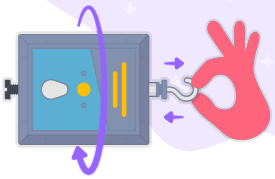
SCRATCH LESSON PLAN



# Physical Computing with Scratch and Vernier Go Direct Force & Acceleration

The Vernier Go Direct Force and Acceleration sensor is a powerful scientific tool that unlocks new ways to connect the physical world to your Scratch projects. Measure force as you push and pull, and interact by shaking, spinning, free falling and more. Then, build creative projects that combine the magic of the digital expression with data from the physical world.

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## Audience:

Classroom Teachers, Instructional Technology Specialists, Library Media Specialists, Informal Learning Environments

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**Time**: Approx 1.5 hours total

- Part 1: Setup and Test - 15 min
- Part 2: Create a Vernier Go Direct Force & Acceleration Project - 30-60 min
- Part 3: Reflect and Share - 30 min

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## Objectives (Learners Will):

- Identify ways to connect the physical to the digital world
- Create projects that utilize the Vernier Go Direct sensor and data from the physical world
- Evaluate problems/identify bugs and test solutions
- Reflect on the design process
- Communicate and share their projects with their learning community

See page 11 for aligned standards.

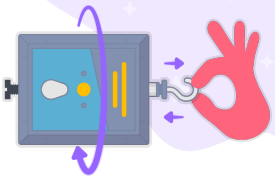
## Resources for Learners:

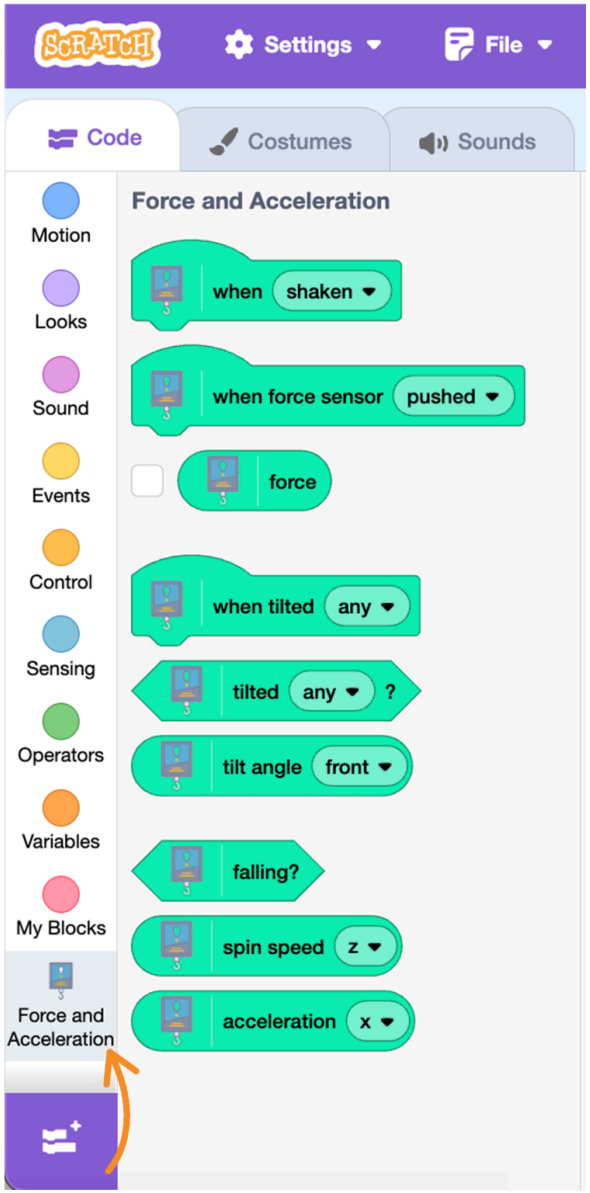
- Vernier Sensor Coding Cards (Student-Facing) - printable cards students can use to follow along
- Scratch All Blocks Posters 18x24 including Vernier Go Force sensor hardware diagrams and blocks
- Extension Page (Website)
- Frog Band (Example Project)
- Day and Night (Example Project)
- Underwater Rocket (Example Project)
- Scratch Design Journal (Worksheet)
- Sprite Creation Cards (Student-Facing)
- Sound and Music Cards and Video Tutorial (Student-Facing)
- Conditional Statements Cards and Video Tutorial Part 1 and Part 2 (Student-Facing)
- Variables and Lists Cards and Video Tutorial Part 1 and Part 2 (Student-Facing)

