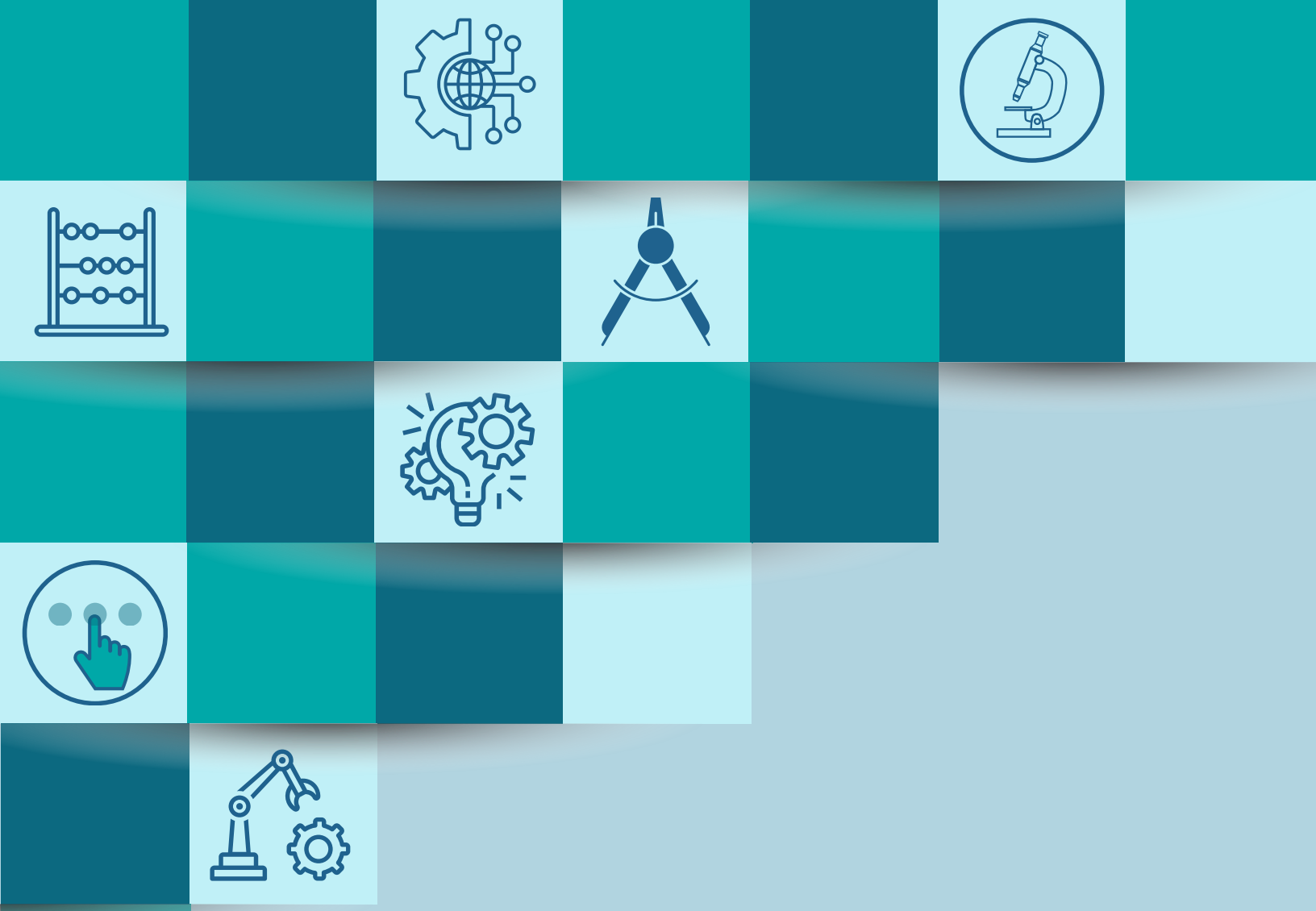
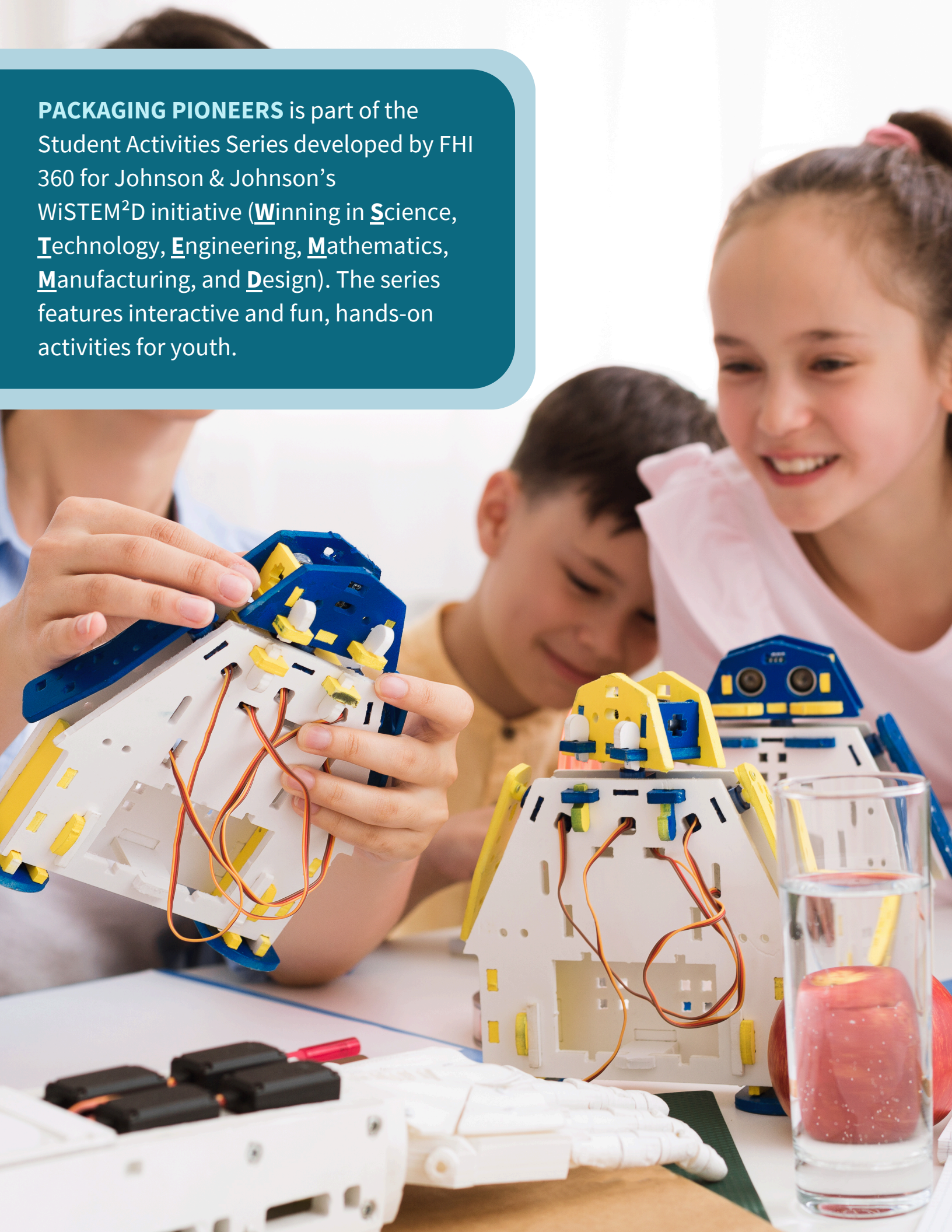


