Techbridge

Design Time

A Toy Lab for the Creative Designer

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We thank the leadership at the Noyce Foundation and the Gordon and Betty Moore Foundation for recognizing Techbridge's potential to impact girls beyond those in our local community. These Foundations' generous support of this project made the partnership with Girl Scout Councils possible.

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The Techbridge staff demonstrated tireless creativity and flexibility while developing and testing these programs. Thanks to Maria Anaya, Megan Davis, Jennifer Diaz, Jennifer Joyce, Linda Kekelis, Molly Larkin, Lulu McCourt, Martha Pena, and Jennifer Wei, with the assistance of Eli Leonardo, Jennifer Tai and Vicki Tu.

Our friends at the Girl Scout councils of Northern California (especially troops 60021, 60656, and 60688), Central Texas, West Central Florida and Central Maryland, piloted early versions of the activities and offered suggestions that helped improve the program boxes. Our partnership with Girl Scout councils embodies the best in collaboration. We have shared resources and learned so much from teaming up on this project. Together we worked to inspire girls to change the world through engineering and science.

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About Techbridge

"Boring, nerdy, and only for boys." Some girls may think of engineering in those terms, but not the girls participating in Techbridge. They say, "I learned that this science thing is very fun and educational at the same time. I LOVE IT!" and "I learned that engineering is not just for men."

Techbridge is a leader in providing girls with firsthand experience working as engineers—from designing toys and building turbines, to meeting professional engineers who help make the world a better place.

Techbridge brings together best practices and lessons learned for partners and offers curriculum that builds on girls' interests and expands their career options. We have seen first-hand the impact that role model visits and field trips can have. We offer training and resources to youth-serving adults to create positive experiences for girls.

The Techbridge program reaches out to girls in under-served communities and offers after-school and summer programs with hands-on projects and career exploration. Techbridge has served over 3,000 girls in elementary, middle, and high schools in Oakland, California and surrounding communities since its start in 2000. The program has been shown to increase girls' confidence, build skills, and promote interest in careers in engineering, science, and technology.

In order to bring a Techbridge experience to girls across the country, we are partnering with Girl Scout councils. The Techbridge team has developed programs-in-a-box that include all the activities and materials you will need to introduce girls to the wonders of engineering and science. The Girls Go Techbridge program-in-a-box includes the leader guide you have in your hands, and the box of materials in front of you, ready for a group of ten girls to dive in and enjoy.

We invite you to partner with us to bring engineering and science to girls in your community. Together we can inspire a girl to change the world.

For more information, visit www.techbridgegirls.org.

Design Time: Suggested Schedule

Time	Session 1	Session 2	Session 3	Session 4
:00	**Pre-Surveys** (if applicable)	**Icebreaker:** Can You Draw This?	**Career Activity:** Daydreaming Careers	**Career Activity:** Your Career Card
:10	**Icebreaker:** Design Your Toy			
:20	**Hands-on Activity:** Toy Prototyping	**Hands-on Activity:** Pencil Bag Design	**Hands-on Activity:** No Cookie Crumbles	**Hands-on Activity:** The Business of Bubbles
:30				
:40				
:50				
1:00				
1:10				
1:20				**Post-Surveys**

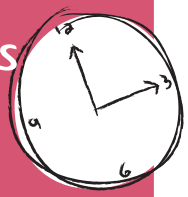
Design Time: Alternative Schedules

	6.5 Hours	4.5 Hours
:00	**Icebreaker:** Design Your Toy	**Icebreaker:** Design Your Toy
:10		
:20	**Hands-on Activity:** Toy Prototyping	**Hands-on Activity:** Toy Prototyping
:30		
:40		
:50		
1:00		
1:10		
1:20		
1:30	**Icebreaker:** Can You Draw This?	**Career Activity:** Daydreaming Careers
1:40		
1:50	**Hands-on Activity:** Pencil Bag Design	**Hands-on Activity:** No Cookie Crumbles
2:00		
2:10		
2:20		
2:30		
2:40		
2:50		
3:00	**Lunch**	**Career Activity:** Your Career Card
3:10		
3:20		**Hands-on Activity:** The Business of Bubbles
3:30	**Career Activity:** Daydreaming Careers	
3:40		
3:50	**Hands-on Activity:** No Cookie Crumbles	
4:00		
4:10		
4:20		
4:30		
4:40		
4:50		
5:00	**Career Activity:** Your Career Card	
5:10		
5:20	**Hands-on Activity:** The Business of Bubbles	
5:30		
5:40		
5:50		
6:00		
6:10		
6:20		
6:30		

Design Time: Introduction

4 Suggested Sessions

approximately 1 hour and 30 minutes each



Skills:

- Learning the Engineering Design Process

Thank you for taking the time to make a difference in the lives of girls. By selecting this program-in-a-box, you've equipped yourself with tested and proven, girl-friendly hands-on activities to expose youth to careers in engineering.

Women are largely under-represented in STEM (science, technology, engineering and math) fields, and with your encouragement and leadership, the girls you work with may change this trend.

Design Time ignites interest in engineering with girls' love of being creative and artistic. It is key that we communicate to girls that engineers are extremely creative; they are problem-solvers, looking for ways to improve the world.

Engineering takes a village! Many different designers, engineers, and marketing specialists work together to create a single product that will be attractive and appealing to their audience. Studies show that girls enjoy working cooperatively and collaborating. Many girls think that being a scientist or engineer means working alone in a lab, but in reality, the opposite is true. In this program, girls frequently work in teams or pairs. We've included recommendations about grouping with each activity.

Girls will experience the **Engineering Design Process**, including brainstorming, designing, testing and redesigning, firsthand as they design and create products. They will also explore careers that play a major role in the creation of products in the market today. Each activity will introduce a career that relates to the activity and emphasizes various parts of the **Engineering Design Process**.

Toy Prototyping:

Girls will be challenged as **Toy Designers** to brainstorm, design and build a toy prototype that is intended for a specific age.

Pencil Bag Design:

Girls will explore being a **Product Designer** and a client as they work with a partner in creating a pencil bag. This pencil bag will reflect that specific needs of their client.

No Cookie Crumbles:

What makes food products and their packaging last long hours in transport? Girls will learn first hand how to design and create shipping packaging for a cookie like real **Packaging Engineers**. They will put their packaging to the test with five stress tests.

The Business of Bubbles:

Girls will experience the design, production and marketing of a bubble solution product. A **Mechanical Engineer**, **Chemical Engineer**, **Marketing Specialist** and **Product Manager** all play a major role in making this bubble product a true success.

Design Time: Introduction

There are three kinds of activities in this program-in-a-box: optional icebreakers, inspirational career activities, and creative hands-on activities. Icebreakers help introduce some of the key concepts the girls will explore in the main activities. All these icebreakers and activities stress the importance of good communication and team work. Communication is a crucial skill that all designers, engineers, and marketing specialists use at work. They don't work alone. They work as a team!

We also encourage you to invite role models into your program or to take your girls on field trips. Our career cards include profiles of women in design and engineering fields, but nothing compares to a trip to see where these professionals work. See page eleven for information and tips on planning a role model visit or field trip.

Recommendations:

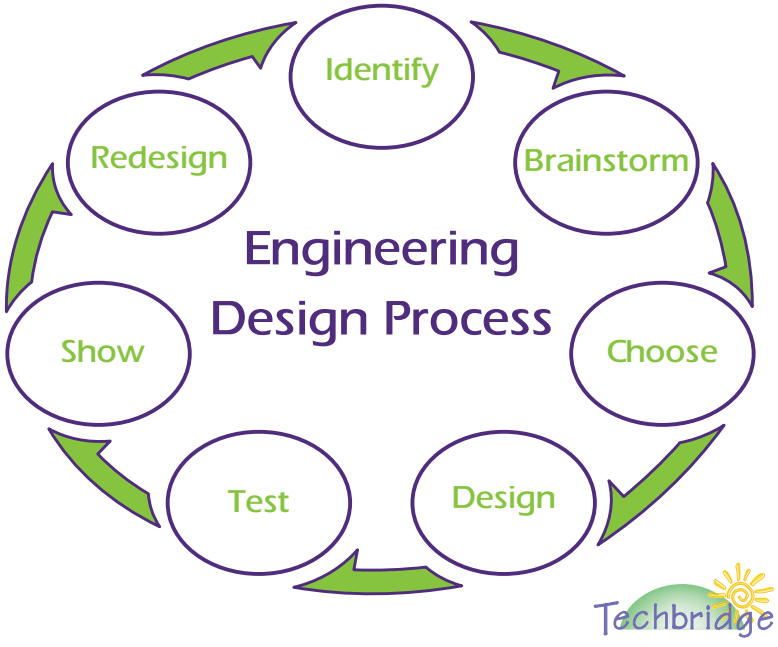
Familiarize yourself with the **Engineering Design Process**. This will be emphasized during the entire unit.

Engineering Design Process

The Techbridge **Engineering Design Process** is a never-ending cycle of creativity. With each of the hands-on activities in this guide, we encourage you to lead girls to identify and talk about where they are in the design cycle. Growing awareness of the design process helps girls strengthen their outcomes, whether it be a hand-made product or a presentation in front of a group.

The design process encourages girls to both "try, try again" and recognize that "two heads are better than one." Engineers, and everyone from kids to professionals, use these steps to reach their desired result. We knew this was an effective tool when one Girl Scout remarked that she used the **Engineering Design Process** when writing and revising a paper for English class, and to persuade her parents to get a later curfew!

As the leader, you'll have to know when it's time to stop, but the more opportunities you allow girls to reflect, redesign, and repeat the design process steps, the better the experience for all. We recommend you display the supplied **Engineering Design Process** poster throughout these activities for easy reference.



Girl Scout Leadership Experience

In 2008, Girl Scouts of the USA introduced fifteen Leadership Outcomes to help leaders create and recognize a successful Girl Scouting experience. You know your girls are enjoying a quality Girl Scout activity when an out-of-school experience is girl-led, experiential, and cooperative. You see that your girls are leaders when they:

Discover…

- Girls develop a strong sense of self
- Girls develop positive values
- Girls gain practical life skills
- Girls seek challenges in the world
- Girls develop critical thinking

Connect…

- Girls develop healthy relationships
- Girls promote cooperation and team building
- Girls can resolve conflicts
- Girls advance diversity in a multicultural world
- Girls feel connected to their communities, locally and globally

Take Action…

- Girls can identify community needs
- Girls are resourceful problem solvers
- Girls advocate for themselves and others, locally and globally
- Girls educate and inspire others to act
- Girls feel empowered to make a difference in the world

We are proud that Techbridge's hands-on activities meet many of the Girl Scout Leadership Experience (GSLE) outcomes. Girls gain practical life skills and develop critical thinking abilities as they work through design challenges in our programs-in-a-box. By testing and redesigning their products, working through the **Engineering Design Process**, girls thrive on challenges, conquer doubts, and gain confidence and new perspective.

Girls develop healthy relationships, learn to cooperate, and resolve conflicts as they share, brainstorm, and negotiate in teams and pairs during Girls Go Techbridge activities. To build connectedness with your community, we encourage you to invite role models in engineering to interact with your girls. Remind your guest engineers to share that they are members of the very same community as your girls, and that together we can all be problem-solvers for the issues facing our world.

We hope, through the reflection and active questioning built into the Girls Go Techbridge activities, you will lead your girls to identify community needs, educate and inspire others, and feel empowered to make a difference in the world. While our hands-on-activities are presented in the context of having fun in an informal learning environment, there are real-world applications. With the skills and concepts learned by working through this program-in-a-box, girls gain the tools to make the world a better place.

