

Fling Flyer Design Challenge 1

Overview:

In the Fling Flyer Design Challenge, Brownies explore the forces that affect flight as they design, build, and test a Fling Flyer. Brownies learn how to design an investigation—and fine-tune their designs after testing it.

Step One: Learn about forces that affect flight.

Step Two: Design and build a Fling Flyer.

Step Three: Test your Fling Flyer. *(To be completed in Fling Flyer Design Challenge 2.)*

Step Four: Analyze and share your results. *(To be completed in Fling Flyer Design Challenge 2.)*

Step Five: Brainstorm ways to improve your design. *(To be completed in Fling Flyer Design Challenge 2.)*

This meeting, Brownies learn about thrust, drag, gravity, and lift before building a Fling Flyer. They complete Step One and Step Two of the Fling Flyer Design Challenge badge.

Note to Volunteers:

Use the Talking Points (But Make Them Your Own): In each session, you'll find suggested talking points under the heading "SAY." Some volunteers, especially new ones, find it helpful to follow the script. Others use the talking points as a guide and deliver the information in their own words. Either way is just fine.

Be Prepared (It's What Girl Scouts Do!): Each meeting includes a "Prepare Ahead" section that includes a materials list and what kind of set-up is required. Read it in advance so you have enough time to gather supplies and enlist help, if needed.

If your troop has the GoldieBlox Making Things Zoom kit, you can find a set of Activity Instructions for the badge in the Meeting Aids section of this badge meeting under "Activities for the Making Things Zoom Kit."

Use Girl Scouts' Three Processes: Girl-led, learning by doing, cooperative learning—these three processes are the key to making sure Brownies have fun in Girl Scouts and keep coming back.

"Learning by doing" and "cooperative learning" are built into this Badge, thanks to the hands-on activities and tips. You'll also find specific "keep it girl-led" tips in the meeting plans. They'll help you create an experience where Brownies know they can make choices and have their voices heard.

Fail Fast. Succeed Sooner: That's how engineers solve problems. In this badge, Brownies will learn about engineering through hands-on activities. They'll learn to: Brainstorm ways to solve a problem, design prototypes, test them to see what does and doesn't work, then improve their designs. To engineers, failure is a good thing because every time a design fails, you learn something and can make it better.

You can help Brownies think this way. When her prototype doesn't work, ask questions like, "Why ~~do you think it didn't work? How can you change your design? Try again—that's what engineers do!~~"

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This approach also keeps the activity girl-led and fun because Brownies are free to invent things without feeling the pressure to make them perfect.

Leave Time for the Closing Ceremony: If Brownies are having fun doing a Design Challenge, you may be tempted to skip the Closing Ceremony so they can keep going—but the Closing Ceremony is absolutely key to their learning. Here's why:

When Brownies leave a meeting, they'll remember how much fun it was to build a Leap Bot or to make a car speed down a ramp. However, they may not realize that they just learned how engineers solve problems or that they're good at engineering—unless you tell them.

That's why the Closing Ceremony is so important. It's where you can connect the dots for Brownies by:

- Pointing out how they acted as engineers. (**For example:** They did rapid prototyping. When one of their prototypes didn't work, they saw that "failure" as helpful feedback and tried something else. They worked together to find solutions. They shared their designs and offered suggestions.)
- Reminding Brownies that they are *already* engineers—and that it's fun to solve problems using engineering.
- Letting them know that they have what it takes to continue exploring STEM.

These simple messages can boost Brownies' confidence and interest in STEM—and end the meeting on an upbeat note!

Tell Your Troop Story: As a Girl Scout leader, you're designing experiences that Brownies will remember their whole lives. Try to capture those memories with photos or videos. Brownies love remembering all they did—and it's a great way for parents to see how Girl Scouting helps their Brownies!

And please do share your photos and videos with GSUSA by emailing them to STEM@girlscouts.org (with photo releases if at all possible!).

Prepare Ahead (Roughly 50 minutes)

1. Go over new words Brownies can learn (2 minutes)

This meeting includes the following words Brownies may not know:

- **Engineers** – People who like to know how things work. They design and build things people use every day, like computers, phones, roads, bridges, and cars.
- **Force** – The strength or energy that creates movement. Push and pull are examples of forces.
- **Thrust** – The force that pushes something through the air.
- **Drag** – The force (air molecules) that acts against something in flight.
- **Gravity** – A force that pulls objects toward each other and towards the earth.

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- **Lift** – A force that pushes back up on the wings during flight.
- **Balanced forces** – When forces are equal on an object, it does not move.
- **Unbalanced forces** – When forces are unequal on an object, it moves in the direction of the greater force.

See the **Glossary for Brownie Design Challenge Badges** for more vocabulary and examples.

2. Read through this guide and handouts (15 minutes)

This will help you get familiar with the flow of the meeting.

The following handouts can be found in Meeting Aids.

- **Brownie Design Challenge Badges: Materials List** Each meeting has its own materials list, but you can use this handout if you like to do all your supply shopping at one time. It includes the materials needed for all three Brownie Design Challenge badges.
- **Glossary for Brownie Design Challenge Badges:** This is a list of words that Brownies may not know and how to define them.
- **Think, Pair, Share:** These facilitation tips will help you to make sure that every girl's voice is heard during brainstorming activities.

3. Gather materials (30 minutes)

Gather materials using the Materials List for this meeting. If your meeting location doesn't have a flag, bring a small one that girls can take turns holding or hang in the room.

Prior to the meeting, make a Fling Flyer to show girls in Activity 4: Design and Build a Fling Flyer.

If your troop has the GoldieBlox Making Things Zoom kit, you can find a set of Activity Instructions for the badge in the Meeting Aids section of this badge meeting under "Activities for the Making Things Zoom Kit."

Get Help from Your Family and Friends Network

Your Friends and Family Network can include:

- Brownies' parents, aunts, uncles, older siblings, cousins, and friends
- Other volunteers who have offered to help with the meeting

Ask your Network to help:

- Bring materials
- Assist with Design Challenge activities

Fling Flyer Design Challenge 1

Award Connection

Brownies will earn one award:

- Fling Flyer Design Challenge badge

Brownies receive the award following the completion of all five steps of the badge in **Fling Flyer Design Challenge 2**.

(Note to Volunteers: You can buy these awards from your council shop or on the Girl Scouts' website.)

