girl scouts of wisconsin southeast

2019 Girl Scout Genius

B.Y.O. = Build Your Own

Girl Scouts like to help people and solve problems to make the world a better place. Engineers use science and math to solve problems, too. You can see examples of engineering everywhere in the world around you. Activities in B.Y.O. = Build Your Own will give you a taste of what it is like to be an engineer. From the start to the end of each day, engineering technologies improve the ways that we talk to each other, work, travel, stay healthy and have fun. Engineers are problem-solvers who want to make things work better. From computer chips and satellites to medical devices and renewable energy technologies, engineering makes our modern life possible. Activities in this final packet, will give you a taste of what it is like to be an engineer.

Girl Scouts is also about spending time with adults who can help you learn and grow, so find an adult partner or older friend to help you read instructions and do activities.

Let's start solving problems!

Thanks for participating in the Girl Genius program this summer. It kept your brain and body moving—even when you weren't in school!

Continue your Girl Scout fun this fall on your own, or start or join a Girl Scout troop at your school. Renew your membership at ***gswise.org***.

Find a Girl Scout event the whole family can enjoy!
School may be back in session--but summer's not over yet!

Register now for:
Family Camping in September at Camp Alice Chester, Camp Pottawatomi Hills or Camp Winding River.

Swim, Camp, Paddle at Camp Pottawotomie Hills or Camp Silver Brook

Girls entering grade 2 and up can sign up for **Rock Climbing** at Camp Alice Chester with their troop or family.

Register at ***gswise.org*** or call ***800-565-4475*** with your questions, or contact ***customercare@gswise.org***

Design a Test Parachute

Learn about ***air resistance*** while making an awesome parachute. Then put it to the test, making modifications as you go!

What you'll need:

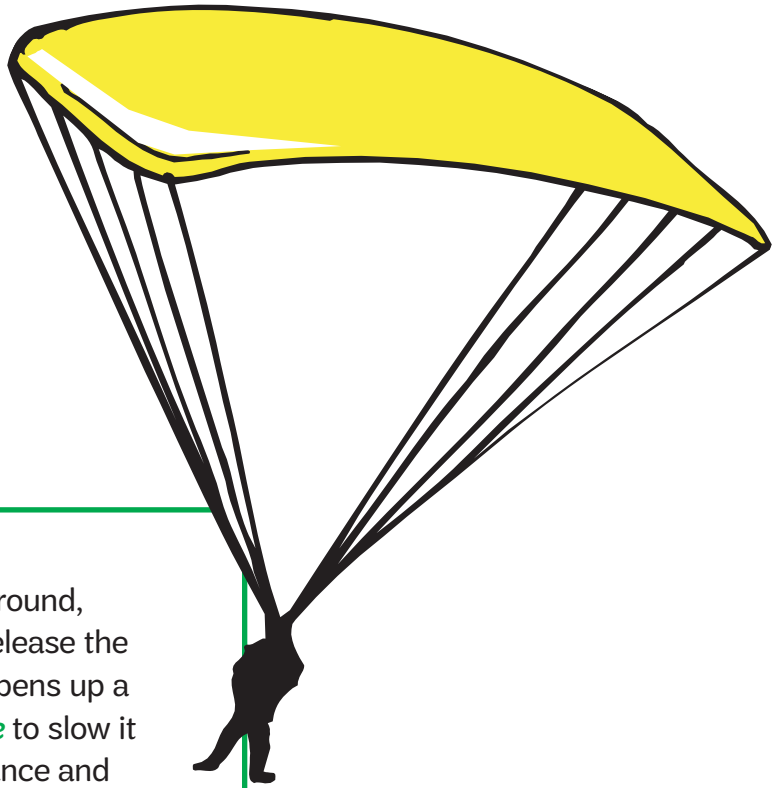
- A plastic bag or light material
- Scissors
- String
- A small object to act as the weight (a little action figure would be perfect)

Instructions:

1. Cut out a large square from your plastic bag or material.
2. Trim the edges so it looks like an octagon (an eight sided shape like a STOP sign).
3. Cut a small hole near the edge of each side.
4. Attach eight pieces of string of the same length to each of the holes.
5. Tie the pieces of string to the object you are using as a weight.
6. With help from an adult, use a chair or find a high spot to drop your parachute and test how well it works. Remember that you want it to drop it as slow as possible so make sure to drop the parachute, not throw it.