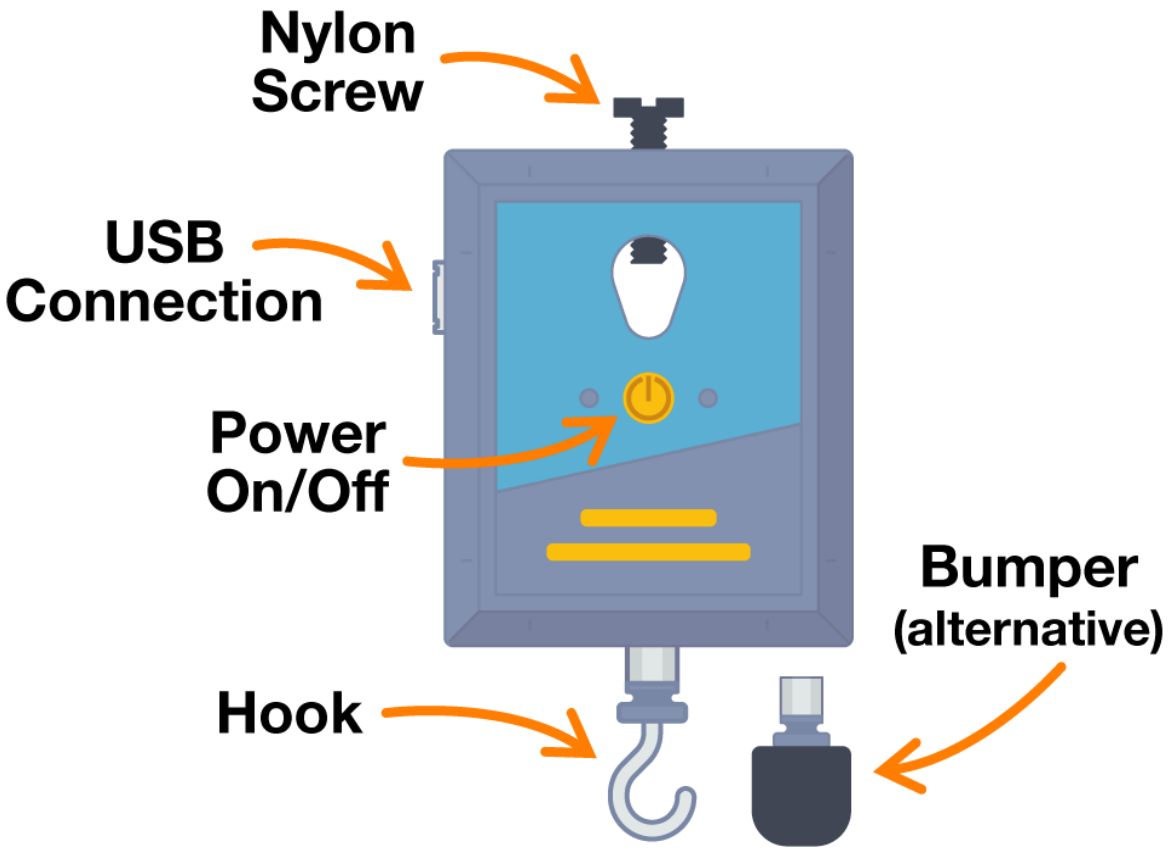
Additional resources provided throughout the guide.

**Where to Purchase the Vernier Go Direct Force & Acceleration Sensor** (Website)

# Get to Know the Vernier Go Direct Force & Acceleration Sensor and Blocks






To learn more technical information about the sensor, see the manual available on the Vernier site. And a poster version of the Vernier Go Force sensor hardware diagrams and blocks is available in the Scratch All Blocks Posters 18x24 set.

# Part 1: Setup and Test

## Setup (10 minutes)

**To add the Vernier sensor extension,** click on the extension menu in the lower-left corner of the Scratch project editor and choose “Go Direct Force & Acceleration.”