Meeting Length

90 minutes

- The times given for each activity will be different depending on how many Brownies are in your troop.
- There is no snack time scheduled in these meetings, but there are 15 minutes of “wiggle room” built in for snacks or activities that run long.
- Give Brownies 10- and 5-minute warnings before they need to wrap up the last activity so you'll have time for the Closing Ceremony.

Materials List:

Activity 1: As Girls Arrive: Engineering Paper Airplanes

- Paper (Construction, white, etc. A variety of papers gives girls the opportunity to try making planes with different paper weights.)
- Crayons, colored markers

Activity 2: Opening Ceremony: Taking Flight!

- Flag
- Optional: Poster Board with the Girl Scout Promise and Law

Activity 3: Learn About Forces that Affect Flight

- Paper Airplanes from Activity 1: As Girls Arrive: Engineering Paper Airplanes

Activity 4: Design and Build a Fling Flyer

- **Sample Fling Flyer** handout
- Prior to the meeting, make a Fling Flyer to show girls
- Paper
- Pencils

For each Fling Flyer, girls will need:

- 1 dowel. Alternatively, you could use BBQ skewers, straws, etc.

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- 10 or more craft sticks
- 1 paper clip
- 1 large rubber band
- 1 piece of heavy cardboard (small square)
- Paper (Construction, white, etc. A variety of papers gives girls the opportunity to try making planes with different paper weights.)
- Tape (masking or duct) or glue
- Scissors

Activity 5: Closing Ceremony: Fling Flyer Forces

- None

Awards

Girls do not receive any awards in this meeting.

Detailed Activity Plan

Activity 1: As Girls Arrive: Engineering Paper Airplanes (10 minutes)

Materials

- Paper (Construction, white, etc. A variety of papers gives girls the opportunity to try making planes with different paper weights.)
- Crayons, colored markers

Steps

Welcome Brownies and ask them to create paper airplanes.

SAY:

Today, you're going to engineer a Fling Flyer that flies across the room!

To start thinking about flight, can you make a paper airplane?

Here are some different types of paper and supplies to try out and decorate your paper airplane.

Activity 2: Opening Ceremony: Taking Flight! (10 minutes)

Materials

- Flag
- Optional: Poster Board with the Girl Scout Promise and Law

Fling Flyer Design Challenge 1

Steps

Recite the Pledge of Allegiance and the Promise and Law.

Conduct any troop business.

Introduce Brownies to the Fling Flyer Design Challenge.

SAY:

Today, we're starting the Fling Flyer Design Challenge badge!

You're going to learn how to create a Fling Flyer, an airplane powered by a rubber band, and explore what keeps it and other things—like birds, planes, and space ships—in the air.

Engineers use their imaginations to solve problems. They invent and build things. You'll do the same thing today!

Activity 3: Learn about Forces that Affect Flight (20 minutes)

Materials

- Paper Airplanes from Activity 1: As Girls Arrive: Engineering Paper Airplanes

Steps

Brownies learn about thrust, drag, gravity, and lift for Step One of the Fling Flyer Design Challenge.

Have Brownies line up (side to side) with their paper airplanes from Activity 1: As Girls Arrive: Engineering Paper Airplanes.

SAY:

Let's see you fly your paper airplanes. On the count of three, release your plane!

One, two, three...fly!

Brownies release their paper airplanes.

Introduce the forces that affect flight using the paper airplanes as an example.

SAY:

What makes the best paper airplane?

Girls may say: One that flies farthest, stays airborne longest, or does the most flips and tricks.

To design the best paper airplane or a Fling Flyer, we need to know about the forces that act on things when they fly.

Fling Flyer Design Challenge 1

What pushes the paper airplane forward through the air?

Girls may say: My arm, I threw it, etc.

By bending your elbow and throwing the airplane, you add extra strength or force into your airplane's flight.

Does anyone know what force is? (Answer: Force is the strength or energy that creates movement.)

Everything in our world moves because of different forces at play. Push and pull are two examples of forces.

You threw the paper airplane, propelling it through the air with force. This is called the "thrust." Thrust is an example of a force, or a push and pull that creates movement.

Why do the paper airplanes slow down?

Girls may say: The air stops them, I didn't throw hard enough, etc.

The airplanes slow down because there are little molecules of air that act with force against the airplane, slowing it down.

When you threw the paper airplane, it came back down, right? Why did that happen? (Answer: Gravity.)

Who knows what gravity is?

Girls may say: What makes things fall to the ground or I don't know.

Gravity is another force. Gravity is a force that pulls objects toward each other.

For example, when you drop a ball, it falls to the ground. That's because the earth's gravity pulls the ball toward it.

If you jump up, gravity brings you back down to the ground.

Can you show me how gravity brings you back when you jump? Try it out!

Brownies jump up and down.

Use the paper airplanes to explain lift and balanced forces.

SAY:

Did your airplane fly straight? If it didn't, why do you think this happened? (Answer: Air is in the way.)

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The wings deflect the air, which pushes back up on the wings. It's why paper flutters to the ground instead of falling straight down. This force is called "Lift."

For example, if you dropped a ball, would it flutter like dropping a paper airplane? (Answer: No or very little.)

The wings help the airplane to move against and through the air. Even when the airplane is falling, its wings are still at work, slowing its fall to the ground.

Now, whose airplane went the farthest? Raise your hand!

The Brownie whose airplane went the farthest raises her hand.

Explain balanced forces.

SAY:

Great job! You designed the airplane that moved through the air with the most force!

Now, what do you think would happen if you tried to fly your airplane outside on a very windy day?

Girls may say: It would be harder, it wouldn't fly straight, it wouldn't go very far, etc.

It would be very windy, adding more force that would act against your airplane, making it very hard to fly straight or even at all!

What way would your airplane move in the wind? (Answer: In the direction of the wind.)

The force of the wind is stronger than the force you put into throwing your airplane, so your airplane would go in the direction of the wind. This is called an unbalanced force.

When forces are unbalanced, the object moves in the direction of the greater force, like your airplane moving with the wind on a windy day.

What do you think happens when forces are balanced though? (Answer: Neither force moves the object.)

The object, like the airplane, doesn't move at all! The paper airplane won't fly itself, so you add force when you throw it.

Now, let's use all this information to build our own Fling Flyers.

Activity 4: Design and Build a Fling Flyer (20 minutes)

Materials

- **Sample Fling Flyer** handout

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Fling Flyer Design Challenge 1

- Prior to the meeting, make a Fling Flyer to show girls.
- Paper
- Pencils

For each Fling Flyer, girls will need:

- 1 dowel. Alternatively, you could use BBQ skewers, straws, etc.
- 10 or more craft sticks
- 1 paper clip
- 1 large rubber band
- 1 piece of heavy cardboard (small square)
- Paper (Construction, white, etc. A variety of papers gives girls the opportunity to try making planes with different paper weights.)
- Tape (masking or duct) or glue
- Scissors

Steps

Brownies build Fling Flyers for Step Two of the Fling Flyer Design Challenge.

