THE DESIGN CHALLENGE

STEM²D Topics:
Design, Engineering, and Technology

Target Population:
Students, ages 11-14

The Design Challenge is part of the STEM²D Student Activities Series. Developed by FHI360 and JA Worldwide as part of Johnson & Johnson's WiSTEM²D initiative (Winning in **S**cience, **T**echnology, **E**ngineering, **M**athematics, **M**anufacturing, and **D**esign), the series includes more than 10 interactive and fun, hands-on activities for youth, ages 11-18 globally.

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This activity was adapted from content and materials created by the Johnson & Johnson Global Strategic Design Office.

ACTIVITY DESCRIPTION

Students will apply design and engineering principles in the Marshmallow Challenge, learn about human-centered design principles, and apply STEM²D disciplines to complete a design challenge around oral hygiene.

ESTIMATED TIME

This session typically takes **4 hours and 30 minutes** to complete and should be conducted in one session.

STUDENT DISCOVERIES

Students will

- Participate in a team-based learning experience.
- Learn how STEM²D-science, technology, engineering, mathematics, manufacturing, and design-subjects are involved in design theory.
- Build important STEM²D skills, such as problem solving, planning, model making, and gathering and analyzing data.
- Recognize that STEM²D offers diverse and exciting career opportunities.
- Have fun experiencing STEM²D.

GETTING READY

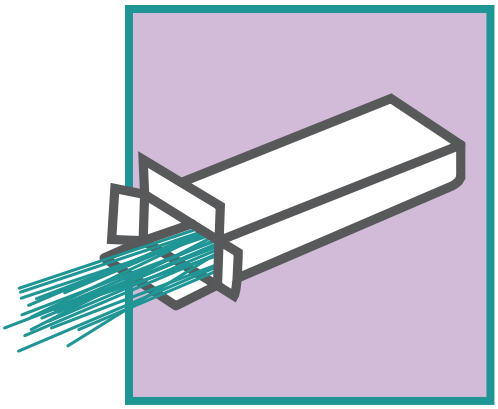
Materials

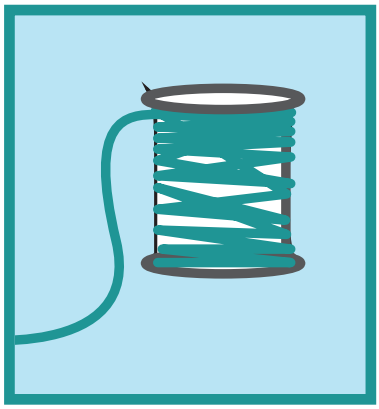
- Computer with projector, speakers, and Internet access
- PowerPoint: The Design Challenge
- Activity Leader Checklist
- Tell My Story Form
- Student Handout (*1 per student*)

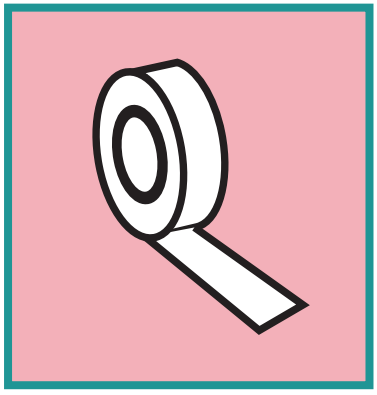
STEM²D Skills

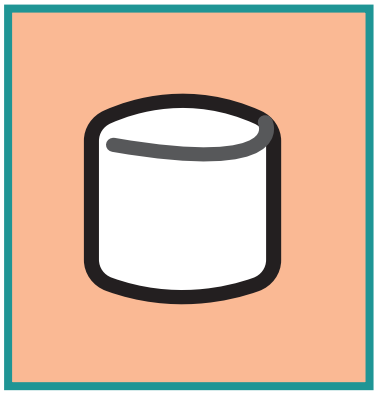
- Problem Solving
- Critical Thinking
- Creativity
- Teamwork
- Collaboration
- Model Making
- Planning
- Organizing
- Information Gathering
- Giving and Receiving Feedback

Imgorthand/Getty Images









- 1 bag of uncooked spaghetti (*20 pasta sticks per team*)
- 1 roll of masking tape (*1 yard or 1 meter per team*)
- 1 ball of string (*1 yard or 1 meter of string per team*)
- 1 bag of marshmallows (*1 marshmallow per team*)
- 1 ream of regular-sized copy paper (*10 sheets per team*)
- Colored pencils (*1 pack per team*)
- Markers (*1 pack per team*)
- Regular-sized sticky notes (*1 pad per team*)
- Different types of arts and crafts paper and materials like cardboard, construction paper, felt, pipe cleaners, Styrofoam, etc. (*1 of each of these items per team*)
- Ruler or tape measure
- Large flipchart paper with the "value proposition" written on it, (*1 flipchart paper sheet per team)*
    - The value proposition reads: For target customer: _____, who has a particular need: _____, concept name: _____ is a product category: _____ that has this benefit: _____. Unlike the alternative product: _____, concept name: _____ is different because _____.

Estimated Materials Cost:

Activity leaders can expect to incur $93.00 in materials costs when completing this activity with 20 students organized into four teams of at least three students.

