




BUILDING WITH WONDERFUL JUNK

STEM²D Topics:
Design, Engineering, Science, Mathematics

Target Population:
Students, ages 11-14

Building with Wonderful Junk 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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ACTIVITY DESCRIPTION

In this construction activity, young people have fun as they work in teams to plan and build large structures using recyclable materials brought from home. In addition to gaining experience with engineering principles, students use interpersonal skills—presenting ideas, negotiating, and organizing—skills needed in STEM²D careers.

ESTIMATED TIME

This session typically takes **1 hour** to complete.

STUDENT DISCOVERIES

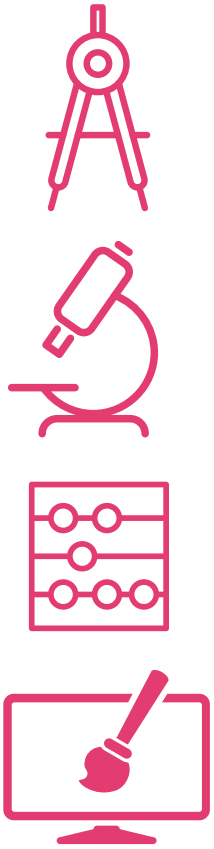
Students will:

- Participate in a team-based learning experience.
- Learn how STEM²D—science, technology, engineering, mathematics, manufacturing, and design—subjects are involved in the building and planning of structures.
- Build important STEM²D skills, such as exploring problems involving shape, size, scale, and stability.
- Consider STEM²D concepts including balance, weight, gravity, and symmetry.
- Recognize that STEM²D offers diverse and exciting career opportunities.
- Have fun experiencing STEM²D.

GETTING READY

Materials

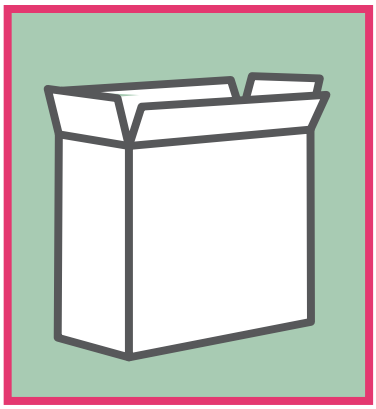
- Activity Leader Checklist
- Tell My Story Form
- Student Handouts *(1 per student)*

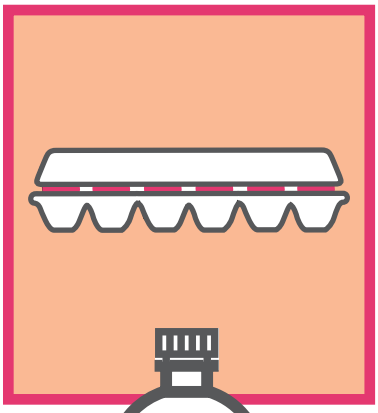


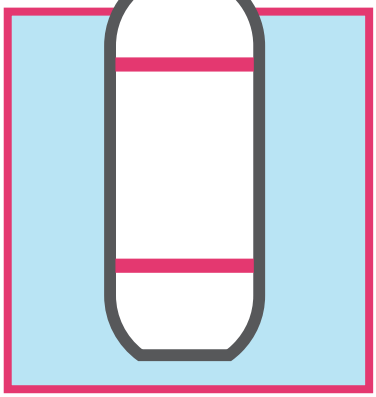
STEM²D Skills

- Creativity
- Collaboration
- Decision Making
- Estimating
- Measuring
- Model Making
- Negotiating
- Organizing
- Planning
- Problem Solving
- Spatial Relations
- Teamwork

Peter Muller/Getty Images







- Lots of clean, wonderful junk:
  - All kinds of empty boxes (cereal boxes, shoe boxes, small and large cartons, gift boxes, egg cartons, etc.)
  - Cups (paper, plastic, cardboard)
  - Tubes (paper towel tubes, toilet paper tubes, poster tubes, gift paper tubes)
  - Foil (pie plates, cake pans)
  - Plastic bottles (no cans or glass)
- Several rolls of masking tape
- Paper and crayons (optional)
- Camera (optional)

Estimated Materials Cost:

Activity leaders can expect to incur $10.00 (assuming the junk used are trash items) in materials costs when completing this activity with 20 students organized into teams of four to six 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 **Activity Leader Checklist** for details and specific steps for planning and preparing to implement this activity.
3. See the **STEM²D Student Activities Overview** for additional information.