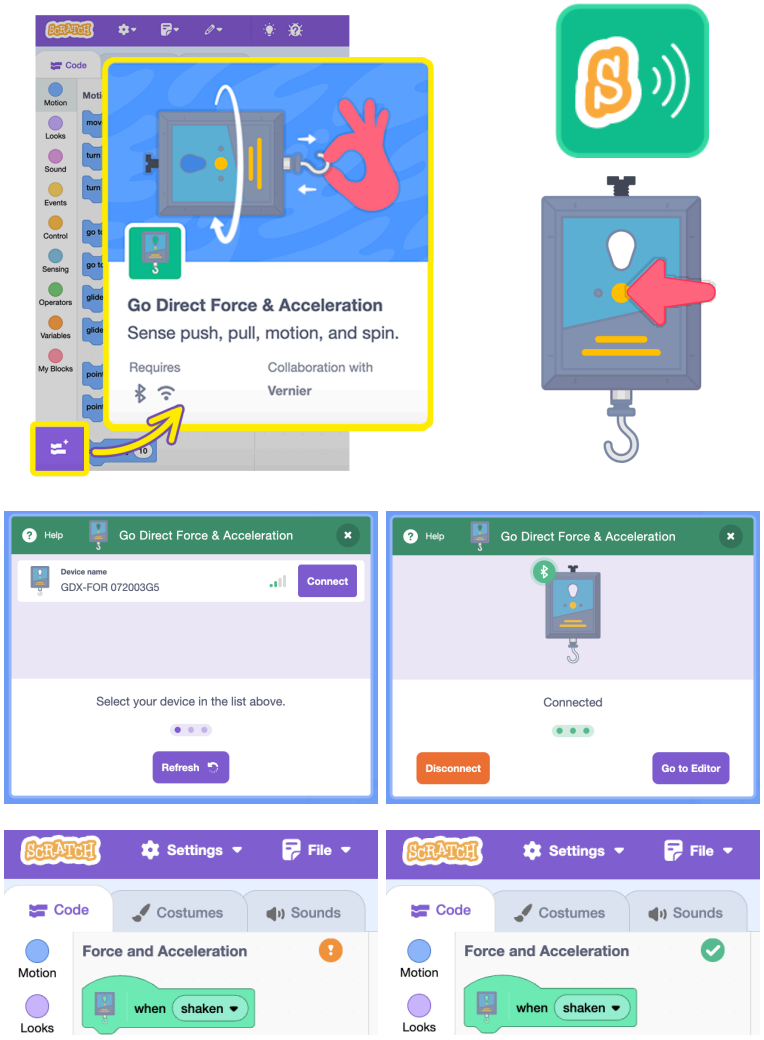
**Step 1:** The first time you connect your Go Direct sensor for use with Scratch, you’ll need to download and install Scratch Link, accessible on our extension page here.

**Each time you want to use the Go Direct sensor with Scratch, you’ll need to start Scratch Link** from your Applications folder and make sure it is running. It should appear in your menu bar when running. *(Note: Scratch Link is compatible with most browsers, but there are minimum operating systems required. See our troubleshooting tips on our extension page here.)*

**Step 2:** **Turn on your sensor** by pressing the power button.

**Step 3:** **Ensure that Bluetooth is switched on** on your device.

**Step 4:** **Head to the Scratch project editor to finish connecting your sensor**. In the blocks palette under the Force and Acceleration category, you should be prompted to connect to your sensor. An orange circle with an exclamation mark at the top of the category signals no connection. Click the orange circle to pull up the connection menu if it does not automatically appear and reconnect. A green check indicates connection.