Our mission at Techbridge is to inspire a girl to change the world. Thank you for sparking the fire for change.

Leader Tips

Tips on Grouping

Throughout the Activities and Icebreakers girls are often asked to work in groups. Below are a few tips to help you get started.

- Before breaking the girls into groups, consider having the girls brainstorm rules or norms for their behavior. They can refer to the Girl Scout Promise and Laws for ideas.
- Consider the relationships between the girls. How well do they know each other? Do they get along? Are some more familiar with the material or topic? This will help you create groups that are well balanced.
- Groups or teams larger than four can present problems for participation and interaction. Suggested group sizes are noted with each activity.
- To give everyone the opportunity to participate, consider assigning roles to each girl within the group. Possible roles include: group leader, reporter, recorder, set-up, clean-up, facilitator, manager. When assigning roles, make sure each girl is aware of the role's responsibilities. If possible across the activities, change it up so that girls are able to experience more than one role.
- Avoid rushing to rescue when a group is stuck, or providing "the answer." Let them discuss and come to their own conclusions. If you are talking, the girls have less time to talk and work together.
- Get involved when the group is hopelessly off task, when the group does not seem to understand enough to get started, when the group is experiencing serious personal conflict, or if the group can't organize themselves.
- To know if your groups are working, as you observe, check to see if the girls are: asking questions, listening to each other, helping each other, and explaining by telling how and why.

Tips on Facilitating Discussions

Discussions are an opportunity for girls to process and extend the different ideas they encounter throughout the activities. Below are a few tips to consider before beginning a discussion.

- Consider the physical set-up in your room. Can the girls see each other?
- Review and enforce the behavioral "norms" or rules established by the group.
- Listen well. Validate questions by either expanding on them or challenging them, and encourage girls to challenge each other in a productive and positive way.
- Allow for wait time when you ask a question. Give girls time to respond. To formulate thorough responses, they need time to process the question.
- Offer different options for participation. Letting girls turn in written responses often helps shyer girls.
- Pause. Give the girls a few minutes to put together a response. Let girls discuss in small groups and then present their thoughts to everyone.
- Prompt girls with a variety of questions that require different levels of thinking.
    * Some questions ask for basic knowledge and comprehension of the activity. For example, What differences exist between...? or Can you name the...?
    * Some questions ask girls to apply or analyze the relationship between different ideas. For example, What factors would you change if...? or What are some of the problems of...?

  * Some require girls to synthesize or evaluate concepts to new or different situations. For example, Can you see a possible solution to…? or How effective are…?
- To know if your discussions are working, check to see if the girls are asking for others' opinions, listening, thinking or reflecting on what has been said, giving reasons for their responses, and allowing everyone to contribute.

Keeping Girls Engaged

Programs-in-a-box are designed to be girl centered. Keeping your activity on track **and** the girls engaged is critical to the success of the activity and will help with learning, retention, and enthusiasm for the other activities. Down time during an activity can lead to girls getting off track. To keep girls engaged, try the following techniques:

- Mental warm up. In addition to using an icebreaker in the program, take a few moments to do a yoga move, a song, or group rhythm using clapping or stomping, etc.
- Know your girls! Who works well together? Who doesn't? Who will struggle with some of the content and who will approach it enthusiastically? Thinking about these different ideas for a few minutes before you begin can help you avoid problems getting started and keeping girls motivated. One of our goals is to promote cooperation and team building.
- Quieting girls down. Have the girls do a quick write, think-pair-share, journal, or draw for a minute. You could also use the Girl Scout tradition of raising your hand and standing silently to get attention. The next person does the same, and it continues until silence spreads throughout the group. The last person not paying attention is soon the only one talking.
- Know your activities. It is vital that you closely read over the activity. When you know what you have to do, there is little confusion and less down time for the girls.
- Ask three then me. This means that the girls ask three peers before coming to you for help. The result is that the girls are more likely to work though a particular problem on their own. They are the ones doing the work—make them accountable.
- Assign girls tasks. Let the girls read the introduction while you set up. Keeping the girls busy and involved in the task allows them to maintain interest and ownership in the activity.
- Heads up! When engaging hesitant or shy girls consider your grouping and let them know a little ahead of time that they will be asked to do something. We want to encourage participation through success!

Tips on Brainstorming

Many girls are familiar with the brainstorming process, but have difficulty getting started or will want to move ahead with the first idea they think of. To encourage girls to generate as many ideas as they can, consider the following tips before you begin.

Begin with the T.E.C.H. guidelines for Brainstorming.

T – Think of many ideas. Write down all ideas, no matter how wild. The more ideas, the better!

E – Everyone's ideas are good. Work as a team and respect every idea. Everyone should participate. Keep the tone positive!

C – Creativity. Be creative and spontaneous. There are no wrong answers and lots of possible solutions.

H – Have an open mind. Consider your own ideas and the ideas of others.

To get their brainstorming going:

- Use a visual. Have the girls examine the materials they'll be using.
- Sketch. Suggest they do rough sketches.
- Think/pair/share. When brainstorming in pairs, have the girls think individually about the topic for a minute, pair with their partner to consider all ideas, and finally share with the group.
- Free writing. Some girls are more comfortable writing their ideas down in a list.
- Clustering/mapping/webbing. This technique focuses on the relationship between different characteristics or traits of the topic.
    * Begin by writing the topic in the middle of a page. From the concept word, write as many related concepts or terms as you can associate with the central topic. If you run out of similar concepts, write down opposites, but try to keep writing and associating. As you jot down ideas, connect them with lines to show how they relate to each other.

Parent Resource Handout

This handout is designed to give parents some tips on how to support and encourage their daughters outside of the program boxes. Please send copies of this *Parent Resource Handout* home.

Encouraging Girls in Science and Engineering

You can make a difference in a girl's future! If you're looking for an activity to do with your daughter, try one that encourages the skills needed in technology, science, and engineering careers. Here are some ideas that build upon the activities in Design Time. They'll give you and your daughter a chance to have fun and may also help spark her interest in becoming an engineer or product designer.

1. Take things apart. If you have an old or broken toy or game around the house, take them apart to see how they work. You and your daughter might even be able to fix them or come up with a design idea to improve upon them.

2. Become an adult coach for the TOYchallenge. Encourage your daughter and her friends or Girl Scout troop to participate in this national challenge and create a new toy or game. This event, which is sponsored by Sally Ride Science, is for teams of 5th through 8th graders. You can learn more and sign up at www.TOYchallenge.com

3. Buy a building kit for your daughter and best yet, work on it with her. K'NEX® and LEGO®s help develop spatial skills and lay a foundation for math concepts. With K'NEX® amusement park kits, your daughter can build her own ferris wheel, musical carousel, and swing ride. Projects like these may set a girl on her way to a career in engineering.

4. Give a girl a biography of a female pioneer in engineering or technology. Many girls are looking for a career that will let them be artistic and express creativity but may not realize how engineering and technology are compatible with such an interest. We recommend ***Robo World, The Story of Robot Designer Cynthia Breazeal*** from the Women's Adventures in Science series available from http://www.nap.edu/catalog/was. Cynthia makes robots that smile and babble like a baby and hopes one day that her sociable robots will benefit people.

5. Jumpstart your daughter's creativity with activities from ZOOM into Engineering. Invite girls from your daughter's Girl Scout troop over for a day of tinkering. Zoom has lots of ideas including toys like a Puff Mobile and Egg Bungee Drop. These activities will get your daughter excited about engineering and may get her thinking about becoming a future toy inventor! For easy-to-follow directions, visit http://pbskids.org/zoom/grownups/engineering/

6. Encourage your daughter to tinker. Allow her the time and space to experiment. If you give her the tools and materials and permission to experiment, you'll be surprised to see what she can come up with.

7. Turn off the TV and spend a day playing board games and puzzles. Look for games that promote problem-solving and spatial skills. Jigsaw puzzles, checkers, chess, tangrams, and Jenga offer a chance to connect with your daughter and will help her develop spatial skills and perseverance.

8. Encourage your daughter to find a club at school or program in the community that will allow her to explore science and technology. Look for a program just for girls where she can work on hands-on projects and develop confidence in her science and technology skills.

9. Help your daughter find a mentor who can answer questions about careers in technology, science, and engineering and offer practical tips on how to get there. Encourage your daughter to explore the workplace by helping her find adults that she can job shadow.

10. Support your daughter's sense of wonder in simple everyday ways. Look at the night skies and identify the constellations, plant a garden and tend it together, and make time to talk about her interests and dreams for the future.

Techbridge

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Planning a Role Model Visit

Hands-on projects can spark an interest in science, technology, or engineering, but on their own they may not lead to a career interest in these fields. Role models can inspire girls and help them make informed decisions about their future.

Interactions with role models require the right combination of career guidance and social engagement. The key is for role models to be personal and passionate while communicating how their work matters.

We encourage you to invite a role model to your program, and plan the visit with her in advance to make it most successful. Rather than give a formal presentation about her working environment and education, or a traditional question-and-answer period, we recommend that your role model lead a hands-on activity that offers a snapshot of her work and a chance to work together creatively, to better engage and inspire your girls.

Finding Role Models:

- Contact your local Girl Scouts STEM coordinator for role model contacts. They may have contacts at organizations such as the Society of Women Engineers that can provide role models in your area.
- Ask your friends and coworkers for leads.
- Check with science teachers who may have contacts.
- Is there an Expanding Your Horizons program in your community? You will find great role models volunteering there who are interested in supporting girls.
- Recruit role models from local businesses (call human resources) or universities (ask for the community engagement office).
- Recruit a diverse group of role models (especially individuals that reflect the diversity of your girls).

Tips for Working With Your Role Model:

1. Share our role model resource guide ***Get Involved…Make a Difference*** and toolkit with suggested activities, questions, and other resources. http://www.techbridgegirls.org/rolemodels.aspx
2. Help your role model start with an icebreaker. We recommend using ***Put Yourself on the Line*** from our online toolkit so the role model can introduce it and then customize questions that relate to her work.
3. Encourage role models to start with a personal story (and even photos) to help them connect with your girls.
4. Invite role models to share their passion for what they do. It's okay to gush about the best parts of the job. When they get excited, your girls will, too.
5. Ask role models to explain why their work is important and how it helps the world.
6. Encourage role models to talk about more than just their job. Invite them to talk about hobbies, family, and friends which will help dispel girls' stereotypes about scientists and engineers.
7. Role models can help by offering guidance such as the importance of taking advanced math and science classes, finding summer classes or internships, and getting good grades.
8. Make sure your girls send thank-you notes to role models. You may start a new pen pal relationship!
9. There is a sample Future Engineer certificate on our website to provide incentive for your girls.