STEP-BY-STEP ACTIVITY: BUILDING WITH WONDERFUL JUNK

1. **Welcome and Introductions (20 minutes)**
   - Greet the students.
   - Tell the students your name and your organization/company. 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.

_____

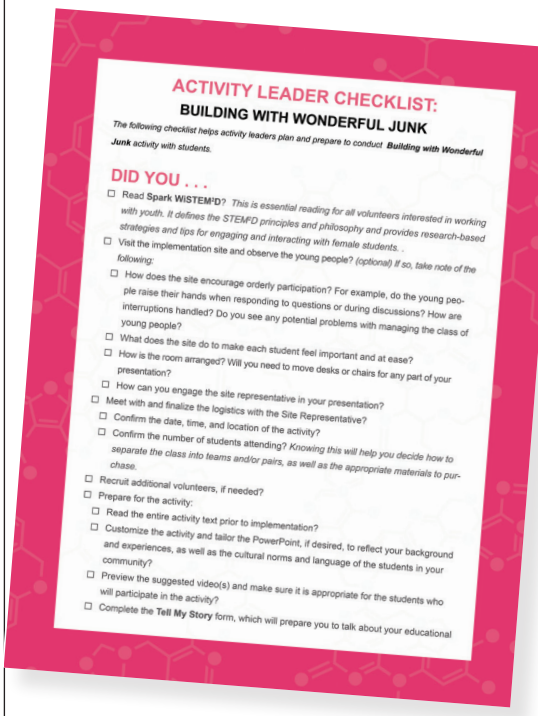
_____

_____

_____

- Ask the students and any volunteers helping today to introduce themselves.
- Use the Conversation Starters to learn more about the students and their interests.
- Discuss the opportunities that exist in the local community 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. **Learning Activity: Building with Wonderful Junk (30 mins)**
    - Separate the students into teams (four to six students per team), and have each team gather next to their pile of "wonderful junk."
    - Explain to each team that they will be constructing with the "wonderful junk." The instructions are to:
        - Plan and work together.
        - Use all the junk in their pile.
        - Build a structure that can stand alone.



ACTIVITY LEADER CHECKLIST:

BUILDING WITH WONDERFUL JUNK

The following checklist helps activity leaders plan and prepare to conduct ***Building with Wonderful Junk*** *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 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?
- ☐ 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?
    - ☐ 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

CONVERSATION STARTERS: CAREER PLANNING

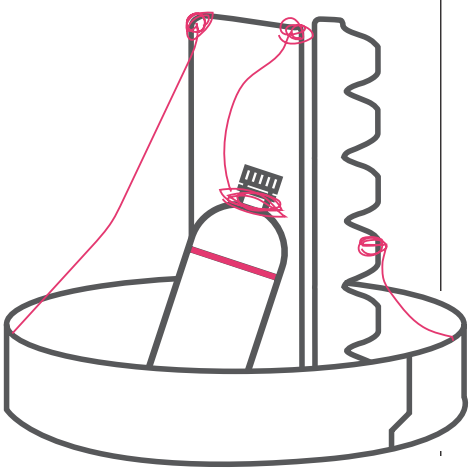
- When you consider your future what are you most excited about?
- Do you see yourself working with others, for a large company, with your friends, for yourself? Why or why not?
- What does the perfect work day look like to you? Are you outdoors? Are you working alone, or with others? Do you solve problems? Do you fix or build things?

KEY WORDS

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

TIPS FOR WORKING WITH STUDENTS

- Encourage creativity and risk taking in their reflections and discoveries.
- Encourage the teams to consider how symmetry adds to the overall strength and stability of their structure.
- Were the teams able to determine ways to make seemingly flimsy materials stronger? Did any of the teams fold or roll their materials as a way to strengthen them?
- Reinforce the need for a strong base, and that although tubes are flexible they add strength to any structure.



