



Think Like an Engineer Multi-Level Badge Series

Think Like an Engineer: Badge Requirements

The Think Like an Engineer journey series has badges available for Daisies through Ambassadors and pairs well with the Daisy Petals: Friendly & Helpful, Considerate & Caring, and Make the World a Better Place. Activities include learning about the design thinking process, designing something for a civil or architectural engineering challenge, designing something for a biomedical or mechanical engineering challenge, and working on a take action project to help make the world a better place. Choose one activity from each category.

Design Thinking

- Ball Launcher
- Ball Run

Design Challenge 1

- Earthquake Resistant Structure
- Zipline Course
- Nature Cabins
- Paper Towers

Design Challenge 2

- Mobility Equipment
- Animal Enrichment
- Assistive device for a person's hands

Take Action Project

- Complete a Take Action Project

Extension for Juniors through Ambassadors

- Learn about Girl Scout Highest Awards

Daisy Petals

In a multi-level troop or family, you might have a Daisy Girl Scouts working on their petals while other Girl Scouts are working towards badges. This badge in a booklet has been designed so that Daisies can earn their Friendly and Helpful, Considerate and Caring, and Make the World a Better Place petals by completing the same activities as the older Girl Scouts. Descriptions of the activities and how they relate to the petals are below and on the following page.



Friendly & Helpful

Think Like an Engineer: Design Challenge 2

Girl Scouts learn about biomedical engineers and assistive devices. They make a prototype design of a device that can help people or animals.



Considerate & Caring,
Make the World a
Better Place

Think Like an Engineer: Take Action Project

Girl Scouts consider the needs of their communities, think about their own talents, and find a way to help meet a need within their community and make it a better place.

Items you will need to supply if you do all the activities:

Suggested tinkering supplies:

- cardboard
- cardboard tubes
- fishing line
- popsicle sticks
- dowels
- clothespins
- straws
- pipe cleaners
- rubber bands
- brass fasteners

Other Resources:

- Basic craft supplies:
 - scissors
 - paper and pencils
 - markers
 - hot glue gun, tape, glue
 - cardstock, posterboard
 - beads
 - yarn/string
- fishing line
- tennis balls
- cardboard
- paint stirring stick
- ping pong balls
- plastic spoons
- toothpicks and marshmallows or building materials such as K'nex or Goldie Blox

Design Thinking Poster: Consider printing copies of the the Design Thinking Poster for Girl Scouts to reference as they work through their creation process



Craft

Tinker

Design Thinking

Learn about the Design Thinking Process while creating a ball launcher or ball run.

From the kit:

Design Challenge Cards

What you need to supply for a ball launcher or ball run:

- **Basic Craft Supplies:** scissors, paper and pencils, markers, hot glue gun, tape, glue, cardstock, posterboard, beads, yarn/string
- **Tinkering Supplies:** cardboard, cardboard tubes, fishing line, popsicle sticks, dowels, clothespins, straws, pipe cleaners, rubber bands, brass fasteners
- ping pong ball
- plastic spoons

Tips for leaders:

Girl Scouts will learn about and follow the Design Thinking Process while creating a ball launcher or ball run. You can choose the goal or let Girl Scouts decide what the goal should be (furthest, highest, or get the ball into a cup). Encourage the Girl Scouts to follow the Build, Test, Redesign cycle and do rapid designing. The ball launcher or run doesn't have to be perfect, this activity is more about learning the design process.

Design Thinking



READ

The Design Thinking Process is a way that engineers work to think about a problem, come up with a solution, test it out, and make their design even better. You will be following this process to do a quick design of a mechanical engineering project. Mechanical Engineering is when we design and make something that moves.

For this project, you will be making a quick prototype, or first try at the design, and then you will test it and make some small changes to see if you can make it better.

THINK

We use the word design to mean create a plan for an object or idea. When have you designed something before? Do you have a favorite thing that you've designed?

DO

You will be creating ball launcher or run. You will read through the design challenge card first, and then you will follow the design process:

1. Read the challenge card
2. Brainstorm ideas for 5 minutes (on your own or in pairs)
3. Decide on one idea to try
4. Build your prototype launcher or ball run, it doesn't have to be perfect the first time!
5. Test it out the first time and see what works and what doesn't work
6. Come up with a quick plan of how to make it better and make those changes
7. Test it again and make more changes!
8. Share your what happened and what things worked or didn't work with other teams

Think Like an Engineer: Design Thinking



Define the Need: What does our customer need or what problems do we notice in our community?