Design Time: Materials

Sessions	Quantity	Consumable Materials	Non-Consumable Materials
1: Design Your Toy	1		CD
	1		string
	1-5		paper clip
	1		ball
	1		skewer
	1-5		rubber band
	10		pencils, 5 sharpened, 5 unsharpened
	5		TECH Brainstorming cards
	1		Engineering Design Process poster
1: Toy Prototyping	20	sticks of clay	
	80	pipe cleaners	
	20	toothpicks	
	1	wire spool	
	5	Toy Prototyping worksheets	
	10		Toy Prototyping reference cards
	10		Toy Designer career cards
	5		TECH Brainstorming cards
	1		Engineering Design Process poster
	10		pencils
	1		pencil sharpener
2: Can You Draw This?	20	Can You Draw This? worksheets	
	10		pencils
	5-10		barriers
	1		pencil sharpener
2: Pencil Bag Design	10	Pencil Bag Design worksheets	
	10	canvas pieces	
	20	buttons	
	30	glue gun sticks	
	1	roll of ribbon	
	10	fabric pieces	
	1	hook and loop tape	
	10	Customer Review cards	
	10		Product Designer career cards
	10		pencils
	1		Engineering Design Process poster
	5		glue guns
	10		scissors
	3		extension cords
	1		set of fabric markers
	1		pencil sharpener

Design Time: Materials

Sessions	Quantity	Consumable Materials	Non-Consumable Materials
3: Daydreaming Careers	10	clay sticks	
	1		Engineering Design Process poster
3: No Cookie Crumbles	10	newspaper sheets	
	10	cardboard squares	
	1	roll of plastic wrap	
	5	plastic baggies	
	1	roll of foil	
	1	roll of wax paper	
	1	roll of duct tape	
	1	roll of masking tape	
	5	labels	
	1		Engineering Design Process poster
	5	Packaging and Testing handouts	
	5		Packaging Material reference handouts
	10		Packaging Engineer career cards
	2		sets of markers
	5		scissors
	1		pie pan
	10		golf balls
	5		rulers
4: Your Career Card	10	blank career cards	
	10		pencils
	2		sets of 5 role model career cards
	2		boxes of permanent markers
4: The Business of Bubbles	10	cups and lids	
	3	Bubble Research worksheets	
	1	roll of paper towels	
	18	plastic cups	
	1	bottle of baby shampoo	
	1	bottle of glycerin	
	1	bottle of dish washing soap	
	3	Mechanical Engineer worksheets	
	38	craft sticks	
	10	feet of wire	
	30	pipe cleaners	
	20	glue gun sticks	
	3	Marketing Specialist worksheets	
	10	chipboard sheets	
	15	sheets of construction paper	

Design Time: Materials

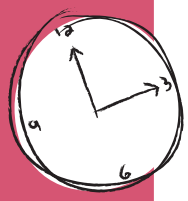
Sessions	Quantity	Consumable Materials	Non-Consumable Materials
4: The Business of Bubbles	1	roll of masking tape	
	1	roll of duct tape	
	3	Product Manager worksheets	
	3	stirring sticks	
	3		plastic jars with lids
	3		bubble wands
	1		Engineering Design Process poster
	3		Chemical Engineer career cards
	3		set of measuring cups and spoons
	10		pencils
	3		Mechanical Engineer career cards
	3		extension cords
	5		scissors
	5		glue guns
	3		Product Manager career cards
	3		Marketing Specialist career cards
	3		box of permanent markers

The following Items are not provided in the box

Sessions	Quantity	Required Materials	Optional Materials
1: Design Your Toy	10	sheets of scratch paper	
1: Toy Prototyping	10	sheets of scratch paper	
2: Pencil Bag Design	optional		key chain loops
	optional		binder clips
	optional		assorted fasteners
3: No Cookie Crumbles	10	cookies	
	5	textbooks	
		water	
4: The Business of Bubbles		water	
		newspaper or plastic tablecloths	
	optional	clipboards	
	optional		ribbon
	optional		foam sheets or shapes
	optional		key rings
	optional		straws
	optional		stickers
	optional		glitter, sequins, other decoration

Design Your Toy

10 Minutes



Materials:

Per Pair

- 2 toy brainstorming items (CD, string, paper clip, ball, skewer, rubber band, pencil)
- 1 sharpened pencil
- 1 TECH Brainstorming card
- 2 sheets of scratch paper (not included)

Per Group of 10

- Engineering Design Process poster

Grouping: 2 - 3 Girls

Introduction: In this activity, girls take ordinary objects and brainstorm how these objects can be turned into a toy. Brainstorming is important for generating new ideas and getting multiple perspectives as part of the creative process.

Objectives: As a result of this activity, the girls will be able to:

- Explain the rules of brainstorming
- Use brainstorming to generate ideas

Opening:

1. Girls will explore the process of designing toys for kids in this activity. They will brainstorm toy ideas they can make with everyday items.

Brainstorm:

2. **Divide** girls into groups of two or three. Ask them if they have brainstormed before.
    - What does brainstorming look like?
    - What rules should we follow when brainstorming?
3. **Distribute** one *TECH Brainstorming* card to each group and then discuss the "TECH" rules of brainstorming.
4. **Distribute** two toy brainstorming items to each group.
5. **Designate** a recorder for each group. This person will jot down all the ideas as they are called out. Give each recorder a pencil and two sheets of scratch paper.
6. **Tell** the group they have five minutes to write down ways to play with the objects or make them into toys.
7. **Stop** the group after five minutes. Ask the recorder to read the five favorite ideas from the list her group came up with.
8. **Ask** the girls about their experience during the activity.
    - Did you feel that your ideas were being heard? Did you feel comfortable elaborating on somebody else's ideas?

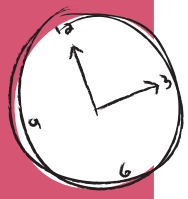
Design Your Toy

- Why do you think brainstorming is important? *(Brainstorming is important for generating new ideas and getting multiple perspectives as part of the creative process.)*
- How would brainstorming help you if you needed to come up with a new product or solve a problem?

The Techbridge TECH Brainstorming card features our suggested rules for generating ideas in a group.

Toy Prototyping

70 Minutes



Materials:

Per Pair

- 2 Toy Prototyping reference cards
- 2 Toy Designer career cards
- 1 Toy Prototyping worksheet
- 1 TECH Brainstorming card
- 4 sticks of clay
- 2 pencils
- 2 sheets of scratch paper (not included)

Per Group of 10

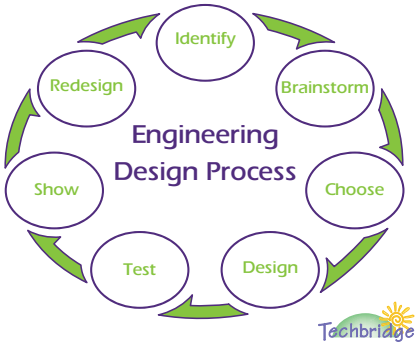
- 80 pipe cleaners
- 1 pencil sharpener
- 20 toothpicks
- 1 wire spool
- 1 Engineering Design Process poster

Grouping: Pairs

Introduction: In this activity, girls will analyze information on the appropriateness of toys for children of various ages. They will use this information to brainstorm and build two identical toy prototypes. Each girl may take a prototype home to share with their family.

Objectives: As a result of this activity, the girls will be able to:

- Use the **Engineering Design Process**
- Explain the importance of developing a product for a specific age group
- Create a prototype
- Explain what a **Toy Designer** does



Science Behind It:

A prototype is a non-functioning example or model that does not work. Prototypes are used to see what a final product will look like and feel like. Creating a prototype is the fifth step in the **Engineering Design Process**. After researching and brainstorming ideas for different toys, designers choose some of their best ideas and make three-dimensional prototypes. Prototyping is an essential step that is repeated many times before the final product is produced for store shelves. They are shared with coworkers, managers, and others for feedback before being approved for mass production.

Toy Designers come with different backgrounds, but many have studied graphic art or industrial design. **Toy Design** requires understanding of computers, mechanics, and materials, including different fabrics, plastics, and metals. For video game designers, computer skills are essential.

Rapid prototyping is a growing field in science that takes computer-aided designs or animations, and uses special manufacturing to create models out of layers of material. Engineers often use software like Revit, AutoCad and SolidWorks to draw and print out 3-D prototypes on rapid prototyping machines. This process creates models made of plastic or crystals, some with movable parts.

Toy Prototyping

Opening (10 minutes):

1. **Introduce** the idea that the girls will design a toy with a partner for a new toy company. They will use the Engineering Design Process to create two identical prototypes of their toy idea and present their design to the rest of the company for approval.

2. **Divide** the girls into pairs. Review what a prototype is.

   - ❍ What is a prototype? *(A prototype is a non-functioning model of a product. It does not have to be perfect and it does not have to work.)*
   - ❍ How do people use prototypes? *(Prototypes are used to see how a final product will look and feel.)*

3. **Tell** the girls they will be designing two toy prototypes that have moving, mechanical parts. Explain to the girls that since they are making a prototype, their toy will not actually move or function.

4. **Display** the **Engineering Design Process** poster and give the girls a chance to look at it. Read through each step as a group before moving on. Throughout the *Design Time* program, the girls will refer to the poster.

5. **Give** each girl a **Toy Designer** career card to read silently. After reading the career card, discuss what they read in a large group.

   - ❍ Who is Janese?
   - ❍ Describe what Janese does at work.
   - ❍ What will you be doing in this activity? *(Be sure to read the back of Janese's card.)*

6. **Hand out** the *Toy Prototyping* reference card that reviews development traits of children and toys catered to that age. Have the girls pick an age group they want to design their toys for.

   - 3 to 5 years - pre-school
   - 6 to 8 years - school age

7. **Ask** the girls to explain their age group choices.

   - ❍ Why does this age appeal to you?
   - ❍ What do kids that age like to play with?
   - ❍ What do you hope kids will gain from using your toy? Is it educational? What does it teach?

Recommendations:

Break up teams from the **Design Your Toy** icebreaker into pairs for this activity.

TECH Brainstorming

T → **Think** of many ideas
E → **Everyone's** ideas are good
C → **Creativity**
H → **Have** an open mind

Brainstorm (10 minutes):

8. **Distribute** a *TECH Brainstorm* card. There are several ways for the girls to brainstorm and come up with their new toy. Clarify that this toy must be a novel idea that is not currently on the toy market. (For example, the girls should not be creating a "Talking Cookie Monster" because it is almost the exact same idea as a "Talking Elmo.") In order to help the girls come up with a new, unique, novel toy, give each group scratch paper and pencils and encourage them to use the following methods for brainstorming.

- Brainstorm as many toys as they can think of that may have mechanical parts
- Mix and match different parts of those toys to create new toys
- Have the girls think back to fun toys from their childhood

9. **Review** the brainstorm list and choose a toy idea to prototype.

Remind the girls to use the TECH method of brainstorming and encourage them to come up with as many new toys as possible.

Hands-On (35 minutes):

10. **Hand out** the *Toy Prototyping* worksheet to each pair. The girls will need to draw and label major parts of their toy. Each pair should check-in with their leader and get their toy design approved before starting to build their prototypes.

11. **Distribute** the clay, pipe cleaners and toothpicks to pairs that are ready to build. Girls should refer to their drawings and worksheets when they build their toys. Emphasize to the girls that their toy will not move or work since it is just a prototype. The pairs should discuss the following questions to prepare for their presentation:

    - ❍ Why is your toy a good fit for your age group?
    - ❍ What the different mechanical parts in your toy?

12. **Present** the prototypes and explain the functions of the toy to the company. If time allows, have each group come up with a commercial to help "sell" their toy to the group. Here is some information that girls may include in their commercial:

    - Name of toy
    - Tag line or catchphrase to market or grab their audience's attention
    - Cost of toy
    - Reason why it's better than other toys offered in the market for the suggested age group

Reflection (15 minutes):

13. **Discuss** with the girls how they felt about the activity and review what steps of the **Engineering Design Process** they used. Use the following reflection questions to lead the discussion.

    ❍ What was challenging about this activity?

    ❍ How easy is it to come up with a new toy? What type of research could you have done to help you think of more ideas for new toys?

    ❍ How similar is your prototype to the final product that you imagined?

    ❍ What similar challenges do you think toy designers have at work?

    ❍ If you could redesign your toy, what would you do differently? What if you had more time or different materials?

    ❍ How do you think your experience compares to being a toy designer like Janese?

Activity Extensions:

Try out these extensions to expand on what the girls have learned about prototypes, the design process and other creation technologies.

