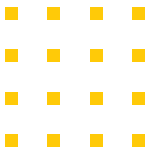





SPIKE PRIME & FIRST LEGO LEAGUE

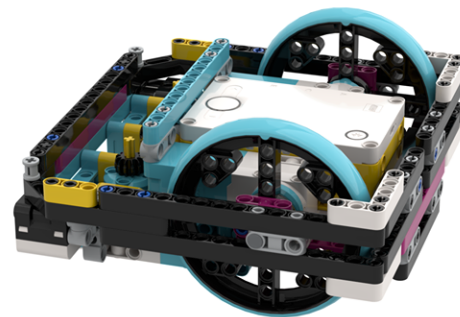
Sanjay Seshan and Arvind Seshan
Primelessons.org, EV3Lessons.com, FLLTutorials.com



Objectives

Compare EV3 and SPIKE Prime

Focus on the needs of FIRST LEGO League teams

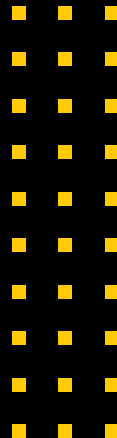


Note: We do not represent *FIRST* or LEGO Education. All opinions are our own.



Comparison

SPIKE Prime vs. EV3 Overview



Hub/Ports

5 second boot time
(convenient for teams if the
hub/brick were to crash
before or during a run)

6 universal ports (can be
used for sensors or motors)
with a built-in gyro



LEGO education

30 second boot time, even
longer for MicroPython

4 sensor + 4 motor
specialized ports



LEGO education

Conclusion: You do not lose much in terms of ports by switching to the SPIKE Prime

Sensors used in *FIRST* LEGO League

Color Sensor (improved with more colors and better recognition)

Distance Sensor (can be taken apart for custom components – for hobbyists, not FLL)

Force Sensor (reads pressures from 0-10N)

Built-in 6-axis gyro and accelerometer (no drift and minimal lag)

Color Sensor

Ultrasonic Sensor

Touch Sensor (binary – pressed or released)

Gyro Sensor (drift and lag issues)



LEGO education



LEGO education

Conclusion: SPIKE Prime has the same sensors and they are overall better than the EV3's

Programming Languages Available

Primary: Word Blocks: Scratch-based programming

Secondary: [Micro-]Python (text-based): built into same App, has basic tutorials and examples available. Has some extra commands and functionality (similar to EV3)

Can only use Scratch or MicroPython

Block based: EV3-G/EV3 Lab (LabView-like) or Scratch-based EV3 Classroom (Mac only right now)

Text based (official): MicroPython. Requires microSD Card, Visual Studio Code IDE (requires additional work/not built-in)

Can use non-LEGO supported languages (e.g. Java, C++, etc.), but usually require an SD card

The text based languages generally provide more functionality



LEGO education



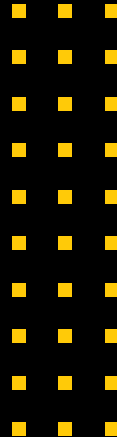
LEGO education

Conclusion: SPIKE Prime's software is easier to switch between block-based and Python, but has fewer languages available



