10th Generation Intel® Core™ i5-10210U processor-powered Chromebook™†△

Intel Celeron® N4020 processor-powered Chromebook†△

Learn, play, and create with LEGO Education sets and Chromebooks powered by an Intel Celeron N4020 processor and an Intel Core i5-10210U processor

Games are more than just fun. From roughhousing and make-believe to video games, play behavior provides kids of all ages a sandbox to develop skills, practice perseverance, and claim foundational victories. In fact, UNICEF considers play "one of the most important ways" for children to gain and develop key skills.[1]

LEGO® Education building sets encourage learning through purposeful play. Users can create robotic playthings and set them to motion with the power of physics and code, making LEGO Education sets a promising avenue to explore for teachers, students, and even adult enthusiasts.

At Principled Technologies, we tested two LEGO Education sets with two Intel processor-powered Chromebooks:

- Intel Celeron N4020 processor-powered Acer® Chromebook 315
- Intel Core i5-10210U processor-powered Acer Chromebook Spin 713

In our experience, the LEGO Education sets were easy to set up and work with, and the Chromebooks each handled the LEGO apps responsively. Get a fuller introduction to the world of LEGO Education sets with Intel processor-powered Chromebooks by diving into this report.

†Acer Chromebook Spin 713 powered by a 10th Generation Intel Core i5-10210U processor and Acer Chromebook 315 powered by an Intel Celeron N4020 processor.
△See the **science behind this report** for detailed system configurations and benchmark results.

Complete SPIKE Prime tasks quickly
with both Chromebooks†△

Complete MINDSTORMS EV3 tasks in up to
37% less time†△

Complete Linux tasks in up to
63% less time†△

Learn, play, and create with LEGO Education sets and Chromebooks powered by an Intel Celeron N4020 processor and an Intel Core i5-10210U processor

Study commissioned by Intel

December 2020

This report features a fictional scenario to illustrate the hands-on testing we performed with each device and LEGO set. While the people we mention are imaginary, their stories reflect the real-world experiences we had during testing.

LEGO Education sets

LEGO offers a variety of kits that enable students and enthusiasts to explore STEAM (science, technology, engineering, art, and math) concepts by building LEGO creations and bringing them to life through motors, gears, and code. After creating a motorized object with gears and other simple machines, you can transmit code via Bluetooth or USB to the computer "hub" of your creation to make it move. We tested two of these kits with an Intel Celeron N4020 processor-powered Chromebook and an Intel Core i5-10210U processor-powered Chromebook.

LEGO Education SPIKE Prime

The LEGO Education SPIKE™ Prime Set is a learning tool for building STEAM skills. According to the LEGO website, SPIKE Prime combines LEGO building elements with a Scratch-based drag-and-drop coding language, helping to build a foundation for further computer science skills. SPIKE Prime introduces 11 brand-new LEGO elements, including a new wheel design, frames and base plates to support prototyping, and a new gear for additional angles.[2] To learn more, visit https://education.lego.com/en-us/meetspikeprime.

LEGO MINDSTORMS Education EV3 Core

An updated iteration of a design 22 years in the making,[3] LEGO MINDSTORMS® Education EV3 Core Set is a multidisciplinary building set for STEM education. Each kit supports up to two students, and includes video tutorials, lesson plans, and an e-learning program for educators. MINDSTORMS Education EV3 features the "EV3 Intelligent Brick," which LEGO describes as a compact, programmable computer that enables users to control motors and collect data from sensors.[4] To learn more, visit https://education.lego.com/en-us/products/lego-mindstorms-education-ev3-core-set/5003400#lego-mindstorms-education-ev3.

ᐞSee the **science behind this report** for detailed system configurations and benchmark results.

Learn, play, and create with LEGO Education sets and Chromebooks powered by an Intel Celeron N4020 processor and an Intel Core i5-10210U processor

Study commissioned by Intel   December 2020 | 2

MINDSTORMS EV3

SPIKE Prime and MINDSTORMS for education

Learning from home during the pandemic has been challenging, but fictional siblings Kara and Anthony are getting by with support from their parents and each other. The siblings' parents invested in two LEGO Education sets to spark their imaginations and boost their engagement with learning. So far, it's worked like a charm, and the pair enjoy building and creating with the LEGO sets along with their school-issued Intel Celeron N4020 processor-powered Chromebooks even on the weekends.

During our tests, it was easy and straightforward for to get started with the LEGO Education sets. Each came with links to online videos that walked us through hardware setup and directed us to the Google Play Store or Chrome Web Store app that enables direct communication with each Education set's hub. The apps provided step-by-step instructions for powering on each set and connecting them to the Chromebook. With setup complete, you're free to create using starter lessons, advanced projects, or whatever your imagination thinks up.