Activity Leader Preparation

1. Read **Spark WiSTEM²D**. This is essential reading for all volunteers interested in working with youth, as it provides important background knowledge about STEM²D, strategies for engaging students, and tips for working with groups of students. Download at STEM2D.org.
2. Review the **Design Challenge Activity Leader Checklist** (at the end of this activity) for details and specific steps for planning and preparing to implement this activity.
3. See the **STEM²D Student Activities Series Overview** for additional information.

STEP-BY-STEP INSTRUCTIONS: THE DESIGN CHALLENGE

1. **Welcome and Introduction (20 minutes)**
   - Begin the PowerPoint. Greet the students. Tell them your name, your organization or company, describe your job, and why you are here to talk to them about design. Introduce the other adults in the room. Say their names, where they work, and what they do.
   - Have students go around and introduce themselves. Keep this brief. Have them state their name and their school (if they come from different schools).
   - **(Agenda Slide and Objectives Slide)** Review the agenda and objectives and goals.
   - **(Reflect Slide)** Distribute the Student Handouts. Have the students complete the initial reflection questions about what they currently know about science, technology, engineering, mathematics, manufacturing, and design and what they think people in those careers look like and do. They can write or draw their responses. Give them 5 minutes to complete this reflection.
   - **(Tell My Story Slide)** Talk about your educational and career path. Use the Tell My Story form as the basis for your remarks. Be prepared to describe your job or a typical day, and provide information about your background including:
     - Your education—focus on secondary and postsecondary classes and courses
     - Current work projects
     - Interests and hobbies
     - Why you love STEM²D, and how your work is connected
   - Write your introduction ideas here.

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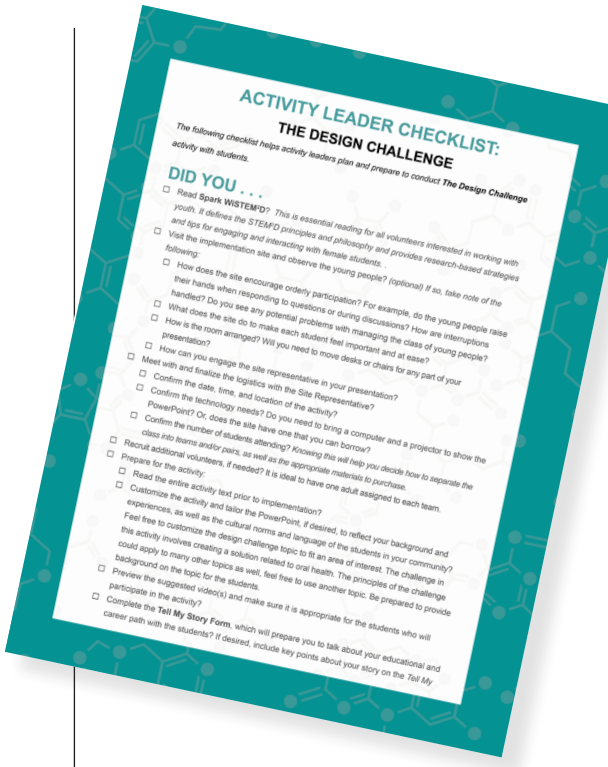
   - Discuss the opportunities that exist in the local community


ACTIVITY LEADER CHECKLIST:
THE DESIGN CHALLENGE
The following checklist helps activity leaders plan and prepare to conduct The Design Challenge activity with students.
DID YOU . . .
☐ Read Spark WISTEM²D? This is essential reading for all volunteers interested in working with youth. It defines the STEM²D principles and philosophy and provides research-based strategies and tips for engaging and interacting with female students.
☐ Visit the implementation site and observe the young people? (optional) If so, take note of the following:
☐ How does the site encourage orderly participation? For example, do the young people raise their hands when responding to questions or during discussions? How are interruptions handled? Do you see any potential problems with managing the class of young people?
☐ What does the site do to make each student feel important and at ease?
☐ How is the room arranged? Will you need to move desks or chairs for any part of your presentation?
☐ How can you engage the site representative in your presentation?
☐ Meet with and finalize the logistics with the Site Representative?
☐ Confirm the date, time, and location of the activity?
☐ Confirm the technology needs? Do you need to bring a computer and a projector to show the PowerPoint? Or, does the site have one that you can borrow?
☐ Confirm the number of students attending? Knowing this will help you decide how to separate the class into teams and/or pairs, as well as the appropriate materials to purchase.
☐ Recruit additional volunteers, if needed? It is ideal to have one adult assigned to each team.
☐ Prepare for the activity:
☐ Read the entire activity text prior to implementation?
☐ Customize the activity and tailor the PowerPoint, if desired, to reflect your background and experiences, as well as the cultural norms and language of the students in your community? Feel free to customize the design challenge topic to fit an area of interest. The challenge in this activity involves creating a solution related to oral health. The principles of the challenge could apply to many other topics as well, feel free to use another topic. Be prepared to provide background on the topic for the students.
☐ Preview the suggested video(s) and make sure it is appropriate for the students who will participate in the activity?
☐ Complete the **Tell My Story Form**, which will prepare you to talk about your educational and career path with the students? If desired, include key points about your story on the *Tell My*

KEY WORD

- **High-demand, high-growth careers**

TIPS FOR WORKING WITH STUDENTS

- Walk around to ensure participation from all team members.
- Allow them to tinker with the materials to get ideas. They should consider the marshmallow from the beginning of the process.
- Ask probing questions that get them to think about engineering design principles:
  - What base shape would best hold the structure?
  - How wide should the base be?
  - What size should the spaghetti be cut?
  - How would you best use the string and tape?
  - How have they considered the placement of the marshmallow?
- Encourage students to take on leadership roles in their teams.
- Check-in with students to see how they are feeling about the process so far.

to support students as they develop their interests and personal experiences.

