

Race Car Design Challenge 1

Overview:

In the Race Car Design Challenge, Brownies design cars and race tracks, then carry out “fair tests” to learn how design affects speed. Brownies learn how to design and test a car—and how design affects speed.

Step One: Learn how design can affect speed.

Step Two: Design and build your race car.

Step Three: Design your racetrack. *(To be completed in Race Car Design Challenge 2.)*

Step Four: Conduct a fair test and record results. *(To be completed in Race Car Design Challenge 2.)*

Step Five: Share what you learned. *(To be completed in Race Car Design Challenge 2.)*

This meeting, Brownies learn about speed and friction before they design and build a race car. They complete Step One and Step Two of the Race Car 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!”

~~This approach also keeps the activity girl-led and fun because Brownies are free to invent things~~

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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:

- **Force** – The strength or energy that creates movement. Push and pull are examples of force.
- **Friction** – A force that slows moving objects.
- **Features** – Parts of a product that are designed make them more useful.

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

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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, you may want to create a sample race car to show to girls. Alternatively, you can show them the Meeting Aid, **Sample Race Car**.

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

Award Connection

Brownies will earn one award:

- Race Car Design Challenge badge

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

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

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

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Activity 5: Closing Ceremony: Share Your Design

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

Awards

Girls do not receive any awards in this meeting.

Detailed Activity Plan

Activity 1: As Girls Arrive: Playing with Force and Friction (10 minutes)

Materials

- 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.

Steps

Prior to girls arriving, create two masking tape lines. The lines should be close enough that Brownies can roll a ball back and forth between them.

As Brownies arrive, welcome them, and have them pair up. Hand each pair a ball, and have them sit facing each other on the lines and roll their ball back and forth.

Brownies can roll their ball a few times, then exchange it with another pair to try another.

SAY:

Roll your ball back and forth with your partner.

What happens when you roll it lightly? Does it reach your partner?

What happens when you roll it with a lot of strength?

Brownies roll their balls, experimenting with force.

Activity 2: Opening Ceremony: Engineering Speed (10 minutes)

Materials

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

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Steps

Recite the Pledge of Allegiance and the Promise and Law.

Conduct any troop business.

Introduce Brownies to the Race Car Design Challenge badge.

SAY:

Today you're going to be engineers as we start the Race Car Design Challenge!

You'll design, build, and test race cars. Next time, you'll get to improve them based on your tests and race them down a race track!

Activity 3: Learn How Design Can Affect Speed (15 minutes)

Materials

- Toy car to demonstrate force and friction

Steps

Brownies explore the concepts of speed and friction through a volunteer demonstration for Step One of the Race Car Design Challenge.

Compare how the different balls rolled in Activity 1: As Girls Arrive: Playing with Force and Friction as examples of force.

SAY:

Let's get started and learn something important engineers have to think about when they build things.

When you were rolling your balls earlier, what made the balls move faster? (Answer: Rolling it with more strength or force.)

When you were rolling your balls earlier, what made the balls move slower? (Answer: Using less strength or force.)

Each time you rolled the ball, you changed the amount of force you used. Force is the amount of strength or energy it takes to move something.

Explain friction to Brownies, using the different balls used in Activity 1: As Girls Arrive: Playing with Force and Friction.

SAY:

Were there any balls that were easier or harder to roll? Why do you think that was?

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Girls may say: It was hard to roll the tennis ball on the carpet, the ping pong ball went the fastest, etc.

Each of the balls is made of a different material and weighs a different amount.

For example, the smaller balls may have been easier to roll. Why do you think that is? (Answer: The smaller balls were lighter, so the surface affected it less as it moved.)

When you roll the ball, there is something called friction that stops the ball.

Friction is a force that slows and stops moving objects. Without friction, any object that was pushed or pulled would keep moving forever!

For example, if there wasn't friction on the road, a car would keep moving forward forever, crashing into other things.

Demonstrate how a car is moved by force and speed, and how the wheels against the road create friction.

SAY:

Why do cars have wheels? Girls may say: To help it to move, etc.