Keep It Girl-Led: Girls may want to work in pairs or small design teams for the activity. Each group will need a full set of supplies, so help the girls to form their teams depending on the amount of materials available.

Show Brownies your sample Fling Flyer. If you want, fly it for girls to see how it works!

SAY:

Here's the Fling Flyer I created using the materials you'll have available today.

While mine is a good starting point, use your imagination to design a Fling Flyer that you think will maximize its ability to fly! Use the materials to make a Fling Flyer anyway you like.

Think about whether you'd like your Fling Flyer to fly far, stay airborne for a long time, or be able to do tricks.

What you want your Fling Flyer to do should inform your design.

Hand out paper and pencils to each team for Brownies to design their Fling Flyer. Show girls the materials available for the Design Challenge.

SAY:

Now, you're going to create a Fling Flyer using these materials.

Before engineers build things, they plan their design. Designing your product before you build allows you to think through any problems and troubleshoot them ahead of time.

Fling Flyer Design Challenge 1

Draw your fling flyer to help figure out how to build it. If you already have ideas to make the Flyer fly even better, feel free to try them out!

When they're finished designing, hand out materials.

Let the girls build their Fling Flyers and practice flying them.

Keep It Girl-Led: By having girls reverse engineer the Fling Flyer, Brownies have a hands-on opportunity to learn about the different parts instead of following directions. If they're having trouble, ask them questions like, "What materials do you recognize in the Fling Flyer? How are the wings constructed? How are the parts stuck together?"

Circulate among the groups, asking questions to prompt further exploration.

(Note to Volunteers: If you can, save the Brownies' Fling Flyers for the next meeting, Fling Flyer Design Challenge 2. Label each Flyer with the girl or group's name(s) and put away until the next meeting. If you are unable to keep them together, don't worry, the girls will have a chance to rebuild at the start of the next meeting.)

Activity 5: Closing Ceremony: Fling Flyer Forces (10 minutes)

Materials

- None

Steps

Have Brownies form a Friendship Circle and discuss with girls how they designed their Fling Flyers.

SAY:

What forces did you think about when designing and building your Fling Flyer?

What pushes the Flyer forward through the air? (Answer: The rubber band. This is called "Thrust.")

Why does the Flyer slow down? (Answer: It has to push air molecules out of the way. This is called "Drag.")

What pulls the Flyer back down to the ground? (Answer: Gravity.)

Why doesn't it fall straight down if gravity is pulling on it? (Answer: Air is in the way—the wings deflect the air, which pushes back up on the wings. It's why paper flutters to the ground. This force is called "Lift.")

Fling Flyer Design Challenge 1

When forces on an object are balanced, like a box being pushed equally by two girls on opposite sides, what happens? (Answer: Neither force moves the object.)

When forces are unbalanced, like two girls pushing on one side of the box or trying to walk on a windy day, what happens? (Answer: The object moves in the direction of the greater force.)

End the meeting with a Friendship Squeeze.

On your honor!

Design Challenge Badges Glossary for Brownies

Brownies may not know some of the words used in these badges. Here are definitions you can share with them:

Balanced forces exist when forces are equal on an object. When the forces are balanced, the object does not move.

Data is information that engineers receive, collect, or observe during testing of their designs.

Drag is the force (air molecules) that acts against something in flight.

Engineers are people who like to know how things work. They design and build things people use every day, like computers, phones, roads, bridges and cars.

Features are parts of a product that are designed make them more useful.

Force is the strength or energy that creates movement. Push and pull are examples of force.

Friction is a force that slows moving objects.

Gravity is a force that pulls objects toward each other and towards the earth.

When potential energy is released, it becomes **kinetic energy** which bring bodies and object to move.

Lift is a force that pushes back up on the wings during flight.

Potential energy is the energy stored in your body and everything else in our world.

Thrust is the force that moves an object.

Unbalanced forces exist when forces are unequal on an object. When the forces are unbalanced, it moves in the direction of the greater force.

Brownie Design Challenge Badges (DIY Activity Version)

Brownie Design Challenge Badges: Materials List**Leap Bot Design Challenge 1****Activity 1: As Girls Arrive: Jump Up!**

- None

Activity 2: Opening Ceremony: What Do Engineers Think About?

- Flag
- Optional: Poster Board with the Girl Scout Promise and Law

Activity 3: Learn About Springs

- **Sample Leap Bot** handout
- Optional: Leap Bot made by you to show girls

Activity 4: Build Your Leap Bot

For each Leap Bot, girls will need at least:

- 1 wooden dowel. Alternatively, you could use straws, BBQ skewers, unsharpened pencils, etc.) (**Note to Volunteers:** Make sure the dowels fit in the spools.)
- 1 spool (**Note to Volunteers:** While girls will only need one spool to build a Leap Bot, offering a variety of spools in different sizes will give girls the chance to engineer individual designs and test out different solutions.)
- 1 piece of heavy cardboard (6 inch x 6 inch square)
- 1 compression spring (**Note to Volunteers:** Make sure the spring fits over the dowel. You should be able to purchase one box of springs with enough springs in a variety of sizes to fit your entire troop.)
- Clay or poster putty
- Tape (masking or duct)
- 2 pipe cleaners
- Scissors
- Optional: wood glue for girls to connect multiple spools into one Bot

Activity 5: Closing Ceremony: Flash Chat

- None

Leap Bot Design Challenge 2**Activity 1: As Girls Arrive: Prepare for Testing**

- Leap Bots created by girls in Leap Bots Design Challenge 1 (**Note to Volunteers:** If you were unable to save the Bots between meetings, Brownies can rebuild them during this activity.)
- Leftover materials, like spools, dowels, pipe cleaners, etc.
- Supplies for girls to change the size of and decorate their Leap Bots, like construction paper, googly eyes, stickers, markers, tape, scissors, etc.
- Optional: wood glue for girls to connect multiple spools into one Bot

Brownie Design Challenge Badges (DIY Activity Version)

Leap Bot Design Challenge 2 (continued)

Activity 2: Opening Ceremony: Leap Bot Forces

- Flag
- Optional: Poster Board with the Girl Scout Promise and Law

Activity 3: Create a Way to Test How Well Your Leap Bot Performs

- Leap Bots created by girls in Activity 1: As Girls Arrive: Prepare for Testing
- Rulers, yardsticks, etc.
- Tape
- Paper

Activity 4: Record the Results of Your Test

- Leap Bots created by girls in Activity 1: As Girls Arrive: Prepare for Testing
- Leap Bot Testing Stations created by girls in Activity 3: Create a Way to Test How Well Your Leap Bot Performs
- Long and short compression springs (3 or more for testing team) (**Note to Volunteers:** Make sure the springs fit over the dowel. You should be able to purchase one box of springs with enough springs in a variety of sizes to fit your entire troop.)
- Paper
- Pencils

Activity 5: Share Your Results

- Papers with testing results created by girls in Activity 4: Record the Results of Your Test.

