WORKS WITH Science Journal an initiative by Google

The Tech Museum of Innovation

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Zipline with Science Journal: Analyzing Data

What's it like to be an amusement park engineer? In this design challenge, participants are tasked with creating a fun zipline experience. Their job is to create a model version of the transport vehicle for a zipline. However, like an engineer, participants must keep in mind that their experience can be fast, but it still needs to be stable, safe and enjoyable. Using Science Journal, an app that can use the sensors in everyday smartphones, participants can find out if their zipline ride can stand the test of amusement park guests.

Activity Duration: 10-15 minutes for building and testing.

Age Recommendation: 7+

Tools and Materials:

- Smartphone with the Science Journal app.
- Protective phone case (recommended).
- Vernier 3-axis Wireless Accelerometer and "un-stuffed" stuffed animals (optional).
- Materials that hold the passenger: Disposable food containers, fabric, parchment paper.
- Materials to navigate the zipline: Spools, straws, chopsticks, dowels, leftover cardboard rolls.
- Materials for the zipline: Smooth yarn, fishing line, plastic wires.
- Materials for holding up the zipline: PVC pipes & joints, walls & small brackets, stable furniture.
- Connector materials: Chenille stems, rubber bands, string, plastic clips, paper clips.

Warning: This activity has potential for dropping a smartphone from a height. Using a durable phone case is highly recommended to protect the phone from damage. Vernier wireless sensors are another option to avoid damaging the phone.

Next Generation Science Standards & Data Literacy in Zipline Descent:

Science & Engineering practices	Crosscutting Concepts
Analyzing & interpreting data • What do smooth, straight lines on the graph tell us about how our zipline vehicle moves? Evaluating and communicating information • What kinds of materials do we need to consider in our design to make our vehicle quicker. How can we use data evidence to show that our designs have improved?	Patterns • Can we recognize the regions of the graph where the zipline vehicle was moving quickly? Slowly? Stopping? Stability & change • Why do the vehicles sometimes fall off the zipline? Looking at the data, how can we recognize that an impact occurred?

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How do we build a zipline?

A zipline can be built from simple materials. The line can be made out of anything string-like, strong and smooth (suggestions in the materials section). The line can be attached to anything stable enough to support a phone hanging on the zipline (e.g walls, furniture, PVC pipes). Try out a few materials and setups that you think will work for your space. You can even try building two lines in parallel side-by-side for added challenge! Just make sure the line has enough tension for smooth vehicle descents.

Experiment:

Using a phone

- Open the X-axis, Y-axis and Z-axis sensors on the Science Journal app.
- Ask participants Incorporate the phone into the zipline vehicle they build so that they can see what the X, Y, and Z-axis sensors are measuring. Then attach the vehicle to the zipline and let it descend!
- Participants can start recording trials by pressing the red circle and then descend the vehicle down the zipline.
- Have participants stop the recording by pressing the black square and then analyze the results with them.
- Do this many times to compare between trials.

Using a Vernier 3-axis wireless accelerometer

- First, plug the Y-axis pin into the Go Wireless Link.
- Follow the setup and device pairing instructions on our "Vernier Go Wireless Link with Science Journal" guide or on https://www.vernier.com/til/3823/
- Use small "un-stuffed" stuffed animals to construct a simple packages for the wireless accelerometers.
- After following the setup and device pairing instructions, select the "VST" sensor on the Science Journal app.
- Utilize the wireless accelerometers by asking participants to place a wirelessly-linked stuffed animal in a zipline vehicle. Then attach the vehicle to the zipline and let it descend.
- Data can be observed in real-time, so recording is optional.

Investigation Questions:

During the activity, you can ask participants these questions:

Engineering Design Question

- What do you think about how your zipline did? Was it quick? Was it smooth? What happened at the end? Would you like to rebuild it to make it better? What materials will you use next? Why?
- What do you notice about different materials? Which materials roll? Which materials slide?
- How can you make sure your zipline is balanced? Does the weight of your vehicle matter?

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Testing Questions

- Based on the data, do you think a passenger would have enjoyed this ride or been safe?
- Have you used graphs before? Even if you have not, can you describe to me what you see? Do you see any similarities between the three graphs (x, y, and z)?
- Was the ride bumpy or smooth, according to the data? How could you make it smoother?
- Was there a big spike on the graph at the end? What can you do the lessen impact?