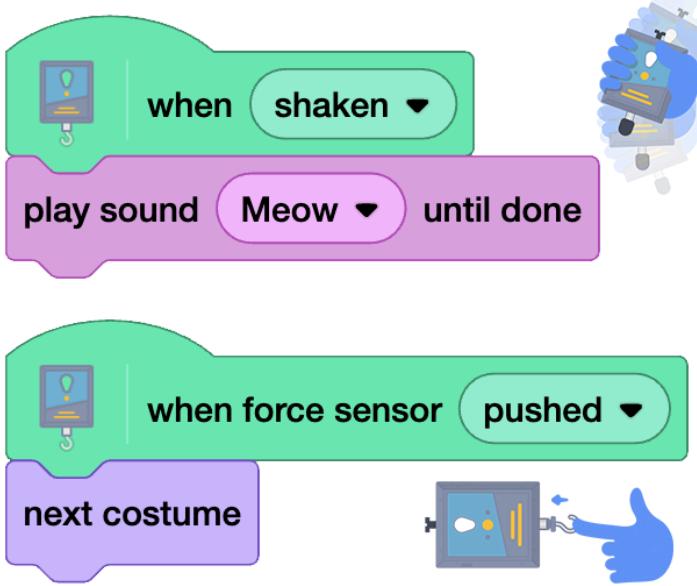

*Steps to connect your Vernier Go Force sensor. An orange circle with an exclamation mark means no connection. A green circle with a check means a connection is established.*

## Test the Connection (5 minutes)

Find the “when shaken” block under the Force and Acceleration block category, drag it to the script area, and attach an animation underneath (like play sound, change color, or next costume). Shake the sensor to see the result.

Now, you can test out other blocks in the Force and Acceleration category to see what they do. Try a “when force sensor pushed” block. Press on the hook at the bottom of the sensor to see the result.

Pair the Force and Acceleration blocks with Scratch blocks from other categories to see how you might use the sensor as a controller for action on the stage (like Motion, Sounds, or Looks).




*Sample scripts to test the sensor connection.*

**Resources:**

- Vernier Sensor Coding Cards (Student-Facing)
- Extension Page (Website)
- Vernier Support articles (Website)

## Try Battery Power

Unplug your Go Force sensor from the computer. The sensor contains a rechargeable battery so you can use it wirelessly. If the battery power is low, connect the sensor to the charging cable and plug into a power source, or connect it with your device to keep collecting data and testing scripts.

Now, you can use the sensor as an unplugged controller in games, animations, informational projects, and more!

# Part 2: Create a Vernier Go Direct Force & Acceleration Project

## Option 1: Frog Band

Shake, push, and drop/toss the sensor to make music.

**Step 1:** Select any three sprites from the Sprite Library, or create your own.

**Step 2:** Select three Force and Acceleration hat blocks to trigger animation, like “when force sensor pushed,” “when started falling,” and “when shaken.”

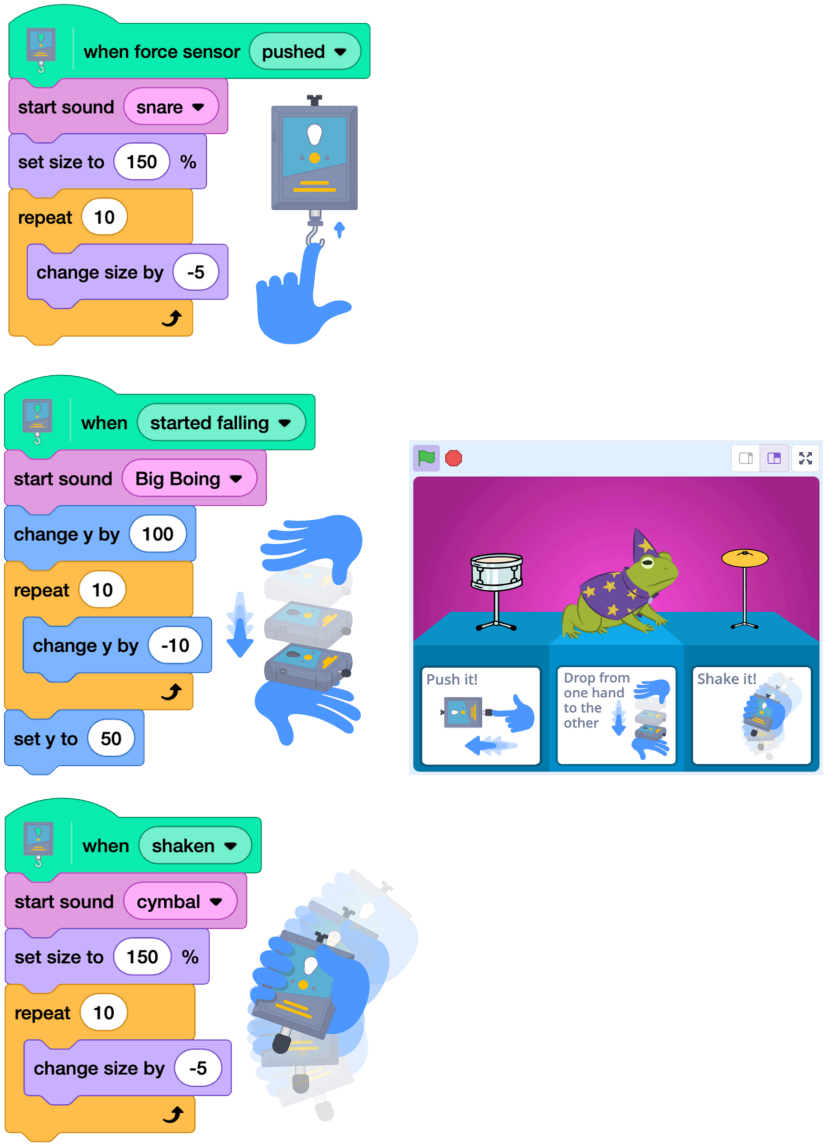
**Step 3:** Choose blocks from other categories (like Motion, Looks, and Sound) to create an animation that the actions will trigger.

