We’re All Engineers:
Making Engineering Meaningful for Girls

Program Type: Training
Audience Type: Adult

Goals:
- Participants will see themselves and the girls in their lives as engineers
- Participants will learn practical strategies for encouraging and supporting girls’ engagement with engineering.
- Participants will engage in an engineering activity, gaining hands-on experience with this kind of learning.

Topics:
Engineering, strategies to facilitate science-related activities

TIME REQUIRED

Advance Preparation: 60 min
Set Up: 10 min
Activity: 60–120 min
Clean Up: 5 min

SITE REQUIREMENTS
- Projector and screen for showing a PowerPoint.
- Tables and chairs for the participants.
<table>
<thead>
<tr>
<th>Supplies</th>
<th>Amount</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projector, computer, and screen</td>
<td>1</td>
<td>For displaying PowerPoint</td>
</tr>
<tr>
<td>“We’re All Engineers” booklet</td>
<td>1/person</td>
<td>See Appendix; print two-sided and fold along center to form booklet</td>
</tr>
<tr>
<td>Pens or pencils</td>
<td>1/person</td>
<td></td>
</tr>
<tr>
<td>Index cards</td>
<td>Pack of 100/group</td>
<td></td>
</tr>
<tr>
<td>Masking tape</td>
<td>12”/group</td>
<td></td>
</tr>
<tr>
<td>Standard ruler</td>
<td>1/group</td>
<td></td>
</tr>
<tr>
<td>Small stuffed animal</td>
<td>1-2</td>
<td>About the size of a tennis ball; can share between groups</td>
</tr>
<tr>
<td>Tennis ball</td>
<td>1-2</td>
<td>Can share between groups</td>
</tr>
</tbody>
</table>
INTRODUCTION

- This document is meant to guide professionals in delivering trainings/workshops for educators and caregivers.
- The content and length of the training can be adapted to fit the needs of the participants and the facilitator’s personal presentation style.
- It is important to approach the topic with sensitivity; participants may have strong opinions and emotions regarding the topics of education, parenting, and gender.
- Making space for personal reflection and small-group discussion may encourage participants to engage more deeply.
- You can download the PowerPoint presentation by going to http://www.omsi.edu/educator-resources and searching “Designing Our World.”
- A suggested script for the facilitator appears below. The facilitator should become familiar with the content and present it in a way that works for them and their audience.

AGENDA

This agenda is meant to be used as a guide to organize the content of the session. Feel free to adapt it to meet the needs of your session/group. The times listed for each section are approximate. Some discussions can take longer due to the group’s background/interests. Plan to spend at least an hour, and as long as 90 minutes, to complete the entire training.

- Introductions – 5 minutes
- Reflection: Maker stories – 10-15 minutes
- The Engineering Design Process – 5-10 minutes
- The Need: Why promote girls in engineering? – 5-10 minutes
- Reflection: Meaningful Learning Experiences – 10-15 minutes
- Strategies: The 3 Pillars – 5-10 minutes
- Reflection: Putting it into practice – 10-15 minutes
- Hands-on activity: Card Tower -15-45 minutes
- Debrief and closing – 5 minutes
# We’re All Engineers: Making Engineering Meaningful to Girls

## 1. Welcome participants

**Introduce self**

**Address housekeeping details**

(restrooms, breaks, etc.)

**Outline the session goals:**

- Participants will see themselves and the girls in their lives as engineers
- Participants will learn practical strategies for encouraging and supporting girls’ engagement with engineering
- Participants will engage in an engineering activity, helping them be more comfortable when planning and delivering science- and engineering-related activities

## 2. Go over agenda:

- **Introductions**
- **Reflection: Maker stories**
- **The Engineering Design Process**
- **The Need**
- **Reflection: Meaningful Learning Experiences**
- Strategies to engage girls in engineering-related experiences
- Hands-on activity: Card Tower
- Debrief and closing
### Reflect and Share: Maker Stories

Think of something you have created, built, or fixed.