1. See if your local community college has a lab with design software and printers that your girls can visit.

2. Try spore.com to make a monster of your own creation. The free trial of Creature Creator is available. You can e-mail or upload your spore to www.sporesculptor.com to purchase a plaster composite model.

3. Buy used toys with mechanical parts from second hand stores to take apart and see how they work. If you buy electric toys, be sure to cut off the power cord before dismantling.

Toy Prototyping Reference Card

Techbridge

Toys for all Ages

3 to 5 years

Three to five-year-olds love to play with toys that make imagination play more fun. Imaginary play helps develop language and social skills. Toys for this age include read-aloud books, blocks, dress-up clothes, and simple games that teach colors, letters, and numbers.

6 through 8 years

Primary-school age children are interested in skill-building toys. They can spend hours with art and crafts materials, particularly washable paints, clay, collage materials, and small beads for jewelry making. Books and more complex games with rules and turn-taking are also appropriate, and natural objects (stones and shells) can encourage an interest in science and the environment.

Source: http://www.kidsource.com/parenting/early.gift.html

Design Time

Toy Prototyping Reference Card

Techbridge

Toys for all Ages

3 to 5 years

Three to five-year-olds love to play with toys that make imagination play more fun. Imaginary play helps develop language and social skills. Toys for this age include read-aloud books, blocks, dress-up clothes, and simple games that teach colors, letters, and numbers.

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Source: http://www.kidsource.com/parenting/early.gift.html

Design Time

Toy Prototyping Worksheet

Techbridge

Group Member Names:
Toy Name:
What age is this intended for?
In this space, draw what your toy will look like. Label all moving parts of your toy. (Example: wheels, gears, moving legs, etc.)
How is this toy different from, and better than, similar toys that are currently sold at toy stores?
Are there safety concerns with the toy?

Design Time

Toy Designer

Toy Designers are creative people who use their imagination to create a new toy or game. They may study graphic arts and computers to help them design their inventions. They don't let challenges keep them from working on their ideas, so they tinker and try until they succeed. They protect their ideas by getting a patent for their invention.

As a **Toy Designer** you might make a video game that appeals to girls, or an interactive toy to entertain your dog. You could make a portable video game that's inexpensive so that every kid can have one. The average annual salary is about $61,400 which is about $29.50 per hour.

Janese Swanson
Degree in Computer Science

Janese's Biography:

As a child I had a knack for fixing broken appliances and tinkering with electronics. I wasn't encouraged in science or technology as a girl, and had jobs in modeling, teaching, and sales. Eventually I found my true calling and founded my own company, Girl Tech, which makes toys that encourage girls to use technology. Today, I teach technology to children and teachers.

How to do it:

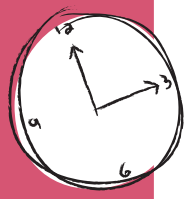
To become a **Toy Designer** like Janese, be sure you take advanced math and science classes like trigonometry and physics at your school. Classes in design or drafting are helpful too. Consider taking computer science, psychology and child development classes in college.

Colleges and universities want to see your commitment to extracurricular activities too. Try working with kids as a summer camp instructor, baby-sitter, tutor, or at a retail toy store.

You and your partner are **Toy Designers**. Decide which age group you want to focus on, then design a new, never-been-seen toy for them. Start by brainstorming a few different ideas, then pick the best idea, and build a prototype. Remember to use the TECH Brainstorming rules to help you!

Can You Draw This?

20 Minutes



Materials:

Per Pair

- 4 Can You Draw This? worksheets
- 2 pencils
- 2 barriers

Per Group of 10

- 1 pencil sharpener

Grouping: Pairs

If you have an odd number, have a leader partner with one of the girls.

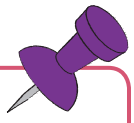
Introduction: In this activity, girls will make a simple drawing and direct their partner to recreate it by giving only verbal directions.

Objectives: As a result of this activity, the girls will be able to:

- Explain the importance of clear, concise instructions
- Practice good communication skills

Directions:

1. **Divide** the group into pairs. It's best if each pair can sit across from each other.
2. **Place** a barrier between the girls and give each pair four copies of the *Can You Draw This?* worksheet.
3. **Show** girls the example drawing on the opposite page and explain to the girls that they will need to draw a simple geometric drawing, similar to the example you are showing them, for their partner to recreate. It is very important that they do NOT let their partner see their drawing. Emphasize that their drawing can be one simple shape that does not take up the entire area.
4. **Describe.** Once all the girls are done with their drawings, have one partner describe her drawing first. The other partner should listen carefully and try to replicate the drawing on a blank worksheet as accurately as possible.
5. **Compare** the original with the new drawing and see how accurate the re-creation was. Then have the partners switch roles.
6. **Facilitate** a discussion using the following questions. After the discussion, explain to the girls that these skills will be critical for the next activity in which they will create a product specific to someone's needs.
   - ❍ Was it difficult giving clear instructions? Was it difficult listening?
   - ❍ Did you have any problems communicating with your partner? If you did, what were the problems?
   - ❍ What things that you and your partner did were helpful? What wasn't helpful?
   - ❍ Why might these skills be important for other activities?

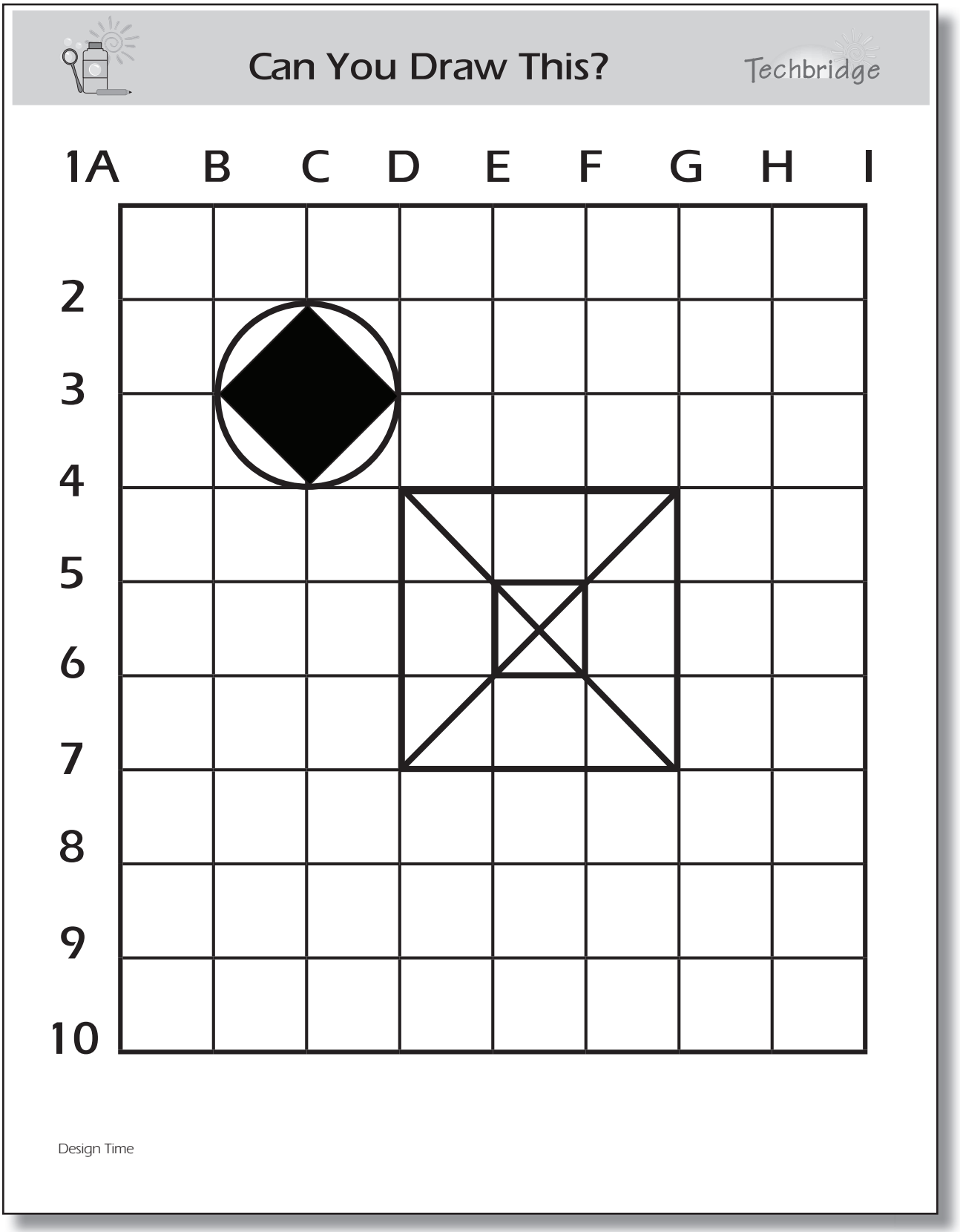


Note:

This activity is adapted from Tribes: A New Way of Learning and Being Together by Jeanne Gibbs.

Can You Draw This?

Example



Can You Draw This?

Techbridge

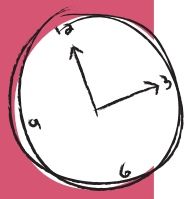
	1A	B	C	D	E	F	G	H	I
2									
3									
4									
5									
6									
7									
8									
9									
10									

Design Time

Pencil Bag Design

70 Minutes

+ 5 minutes preparation time



Materials:

Per Pair

- 2 Pencil Bag Design worksheets
- 2 Product Designer career cards
- 2 Customer Review cards
- 2 canvas pieces
- 2 pencils

Per Group of 10

- 1 Engineering Design Process poster
- 20 buttons
- 5 glue guns
- 30 hot glue sticks
- 1 roll ribbon
- 10 scissors
- 10 fabric pieces
- 5 ft. hook and loop tape
- 3 extension cords
- 1 set fabric markers
- 1 pencil sharpener

Optional

- key chain loops (not included)
- binder clips (not included)
- other fasteners (not included)

Grouping: Pairs

Introduction: In this activity, girls will take on the role of a **Product Designer** and design a pencil bag to fit the specifications given by their partner.

Objectives: As a result of this activity, the girls will be able to:

- Use the **Engineering Design Process**
- Create a product specific to a client's needs
- Practice communication skills
- Explain what a **Product Designer** does

Science Behind It:

Communication is a crucial aspect of design. A designer must keep the customer's needs and preferences in mind. In this activity, girls use all steps in the **Engineering Design Process** to create a one-of-a-kind product. As designers, they identify the need for a pencil bag and interview (research) their client about their needs. They brainstorm a few different ideas and may change their initial design after starting to make the bag. After drafting their pencil bag prototype, the girls experience a review process with their clients. Based on their clients' thoughts, they may redesign their products.

The pencil bag activity combines the idea of a prototype with practicing the steps of the **Engineering Design Process.** Lots of companies and laboratories have Research and Development (R&D) departments to brainstorm, test, and revise products, technologies, and ideas—just like your girls will do today.

Preparation:

- **Display** all of the materials available for creating and modifying the bags so that it is easy for the girls to see and decide what to use.
- **Review** the **Engineering Design Process** poster.

Pencil Bag Design

Opening (5 minutes):

1. **Tell** the girls that they will role play as **Product Designers** and clients. As clients they will specify what they want in a pencil bag. As designers they will design a pencil bag that follows their client's specifications.

Brainstorm (10 minutes):

2. **Review** the **Engineering Design Process** poster. The girls should be familiar with the poster from the *Toy Prototyping* activity. Clarify that girls will need to focus on the **Engineering Design Process,** and not get caught up in decorating.