PACKAGING PIONEERS

STEM^{2}D Topics:
DESIGN, SCIENCE & ENGINEERING

Target Population:
Students, ages 12-16



PACKAGING PIONEERS is part of the Student Activities Series developed by FHI 360 for Johnson & Johnson's WiSTEM²D initiative (**W**inning in **S**cience, **T**echnology, **E**ngineering, **M**athematics, **M**anufacturing, and **D**esign). The series features interactive and fun, hands-on activities for youth.

PACKAGING PIONEERS

STEM²D Topic: Design, Science & Engineering
Target Population: Students, ages 12-16

ACTIVITY DESCRIPTION

In this activity, students will explore ways to reduce the environmental impact of plastics by reimagining eco-friendlier, more sustainable packaging solutions. Additionally, students will be introduced to the engineering design process, which will break down the design process into small, actionable steps to help students become more focused, productive, and creative!

ESTIMATED TIME

This session typically takes 135 minutes to complete and should be conducted in one session.

STUDENT DISCOVERIES

Students will:

- Learn how STEM²D —Science, Technology, Engineering, Mathematics, Manufacturing, and Design—knowledge and skills are relevant to careers in environmental sustainability.
- Consider STEM²D concepts including engineering, design, and material science.
- Participate in a team-based learning experience.
- Build important STEM²D skills, such as creative thinking, problem solving, decision making, and teamwork.
- Recognize how science and engineering can be used to solve a variety of complex challenges throughout the world.
- Realize that STEM²D offers diverse and exciting career opportunities.
- Have fun experiencing STEM²D!

STEM²D Skills

- Problem Solving
- Communication
- Critical Thinking
- Responsibility
- Creativity
- Teamwork
- Design Thinking
- Adaptability
- Grit

GETTING READY

Materials:

- Pre-Activity Checklist
- Tell My Story form
- PowerPoint: Packaging Pioneers
- Student Activity Workbook: Packaging Pioneers, *1 per student*
- Computer with projector, speakers, and Internet access, *1 for the entire group*
- Computer, Chromebook, Tablet, etc. that has internet capabilities, *1 per team*
- Poster board (22" x 28" or 56cm x 71cm), *1 per team*
- Markers/crayons, *1 package of multi-color markers or crayons per team*
- Pencil, *1 per student*
- Physical examples of items for groups to choose from to redesign *(optional)*

Estimated Cost:
Activity leaders can expect to incur less than $10.00 in materials costs when completing this activity with 20 students organized into teams of four.

ACTIVITY LEADER PREPARATION

- Read **Spark WiSTEM^{2}D**. This is essential reading for all volunteers interested in working with youth. It defines the STEM^{2}D principles and philosophy and provides research-based strategies and tips for engaging and interacting with students.
- Review the **Pre-Activity Checklist** (at the end of this document) for details and specific steps for planning, preparing, and implementing this activity.
- See the STEM^{2}D Student Activities Overview for additional information about the Student Activity series.

STEP-BY-STEP INSTRUCTIONS

1. **Welcome & Introductions (5 minutes)**
   - Welcome the students.
   - Introduce yourself by saying your name, title, and your organization/company.
   - **(Today's Plan Slide)** Review the agenda. Explain that today students will learn about the effects of plastic waste and will use the engineering design process to develop eco-friendly packaging solutions to help reduce plastic waste.
     - Break the large group into teams of four and instruct them to sit together for the remainder of the session.
2. **Career Awareness: STEM²D in the World of Work (15 minutes)**
   - **(What is STEM²D? Slide)** Explain that STEM²D refers to: Science, Technology, Engineering, Mathematics, Manufacturing, and Design.
     - Tell the students there is high growth and demand among STEM²D careers. Tell them your own career is only one of many in STEM²D fields.
     - Explain that some STEM²D careers do not require college degrees and still offer exciting, high-paying opportunities. Stress the importance of gaining mathematics skills to succeed in any STEM²D career.
   - **(My Story Slides)** Continue the introductions by talking about your educational and career path. Use the **Tell My Story** form as a basis for your remarks and share your interest in STEM²D. Additionally, be prepared to describe your job or a typical day and provide information about your background including:
     - When/why you developed an interest in your field.
     - The classes/courses you took in secondary school.
     - Your post-secondary path, including any university and non-university institutions, certificates, or degrees. If you switched disciplines, make sure you explain why to the students.
     - What your current position entails. Be sure to include how you use STEM²D concepts and skills and what you do on a typical workday.