Brainstorm: Write down a lot of ideas and share those ideas before deciding which idea or ideas will work the best.

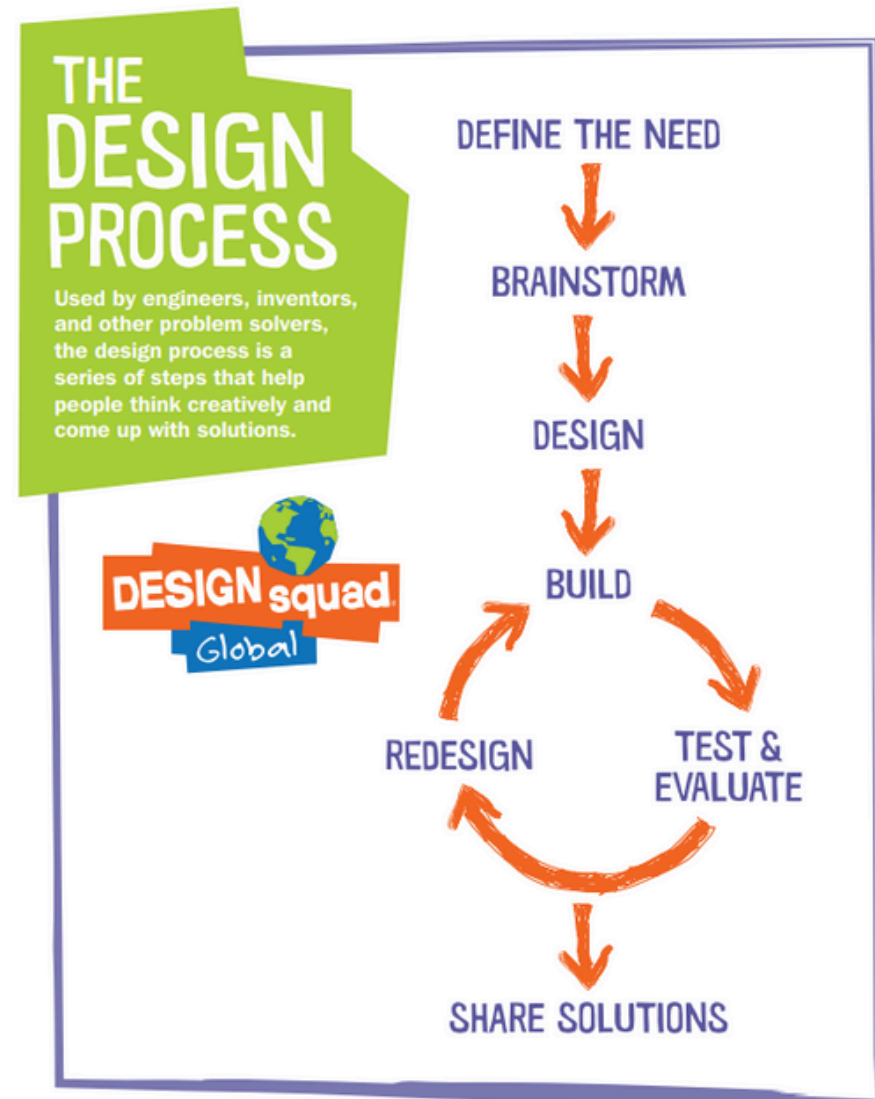
Design: Make a sketch of what you will be creating. Think about the need, what materials you will use, and how you'll attach the materials together.

Build: Make your prototype, or in other words, first design. This won't be perfect, but it's a starting place

Test & Evaluate: Test out your design, did it work the way you thought? What works or doesn't work?

Redesign: Make changes to your design

Share Solutions: Share with other people the things that worked, but also share what doesn't work. Sometimes other people will have new ideas for you to use in your design too!