- Tell the students that your career is only one of the many careers available in STEM²D—science, technology, engineering, mathematics, manufacturing, and design. Explain that STEM²D careers are **high-demand**, **high growth careers** and are predicted to remain in demand over the next 10 years.
- Some STEM²D careers do not require a college degree and offer young people exciting, high-paying opportunities. Stress the importance of gaining mathematics skills and engineering practices to succeeding in any STEM²D career.

2. **Warm-Up Activity: The Marshmallow Challenge (40 mins)**
   - **(The Marshmallow Challenge Slide)** Organize the students into teams (at least four students per team). Tell the students that they will be completing the Marshmallow Challenge.
   - **(Build the Tallest Freestanding Structure Slide)** Describe the Marshmallow Challenge objective: this is a competition among the teams on who can build the tallest free-standing structure using spaghetti, string, and tape. The marshmallow must go on the top of their structure.
   - **(Rules for the Marshmallow Challenge Slide)** Review the rules for the challenge:
   - The structure must be able to stand on its own.
   - The entire marshmallow must sit on top.
   - Use as much or as little of the materials as you need.
   - You are allowed to break up the spaghetti, string, or tape.
     - The time limit is 15 minutes.
     - You will measure the height of their structures with a ruler or tape measure at the end of the challenge to determine the winner.
   - Ask the students whether they have any questions and provide answers to those questions.
   - Set your phone or other timer for 15 minutes and have students begin the challenge.
   - **(Time's Up! Slide)** Announce when time is up and have students stop what they are doing.
   - Using your ruler or measuring tape go around to measure the

height of each team's structure. Note the measurement on a sticky note and leave it next to the structure.

- Announce the winning team and have students give each other a round of applause.
- **(Reflection: The Marshmallow Challenge Slide)** Debrief the Warm-Up Activity (5 minutes)
- On their handouts, have the students individually reflect on what worked and what did not work about their design and about the team dynamics during the challenge. They may write or draw their responses.
- Have one person from each team share their responses with the class.
- **(Video Slide)** Tell the students that you will play a video that describes what happens during the Marshmallow Challenge from a design perspective and will introduce the concept of design thinking. Play the video, which takes about 7 minutes.
    - The video mentions the word **tinker**, which is learning by creating and continuously refining and improving the creation. Tinkering is a driver of creativity, excitement, and innovation in STEM²D learning!

3. **Introducing Design Concepts (20 mins)**
    - **(Design: Putting People at the Center Slide)** Tell students that design is putting people at the center of solving problems.
    - **(Sophistication and Individualized Experiences Slide)** Explain to students that the world is becoming much more sophisticated and people are looking for individual experiences. How can we design products that offer that level of sophistication?
    - The slide offers the example of personalized donuts.
        - Ask students to provide additional examples of how sophisticated and individualized the world has become (personalized health care, shopping, customized drinks).
        - **Design thinking** is a solution-focused, action oriented, people-centered approach to problem solving.
    - **(Design Thinking Process Slide)** Explain the components of people-centered design thinking. Through defining the needs and understanding

KEY WORD

- **Tinker**

➤ **The Marshmallow Challenge is an activity done to help students realize the power and challenges of team problem solving.**

Celia Looney/Flickr Creative Commons

KEY WORDS

- Design thinking
- Empathy
- Ideate
- Prototype
- Test
- Journey mapping

people, creativity and ideas come about. You create prototypes of these ideas and test them, just like the Marshmallow Challenge. When you had an idea, you put it together, and you kept refining it to make it better. The important thing to remember is that this is a cycle. You repeat this process to continue to refine and make your product better. Definitions of each component of the design process:

  - **Empathy:** Getting an understanding of what others see, feel, and experience.
  - **Defining the problem:** Describing the issue/challenge you are addressing.
  - **Ideate:** To form an idea, thought, or image of something.
  - **Prototype:** An early model or experiment to rapidly create solutions to challenges and problems.
  - **Test:** To try something out.
- **(Tools and Strategies Slides)** These two slides introduce storytelling, visualizing stories, and journey mapping as ways to build empathy and define needs. **Journey mapping** is telling the story of one's experience visually and verbally, from initial contact or concept, through the details of the journey, and through its conclusion or end point.
  - Ask students if they have ever had to create a life map or tell their stories verbally or visually. Ask them to provide feedback on that experience.
  - Tell them that they will be practicing this in the design challenge.
- **(Tools and Strategies for Ideation and Prototypes Slide)** This slide introduces sketching, and capturing feedback from users as ways to ideate and design prototypes. Capturing feedback also helps you continue to refine your prototype.
  - Ask students about their experience brainstorming during the Marshmallow Challenge. Did it help? Did they sketch out their design before building it? If so, they have already done some design thinking!
  - Tell them that they will be practicing this again in the Design Challenge.