Engaging Students

- Circulate and answer questions throughout the activity.
- Check frequently for understanding by asking open-ended, topic-specific, or process questions.
- Encourage students to ask questions to gain deeper understanding.

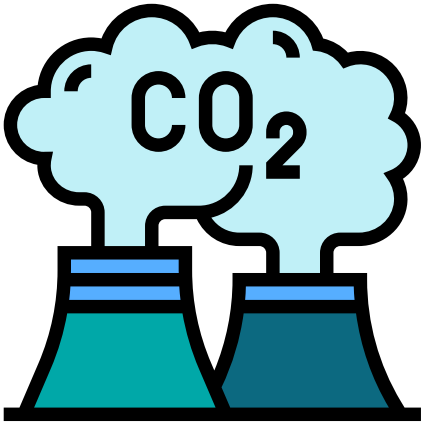
- **(Design, Science & Engineering in the World of Work Slide)** Initiate an opening discussion and brainstorming activity around STEM²D careers. Consider asking teams to:
    - Describe the term 'environmental sustainability'.
    - Think about how engineering, design, and science might be used in environmental sustainability fields.
    - Discuss what careers fit within the environmental sustainability pathway.
    - Give examples of Johnson & Johnson careers, job titles, and other careers that align with environmental sustainability.

3. **Content Presentation: Packaging Pioneers (20 minutes)**

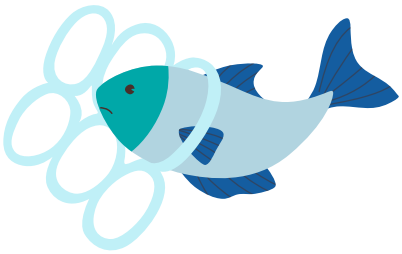
- **(Introduction Slide)** Begin by asking what the students already know about plastic waste. Provide a definition of plastic waste and discuss how humans produce more than 430 million tons of plastic each year according to the Organization for Economic Cooperation and Development (OECD).
    - Plastic pollution is a part of the climate crisis because the production of plastic from fossil fuels releases a large amount of greenhouse gases—specifically carbon dioxide or CO_2.
    - Plastic waste is made up of synthetic plastic products that can cause problems for wildlife, habitats, and people. Plastic is not biodegradable and doesn't break down naturally.
    - Plastic is strong and bendable and can be found in many everyday items like clothes, beauty products, and packaging.
    - Plastic sticks around, polluting our oceans and damaging soil. It can even find its way into the human food chain!
- **(Biggest Contributors to Plastic Waste Slide)** Explain that plastic waste is a global problem that mostly impacts our oceans, landfills, and environment. Ask students where they think the majority of plastic is produced and in what sectors.
    - China is the world's largest producer of plastic materials, accounting for 32% of global plastic production in 2022. Additionally, the rest of Asia contributes 19%, while North America holds 17% of global plastic production.

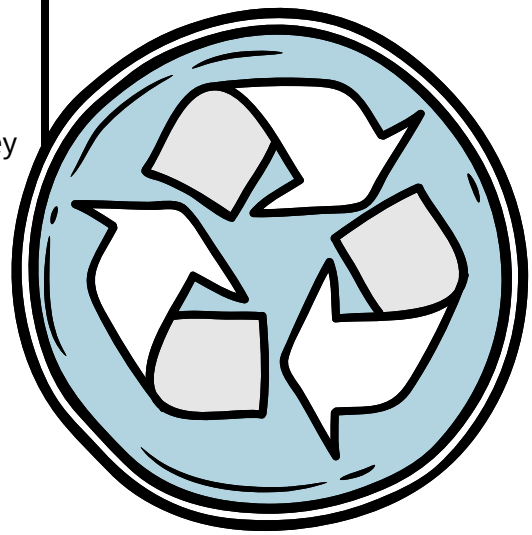
Key Words

- Biodegradable
- CO_2 Emissions
- Contamination
- Iterative
- Landfill
- Microplastics
- Prototype
- Recyclable
- Sustainable
- Synthetic



    - Containers and packaging make up the most significant plastic producing sector, which used over 14.5 million tons of plastic in 2018. Items created in this sector include bags, sacks, wraps, bottles, and other containers. Manufacturers also use plastic in durable goods like appliances and furniture.
    - The Construction industry is the second-largest producer of plastics, utilizing them in pipes, insulation, and various building components.
- **(Plastic Waste Impact Slide)** Ask the students how they think plastic waste affects the environment and to discuss why companies use plastic packaging despite it being so bad for the environment.
    - Some examples of how plastic waste affects the environment can be seen in marine ecosystems, greenhouse gas emissions, and human health.
        - Marine ecosystems are affected by plastic entanglement, ingestion, and toxic contamination.
        - The refinement of plastic emits 184 to 213 million metric tons of greenhouse gases each year.
        - Human health is affected by the carcinogenic chemicals found in plastic products that can spread into tap water, which could cause developmental, reproductive, neurological, and immune disorders. Additionally, microplastics found in many places—including the air, oceans, food supply and blood—have been linked to poor health outcomes affecting multiple systems of the human body.
    - Plastic is easy to produce, lightweight, and can be made with a wide range of physical characteristics, making it ideal for packaging materials. Additional responses could include durability, versatility, and cost-effectiveness.
- (**Making a Difference Slide)** Discuss with students what they can do to reduce plastic waste and how they can encourage others to follow in their footsteps by:
    - Using a reusable water bottle.
    - Bringing a reusable bag to the store.
    - Avoiding overly packaged items at the grocery store, such as pre-cut fruits and vegetables.
    - Repurposing old bottles or containers.





