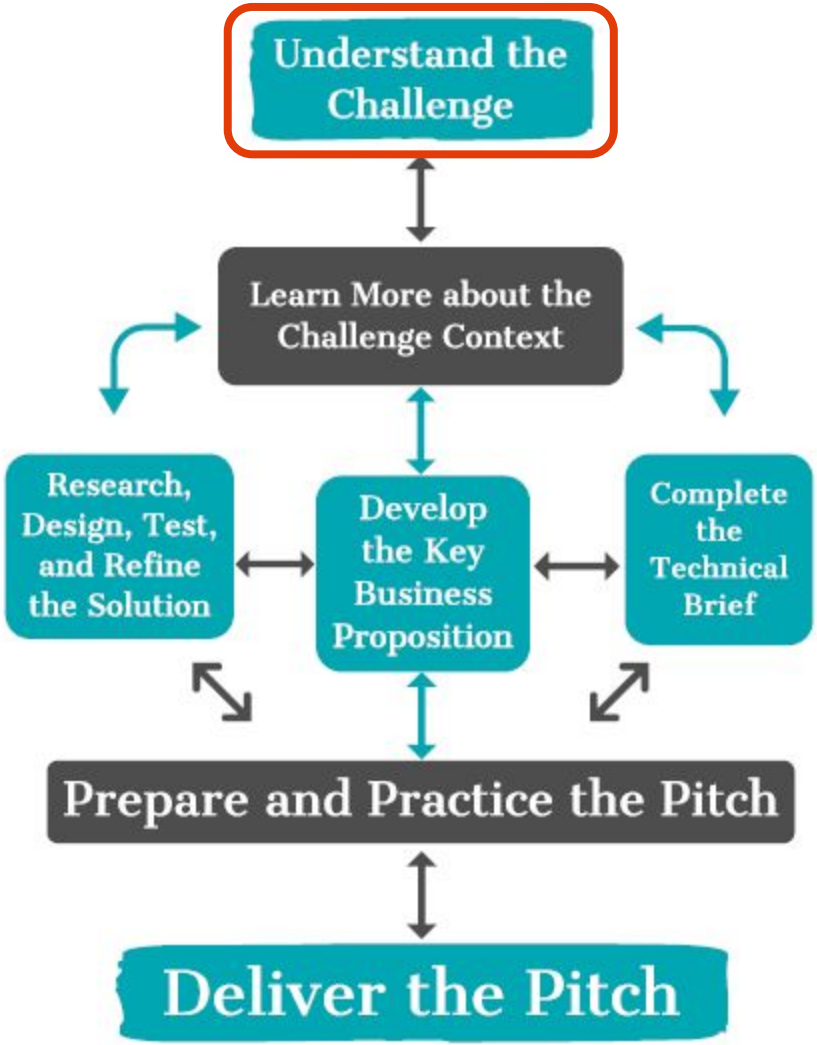
The Design & Pitch Framework



What does it feel like to

Participate in a Challenge?

Understand the Challenge



The Challenge Statement

Your challenge is to design a physical product that will help solve a problem facing your community. Your solution should include:

- Research that shows the product helps solve the problem.
- A prototype of your solution. This should be a 2-D sketch or 3D model, and also include the dimensions of the product and a description of the materials needed.
- A description of how the product will be distributed to customers, including the volume and surface area of the shipping container.

Your final submission should include a detailed sketch of your product. You do **not** need to print your solution. Visit the Prepare page to learn about TinkerCAD, a free program for creating 3D printable designs.