Cars have wheels that turn to push the car forward with force.

The toy car also moves because you push it with force, just like the balls moved before.

As the car moves, friction between the car's wheels and the road slow it down so that it doesn't keep going forward forever.

Designing a car with wheels allows the car to move with more force and less friction. Wheels reduce the amount of the space touching the ground, allowing the car to move with more ease.

Hold up the car and ask girls what they could do to the wheels or the race track to make the car go faster.

Spin the wheels and point out the axles. You might talk about reducing friction between the wheels and the track, reducing friction between the wheels and axles, reducing friction between the wheels and the body, keeping the car rolling straight, changing the center of gravity, etc.

SAY:

Race car designers add or create special features, parts of something, that help their car to go fast. Engineers create these features to make their products more useful.

Today, we'll design and build race cars! Let's see how can we use science to make a faster Race Car!

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Activity 4: Design and Build Your Race Car (25 minutes)

Materials

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

Steps

Brownies design and build their race cars for Step Two of the Race Car 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 girls the **Sample Race Car** or the race car you made prior to the meeting.

SAY:

Now, you're going to create a Race Car.

Here's a sample race car. Its use the materials to make a body with wheel attachments, but you can do it anyway you like. What are some other ways you could use the materials to make your race car?

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.

Hand out paper and pencils to each team for Brownies to design their Race Car.

SAY:

Draw your Race Car to help figure out how to build it. Look at the materials available to see what you could use to create your car. Use your creativity to build upon the sample!

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When they're finished designing, hand out materials to each team.

Let the girls build their Race Cars.

Keep It Girl-Led: By having girls reverse engineer a Race Car, 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 could you use for your car's cabin? How do you attach the wheels?"

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

(Note to Volunteers: If you can, save the Brownies' Race Cars for the next meeting, Race Car Design Challenge 2. Label each car 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.)

If Brownies have extra time, they can practice pushing their cars around the room using different amounts of force.

Activity 5: Closing Ceremony: Share Your Design (10 minutes)

Materials

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

Steps

Have Brownies form a Friendship Circle and share their race cars from Activity 4: Design and Build Your Race Car.

Give each girl a chance to share her design decisions.

SAY:

How did you design your car?

What special features did you add to your car?

Did you improve the speed of your car? How?

How could you make your car go even faster?

End the meeting with a Friendship Squeeze.

