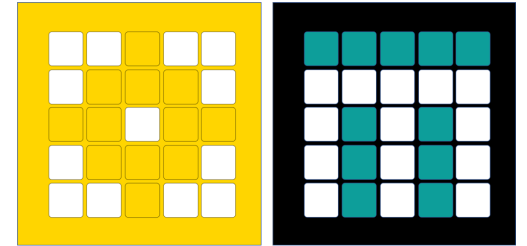


PRIME LESSONS

By the Makers of EV3Lessons



INTRODUCTION TO SPIKE PRIME/ ROBOT INVENTOR HUB & SOFTWARE

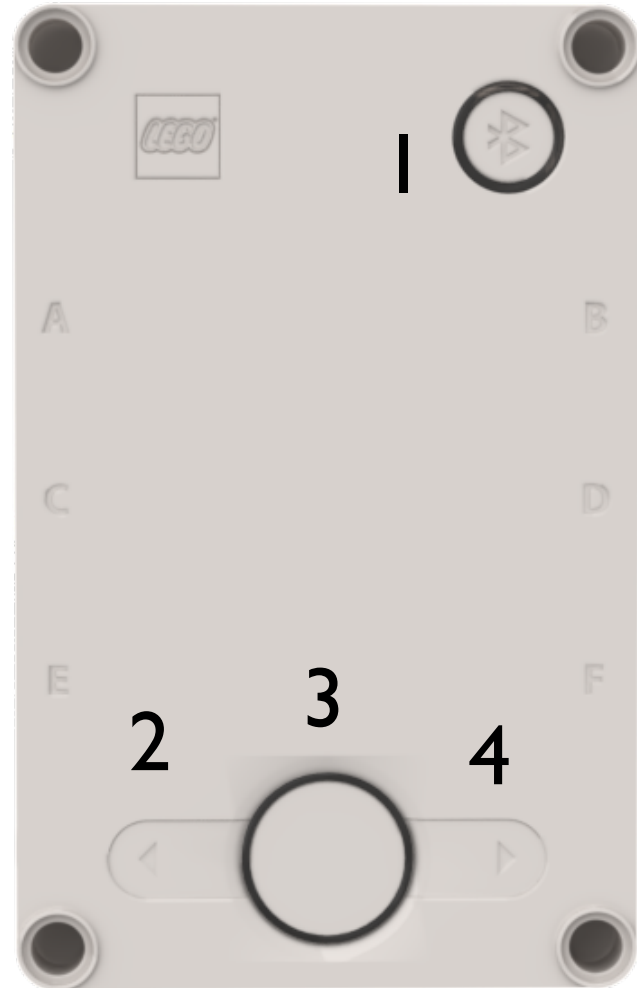
BY SANJAY AND ARVIND SESHAN

LESSON OBJECTIVES

- Learn how the SPIKE Prime and Robot Inventor Hub operates
- Learn about the main components of the SPIKE Prime and Robot Inventor Software
- Learn how to connect your Hub

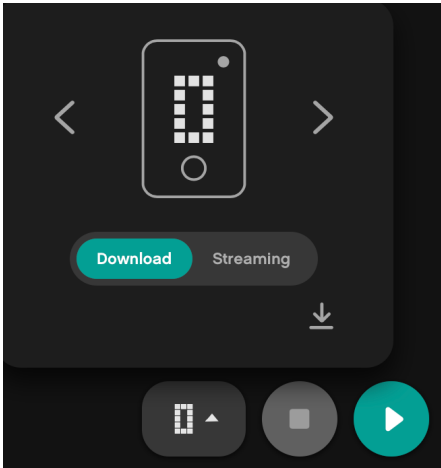
THE HUB BUTTONS

1. Put Hub in Bluetooth pairing mode
2. Left button for program navigation in home menu
3. Select program or exit program when running. Hold down for 5 seconds to power off. Turns on Hub.
4. Right button for program navigation