- **(Recap: What is Design? Slides)** Recap what design is not and what the components of people-centered design are:
  - Build empathy
  - Define the problem
  - Ideate
  - Prototype
  - Refine

4. **Learning Activity:** The Design Challenge—How might we improve oral health throughout the day? **(2 hours, 15 minutes)**

Introducing the Challenge (10 minutes)

- **(The Design Challenge Slide)** Let the students know that they will be designing a product that will tackle an oral health problem.
- **(Setting the Stage: Statistics Slide)** Set the stage by describing the global oral health problem, noting the following:
  - Tooth decay is the world's most common non-contagious disease—also known as cavities!
  - Over 90% of the world's population will suffer from some form of dental disease in their lifetime.
- **(Setting the Stage: 8 Tips Slide)** Review the eight tips of preventative oral health measures. Ask students if they practice more than two things on the list and have them raise their hands.
- **(Challenge Question Slide)** Introduce the challenge. Knowing the preventive measures, how might we improve oral health during the day? What can we design to help with that? We will go through the design thinking process to complete this challenge.
  - Ask whether the students have any questions about the challenge. Further instructions are forthcoming.
- **(Ask the Adults! Slide)** Indicate that the adult assigned to their team is the **end user** who will ultimately use the final product. She or he serves as a resource for the team.

Empathy (20 minutes)

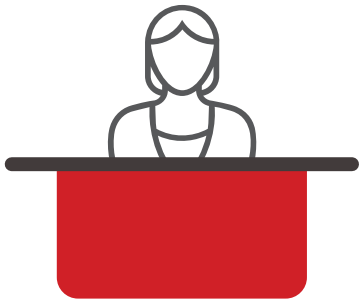
- **(Empathy: Journey Mapping Slide)** The first step of the design process is empathy. The students will engage in journey mapping to help them complete this step. Describe your own oral health journey throughout the day. This may

➤ **These designer donuts are an example of the way design has made products available that are more sophisticated and offer individual experiences.**

KEY WORD

- End user

Busara/Shutterstock



➤ **The adult at the table will serve as the end user students can ask questions. This is another method for gathering information about people.**

include brushing your teeth in the morning, consuming breath mints after meals, flossing at night, and so on.
    - If you have access to a white board or flipchart paper, draw out your oral health journey as an example.
- On their Student Handouts, have them journey-map their oral health throughout the day through visualizing and storytelling. Students further reflect on their journey using emojis. Students use smiley faces for those moments they enjoyed, and sad faces for those that felt like a chore. They may use the colored pencils to complete this task. Students have 5 minutes.
    - Have students share among their team members to find commonalities in their journeys. This should lay the foundation for what they may want to design.
- **(Empathy: Ask the End User Slide)** Another method for gathering information about people is to ask them! The adult at each table will serve as the end user. Students can ask the end user questions. In their teams, have the students spend 5 minutes drafting interview questions they would like to ask the end users. There is space for them to draft these questions on their Student Handouts.
- At the end of 5 minutes, announce to teams that they now have 5 minutes to interview the **end user** at their table. Students can write the answers to the questions on their handouts. Instruct the adults at the table to go through their journey map of oral health as a starting point, then have the students ask the questions they drafted.

Define the Needs (10 minutes)

- **(Define the Needs: Brainstorm Slide)** Using the information they gathered in empathy, have the teams brainstorm and capture the possible needs of their end user. This can be documented on their handouts. They have 5 minutes to complete this task.
    - Have students consider their end user's wants and needs in oral health.
    - Have students think about their needs and wants to develop insights into possible solutions. Have them look at their own journey maps and the journey maps they heard about from the end user.

- From the lists created, have students circle one need and one insight to focus on.

- **(Define the Needs: Identify a Focus Slide)** As teams define the needs, have them think about what products are currently used for oral health and what they see for the future. Encourage teams to get creative. This can be documented on their handouts. Teams have 5 minutes to complete this task.

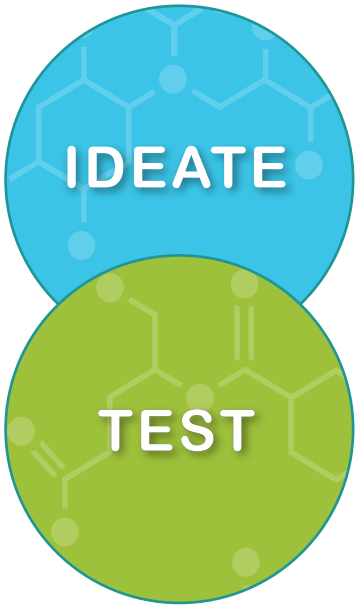
Ideate (25 minutes)