Now try this!

Cut a small hole in the middle of the parachute and let it drop again. What happens? You should notice that the parachute falls in a straighter line than it did the first time. The hole allows air to slowly pass through the parachute rather than spilling out over one side, helping it to fall straighter.



What's happening?

Hopefully your parachute will descend slowly to the ground, giving your weight a comfortable landing. When you release the parachute the weight pulls down on the strings and opens up a large surface area of material that uses ***air resistance*** to slow it down. The larger the surface area the more air resistance and the slower the parachute will drop.

Gravity – not just a good idea...it's the law!

Use the Law of Gravity and your engineering creativity to build a structure that can tell time.

What you'll need:

- Super balls (or marbles)
- Paper towel rolls
- Construction paper
- Tape
- A flight of stairs
- Stop watch or timer

Instructions:

1. Try to make a clock that can measure ten seconds exactly.
2. The only materials you can use are super balls, paper towel rolls, construction paper, tape and a flight of stairs.
3. If the super ball gets to the bottom of the stairs in exactly ten seconds, without any help from you, you've mastered the challenge!

Now try this!

- Make the super ball take only five seconds to reach the bottom of the stairs. How would you adjust your design?
- Figure out how to use the ten second clock and six super balls to count off a minute. Use the timer to check your clock's accuracy.

What's happening?

You learned how to harness the power of gravity! Gravity is always pulling objects and people toward the ground. You used the materials to control the time it took for gravity to move the ball toward the ground.

Draw your final design in this box (or take a picture and stick it here):

Can You Dig It?

*This engineering design isn't for kids who like to keep their hands clean.

The sandbox will be your lab as you work to set up an epic water race. Will water flow faster in a shallow sand trench or in a deep sand trench?

What you'll need:

- Small shovel and/or trowel
- Sandbox or sandy beach at least a foot deep
- 2 buckets
- Water
- Stopwatch or timer

Instructions:

1. **Draw your design.** Use the space below to draw trench designs before you move to the sandbox or beach. You want to design a trench that will move water the fastest from one side of the sand box or beach to the other. How do you think you can do this?
    - Think about what you know about sand and water and motion and then begin to design.
        - You will draw two trench designs. One that is shallow and another that is deep.
        - The trenches have to be parallel, that means side-by-side.
        - The trenches have to be the same length so the "water race" is even.
6. **Start digging.** Head over to your sandbox or beach. Just make sure that wherever you are, the sand is at least a foot deep. Remember that you want to create one shallow trench and one very deep trench. Your trenches should be parallel to each other and of the same length.
7. **Run your water race.** Have you and your friend or family member fill the two buckets with an equal amount of water.
8. Stand at the beginning of one trench and have your partner stand at the beginning of the second trench.
9. At the same time, you and your partner should begin pouring water into your separate trenches. Watch closely to see which trench moves the water the fastest.

What's happening?

Water moved faster in the shallow trench than in the deep trench. But why? The key is in the sand. While the water is rushing into the trenches it is also soaking into the sand. Since the tall trench is bigger it takes more time for the water to fill it up. That also gives the water more time to soak into the sand before moving it toward the finish line.

Now try this!

Trenches can be made with lots of different materials, not just sand! Now that you know a little about water ***flow design***, continue your experiments with trenches made of dirt or wood. Do you think those trenches would be faster or slower than your trenches made of sand? Never stop guessing and testing!

Draw your sample trench designs here:

Build a Tent

What if you didn't have a tent to sleep in when you went camping? You would have to find other ways to build a tent. Make your own tent indoors using materials you find around the house. Draw your idea, make a small model and then make your design come to life.