DESIGN SQUAD GLOBAL is produced by WGBH Boston

MAJOR FUNDING



PROJECT FUNDING



The DESIGN SQUAD GLOBAL material is based on work supported by the National Science Foundation under Grant No. DRL-1422236. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation. © 2016 WGBH Educational Foundation. All rights reserved.

Ball Launcher

Ball launchers can be used to throw a ball for a pet, launch a tennis ball or baseball for practices, or to launch things that aren't even balls such as t-shirts or hot dogs at a baseball game!

As you start designing your ball launcher, you will want to consider:

- What type of object are you launching?
- How heavy is the object and is it solid or hollow?
- What is the most important:
 - How far the ball goes
 - How high the ball goes
 - Does the ball go right where we want it to?

Requirements

1. Launches one ball at a time
2. Sturdy enough that it can be used again
3. Works using the machine and not a person throwing the ball

Challenge Yourself

- See if you can make your machine throw accurately **and** far or high

Ball Run

Roller Coasters are made by having a lift hill or launch to give the roller coaster car energy that it uses to go through the rest of the track. A ball run or marble run doesn't need to have the lift hill or launch since you can start the ball at the top of the hill and then have it go down the ball run.

As you create your ball run, you will need to think about:

- how far apart the rails are for the track
- how steep the track is
- how tight you can make a turn in the track

Requirements

1. The ball run has to be at least 6 inches tall
2. The ball has to go from the top to the bottom without help
3. There has to be at least one turn in the track

Challenge Yourself

- Create a ball run that is over 12 inches tall
- Create a ball run that has one hill where the ball has to go up and then come back down

Design Challenge 1



Tinker

Craft



General supplies you need to provide for earthquake, nature cabins, and zipline:

- **Basic Craft Supplies:** scissors, paper and pencils, markers, hot glue gun, tape, glue, cardstock, posterboard, beads, yarn/string
- **Tinkering Supplies:** cardboard, cardboard tubes, fishing line, popsicle sticks, dowels, clothespins, straws, pipe cleaners, rubber bands, brass fasteners

All supplies for the paper tower:

- scissors, paper and pencils, tape, ruler or Meter Stick

Design Challenge 1

Follow the Design Thinking Process while completing an architecture or civil engineering challenge.

From the kit:

Design Challenge Cards

Challenge Specific Supplies:

- **Earthquake:** tennis balls, flat corrugated cardboard cut into 2 rectangles big enough as a building base, 2 large rubber bands, 2-3 tennis balls, binder clip, paint stir stick, building materials such as: K'nex, Goldie Blox, toothpicks and marshmallows, or something similar



- **Zipline:** fishing line, ping pong balls, straws



Think Like an Engineer: Design Challenge 1



READ

In this design challenge, you are going to use the design thinking process again to work on a civil or architectural engineering project. Civil engineers design things such as bridges, roads, water systems, parks, some types of buildings, and other things that support our cities and towns. Architects design houses, office buildings, stores and other spaces that people live or get together. Both civil and architectural engineers work on making things that keep people safe and comfortable.



THINK

When an architect or civil engineer creates a prototype, they make a smaller version called a **scale model**. A scale model looks the same as the final design will be, just a lot smaller. Why do you think that their prototype is always a scale model?



DO

You will be following the design thinking process to create a scaled model of a civil or architectural project. As you design your building or structure, you will draw it on paper first before you start putting materials together to see if your design works. For a first prototype, it's ok to use different materials or colors--you're just getting an idea of what would work or not work for the design. If you're designing a house, you wouldn't use tiny bricks, instead you might use paper, cardboard, or plastic for your **scale model**.

Read the design challenge and follow the design thinking process!

Earthquake Resistant Structure

Challenge 1



When civil engineers and architects design a building, they have to look at the building codes, or rules, for the location that they are building it. Different places have different types of weather or natural disasters. In Wisconsin, they have to think about the weight of snow on a roof in the winter. In California, they need to think about earthquakes.

Earthquakes cause seismic waves, or vibrations. When a building is created along the Pacific Ocean's coastline where earthquakes happen more frequently, the building has to be able to withstand the vibrations without falling apart or falling to the ground.

You will be creating a prototype of a building that can survive an earthquake's seismic waves. You will test your prototype using a shake table. This table will make the same back and forth motion that is one of the types of vibrations that an earthquake makes.

