VEX IQ Testbed Activity Series -Teacher Notes

Activity Series Overview

In the **Testbed Activity Series**, students will build a simple frame to use as a Testbed and through the activities in this series, they will add IQ Sensors, explore how they work, and code the sensors in VEXcode IQ. The IQ Activities in this series can be used individually, or in a sequence, to enable students to create their own testbed, base build and explore the different IQ Sensors. IQ Activities are open-ended and encourage further exploration. The “Level Up” section prompts students to complete related activities that build on what they have learned. The “Pro-Tips” section provides scaffolding for students to help them complete the Activity successfully.

The following Activities are included the Testbed Activity Series:

- **Find Your Direction -** Students build a device to simulate a compass using Inertial Sensor data reported on the Robot Brain. In Level Up, they can create a mystery path for a fellow student to follow based on the headings that are reported on the Brain.
- **Measuring Up** - Students build a device to measure distance using the Distance Sensor and the Bumper Switch. They will configure these sensors in VEXcode IQ, and build a project that will enable them to use their device to measure distances.
- **Guess that Hue** - Students build a device to detect the degree of color hue of classroom objects using the Optical Sensor. They will configure the sensor in VEXcode IQ, and observe the sensor data reported on the Sensor Dashboard on the Brain.
- **Guess that Color** - Students add a Touch LED Sensor to their build and create a VEXcode IQ project to have the color of the sensor change when it is pressed. In their project, students will be creating a condition that will have their testbed use sensor input (is the Touch LED pressed?) to determine the output (the color that the Touch LED will light up). Then, students are encouraged to create a game based on sensor feedback. This is a great opportunity for students to apply what they have learned about the IQ Sensors in an open-ended challenge.

All the Activities in this series can use the same base build so you can keep it together from one Activity to the next. Students can switch out the sensors, or add one on with each Activity, so their build has all the IQ Sensors configured. Then, you can have students deconstruct the build at the conclusion of the Activity Series.

Students will experiment with the following IQ Sensors:

- **Inertial Sensor -** built into the Robot Brain, and reports the Brain’s heading and/or how much it has turned. When turned to the left (counterclockwise), its readings increase and when turned to the right (clockwise), its readings decrease. See this article to learn more about Inertial Sensors and how they work.
    - **Additional Setup for this Activity-** Use classroom supplies to place an ‘N’ in the classroom to identify true North cardinal direction for students. They will need to point their builds to North when they calibrate their Inertial Sensor.
- **Bumper Switch** - a switch that reports if it is pressed or released. See this article to learn more.
- **Distance Sensor (2nd gen)** - can detect an object, measure the distance from the front of the sensor to an object, and determine the relative size of the detected object. The sensor uses a pulse of classroom-safe laser light to measure the distance from the front of the sensor to an object. See this article to learn more.

- **Optical Sensor** - detects if there is an object present and the color of the object. It will also register the brightness of light — this could be the brightness level of a room, or the brightness of a particular object. See this article to learn more.
- **Touch LED** can detect capacitive touch (such as the touch of a finger) and can be used to display colored light. See this article to learn more.

Teacher as Facilitator in this Series

Testbed Activities are designed to be student-facing so that students can directly interact with the content. This places the teacher in the role of facilitator of learning, rather than a supplier of information, in the classroom. As such, you can choose how you want the students to move through the Activity content, based on the needs and interests of your students.

Each Activity sheet can be edited to best meet the needs of your students. You know your students best, so tailor your teaching and Activity implementation to best suit your students. The Testbed Activity Series is designed to be flexible, so that you can meet students where they are, giving them the time, space, and instruction necessary to make the most of their learning. See the following articles for more information about editing Google docs for your own classroom use with Google drive or with Microsoft Office. You may want to print those Activities out ahead of time and give them to your students, or project one in the classroom for all students to access at the same time.

