Engineering Project: Build a Zipline

Difficulty Level: Easy/Moderate for ages 8-14; ages 4-8 may need help
Objective: Build a zipline to send a toy across the room in the shortest possible time.

Engineering is using science to find ways to solve problems. An engineer starts with an idea, then makes plans for how they could make the idea happen. They design, build, and test out different solutions, and they might start over a few times.

If you've ever made a fort, a LEGO model, or a sandwich, you were thinking like an engineer, especially if you made changes to your idea along the way.

You don't need a lot of special equipment or fancy parts to do fun engineering projects. You can use things from around your house. If you don't have exactly every item on the project list, think about what you can substitute. That's another thing engineers do.

The instructions will suggest a couple of basic ideas, but part of the fun of engineering is starting with those ideas, and trying your own modifications. When you modify the idea, you can use the data sheet to record what you changed, and how it affected your project. Then you can figure out what methods work best, and share them with other engineers!

If your idea doesn't work out the way you thought it would, that's okay. Keep trying! Engineers try lots of times, and keep making changes to make their designs work better.

When you finish your engineering project, take a picture or video and share it with us at online@scienceworksmuseum.org, or have a parent or guardian post it on social media with the hashtag #scienceworksonline. We love to see your ideas at work, and can share them so other engineers can see what you did.

Materials

- String
- Two attachment points per zip line
- Paper clips
- Binder clips
- Plastic or paper cup
- Rubber bands
- Plastic bottle cap
- Hot glue
- Scissors
- Hammer
- Nail or awl
- An action figure or small toy
- Wheels (Ideas: Toy car wheels, sewing bobbins, thread spools, two plastic soda bottle tops glued together, cardboard wheels, two buttons glued together)
- Glue gun (If you don't have a glue gun and hot glue, try super strong tape)

Procedure

1. Sketch out where you will set up your zip line. What objects could you attach your zipline to? Look for sturdy chairs, door knobs, cabinets pulls, or other things to attach to. Make sure that everyone has agreed ahead of time not to disturb the area where you're setting things up.
2. Attach one end of the zipline to a sturdy spot. The top of the zipline will have to be high enough that your zipline cart can slide down it. Some sturdy tape, like masking tape, could help anchor the zipline.
3. String the zipline across the room and attach the other end to a lower point. Your zipline should be pulled tight, and shouldn't have any loose material. If you are competing against someone, you can work together to set up two ziplines so you can race your figures across the room.

4. Make a gondola, or basket for your rider. For this project, I made two different types of baskets-- one from a cardboard toilet paper tube, and one from cutting down a plastic bottle. (You can make your gondola from these materials, or from a plastic or paper cup, or some other material.)
    a. **Cardboard tube basket:** I cut a toilet paper tube until it was a little bigger than my action figure, about three inches tall. I cut out two straight pieces and taped them to the shortened round tube with masking tape. Then, I punched holes in the straight pieces. I wanted to use these pieces to attach my basket to the zipline.
    b. **Plastic bottle basket:** I cut a 1 liter soda pop bottle down so only the rounded bottom part remained, about three inches tall. I measured across the diameter of this container and made a dot with a marker pen on two points straight across from each other. Then, I used a hole punch to punch through the plastic. I wanted to use these holes to attach my basket to the zipline. The plastic bottle is stronger and also weighs more than the cardboard tube. How do you think this might affect the zipline?
5. Take two rubber bands that are the same size. Thread a rubber band through each hole, and slide it through itself, to tie it.
6. Bend the paper clip so that it is in an “S” shape, with a hook at the top and bottom. Hook the bottom hook through the two rubber band loops. A big paperclip might be easier to bend.
7. Put your toy in the cup and hook the paperclip over the zipline string. Let go. What happens? Try launching the gondola from different points on the string, and using a timer-- which point on the string makes the zipline go fastest?

Think Like A Scientist

- What were some problems that the gondola had when it went down the zipline?
- Brainstorm some ways you could make your zipline go faster.

- Write them down or sketch them in your notebook.
- Then build them and record your results. What worked best?

Try Another Design: Pulley Instructions

CAUTION: Don't get hot glue on your skin! If you aren't allowed to use hot glue, try super glue with adult supervision, or really strong tape.

1. To go faster, you want the gondola to be able to roll smoothly down the string, without getting stuck. Toy car wheels, sewing bobbins or thread spools, or plastic lids glued together can roll smoothly and make a good pulley.
2. Think about how you could attach a thread spool to your gondola. How would you attach it to the paper clip hook? What materials could you use? Maybe a sewing bobbin or a toy wheel might work better. Draw your ideas on a sheet of paper, or just try different things and see what works.
3. You can make a pulley by hot gluing two bottle caps together (make sure you have a grown up supervising). Spread a thin line of hot glue around the top of a plastic bottle cap. Carefully press the top of another bottle cap to it, and let the hot glue dry.
4. When the glue has dried, carefully use the hammer and nail to put a small hole in your bottle cap.
5. Hook the paper clip through the hole in the bottle cap, then slide the wheel onto the zipline.
6. Pull the wheel up to the height you want to launch your gondola from, and let it go! Time how long it takes your gondola to get from one side of the room to the other.

What other changes can you try, to make your gondola go faster and farther down the zipline?

Take a video of your zipline in action, and share it with us, so we can see what you made! Have an adult send it to online@scienceworksmuseum.org or share it using the hashtag #ScienceWorksOnline