    - ❍ What is the **Engineering Design Process**?
    - ❍ Which steps do you think will be important in this activity?

3. **Emphasize** steps one through seven of the **Engineering Design Process** poster. The girls will be using these steps to make a pencil bag prototype for their client.

4. **Distribute** the **Product Designer** career card to each pair. Have the girls read through the career card, including the back. The back side explains what their specific tasks are for the day.

    - ❍ Who is Heather?
    - ❍ What does Heather do at work?
    - ❍ What will you be doing in this activity?

Hands-On (45 minutes):

5. **Hand** each girl a *Pencil Bag Design* worksheet.

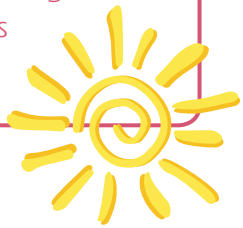
6. **Interview.** Each girl will interview her partner about her ideal pencil bag and use the *Pencil Bag Design* worksheet to ask specific questions relating to closures and other functions.

7. **Sketch.** As designers, girls will also need to sketch a picture of the pencil bag for their partner. Encourage girls to use the back of the *Pencil Bag Design* worksheet if they need more space for their drawing.

8. **Separate.** Once all of the designers and the clients have had a chance to discuss the important elements of their bags, split the partners up so they are not sitting at the same table. This is important because the girls should not give continual feedback.

Recommendations:

Use the same pairing from the **Can You Draw This?** icebreaker for this activity. This will allow girls to build upon the communication skills they exercised during the icebreaker.



Pencil Bag Design

9. **Hand out** a piece of canvas to each girl and ask her to prototype the pencil bag that she has sketched for her partner. She may also use the other materials provided.

10. **Emphasize** the **Product Design** aspect of this activity and not let the girls get carried away with decorating. The girls should understand that the **Engineering Design Process** can be very helpful when creating a product for a specific person and need.

    - ❍ What were your client's specifications?
    - ❍ How are you integrating them in your design?

Note:
The girls will be using glue guns. Stress that they get VERY hot and the glue can burn. You may want to lay paper to avoid getting hot glue on tables. Use craft sticks to press down the glue rather than your finger to help prevent burns.

11. **Allow** thirty minutes for designing, then have the girls show their partners the bag they designed for them.

12. **Interview.** Have designers re-interview their client on their prototype and discuss changes that their partner wants.

13. **Allow** them fifteen more minutes to continue working on the bag for their partner.

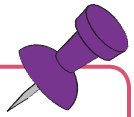
14. **Present** the innovative pencil bag design to the client. Have clients fill out the *Customer Review* card. Designers and clients should discuss their answers. Encourage the girls to critique the product changes since their original meeting. Were those changes closer or farther from what the client wanted? This review should help designers think about the **Engineering Design Process,** and meeting clients' needs rather than their own.

Reflection (10 minutes):

15. **Discuss,** as a large group, how girls felt as the designer and as the client. Use these reflection questions to help you with the discussion.

    - ❍ What was it like to design something for someone else?
    - ❍ Which questions were most helpful during the interview?
    - ❍ Why is communication so important when working with a client?
    - ❍ Explain which steps of the **Engineering Design Process** you used during today's activity. Which step did you think was the most important? Why?
    - ❍ How do you think your experience compares to being a real **Product Designer** like Heather?

16. **Take home.** The client can take this bag home to keep and enjoy.



Note:
This activity is adapted from an activity introduced by role model Heather Fleming, founder and CEO of Catapult Design.

Pencil Bag Design Worksheet

Techbridge

Interview your client by asking the questions below. Use the back of this worksheet to add your own questions, take additional notes, or sketch a larger prototype.

Client: _____

Product Designer: _____

Ask the client:

I would like the pencil bag to have:

1. _____
2. _____
3. _____

I don't want the pencil bag to have:

1. _____
2. _____
3. _____

1. Would you like the bag to have a pocket? If so, what will you put into this pocket?

2. How would you like the bag to close?

3. What do you want your pencil bag to look like? Will you carry anything other than pencils in your bag?

4. Do you want anything written on your bag?

Before beginning any work on the bag, sketch a prototype below and ask your client for feedback.

Design Time

Pencil Bag Design
Customer Review Card

Techbridge

Client: _____

Product Designer: _____

Now that you have your pencil bag, review it to see if your Product Designer followed your specifications. Talk to your Product Designer after filling out this card and discuss your answers.

1. Does your pencil bag look like what you asked for?

2. Does the closure (hook and loop, button, etc.) work correctly?

3. What do you like the most? What you would change?

Pencil Bag Design
Customer Review Card

Techbridge

Client: _____

Product Designer: _____

Now that you have your pencil bag, review it to see if your Product Designer followed your specifications. Talk to your Product Designer after filling out this card and discuss your answers.

1. Does your pencil bag look like what you asked for?

2. Does the closure (hook and loop, button, etc.) work correctly?

3. What do you like the most? What you would change?

Career Card

Product Designer

Product Designers have talent for design. They combine art, science, and technology to make the products we use at home, at school and at play. They often use engineering skills to help them create a product that people want to use and buy. **Product Designers** have good "people skills" and spend time listening to what people want and watching how they use products.

As a **Product Designer** you might make a car seat for pets or a toothbrush that kids like to use. Or you might design an electronic toy that lets girls exchange notes. The average annual salary is about $61,400 which is about $29.50 per hour.

Heather Fleming
Degree in Mechanical Engineering

Heather's Biography:

I grew up in a small town in New Mexico with lots of animals and a sister to keep me company in the country.

I started my company, Catapult Design, where I do product design for the developing world. The best part of my job is traveling and experiencing new cultures. I also like that the work I do makes a difference in people's lives. I volunteer with Engineers Without Borders and made a wind turbine for a village in Guatemala.

How to do it:

To become a **Product Designer** like Heather, be sure you take advanced math and science classes like trigonometry, calculus, physics, and biology at your high school.

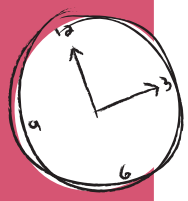
Try joining different clubs that concentrate in art or design. Take classes like psychology or sociology. Try volunteering at places like nursing homes or service providing centers. Find out about local internships in graphic design firms.

You and your partner will switch roles as **Product Designer** and client. As the designer, interview your client and fill out the Bag Design worksheet getting all the details on what she wants for her pencil bag. Your client will specify how she wants her bag to function. Then, switch roles with your partner.

Note: You will meet with your client after finishing the pencil bag and she will fill out a Customer Review card on how well you followed her instructions.

Daydreaming Careers

20 Minutes



Materials:

Per Girl

- 1 clay stick

Grouping: Whole Group

Introduction: In this activity, girls will mold a piece of clay into an object that represents their dream career and consider steps toward their goal.

Objectives: As a result of this activity the girls will be able to:

- Imagine future career ideas

Brainstorm (10 minutes):

1. **Lead** a discussion about careers. Facilitate idea generation by suggesting careers that your girls may not have thought about or may seem out of reach. You can facilitate discussion by asking girls to brainstorm answers to these questions:
   - Is there a difference between a job and a career?
   - What kinds of careers would you like to have?
   - What are some careers you wouldn't want to have?
   - What is appealing about these careers? What is not appealing about them?
2. **Tell** students the goal of this activity is "To open your mind to all of the possibilities your future holds." If you have instrumental, relaxing music to play, it might enhance the daydreaming ambiance.

Hands-On (10 minutes)

3. **Hand** each girl a stick of clay and ask girls to create an object that represents their dream career with the clay.
4. **Share** the objects made with the whole group. Use the following questions to facilitate the discussion:
   - Why did you choose to make that object? How does the object represent your dream career?
   - What skills do you need for this careers? Which of these skills do you already have?
5. **Encourage** girls to save their creations from this lesson. Girls can take their project home as a reminder of what is possible.

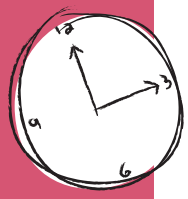
Note:

If a girl has no idea what she wants to be, ask her to take a career card from this program-in-a-box and interpret it in clay.

No Cookie Crumbles

70 Minutes

+ 15 minutes preparation time



Materials:

Per Pair

- 1 Packaging and Testing handout
- 1 Packaging Material reference handout
- 2 Packaging Engineer career cards per girl

Per Group of 10

- newspaper
- cardboard
- plastic wrap
- plastic baggies
- foil
- wax paper
- markers
- duct tape
- scissors
- masking tape
- pie pan
- ribbon
- golf balls
- ruler
- labels

Not Included

- cookies (we suggest vanilla wafers, graham crackers, or Girl Scout cookies)
- 5 textbooks
- water

Grouping: Pairs

Or individuals if supplies and time allow.

Introduction: In this activity, girls will investigate how to properly package a cookie. They will test their packaging for sturdiness and resistance to weight, movement, and water.

Objectives: As a result of this activity, the girls will be able to:

- Use the **Engineering Design Process**
- Design a package that is attractive for a consumer
- Design a shipping package that can withstand stress tests
- Explain what a **Packaging Engineer** does

Science Behind It:

A **Packaging Engineer** designs packages and containers for things like food, clothing, electronics and toys. They often work with people in labs, and consider cost and durability when designing their packaging.

This activity stresses the sixth step in the **Engineering Design Process**. After brainstorming and drafting the packaging, the tests assess whether the packaging can withstand normal stresses it might encounter on its way to the store or in handling by a consumer.

A drop test demonstrates what might happen if the package fell from a great height. The shake test represents what products endure when being transported on a truck. The weight test duplicates the weight that might be placed on top of the package. The throw test ensures a product may survive being mishandled or thrown. The water test duplicates stress the package might suffer after a rain storm or other water contact.

Preparation:

- **Have** one cookie in a baggie ready for each pair.
- **Review** the stress tests the girls will be using on their cookie packaging. For the shake test, place the golf balls in the pie pan.

- **Cut** the plastic wrap, wax paper, and foil into 12" x 6" rectangles.
- **Mark** a 6 foot high spot on the wall with tape and make sure you have access to water.

Opening (5 minutes):

1. **Inform** the girls that they will explore the packaging industry by creating the packaging materials for a cookie. They will test their designs in five stress tests that simulate actual stress tests **Packaging Engineers** use.

Brainstorm (10 minutes):

2. **Group** the girls into pairs and pass out a **Packaging Engineer** career card. Explain to girls that they will take on the role of a **Packaging Engineer**. Have the girls read through the career card, including the back. The back side explains what their specific tasks are for the day.

    - ❍ Who is Ann?
    - ❍ What does Ann do at work?
    - ❍ What will you be doing in this activity?

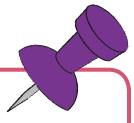
3. **Review** the available materials with the girls, emphasizing the strengths, costs and environmental considerations of each material. Refer to the *Packaging Material* reference handout. Each team will need to stay within a $4.00 budget. They also earn points for their cookie baggie's appearance after the stress tests. Discuss the following questions:

    - ❍ What materials would be the most affected by the water test? The throw test?
    - ❍ Do you think looks or cost are more important? Why?
    - ❍ Why is being environmentally friendly so important?

Hands-On (45 minutes):

4. **Distribute** the *Packaging and Testing* handout to each pair. Each group should finish filling out the first two pages before moving on to the building. Girls can design an attractive label with ribbon, markers, and labels for the plastic baggie holding their cookies. Check in with each group to be sure they think about the following:

    - ❍ Who will buy your cookie? Kids or adults?
    - ❍ Does your cookie baggie fit in your shipping box?