Fix It: Targeted Math Concepts

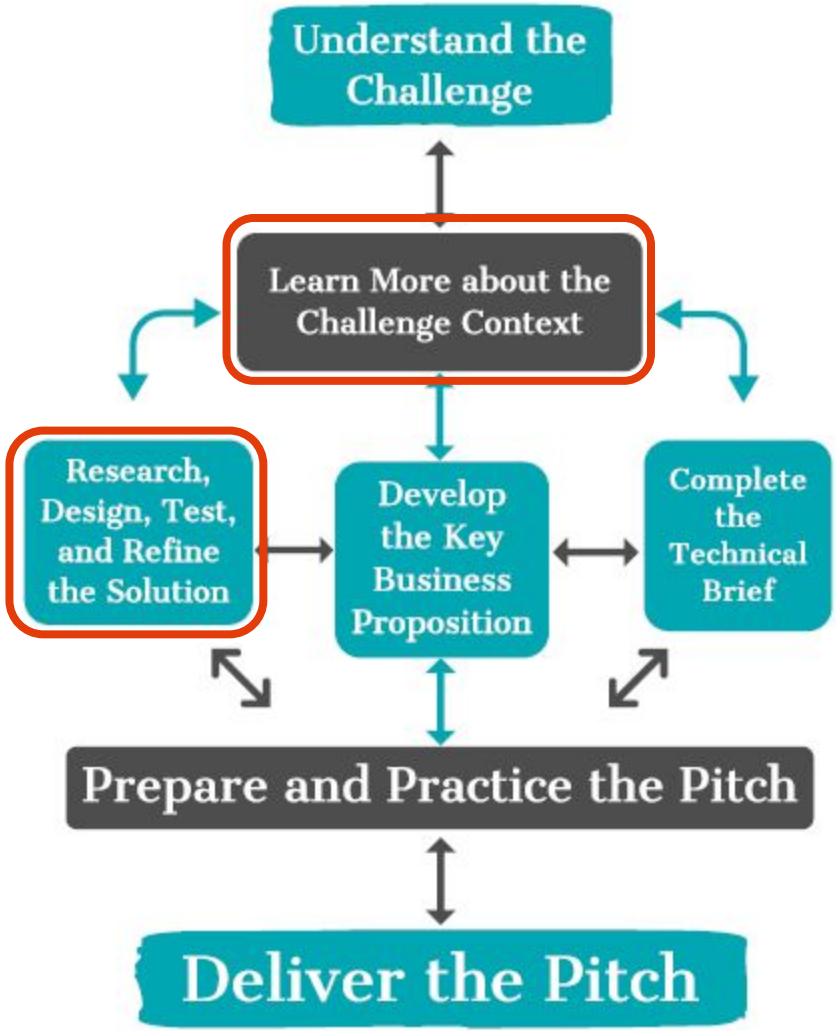
Number Sense and Computation

- Proportional Reasoning 6.RP.A.1, 6.RP.A.2, 6.RP.A.3.D

Geometry

- Investigating Transformations and Scale 8.G.A.4
- Measuring Characteristics of 3-D Figures 6.G.A.1, 6.G.A.4, 7.G.B.6, 8.G.C.9

Research and Prototype



Challenge Resources

Global Problems: Use these resources to learn about the big problems facing the world. These problems are too big to solve with one product, but this is a good place to start. UN Sustainable Development Goals or Ideas for Student Action

Your Community: We are all members of several communities, including your geographic communities (like cities and neighborhoods), your cultural communities (like family, gender, and ethnicity), and communities of people who share your interests (like school clubs, fan groups, or sports teams).

Ideas to Get Started: Use these resources to learn about how students like you have tackled important social problems: Do Something and Design for Change .
Building Solutions

The Design Process: Use this resource to learn about the design process and how it can help you build your solution: Kid Engineer: Bike Trailer

Prototyping: Use these resources to learn about how 3D modeling software can help you design your solution: How To: Basic 3D Design using Tinkercad and Tinkercad – Join

3D Printing: Use this resource to learn more about 3D printing: What is 3D Printing?

Packaging your Product for Shipping

Designing Your Shipping Container: Use this resource to learn more about designing a package for shipping your product: Functions of packaging

Math Resources and Tools

Planning How Much Material to Use: Use this resource to learn more about using nets to find the surface area of your shipping container: Surface Area and Nets