Activity 6: Closing Ceremony: Awards

- Leap Bot Design Challenge award, one for each girl

(Note to Volunteers: You can buy these awards from your council shop or the Girl Scouts' website.)

Fling Flyer Design Challenge 1

Activity 1: As Girls Arrive: Engineering Paper Airplanes

- Paper (Construction, white, etc. A variety of papers gives girls the opportunity to try making planes with different paper weights.)
- Crayons, colored markers

Activity 2: Opening Ceremony: Taking Flight!

- Flag
- Optional: Poster Board with the Girl Scout Promise and Law

Activity 3: Learn About Forces that Affect Flight

- Paper Airplanes from Activity 1: As Girls Arrive: Engineering Paper Airplanes

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Brownie Design Challenge Badges (DIY Activity Version)

Fling Flyer Design Challenge 1 (continued)

Activity 4: Design and Build a Fling Flyer

- **Sample Fling Flyer** handout
- Prior to the meeting, make a Fling Flyer to show girls.
- Paper
- Pencils

For each Fling Flyer, girls will need:

- 1 dowel
- 10 or more craft sticks
- 1 paper clip
- 1 large rubber band
- 1 piece of heavy cardboard (small square)
- Paper (Construction, white, etc. A variety of papers gives girls the opportunity to try making planes with different paper weights.)
- Tape (masking or duct) or glue
- Scissors

Activity 5: Closing Ceremony: Fling Flyer Forces

- None

Fling Flyer Design Challenge 2

Activity 1: As Girls Arrive: Prepare for Testing

- Fling Flyers created by girls in Fling Flyer Design Challenge 1 (**Note to Volunteers:** If you were unable to save the Flyers between meetings, Brownies can rebuild them during this activity.)
- Materials for girls to redesign or decorate their Flyers, like craft sticks, paper, markers, stickers, etc.

Activity 2: Opening Ceremony: Forces that Affect Flight

- Flag
- Optional: Poster Board with the Girl Scout Promise and Law

Activity 3: Test Your Fling Flyer

- Fling Flyers created by girls in Activity 1: As Girls Arrive: Prepare for Testing
- Leftover materials for girls to redesign their Flyers, like craft sticks, paper, paper clips, tape, etc.
- Masking tape
- Cone, rock, or anything else to mark the furthest distance flown

Activity 4: Analyze and Share Your Results

- None

Brownie Design Challenge Badges (DIY Activity Version)

Fling Flyer Design Challenge 2 (continued)

Activity 5: Brainstorm Ways to Improve Your Design

- Fling Flyers from Activity 3: Test Your Fling Flyer
- Optional: Leftover materials for girls to redesign their Flyers, like craft sticks, paper, paper clips, tape, etc.

Activity 6: Closing Ceremony: Awards

- Fling Flyer Design Challenge award, one for each girl

(Note to Volunteers: You can buy these awards from your council shop or the Girl Scouts' website.)

Race Car Design Challenge 1

Activity 1: As Girls Arrive: Playing with Force and Friction

- Sports and game balls (one for each pair of girls). Bring different types of balls for girls to roll and observe friction. For example, you might bring a marble, tennis ball, basketball, ping pong ball, baseball, etc.
- Create two lines with masking tape on the floor. Each Brownie should sit on the line, facing their partner.

Activity 2: Opening Ceremony: Engineering Speed

- Flag
- Optional: Poster Board with the Girl Scout Promise and Law

Activity 3: Learn How Design Can Affect Speed

- Toy car to demonstrate force and friction

Activity 4: Design and Build Your Race Car

- **Sample Race Car** handout
- Optional: Create a sample race car for girls to reverse engineer.

Suggested materials for each race car:

- 2 or 4 (depending on length and size of cabin) wooden dowels. Alternatively, you could use BBQ skewers, straws, or other materials to attach the wheels through the car cabin. **(Note to Volunteers:** Make sure the dowels or other wheel attachments fit in the wheels and allow wheel rotation.)
- 4 wooden wheels. Alternatively, you could bring round soda caps, CDs, or other round materials for girls to test.
- Clay or poster putty
- Small and medium boxes (assorted sizes.) A variety of boxes give girls the opportunity to try different materials for their car.
- Optional: Other materials for girls to use in their race car, such as paper towels, pieces of cardboard, cups, etc.

Brownie Design Challenge Badges (DIY Activity Version)

Race Car Design Challenge 1 (continued)

Activity 4: Design and Build Your Race Car (continued)

- **Note to Volunteers:** Depending on what you have available, Brownies can experiment using the different materials to create their race car.

Activity 5: Closing Ceremony: Share Your Design

- Race Cars built by Brownies in Activity 4: Design and Build Your Race Car

Race Car Design Challenge 2

Activity 1: As Girls Arrive: Build A Simple Ramp

- Race cars created by girls in Race Car Design Challenge 1. (**Note to Volunteers:** If you were unable to save the race cars between meetings, Brownies can rebuild their cars during this activity.)
- Folders, poster boards, cardboard, etc., to lean against something to create a ramp
- Books, boxes, tables, etc. to create the height and top of a ramp

Activity 2: Opening Ceremony: Reviewing Force and Friction

- Flag
- Optional: Poster Board with the Girl Scout Promise and Law

Activity 3: Design Your Racetrack

- Poster boards, cardboard, etc., to lean against something to create ramps
- Table(s) or books to create the top of ramps
- Paper or newspaper
- Masking tape

Activity 4: Conduct a Fair Test and Record Results

- Yardstick
- Ramp created by girls in Activity 3: Design Your Racetrack
- Race cars created by girls in Race Car Design Challenge 1 or rebuilt in Activity 1: As Girls Arrive: Build a Simple Ramp
- Leftover or additional materials for girls to rebuild their race cars. You may want to bring dowels, wheels, boxes, cups, cardboard, paper tubes, clay or poster putty, tape, etc.
- Optional: Phone or camera to capture “photo finishes”

Activity 5: Share What You Learned

- Race cars redesigned by girls in Activity 4: Conduct a Fair Test and Record Results

Activity 6: Closing Ceremony: Awards

- Race Car Design Challenge award, one for each girl

(Note to Volunteers: You can buy these awards from your council shop or the Girl Scouts’ [website](#).)