Group Size and Student Collaboration

- A group size of 3 students (or less) per VEX IQ Kit is recommended.
- Set clear expectations for respectful collaboration and encourage students to take ownership over certain responsibilities within their groups to help group work become a more student-led process:
  - Break up the build so that group members are taking turns
  - Establish roles for collaborative coding
  - Establish roles for testing and iterating on the build and code.

Prepare Your Classroom:

Have the following spaces and materials ready prior to the start of class:

- [ ] An VEX IQ Kit for each group or individual completing the series
- [ ] A charged VEX IQ Battery for each group
- [ ] Designated space to build
- [ ] An engineering notebook for each student
- [ ] Place a large ‘N’ in the classroom to indicate true North for the **Find Your Direction Activity**
- [ ] ***Optional***: A ‘saving space’ for groups to store their project for the duration of the Activity Series.

Troubleshooting Tips for this Series

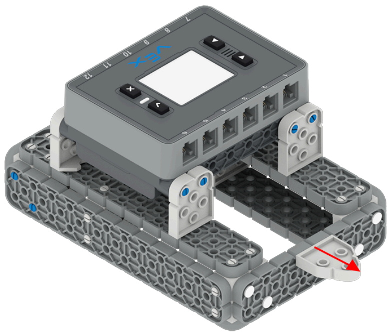
- Be sure that your VEX IQ Brains and Batteries are ready to use. For more information on getting started with VEX IQ, see this section of the STEM Library
- Students will need to have access to VEXcode IQ on their computers or tablets. For more information about installing VEXcode IQ, see Install section of articles for device-specific information.
- Be sure that your VEXcode IQ firmware is up to date. To learn more about updating firmware, you can view the **Updating Firmware** tutorial video, or see this section of articles.
- **To further support students as they are getting started with VEXcode IQ**, you can use the following resources:
  - For help with pairing the Brain with VEXcode IQ, see this section of articles.

    - For help with naming and saving projects, see these device-specific articles.
    - For help with downloading and running projects, have students watch the **Download and Run a Project** tutorial video.

Standards That Can Be Reached with this Activity Series

- **ISTE (4) Innovative Designer - 4a:** Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
- **Next Generation Science Standards (NGSS)**: **NGSS MS-ETS1-4:** Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs, for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.
- **Common Core State Standards (CCSS) - Math**: **CCSS.MATH.PRACTICE.MP5:** Use appropriate tools strategically.

VEX IQ Activity

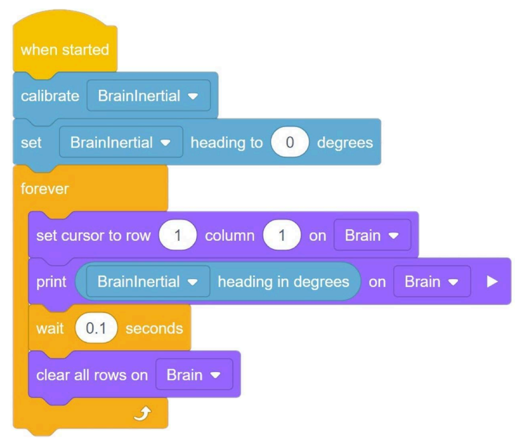


Find Your Direction!

Can you build a device to simulate a compass using the IQ Robot Brain's Inertial Sensor?

Step by Step

1. Build a simple frame (testbed) for your IQ Robot Brain and add a component like the 60 Degree Omni Corner Connector to act as a pointer, as shown in the example above. [Use this link to view a 3D model of the example build in more detail.]
2. Open [VEXcode IQ], and build the project on the right.
3. Save and download the project to the Brain.
4. Find the letter N your teacher has placed in the classroom marking North. *(Or, use a compass or smartphone compass application to find N)*
5. Point your device at North and run your project.
6. Then, point your device at another object in the room.
    a. What is its heading displayed on the Brain's screen?
    b. Can you explain why your device needed to be pointed North before you ran your project? (hint in Pro Tips)



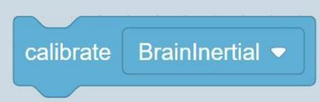
'LEVEL UP'

- **Find your way -** Use your device to help you write a set of directions from your location to another, such as:
    - Start at my desk
    - Take 10 steps at a heading of 64.
    - Turn to a heading of 154 and take 6 steps. Where are you?