- **(Ideate: Generate Potential Solutions Slide)** Tell students that they can now put their ideas to paper! First, have them spend 5 minutes *individually* capturing as many ideas or solutions as possible that address the problem. Tell them to think big and consider everything. Have students write, sketch, and/or draw their ideas on sticky notes. They have 5 minutes.
- **(Ideate: Share Solutions Slide)** Now have students share their ideas among their team members. The teams must then select the top three ideas among those shared. They have 10 minutes.
  - Walk around to hear about some of the ideas and ask questions to get more detail from team members.
  - Toward the end of the 10 minutes, ensure that every team has selected their top three ideas. If teams need more time, give them an extra few minutes. At the end of the time allotted, have teams hold up their three sticky notes.
- **(Ideate: Reflections Slide) Reflection:** On their Student Handouts, have students spend 10 minutes reflecting and recording their reflections on the ideation process. The reflection questions include:
  - Why were the top three chosen among the team?
  - How do they feel about the design process so far?
- Have students reflect on the journey mapping process. How was their oral health journey different or similar to that of their end user?
- Have team members pick one of the top three ideas and sketch out what they think the product should look like.

➤ **Using the information students gathered in emapthy, have the students in their team brainstorm and capture possible needs of their end user.**

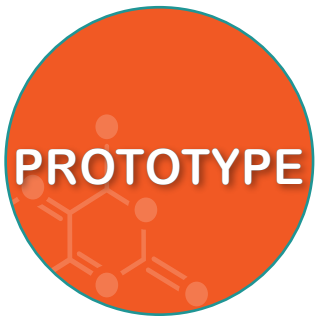
TIPS FOR WORKING WITH STUDENTS

- Periodically check in and see how students are feeling about the design process. You can do a thumbs up, thumbs sideways, or a thumbs down to get a better understanding of the students' feelings about the challenge so far.



TIPS FOR ASKING QUESTIONS

- Encourage creativity and risk taking.
- Ask the students to explain their ideas in a new way.
- Have them put the ideas into their own words.
- Have teams consider ways technology can be used for oral health.
- Consider how people use their phones. Are there any ideas for phone apps?



KEY WORDS

- **Refine**
- **Value Proposition**

Ideate—Test and Refine (15 minutes)

- In their teams, have students share their sketches so they can have a chance to practice explaining an idea to other people. All team members should share the idea that they sketched from the reflection. The other team members and the end user should provide feedback. Allow teams 7 minutes to complete this task.
- **(Ideate and Test: Summarize Learning Slide)** Within their teams, have the students use their Handouts to synthesize what they learned. Have them talk through the feedback they received and the additional feedback the end user gave them. They should also document what new things they learned about their solutions and their approach. At the end of this time, teams should decide on one concept. Allow 8 minutes.
    - During this time, distribute the arts and crafts materials to each table. Make sure teams receive the same amount of each supply.
    - Toward the end of the 8 minutes, check to make sure teams have agreed on one concept by having a student from each team raise his or her hand when the team is ready to share the concept .

Prototype (25 minutes)

- **(Prototype: Build Your Concept! Slide)** Teams now have a chance to build their concepts! Using the materials provided, they can draw and build the way their ideas will look and function. Have them name their products and allow 15 minutes for teams to work on this task.
    - During this time, put one value proposition chart paper by each team.
- **(Prototype: Value Proposition Slide)** Gather the teams back together at the end of their allotted time and tell them to spend the next 10 minutes filling out their value propositions on the flipchart paper. Each team will assign one person to fill in their value propositions.
    - Explain that a **value proposition** describes the value of a product. It is an innovation, service, or feature intended to make a product attractive to customers. Have the students come up with something that would help sell their product.

Presentations (35+ minutes)

- **(Presentations Slide)** Give the teams 20 minutes to prepare a product presentation of their product value proposition as well as a sales pitch for the class. Get creative! They can do a skit, create a sales jingle, or do a basic presentation. Their presentation should be no more than 5 minutes and address the following items:
  - Introduce the end user from their table (empathy).
  - Share the need they decided to address (define the problem).
  - Give the concept a name and tell what type of product it is (ideate).
  - Demonstrate the prototype.
  - Describe the product's benefits and how it is different from the products already on the market.
- At the end of the planning time, each team will spend no more than 5 minutes presenting to the class. Ask for a volunteer to go first. Or, if you feel comfortable, you can call on a team to go first.
  - After each presentation, allow 2 minutes for the class, end users, or yourself to ask the team questions.
  - Be sure to give each team a round of applause.

Summary and Review (8 minutes)

- **(Recap: The Design Process Slide)** Tell the students they completed the design process.
  - Go through each step of the design process. Have one student describe what that step entails and what part of the activity addressed that step.
  - Make sure to call on different people and have team members chime in if they have something to add. The students should lead the summary and review.

Student Reflection (20 minutes)

- **(Final Reflections Slide)** Give students 15 minutes to complete this reflection. The students will consider the following:
  - How can they use the design process in their school, work, or everyday lives?
  - What did they learn about STEM²D careers and pro fessionals? What did they learn about people in these fields?

TIPS FOR WORKING WITH STUDENTS

- If you see students not contributing, ask them to talk about their ideas and the feedback they received.
- The concept the students select does not have to be one concept. Teams can combine and modify several concepts, based on feed-back, to come up with the final concept.
- Ask questions to get them to think about what makes their product different from what is already on the market.
- How does the product fit the needs of the end user?