Now, think about something you have made, created, or built. It can be something you created a day ago or something you created when you were a child. Think about what it was, what materials you used to make it, and why you decided to make that specific thing. You can write about it or you can draw it.

Refer participants to page 1 of the booklet. Give participants 5–10 min to complete their story and/or drawing.

Invite participants to share with large group, if desired.

### The Engineering Process

Chances are, whatever it is you made, you probably used one or more steps in the engineering design process. As you outline each step, refer to the example in the script (making a bookcase), or use one of the participant’s responses as an example.

- **Ask** - Ask questions to understand the problem and understand what you need to solve. (Example: The problem is my kids have too many books and they are all over the place. There is not enough space to store them. Questions I may ask: What can I do to organize the books? How can I organize them?)

- **Imagine** - Brainstorm as many solutions and designs as you can. (Example: I could build a bookcase in the kids’ room. I could build boxes and put the books in the garage, etc.)

- **Plan** - Pick a design and decide how you will use the material. (Example: I’ll build a bookcase with wood, nails, paint. I’ll cut the wood first, and then I’ll start...
• **Create** - Build and test your design to see how well it solves the problem (Example: Build the bookcase, put it in the room, organize the books…)

• **Improve** - Make changes to your design based on what you learned (Example: The bookcase was great, the wood was super sturdy and could hold the books well, but the bookcase needs more shelves. The process to improve the design starts again with step one (Ask) to understand what we need. The process can be repeated (iteration) multiple times until we get the desired result.)

Think about the design (thing) you thought about in the previous activity. How do these steps apply to your design? *Invite one or two participants to share, if desired.*

---

**The Need**

Students Earning Bachelor’s Degrees in Engineering

- Women: 19%
- Men: 81%

According to National Science Foundation statistics, only 19% of students earning bachelors degrees in engineering are women. This is despite the fact that over half of all college degrees in general go to women.
In the field, the statistics are even worse. Of the women who get engineering degrees, many of them do not advance to a career in engineering; only 11% of practicing professional engineers are women.

Research shows that girls’ interest in STEM drops in late elementary to middle school.
- Girls and boys start out with equal interest and ability in science.
- Around middle school, this changes.
- By high school, even highly prepared girls are less likely to choose science career paths than boys.

So why does it matter that girls and women are underrepresented in engineering? So what?
- Diversity promotes innovation!
- Decades of research by organizational scientists, psychologists, sociologists, economists and demographers show that socially diverse groups are more innovative than homogeneous groups.
- This is especially important in a field like engineering, where innovation can mean better medical treatments for sick people, cleaner, more efficient forms of energy, and other new technologies that improve the way we live.
Now I’d like each of you to reflect on a memorable learning experience you have had.
- Keep in mind that meaningful learning experiences happen in a variety of settings. It doesn’t have to be an academic environment.
- A lot of learning is social, cultural, and implicit.

Invite participants to reflect on their own for approximately 5 minutes before sharing in partners or small groups. Participants can refer to page 3 or their booklets if they wish to write or draw.

If there is time after individual and small group reflection, you may invite a few participants to share their stories with the whole group.

Invite large group discussion:
- Based on your small group discussion, what did your experiences have in common?
- Were there any patterns or repeated qualities?

Write on the board key words or phrases. The title could be “Meaningful experiences: What made them special.” (Some examples could be family, a good listener, a teacher that encouraged me, someone that cared, etc.)

The facilitator guides conversation and highlights commonalities between experiences.
In the Designing Our World project, we’ve identified three features that make learning experiences meaningful for girls. We call these the 3 Pillars. Research has shown that when you make an experience social, altruistic, and/or personal, it is more attractive to girls. We have also noticed that when we ask adults to recall memorable learning experiences from their own lives, those experiences often include aspects of the three pillars. Next, we will describe each pillar in detail.