Note:

You may want to save packing peanuts and bubble wrap for girls to use. These are optional materials on their packaging material list and they are not included in the box.

- ❍ Is the price of your materials within budget? Why is it necessary to work on budget?
- ❍ What materials can you replace or change to make your packaging better?

5. **Review** the girls' budget with a leader, and allow them to get their materials. If their budget is over $4.00, have them go back to the drawing board. Allow at least fifteen minutes for filling out the handout.

6. **Allow** thirty minutes for designing and building their cookie baggie label and shipping box.

7. **Test** the finished package. Label each pair's package with their names. Switch packages and worksheets amongst the pairs. This way each pair is testing a different package then their own. This will ensure no pair goes easy during testing. The display package (cookie baggie) should be inside the shipping package before beginning testing. For each group, complete the following tests in the following order:

   - Drop Test: Drop from six feet, five times.
   - Shake Table Test: Shake the package for thirty seconds.
   - Weight Test: Place five text books on the package for fifteen seconds.
   - Throw Test: Throw against a wall.
   - Water Test: Pour a cup of water over the package.

8. **Turn** the package over after each test. If there are tears or if the package is beginning to come apart, deduct points from the pair's score. After all tests are done, have each pair open the shipping package they are testing to score how well it did overall. Have them score questions six and seven from the testing worksheet. Girls that used recycled materials can also get extra points (question eight). Have each team add up their final scores.

Reflection (10 minutes):

9. **Return** the packages and worksheets to the original designers. As a large group, discuss the final outcomes of the stress tests.

   - ❍ What materials worked best for shipping?
   - ❍ When you were designing, was cost more important or was making your shipping box better quality more important? Why?
   - ❍ How similar or different do you think this process is for major companies like Kellogg's or Nabisco?
   - ❍ How would you redesign after testing and seeing other's designs?
   - ❍ Why was the **Engineering Design Process** important in this activity?
   - ❍ How do you think your experience compares to being a real **Packaging Engineer** like Ann?

Note:

This activity is adapted from the 2009 WEPAN conference's presentations by Purdue and Ohio State Universities.

Package Engineer Worksheet

Techbridge

Each material you use will have a cost associated with it. The more materials you use, the more expensive your package is. You may use up to $4.00 for **both** packages, but you want the lowest cost for your two packages.

Material	Cost per item	Quantity	Total amount per item
Plastic baggies	$0.25 per bag		
Ribbon (4" piece)	$0.50		
Stickers/ Labels	$0.25 each		

Display Package Cost: $_____

In the space below, draw what your **display package** (label for cookie baggie) will look like. Remember, what you design in this space is what somebody would see if they were in the store or cookie booth.

Package Engineer Worksheet

Techbridge

Now it is time to design your shipping package. You have $4.00 total for both packages, so figure out how much money you have left for your shipping package:

Total budget	$4.00
- Display package cost	-$_____
Budget for shipping package	**$_____**

Material	Cost per item	Quantity	Total amount per item
Recyclable newspaper (1 sheet)	$0.25 per sheet		
Cardboard square	$1.00 each		
Plastic wrap (12" x 6")	$0.75		
Plastic baggies	$0.25 each		
Foil (12" x 6")	$0.75		
Wax paper (12" x 6")	$0.50		
Duct tape (1" piece)	$0.50		
Masking tape (1" piece)	$0.25		
Optional			
Packing peanuts (5)	$0.25		
Bubble wrap (12" x 6")	$1.00		

Shipping Package Cost: $_____

In the following space, design what your **shipping package** will look like. Label what materials you are planning to use. Remember your cookies travel across the country!

Shipping Package Cost + Display Package Cost = Total Cost for Packaging:

$_____ + $_____ = $_____

Package Engineer Worksheet

Techbridge

Use this worksheet to keep track of how well your display baggie and shipping package hold up after each stress test. Be sure your display package (cookie baggie) is inside your shipping package before beginning any tests.

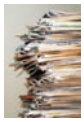
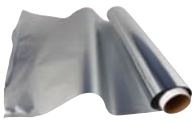
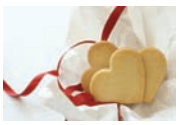
Score your package after each test. You will open your package after all tests are done.

1. Drop Test (from 6 feet), 5 times No Damage: 3pts. Little Damage: 2 pts. Lots of Damage: 1 pt. Your Score: _____	5. Water Test (Pour 1 cup of water) No Damage: 3pts. Little Damage: 2 pts. Lots of Damage: 1 pt. Your Score: _____
2. Shake Test (for 30 seconds) No Damage: 3pts. Little Damage: 2 pts. Lots of Damage: 1 pt. Your Score: _____	6. Marketing Test: How presentable is your display baggie after all testing? Very Presentable: 3pts. Presentable: 2 pts. Not Presentable: 1 pt. Your Score: _____
3. Weight Test (5 books for 15 seconds) No Damage: 3pts. Little Damage: 2 pts. Lots of Damage: 1 pt. Your Score: _____	7. Crumble Test: What does your cookie look like? No Damage: 3pts. Little Damage: 2 pts. Lots of Damage: 1 pt. Your Score: _____
4. Throw Test (throw against a wall) No Damage: 3pts. Little Damage: 2 pts. Lots of Damage: 1 pt. Your Score: _____	8. Bonus: Environmental Considerations in Design Used/recycled materials: 3pts. Cost under $3.50: 2 pts. Your Score: _____

Your Total Score: _____

The winner of the challenge is the box with the highest score and the lowest cost. In the real world, this is an example of cost-benefit analysis. Is the extra cost of additional packing materials worth it? Could your cookie withstand less expensive packing?

Package Engineer Reference Guide

Material		Description
	Newspaper	Newspaper is a cheap option to ship something. When you shred or crunch it together, it gives your packaging some cushioning. Newspaper is 100% recyclable. However, if this material gets wet, it may not be sturdy.
	Cardboard	Cardboard is a very common shipping material because corrugated (with ribbing inside) cardboard is sturdy. Cardboard boxes are often used to package many things from cereal boxes to heavy objects. Cardboard can be hard to shape, and does get soggy when wet.
	Plastic wrap	Plastic wrap is commonly used to store food. One advantage to using plastic wrap is that it sticks to itself, giving you a tight seal. It doesn't provide much cushioning unless you wrap the object several times in lots of plastic wrap. This material will remain in landfills for hundreds of years.
	Plastic baggies	Plastic bags keep things air tight and are waterproof. Some bags can be used during freezing. The bags can be sealed with lots of air inside the bag. Other than air, the bags offer no padding or cushioning for the objects inside. Plastic, when thrown away, takes a very long time to break down.
	Foil	Foil is great for storing and packaging food. Foil keeps out moisture, light, and even bacteria. Because foil is very thin, it can rip easily. Because it's made of aluminum, foil can be easily recycled, often with aluminum drink cans.
	Wax paper	This paper has a coating of wax. It is considered water proof, but perhaps not as much as plastic. It is used for storing food, but should not be used in instances of high heat. It is more biodegradable than plastic, but not as much as newspaper.
Optional Materials:		
	Packing peanuts	Packing peanuts are commonly used for packaging and cushioning. These peanuts help protect fragile objects. The "peanut" looking shape allows for the materials to interlock when they are compressed. When the material is not compressed the peanuts move loosely. Biodegradable peanuts are made from corn, and will break down naturally over time in a compost or landfill. Styrofoam peanuts take hundreds of years to disintegrate, and are made using fossil fuels.
	Bubble wrap	Bubble wrap is a flexible material made of plastic. It is often used to wrap fragile things like glass or porcelain. The bubbles are made from air trapped within the plastic. This material is good for cushioning all kinds of objects. However, plastic is made from fossil fuel and takes hundreds of years to break down in a landfill.

Packaging Engineer

Packaging Engineers combine engineering, design, and marketing all into one career. As a **Packaging Engineer** you work with many different people and you can work in many different industries. You use your creativity and problem solving skills to develop packaging for products so they stay in mint condition for customers to buy, attract them to the product and keep contents contained. Having good communication skills is very important.

As a **Packaging Engineer** you might test new packaging materials for food to see if it would survive a long truck drive or rainy weather. The average annual salary is $51,391 annually which is about $24.70 per hour.

Ann Cheng
Degree in Applied Science

Ann's Biography:

When I was in middle school I knew I wanted to work in science. I enjoyed science class, and loved to learn about new things. I took a college tour in high school of the School of Engineering and when I toured the Packaging Lab I was fascinated that it was a profession.

At my job I write specifications (design rules) for packaging materials, test them and talk to suppliers about new ideas. I also get to work with our sales and marketing team to develop new products and packaging ideas.

How to do it:

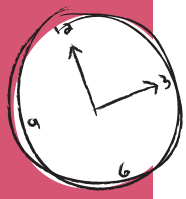
To become a **Packaging Engineer** like Ann take classes like physics, economics, and higher math.

Ann suggests you take a variety of classes in college so you can identify what you really have a passion for. Look for opportunities to job shadow someone in the field you are interested. Too many times you may be interested in a certain field only to find out that your imagined career path is much different in reality!

You will be a **Packaging Engineer** today. Your job is to help design the packaging for cookies so they can survive a drop test, a water test, a shake test, a weight test and a marketing test. You must first calculate the cost of the packaging and stay under a $4 budget. You will then build your packaging. Be sure you come up with a great name for your cookie product, and that your packaging stays presentable through all the stress tests.

Your Career Card

20 Minutes



Materials:

Per Girl

- 1 blank career card
- 1 pencil

Per Group of 10

- 2 sets of 5 role model career cards
- 2 boxes of permanent markers

Grouping: Individual

Introduction: In this activity, girls will think about their futures and create a role model career card about themselves.

Objectives: As a result of this activity, the girls will be able to:

- Illustrate future career plans
- Consider career options

Preparation:

- **Optional.** Take and print headshot photos of your girls ahead of time and attach them to the cards.

Directions:

1. **Pass** around the role model career cards from this box and give the girls a chance to become familiar with them. Discuss some of the projects they have done so far and some of the careers they have learned about during those activities.
    - What kind of designer makes toys?
    - What kind of designer makes pencil bags or other similar items?
    - What does a **Packaging Engineer** do?
2. **Explain** that they will be making their own career cards today. Girls will need to choose a career from the career cards.
3. **Ask** them to think about what college they might attend for this career and what degree they might have. Would they like to have a family? Where do they see themselves living?
4. **Give** the girls ten minutes to make cards for themselves modeled after the role model cards in your box. If any girl is having trouble choosing a career, ask her to think back on what activity she liked the best or what career she thought was most interesting.
5. **Present** these career cards to the group. Discuss why girls chose a specific career.
    - Why did you choose this career for yourself?
    - What other things do you hope to accomplish in your future?
    - Explain why science and engineering are good careers for women.

Your Career Card

Your Career Card

Techbridge

Picture

Name

Occupation

Degree in:

Biography:

Interesting Facts:

At my job, I work on...

Your Career Card

Techbridge

Picture

Name

Occupation

Degree in:

Biography:

Interesting Facts:

At my job, I work on...

Career Card

Toy Designer

Toy Designers are creative people who use their imagination to create a new toy or game. They may study graphic arts and computers to help them design their inventions. They don't let challenges keep them from working on their ideas, so they tinker and try until they succeed. They protect their ideas by getting a patent for their invention.

As a **Toy Designer** you might make a video game that appeals to girls, or an interactive toy to entertain your dog. You could make a portable video game that's inexpensive so that every kid can have one. The average annual salary is about $61,400 which is about $29.50 per hour.