As you start designing your structure, play around with different shapes to see if one shape such as a rectangle, circle, or triangle, is more stable than another.

Requirements

1. Create a structure that does not collapse or fall apart on the shake table
2. Your structure must be at least 6 inches tall

Challenge Yourself

- Try to create an even taller structure that doesn't collapse!

Challenge

1

Zipline Course



A zipline course is a fun way to see nature from above. Ziplines have become part of Ecotourism that allow tourists to see parts of rainforests or other landscapes without walking through it.

You will be designing a zipline course for a summer camp. Your prototype will have three zip lines connected together and you will be able to help move the object going down the zipline from one line to the next.

As you design your zipline, you will need to think about how to reduce friction. Friction is a force that slows down an object. If you think about sledding down a hill, the snow would have less friction than a hill of gravel and rocks. Your sled would be able to smoothly ride over the snow, but it would go slowly or might even be stopped by the gravel. You'll need to think about how to make it so that your object goes down each zipline without getting stopped by friction in the middle.

Requirements

1. Must be at least 3 feet tall
2. Must have at least 4 platforms and three ziplines
3. Must be able to carry a ping pong ball from the top of the course to the bottom of the course without getting stuck in the middle of a zipline.

Challenge Yourself

- Create a zipline course with 4 or more lines
- Make your zipline course so that the ping pong ball can get from the bottom to the top in 15 seconds or less

Challenge



Nature Cabins

Architectural engineers create buildings that serve a purpose, such as a house, a school or a business. Engineers might use different types of inspiration, or something that sparks a creative idea, to make their building fun or unique.

You will be taking inspiration from animal shelters to create nature cabins for a camp. Your cabin might be inspired by one animal's home or it might take parts and pieces from several animal's shelters to create your nature cabin.

As you design your prototype, think about how animals make their shelters waterproof from the rain or windproof from a storm. How do animals get in or out of their shelters? How do they keep other animals out?

You can choose to model your cabin after an animal you already know about or research new animals for inspiration.

Don't forget, the cabins you are creating are for a summer camp, so they need to be fun for the kids but also still have everything you need to stay in for camp.

Requirements

1. The cabin must be inspired by one or more animal shelters
2. It must be water and wind resistant
3. It must be at least 5 inches tall and 5 inches wide.

Challenge Yourself

- Design your prototype so that it can be opened up and you can see the inside

Challenge

1

Paper Tower

There are many famous towers in world: the Eiffel Tower, the Tower of Pisa, the Big Ben Clock Tower, and the Seattle Space Needle. These towers are all different shapes and heights.

You will be creating your own tower from a single piece of paper. You will have one sheet of paper for the final tower, 1 foot of tape, and a pair of scissors to create the tallest tower you can make.

Think about different shapes and how they are used in different types of towers. You can use scrap paper for testing and practicing ideas before building your tower.

Requirements

1. Uses only 1 sheet of paper
2. Uses 12 inches or less of tape\
3. Make it as tall as you can, at least 15 inches.

Challenge Yourself

- Create a tower that is more than 20" tall
- Create a tower that uses more than one shape



Tinker

Craft



Design Challenge 2

Follow the Design Thinking Process while completing a biomedical or mechanical engineering challenge that helps others.

From the kit:

Design Challenge Cards

Supplies you need to provide for Design Challenge 2

- **Basic Craft Supplies:** scissors, paper and pencils, markers , hot glue gun, tape, glue, cardstock, posterboard, beads, yarn/string
- **Tinkering Supplies:** cardboard, cardboard tubes, fishing line, popsicle sticks, dowels, clothespins, straws, pipe cleaners, rubber bands, brass fasteners

Tips for leaders:

You can choose from the three Design Challenge 2 choices which one you'd like to do for the activity, or you can let the Girl Scouts decide. Emphasize that as Girl Scouts design for other people or animals, they need to consider those people's needs. In a real world design, it would be really important to work with the customer and listen to their ideas and concerns.

Think Like an Engineer: Design Challenge 2



Daisy Petal

READ

Biomedical engineers create things to help people's bodies work better. Some biomedical engineers create assistive devices. An assistive device is a piece of equipment that someone can use to help them overcome a disability. Some examples of assistive devices are crutches, hearing aids, and speech devices.