- Cooking at home instead of ordering takeout, which often includes extra plastic packaging.
- Buying products from companies committed to reducing plastic use.

If youth are looking to have a larger impact on the battle against plastics, encourage them to:

- Raise awareness by educating community members on the adverse effects of plastic.
- Advocate for change by supporting legislation that reduces plastic use or supporting organizations addressing plastic pollution.
- Collaborate with community members to organize and participate in a local cleanup day or recycling demonstration.

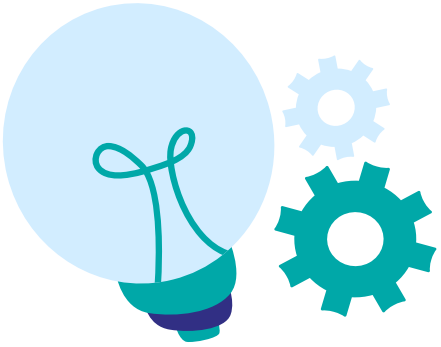
- **(What is the Engineering Design Process? Slide)** Introduce the engineering design process and how its use will help teams find inventive solutions by working through smaller, actionable steps. Explain that for today's activity, we will use one of the several existing forms of the engineering design process.
  - The engineering design process is a series of steps that engineers follow to find a solution to a problem. It emphasizes open-ended problem solving and encourages students to take risks and learn from failure. This process nurtures students' ability to create innovative solutions to challenges.
  - We will be using the following seven steps: ask, collect, imagine, plan, create, present, and improve.
- **(Design Process: Ask Slide)** Discuss the importance of identifying the problem you've been asked to solve. Teams may need to ask questions to fully understand the problem and develop a viable solution.
  - Team members must have the same understanding of the goals and objectives of the project. This step requires the team to identify the criteria or limitations associated with the project.
- (**Design Process: Collect Slide)** Explain that it's important for engineers and designers to learn from the experiences of others, avoid mistakes that were made in the past, and improve current solutions. During this step, it's important for

Engineering Design Process

teams to gather detailed information and network with other people to create a solid foundation for their design.
    - This step requires engineers to conduct research, collect information, and gain a better understanding of the product that needs to be built.
    - Additionally, in this step students will dig deeper into the problem by identifying why it is a problem, who it affects, and why the problem is worth solving.
- **(Design Process: Imagine Slide)** Discuss with students that brainstorming is a technique that design teams use to generate ideas to solve clearly defined problems. Brainstorming helps teams to draw from all of their team members' experience, consider several approaches to the challenge, and generate the most successful design solution.
    - There are several successful brainstorming techniques that teams can utilize during this step of the design process—including mind-mapping, brain dumping, and brain netting (online brainstorming).
    - Explain the rules of a successful brainstorming session:
        - Accept all creative and wild ideas without judgement
        - Build on other participants' ideas
        - Don't criticize other collaborators' ideas
        - Aim for quantity over quality
        - Make it collaborative and fun!
    - During this step, creating sketches of the proposed designs could help the team fully understand the proposed solutions.
- **(Design Process: Plan Slide)** Explain that, after assessing each possible solution, engineers and designers must choose the best design to proceed with. This could include merging features from several designs or altering a design to better match the needs of the challenge.
    - One tool engineers and designers use to narrow down their list of solutions to a single solution is a decision matrix. A decision matrix evaluates each potential solution based on a set of criteria, such as material type, cost, performance, safety, and ease of use.
- **(Design Process: Create Slide)** Explain that this is often the most exciting part of the engineering design process! During this step, teams get to use their hands to build and test their selected design.

Tips on Starting Conversations

- When you consider your future, what are you most excited about?
- Do you see yourself working with others, for a large company, with your friends, for yourself? Why or why not?
- Do you imagine yourself solving problems? Do you prefer fixing or building things?
- What does the perfect workday look like to you?



- Creating a prototype is a key step in the development of a final solution because it allows designers to test how the solution will work. Prototypes can help teams to develop the structure, function, and appearance of their solution.
- Prototyping is an important step in the iterative design process. Once a prototype has been developed based on the initial proposed design, it's important to take time and evaluate the prototype through testing and feedback. Then, that feedback gets incorporated into the next iteration of the design. Teams should repeat this process until the desired outcome is achieved, regardless of how many iterations they must go through!

- **(Design Process: Present Slide)** Engage in conversations about how public speaking and communication are highly sought-after professional skills. Without these skills, the ability to progress in the working world would be more difficult.
  - Explain to students that public speaking allows them to inform, educate, and motivate change. Additional benefits of presenting their solution to an audience is the opportunity to receive feedback on the design's functionality, aesthetics, and overall design.
- **(Design Process: Improve Slide)** The engineering design process is iterative, meaning that engineers and designers often repeat some or all of the steps several times to refine their solution.
  - Remind teams that they are not expected to develop a perfect solution the first time. Teams must reflect on received feedback and determine how to improve on their original solution.
  - It is perfectly acceptable and expected for teams to go back to previous steps in the design process. This iterative process teaches grit, as well as the difference between finishing your work and doing your best work.