Janese Swanson
Degree in Computer Science

Janese's Biography:

As a child I had a knack for fixing broken appliances and tinkering with electronics. I wasn't encouraged in science or technology as a girl, and had jobs in modeling, teaching, and sales. Eventually I found my true calling and founded my own company, Girl Tech, which makes toys that encourage girls to use technology. Today, I teach technology to children and teachers.

How to do it:

To become a **Toy Designer** like Janese, be sure you take advanced math and science classes like trigonometry and physics at your school. Classes in design or drafting are helpful too. Consider taking computer science, psychology and child development classes in college.

Colleges and universities want to see your commitment to extracurricular activities too. Try working with kids as a summer camp instructor, baby-sitter, tutor, or at a retail toy store.

Product Designer

Product Designers have talent for design. They combine art, science, and technology to make the products we use at home, at school and at play. They often use engineering skills to help them create a product that people want to use and buy. **Product Designers** have good "people skills" and spend time listening to what people want and watching how they use products.

As a **Product Designer** you might make a car seat for pets or a toothbrush that kids like to use. Or you might design an electronic toy that lets girls exchange notes. The average annual salary is about $61,400 which is about $29.50 per hour.

Heather Fleming
Degree in Mechanical Engineering

Heather's Biography:

I grew up in a small town in New Mexico with lots of animals and a sister to keep me company in the country.

I started my company, Catapult Design, where I do product design for the developing world. The best part of my job is traveling and experiencing new cultures. I also like that the work I do makes a difference in people's lives. I volunteer with Engineers Without Borders and made a wind turbine for a village in Guatemala.

How to do it:

To become a **Product Designer** like Heather, be sure you take advanced math and science classes like trigonometry, calculus, physics, and biology at your high school.

Try joining different clubs that concentrate in art or design. Take classes like psychology or sociology. Try volunteering at places like nursing homes or service providing centers. Find out about local internships in graphic design firms.

Packaging Engineer

Packaging Engineers combine engineering, design, and marketing all into one career. As a **Packaging Engineer** you work with many different people and you can work in many different industries. You use your creativity and problem solving skills to develop packaging for products so they stay in mint condition for customers to buy, attract them to the product and keep contents contained. Having good communication skills is very important.

As a **Packaging Engineer** you might test new packaging materials for food to see if it would survive a long truck drive or rainy weather. The average annual salary is $51,391 annually which is about $24.70 per hour.

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At my job I write specifications (design rules) for packaging materials, test them and talk to suppliers about new ideas. I also get to work with our sales and marketing team to develop new products and packaging ideas.

How to do it:

To become a **Packaging Engineer** like Ann take classes like physics, economics, and higher math.

Ann suggests you take a variety of classes in college so you can identify what you really have a passion for. Look for opportunities to job shadow someone in the field you are interested. Too many times you may be interested in a certain field only to find out that your imagined career path is much different in reality!

Chemical Engineer

Chemical Engineers use chemicals to find creative ways to solve problems, and create products to improve the lives of others. **Chemical Engineers** can work in many areas including electronics, pollution control, even medicine and the food industry.

Right now **Chemical Engineers** are researching how to turn seawater into drinking water, how to develop a delicious new energy bar, and how to reduce pollution by developing cleaner burning fuel for cars. The average annual salary is about $91,670 which is about $44 per hour.

Carrie Kelley
Degree in Chemical Engineering

Carrie's Biography:

I graduated from the Georgia Institute of Technology. Now, I am a process developer in the cleaning division at Clorox. That means I get to play all day at work. I figure out what pieces of equipment to use that create the cleaners you see at the store. I think it is very magical to mix two things together to get something totally different.

How to do it:

To become a **Chemical Engineer** like Carrie, be sure you take advanced science classes like biology and chemistry, and math and computer classes at your school.

You should search out opportunities to work as a lab assistant to learn procedures, safety, and how to analyze results. If possible get a summer internship at a pharmacy or lab. Check out the American Institute of Chemical Engineers at www.aiche.org/students/ for scholarships and opportunities.

Career Card

Marketing Specialist

Marketing Specialists work with a diverse group of people. They help companies sell their brand products and maintain positive relationships with customers and partner companies or organizations. They research potential customers, their competition, trends, and they figure out how they can improve their products.

Marketing Specialists also think about how much products should cost, where they should advertise, and who they should partner with to improve the look and feel of the brand. The average annual salary is about $67,500 which is about $32.45 per hour.

Shanna Gazley
Degree in Business Administration

Shanna's Biography:

When I was in middle school, I wanted to be an architect. After college, I worked at a tech company where I was exposed to marketing. I liked the field so much that I decided to get my masters in business to broaden my marketing skills. Outside of work, I love to read (books, magazines, internet sites), exercise, hang out with friends, travel, and volunteer.

How to do it:

To become a **Marketing Specialist** like Shanna, be sure you take advanced math or business at your school. Consider joining the newspaper or yearbook staff, especially the advertising sales division.

In college take marketing strategy classes and psychology courses. If you get the chance to study abroad do it! Companies want to see that you understand different cultures and economies.

Mechanical Engineer

Mechanical Engineers design and test different kinds of mechanical parts to products. Imagine your daily life and all the mechanical devices you use like appliances and automobiles. They are designed by **Mechanical Engineers** who find out what we need and how best to make them so they're safe and work well.

As a **Mechanical Engineer**, there's no limit to the kinds of projects you might work on. You could design a bike that is easy to pedal up hills or a car that doesn't pollute. Or you might create a mechanical game for blind children. The average annual salary is about $80,580 which is about $38 per hour.

Judy Lee
Degree in Mechanical Engineering

Judy's Biography:

As a kid, I loved taking things apart and trying to put them back together. I was always curious about what made things work. Having the chance to tinker helped me decide to study mechanical engineering.

Today I have my dream job at IDEO, a product design firm. As a **Mechanical Engineer**, I have the chance to make a range of products - from toys to medical devices and food to interior spaces.

How to do it:

To become a **Mechanical Engineer** like Judy, be sure you take advanced math or science classes like trigonometry and calculus at your school.

If you like learning about how things work, get your parent's permission and try taking apart things in your house like old hair dryers, coffee machines or a lawn mower. Find information about your local engineering society and learn about opportunities they have available.

Product Manager

Product Managers work in all fields of design, engineering, and other non-science related fields. They work with many different people. They must have great communication skills so they can delegate and coordinate people's schedules and tasks. This ensures that projects are completed on time and correctly.

As a **Product Manager** you might be in charge of few or many people. You might work together on designing and building a school, or get a product manufactured on time and out to the right stores. The average annual salary is $122,810 which is about $59.04 per hour.

Angela Chung
Degree in Engineering

Angela's Biography:

I loved math and science growing up. My parents were both physicists so it seemed natural to pick a field that was related to math and science. I worked very hard to learn everything I could about engineering when I was in high school.

I also wanted to be an environmentalist and save the world around us. Now I can be an engineer and encourage clients to develop and build in a more sustainable way.

How to do it:

To become a **Product Manager** like Angela, be sure you take advanced math and science classes like trigonometry and physics at your school. Practice your team-building and communication skills by joining a debate or robotics team.

Colleges and universities want to see your commitment to extracurricular activities too. Join and participate in programs that challenge you, or volunteer in an organization that interests you.

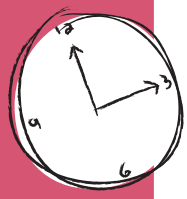
Note:

Salary information is from the National Bureau of Labor Statistics Occupational Employment and Wage Estimates as of May 2009.

The Business of Bubbles

70 Minutes

+ 10 minutes preparation time



Materials:

Per Group of 10

- 1 Engineering Design Process poster
- 10 cups and lids (for taking home bubble solution)

Per Chemical Engineer

- 1 Bubble Research worksheet
- 1 Chemical Engineer career card
- 1 set of measuring cups and spoons
- 1 pencil
- 1 roll paper towels
- 6 stirring sticks
- 6 plastic cups
- baby shampoo
- glycerin
- dish washing soap
- water or access to a sink (not included)
- 10 sheets newspaper or plastic table cloths (not included)

Per Mechanical Engineer

- 1 Mechanical Engineer worksheet
- 1 Mechanical Engineer career card
- 1 pencil
- 1 extension cord
- 6-7 craft sticks
- 3-4 feet wire
- 1 pair of scissors
- 10 pipe cleaners
- 1 glue gun
- 3-4 glue gun sticks

Grouping: 4 Girls per team

See step 3 if you don't have multiples of 4.

Introduction: In this activity, girls will take on various engineering roles to make an innovative new bubble product.

Objectives: As a result of this activity, the girls will be able to:

- Use the **Engineering Design Process**
- Work on a team to create a product
- Explain what a **Chemical Engineer, Mechanical Engineer, Marketing Specialist** and **Product Manager** do

Science Behind It:

Bubbles are formed when a very thin layer of water is trapped between two layers of soap. The water holds the bubble together while the soap allows it to stretch. As the layer of water gets thicker and thinner, different colors are created. Bubbles pop when the layer of water gets too thin or evaporates. Glycerin helps slow down the rate of evaporation but it makes the bubble less stretchy.

This activity follows the **Engineering Design Process** steps. Girls are designing a new bubble design product. The research they do on bubble solutions and bubble wands leads them to choose a better solution and wand. After creating a few samples and testing, the teams can develop a product that they feel proud of showing to their peers. The **Engineering Design Process** is at work throughout this activity.

Preparation:

- **Cover** the **Chemical Engineer** station with tablecloths or newspaper.
- **Arrange** the materials in separate stations for each role.
- **Read** through each career card to familiarize yourself with the career and career tasks for the activity.

The Business of Bubbles

Materials:

Per Marketing Specialist

- 1 Marketing Specialist worksheet
- 1 Marketing Specialist career card
- 3-4 chipboard sheets
- 1 box of permanent markers
- 1 glue gun
- 3-4 glue gun sticks
- 1 extension cord
- 1 plastic jar with lid
- 5 sheets of construction paper
- masking tape
- duct tape
- 1 pair of scissors
- 1 pencil

Per Product Manager

- 1 Product Manager worksheet
- 1 Product Manager career card
- 1 pencil
- 1 pre-made bubble wand
- 1 clipboard (not included)

Recommended Materials (Not Included)

- ribbon
- foam sheets or shapes
- key rings
- straws
- stickers
- glitter/sequins/ pompoms/other miscellaneous decorations

Opening (5 minutes):

1. **Review** the **Engineering Design Process** and work as a team to create a bubble product. The bubble product includes a bubble wand, bubble solution and bubble packaging. Each girl in a team will be responsible for a specific task and will have a specific career.

Brainstorm (20 minutes):

2. **Display** the **Engineering Design Process** poster and review with the girls what steps they think should be followed in developing a new innovative bubble product.
    - ❍ Identify which steps you think are important in this activity.
    - ❍ How do you think this activity is similar to ones we have done before? How is it different?
3. **Organize** girls into groups of four. If you have extra or too few girls, you can have a group of five girls with two **Chemical Engineers** or a group of three girls where everyone shares the **Product Manager**'s responsibilities.
4. **Tell** the girls they will be working in a team to create a new product today. Their product will include bubble solution, bubble wand(s), and packaging for the product. Emphasize the importance of working as a team and that their product will not succeed unless everyone does their job.
5. **Hand out** all four career cards to each group. Have girls read over the cards and have each girl choose a role. Instructions for each role are on the back:
    - **Chemical Engineer**: Formulates and tests the best bubble solution.
    - **Product Manager**: Communicates between the other three teammates. Tests the quality of the bubble wand and bubble solution. Develops a procedure for testing and sampling the product.
    - **Marketing Specialist**: Designs and implements the best way to sell the product. (Think about the look and the feel of the label, the packaging, the name, etc.)
    - **Materials Engineer**: Designs and builds the best bubble wand.

