Overview
In the Leap Bot Design Challenge, Brownies learn about engineering, gravity, and force by building and testing a Leap Bot. Brownies learn how to build and test a new product.

Step One: Learn about springs
Step Two: Build your Leap Bot
Step Three: Create a way to test how well your Leap Bot performs (To be completed in Leap Bot Design Challenge 2).
Step Four: Record the results of your test (To be completed in Leap Bot Design Challenge 2).
Step Five: Share your results (To be completed in Leap Bot Design Challenge 2).

This meeting, Brownies learn about gravity, force and potential energy before building a Leap Bot with GoldieBlox. Brownies complete Step One & Step Two of the Leap Bot 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.

This badge requires 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, buy one kit per them to work in pairs. You can purchase the kit online from the Girl Scout Shop: http://www.girlscoutshop.com/

You will not be able to buy the correct kit from the GoldieBlox website or your council shop.
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 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.

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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)

PLEASE NOTE: You will need the GoldieBlox Making Things Zoom kit for girls to complete the requirements and earn the badges. Details for the kit are listed in this section and on the Materials List.

1. Review vocabulary (2 minutes)

This meeting introduces a new word:

- **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.
- **Gravity** – a force that pulls objects toward each other and towards the earth.
- **Potential energy** – potential energy is the energy stored in your body and everything else in our world.
- **Kinetic energy** – when potential energy is released, it becomes kinetic energy which bring bodies and object to move.

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 all materials needed for the entire badge.

• **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 Brownies can take turns holding or hang in the room.

(Note to Volunteers: You will need the GoldieBlox Making Things Zoom kit for the girls to complete the requirements and earn the badges. You can purchase this from the Girl Scouts Shop: [http://www.girlscoutshop.com/](http://www.girlscoutshop.com/).

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 art supplies.
• Assist with Design Challenge activities.

**Award Connection**

Brownies will earn one award:

• Leap Bot Design Challenge badge

Brownies receive the award following the completion of all three steps of the badge in Leap Bot Design Challenge 2.

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

In the Leap Bot Design Challenge, Brownies learn about engineering, gravity, and force by building and testing a Leap Bot. Brownies learn how to build and test a new product.

**Step One:** Learn about springs
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This meeting, Brownies learn about gravity, force and potential energy before building a Leap Bot with GoldieBlox. Brownies complete Step One & Step Two of the Leap Bot Design Challenge badge.

**Materials List**

**Activity 1:** As Girls Arrive: Jump Up!
- None

**Activity 2:** Opening Ceremony: What Do Engineers Think About?
- Flag
Leap Bot Design Challenge 1

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

Activity 3: Learn About Springs
- Sample Leap Bot made from the GoldieBlox Making Things Zoom kit

Activity 4: 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

Activity 5: Closing Ceremony: Talk About Your Leap Bot
- None

Awards
Girls do not receive any awards in this meeting.

Detailed Activity Plan

Activity 1: As Girls Arrive: Jump Up!

Time Allotment
10 Minutes

Materials
- None

Steps
Leap Bot Design Challenge 1

Welcome Brownies, and ask them to try jumping three different ways. Brownies will start to explore the concepts of energy and gravity which will be reiterated throughout the meeting.

SAY:
Today, we’re going to be creating something called a Leap Bot! You will be testing the Leap Bot to see how high you can make it jump.

Do you think you could be a human Leap Bot?

Try jumping three different ways: Jump with your knees straight, jump with your knees bent, and crouch down really low (into a ball) before jumping as high as you can!

Which type of jumping gets you the highest? Try it out!

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

Time Allotment
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.

Brownies are introduced to the Leap Bot Design Challenge badge.

SAY:
Today, we’re starting the Leap Bot Design Challenge badge!

You’re going to learn how design, build, and test things like an engineer.

Who knows what engineers do?

Girls may say: Drive trains, build things, invent things, etc.
Engineers use their imaginations to solve problems. They invent and build things that can be used in the real world.

Every day you see a problem an engineer has solved. For example, engineers design bridges so your car can cross a river. They design planes so you can fly to another place. They design really tall buildings for lots of people to work or live in.