**Step 4:** Now, push, shake, or gently drop or toss the sensor between your hands to see the effects!

**Step 5:** What else can you add to customize your project?

**Resources:**

- Vernier Sensor Coding Cards (Student-Facing)
- Frog Band (Example Project)
- Sprite Creation Cards (Student-Facing)




*Example “Frog Band” scripts.*

## Option 2: Day and Night

Turn the sensor face down to change day into night.

**Step 1:** Select a backdrop from the Backdrop Library, or create your own.

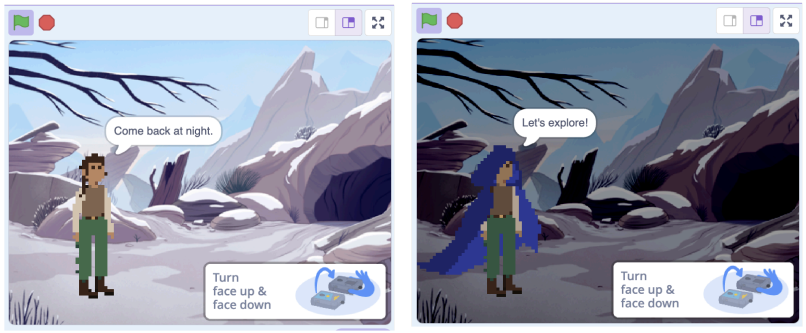
**Step 2:** While on the Backdrop, select two Force and Acceleration hat blocks “when turned face up” and “when turned face down.”

**Step 3:** Under the Looks category, select a “clear graphic effects” and “set brightness effect” block and add them under the hat blocks. Use a negative number when setting the brightness effect to darken the backdrop. Clear the effect or use a block to set the brightness to a positive number to reset or brighten the backdrop.

**Step 4:** Now, flip the sensor over a few times to see the effects!

**Step 5:** What else can you add to customize your project? What if you wanted the backdrop to slowly brighten and darken? How might you use a loop to adjust the brightness slowly?

What if you wanted to add a sprite that would respond to the change in brightness?

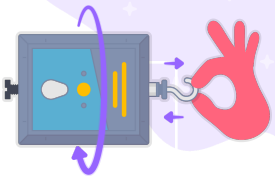




*Example “Day and Night” scripts.*

**Resources:**

- Vernier Sensor Coding Cards (Student-Facing)
- Day and Night (Example Project)
- Sprite Creation Cards (Student-Facing)

## Option 3: Underwater Rocket



Spin and push the sensor to steer a ship.

**Step 1:** Select any two sprites from the Sprite Library..

**Step 2:** Create a script that has one sprite forever turn and move around the stage. But instead of a fixed amount to turn and move by, use the “spin speed” reporter block under the Force and Acceleration category as the amount to turn by, and the “force” reporter block as the amount to move by.