4. **Hands-on, Minds-on Learning Activity: Packaging Pioneers (90 mins)**

- **(Learning Activity Slide)** Introduce the challenge with these instructions:
  - Today, we are going to do a team-based activity where you will design new, environmentally friendly packaging

Tips on Starting Connections

Encourage students to:

- Ask questions if they don't understand.
- Summarize what they have learned.
- Explain their thinking process aloud.
- Describe how they applied the engineering design process to solve the challenge.
- Compare and contrast the different types of eco-friendly packaging materials.

for an existing product. We will work through the steps of the engineering design process to complete this challenge.

- Consider sharing the following resources with students for inspiration.
  - 24 Eco Friendly Packaging Examples that Benefit your Brand | Packhelp
  - 12 Packaging Designs That Are As Good As the Product (interestingengineering.com)
  - 11 Most Innovative Sustainable Packaging Ideas (remesh.ai)
- Each team will select a product for which to redesign the packaging. *Note: if physical examples of the products are provided, allow students to take their selected product back to their group for further investigation.*
- Distribute the Student Activity Workbook to each student. Ask students to turn to page 2 in the Student Activity Workbook, which shows the steps of the engineering design process that will be used today. Explain that utilizing this workbook will help students stay organized as they work through the steps of the engineering design process.

- **(Design Process in Action! Ask & Collect Slide)** Ask students to turn to page 3 in their Student Activity Workbook. Explain that 'ask' and 'collect' will be combined into a single step for the purpose of this activity. Students will be given 10 minutes to ask questions, research examples of sustainable packaging, and identify key characteristics of their assigned product using the internet.
  - Potential research topics could include the following:
    - The difference between sustainable and non-sustainable packaging.
    - Examples of sustainable packaging that reduces waste.
    - The cost of various eco-friendly packaging materials.
    - Positive and negative characteristics of the current packaging solution for their product.
    - Temperature requirements for their product to consider during shipping.
    - Size constraints for their product.
  - Remind students to record their research in their Student Activity Workbook to ensure all information is captured.

Possible Packaging Items to Redesign

- 6-Pack rings
- Disposable coffee cups
- Bubble wrap
- Single-use plastic water bottles
- Single-use lunch containers
- Meat/poultry trays
- Bait container for fishing
- Toothbrushes
- Disposable utensil packaging
- Video game packaging

- **(Design Process in Action! Imagine Slide)** Ask students to turn to page 4 in their Student Activity Workbook. Using what they learned from the content presentation and their own research, engage students in a 20-minute brainstorming session to create a list of eco-friendly packaging solutions for their product.
    - Remind students to record all ideas from the brainstorming session in their Student Activity Workbook.
    - Encourage teams to think big, be creative, and consider everything!
    - Walk around to hear about some of the ideas and ask questions to get more detail from team members.
    - Encourage teams to use page 5 in the Student Activity Workbook to sketch potential solutions.
    - Toward the end of the 20 minutes, ensure that every team has selected their top five ideas.
- **(Design Process in Action! Plan Slide)** Ask students to turn to page 6 in their Student Activity Workbook. Explain that teams will be using a decision matrix to select the final design solution for their product. Allow students 5 minutes to complete this step of the design process. Assist each team with the following steps:
    - List the top 5 solutions determined by the team in the first column.
    - Determine the factors or criteria that matter most to each team. List those factors across the first row. Possible factors could include cost, strength, access to materials, eco-friendliness, ease of development, aesthetics, etc.
    - Evaluate each solution option against the criteria (usually on a scale of 1 to 5).
    - Add the scores across each row.
    - The highest-scoring solution is the best choice!
- **(Design Process in Action! Create Slide)** Using the poster and markers, ask teams to create a poster that they will use to present their solution to the larger group. Teams will have 15 minutes to complete this step of the design process. Review the presentation requirements with each team. Encourage students to use page 7 in their Student Activity Workbook to create a draft version of their poster.

Tips for Working with Students

- Ask open-ended questions to encourage student reflection and discussion. For example:
    - Encourage teams to think about why designing through an environmentally focused lens might benefit their community.
    - Reinforce the need for young people to learn about environmental sustainability and what they can do to actively participate in sustainable practices.
    - Why might someone be interested in pursuing a career in environmental sustainability?
    - What have you learned so far in this activity?
- Help students stay on track of time during the group challenge.
- Move around the learning space and provide support when necessary.
- Encourage all students to participate.
- Encourage students to take on leadership roles in their teams.
- Provide support and answer questions, as needed.

Teams should include the following information in their poster presentations:

- Product title and names of team members.
- Steps taken to develop the final solution.
- Key words from research that were most helpful in developing a solution.
- Criteria used to determine the final solution.
- An illustration of the final solution.
- The strengths of the solution.
- The most unique feature of the design.
- How the new solution is more environmentally friendly than the existing solution.

Encourage teams to use new vocabulary learned throughout this activity in their presentation. Remind teams that each presentation should be no longer than 5 minutes.

- **(Design Process in Action! Present Slide)** Reconvene the large group. Explain that it's now time for teams to present their eco-friendly packaging solution to the group. This step should take between 25-35 minutes to complete.
  - Ask for a team to volunteer to present first. Request that the presenters stand where everyone in the room can see them.
  - After each presentation, allow students time to ask the presenting team questions.
  - Provide brief feedback and ask the team questions you may have on their design. Consider asking any of the following questions.
    - Did you discover any unexpected obstacles or solutions?
    - What would you change about your design if you were to do it again?
    - Which step of the engineering design process do you think is most important?
  - Ask students to write down feedback received from the audience on page 8 of the Student Activity Workbook.
  - Repeat the process until all teams have shared their solutions.