To solve problems and create products that work, engineers have to think about all of the different things that might affect their design.

If you were an engineer building a rocket ship, what would you think about?

Girls may say: How to make the rocket fly, how to steer the rocket, what to make it out of, etc.

One of the things an engineer building a rocket would need to think about is how to make a rocket ship that can fly. Engineers have to think about how different forces, like gravity, affect their design.

Today, you’ll find out more about forces like gravity by using GoldieBlox to build a Leap Bot that goes as high as it can!

Activity 3: Learn About Springs

Time Allotment
15 Minutes

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

Steps
Brownies learn about gravity, force, and potential energy for Step One of the Leap Bot Design Challenge.

Explain force and gravity using Activity 1: As Girls Arrive: Jump Up! as an example.

SAY:
Was it easier to jump with your knees straight or bent? Why do you think that is? (Answer: It is easier to jump with your knees bent because you are able to put more force into your jump.)

When you jump, you push yourself off the ground. By bending your knees, you are able to add extra strength or force into your jump.

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.

But every time you jumped up, you 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.

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

Let’s take a look at the kit!

Show girls the kit.

SAY:
You can see there’s a spring in the kit.

The spring force uses compression to push Leap Bot into the air, just like you bend your knees to jump higher.

The spring stores something called potential energy when you push it down (or even when you pull it), just like your knees are able to boost your jump or bring you down.
When you release your Leap Bot, the energy turns into kinetic energy, and your Leap Bot launches into the air, just like your knees help to move you off the ground!

Potential energy is the energy stored in you and everything else in our world. When potential energy is released, it becomes kinetic energy, making you move.

But why does the Leap Bot come back down? (Answer: Gravity.)

The force that pulls the Leap Bot back to the ground is gravity. Just like us, the Leap Bot will eventually come back down.

How long do you think something can go up before it must come down?

Give girls time to answer.

SAY:
Next, you’ll use GoldieBlox to build a Leap Bot and look more at these different forces!

Activity 4: Build Your Leap Bot

Time Allotment
25 Minutes

Materials
- 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
Steps
Divide Brownies into pairs or small groups to build Leap Bots for Step Two of the Leap Bot Design Challenge.

Give each group a set of parts from the Making Things Zoom kit to build a Leap Bot without instructions.

SAY:
*Sometimes, engineers don’t know exactly how things are built. They have an idea through something like this sample, but then they have to figure out how to make it.*

*Testing out different parts gives engineers a chance to learn more about how each piece works and may even give them new and better ideas!*

*Can you put together a Leap Bot?*

Let girls put the parts together.

**Keep It Girl-Led:** By having girls reverse engineer the Leap Bot, 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 parts do you recognize in the Leap Bot? How are they stuck together? What parts do you see in the launch pad?”

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

(**Note to Volunteers:** You may want to save the Brownies’ Leap Bots for the next meeting, Leap Bot Design Challenge 2. If you are able to, label each Bot 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: Talk About Your Leap Bot**

**Time Allotment**
10 Minutes

**Materials**
- None
Steps

Have Brownies form a Friendship Circle and talk about their Leap Bots.

SAY:
What is causing the Leap Bot to leap? (Answer: The energy and force from the spring.)

What do you think would happen if you changed the mass of the Bot? (Answer: It would affect how high the Bot leaps.)

What force is pulling the Bot back to the ground? (Answer: Gravity.)

How could you make the Bot leap higher/further? (Answer: Decrease its weight or add more springs.)

How could you test how well your Leap Bot does on each jump? (Answer: Measure how high it goes.)

End the meeting with a Friendship Squeeze.

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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:

**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.

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

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

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

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

**Thrust** is a force that slows moving objects.

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

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

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

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

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

**Friction** is a force that slows moving objects.
Brownie Design Challenge Badges: Materials List

Leap Bot Design Challenge 1

Activity 2: Opening Ceremony: All About Solving Problems
- Flag
- Optional: Poster Board with the Girl Scout Promise and Law

Activity 3: Learn About Springs
- Sample Leap Bot made from the GoldieBlox Making Things Zoom kit

Activity 4: 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

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 pieces from the GoldieBlox Making Things Zoom kit (one set for each pair or small team).