6. **Using** the career cards, review each career with the girls and the different responsibilities.
   - ❍ What does Carrie do?
   - ❍ What will you, as the **Chemical Engineer,** do today?
   - ❍ What does Shanna do?
   - ❍ What will you, as the **Marketing Specialist,** do today?
   - ❍ What does Angela do?
   - ❍ What will you, as the **Product Manager,** do today?
   - ❍ What does Judy do?
   - ❍ What will you, as the **Mechanical Engineer,** do today?
   - ❍ How are both **Engineering (Chemical and Mechanical)** jobs similar? Different?

Hands-On (30 minutes):

7. **Choose.** Once girls have chosen a role, have the girls discuss as a group any theme or direction they want the product to go in (e.g., hearts, flowers, large wand, tiny bubbles, etc.).

8. **Send** each team member to their specific station in order to complete their task. **Product Managers** will need to walk between girls and stations coordinating their team's work.

Note:
The girls will be using glue guns. Stress that they get VERY hot and the glue can burn. Use craft sticks or other objects to press down the glue rather than your fingers to help prevent burns.

   - Your **Product Manager** might ask the **Marketing Specialist**:
     - ❍ Think of a product you like. How is it advertised? Does it appeal to you? Why?
   - Your **Product Manager** might ask the **Mechanical Engineer**:
     - ❍ Who uses or buys bubble wands? What makes bubbles fun for kids?
   - Your **Product Manager** might ask the **Chemical Engineer**:
     - ❍ Are big bubbles or small bubbles more fun? Why?

9. **Present.** Once every team has completed their assigned tasks and have finished building their product, ask them to prepare and practice a presentation, a mini commercial, of their bubble product to the whole group. While a **Marketing Specialist** may develop advertising campaigns in real life, any available member of the team may lead the development of the presentation.

Reflection (15 minutes):

10. **Discuss** how each girl felt about the process after every team has presented. Use the reflection questions to help you through a discussion on the activity.

    - ❍ How was working in a team to create a product different from working alone or with a partner?
    - ❍ How did having different jobs on your team help your team create a successful product?
    - ❍ What is the most important skill to have for this activity?
    - ❍ Which steps of the **Engineering Design Process** helped you create this product?
    - ❍ How similar do you think what you did today is to what the role models (Judy, Carrie, Shanna, and Angela) do in their jobs?
    - ❍ What would you change about your bubble product after seeing others?

11. **Take home.** There are enough cups and lids provided in the box so that each girl can take some of her team's bubble solution home. You could also send home extra craft sticks and wire so that each girl could make her own bubble wand to use with her bubble solution at home.

Activity Extensions:

If you have more time or wish to further challenge your girls, try the following:

1. Let the **Marketing Specialists** in your group use computers and digital cameras to make commercials or newspaper ads featuring the bubble product. They could create a PowerPoint presentation or design and print out a label.

2. Have the **Mechanical Engineers** test the tensile strength (the maximum stress or strain a material can withstand) of their materials. They can use this information to determine the appropriate age group plus safety warnings for the product. One way to test tensile strength is to count how many times the wire can bend before it breaks. Use the internet to research safety concerns and strength testing.

Product Manager Worksheet

Techbridge

Use the chart below to keep track of how each team member is doing on her tasks. Write down her progress and the times you've met with each team member. Meet with the **Marketing Specialist** first.

Marketing Specialist	Mechanical Engineer	Chemical Engineer

Bubble Solution: Use the pre-made bubble wands to test the bubble solutions made by the **Chemical Engineer**.

	How big were the bubbles? (estimate)	How long did they last? (estimate)	How many bubbles were made?	Did the bubbles float or sink?
Solution 1				
Solution 2				
Solution 3				
Solution 4				
Solution 5				
Solution 6				

Design Time

Chemical Engineer Worksheet

Techbridge

Bubble Solution Formula:
(formulas to test)

Recipe 1	Recipe 2	Recipe 3
½ cup water	½ cup water	½ cup water
2 tablespoons dishwashing soap	1½ teaspoon dishwashing soap	1½ teaspoon baby shampoo
	½ teaspoon glycerin	½ teaspoon glycerin

Your Formula:
(new and improved formulas that you have developed)
Work with your **Product Manager** to determine the best formula.

water	water	water
dish soap	dish soap	dish soap
glycerin	glycerin	glycerin
baby shampoo	baby shampoo	baby shampoo
Observations:	Observations:	Observations:

water	water	water
dish soap	dish soap	dish soap
glycerin	glycerin	glycerin
baby shampoo	baby shampoo	baby shampoo
Observations:	Observations:	Observations:

Design Time

Marketing Specialist Worksheet

Techbridge

Marketing: Use the space below to sketch your ideas for the theme of your packaging. With your team, choose the one that fits the product the best.

Design 1	Design 2

Develop a slogan for your bubble product. _____
Is the packaging visually appealing? _____
Will both the bubble container and the wand fit in the package? _____
Work with your **Product Manager** to pick the age range for your product and the price.

Age Range	Price $

Decide if you should include a warning label or ingredients list, and what it should look like on the package.

Design Time

Mechanical Engineer Worksheet

Techbridge

Bubble Wands: Design 2 bubble wands that will be tested by the **Product Manager**. Keep track of how much of each material you use in your design.

Design 1	Design 2

Materials list:
_____ Craft sticks
_____ inches of Wire
_____ Pipe cleaners

Materials list:
_____ Craft sticks
_____ inches of Wire
_____ Pipe cleaners

Is the wand sturdy? (Will it break easily?) _____

Are there any sharp points that could harm the user? _____

Will the wand make big or small bubbles? _____

Work with your **Product Manager** and **Marketing Specialist** to be sure your wand fits in the packaging.

Design Time

Chemical Engineer

Chemical Engineers use chemicals to find creative ways to solve problems, and create products to improve the lives of others. **Chemical Engineers** can work in many areas including electronics, pollution control, even medicine and the food industry.

Right now **Chemical Engineers** are researching how to turn seawater into drinking water, how to develop a delicious new energy bar, and how to reduce pollution by developing cleaner burning fuel for cars. The average annual salary is about $91,670 which is about $44 per hour.

Carrie Kelley
Degree in Chemical Engineering

Carrie's Biography:

I graduated from the Georgia Institute of Technology. Now, I am a process developer in the cleaning division at Clorox. That means I get to play all day at work. I figure out what pieces of equipment to use that create the cleaners you see at the store. I think it is very magical to mix two things together to get something totally different.

How to do it:

To become a **Chemical Engineer** like Carrie, be sure you take advanced science classes like biology and chemistry, and math and computer classes at your school.

You should search out opportunities to work as a lab assistant to learn procedures, safety, and how to analyze results. If possible get a summer internship at a pharmacy or lab. Check out the American Institute of Chemical Engineers at www.aiche.org/students/ for scholarships and opportunities.

You are the **Chemical Engineer**. You need to develop the best bubble solution. Adjust the amounts of water, soap, glycerin, or baby shampoo in the example recipes. **Remember** to write down your recipe on your Bubble Research Worksheet. Keep track of every drop and teaspoon! Your **Product Manger** will test each recipe to find the best one!

Mechanical Engineer

Mechanical Engineers design and test different kinds of mechanical parts to products. Imagine your daily life and all the mechanical devices you use like appliances and automobiles. They are designed by **Mechanical Engineers** who find out what we need and how best to make them so they're safe and work well.

As a **Mechanical Engineer,** there's no limit to the kinds of projects you might work on. You could design a bike that is easy to pedal up hills or a car that doesn't pollute. Or you might create a mechanical game for blind children. The average annual salary is about $80,580 which is about $38 per hour.

Judy Lee
Degree in Mechanical Engineering

Judy's Biography:

As a kid, I loved taking things apart and trying to put them back together. I was always curious about what made things work. Having the chance to tinker helped me decide to study mechanical engineering.

Today I have my dream job at IDEO, a product design firm. As a **Mechanical Engineer,** I have the chance to make a range of products - from toys to medical devices and food to interior spaces.

How to do it:

To become a **Mechanical Engineer** like Judy, be sure you take advanced math or science classes like trigonometry and calculus at your school.

If you like learning about how things work, get your parent's permission and try taking apart things in your house like old hair dryers, coffee machines or a lawn mower. Find information about your local engineering society and learn about opportunities they have available.

You are going to be the **Mechanical Engineer**. As a **Mechanical Engineer,** you have to design and construct 2 bubble wands. Your **Product Manager** will test them to see which works the best and will be the most marketable. Take the advice and suggestions she gives you and incorporate them into a new and better design!

Marketing Specialist

Marketing Specialists work with a diverse group of people. They help companies sell their brand products and maintain positive relationships with customers and partner companies or organizations. They research potential customers, their competition, trends, and they figure out how they can improve their products.

Marketing Specialists also think about how much products should cost, where they should advertise, and who they should partner with to improve the look and feel of the brand. The average annual salary is about $67,500 which is about $32.45 per hour.

Shanna Gazley
Degree in Business Administration

Shanna's Biography:

When I was in middle school, I wanted to be an architect. After college, I worked at a tech company where I was exposed to marketing. I liked the field so much that I decided to get my masters in business to broaden my marketing skills. Outside of work, I love to read (books, magazines, internet sites), exercise, hang out with friends, travel, and volunteer.

How to do it:

To become a **Marketing Specialist** like Shanna, be sure you take advanced math or business at your school. Consider joining the newspaper or yearbook staff, especially the advertising sales division.

In college take marketing strategy classes and psychology courses. If you get the chance to study abroad do it! Companies want to see that you understand different cultures and economies.

You will be a **Marketing Specialist**. Your job is to market the bubble product. Come up with a product name and develop the packaging that you will put the wand and bubble solution in. Think about what's on the package like warning labels, ingredients, price, slogan and appropriate age of your customer. You will then make a commercial to share with the rest of the group.

Note: The jars for the bubble solution need to be returned at the end of the activity so make sure you don't mark them or glue anything on them.

Product Manager

Product Managers work in all fields of design, engineering, and other non-science related fields. They work with many different people. They must have great communication skills so they can delegate and coordinate people's schedules and tasks. This ensures that projects are completed on time and correctly.

As a **Product Manager** you might be in charge of few or many people. You might work together on designing and building a school, or get a product manufactured on time and out to the right stores. The average annual salary is $122,810 which is about $59.04 per hour.

Angela Chung
Degree in Engineering

Angela's Biography:

I loved math and science growing up. My parents were both physicists so it seemed natural to pick a field that was related to math and science. I worked very hard to learn everything I could about engineering when I was in high school.

I also wanted to be an environmentalist and save the world around us. Now I can be an engineer and encourage clients to develop and build in a more sustainable way.

How to do it:

To become a **Product Manager** like Angela, be sure you take advanced math and science classes like trigonometry and physics at your school. Practice your team-building and communication skills by joining a debate or robotics team.

Colleges and universities want to see your commitment to extracurricular activities too. Join and participate in programs that challenge you, or volunteer in an organization that interests you.

You will be a **Product Manager** today. Your job is to oversee the whole project and support the rest of your team. You will also need to test the bubble solution with the wands. They need to work together and be appealing to your consumers. Make sure to take notes on the **Product Manager** Worksheet so you can keep accurate records, and make the best decision. You will lead your team's presentation to the entire group. Work with your Marketing Specialist first to determine the theme for your product.

Hint: If your bubble solution is ready to be tested but your bubble wands aren't, you can test the different solutions with the pre-made wands that are included in your materials.