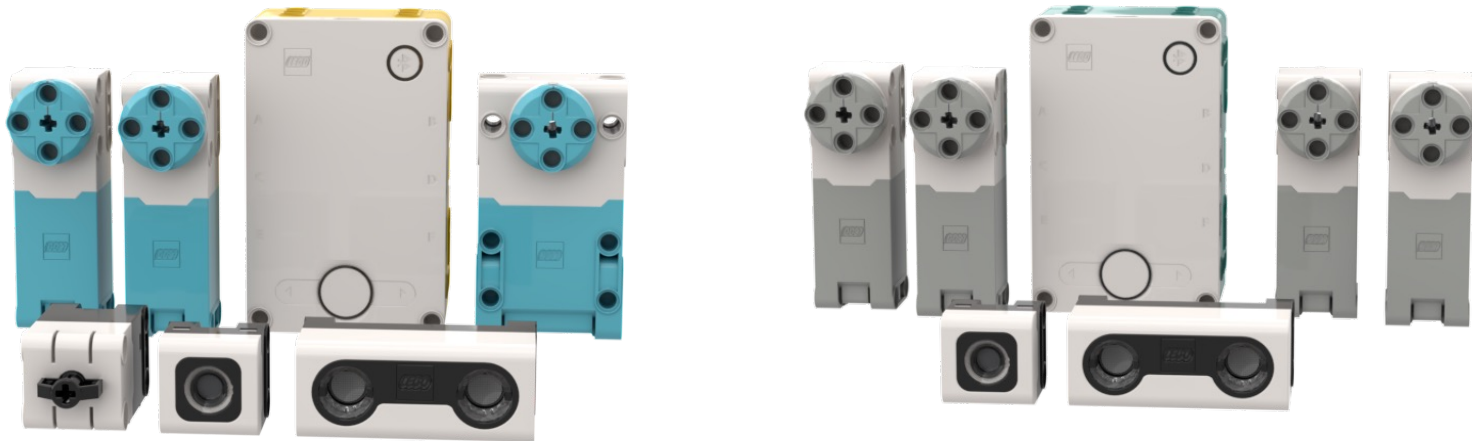
THE HUB SCREEN

- 5x5 LED pixel matrix can be used to make designs, but also pick programs
- Use the arrows and center button to navigate/launch programs
- You can have a maximum of 20 programs