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 Leap Bot Design Challenge 1 or 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 Leap Bot Design Challenge 1 or 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
- Leap Bot Recording Sheet
- 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)
Brownie Design Challenge Badges: Materials List

Leap Bot Design Challenge 2 (continued)

Activity 5: Share Your Results
• Leap Bot Recording Sheets, filled out by girls in Activity 4: Record the Results of Your Test

Activity 6: Closing Ceremony: Awards
• Leap Bot Design Challenge award
(Note to Volunteers: You can buy these awards from your council shop or on 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 the Forces that Affect Flight
• Paper Airplanes from Activity 1: As Girls Arrive: Engineering Paper Airplanes

Activity 4: 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

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.)

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 Fling Flyer Design Challenge 1 or Activity 1: 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

Activity 5: Brainstorm Ways to Improve Your Design
- Fling Flyers from Activity 3: 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)

Activity 6: Closing Ceremony: Awards
- Fling Flyer Design Challenge award
  (Note to Volunteers: You can buy these awards from your council shop or on 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
Brownie Design Challenge Badges: Materials List

Race Car Design Challenge 1 (continued)

Activity 4: 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.

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
- 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

(Note to Volunteers: You can buy these awards from your council shop or on the Girl Scouts’ website.)
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.
Leap Bot Design Challenge badge

I built it!

build date: 

engineering concept: COMPRESSION

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Step One: Learn about springs (completed in Leap Bot Design Challenge 1)
Step Two: Build your Leap Bot (completed in Leap Bot Design Challenge 1)
Step Three: Create a way to test how well your Leap Bot performs
Step Four: Record the results of your test
Step Five: Share your results

This meeting, Brownies create a fair test, test their Leap Bots, and share their results. Brownies complete Step Three, Step Four & Step Five, earning the Leap Bot 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.

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Leap Bot Design Challenge 2

keep coming back.

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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)

PLEASE NOTE: You will need the GoldieBlox Making Things Zoom kit for girls to complete the requirements and earn the badges. Details for the kit are listed in this section and on the Materials List.

1. Review vocabulary (2 minutes)

This meeting introduces a new word:

- **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.
- **Gravity** – a force that pulls objects toward each other and towards the earth.
- **Potential energy** – potential energy is the energy stored in your body and everything else in our world.
- **Kinetic energy** – when potential energy is released, it becomes kinetic energy which bring bodies and object to move.

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.
Leap Bot Design Challenge 2

- **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.

- **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 Brownies can take turns holding or hang in the room.

(Note to Volunteers: You will need the GoldieBlox Making Things Zoom kit for the girls to complete the requirements and earn the badges. You can purchase this from the Girl Scouts Shop: [http://www.girlscoutshop.com/](http://www.girlscoutshop.com/).)

**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 art supplies.
- Assist with Design Challenge activities.

**Award Connection**

Brownies will earn one award:
- Leap Bot Design Challenge badge

Brownies receive the award following the completion of the final three steps of the badge this meeting.

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Leap Bot 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.

In the Leap Bot Design Challenge, Brownies learn about engineering, gravity, and force by building and testing a Leap Bot. Brownies learn how to build and test a new product.

Step One: Learn about springs (completed in Leap Bot Design Challenge 1)
Step Two: Build your Leap Bot (completed in Leap Bot Design Challenge 1)
Step Three: Create a way to test how well your Leap Bot performs
Step Four: Record the results of your test
Step Five: Share your results

This meeting, Brownies create a fair test, test their Leap Bots, and share their results. Brownies complete Step Three, Step Four & Step Five, earning the Leap Bot Design Challenge badge.

Materials List

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 pieces from the GoldieBlox Making Things Zoom kit (one set for each pair or small team).

For each Leap Bot, girls will need these GoldieBlox:
Leap Bot Design Challenge 2

- 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

**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 Leap Bot Design Challenge 1 or 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 Leap Bot Design Challenge 1 or 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
- **Leap Bot Recording Sheet**
- 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)

**Activity 5: Share Your Results**
- **Leap Bot Recording Sheets**, filled out by girls in Activity 4: Record the Results of Your Test.