Tech Tools

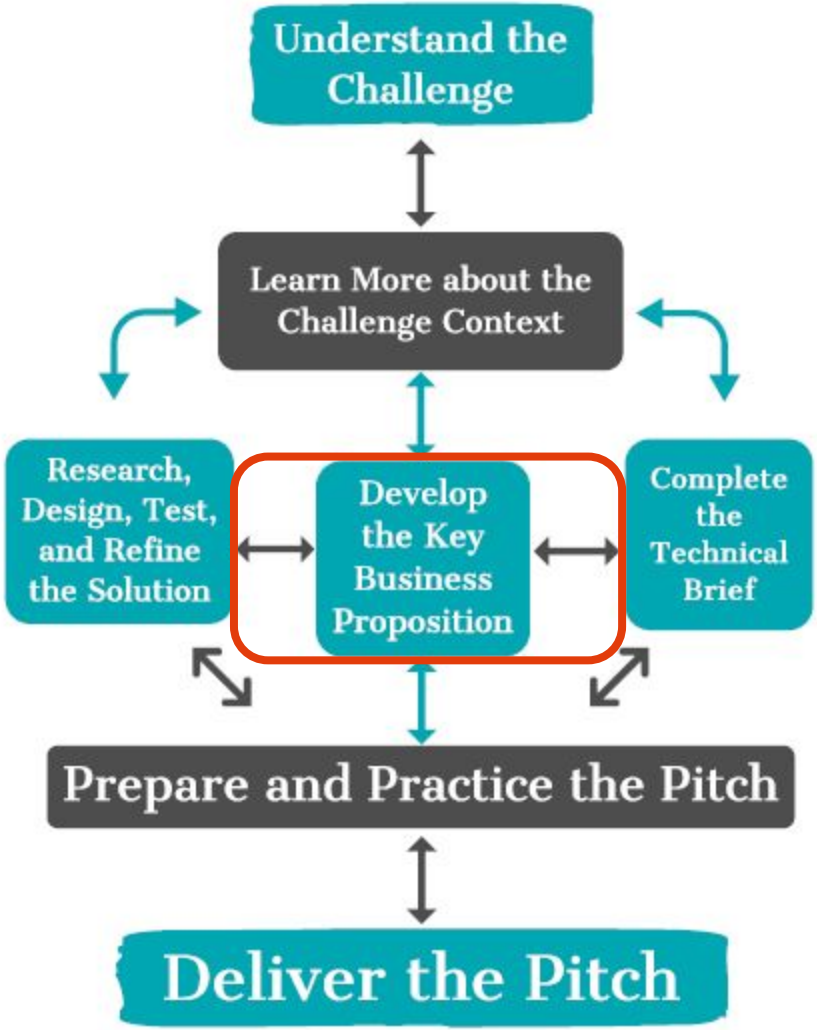
Technology can be a useful tool in many challenges. As you are designing your solution for Fix It, you might consider using TinkerCAD to help you design your sketch. Read the How To Use TinkerCAD Tutorials guide and visit the Tech Tools page to learn more about TinkerCAD.

Now You Try!

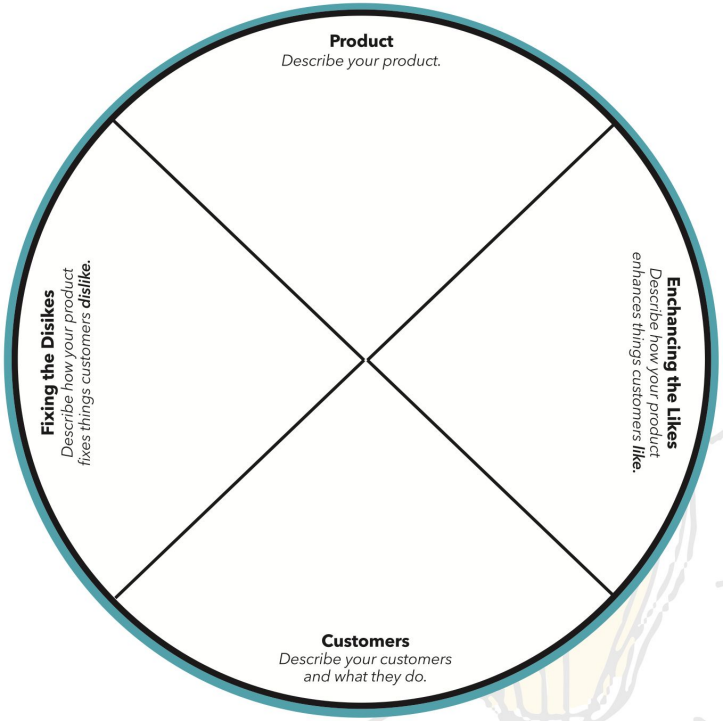
Pause your video, follow the QR code, and browse the resources for the Fix It challenge. Try to brainstorm an issue facing your community and one solution to that issue. As a teacher, consider how you might use these resources with your students.

Follow me to the Fix It Prepare page!

Making Solutions Actionable



The Key Business Proposition



Practicing your Elevator Pitch

Entrepreneurs must be able to quickly and convincingly explain their product to investors. This is often called an **elevator pitch**, because they should be able to fully explain their product during an elevator ride.

Sentence starters are a great way to practice describing your product. Each blank represents part of your Key Business Proposition. Fill in the blanks to describe what your product is, who it is for, and how it creates value.