Other engineers, such as mechanical or civil engineers, can also help animals and people by designing things such as zoo habitats that mimic nature or animal enrichment toys.



THINK

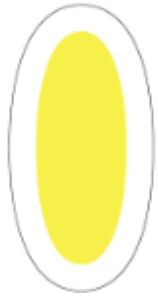
Can you think of any other assistive devices that you have used, seen, or heard about?

DO

You will be following the design thinking process to create an assistive device for people or something to help animals. Depending on what you design, your prototype might be full size or it might be a scaled model. When you design an object to help other people or animals, you will need to make sure that you are thinking about what they need and what the problem is.

Read the design challenge card and then follow the design thinking process to create something that helps others!

Think Like an Engineer: Design Challenge 2



Friendly and Helpful

When we think about what other people need and design something to make their life easier, we are being friendly and helpful.

Sometimes helping other people and being a friend can be as easy as listening to another person or playing with someone on the playground who is lonely.

Challenge

2

Mobility Equipment



Mobility equipment includes things like wheelchairs, canes, walkers, and prosthetic legs. These are all devices that help someone who has trouble moving around. People can have different types of mobility disabilities such as:

- **limb differences:** missing toes, feet, part of a leg, or the entire leg
- **paralysis:** not being able to move part of their body
- **arthritis:** stiff joints that can make it painful to move
- **low stamina:** not being able to walk long distances because of the shape of the legs, the way the muscles work, breathing difficulties, or other reasons

The type of mobility equipment a person uses will depend on the person's disability and what they need the equipment for:

- moving around the house
- walking around the grocery store
- playing sports
- hiking through the woods
- playing on a playground

Requirements

1. Choose a type or level of disability to design for (can they walk at all, transfer into a chair by themselves, etc)
2. Choose what type of activity you are designing for
3. Create a mobility device prototype that is different than devices you already know about

Challenge Yourself

- Create a mobility device that works for several different uses

Animal Enrichment

You will be creating a new product that makes an animal's environment better, more entertaining, or challenges the animal.

When engineers create something for animal enrichment, they are designing something that helps the animal's ability to thrive in their habitat.

These enrichment products could be used at a zoo, in a farm pen or at home for a pet. When animals don't live in the wild, they can lose some of their natural instincts or become bored.

Enriched environments help with long-term animal happiness and helps keep animals active and curious.

Some examples of animal enrichment products are: chew toys, play feeders, agility courses.

Requirements

1. Enrich the life of one or more types of animals.
2. Help fulfill the animals need for feeding, fun or being active.
3. Be safe for the animal.
4. Be easy for the animal caretakers to use and take care of.

Challenge Yourself

- Create a new type of enrichment toy that you haven't see or heard of before.
- OR
- Create an enrichment product that works for several types of animals.

Challenge

2



Assistive Devices for a Person's Hands

You will be creating an assistive device. Assistive means help. These devices can help someone with a disability or an elderly person. To make an assistive hand device, you will need to start thinking about:

- What do you use your hands for?
- How do hands (and arms) work?

Some disabilities that require assistive hand devices are:

- **limb differences:** missing fingers, a hand, or even part of an arm too
- **low grip strength:** having a hard time holding or grabbing something
- **arthritis:** stiff joints and pain bending their fingers, hands, and elbows

Some assistive devices we currently have are:

- grabbers
- braces
- prosthetic hands

Requirements

1. Helps one of the disabilities listed above with grabbing a spoon, pencil, or clothing.
2. Picks things up and puts them back down
3. Is sturdy and won't break when picking something up

Challenge Yourself

- Create an assistive device that can also turn a door knob
- Create a device that can also open a box



Take Action Project

Help make the world a better place by completing a take action project and using your talents to help your community.

Supplies you need to provide for Take Action Project

- **Planning Supplies:** paper and pencils, optionally post it notes, whiteboard, etc
- **Project Supplies:** This will be highly dependent on what your group decides to do for their project. You may need cleaning materials, tools for repairing broken things, poster making supplies, or building supplies. Make sure you communicate with the group about the budget and the supplies you already have available.