- How did what they learn and what they originally thought about STEM²D careers and professionals differ?
- Could they see themselves as a STEM²D professional? Why or why not?

  What courses do they need to take in the future to be successful in the STEM²D fields?

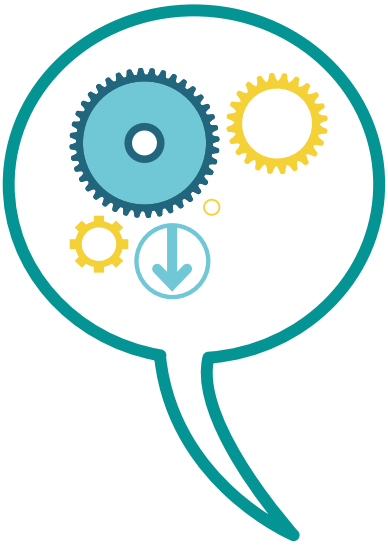
  What are their goals and how does STEM²D help them reach those goals?

- Give the students 5 minutes to share among their team members at least one thing from their reflection.
- Allow time for teams to clean up their tables and collect their materials.
- **(Thank You Slide)** Thank them for participating and completing the activity. Encourage the students to continue exploring careers and opportunities in STEM²D. Reassure them that they can do STEM²D!.

Extended Learning

Some ideas to extend the learning include:

- Create a "class blog" on Wordpress and have students document their thoughts on the design thinking experience in the days after the activity.
- Journey map a typical day at school and figure out if there is anything that can be created to make the day easier!
- Students can re-design their school as a project in design thinking.



Key Words

Design thinking is a solution-focused, action-oriented, people-centered approach to problem solving.

Empathy is getting an understanding of what others see, feel, and experience.

End User is the person(s) who will ultimately use the final product.

High-demand, high-growth careers are occupations predicted to have more positions available than qualified applicants over the next 10 years.

Ideate is to form an idea, thought, or image of something.

Journey mapping is telling the story of the one's experience visually and verbally, from initial contact or concept, through the

details of the journey, and through its conclusion or end point.

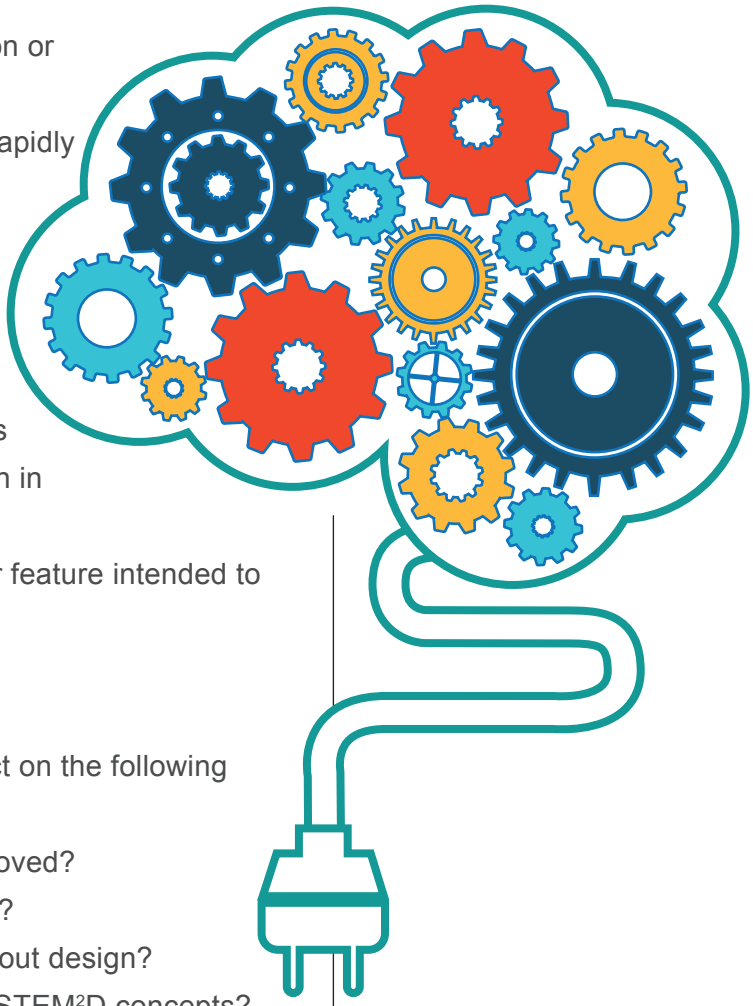
Prototype is an early model or experiment to rapidly create solutions to challenges and problems.

Refine is to improve something by making small changes.

Test is to try something out.

Tinker is to learn by creating and continuously refining and improving the creation. Tinkering is a driver of creativity, excitement, and innovation in STEM²D learning.

Value proposition is an innovation, service, or feature intended to make a product attractive to customers.



Activity Leader Reflections

After the session, take a few moments to reflect on the following items about implementing this activity:

- What went well and what could be improved?
- What would you do differently next time?
- How comfortable did you feel talking about design?
- Do you have a better understanding of STEM²D concepts?

Resources and References

This activity was adapted from content and materials created by the Johnson & Johnson Global Strategic Design Office. We thank GDSO for their expertise and creativity in helping to design this activity.