Features and Tradeoffs

More detailed look at SPIKE Prime



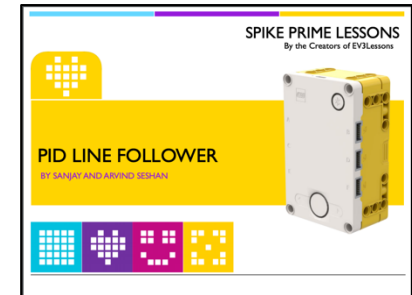
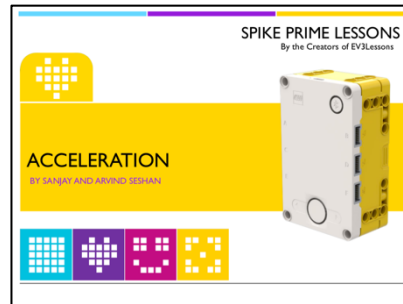
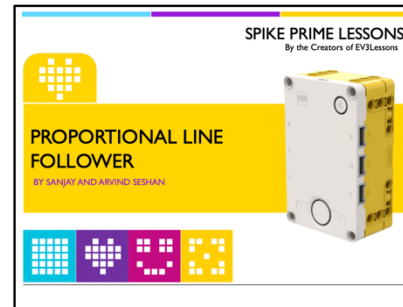
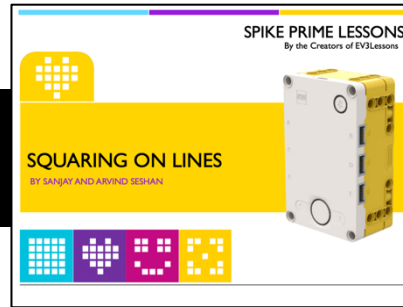
Advanced Programming

EV3 programming techniques can also be done in SPIKE Prime. You can use Proportional control, gyro move straight, PID line follower, squaring on a line, etc. in both Scratch and MicroPython.

Videos

<https://www.facebook.com/PrimeLessons/>

Lessons: <http://www.primelessons.org/>



Improvements with SPIKE Prime (Software)

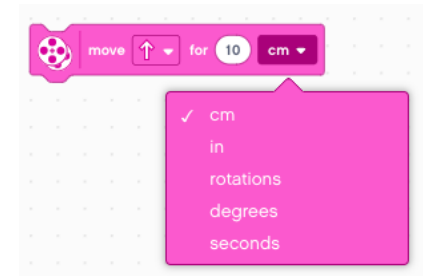
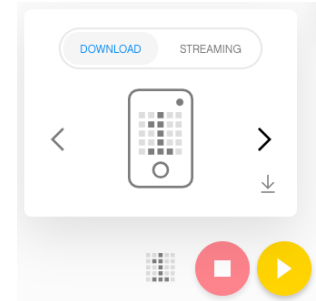
Finding and Ordering Programs: Built in menu with slots for projects (can organize list by run number unlike with the EV3)

Monitoring Variables Easily: Variables monitor allows users to easily view data to debug code – you can easily debug without an LCD screen – write debug data to a variable and it will show up on the PC screen when connected

Different Platforms – Same Blocks: Same software across all platforms (for EV3, Chromebooks, Android, and iPads had a limited version of the software) – allows for mixed-platform programming amongst team members

Move_CM: Movement blocks can take centimeters/inches as an input in addition to degrees, rotations, and seconds – easier to program robot to navigate the field (for EV3, you would have to make a My Block)

Stall Detection: Built in stall detection on motors



Improvements with SPIKE Prime (Hardware)

Size: Smaller form factor for electronic components

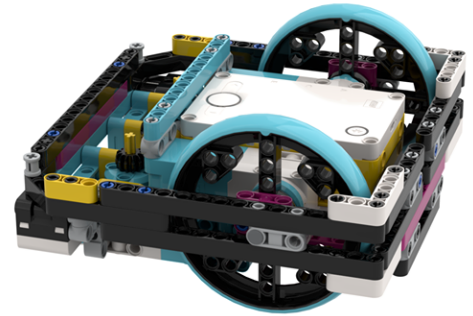
Shape: Electrical components have a more rectangular shape and more connection points (overall easier to build with)

Wires: Wires are easier to manage with thinner wires and wire clips

Motors: Built-in absolute positioning on motors

Charging: USB charging for battery – same as download port

Color Sensor: Improved color sensor – more colors and works at a greater distance from the mat



Tradeoffs: My Blocks

My Blocks are only available for use in the project that they are created in.