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Brainstorming Tips: Think, Pair, Share

How to Run a Think, Pair, Share Activity:

Tell girls that they're going to brainstorm answers to your question using "Think, Pair, Share."

Lead girls through the basic steps by telling them they will:

1. Break into small groups.

2. Listen to the question or prompt.

3. Think about their answers.

- Girls may want to write their answers down.
- Twenty seconds should be enough time, since girls will need to sit quietly.

4. Pair with other girls.

- Girls talk with one to three other girls (depending on group size), making sure everyone has a chance to share their answers. If there's time, it's OK for girls to ask questions about each other's answers.
- For pairs, 20 seconds should be enough time. If your troop enjoys discussion, consider extending this to 1 to 2 minutes.

5. Share with the group.

- Girls share their answers with the larger group.
- This can be completed in 20 – 30 seconds, but will run longer based on group size and how the group sharing is done.

There are two ways to set up group sharing:

- **Strongly Recommended:** One girl shares the best/most interesting/summary answer for the group. This approach is great if you're running short on time. It also helps develop conflict resolution and compromise skills.
- **Optional:** Each girl shares her partner's answer. This helps girls develop active listening skills, but will run longer because all girls are sharing.

The Girl Scout Promise

On my honor, I will try:

To serve God and my country,

To help people at all times,

And to live by the Girl Scout Law.

The Girl Scout Law

I will do my best to be

honest and fair,

friendly and helpful,

considerate and caring,

courageous and strong, and

responsible for what I say and do,

and to

respect myself and others,

respect authority,

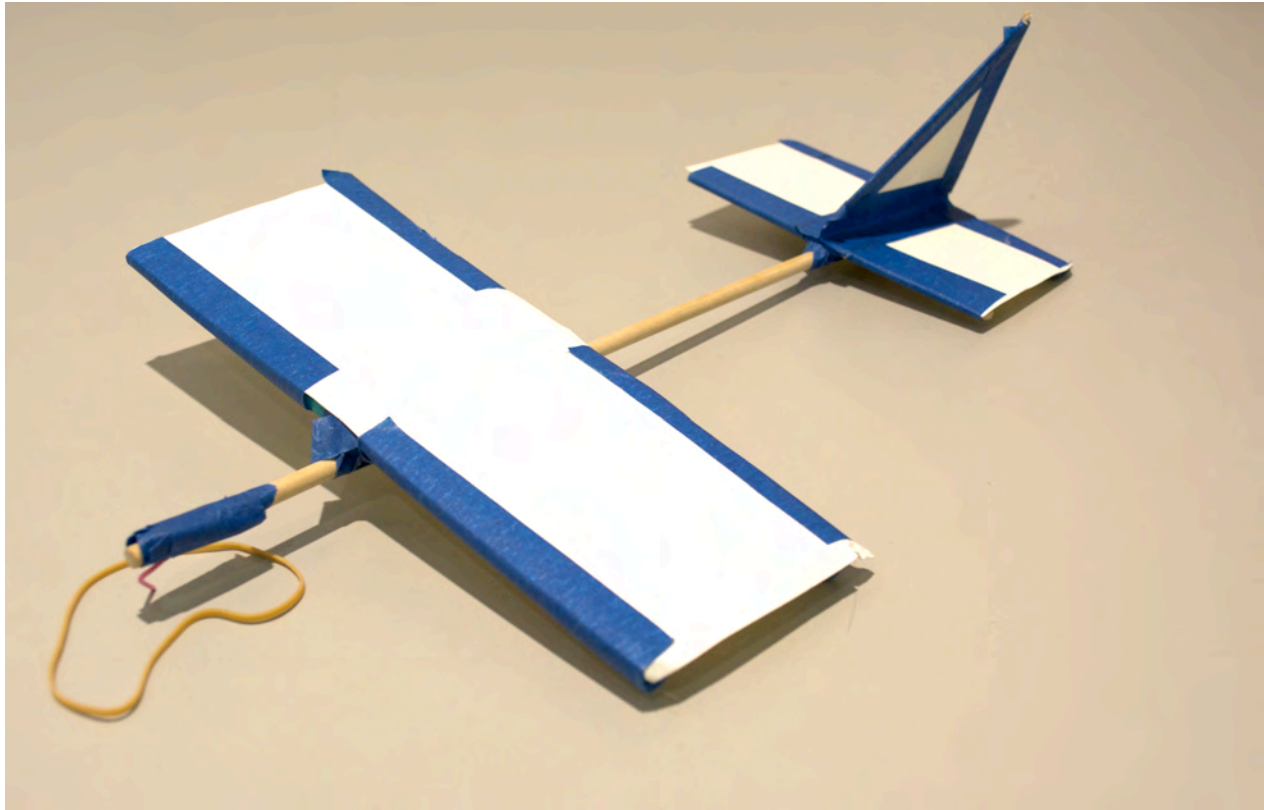
use resources wisely,

make the world a better place, and

be a sister to every Girl Scout.

Fling Flyer Design Challenge

Sample Fling Flyer



This Fling Flyer is made from: 1 dowel, 8 craft sticks, 1 paperclip, 1 rubber band, paper, tape.

Fling Flyer Design Challenge 1 (Version for the Making Things Zoom Kit)

Note to Volunteers on the GoldieBlox Making Things Zoom kit:

This version of the badge uses the GoldieBlox Making Things Zoom kit. Each kit includes 6 sets of GoldieBlox parts for the badge, (i.e. you can create 6 of any Brownie Design Challenge badge from one kit). Inside the kit are six sets of GoldieBlox parts that allow girls to earn all 3 Brownie Design Challenge badges. Two to four girls can use each set. So, if you have 12 girls, you will need one kit for them to work in pairs.

The kit is no longer available to purchase, but you can find a full parts list at the end of this handout if you want to pull together the GoldieBlox for the badges. If you do not have the GoldieBlox, we recommend completing the badge using the DIY instructions now included as the Meeting Plan on VTK.

