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Toy Tops with Science Journal: Exploring Data

You've played with fidget spinners and spinning tops, but have you ever designed them? In this design challenge, participants will develop and test their very own spinning toy! Toy designers and engineers get to play with their toys, but they also need a scientific way to figure out how to make them fun. Use everyday materials to build a spinning toy, then test it using the accelerometer sensors found in smartphones!

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

Age Recommendation: 7+

Tools and Materials:

- Smartphone with the Science Journal app.
- Vernier 3-axis Wireless Accelerometer (optional).
- Protective phone case (recommended).
- Connecting materials: rubber bands, pipe cleaners, small pieces of foam.
- Base materials: hole-punched CDs, flat pieces of foam, flat plastics.
- Bottom materials: small rounded caps, mini-party hats, cut-in-half tennis balls.

Warning: This activity involves spinning the smartphone at high accelerations. A durable phone case is highly recommended to protect the phone from damage. Vernier wireless sensors are another way to avoid damaging the phone.

Next Generation Science Standards & Data Literacy in Toy Top:

Science & Engineering practices	Crosscutting Concepts
Analyzing & interpreting data • What do the wiggly lines on the graph tell us about how our toy spins? Evaluating and communicating information • What kind of materials do we need to change the toy's spinning? How can we use data evidence to show the toy's balance?	Patterns • Can we recognize the regions of the graph where the top spun? Fell over? Stability & change • Why does the top first show stability, then become less stable, and then become stable again?

How do we make spinning toys?

This is the challenge for both you and your participants! The minimum materials required for building a successful top are the bottom point (the part that spins on a surface) and the body. The body can be placed right above the bottom point and gives the spinning toy mass for a sustained and balanced (or unbalanced) spin. An extra component participants may choose to incorporate is a crown. The crown is the top-most part of a spinning toy and often acts a good place to grab and

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wind up the spin. Materials with low-profiles and rounded bottoms work well since they help scaffold the engineering design process and enable guests to spend more time with the data captured by Science Journal.

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 toy they build so that they can see what the X, Y, and Z-axis sensors are measuring. Then spin!
- Participants can start recording data by pressing the red circle and then spinning the toy again.
- Participants can stop the recording by pressing the black square. Analyze the results with the your participants.
- 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 setup and device pairing instructions on our "Guide for Vernier Go Wireless Link with Science Journal" or on https://www.vernier.com/til/3823/.
- Use a 15-cm. diameter petri dish and tape to construct a simple and flat package for the wireless accelerometer.
- After following the setup and device pairing instructions, select the "VST" sensor on the Science Journal app.
- Ask participants incorporate the Go Wireless Link package into the toy they build so that they can see what Y-axis sensor is measuring. Then spin!
- 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 quickly your top spins? Duration? Balance? What spinning toy would you want to have? Would you like to rebuild it to make it better?
- What do you notice about the designs of different toys? Which ones work better or spin differently? Which parts of the top do you think are most important?

Example Data Testing Phase Questions

- Have you used graphs before? Even if you have not, can you describe to me what you see? Is it smooth, straight, bumpy, long? Do you see any similarities between the three graphs (x, y, and z)?
- Does what you saw match the graph? If not, why do you think the graph is different?