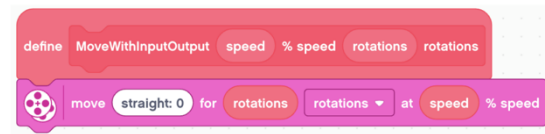
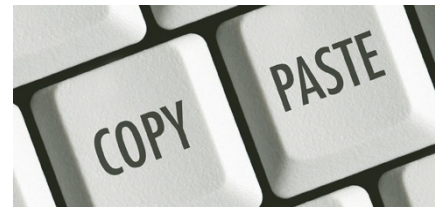
However, they can be copied and pasted from one project to another

No outputs from My Blocks

There is a work around that uses variables

In MicroPython, functions can be imported and have outputs

These are all problems specific to Scratch (also problems with EV3 Classroom)



Tradeoffs: Calibration, Files, Wires

Distance Sensor: Does not work at angles when close to a surface

Color Sensor Calibration: None

You can work around this with code

The sensor seems to work well without a calibration

Files: No file reading/writing

This can be done in MicroPython

Battery: Battery must be connected to the hub to charge - you cannot have extra batteries on the side charging (i.e. you must own another hub to charge extras)

Wire length: Fixed

However, for FIRST LEGO League, the wire length is sufficient

If the length is too long, you can use the wire clips to easily keep wires out of the way

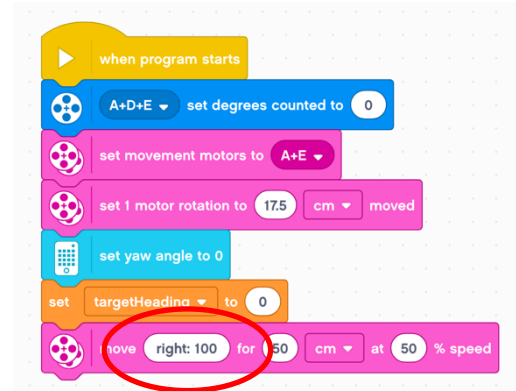


Tradeoffs: Steering Blocks

Steering input is not linear

The difference between 100 steering and 99 steering is significant

Workaround: Use Tank Blocks



Tradeoffs: File Size

At some project size (we have seen this in programs as small as 100 blocks), the program starts to fail

The motors and sensors disconnect when the program starts and then reconnect. Code run while sensors/motors are disconnected fail to run correctly.

For even larger programs, the code may not download at all

Workaround: Teams will need to wait at the beginning of their code for sensors and motors to reconnect

Tradeoffs: Gyro

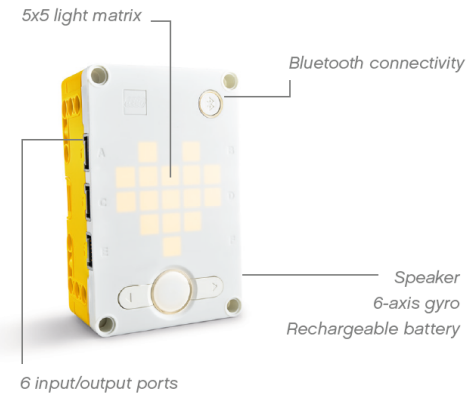
There is no Gyro Drift or Lag, but there are other tradeoffs

Gyro Rate: Cannot access the gyro rate or accelerometer in Scratch, but this can be done in MicroPython

Gyro Inaccuracies: E.g. turning the hub 360 degrees produces a gyro reading that is not 360.

1. This is typically hub specific. E.g. Hub 1 will consistently be 7 degrees off and Hub 2 will consistently be 4 degrees off.
2. The error is impacted by the complexity of other running code. E.g. updating the light matrix at the same time will increase the error by about 25 degrees per 360 degree turn.

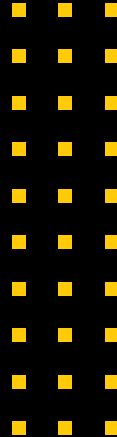
Workaround: For (1), you may need to scale gyro readings after measuring the error for your hub. For (2), you will need to make sure gyro readings are done less frequently and/or have little code running at the same time.