Materials List

As Girls Arrive: Engineering Paper Airplanes

- Paper (Construction, white, etc. A variety of papers gives girls the opportunity to try making planes with different paper weights.)
- Crayons, colored markers

Opening Ceremony: Taking Flight!

- Flag
- Optional: Poster Board with the Girl Scout Promise and Law

Step One: Learn About Forces that Affect Flight

- Paper Airplanes from As Girls Arrive: Engineering Paper Airplanes

Step Two: Design and Build a Fling Flyer

- GoldieBlox Making Things Zoom kit (one set for each girl, pair, or small team)
- Sample Fling Flyer
- Paper
- Pencils
- Optional: **Fling Flyer Investigation worksheets**

For each Fling Flyer, girls will need these GoldieBlox:

- 2 mini axles
- 1 long axle
- 2 star stoppers
- 1 angle joint

Fling Flyer Design Challenge 1 (Version for the Making Things Zoom Kit)

- 2 T-joints
- 1 craftstruction wing (Alternatively, you can prepare or have girls create their own wings using cardstock, construction, or copy paper and scissors/paper hole push.)
- 1 rubber band

Closing Ceremony: Fling Flyer Forces

- None

Awards

Girls do not receive any awards in this meeting.

Detailed Activity Plan

As Girls Arrive: Engineering Paper Airplanes (10 minutes)

Materials

- Paper (Construction, white, etc. A variety of papers gives girls the opportunity to try making planes with different paper weights.)
- Crayons, colored markers

Steps

Welcome Brownies, and ask them to create paper airplanes.

SAY:

Today, you're going to engineer a Fling Flyer that flies across the room!

To start thinking about flight, can you make a paper airplane?

Here are some different types of paper and supplies to try out and decorate your paper airplane.

Fling Flyer Design Challenge 1 (Version for the Making Things Zoom Kit)

Opening Ceremony: Taking Flight! (10 minutes)

Materials

- Flag
- Optional: Poster Board with the Girl Scout Promise and Law

Steps

Recite the Pledge of Allegiance and the Promise and Law.

Conduct any troop business.

Introduce Brownies to the Fling Flyer Design Challenge.

SAY:

Today, we're starting the Fling Flyer Design Challenge badge!

You're going to learn how to create a Fling Flyer, an airplane made with GoldieBlox, and explore what keeps it and other things, like birds, planes, and space ships, in the air.

Engineers use their imaginations to solve problems. They invent and build things. You'll do the same thing today!

Step One: Learn About Forces that Affect Flight (20 minutes)

Materials

- Paper Airplanes from Activity 1: As Girls Arrive: Engineering Paper Airplanes

Steps

Brownies learn about thrust, drag, gravity, and lift for Step One of the Fling Flyer Design Challenge.

Have Brownies line up (side to side) with their paper airplanes from Activity 1: As Girls Arrive: Engineering Paper Airplanes.

SAY:

Let's see you fly your paper airplanes. On the count of three, release your plane!

One, two, three...fly!

Brownies release their paper airplanes.

Introduce the forces that affect flight using the paper airplanes as an example.

Fling Flyer Design Challenge 1 (Version for the Making Things Zoom Kit)

SAY:

What makes the best paper airplane?

Girls may say: One that flies farthest, stays airborne longest, or does the most flips and tricks.

To design the best paper airplane or a Fling Flyer, we need to know a little bit about the forces that act on things when they fly.

What pushes the paper airplane forward through the air?

Girls may say: My arm, I threw it, etc.

By bending your elbow and throwing the airplane, you can add extra strength or force into your airplane's flight.

Does anyone know what force is? (Answer: Force is the strength or energy that creates movement.)

Everything in our world moves because of different forces at play. Push and pull are two examples of forces.

You threw the paper airplane, propelling it through the air with force. This is called the "thrust". Thrust is an example of a force, or a push and pull that creates movement.

Why do the paper airplanes slow down?

Girls may say: The air stops them, I didn't throw hard enough, etc.

The airplanes slow down because there are little molecules of air that act with force against the airplane, slowing it down.

When you threw the paper airplane, it came back down, right? Why did that happen? (Answer: Gravity.)

Who knows what gravity is?

Girls may say: What makes things fall to the ground or I don't know.

Gravity is another force. Gravity is a force that pulls objects toward each other.

For example, when you drop a ball, it falls to the ground. That's because the earth's gravity pulls the ball toward it.

If you jump up, gravity brings you back down to the ground.

Fling Flyer Design Challenge 1 (Version for the Making Things Zoom Kit)

Can you show me how gravity brings you back when you jump? Try it out!

Brownies jump up and down.

Use the paper airplanes to explain lift and balanced forces.

SAY:

Did your airplane fly straight? If it didn't, why do you think this happened? (Answer: Air is in the way.)

The wings deflect the air, which pushes back up on the wings. It's why paper flutters to the ground instead of falling straight down. This force is called "Lift."

For example, if you dropped a ball, would it flutter like dropping a paper airplane? (Answer: No or very little.)

The wings help the airplane to move against and through the air. Even when the airplane is falling, its wings are still at work, slowing its fall to the ground.

Now, whose airplane went the farthest? Raise your hand!

The Brownie whose airplane went the farthest raises her hand.

Explain balanced forces.

SAY:

Great job! You designed the airplane that moved through the air with the most force!

Now, what do you think would happen if you tried to fly your airplane outside on a very windy day?

Girls may say: It would be harder, it wouldn't fly straight, it wouldn't go very far, etc.

It would be very windy, adding more force that would act against your airplane, making it very hard to fly straight or even at all!

What way would your airplane move in the wind? (Answer: In the direction of the wind.)

The force of the wind is stronger than the force you put into throwing your airplane, so your airplane would go in the direction of the wind. This is called an unbalanced force.

When forces are unbalanced, the object moves in the direction of the greater force, like your airplane moving with the wind on a windy day.

What do you think happens when forces are balanced though? (Answer: Neither force moves the object.)

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Fling Flyer Design Challenge 1 (Version for the Making Things Zoom Kit)

The object, like the airplane, doesn't move at all! The paper airplane won't fly itself, so you add force when you throw it.

Now, let's use all this information to build our own Fling Flyers.