<table>
<thead>
<tr>
<th>Strategies: The 3 Pillars</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Make it social</td>
</tr>
<tr>
<td>2 Highlight altruism</td>
</tr>
<tr>
<td>3 Make it personal</td>
</tr>
</tbody>
</table>

As you describe and discuss each pillar, connect back to the Meaningful Learning Experiences participants shared. Point out where participant’s experiences were social, altruistic, or personal experiences. Social experiences encourage collaboration and discussion. Some ways you can do this:

- Establish a shared goal, like “Let’s see how many ideas we can generate as a class in 5 minutes,” rather than a competitive goal like, “Let’s see who can come up with the most ideas.”
- Set up activities so that more than one person can participate at a time.
- Consider assigning roles so that every student has an active role to play.
The second strategy is to highlight the altruistic nature of the activity. Sometimes altruism is more evident in some activities than others. Another way to think about altruism is to link the activity to ways in which this thinking can improve the lives of people, the environment, or animals/pets. Some ways to do this:

- Always connect the challenge back to people. For example, if the engineering challenge is to build a tower/structure with blocks, ask students how strong structures help communities/people. Tie that topic to engineering and how engineers help make structures that are safer to protect people, particularly during earthquakes.
- Introduce characters and/or scenarios to support the altruism of the activity. For example, instead of just telling students to “build a zipline,” create a narrative in which characters need to be rescued from a burning building via zipline.
- Whatever the topic, highlight real-life engineering innovations that have helped people, the environment, or animals/pets.

The third strategy is to make the experiences/activities personally relevant. This strategy refers to the connection that some group and/or individuals have with a narrative or activity. For example, students who live on the coast may have a strong personal connection to an activity that asks them to build tsunami-proof buildings. Students who live in Kansas, however may be less personally invested in that activity.
We’re All Engineers
Adult Engagement Module

**Reflect and Share:**

1. Make it social
2. Highlight altruism
3. Make it personal

In what way(s) are you already using the 3 Pillars as a parent or educator?
How could you incorporate them more?

**Activity: Index Card Tower**

For this section form teams of 2–4 people
Each team will need:
- 100 index cards
- 12 inches of tape
- A standard ruler
- A “testing” object – either a tennis ball or a small stuffed animal about the size of a tennis ball

*Explain the activity:*
The challenge: Using just index cards and tape, can you build a stable structure that can support an object? You can either build a water tower—with a tennis ball representing the water tank—or a climbing tower for a

But they may be more invested in building tornado-proof buildings. Activities that are personally relevant usually:
- Resonate with experiences that are important to individuals and/or groups.
- Engage participants emotionally
- Connect new information to previous knowledge

Refer participants to page 4 of their booklet. Invite them to reflect on their own for a few minutes, then share with their groups. (Each group can discuss all three pillars OR you can divide the room into thirds, and assign one pillar per group).
- In what way(s) are you already using the 3 Pillars as a parent or educator?
- How could you incorporate them more?

*After 5 minutes (or longer as time and interest allows), invite groups to share their thoughts.*
cat or other small pet—represented by the stuffed animal. As your team does this activity, think about the engineering design process and how the steps are represented in this challenge.

Regardless of which kind of tower you make, these are the criteria:

- The structure must be at least 12 inches tall (use the ruler as a reference.)
- It must be freestanding.
- It must hold the ball or stuffed animal for at least 10 sec.
- You can only use 12 inches of tape and up to 100 index cards per team.
- You will have 10 min (adjust as appropriate for grade level, available time) to build.

After 10 minutes, ask all teams to stop building.

Each team will use the stuffed animal or ball to test their design. Other teams observe the testing. The facilitator counts 10 sec for each testing.

Encourage teams to share about their process, the designs, and references the steps outlined in the engineering design process.

After all of the testing is completed, the teams are encouraged to do another iteration to improve their designs.