  Can a classmate use your device and successfully find the location from your directions?

Pro Tips

- Don't move the Brain while calibrating. The [Calibrate] block starts the Inertial Sensor and gives it time to orientate itself to the position of the Brain. After it is calibrated, your device will act like a compass.



Standard: ISTE (4) Innovative Designer - 4a: Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.

Measuring Up!

Can you build a device to measure distance instead of using a tape measure?

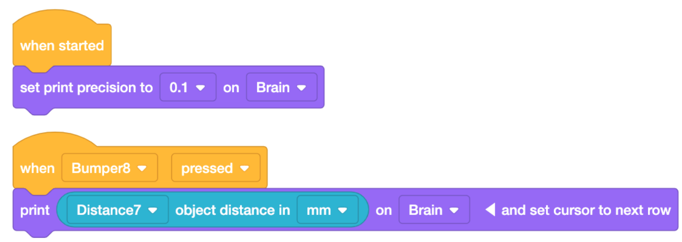
Step by Step

1. Build a simple frame (testbed) for your IQ Robot Brain and add a Bumper Switch and Distance Sensor as shown above. Connect the Bumper Switch into Port 8 and Distance Sensor into Port 7. Use this link to view a 3D model of the example build in more detail.

2. Open VEXcode IQ and configure the Bumper Switch and Distance Sensor.

3. Add [Set print precision to 0.01] to the {When started} block.

4. Add the {When bumper} event block to your project, and attach a [Print] block.



5. Replace the value in the [Print] block with an (Object distance), sensing block, and select 'and set cursor to next row' option on the block.

6. Save, download, and run the project.

7. Open the Devices screen on the Brain, and as the project is running, point the distance sensor towards the object you want to measure the distance from, and press the Bumper Switch. Read the measurement on the Brain's display.

'LEVEL UP'

- **Doing the conversion -** One millimeter equals 0.1 centimeter. Can you use an operator to convert the distance from millimeters to centimeters?
- **How Precise -** Change the [Set print precision] block. How does this affect your measurement?
- Project update - Can you change your project so that the Distance Sensor continually prints the Distance of an object in motion?

Pro Tips

- Hold the testbed steady, or place it on a steady table or chair to get more accurate readings.
- Construction workers, surveyors, engineers, and other professionals use laser measuring tools to measure distance. They use a tripod to hold their measuring tools steady to get accurate measurements.

Standard: ISTE (4) Innovative Designer - 4a: Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.

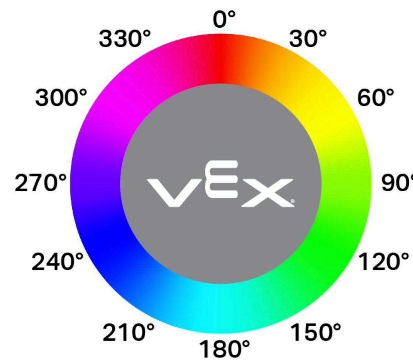
VEX IQ Activity

Guess That Hue!

Can you build a device to detect the degree of color hue of classroom objects?

Step by Step

1. Build a simple frame (testbed) for your IQ Brain and add an Optical Sensor as shown above. Connect the Optical Sensor into Port 3. Use this link to view a 3D model of the example build in more detail.
2. Open VEXcode IQ and configure the Optical Sensor.
3. Select a small classroom object which has a single color.
4. Look at the color wheel on the right and estimate the degree of color hue of the object.
5. Hold the object above the Optical Sensor and use the Sensor Dashboard on the VEX IQ Brain to measure the degree of color hue. How close was your guess?