Step Two: Design and Build a Fling Flyer (20 minutes)

Materials

- GoldieBlox Making Things Zoom kit (one set for each girl, pair, or small team)
- Sample Fling Flyer
- Paper
- Pencils
- Optional: **Fling Flyer Investigation worksheets**

For each Fling Flyer, girls will need these GoldieBlox:

- 2 mini axles
- 1 long axle
- 2 star stoppers
- 1 angle joint
- 2 T-joints
- 1 craftstruction wing (Alternatively, you can prepare or have girls create their own wings using cardstock, construction, or copy paper and scissors/paper hole push.)
- 1 rubber band

Steps

If you don't have enough supplies for each Brownie to make her own Fling Flyer, divide Brownies into pairs or small groups for Step Two of the Fling Flyer Design Challenge.

Show Brownies your sample Fling Flyer.

Optional: Distribute **Fling Flyer Investigation worksheets** for girls to design their Fling Flyer, thinking and considering the forces at work. Give the girls time to design their investigations.

Hand out paper and pencils to each team for Brownies to design their Fling Flyer.

SAY:

Now, you're going to use your GoldieBlox to create a Fling Flyer.

Before engineers build things, they plan their design. Designing your product before you build allows you to think through any problems and troubleshoot them ahead of time.

Fling Flyer Design Challenge 1 (Version for the Making Things Zoom Kit)

Draw your fling flyer to help figure out how to build it. If you already have ideas to make the Flyer fly even better, feel free to try them out!

When they're finished designing, hand out the GoldieBlox sets.

(Note to Volunteers: If you do not have enough craftstruction wings for every Fling Flyer, have girls use one as a template to cut and create others with heavy paper and scissors/hole punch.)

Let the girls build their Fling Flyers and practice flying them.

Keep It Girl-Led: By having girls reverse engineer the Fling Flyer, Brownies have a hands-on opportunity to learn about the different parts instead of following directions. If they're having trouble, ask them questions like, "What GoldieBlox do you recognize in the Fling Flyer? How are they stuck together?"

If girls need help, lead them to connect the angle joint to the long axle. On the other end of the long axle, add a T-Joint, mini axle, and another T-joint. Connect the craftstruction or paper wing by placing the holes on top on the T-joints and attaching the star stoppers.

Optional: Show Brownies the "How to Build a Fling Flyer" video [here](#) for video instructions.

Circulate among the groups, asking questions to prompt further exploration.

(Note to Volunteers: You may want to save the Brownies' Fling Flyers for the next meeting, Fling Flyer Design Challenge 2. If you are able to, label each Flyer with the girl or group's name(s) and put away until the next meeting. If you are unable to keep them together, don't worry, the girls will have a chance to rebuild at the start of the next meeting.)

Closing Ceremony: Fling Flyer Forces (10 minutes)

Materials

- None

Steps

Have Brownies form a Friendship Circle, and discuss with girls how they designed their Fling Flyers.

SAY:

What forces did you think about when designing and building your Fling Flyer?

What pushes the Flyer forward through the air? (Answer: The rubber band. This is called "Thrust.")

Fling Flyer Design Challenge 1 (Version for the Making Things Zoom Kit)

Why does the Flyer slow down? (Answer: It has to push air molecules out of the way. This is called “Drag.”)

What pulls the Flyer back down to the ground? (Answer: Gravity.)

Why doesn't it fall straight down if gravity is pulling on it? (Answer: Air is in the way—the wings deflect the air, which pushes back up on the wings. It's why paper flutters to the ground. This force is called “Lift.”)

When forces on an object are balanced, like a box being pushed equally by two girls on opposite sides, what happens? (Answer: Neither force moves the object.)

When forces are unbalanced, like two girls pushing on one side of the box or trying to walk on a windy day, what happens? (Answer: The object moves in the direction of the greater force.)

End the meeting with a Friendship Squeeze.

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Fling Flyer Design Challenge 1 (Version for the Making Things Zoom Kit)

GoldieBlox Making Things Zoom kit – Parts Breakdown

GoldieBlox	# in set	# in kit (6 sets)
Quarter Pegboard	1	6
Small Wheel Hub	6	36
Small Wheel End	8	48
Big Wheel End	2	12
Blox (18 mm)	8	48
Coupler Joint	4	24
Elbow Joint	6	36
T-Joint	4	24
Corner Joint	4	24
Cross Joint	4	24
5-way Joint	8	48
Popcorn Joint	2	12
Peg	18	108
Mini Axle	16	96
Short Axle	12	72
Long Axle	8	48
Short Flexi Axle	6	36
Long Flexi Axle	2	12
Washer	8	48
Spacer	12	72

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Fling Flyer Design Challenge 1 (Version for the Making Things Zoom Kit)

Crank	1	6
Star Stopper	10	60
Suction Cup	2	12
Tire	4	24
Noodle Belt	1	6
Spring - medium	2	12
Spring – short	2	12
Rubber band	1	6
Pom Poms	10	60
Stickers	2	12
Punch Outs	2	12
Poster	1	6

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Fling Flyer

engineering concept:
AERODYNAMICS

build date:

I built it!



x1



x1



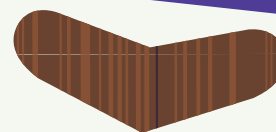
x2



x2



x1



x1



x1



Fling Flyer Design Challenge badge

NAME _____

Fling Flyer Investigation

1. Choose the criteria for success (Response Variable). Circle one or write your own:

Flies farthest

Stays airborne longest

Does the most flips

2. Which forces do you need to maximize? Which do you need to reduce?

MAXIMIZE	reduce

3. Choose a design to test (Independent Variable). Circle one or write your own:

Tail Width

Tail Length

Tail Shape

Bend Tips Up

Bend Tips Down

Cut Slits Along the Back

4. Write your research question:

How does _____ affect _____?
independent variable *response variable*

5. Predict how you think the shape of your Fling Flyer will affect its motion. This is your *hypothesis*.

6. How will you measure your Fling Flyer's motion?

7. How will you make your trials "fair tests"?

8. How many times will you measure your design to be sure of your results?

Draw a table on the back of this page to record your data.

Brownie Design Challenge Badges: Materials List

Leap Bot Design Challenge 1

Opening Ceremony: All About Solving Problems

- Flag
- Optional: Poster Board with the Girl Scout Promise and Law

Step One: Learn About Springs

- Sample Leap Bot made from the GoldieBlox Making Things Zoom kit

Step Two: Build Your Leap Bot

- GoldieBlox Making Things Zoom kit (one set for each pair or small team)

For each Leap Bot, girls will need these GoldieBlox:

- 4 mini axles
- 1 long axle
- 2 angle joints
- 2 elbow joints
- 4 spacers
- 4 pegs
- 1 star coupler
- 3 wheel hubs
- 3 small wheel ends
- 2 big wheel ends
- 1 long spring

Leap Bot Design Challenge 2

As Girls Arrive: Prepare For Testing

- Leap Bots created by girls in Leap Bots Design Challenge 1. (**Note to Volunteers:** If you were unable to save the Bots between meetings, Brownies can rebuild them during this activity.)
- Leftover pieces from the GoldieBlox Making Things Zoom kit (one set for each pair or small team).