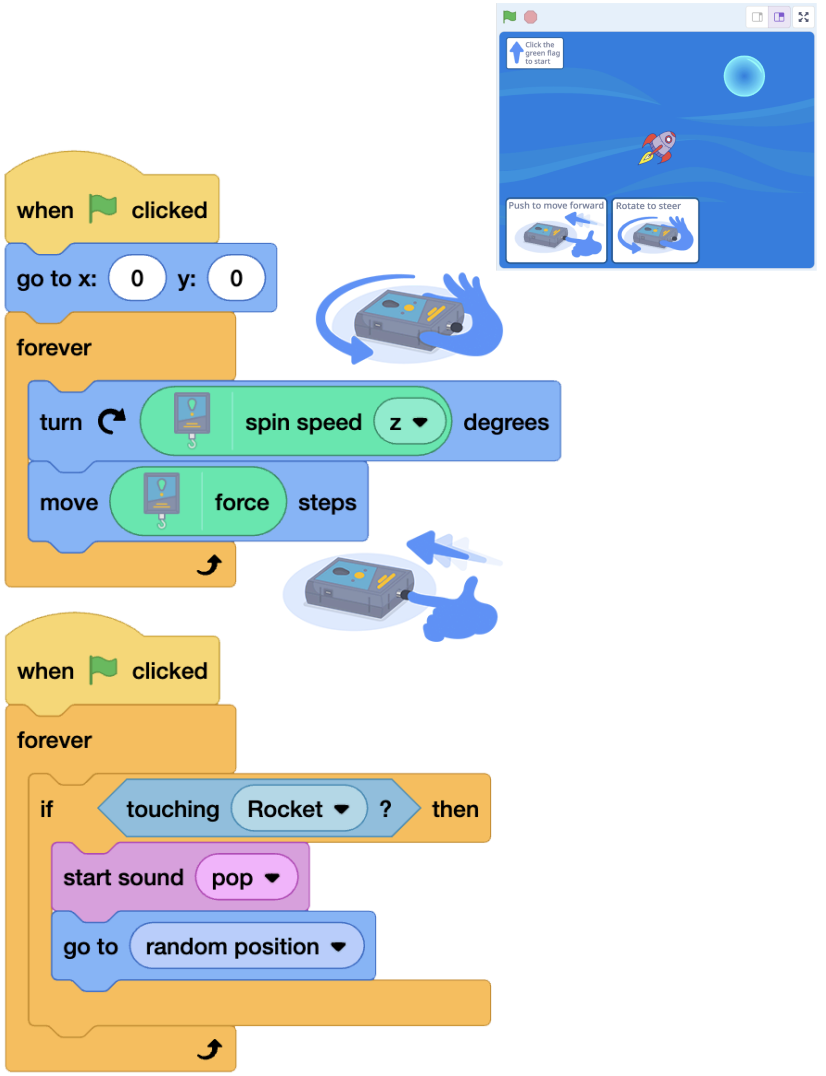
**Step 3:** For the second sprite, code something to happen when it touches the first sprite (like move positions).

**Step 4:** Now, spin the sensor between your hands and push on it to see the effects! Can you steer your first sprite into your second, causing an action when they touch?

**Step 5:** What else can you add to customize your project? Can you add an element of difficulty by making the second sprite move after a certain number of seconds? Or maybe add a scoring element or obstacles to avoid.

**Resources:**

- Vernier Sensor Coding Cards (Student-Facing)
- Underwater Rocket (Example Project)
- Conditional Statements Part 1 and Part 2 (Video Tutorial)
- Conditional Statements Written Guide and Coding Cards
- Variables and Lists Part 1 and Part 2 (Video Tutorial)
- Variables and Lists Written Guide and Coding Cards




*Example “Underwater Rocket” scripts.*

## Option 4: Create Your Own Unique Project

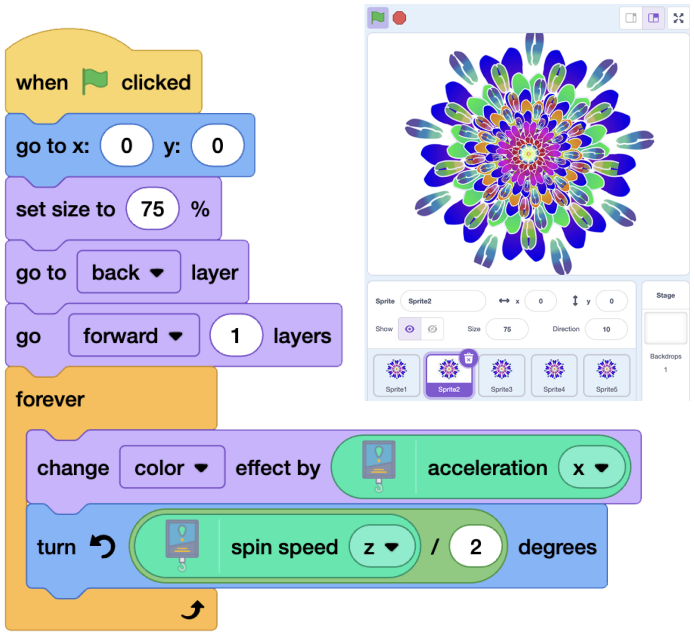
Try creating your own unique project or remix projects to use the Vernier sensor (versus keyboard keys or the mouse, etc.) to control sprites.