- Encourage everyone to participate in the building process. If you see that someone is not involved, try suggesting that she or he pick out something special to add to the structure.
- As teams work, ask open-ended questions that will lead them to problem-solve:
  - How could you make your structure steadier?
  - Where do you think the largest carton might be most useful?
  - Can you think of a way to attach that box to the top of the structure?
- If teams like, they can name and label their structures.
- After the structures are completed, ask each team to talk about its structure and how it was built. If words like gravity, balance, or weight come up in describing the structure, be sure students know what they mean. (See Key Words.)
  - Note: Remember to give each team positive feedback on its architectural creation!
- If you have a camera, take a picture of each structure and its "building crew." Mount and display the photos.

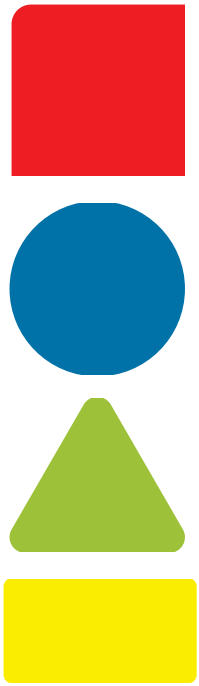
3. Student Reflection (10 minutes)

- Distribute the Student Handouts. Have students reflect on this activity by answering the following questions:
  - What did you learn doing this activity?
  - Was it fun? What made it fun?
  - Were you doing engineering or design? Why do you think so?
- After a few minutes, ask the students to share their thoughts. If time permits, have the students discuss their responses to the following questions:
  - Can you name some of the careers that would support the engineering and design work you did today?
  - What are some other STEM²D careers?
- Here are some ideas of what to do with the wonderful junk structures that you should share with the students:
  - Save them to display at the next parent meeting or event. Or, if there is space, display the structures in the hallway or entryway.
  - Have a discussion about shapes. Make a list of all the shapes students mention. Help young people create a

graph of different shapes in their structures. Write words or draw the shapes (square, rectangle, circle, triangle) along the bottom of a piece of paper; along the left side from bottom to top write the numbers 1 to 10. Count all the squares you see in a structure; enter the result on the graph. Next, count all the circles, and so on. What shape was the most-common? The least common?

- Have teams estimate the height of a given structure. Then measure it. How close were their estimates?
- Monitor how long the structures last without falling apart. Make observations on a daily basis to talk about what is happening to the structures. Are they beginning to lean to one side? Why might that be happening? Are certain pieces falling off? What are some guesses about why that is happening? The discussion may come in handy when you make plans to build your next structures.

- Thank the students for participating. If necessary, recycle the structures by taking them apart, sorting the materials, and discarding them in the appropriate recycling bins at the site or at a community recycling plant.



Extended Learning

There are many ways to extend the learning of this activity:

- Use materials such as newspapers, straws, paper clips or clay, and toothpicks to create other structures.
- Have a Structure Exhibit and invite other young people, staff, and family members to come for a viewing.
- Ask young people to sort a pile of wonderful junk based on the different materials in it.
- Have a discussion about recycling. Ask them to think about this question: Where would this junk be if it had not become part of your structure? If possible, arrange a trip to a local recycling plant.
- Have a discussion about how companies are engaging in sustainability and conservation of resources. Students should look up companies that have dedicated resources and programs around sustainability and conservation and share among the teams.

- Invite someone from the Department of Sanitation, or a recycling plant, to come in and talk about what happens to trash after it has been collected.
- Take a trip around the block, observing and making notes/sketches about the buildings, stores, parks, fences, etc. Then, using recyclables, have students create a model of what they have observed.

Key Words

Here are some key words related to this activity:

Balance. A state of equilibrium; a stable state in which all forces are cancelled by equal, opposing forces.