Opening Ceremony: Leap Bot Forces

- Flag
- Optional: Poster Board with the Girl Scout Promise and Law

Step Three: Create a Way to Test How Well Your Leap Bot Performs

- Leap Bots created by girls in Leap Bot Design Challenge 1 or As Girls Arrive: Prepare for Testing
- Rulers, yardsticks, etc.
- Tape
- Paper

Brownie Design Challenge Badges: Materials List

Leap Bot Design Challenge 2 (continued)

Step Four: Record the Results of Your Test

- Leap Bots created by girls in Leap Bot Design Challenge 1 or As Girls Arrive: Prepare for Testing
- Leap Bot Testing Stations created by girls in Step Three: Create a Way to Test How Well Your Leap Bot Performs
- **Leap Bot Recording Sheet**, one for each girl or team
- Long and Short springs from the GoldieBlox Making Things Zoom kit (3 or more from each set for each pair or small team)
- Leftover pieces from the GoldieBlox Making Things Zoom kit (for each pair or small team)

Step Five: Share Your Results

- **Leap Bot Recording Sheets**, filled out by girls in Step Four: Record the Results of Your Test

Closing Ceremony: Awards

- Leap Bot Design Challenge award, one for each girl

(Note to Volunteers: You can buy these awards from your council shop or on the Girl Scouts' website.)

Fling Flyer Design Challenge 1

As Girls Arrive: Engineering Paper Airplanes

- Paper (Construction, white, etc. A variety of papers gives girls the opportunity to try making planes with different paper weights.)
- Crayons, colored markers

Opening Ceremony: Taking Flight!

- Flag
- Optional: Poster Board with the Girl Scout Promise and Law

Step One: Learn About the Forces that Affect Flight

- Paper Airplanes from As Girls Arrive: Engineering Paper Airplanes

Step Two: Design and Build a Fling Flyer

- GoldieBlox Making Things Zoom kit (one set for each girl, pair, or small team)
- Sample Fling Flyer
- Paper
- Pencils
- Optional: **Fling Flyer Investigation worksheets**

For each Fling Flyer, girls will need these GoldieBlox:

- 2 mini axles
- 1 long axle
- 2 star stoppers
- 1 angle joint
- 2 T-joints
- 1 craftstruction wing (Alternatively, you can prepare or have girls create their own wings using cardstock, construction, or copy paper and scissors/paper hole push.)
- 1 rubber band

Brownie Design Challenge Badges: Materials List

Fling Flyer Design Challenge 2

As Girls Arrive: Prepare for Testing

- Fling Flyers created by girls in Fling Flyer Design Challenge 1. (**Note to Volunteers:** If you were unable to save the Flyers between meetings, Brownies can rebuild them during this activity.)

Opening Ceremony: Forces that Affect Flight

- Flag
- Optional: Poster Board with the Girl Scout Promise and Law

Step Three: Test Your Fling Flyer

- Fling Flyers created by girls in Fling Flyer Design Challenge 1 or As Girls Arrive: Prepare for Testing
- Cardstock, construction paper, or copy paper (the heavier the better)
- Scissors or hole punches
- Leftover pieces from the GoldieBlox Making Things Zoom kit (one set for each pair or small team)
- Masking tape
- Cone, rock, or anything else to mark the furthest distance flown

Step Five: Brainstorm Ways to Improve Your Design

- Fling Flyers from Step Three: Test Your Fling Flyer
- Cardstock, construction paper, or copy paper (the heavier the better)
- Scissors or hole punches
- Leftover pieces from the GoldieBlox Making Things Zoom kit (one set for each pair or small team)

Closing Ceremony: Awards

- Fling Flyer Design Challenge award, one for each girl

(**Note to Volunteers:** You can buy these awards from your council shop or on the Girl Scouts' website.)

Race Car Design Challenge 1

As Girls Arrive: Playing with Force and Friction

- Sports and game balls (one for each pair of girls). Bring different types of balls for girls to roll and observe friction. For example, you might bring a marble, tennis ball, basketball, ping pong ball, baseball, etc.
- Create two lines with masking tape on the floor. Each Brownie should sit on the line, facing their partner.

Opening Ceremony: Engineering Speed

- Flag
- Optional: Poster Board with the Girl Scout Promise and Law

Step One: Learn How Design Can Affect Speed

- Toy car to demonstrate force and friction

Brownie Design Challenge Badges: Materials List

Race Car Design Challenge 1 (continued)

Step Two: Design and Build Your Race Car

- GoldieBlox Making Things Zoom kit (one set for each pair or small team.) Feel free to add additional pieces from personal GoldieBlox kits that you or your Girl Scouts may own.

Closing Ceremony: Share Your Design

- Race Cars built by Brownies in Step Two: Design and Build Your Race Car

Race Car Design Challenge 2

As Girls Arrive: Build A Simple Ramp

- Race cars created by girls in Race Car Design Challenge 1. (**Note to Volunteers:** If you were unable to save the race cars between meetings, Brownies can rebuild their cars during this activity.)
- Folders, poster boards, cardboard, etc., to lean against something to create a ramp
- Books, boxes, tables, etc. to create the height and top of a ramp

Opening Ceremony: Reviewing Force and Friction

- Flag
- Optional: Poster Board with the Girl Scout Promise and Law

Step Three: Design Your Racetrack

- Poster boards, cardboard, etc., to lean against something to create ramps
- Table(s) or books to create the top of ramps
- Paper or newspaper
- Masking tape

Step Four: Conduct a Fair Test and Record Results

- Yardstick
- Ramp created by girls in Step Three: Design Your Racetrack
- Race cars created by girls in Race Car Design Challenge 1 or rebuilt in As Girls Arrive: Build a Simple Ramp
- Optional: Phone or camera to capture “photo finishes”

Step Five: Share What You Learned

- Race cars redesigned by girls in Step Four: Conduct a Fair Test and Record Results

Closing Ceremony: Awards

- Race Car Design Challenge award, one for each girl

(**Note to Volunteers:** You can buy these awards from your council shop or on the Girl Scouts’ website.)