The following resources provide more detailed information about the design process and provide additional activities:

- **IDEO:** An award-winning global design firm that takes a human-centered, design-based approach to helping organizations in the public and private sectors innovate and grow. www.ideo.com
- **REDlab:** REDlab's mission is to conduct research to inform our understanding of design thinking in K-12, undergraduate, and graduate educational settings. http://web.stanford.edu/group/redlab/cgi-bin/index.php

- **Institute of Design at Stanford:** The Hasso Plattner Institute of Design at Stanford was founded in the School of Engineering in 2005 to prepare a generation of innovators to tackle these challenges. Known on campus as the d.school, the institute brings students and faculty from radically different backgrounds together to develop innovative, human-centered solutions to real-world challenges. http://dschool.stanford.edu/
- **Henry Ford Learning Institute:** A leader in developing successful design thinking models with academic and business partners. http://hfli.org/

For a simpler and shorter activity that still applies the principles of design, please see the **engineering** and **manufacturing activities** included in the STEM²D Student Activities Series.

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ACTIVITY LEADER CHECKLIST:

THE DESIGN CHALLENGE

The following checklist helps activity leaders plan and prepare to conduct

The Design Challenge activity with students.

DID YOU . . .

- Read **Spark WiSTEM²D**? *This is essential reading for all volunteers interested in working with youth, as it provides important background knowledge about STEM²D, strategies for engaging students, and tips for working with groups of students.*
- Visit the implementation site and observe the young people? *(optional) If so, take note of the following:*
  - How does the site encourage orderly participation? For example, do the young people raise their hands when responding to questions or during discussions? How are interruptions handled? Do you see any potential problems with managing the class of young people?
  - What does the site do to make each student feel important and at ease?
  - How is the room arranged? Will you need to move desks or chairs for any part of your presentation?
  - How can you engage the site representative in your presentation?
- Meet with and finalize the logistics with the Site Representative?
  - Confirm the date, time, and location of the activity?
  - Confirm the technology needs? Do you need to bring a computer and a projector to show the PowerPoint? Or, does the site have one that you can borrow? *Does the site have Internet access? Can you use it during the activity?*
  - Confirm the number of students attending? *Knowing this will help you decide how to separate the class into teams and/or pairs, as well as the appropriate materials to purchase.*
- Recruit additional volunteers, if needed? It is ideal to have one adult assigned to each team.
- Prepare for the activity:
  - Read the entire activity prior to implementation?
  - Customize the activity and tailor the PowerPoint, if desired, to reflect your background and experiences, as well as the cultural norms and language of the students in your community? Feel free to customize the design challenge topic to fit an area of interest. The challenge in this activity involves creating a solution related to oral health. The principles of the challenge could apply to many other topics. Be prepared to provide background on the topic selected.
  - Preview the suggested video(s) and make sure it is appropriate for the students who will participate in the activity?
  - Complete the **Tell My Story Form**, which will prepare you to talk about your educational and career path with the students? If desired, include key points about your story on the PowerPoint (see **Tell My Story Slide**).

- Determine how you will assign the teams? You will need at least four students per team. *It is recommended that you randomly assign students to each team; this will foster the skills needed to work with new people.*

- Obtain the required materials (see the **Materials** and **Estimated Materials Costs** section) and photocopy the **Student Handouts**? In addition:
  - Prepare the flipchart paper with the "value proposition" written on it, *(1 flipchart paper sheet per team)*. The value proposition reads:
    For target customer: _____, who has a particular need: _____, concept name: _____ is a product category: _____ that has this benefit: _____. Unlike the alternative product: _____, concept name: _____ is different because _____.
  - Collect the recommended arts and crafts supplies. Be sure to collect enough to ensure each team receives the same amount and type of supplies.
- Practice your presentation, including the hands-on, minds-on activity? Be sure to:
  - Review the Reflection Questions presented throughout the activity (see **Student Handouts**); consider the Marshmallow Challenge rules and review the accompanying PowerPoint slides for this warm-up challenge (see **The Marshmallow Challenge Slides**), become familiar with the Design Thinking Process and its components, and be prepared to facilitate the design challenge—How might we improve oral health throughout the day?
- Set up the site appropriately for the activity? Specifically:
  - Make sure tables and chairs are arranged to accommodate teams of students, at least four students per team.
  - Assign one adult per team. Consider teachers or other volunteers at the site.
- Set up each team's table to have the following materials:
  - Student Handouts *(1 per student in the team)*
  - 1 pack of colored pencils
  - 1 pack of markers
  - 10 sheets of regular-sized copy paper
  - 1 regular sized sticky note pad
  - 20 uncooked spaghetti pasta sticks
  - 1 yard (or 1 meter) of masking tape
  - 1 yard (or 1 meter) of string
  - 1 marshmallow
  - Bring a camera, if desired, to take photographs.
  - Set up the computer and projector for the PowerPoint presentation; be sure that speakers and an Internet connection are available.
- Obtain and collect permission slips and photo release forms for conducting the activity if applicable?
- **Have fun!**

Tell My Story Form

This form will help volunteers prepare to talk about their STEM²D interests, education, and career path in a relevant and personal way.