**Activity 6: Closing Ceremony: Awards**

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Leap Bot Design Challenge 2

- Leap Bot Design Challenge award

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

Detailed Activity Plan

Activity 1: As Girls Arrive: Prepare for Testing

Time Allotment
10 Minutes

Materials
- 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).

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

Steps
Welcome Brownies, and ask them to explore how changing the shape of their Leap Bot affects its jump.
Optional: If you were unable to save the Leap Bots between meetings, Brownies can rebuild them.

SAY:
Today, we’re going to test our Leap Bots!

Before we begin, see if you can change your Leap Bot’s leap by changing pieces of the Bot’s body.

What happens when you add more pieces to the Bot? What happens when you take away pieces from the Bot?

Activity 2: Opening Ceremony: Leap Bot Forces

Time Allotment
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.

Review the forces that affect the Leap Bot’s jump with Brownies.

SAY:
Does anyone remember how the Leap Bot is able to jump? (Answer: Force and energy!)

The spring on the launchpad stores potential energy when you push it down.

When you release your Leap Bot, the energy turns into kinetic energy, and your Leap Bot launches into the air!
Potential energy is the energy stored in you, your Leap Bot, and everything else in our world. When potential energy is released, it becomes kinetic energy, making you and your Bot move.

But why does the Leap Bot come back down? (Answer: Gravity.) The force that pulls the Leap Bot back to the ground is gravity. Just like us, the Leap Bot will eventually come back down.

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

Time Allotment
10 Minutes

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

Steps

Brownies brainstorm how to test their Leap Bots for Step Three of the Leap Bot Design Challenge.

SAY:
In order to test and improve your Leap Bot, you need to come with a way to measure how well it performs.

How can you accurately measure how high your Leap Bot is jumping?

Girls may say: Catching the bot and measuring how high your hands are, marking height on the wall, taping a ruler to the launchpad, filming the leap on a tablet to play back.

What tools will you need?

Girls may say: Rulers, poster paper and markers, tape, or iPads.
Which method do you think will work best? What makes it the “best” method?

**Girls may say:** Taping a poster is more work initially, but easier than lining up rulers each time. iPad videos would need editing to compare leaps. Catching Leap Bot at the apex of the jump could be tricky.

Which do you think would be the most accurate method?

**Girls may say:** Taping a poster or ruler up.

Divide Brownies into Leap Bot testing teams. *(Note to Volunteers: These groups can be the same as the groups Brownies divided into to build their Leap Bots in Leap Bot Design Challenge 1.)*

Hand out rulers, yardsticks, tape, and paper. Note that you can use other methods if you have the right tools and the time.

**SAY:**
You came up with some great ways to test your Leap Bots!

Here are the tools we have today. Engineers are very creative and can use what they have to do their projects.

In your Leap Bot testing team, set up your testing station.

Help girls tape large sheets of paper to the walls and place rulers or yardsticks by each testing station.

**Activity 4: Record the Results of Your Test**

**Time Allotment**
20 Minutes

**Materials**
- Leap Bots created by girls in Leap Bot Design Challenge 1 or 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
- Leap Bot Recording Sheet
Leap Bot Design Challenge 2

- 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)

Steps
Brownies test their Leap Bots for Step Four of the Leap Bot Design Challenge.

Give each group a Leap Bot Recording Sheet.

SAY:
Now that we’ve thought about what we want to test, it’s time to see how your Leap Bot performs!

First, try testing the Bot using the short spring. What happens?

What do you think will happen if you combine the short and long springs?

Give girls time to answer.

SAY:
Those are interesting predictions! Let’s test them out and see if they’re right.

Give girls time to test their Leap Bot and record the results.

SAY:
Are you ready for a challenge? Make your Bot leap at least 5 times for each of the three different spring combinations (Small spring, large spring, combination of two springs) and record how high the Bot jumped each time.

Wait for girls to try the different jumps and make their recordings.

SAY:
Why do you think your results turned out this way?

Keep It Girl-Led: Let girls talk and analyze their results. They may reach the conclusion that springs store potential energy, so the greater the length of the spring, the more energy there is to be converted into motion. Using their test results, they could say along the lines of “the short spring caused the shortest leap, the long spring a longer leap, and both springs caused the longest.”
Activity 5: Share Your Results

Time Allotment
10 Minutes

Materials
- Leap Bot Recording Sheets, filled out by girls in Activity 4: Record the Results of Your Test.