PORTS, MOTORS AND SENSORS

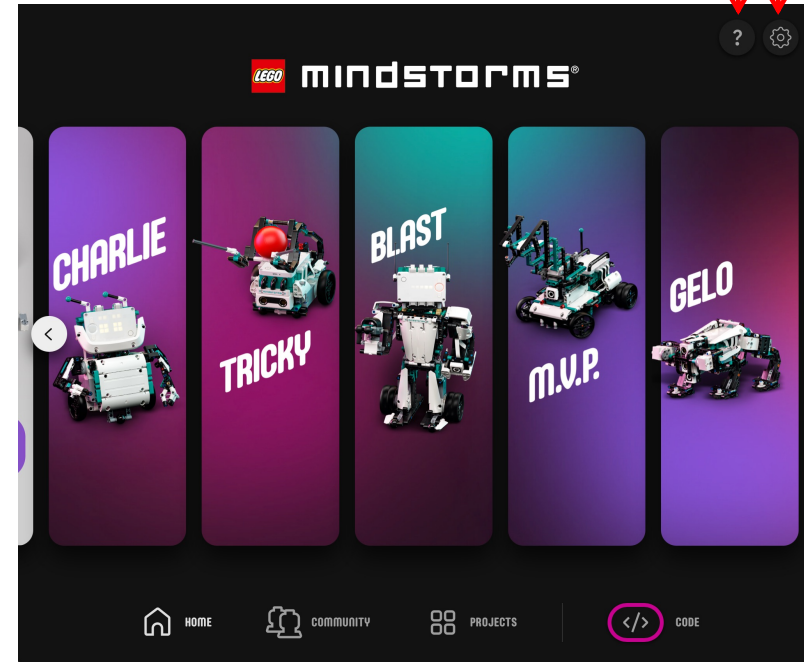
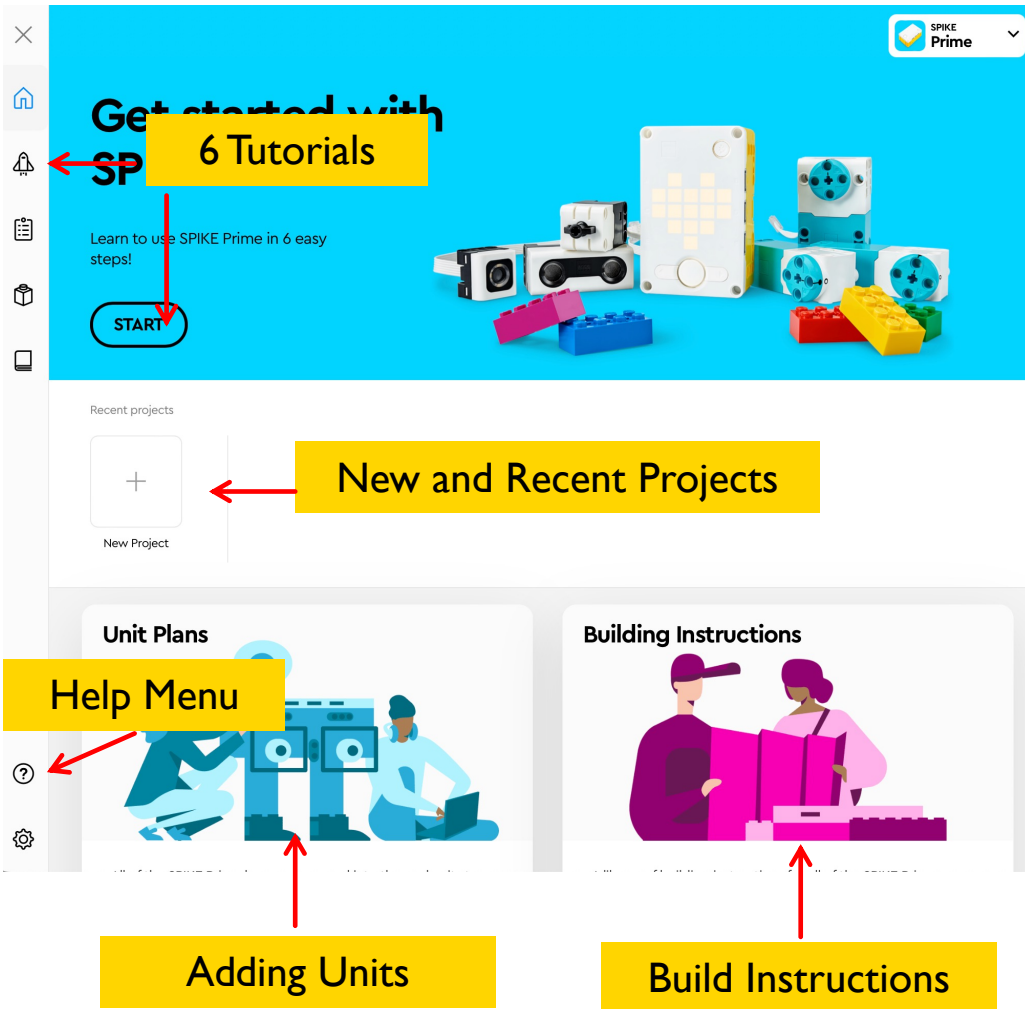
- The hub has 6 built-in ports (A-F)
- Any port can be used for any motor or sensor
- The main SPIKE Prime set comes with 1 Large Motor and 2 Medium Motors, 1 Force Sensor, 1 Distance Sensor, 1 Color Sensor, and a built-in 6-axis IMU (3-axis accelerometer + 3-axis gyro)
- The Robot Inventor set comes with 4 Medium Motors, 1 Distance Sensor, 1 Color Sensor, and a built-in 6-axis IMU (3-axis accelerometer + 3-axis gyro)