See our Starter Projects page for projects you might remix. Such as:

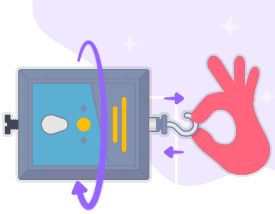
- Make It Fly
- Maze Starter
- Pong Starter
- Spin Art
- Soundflower

How could you use tilt, acceleration, spin speed, shaking, etc., to control a sprite's direction, movement, or variable values?

Educator Rick Bush has shared a fun project that combines art and physical activity. In Rick's project, a Go Force sensor is placed inside a foam football and then thrown to animate a mandala, inspired by fellow educator Shawn Patrick Higgins. Use a rubber band, pipe cleaners, hair bands, zip ties, adhesive tape, etc., to attach a Vernier sensor to various objects like a golf club, juggling stick, pool noodle, or (in this remix) a frisbee (ensure the area where you'll attach is clean and dry). Code animation when the object is thrown, swung, or moved. In the remix example, the color change is tied to x acceleration of the sensor and the turn is tied to the z spin speed of the sensor. The sprite is duplicated, with each version getting a different size, layer order, color, and speed (by dividing the spin speed by a different number each time).




*Example project "Vernier Go Direct Force Mandala - Frisbee Version" that is capturing the spin and acceleration data to animate a mandala. Attach a Vernier Go Direct Force & Acceleration sensor to a frisbee, fly it to a friend to catch, and see the art created!*

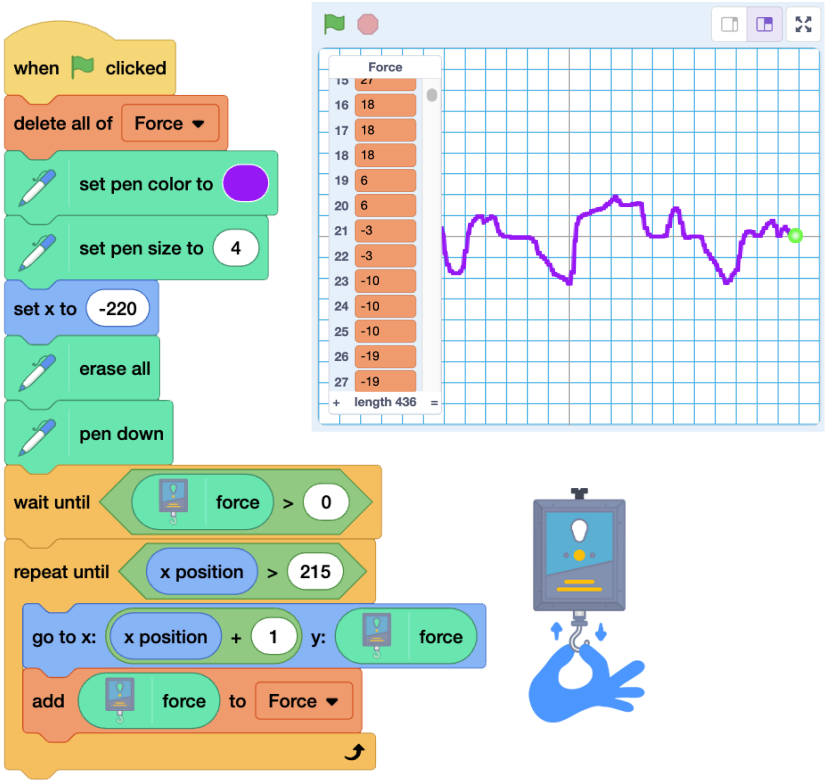


Interested in capturing the data the sensor is collecting? Try remixing a project like Sound Graph to capture readings such as force. Draw the results on the stage and capture them in a list (that could also be exported into a spreadsheet).