What you'll need:

- Cardboard shoeboxes
- Thumbtacks or push pins
- String
- Straws
- Scissors
- Stuff from around your house to make your tent, like wrapping paper tubes, broomsticks, tape, rope, sheets, etc.

Instructions:

1. **Make a small scale model.** Engineers always test their ideas first. Start by building a few tent models on top of a cardboard shoebox.
    a. Things to think about:
        - What size and shape do you want your tent to be?
        - How complicated it would be to set up?
        - How portable, or easy to move, it would be?
        - Would you have enough room to sleep in it?
    b. Try using:
        - Straws as tent poles
        - String as rope
        - Thumbtacks as stakes
2. **Test your design.** As you test different designs, remember that the tension on the string keeps the poles from falling and holds the tent together.
3. **Build your tent.** Once you've chosen the best design, find the materials you need to build a full-scale tent based on your design model. If you're building your tent indoors, your materials don't need to be waterproof.

Now try this!

Use the same process to build a tent outside. What would you do differently? Would you use different materials? For example, you might want to have plastic on the floor so your sleeping bags don't get damp- or you could use stakes instead of tape to hold the ropes in place.

Draw your final design below (or take a picture and stick it here):

Design a Water Filter

Hydro-neers wanted. Invent a filter to clean dirty water.

What you'll need:

- 2 liter soda bottle cut in half (cut by an adult)
- Napkins or paper towels
- Gravel, sand and cotton balls for your filter
- Dirty water (you can make dirty water by adding cooking oil, food coloring, pieces of paper and tiny pieces of Styrofoam to tap water)

Instructions

1. Make the filter bottle. Put the top half of the soda bottle upside-down (like a funnel) inside the bottom half. The top half will be where you build your filter; the bottom half will hold the filtered water.
2. Think about what each material might remove from the dirty water and in what order you should layer the materials.
3. Layer the filter materials inside the top half of the bottle.
4. Pour the dirty water through the filter.
5. Observe the results. What does the filtered water look like?
6. Take the filter apart and look at the different layers. Can you tell what each material removed from the water?
7. Wipe the bottle clean and try again. Try putting materials in different layers or using different amounts of materials.

What's happening?

As the dirty water traveled through each layer of filter material, some of the ***impurities***, the stuff that makes water dirty, were removed. Each type of filter material removed different things. Some materials removed the larger impurities while others removed the smaller impurities which made the water cleaner.

Now try this!

- Make the filter using only two of the materials listed above. Did it work better or worse?
- Can you make a better filter? Look around your house and think about what other materials might work better than the ones you already used. Be sure to predict what you think is going to happen. Then, test it out.

Write or draw a picture of what happened below.

Balloon Blast Off

We're not going to tell you how to do this one! Be a true engineer and figure it out on your own.

What you'll need:

- Target drawn on paper
- Balloons
- Straws
- Tape
- String

Instructions:

1. Draw a target on a piece of paper and place it somewhere across the room.
2. Use your creativity and design ingenuity to see if you can hit a target using balloons, straws, tape and string.

Draw your final design below (or take a picture and stick it here):

Egg Boat Float

Eggs ahoy! Boats can hold lots of things: people, cargo, even cars. Can you make a boat that can hold eggs? Be a true engineer and figure it out on your own.

What you'll need:

- Raw eggs
- 2 aluminum pie pans
- 2 plastic sandwich bags
- Tape
- Scissors
- A place to float your boat (large plastic container, bathtub or sink)

How did you build your boat? How many eggs could it hold?

Now try this!

Get together with some friends or family and have a contest to see whose boat can hold the most eggs without sinking. Who knows - maybe you've built the first ocean liner for vacationing eggs!

Draw your final design below (or take a picture and stick it here):

Keep it Fresh

Have you noticed that different types of fruits are packaged in different ways? Strawberries are packaged in plastic baskets, grapes in plastic bags with holes and lettuce is wrapped up in plastic sheets. Businesses that sell fruit have worked with designers to develop packaging that keeps each type of fruit fresh for as long as possible.