HOME MENU

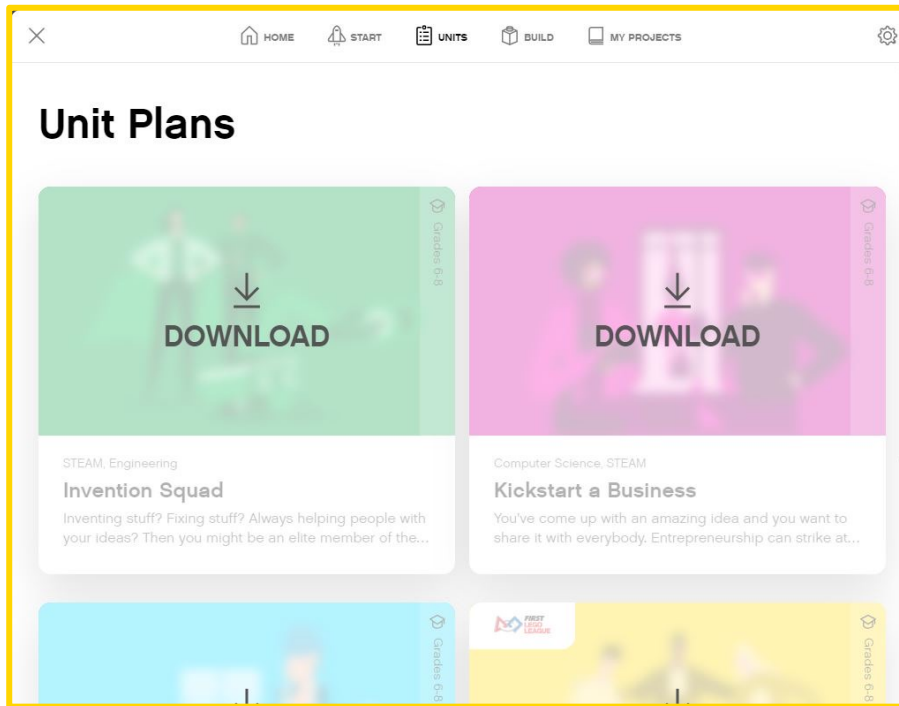
Build Instructions

Help Menu



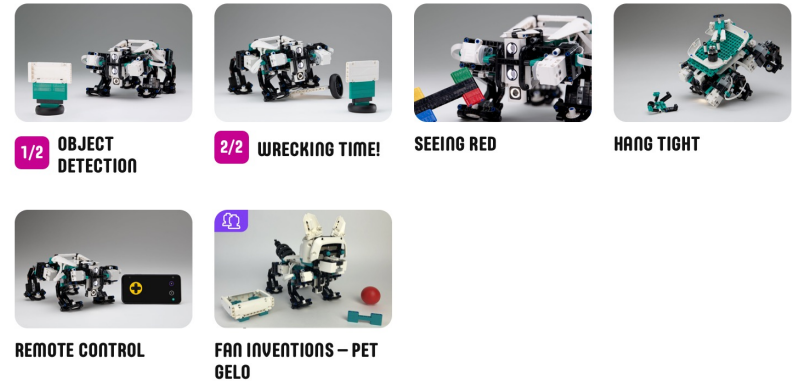
ADDING NEW CONTENT

- In SPIKE Prime, you can download new Units
- The *FIRST* LEGO League Curriculum is called “Competition Ready”



- In Robot Inventor, you download new Further Activities for the main models or click on the Community Tab from the main screen

FURTHER ACTIVITIES



SPIKE PRIME: PROGRAMMING CANVAS ESSENTIALS

Back to Home

Opened Project

The screenshot shows the main programming interface. At the top, there are tabs for 'Project 2' and 'Project 1'. A 'New Project' button is visible on the right. The left sidebar contains various toolbars: MOTORS, MOVEMENT, LIGHT, SOUND, EVENTS, CONTROL, Movement, OPERATORS, VARIABLES, and MY BLOCKS. The central area is the 'Programming Canvas' where a program is being built. The program starts with a 'when program starts' block, followed by a 'run for 1 rotations' block, a 'go shortest path to position' block, and a 'start motor' block. A 'Project Properties' dialog box is open, showing options to 'Rename Project or Move File to new location (i.e. Save as)'. At the bottom left, there is an 'Extensions' button. The bottom right corner has playback controls: a play button, a stop button, and a refresh button.