Then, everyone in your group should practice saying this statement several times. This will help you be sure that you all agree on how to describe your product.

Hi, our names are _____ (group member's name), _____ (group member's name) **, and** _____ (group member's name) **.**

Our company, _____ (company name) **, invented** _____ (product name) **.**

It helps _____ (customers) **, who** _____ (customer's situation or job) **.**

Unlike _____ (competitor) **, which** _____ (competitor weakness 1) **, and** _____ (competitor weakness 2)

our product _____ (improves, makes easier, lessens, etc.) **the** _____ (a **customer dislike**) **, by**

_____ (how the product lessens a **customer dislike**) **. It also**

_____ (increases, enhances, etc.) **the** _____ (a **customer like**) **, by**

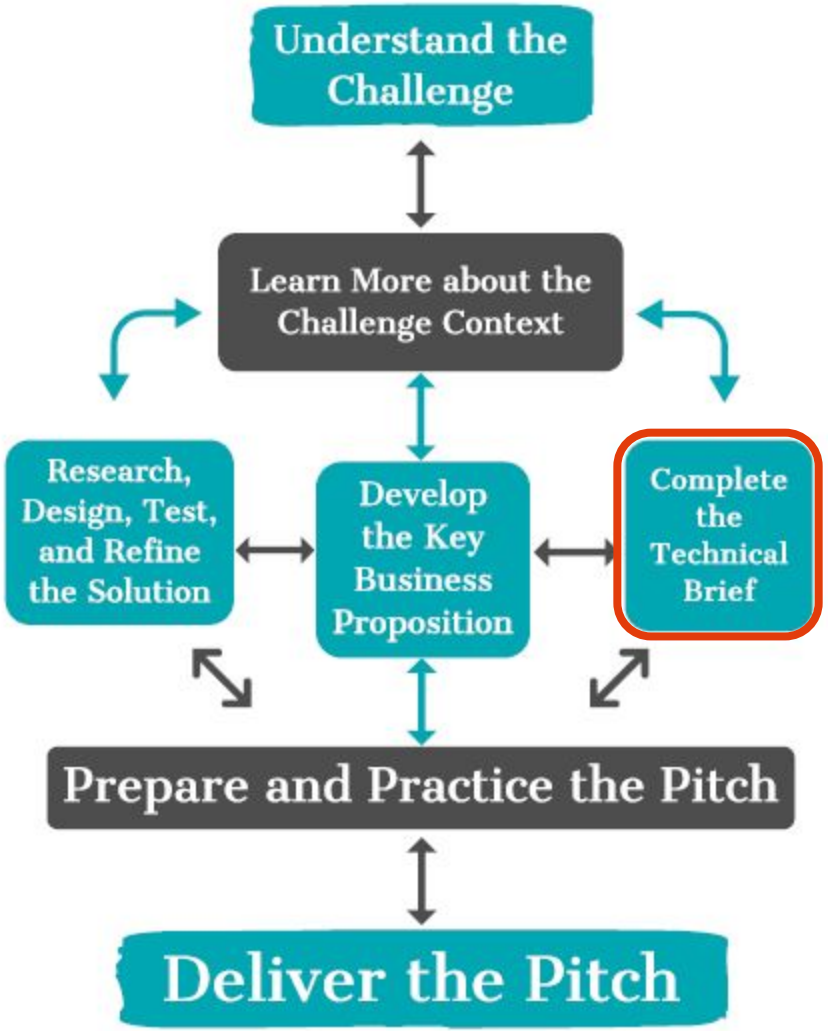
_____ (how the product enhances a **customer like**) **.**

Now You Try!

Pause your video, follow the QR code, and open your Key Business Proposition resource. Imagine what business type might be most effective for your solution. Don’t forget your elevator pitch!

Follow me to the Fix It Engage page!

Describing Product Specifications



The Technical Brief

PART 7. Fully describe your Fix it: Design for Community Impact solution based on the questions below.