Steps
Have Brownies form a Friendship Circle and share their results for Step Five of the Leap Bot Design Challenge.

SAY:
After engineers create and test something, they share what they’ve learned with others. Why do you think they do that?

Girls may say: To help other people who want to do the same thing, to get ideas about how to make their invention better, etc.

When you tell the group about what worked and didn’t work with your Leap Bot, you help them know what they could do differently. And they may have ideas about how you can make your Leap Bot better.

So let’s act like engineers! We’ll go around the circle and each group can talk about what you did and what you learned.

If girls need some help getting started, try these prompts:
- What was your favorite part of making and testing your Leap Bot? Why?
- What worked?
- What didn’t work?
- What did you do when something didn’t work?

Let girls answer. Make sure every girl gets a chance to speak.

Activity 6: Closing Ceremony: Awards
Time Allotment
10 Minutes

Materials
- Leap Bot Design Challenge award

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

Steps
Brownies earn their Leap Bot Design Challenge badge.

SAY:
You’ve now earned the Leap Bot Design Challenge badge.

Please step forward when I say your name to accept your award.

Lead a round of applause for each Brownie as she steps forward.

SAY:
You have earned your Leap Bot Design Challenge award, which means you have learned about engineering, gravity, and force by building and testing a Leap Bot. You also learned how to build and test a new product.

When you leave here, who do you want to tell about what you learned?

Girls may say: My parents, my brothers and sisters, my friends at school.

That’s great! When you learn something, it’s fun to pass it on to others. We can all learn from each other.

End the meeting with a Friendship Squeeze.

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Now that I’ve earned this badge, I can give service by:
Leap Bot Design Challenge 2

- Showing Daisies that engineering can be fun by demonstrating my Leap Bot.
- Sharing what I learned about gravity, force, and energy with my friends or family.
- Letting others know what engineers do by doing a Show-and-Tell with my Leap Bot at school.
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:

**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.

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

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

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

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

**Thrust** is a force that slows moving objects.

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

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

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

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

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

**Friction** is a force that slows moving objects.
Brownie Design Challenge Badges: Materials List

Leap Bot Design Challenge 1

Activity 2: Opening Ceremony: All About Solving Problems
- Flag
- Optional: Poster Board with the Girl Scout Promise and Law

Activity 3: Learn About Springs
- Sample Leap Bot made from the GoldieBlox Making Things Zoom kit

Activity 4: 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

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 pieces from the GoldieBlox Making Things Zoom kit (one set for each pair or small team).

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 Leap Bot Design Challenge 1 or 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 Leap Bot Design Challenge 1 or 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
- Leap Bot Recording Sheet
- 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)
Brownie Design Challenge Badges: Materials List

Leap Bot Design Challenge 2 (continued)

**Activity 5: Share Your Results**
- Leap Bot Recording Sheets, filled out by girls in Activity 4: Record the Results of Your Test

**Activity 6: Closing Ceremony: Awards**
- Leap Bot Design Challenge award

(Note to Volunteers: You can buy these awards from your council shop or on 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 the Forces that Affect Flight**
- Paper Airplanes from Activity 1: As Girls Arrive: Engineering Paper Airplanes

**Activity 4: 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 GoldieBloxs:
- 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

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.)

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 Fling Flyer Design Challenge 1 or Activity 1: 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

Activity 5: Brainstorm Ways to Improve Your Design
- Fling Flyers from Activity 3: 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)

Activity 6: Closing Ceremony: Awards
- Fling Flyer Design Challenge award
  (Note to Volunteers: You can buy these awards from your council shop or on 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
Brownie Design Challenge Badges: Materials List

Race Car Design Challenge 1 (continued)

**Activity 4: 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.

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

I built it!

工程概念：COMPRESSION

制造日期：

我制造了它！

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## Leap Bot Recording Sheet

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<thead>
<tr>
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<th>Short Spring</th>
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Do you see a pattern?

What do you conclude about springs?

How do you know?