If all teams were successful in the testing, the facilitator can introduce another constraint: the teams can’t use tape to build the same structure. The testing process is repeated, and the facilitator asks questions about
We’ve discussed in depth how to use the 3 Pillars to make an activity meaningful. But what makes an activity an engineering activity specifically? How is an engineering activity different from a regular science activity?

Invite participant responses before revealing answers.

There are two things present in all engineering activities or challenges.

- **Clear objective** or challenges (as opposed to open-ended tinkering). In the tower activity the outcome has a clear description: build a tower that’s at least 12 inches high using the given materials. There were a few clear restrictions as well: the amount of tape, time, and the number of index cards.

- **Encourages iteration**: repeatedly trying to improve a design, known as iteration, is encouraged. That’s why the engineering design process is a cycle: it requires repetition and improvement.

Invite final questions and comments before bidding participants goodbye!
We’re All Engineers
Appendix
Making Engineering Meaningful for Girls

We're All Engineers

Name

Make it Personal

Highlight altruism

Make it social

Reflect and Share: In what way(s) are you already engaged in learning experiences that are social, altruistic, and personal?

using the 3 Pillars as a parent or educator. How could you incorporate them more?

Maker Stories: Think of something you have created, built or fixed. Think about what it was, what materials you used to make it, and why you decided to make that.

Specific thing. You can write about it or you can draw it.
The Engineering Design Process: Whether you’re a civil engineer designing a drawbridge, a baker developing a new cupcake recipe, or a kid building a Lego tower, chances are, you are using some combination of the steps below.

Meaningful Learning Experiences: Think of an example of a learning experience. It doesn’t have to be from an academic setting. What made the experience meaningful or memorable?

Share with group: What did your meaningful learning experiences have in common?

Engineering design cycle adopted by Head Start and Engineering, with permission from the Engineering is Elementary project, Museum of Science, Boston.
We’re All Engineers: Making Engineering Meaningful for Girls

Designing our World: An Oregon Museum of Science and Industry project, in partnership with Boys and Girls Club, Girls Inc., and Adelante Mujeres

Designing Our World is made possible with funding from the National Science Foundation
Agenda

- Introductions
- Reflection: Maker stories
- The Engineering Design Process
- The Need: Why focus our efforts on including girls in science and engineering-related activities?
- Reflection: Meaningful Learning Experiences
- Strategies to engage girls in engineering-related experiences
- Hands-on activity: Card Tower
- Debrief and closing
Reflect and Share: Maker Stories

Think of something you have created, built, or fixed.
The Engineering Process

Engineering design cycle adapted by Head Start and Engineering, with permission from the *Engineering is Elementary* project, Museum of Science, Boston.
The Need

Students Earning Bachelor’s Degrees in Engineering

- Women: 19%
- Men: 81%

The Need

Practicing Engineers in the U.S.

The Need

Research shows that girls’ interest in STEM drops in late elementary to middle school.

Attracting underrepresented groups will diversify the field and maximize innovation.
Reflect and Share: Meaningful Learning Experiences

Think of an example of a learning experience. Consider what about the experience made it memorable.
Reflect and Share: Meaningful Learning Experiences

What did your experiences have in common?
Any patterns or repeated qualities?
Strategies: The 3 Pillars

1. Make it social
2. Highlight altruism
3. Make it personal
Strategies: The 3 Pillars

1. Make it social

Encourage collaboration and discussion over competition.
Strategies: The 3 Pillars

2 Highlight altruism

Connect the activity to helping others.
Strategies: The 3 Pillars

3 Make it personal

Find common connections between the activity and the everyday lives of girls.
Reflect and Share:

In what way(s) are you already using the 3 Pillars as a parent or educator?
How could you incorporate them more?

1. Make it social
2. Highlight altruism
3. Make it personal
Activity: Index Card Tower
What makes an activity an engineering activity?

- Clear objective
- Encourages iteration
Questions?

Thank you! Gracias!

Contact info: ________________________________