As bananas ripen they turn from green, to yellow to brown. Find out which type of packaging allows bananas to stay fresh the longest.

What you'll need:

- 2 green bananas
- Brown paper bag
- Plastic bag

Instructions

1. Place one banana in the brown paper bag and one banana in the plastic bag. Set the packages in the same place, choosing a place that is cool and not in direct sunlight.
2. Check on your fruit once a day for a week, noting the color and smell of the fruit.
3. Keep a daily log of your experimental results below. You can also note other things like firmness, softness, wrinkles or mold.
4. Check your results. Which packaging worked the best?

Day	Package Type: Brown Paper Bag List color, smell and other factors.	Package Type: Plastic Bag List color, smell and other factors.
1		
2		
3		
4		
5		
6		
7		

What's happening?

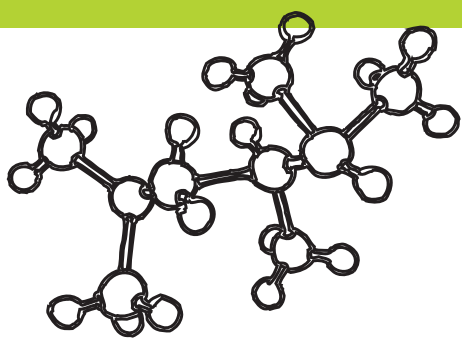
All fruit give off gases as they ripen. When you place them in a closed space, such as a bag, it traps the gases inside the bag which speeds up the process.

Use what you learned to answer these questions:

- Did the banana ripen faster in the brown paper bag or the plastic bag?
- Grocery stores want to keep fruit fresh as long as possible. Should they put bananas in a brown bag or a plastic bag?
- Most grocery stores do not put their bananas in a paper or plastic bag. Why do you think that is?

Now try this!

Try this same activity using other varieties of fruit or packaging such as paper bag without holes, paper bag with hole, plastic bag without holes, plastic bag with holes (sometimes used for grapes), plastic netting, strawberry containers, or anything else you can think of.



Keep-a-Cube

Play it cool by building your own ice box. Use the materials below to make the most efficient ice box. Be a true engineer and figure it out which materials work best on your own.

What you'll need:

- Cardboard box (less than one cubic foot)
- Waxed paper
- Masking tape
- Newspaper
- Aluminum foil
- Rubber bands
- A glass
- Ice cubes

Instructions:

1. Think about your design. Which materials listed above would work best to keep an ice cube from melting? What materials do you think will keep the heat away from the ice cube? Where should you put the materials? Inside the box? Outside the box?
2. Make your ice box.
3. Test your ice box.
    a. Put one ice cube in the ice box you built.
    b. Put another ice cube in a glass. This will be your *control*. That means it will be something that always stays the same so you can compare your results more than once.
    c. Place both side by side any place you would like.
    d. Wait 90 minutes.
4. Check your results. (Record them if you'd like.)
    a. Look at the ice cube in the glass, how big is it?
    b. Open the ice box and look at that ice cube, how big is it?
5. Compare your results. If the ice cube in the ice box is bigger than the ice cube in the glass then your design worked well. If both ice cubes are the same size, then your ice box didn't do much to keep the ice cube from melting.

What's happening?

The ice cube in the glass should always start to melt. The ice cube in your ice box may or may not melt, that depends on your design and if the materials you chose to use were good *insulators* – materials that are good at keeping heat out.

Now try this!

Change your design and try again. Which ice box design kept the ice cube cold the longest? Do you think your results would change if you change the location? Which material was the best insulator?

Go Fly a Kite

Using the materials below, construct a kite that will work with the air pressure to fly!