Tips About STEM2D Careers

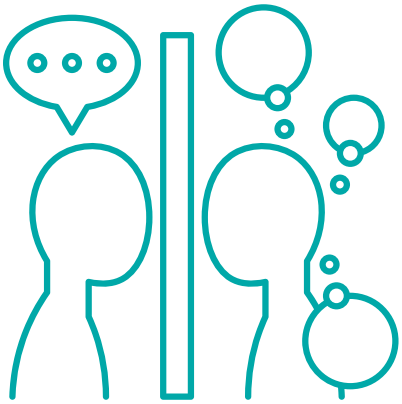
Share with students that there are many different kinds of careers related to STEM²D. Possible STEM²D careers related to this activity:

- Material Science Engineer
- Packaging Engineer
- Mechanical Engineer
- Industrial Engineer
- Waste Management Engineer
- Recycling Coordinator
- Plastics Recycling Technician
- Environmental Scientist
- Green Transportation Professional
- Research Scientist

- **(Design Process in Action! Improve Slide)** Allow students 5 minutes to regroup in their teams to incorporate any feedback from volunteers and peers into their designs. Remind teams that the engineering design process is iterative, which means they can repeat some or all the design processes multiple times to fine-tune their solution. Encourage teams to document any updates to their design on page 8 of the Student Activity Workbook.

5. **Reflection (5 minutes)**

- **(STEM²D Careers in Engineering Design Slide)** Review the list of STEM²D careers that are connected to packaging and design. Encourage students to research some of the careers to determine if one of them might be a match.
- **(Reflection Slide)** Ask students to reflect on the challenge. Have students spend a few minutes thinking about the listed questions and then ask for volunteers to share their thoughts on any of the following:
  - How do you think this activity relates to a career in science and/or working at Johnson & Johnson?
  - Can you see yourself as a STEM²D professional? In what role? Why or why not?
  - What do you need to do to make this happen?
  - What is one thing you learned that you did not know coming in today?
- **(Packaging Pioneers Slide)** Thank students for joining you today and encourage them to continue exploring careers in STEM²D.



EXTENDED LEARNING

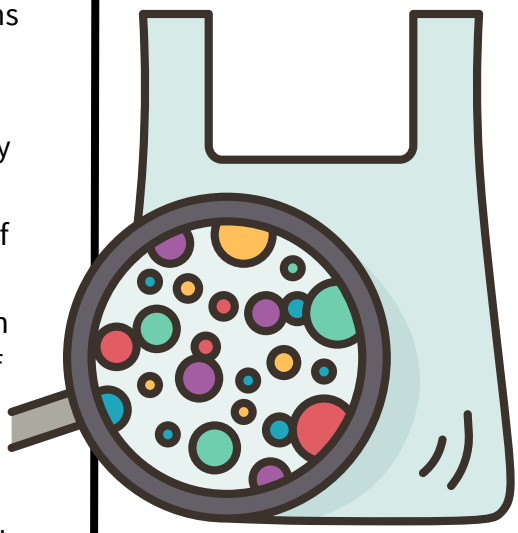
Here are a few ways to extend the learning:

- Encourage students to contact companies that could help teams acquire the materials they proposed in their design to build a prototype of their eco-friendly packaging solution.
- Consider asking students to conduct consumer research to obtain feedback on their new packaging design. Using this feedback, they can enhance their design and make it more appealing to consumers.

- Assist students in establishing connections with nearby companies to discover and create more economical and environmentally friendly packaging options. This will provide students with the opportunity to network with nearby manufacturers to gain real-world information about business and customer requirements.

KEY WORDS

- **Biodegradable**: The capability of a material to be broken down by living organisms and reabsorbed by the natural environment.
- **CO_2 Emissions:** The primary greenhouse gases emitted through human activities, which accounts for 80% of all U.S. greenhouse gas emissions.
- **Contamination:** The process of making something impure or unsuitable by adding harmful or undesirable elements.
- **Decision Matrix:** A tool used to compare design solutions against one another, using specific project requirements criteria.
- **Iterative:** A cyclic approach where creators continuously improve a concept, design or product.
- **Landfill:** A specifically engineered facility for disposing of solid waste.
- **Microplastics:** Tiny plastic particles that result from both commercial product development and the breakdown of larger plastics.
- **Prototype:** An early sample, model, or release of a product built to test a concept or process.
- **Recyclable:** A substance or object that can be processed in a way that allows it to be used again or transformed into new material.
- **Sustainable:** Practices, methods, or lifestyles that can be maintained over time without reducing natural resources or causing permanent damage to the environment.
- **Synthetic:** Created through a chemical process rather than occurring naturally.



RESOURCES AND REFERENCES

Special thanks to Anju Malhotra, Sophia “Olga” Yiantsos, and Jacqueline Park at Johnson & Johnson for their insights and help developing this activity.

The following resources provide additional information or activities.

- Teach Engineering, It’s All in the Package https://www.teachengineering.org/activities/view/cub_environ_lesson05_activity1
- Glowforge, Think Inside the Box https://glowforge.com/educators/lessons/think-inside-the-box-redesigning-packaging-to-reduce-waste
- United Stated Environmental Protection Agency, Plastics: Material-Specific Data. https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/plastics-material-specific-data
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PACKAGING PIONEERS

Student Activity Workbook

Engineering Design Process

The engineering design process is a series of steps that engineers follow to find a solution to a problem. It emphasizes open-ended problem solving and encourages designers and engineers to take risks and learn from failure. This process nurtures their ability to create innovative solutions to challenges.

The image below represents one example of the Engineering Design Process.

Steps of the Engineering Design Process

Step 1: Ask
Team members must have the same understanding of the goals and objectives of the project. This step requires the team to ask questions to identify the criteria or limitations associated with the project.

Step 2: Collect
This step encourages engineers and designers to conduct research, collect information, and gain a better understanding of the product that needs to be built. Additionally, in this step teams will dig deeper into the problem by identifying why it is a problem, who it affects, and why the problem is worth solving.