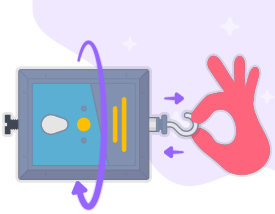
As Vernier's website suggests, you could see the results if you hold it while on a swing or slide, "attach a string to the hook and whirl it in a horizontal or vertical circle…[or use the sensor to] pull an object across a surface to measure frictional forces."

**Resources:**

- Starter Projects (Website) - remix and explore
- Scratch Coding Cards (Student-Facing) - individual coding cards are also available
- Vernier Go Direct Force Mandala - Frisbee Version (Example Project)
- Vernier Go Direct Force Graph (Example Project)




*Version of the "Sound Graph" starter project that is capturing force data. Try pushing and pulling to see the results.*



# Part 3: Reflect and Share

## Reflect (15 minutes)

Learners can reflect on their project creation and process as they complete the Show-and-Tell Sharing Sheet. Next, their peers are encouraged to leave feedback or comments on the sheet for the creator as they view the projects in a studio or participate in the gallery walk.

**Resources:**

- Show-and-Tell Sharing Sheet or Project Gallery Walk Self-Reflection and Peer Feedback Sheet (Worksheet)

## Share Option #1: Create a Class Studio to Gather Shared Projects

Studios are a space on Scratch where users can come together to make, share, and collect projects related to a particular theme, idea, or prompt. Set up a class studio* for your learners and add their original asset projects. Learners are encouraged to take time to look at projects and read/listen/interact with them to learn more about their peers.

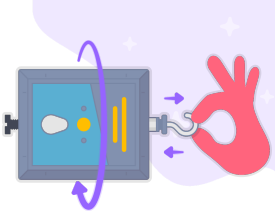
**Resources:**

- Teacher Account Guide (Written Guide) - This resource contains information on setting up teacher accounts and student accounts, managing classes, and class studios.
- Scratch Studios Guide (Written Guide) - General information on setting up and managing.

**Note: Learners need a Scratch account and access to the online editor to participate in this option.*

## Share Option #2: Gallery Walk

Have each participant's project open on their computer or other device. Participants can walk around a room, or take turns sharing their screen in a virtual space, to experience each other's creations. Or display one project at a time on a large screen. Learners are encouraged to take time to look at projects and read/listen/interact with them to learn more about their peers.



## More Things to Try

- Vernier Scratch Lessons (Website)
- Other Go Direct Force and Acceleration Sensor Experiments from Vernier (Website)
- Scratch Design Journal (Worksheet) - imagine, plan, iterate, and reflect throughout all of the phases of your project's development
- Debugging Strategies Posters (Printable Posters)

## Standards Aligned

| CSTA Standards | ISTE Standards | CASEL Framework | RITEC Indicators |
|---|---|---|---|
| Link to full standards | Link to full standards | Link to full standards | Link to full standards |
| • 1B-AP-08 Compare & refine algorithms<br>• 1B-AP-10 Create programs<br>• 1B-AP-11 Decompose problems<br>• 1B-AP-12 Modify, remix, or incorporate<br>• 1B-AP-15 Test and debug<br>• 1B-AP-17 Describe choices made<br>• 1B-CS-02 Model how computer hardware and software work together<br>• 2-CS-02 Design projects that combine hardware and software | • 1.1a Learning Goals<br>• 1.1d Technology Fundamentals<br>• 1.5.b Data Sets<br>• 1.5.c Decompose Problems<br>• 1.5.d Algorithmic Thinking<br>• 1.6.b Creative Communicator<br>• 1.6.c Communicate Complex Ideas | • Self-awareness<br>• Self-management | • Autonomy<br>• Competence<br>• Creativity<br>• Diversity, equity and inclusion |

This lesson also fulfills all three of the ISB Indicators of Playful Learning (Choice, Delight, Wonder), developed by the Pedagogy of Play (PoP) research project at Harvard University.

**Tip**: If you'd like to translate this guide, **click here to make a copy** of this Google doc.