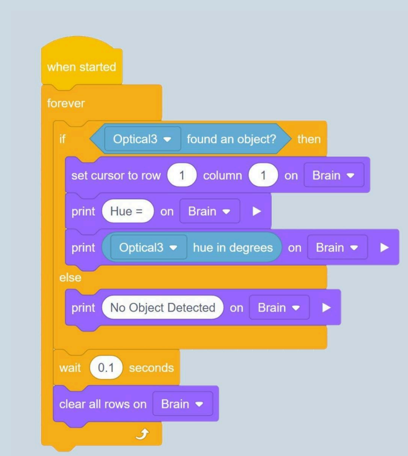


'LEVEL UP'

- **In the Shade -** Use something like a piece of paper to shade the classroom object. Measure the degree of color of hue for the object again. Does the amount of light change the value?
- **In the spectrum -** Obtain a picture of the color spectrum. Measure and record the degree of color hue for each of the colors in the spectrum.

Pro Tips

A VEXcode IQ project with the Optical Sensor configured to port 3 can also be created to measure the hue of an object.



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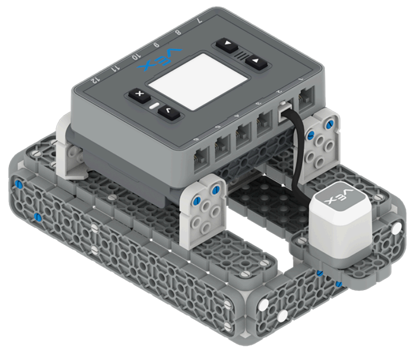
VEX IQ Activity

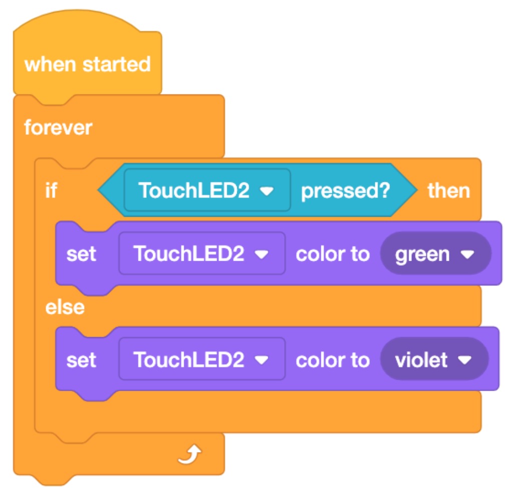


Guess That Color!

Can you build a device to play a game using the LED Touch Sensor?

Step by Step

1. Build a simple frame for your IQ Robot Brain and add an LED Touch Sensor as shown above. Connect the LED Touch Sensor into Port 2. Use this link to view a 3D model of the example build in more detail.
2. Open VEXcode IQ and configure the LED Touch Sensor.
3. Build the project on the right, and be sure to save, download, and run the project. Select two different colors of your choice for the Touch LED.
4. Ask a classmate to guess what color the LED will change to when they touch the sensor. Then have them test their guess.
5. Can you come up with a game which uses the LED Touch Sensor? Think about how you can use the LED Touch with other sensors to create an interactive game w/ a friend.



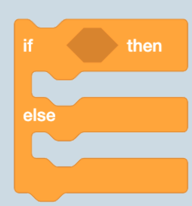
'LEVEL UP'

- **Automatic change -** Can you adjust your project to automatically change the color of the LED after a certain time period?
- **Emergency light-** Can you create a project which simulates the light bar on top of an emergency vehicle, like a fire truck, police cruiser, or utility truck?

Pro Tips

- The [Forever] block continually repeats the project flow within the loop. This is important for feedback from sensors and controllers.

- The [If else] block allows you to create conditions in your project. **If** the Touch LED is pressed, **then** X will happen, **Else** (if not pressed) then Y will happen.



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