1. What community are you working with?
    a. Describe the community and why it is important to you.
    b. Describe the problem facing the community.
2. Why does the problem need to be solved?
    a. Describe the problem and why it matters.
    b. Describe how big the problem is. How many people does it impact? How does it impact them? How frequently does it impact them?
    c. Describe how people have tried to solve the problem in the past and why their solutions were not successful.
3. What are the specifications for your product?
    a. Show a sketch of your product with all dimensions labeled with appropriate units.
    b. List the materials that will be used in your product.
    c. Describe and justify with calculations how much of each material will be used in your product.
4. How will your product be shipped?
    a. Show a sketch of your shipping container with all dimensions labeled with appropriate units.
    b. Explain how you have used sustainable principles in your packaging design and how your design will protect your product during delivery.
    c. List the materials that will be used in the shipping container for your product.
    d. Describe and justify with calculations the surface area of the shipping container for your product.

Now You Try!

Pause your video, follow the QR code, and open the Fix It Tech Brief. Look at the different components. How could you use this with your students? Consider why it might be important to ask these questions.

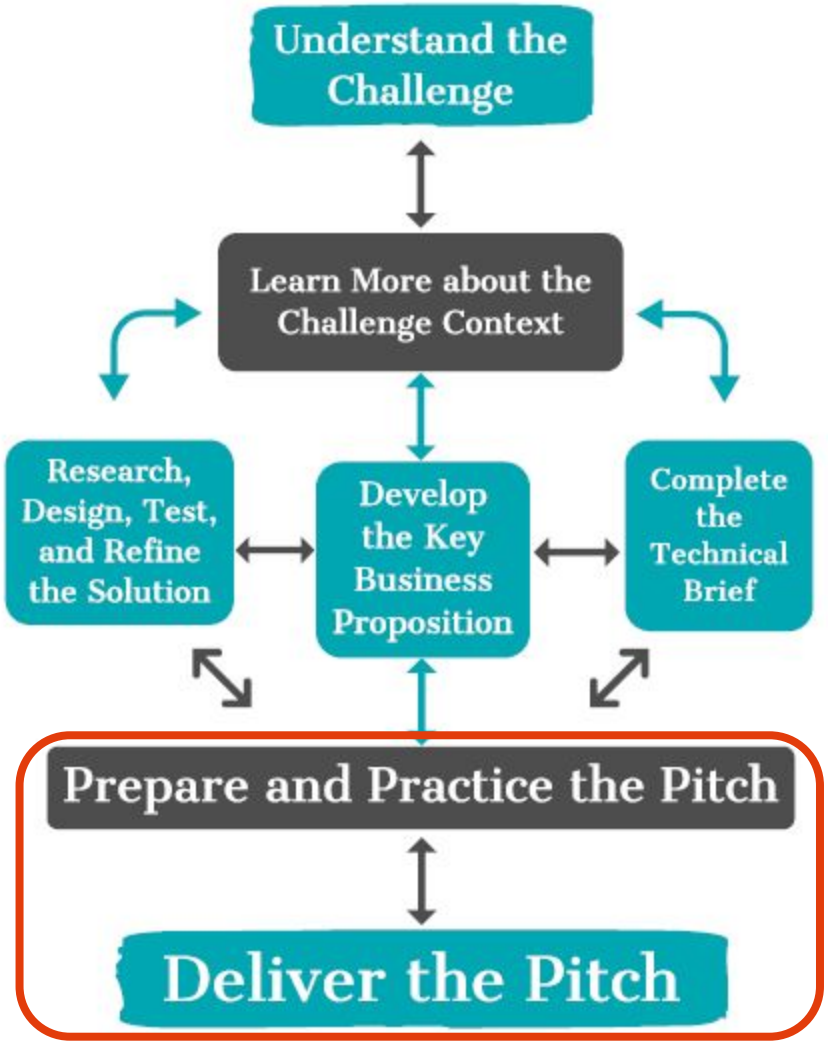
Follow me to the Fix It Engage page!

Convincing Investors

Rules for Pitching:

Pitches cannot exceed 5 minutes

Judges cannot ask questions



Pitch Resources

BUILDING YOUR PITCH

1. Before you start, think about the story you want to tell about your product. you convince someone that you have a good idea that can make money?

2. It's important to consider your Key Business Proposition as you are plannin Be flexible. As you start thinking about how to pitch your product, you may edits to your Key Business Proposition. And, as you make changes to your Proposition, you may also want to make changes to your pitch.

THE PROBLEM

What problem are you solving and why does it matter?

Start by giving investors some background on the problem you wanted to solve. Explain why it matters to you and your customers, and why it should matter to investors. Your goal is to make investors feel the importance of finding a solution for this problem.

Tip: The less writing, the better. If you ne in the speaker notes section in your pres

YOUR PRODUCT

Describe your product and how it enhances customers' likes and fixes customers' dislikes.