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,

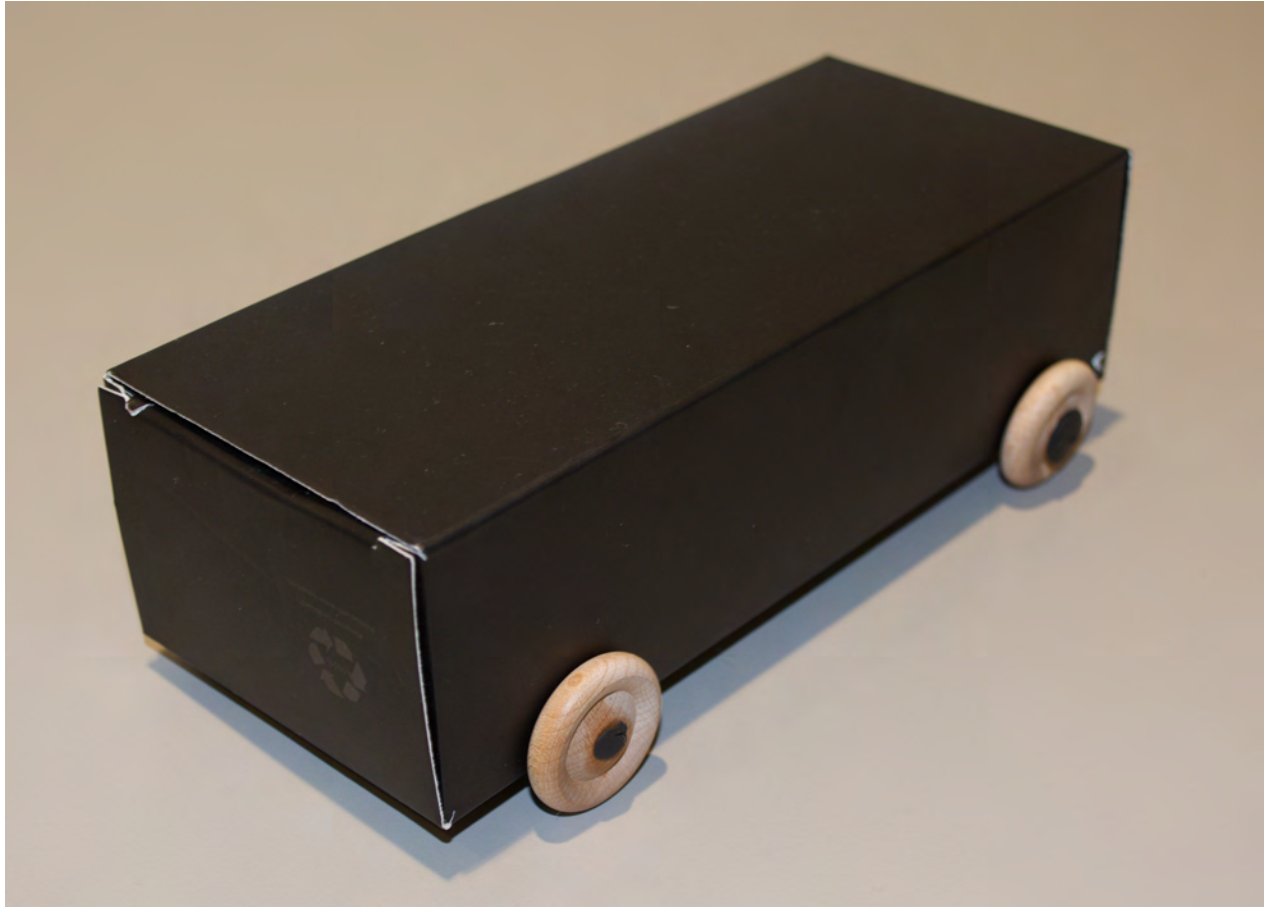
use resources wisely,

make the world a better place, and

be a sister to every Girl Scout.

Race Car Design Challenge

Sample Race Car



This Race Car is made from: 1 box, 4 wooden wheels, 2 small dowels/craft sticks, clay.

Race Car 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: 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

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

Awards

Girls do not receive any awards in this meeting.

Race Car Design Challenge 1 (Version for the Making Things Zoom Kit)

Detailed Activity Plan

As Girls Arrive: Playing with Force and Friction (10 minutes)

Materials

- 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.

Steps

Prior to girls arriving, create two masking tape lines. The lines should be close enough that Brownies can roll a ball back and forth between them.

As Brownies arrive, welcome them, and have them pair up.

Hand each pair a ball, and have them sit facing each other on the lines and roll their ball back and forth.

Brownies can roll their ball a few times, then exchange it with another pair to try another.

SAY:

Roll your ball back and forth with your partner.

What happens when you roll it lightly? Does it reach your partner?

What happens when you roll it with a lot of strength?

Brownies roll their balls, experimenting with force.

Opening Ceremony: Engineering Speed (10 minutes)

Materials

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

Race Car Design Challenge 1 (Version for the Making Things Zoom Kit)

Steps

Recite the Pledge of Allegiance and the Promise and Law.

Conduct any troop business.

Introduce Brownies to the Race Car Design Challenge badge.

SAY:

Today you're going to be engineers as we start the Race Car Design Challenge!

You'll design, build, and test race cars made from GoldieBlox. Next time, you'll get to improve them based on your tests and race them down a race track!

Step One: Learn How Design Can Affect Speed (15 minutes)

Materials

- Toy car to demonstrate force and friction

Steps

Brownies explore the concepts of speed and friction through a volunteer demonstration for Step One of the Race Car Design Challenge.