Step 3: Imagine
Brainstorming helps teams to draw into all their team members' experiences and consider several different approaches to the challenge of generating the most successful design solution. Creating sketches of the proposed designs could help the team fully understand the proposed solutions during this step.

Step 4: Plan
After assessing each possible solution, engineers and designers must choose the best design to proceed with. It's common for teams to use a decision matrix to pick the best solution. A decision matrix evaluates each potential solution based on a set of criteria, such as material type, cost, performance, safety, and ease of use.

Step 5: Create
Creating a prototype is a key step in the development of a final solution because it allows engineers and designers to test how the solution will work. Prototypes can help teams to develop the structure, function, and appearance of their solution. Prototyping is an important step in the iterative design process. Once a prototype has been developed based on the initial proposed design, it's important to take time and evaluate the prototype through testing and feedback, then incorporate that feedback into the next iteration of the design.

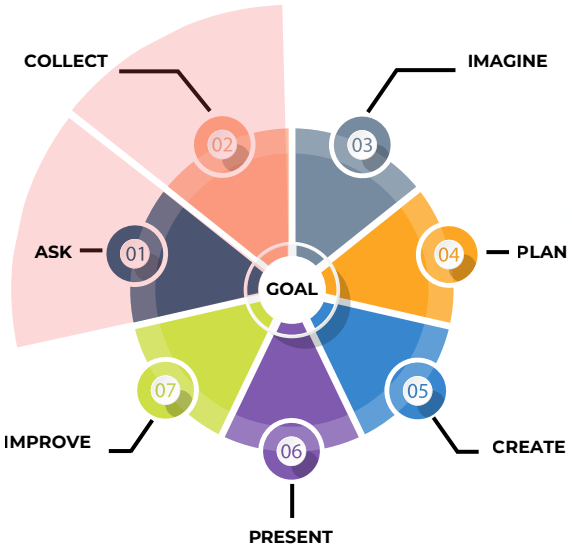
Step 6: Present
When designers and engineers present their solutions, it allows them to visually convey their message, making it easier for the audience to understand their information or ideas. Well-designed presentations enhance the quality of communication and engagement with the audience.

Step 7: Improve
The engineering design process is iterative, meaning that engineers and designers often repeat some or all of these steps several times to refine their solution. It's important it go back and make changes to the proposed design based on feedback received throughout the process.

Design Process in Action

Ask & Collect

Identify key characteristics, criteria, and limitations of the product. Ask questions and research examples of sustainable packaging. Summarize your findings below.



Potential research topics could include:

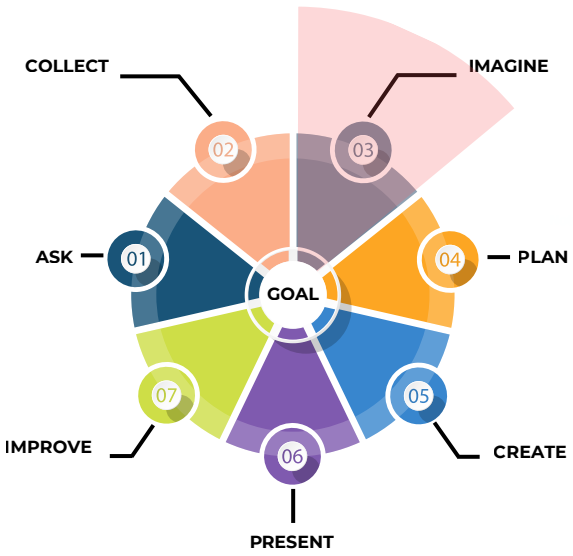
- The difference between sustainable and non-sustainable packaging.
- Examples of sustainable packaging that reduces waste.
- The cost of various eco-friendly packaging materials.
- Positive and negative characteristics of the current packaging solution for the product.
- Temperature requirements for the product to consider during shipping.
- Size constraints for the product.

Design Process in Action

Imagine

Brainstorming involves generating a large number of ideas to solve a specific problem or challenge. Brainstorming helps teams to draw into all their team members' experience and consider several approaches to the challenge to generate the most successful design solution.

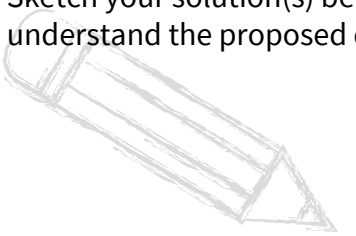
Use the space below to brainstorm possible solutions. It's OK for brainstorming to be messy and unorganized. Be sure to think big and record all suggestions, no matter how wild they might be!



Design Process in Action

Imagine

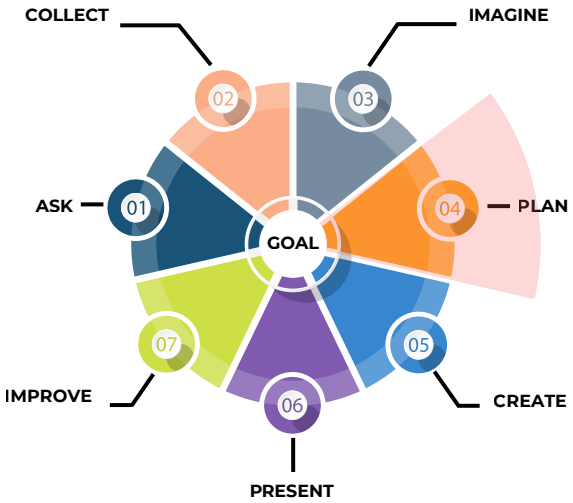
Sketch your solution(s) below to help your team better understand the proposed design.



Design Process in Action

Plan

A decision matrix evaluates each potential solution based on a set of criteria, such as material type, cost, performance, safety, and ease of use. A decision matrix helps teams with assessing each possible solution to choose the best design.