These should be brief statements of the ways in which your product enhances the customers' likes or fixes the customers' dislikes.

Tip: Use pictures to illustrate your product.

HOW YOUR PRODUCT WORKS

Explain how each part of your product works. This should line up with what you described in the section above (YOUR PRODUCT).

Tip: You don't have to include everythi summarize your main points and expla

THANK YOU

Always thank investors for their time a

THE COMPETITION

Convince investors that current solutions are not good enough. What other products ha been designed for your customers?

Describe competitors' solutions and make it clear to investors what these solutions are missing, from the customers' perspectives. This should connect to the likes and dislikes you described in the Key Business Proposition.

Tip: Make sure that anything you describe as missing from competitors' solutions is addressed by your solution. For example, if you say "Most competitors' products do not result in world peace," then it should be clear how your solution will achieve world peace.

Criteria	3 points	2 points	1 point	0 points
The team clearly defines the "problem" and explains how their solution adds value for customers.				
The team describes the target customers, estimates how many potential customers there are, and explains what they need in a solution.				
The team discusses the research they conducted and how it led to their solution.				
The team describes the features of their solution and explains how and why they work.				
The team includes a sketch or prototype of their solution to show its features.				
The team demonstrates that their solution will work under real-world conditions.				
The solution shows creativity and imagination.				
The team identifies limitations of their solution.				

Now You Try!

Pause your video, follow the QR code, and browse the resources for preparing and practicing your pitch. Take a look at the Pitch Judging Sheet to see how judges will evaluate your pitch.

Follow me to the Fix It Persuade page!

What does D&P look like

in a Classroom?

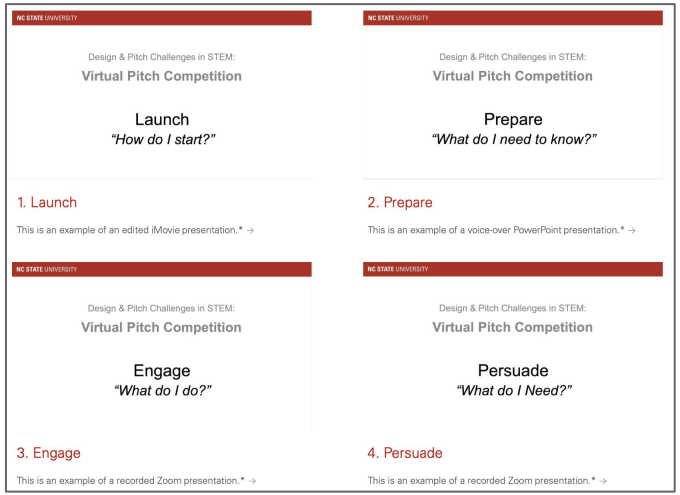
Design & Pitch in the Classroom

- Implementation Models
  - Day 0
  - 6-Day Model
  - 8-Day Model
  - Virtual
  - Others

Day	Activities/Benchmarks
0	Launch the competition, introduce the components, and discuss entrepreneurship.
1	Launch the challenge (T) and begin researching and brainstorming solutions (S).
2	Introduce the technical brief and grading rubric (T). Continue researching and begin building prototype solutions and working on the technical brief (S).
3	Introduce (T) and begin working (S) on the Key Business Proposition (KBP).
4	Discuss (T and S) pitching and begin building (S) pitch decks. Conducts "expert" check-ins with teams (Teacher or school community member).
5	Finalize solutions and complete a practice pitch (S) with a pitch coach (school community member). Revise pitches based on feedback (S).
6	Deliver (or record) final pitches (S). Pick winners (school community members).

Virtual Pitch Competitions

- Fall 2020 Competition
  - Multiple challenges
  - Judging
  - Top 3 “Live” Event
- Spring 2021 Competition
- All materials are on website
  - Instructional videos
- Research team is here to help!



Follow me to the Spring 2021 VPC page!