ABOUT YOU

Name: _____

Job Title: _____

Company: _____

When/Why did you become interested in STEM²D? _____

_____

_____

What do you hope young people will get out of this activity? _____

_____

FUN FACT

Share a little about your background. Ideas:

- Share a memory from childhood when you first had your spark or interest in STEM²D.
- Detail your journey, highlighting what you have tried, what you learned, steps to success, etc.
- Failures or set backs are also great to talk about—difficulties, and/or challenges and how you overcame them.

EDUCATION AND CAREER PATH

What classes/courses did you take in secondary school and in college that helped or interested you most? _____

_____

How did you know you wanted to pursue a STEM²D career? _____

_____

What was your postsecondary path, including the institution you attended and your degree? *If you switched disciplines, make sure you explain why.* _____

_____

What your current position entails. *Be sure to include how you use STEM²D during a typical work day.*

_____

_____

_____

THE DESIGN CHALLENGE

Student Handouts

Pre-Activity Reflection

Think about the questions listed below. Record your answers using phrases or pictures in the space provided.

What do you already know about STEM^{2}D?

What do you think people with STEM^{2}D careers look like and do?

Reflection: The Marshmallow Challenge

Think about the questions listed below. Record your answers using phrases or pictures in the space provided.

What worked about your design in the Marshmallow Challenge?

Was there anything about your design that did not work?
If so, please explain.

How did it feel working in your team?

Empathy: Journey Mapping

EMPATHY

Take us on a journey through your oral health for the day.

1. **What do you do in the morning, daytime, and nighttime with oral health? Draw and/or write in the figure below.**

Morning **Day** **Night**

2. **Reflect on your journey. Which moments listed above made you feel good? Mark with a ☺**

Which were more difficult? Mark with a ☹

Empathy: Interview your End User

As a team, brainstorm questions that you would like to learn more about or find out about from your end user.

1. **Draft Interview Questions**
   What do you want to learn/find out?

2. **Interview Your End User**
   Jot down any notes here.

DEFINE

Defining the Needs: Brainstorm

As a team, brainstorm and capture the possible needs of your end user. What do they need or want in their oral health? What does their mouth or oral health mean to them? Capture your thoughts below.

Things They Need or Want in Oral Health

Ways Their Mouth Makes Them Feel

After you have finished brainstorming as a team, circle both the need and the insight that you feel is most important.

Defining the Needs: Identify a Focus

DEFINE

What is the most compelling need and insight that you identified as a start for where to focus?

Currently,

In the future,

Your Ideation Prompt

How might we...

(problem to solve)

Ideate: Reflection

Reflect on the ideation process. You may answer these questions with words or pictures.

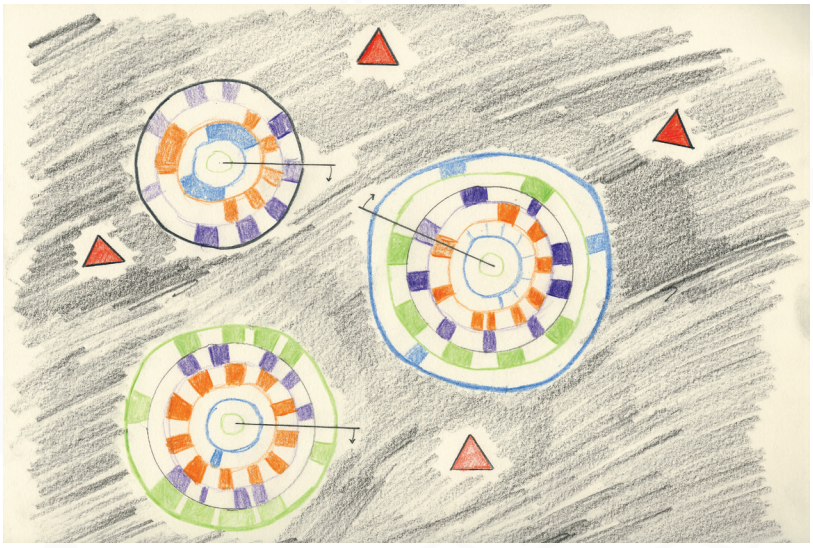
Why were the top three chosen among the team?

How do you feel about the design process so far?

Ideate: Reflection

Choose one of your three ideas and sketch what you think the product should look like.

Sketch your idea.



Sketching, and capturing feedback from users as ways to ideate and design prototypes. Capturing feedback also helps you continue to refine your prototype.

Ryan Raffa/Flickr Creative Commons

Ideate and Test: Summarize Your Learnings

Combine your learnings and reflect to deepen your understanding. You may answer these questions with words or pictures.

What new things did you learn about the end user and his/her needs?

What new things did you learn about your solution?

After brainstorming as a team, circle both the need and the insight that you feel is most important.

Post-Activity Reflections

You may answer these questions with words or pictures.

How can you use the design process in your school, work, or everyday lives?

What did you learn about STEM²D careers and professionals? What did you learn about people in these fields?

How did what you learned and what you originally thought about STEM²D careers and professionals differ?

Could you see yourself as a STEM²D professional? Why or why not? What courses do you need to take in the future to be successful in the STEM²D fields? What are your goals and how does STEM²D help you reach those goals?

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