Utilize the decision matrix steps below to help your team select the best solution.

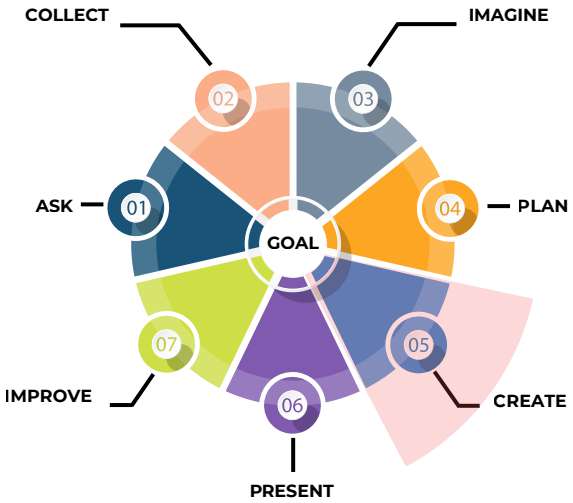
- List the top 5 solutions determined by the team in the first column.
- Determine the factors or criteria that matter most to each team. List those factors across the first row. Possible factors could include cost, strength, access to materials, eco-friendliness, ease of development, aesthetics, etc.
- Evaluate each solution option against the criteria (usually on a scale of 1 to 5).
- Add the scores across each row.
- The highest-scoring solution is the best choice!

	Criteria 1 _____	**Criteria 2** _____	**Criteria 3** _____	**Criteria 4** _____	**Total**
Solution 1					
Solution 2					
Solution 3					
Solution 4					
Solution 5					

Design Process in Action

Create

Creating a draft poster helps teams organize the content of the poster logically. Use this page to create of draft of your poster presentation. Taking the time to draft a plan for how to display the solution will help your team with the organization, layout, and visual structure of your poster presentation.



DRAFT LAYOUT:

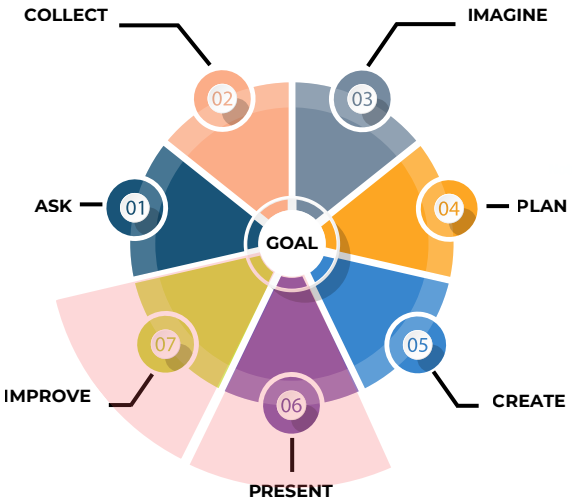
Design Process in Action

Present & Improve

PRESENTING:

Presenting can be both exciting and challenging. Here are some tips to help teams deliver an engaging and effective project presentation.

- Show genuine enthusiasm for your solution!
- Use personal anecdotes to engage the audience and illustrate your solution.
- Project your voice, avoid rushing, and speak with conviction.
- Maintain eye contact and good body posture.
- Balance speaking time to demonstrate equal investment, preparation, and passion.
- Rehearse your presentation multiple times.



FEEDBACK:

Designing a product or developing a solution to problem can be challenging, and feedback helps improve it. Feedback encourages dialogue, fosters collaboration, and ensures that the collective efforts of the team lead to successful outcomes. Use the space below to write down any feedback received following your team's presentation.

IMPROVE:

After reflecting on received feedback, use the space below to write down possible future improvements to your proposed solution. Keep in mind that the design process is iterative. Iteration allows designers and engineers to refine and enhance their work over time. By revisiting and adjusting your design, you can address shortcomings, incorporate new insights, and create more effective solutions.

TELL MY STORY FORM

This form will help activity leaders and other volunteers prepare to talk about their STEM²D interests, education, and career path.

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 post-high school pathway? What technical or educational institutions did you attend? If you switched disciplines, make sure you explain why. _____

_____

_____

What does your current position entail? Be sure to include how you use STEM²D during a typical work day. _____

_____

_____

PRE-ACTIVITY CHECKLIST

Packaging Pioneers

*The following checklist helps activity leaders plan and prepare to conduct the **Packaging Pioneers** activity with students.*

DID YOU . . .

- ☐ Read Spark WiSTEM^{2}D? This is essential reading for all volunteers interested in working with youth. It defines the STEM^{2}D principles and philosophy and provides research-based strategies and tips for engaging and interacting with students.
- ☐ Visit the event venue (optional) and/or finalize logistics with the organizer? Ask:
  - ☐ What is the date, time, and location of the event?
  - ☐ How will the room be arranged? Do I have access to tables? How big are they?
  - ☐ How many students do you expect? How will the students be organized/participate in the event? Knowing this will help you determine the quantity of materials to purchase.
- ☐ Recruit additional volunteers, if needed?
- ☐ Prepare for the activity? Did you:
  - ☐ Read the entire activity text prior to implementation?
  - ☐ Customize the activity, if desired, to reflect your background and experiences, as well as the cultural norms and language of the students in your community?
  - ☐ Complete the **Tell My Story Form**, which will prepare you to talk about your educational and career path with the students? *(optional)*
- ☐ Obtain the required materials? See the Materials and Estimated Materials Costs sections.
- ☐ Set up the site appropriately for the activity?
- ☐ Practice your presentation? *Make sure you can explain the concepts to students, if needed, and that you know the correct answers.*
- ☐ Bring a camera, if desired, to take photographs?
- ☐ Obtain and collect permission slips and photo release forms for conducting the activity, if applicable?
- ☐ Have fun!