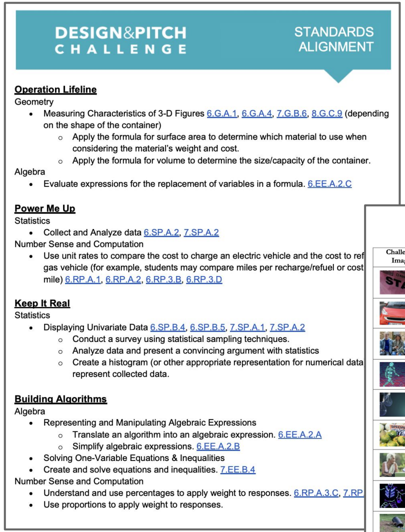
Teacher Resources

Developed and Ready for Teachers:

- Challenge Overview Matrix
- Standards Alignment documents

In Development:

- Teacher Guides



DESIGN&PITCH CHALLENGE — STANDARDS ALIGNMENT

Operation Lifeline
Geometry
- Measuring Characteristics of 3-D Figures 6.G.A.1, 6.G.A.4, 7.G.B.6, 8.G.C.9 (depending on the shape of the container)
  - Apply the formula for surface area to determine which material to use when considering the material's weight and cost.
  - Apply the formula for volume to determine the size/capacity of the container.

Algebra
- Evaluate expressions for the replacement of variables in a formula. 6.EE.A.2.C

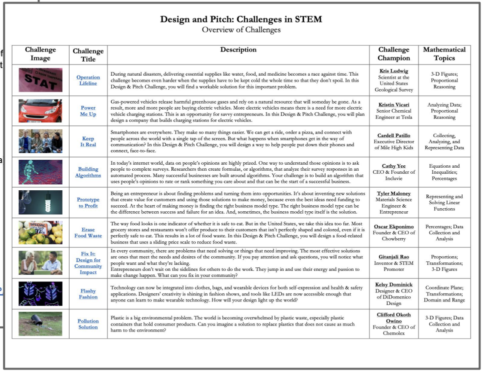
Power Me Up
Statistics
- Collect and Analyze data 6.SP.A.2, 7.SP.A.2

Number Sense and Computation
- Use unit rates to compare the cost to charge an electric vehicle and the cost to ref gas vehicle (for example, students may compare miles per recharge/refuel or cost mile) 6.RP.A.1, 6.RP.A.2, 6.RP.3.B, 6.RP.3.D

Keep It Real
Statistics
- Displaying Univariate Data 6.SP.B.4, 6.SP.B.5, 7.SP.A.1, 7.SP.A.2
  - Conduct a survey using statistical sampling techniques.
  - Analyze data and present a convincing argument with statistics
  - Create a histogram (or other appropriate representation for numerical data represent collected data.

Building Algorithms
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
- Solving One-Variable Equations & Inequalities
- 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
- Use proportions to apply weight to responses.



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're lacking. 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

[Let us know what would make D&P easier for you as a teacher!]()

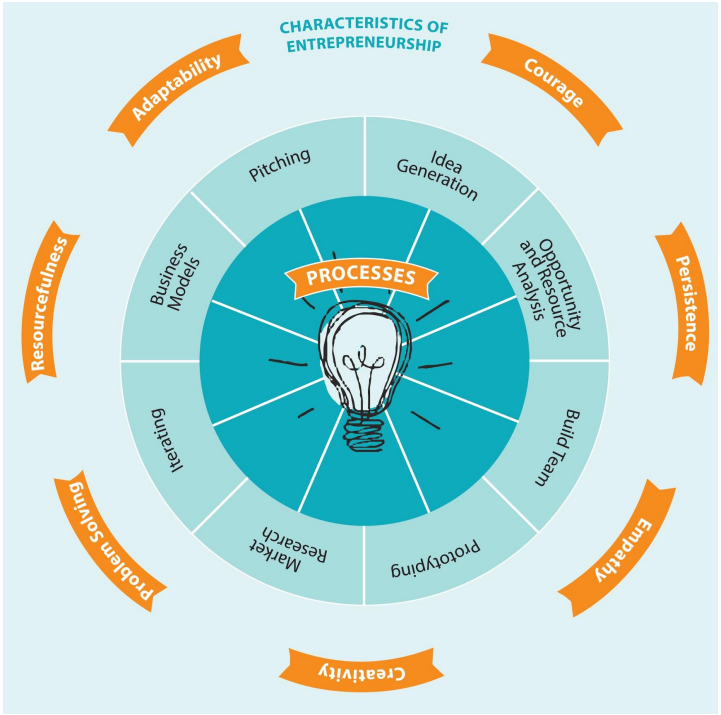
Why do we believe in

Design & Pitch?