New Project

Project Properties
Rename Project or
Move File to new
location (i.e. Save as)

Connect to Hub and Access Hub
Dashboard

The screenshot shows the 'ADB' (Advanced Dashboard) for a SPIKE Prime Hub. It displays the hub's status (Hub ID: 181, 100% battery) and a 'reconnect' button. Below the status, there are controls for 'Yaw', 'Pitch', 'Roll', and 'TILT ANGLE'. A central diagram shows the hub with six motor ports labeled A through F, each with a corresponding rotation value: A (180°), B (180°), C (0°), D (180°), E (283°), and F (180°).

Programming
Canvas

Extensions

ROBOT INVENTOR: PROGRAMMING CANVAS ESSENTIALS

Opened Project

Project Properties Rename Project or Save As

Programming Canvas

Extensions

The screenshot shows the Robot Inventor software interface. On the left is a vertical toolbar with categories: Motors, Movement, Light, Sound, Events, Control, Sensors, Operators, Remote..., Variables, and My Blocks. The 'Motors' category is expanded, showing blocks like 'run for 1 rotations', 'go shortest path to position 0', 'start motor', 'stop motor', and 'set speed to 75%'. The 'Movement' category is also expanded, showing blocks like 'move up for 10 cm', 'move straight: 0 for 10 cm', 'start moving straight: 0', 'stop moving', 'set movement speed to 50%', 'set movement motors to A+B', and 'set 1 motor rotation to 17.5 cm moved'. The central 'Programming Canvas' contains a yellow 'when program starts' block. A red arrow points from the 'Project Properties' label to the top right of the canvas. A red arrow points from the 'Extensions' label to the bottom left toolbar icon. A teal box highlights the home icon in the top left corner.

Connect to Hub
Access Hub Dashboard

LEGO Hub

The screenshot shows the LEGO Hub dashboard. At the top, it says 'LEGO Hub' and 'Hub ID: 193'. Below that, there are tabs for 'Hardware' and 'Programs'. The 'Hardware' tab is active, showing a central hub icon connected to various sensors and motors. The sensors include a camera, a light sensor, a touch sensor, and a distance sensor. The motors include two large motors and two smaller ones. The dashboard also shows a table with columns for 'Year', 'Pitch', and 'Roll', and a 'Zoom' control.

Download Programs

The screenshot shows the 'Download Programs' screen. It features a central hub icon with a grid of program icons. Below the icon are two buttons: 'Download' and 'Streaming'. At the bottom right, there is a download arrow icon.

EXTENSIONS: ADDING MORE BLOCKS



- When you open either software, not all available blocks are enabled.
- Click on the Extensions icon at the bottom of the Block Palette panel
- In our lessons, we will use “More Motors” and “More Movement” often
- These blocks will show up as separate tabs in the programming palette once downloaded.

Extensions

Weather Manager
Get this week's weather forecast. Your computer needs to be connected to the internet.
> LEARN MORE

More Motors
Make motors hold their position or run motors with unregulated power.
> LEARN MORE

More Movement
Set the individual motor speed on a Driving Base or make it hold its position.
> LEARN MORE

More Sensors
This extension provides additional sensor data, such as acceleration, peak pressure, and temperature.
> LEARN MORE

Music
Play instruments and drums. Music will play from your computer or tablet.
> LEARN MORE

Line Graph
This extension allows you to display and experiment with line graphs.
> LEARN MORE

Extensions

Regular

- More Motors [Add](#)
- More Movement [Add](#)
- Weather Manager [Add](#)
- Music [Add](#)
- Model Blocks [Add](#)

Experimental

- DualShock®4 Controller [Add](#)
- Xbox One® Controller [Add](#)