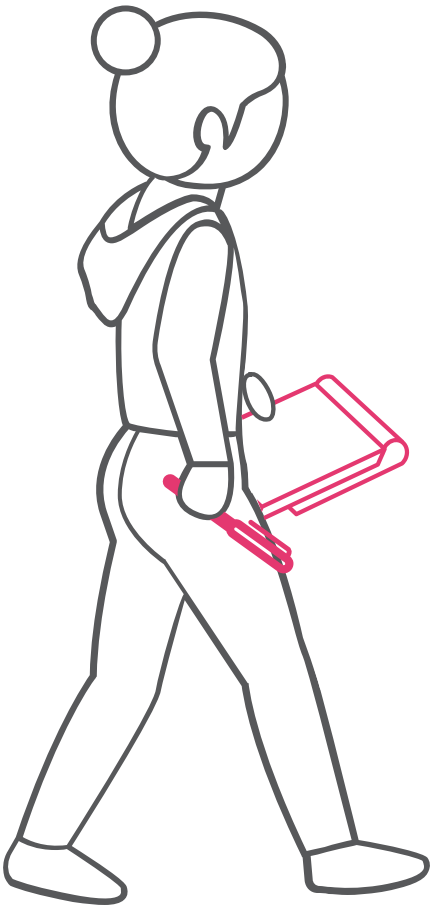
Flexible. Able to bend without breaking.

Gravity. A force that pulls objects toward each other.

Recycle. To reuse products.

Rigid. Unbending, stiff, or unyielding.

Symmetry. A balanced, mirror-image correspondence of size, form, and arrangement of parts.



Activity Leader Reflections

After the activity, take a few moments to reflect on the following:

- What went well and what could be improved?
- What would you do differently next time?
- How comfortable did you feel leading the discussions?
- Do you have a better understanding of STEM^{2}D concepts?
- How useful was the information presented in **Spark WiSTEM^{2}D**?
- Will you volunteer for this type of experience again?

Resources and References

The following resources provide additional engineering activities:

- The Homeschool Scientist's gum drop structure: http://thehomeschoolscientist.com/gumdrop-structures-engineering-challenge/
- Instructables' rubberband helicopter: http://www.instructables.com/id/Rubberband-Helicopters-step-by-step/
- Fun-A-Day catapult: http://fun-a-day.com/14-catapults-kids-create-experiment/

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- Recruit additional volunteers, if needed?
- Prepare for the activity:
  - Read the entire activity 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?
  - 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?
  - 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 and photocopy the **Student Handouts**? In addition:
  - During the week leading up to your visit, ask the students to bring in clean recyclable junk.
- Practice your presentation, including the hands-on, minds-on activity? Be sure to:
  - Review the Key Words; be prepared to guide students through the reflection activity (see Student Handouts); review the ideas presented to help students decide what to do with their wonderful junk structures.
- Set up the site appropriately for the activity? Specifically:
  - Plan where the activity will take place. You will need a large space for building and storing the structures.
  - Place the “wonderful junk” on the floor. Dividing the clean trash into separate piles according to the number of teams that will be participating. Students should be grouped into teams of four to six students.
  - Make sure each team has large boxes that will make good bases.
  - Bring a camera, if desired, to photograph each structure and its “building crew.”
- 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.* _____

_____

BUILDING WITH WONDERFUL JUNK

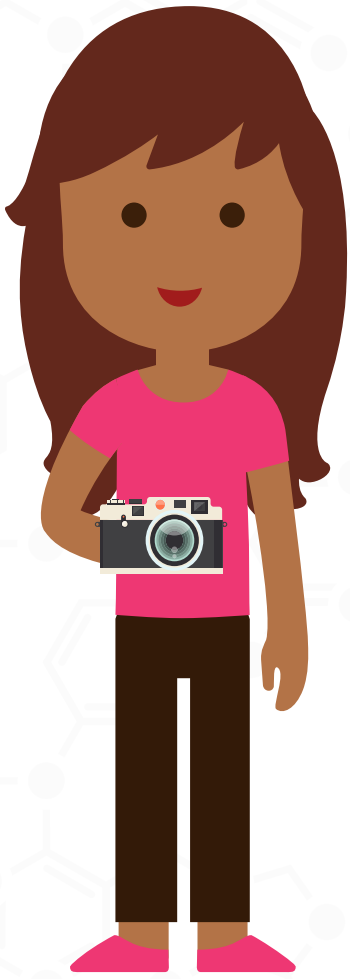
Student Handouts

Reflection

Reflect on Building with Wonderful Junk.

You may answer these questions with words or pictures.

What did you learn while doing this activity?



Was it fun? What made it fun?

Were you doing engineering or design? Why do you think so?

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