Entrepreneurship, Engagement, and Opportunities for Math Learning

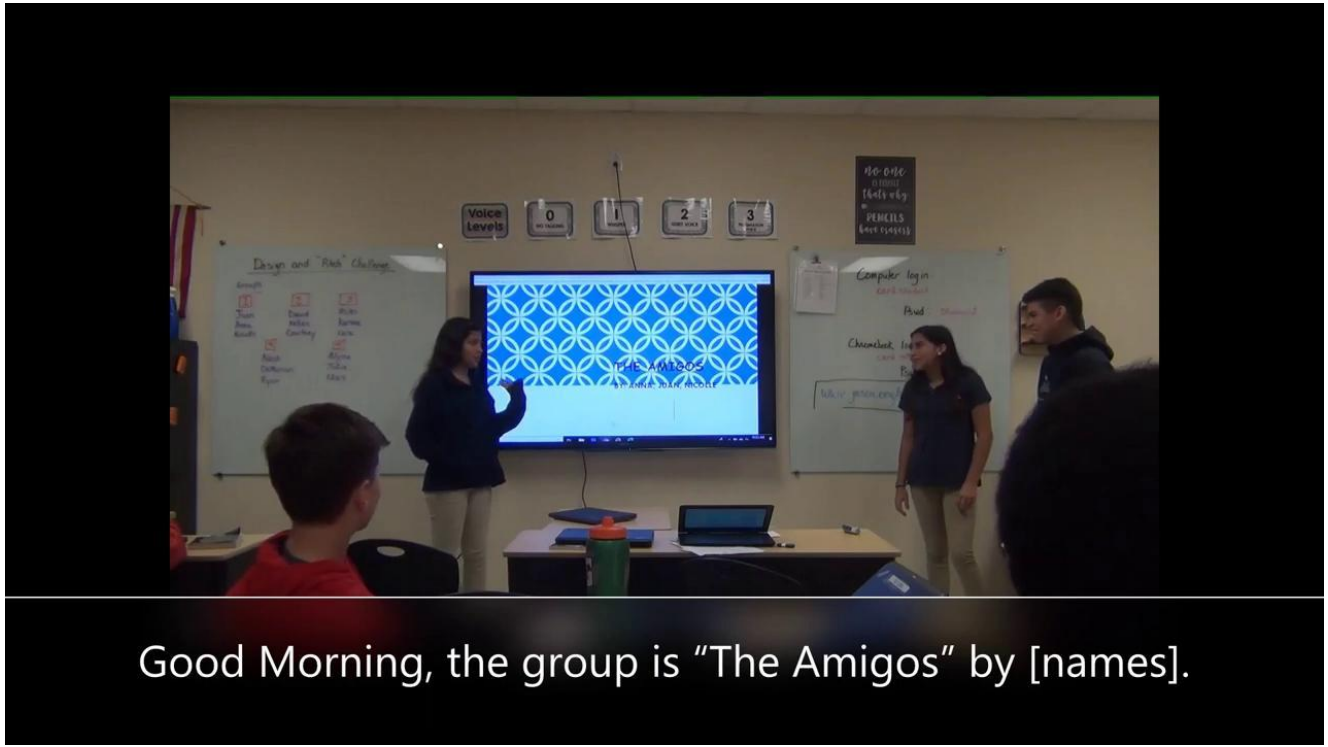
Processes

- **Opportunity and Resource Analysis:** Creating ownership and empowering students as experts
- **Business Models:** Establishing the authenticity of the challenge
- **Pitching:** Providing an appealing outlet for sharing and defending work



Confrey, Krupa, & Belcher (2019)

Student Pitch



Going Beyond STEM Skills

“For me, one of the best things that came out of the call...was actually [one of my students] talking about overcoming anxiety and being more confident speaking in front of his peers because of the projects...Y'all are making a more powerful difference than you realize and in more ways than just math.”

- D&P Ambassador Teacher

Conclusions

Entrepreneurship:

- Creates opportunities for students to solve problems by decentering and considering the needs of users.
- Supports engagement and empowers students to act on and take ownership of their solutions.
- Provides a unique and flexible approach to introducing students to career opportunities in STEM.

Thank You!

Questions? Comments?

For more information, visit our website:

https://sites.ced.ncsu.edu/design-and-pitch/

OR contact us at: design_pitch@ncsu.edu

Partner with Us!

We are looking for teachers to test the challenges with their students.

If interested in partnering with us, please complete the Google form found by following the QR code below or using the link, https://go.ncsu.edu/design-and-pitch-signup

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