PROGRAMMING CANVAS

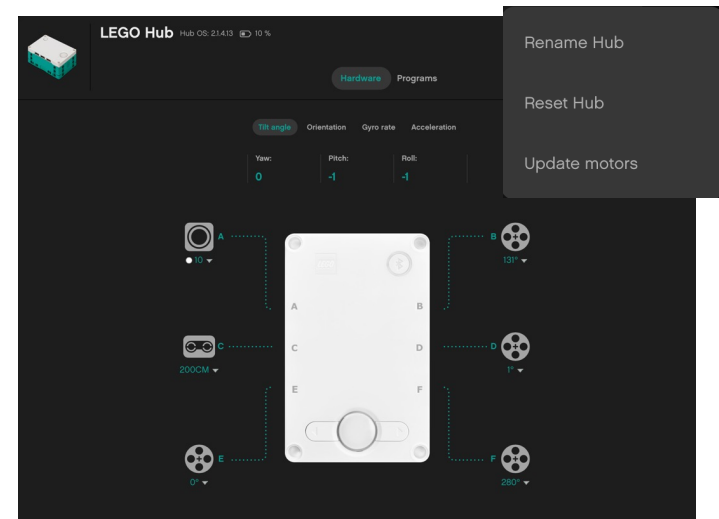
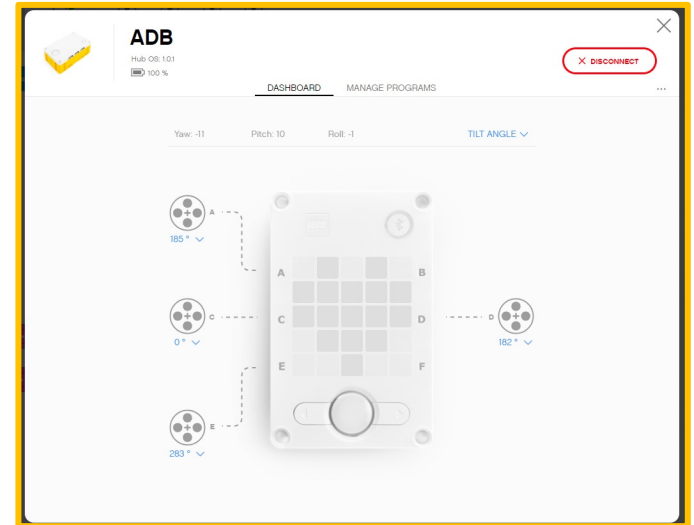
The image shows the SPIKETM Prime programming interface. On the left is the 'Block Palette' with categories: MOTORS, MOVEMENT, LIGHT, SOUND, EVENTS, CONTROL, Movement, SENSORS, OPERATORS, VARIABLES, and MY BLOCKS. The main area is the 'Project' programming canvas, which contains a 'when program starts' block and a 'Hub Dashboard' window. The 'Hub Dashboard' window shows a grid of motor ports (A-F) and a 'Download' button. Below the canvas are 'Download' and 'Stop and Play' buttons. A yellow box highlights the 'Connect' icon in the top left of the canvas, and a red box highlights the 'Download' and 'Stop and Play' buttons.

- The main programming canvas is where you will create each program (called 'Project')
- All the programming blocks are on the Block pallet on the left
- The Connect Icon lets you access the Hub Dashboard
- The Download Icon lets you pick the mode to download

HUB DASHBOARD



- You must connect your Hub to access this section (click on the small Hub icon)
- This section is very useful for:
 - Checking battery level
 - Hub OS version
 - Gyro Sensor Values
 - See which motors and sensors are connected
 - Get real time values from the motors and sensors
- Clicking three dots (...) lets you rename and reset your but and calibrate your motors
- The Manage Programs has a list of all programs on the Hub (maximum of 20). Use this section to change the order of the programs.



BLOCK PALETTE OVERVIEW FOR SPIKE PRIME & ROBOT INVENTOR

SPIKE PRIME



- Motors** – Control an individual motor
- Movement** – Control two motors at a time with synchronization
- Light** – Program the 5X5 matrix
- Sound** – Play a sound
- Events** – Run actions based on events (e.g. sensor or timer)
- Control** – Loops, if/else statements, etc.
- Sensors** – Read a sensor value
- Operators** – Mathematics and logic
- Variables** – Store data in a variable or list
- My Blocks** – Custom defined blocks
- More Movement** – Additional movement blocks
- More Motors** – Additional motor blocks
- Weather** – Access weather information and forecasts
- Music** – Play musical notes and select instrument
- More Sensors** – Raw color values, acceleration
- Music** – Pick instruments and tempo
- Line Graph** - Datalogging
- Display** – Display images