Tips for leaders:

As Girl Scouts start to brainstorm their talents, the community needs, and possible solutions, you will want to make sure that they stay on track to a project that has the right scope and isn't too big. Younger Girl Scouts may choose something simple such as designing posters to advocate for an important topic or creating bird houses. Older Girl Scouts might choose a more involved project.

Make sure that you are upfront with Girl Scouts about a budget or supplies they will have access to. You will also need to decide how much time you have for the project and if you will do it during a regular troop meeting, on their own time, or with a group outside of regular meetings. If you are looking for take action projects that are more affordable, focus on advocacy through posters, letters, pins, etc or partnering with an organization that needs help with a project and can supply the materials.

Think Like an Engineer: Take Action Project



READ

A Take Action Project matches your talents to a problem or need in your community. The project is also sustainable. Sustainable means that the good that your project is doing for the community keeps happening, even when you're done with the project.

THINK

What community service projects have you done with your troop, service unit, or school before?

DO

You are going to start your Take Action Project by brainstorming:

1. Your **Talents**: what are you good at?
2. What your **Community Needs**: what are some things that could help your community or make it even better?
3. **Solutions**: What could you do to help fill the **Community's Needs**?

Pick a solution, follow the design thinking process and help your community! Try to make your solution **Sustainable** so that it keeps helping your community even when you are done with the project.

Think Like an Engineer: Take Action Project



Considerate and Caring Make the World a Better Place

Considerate means that we think about what other people or places need. When we are caring, we help those people or places with their needs.

When we look around our meeting place or community and figure out ways to make it better, we are being considerate and caring. When we make changes to things in our community to make it better, we are helping to make the world a better place!

Take Action Project: Talents

To get started with a Take Action Project, you need to think about your **Talents**: What are some of your strengths or things you are good at? What positive things would a friend or troop leader say about you? Draw or write your ideas below.

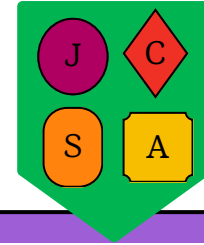
Take Action Project: Community Needs

Next, you are going to work as a group to brainstorm some things that your **Community Needs**. Pay attention to the places and groups of people around you. Are there any problems that you notice or things that could be improved? Write or draw your ideas.

Take Action Project: Solutions

Now you will use your Design Thinking process to brainstorm **Solutions**, design it, build it, test and evaluate, and then make any changes that you need to . What are some ways that we can help fill the Community Need your group decided on? Which of these solutions are you able to do? Are there some problems or solutions that fit with your talents better?

Learn About Highest Awards



READ

In Girl Scouts, you can earn a Bronze Award as a Junior, the Silver Award as a Cadette, and the Gold award as a Senior or Ambassador. These Highest Awards recognize Girl Scouts who have focused on developing their leadership skills while completing a sustainable project to help their communities and beyond.

These projects go well beyond a community service project or take action project. A Highest Award project focuses on developing teamwork and team management skills, identifying the Girl Scouts' own skills and talents and then using them to help fulfill a significant need in the community. These projects often approach a topic from multiple aspects and are sustainable beyond the next month or even year. Highest Awardees become an expert in that community need and lead the way to make change.

Highest Awards are recognized by many employers and colleges as a sign that the Girl Scout has organizational and leadership skill that will help make them successful. This can open up opportunities for scholarships, higher education, and employment in the future.

DO

Learn more about Highest Awards on our website:
gsbadgerland.org



Congratulations, you've completed the Think Like an Engineer Journey!

What's next?

- **Leave us your [feedback](#)!** Do you have suggestions for this Badge in a Booklet or requests for other multi-level badge series? Submit your ideas here.
- **Find another [Badge in a Booklet](#) or [Patch Program](#)**
- **Learn about Highest Awards.** Highest Awards can be completed by Juniors, Cadettes, Seniors, and Ambassadors. Check out information from gsbadgerland.org and [GSUSA](#).
- **Find a [Preferred Community Connections Partner](#)** to schedule a field trip as an extension of this badge or for your next badge earning experience.



[Submit your feedback](#)



[Find a digital resource](#)



[Highest Awards](#)



[Preferred Community Connections Partners](#)