What you'll need:

- One 13-gallon plastic trash bag (white bags are best for decorating)
- Two wooden dowels or straight sticks, one 24 inches long, the other 20 inches long
- Scissors
- String or fishing line
- Ruler
- Clear packing tape
- Permanent markers to decorate the kite
- Ribbon

Instructions:

1. Cut open the trash bag to form a flat plastic sheet.
2. Measure six inches down on the long stick and make a mark. Lay the short stick at the mark and form a "t" or cross shape. Tie the sticks together and use some tape if necessary.
3. Put the sticks down on the trash bag and use your ruler to draw a line around the frame from the top stick to the side and then down to the bottom point. Use your ruler to continue the outline on the other side of the t-shape. It should look like a diamond.
4. Cut your diamond two inches wider than your diamond pattern.
5. Lay the sticks on the plastic diamond shape and fold the edges over the stick frame and tape it down.
6. Turn the kite over and decorate it using your markers.
7. Cut a piece of string 20 inches long. Poke holes in the top and bottom of the kite and tie the string in a knot in the top and bottom holes (if necessary, use some tape to keep it secure). Then tie on the rest of your string to the middle of the string.
8. Tape the ribbon to the bottom of the kite to create a tail.
9. On a windy day, take your kite outside and start running, holding tightly onto the kite string. Keep your kite away from power lines and trees.

Build an Arch

You can find arches in buildings and bridges; they have the same shape as a rainbow. How can they stand up without needing support in the middle? Build your own arch to find out.

What you'll need:

- Box of sugar cubes
- Frosting
- Aluminum foil
- Plastic or table knife
- Drinking glass or cup, same width as desired arch
- Portable tray (like a cookie sheet, cutting board or piece of cardboard)
- Optional: Acrylic sealer

Instructions

1. Line the tray with foil. The arch will need to harden overnight, so find a safe place to store it. You will construct the arch horizontally, and stand it up once it is dry.
2. Lay out your sugar cubes leaving about 1/4 between them for frosting "mortar." Start by making two side columns, make them as tall as you want but make sure to use the same number of cubes. The arch itself should have a center "keystone" and two or three cubes in a curved layout on each side leading down to the columns.
3. Add the frosting "mortar" to the columns. Frost one side of the bottom of a cube with a table knife, and press gently so it adheres to the next one. Do the next cube the same way. Continue to add layers of mortar and bricks until your columns are complete.
4. Place the drinking glass or cup inside the arch bricks to hold them in place. Start cementing arch bricks together using the same method as above. A small gap will develop at the outside edge of the arch, fill it in with mortar.
5. Use the mortar to attach the columns to the arch.
6. Allow the arch to dry overnight and then carefully stand it up.
7. Once dry, you can spray with acrylic sealer to make it last a little longer.

Paper Bridge

Do you think that by using just one piece of paper and two cups, you can make a bridge that holds one hundred pennies?

What you'll need:

- Piece of 8 1/2" x 11" paper
- 2 cups of the same height
- 100 pennies
- Ruler

Instructions:

1. Place the cups on a flat surface approximately 6 inches apart. This distance should remain the same.
2. Make a bridge by putting the sheet of paper across the cups.
3. Place pennies on the bridge once at a time.
4. Record your data in the chart. How many pennies did the bridge support before it collapsed?
5. Try rearranging the pennies to see if the bridge can hold more pennies. Place them in the center of the bridge or on each end. Record your data.
6. Find a way to make the bridge stronger by bending, folding or tearing the paper.
7. Test your bridge designs by adding pennies one at a time. Record your data.

Bridge Design	How Many Pennies Did it Hold?
Example: Laid the piece of paper flat across the two cups	*5 pennies*

Who Can Build the Tallest Tower?

Find friends or family members to engineer this activity! Who can build the tallest free-standing tower? Hint: Remember what you learned about how to make paper from the last experiment!

What you'll need:

- Newspaper
- Tape
- Stopwatch

Instructions:

1. Divide the supplies into two equal piles.
2. Form two teams.
3. Each team works together, using only the newspaper and tape, to try to build the tallest free-standing tower.
4. Give yourselves approximately 10-15 minutes to complete this activity.

What's happening?

One sheet of paper cannot hold much weight when it was flat because it is very thin. You made it stronger when you changed its shape by rolling, folding or tearing it.