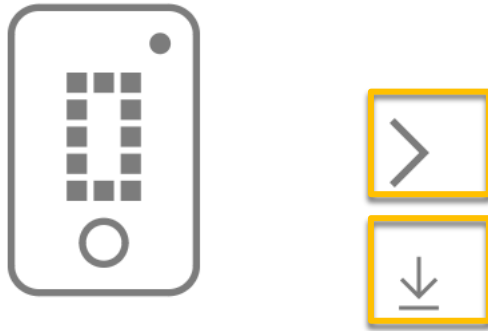
ROBOT INVENTOR



- Motors** – Control an individual motor
- Movement** – Control two motors at a time with synchronization
- Light** – Program the 5X5 matrix
- Sound** – Play a sound
- Events** – Run actions based on events (e.g. sensor or timer)
- Control** – Loops, if/else statements, etc.
- Sensors** – Read a sensor value
- Operators** – Mathematics and logic
- Variables** – Store data in a variable or list
- My Blocks** – Custom defined blocks
- More Movement** – Additional movement blocks
- More Motors** – Additional motor blocks
- Weather Manager** – Access weather information and forecasts
- Music** – Play musical notes and select instrument
- Model Blocks** – Coding Blocks for 5 built-in models
- DualShock 4 Controller**
- Xbox One Controller**

DOWNLOADING CODE TO YOUR HUB

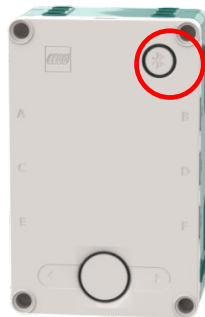
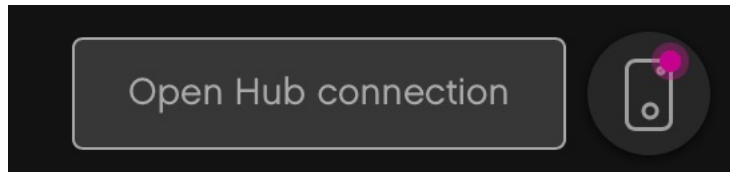
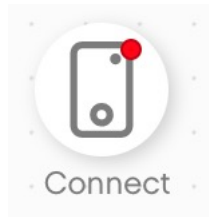
Download to Hub



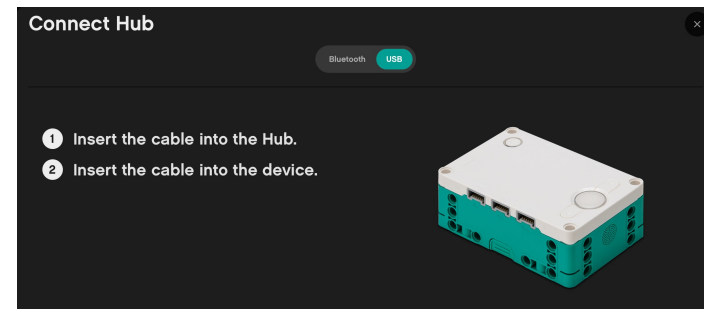
- Download: The program runs on the hub and can be run at any time with or without your PC
- Use the right arrow to select which slot you want to download your program to (0-19).
 - Once the code is on your hub, you can use the arrow keys on your hub to pick the correct program number.

Note: *FIRST* LEGO League Teams must Download code to their Hub. At robot matches, they will play their code using the Hub. There is no current method to recover code from the Hub if you lose your saved file on your computer. Save often and keep backups of the code.

CONNECTING TO HUB



- For both SPIKE Prime and Robot Inventor, the software will auto-connect to the Hub if you are using a USB cable
- To connect over Bluetooth, click the connect icon in the software. (the small Hub icon)
- Enable Bluetooth by pressing the Bluetooth button on the Hub.
- Your Hub will show up in the list at the bottom. Select your Hub



Note: FIRST LEGO League Teams will be asked to not use Bluetooth in competition areas. Bring a USB cable to events to modify your code.

CREDITS

- This lesson was created by Sanjay Seshan and Arvind Seshan for Prime Lessons
- More lessons are available at www.primelessons.org



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