Common Misconceptions

What people think about SPIKE Prime



Age Level

SPIKE Prime is only for a
beginners and primary school
students

Even though the default software is
Scratch and the colors target younger
ages, the capabilities of SPIKE Prime
match those of the EV3

There is also MicroPython for older
students

SPIKE Prime has lowered the entry point,
but the ceiling is as high as EV3

SPIKE Prime Motors

SPIKE Prime motors are less powerful and worse for FIRST LEGO League



It is true that the motors are less powerful

However, there really is no need for more power than what the SPIKE Prime motors have. If more torque is needed, increasing the gear ratio should be sufficient.

Accuracy and Reliability

SPIKE Prime is less accurate and less reliable than EV3.



SPIKE Prime has built in stall detection, an improved color sensor

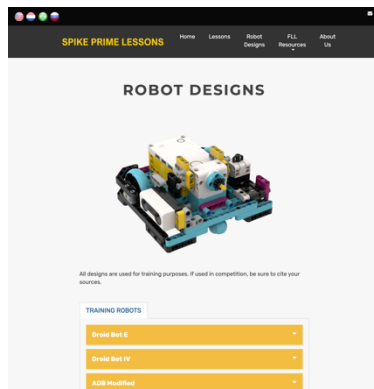
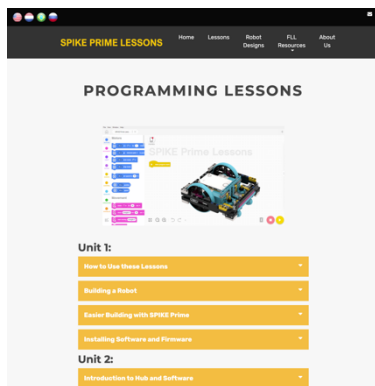
The SPIKE Prime Gyro is less accurate, but it does not have drift and lag

Regarding accuracy, the SPIKE Prime motors are comparable with the EV3 motors

All reliability techniques that can be done in EV3 can also be done in SPIKE Prime.

Resources

There are few resources for SPIKE Prime, but many available for EV3



PrimeLessons.org will have a complete set of lessons from beginner to advanced

We will support all teams

There is an online community to ask for help (LEGO SPIKE Community and FLL Challenge Share & Learn on Facebook)

New resources are coming out every week.

Built-in resources in the software for Scratch and MicroPython

Cost

SPIKE Prime is expensive or
same price as EV3

45680

**LEGO® Education
SPIKE™ Prime
Expansion Set**

\$99.95

45678

**LEGO® Education
SPIKE™ Prime Set**

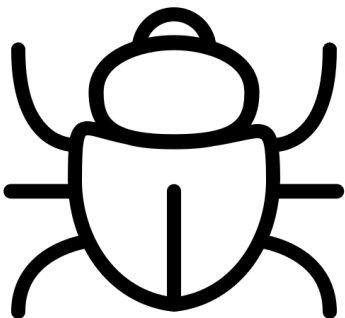
\$329.95

SPIKE Prime is actually cheaper
than the EV3

The expansion pack gives you
motors and sensors (much
better value compared to EV3
expansion)

Bugs

SPIKE Prime will
have bugs



SPIKE Prime is new.

There are updates coming all the time to fix bugs. Install the updates.

EV3 also had bugs. LEGO has historically addressed these quickly in updates but some bugs were only uncovered/addressed after several years.

The community usually develops workarounds

Overall Conclusions

If you have EV3s or just bought them, no problem

EV3 is a great product

FIRST always allows multiple platforms

Competitions are not geared to a platform (no extra points for one platform over another)

If you have the budget/just starting out (regardless of age of the students), want a new challenge, you can give SPIKE Prime a try

There are limitations in SPIKE Prime. It is not the same as EV3

But DO NOT underestimate the capabilities of SPIKE Prime

Thank You!

Do you have any questions?

www.primelessons.org

www.flltutorials.com

www.ev3lessons.com

<https://www.facebook.com/groups/FLLShareandLearn/>