Compare how the different balls rolled in the activity for As Girls Arrive: Playing with Force and Friction as examples of force.

SAY:

Let's get started and learn something important engineers have to think about when they build things.

When you were rolling your balls earlier, what made the balls move faster? (Answer: Rolling it with more strength or force.)

When you were rolling your balls earlier, what made the balls move slower? (Answer: Using less strength or force.)

Each time you rolled the ball, you changed the amount of force you used. Force is the amount of strength or energy it takes to move something.

Explain friction to Brownies, using the different balls used from As Girls Arrive: Playing with Force and Friction.

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Race Car Design Challenge 1 (Version for the Making Things Zoom Kit)

SAY:

Were there any balls that were easier or harder to roll? Why do you think that was?

Girls may say: It was hard to roll the tennis ball on the carpet, the ping pong ball went the fastest, etc.

Each of the balls is made of a different material and weighs a different amount.

For example, the smaller balls may have been easier to roll. Why do you think that is? (Answer: The smaller balls were lighter, so the surface affected it less as it moved.)

When you roll the ball, there is something called friction that stops the ball.

Friction is a force that slows and stops moving objects. Without friction, any object that was pushed or pulled would keep moving forever!

For example, if there wasn't friction on the road, a car would keep moving forward forever, crashing into other things.

Demonstrate how a car is moved by force and speed, and how the wheels against the road create friction.

SAY:

Why do cars have wheels?

Girls may say: To help it to move, etc.

Cars have wheels that turn to push the car forward with force.

The toy car also moves because you push it with force, just like the balls moved before.

As the car moves, friction between the car's wheels and the road slow it down so that it doesn't keep going forward forever.

Designing a car with wheels allows the car to move with more force and less friction. Wheels reduce the amount of the space touching the ground, allowing the car to move with more ease.

Hold up the car, and ask girls what they could do to the wheels or the race track to make the car go faster.

Spin the wheels and point out the axles. You might talk about reducing friction between the wheels and the track, reducing friction between the wheels and axles, reducing friction between the wheels and the body, keeping the car rolling straight, changing the center of gravity, etc.

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Race Car Design Challenge 1 (Version for the Making Things Zoom Kit)

SAY:

Race car designers add or create special features, parts of something, that help their car to go fast. Engineers create these features to make their products more useful.

Today, we'll use GoldieBlox to design and build race cars! How can we use science to make a faster Race Car?

Step Two: Design and Build Your Race Car (25 minutes)

Materials

- 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.

Steps

Divide Brownies into pairs or small groups to design and build their race car for Step Two of the Race Car Design Challenge.

Hand out paper and pencils to each team for Brownies to design their Race Car.

SAY:

Now, you're going to use your GoldieBlox to create a Race Car.

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.

Draw your Race Car to help figure out how to build it. Look at the pieces in the kit to see what fits together to create your car.

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

Let the girls build their Race Cars.

Keep It Girl-Led: By having girls reverse engineer a Race Car, 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 should you put into your car? How do you attach the wheels?"

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

Race Car Design Challenge 1 (Version for the Making Things Zoom Kit)

(Note to Volunteers: You may want to save the Brownies' Race Cars for the next meeting, Race Car Design Challenge 2. If you can, label each car 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.)

If Brownies have extra time, they can practice pushing their cars around the room using different amounts of force.

Closing Ceremony: Share Your Design (10 minutes)

Materials

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

Steps

Have Brownies form a Friendship Circle, and have them share their race cars from Step Two: Design and Build Your Race Car.

Each girl has a chance to share about her design decisions.

SAY:

How did you design your car?

What special features did you add to your car?

Did you improve the speed of your car? How?

How could you make your car go even faster?

End the meeting with a Friendship Squeeze.

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Race Car 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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Race Car 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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Race Car Design Challenge badge

Spring Car

engineering concept:
SIMPLE MACHINES

build date:

I built it!



x2



x8



x3



x6



x2



x1



x1



x8



x4



x7



x2

x3



x1



x1



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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.)