With their Intel Celeron N4020 processor-powered Chromebooks, Kara and Anthony can easily interact with their LEGO Education SPIKE Prime and MINDSTORMS EV3 sets.
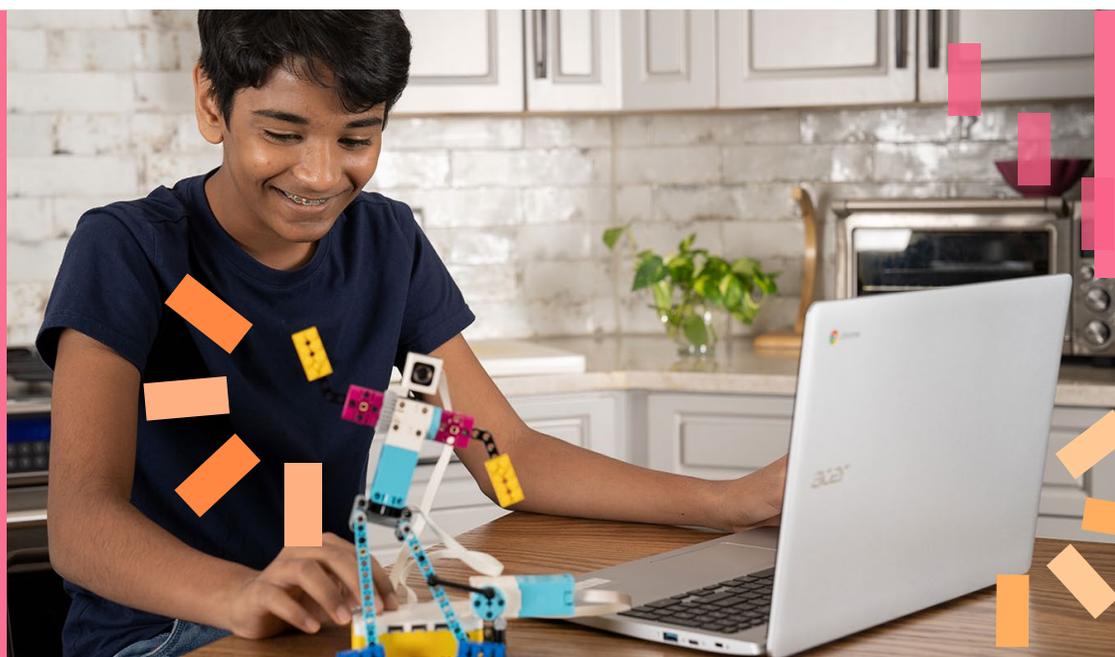
SPIKE Prime

△See the **science behind this report** for detailed system configurations and benchmark results.

Figure 1 shows the time required to complete certain tasks on each of the LEGO education sets. For example, with the siblings' Intel Celeron N4020 processor-powered Chromebook, it takes less than a second to create a new project in the Python coding language. Connecting to either set's hub takes just over two seconds, and downloading and running a complex program is also fast. However, some tasks could be even faster if the siblings had a Chromebook powered by an Intel Core i5-10210U processor.

Who knows what the future will hold for Kara and Anthony? Whether they become engineers, writers, bakers, teachers, or anything else—now, in the present, they are enjoying their time, expanding their minds, and building important skills as they tinker and play with their LEGO Education sets and Intel Celeron N4020 processor-powered Chromebooks.

Complete SPIKE Prime tasks quickly
With Chromebooks powered by an Intel Celeron N4020 and an Intel Core i5-10210U processor

Launch SPIKE LEGO education app · Create a new Python project in Chrome Web Store · Connect to hub via bluetooth in Chrome Web Store · Open obstacle course project · Download and run a complex program

22.2 sec

23.6 sec

Up to **7.5%** less time[Δ]

■ 10th Generation Intel Core i5-10210U processor-powered Chromebook
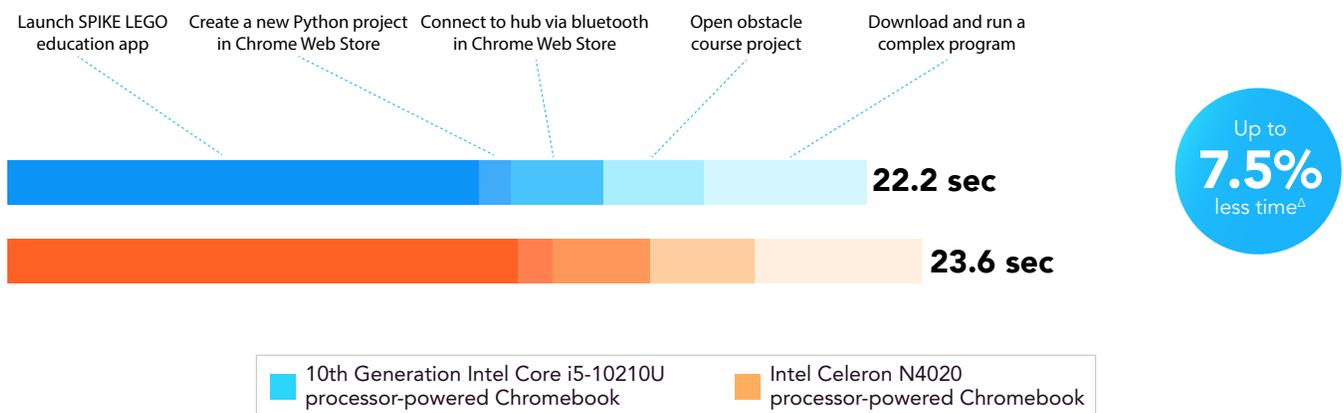■ Intel Celeron N4020 processor-powered Chromebook

Figure 1: Total time (in seconds) to complete a non-sequential group of tasks in the LEGO Education SPIKE Prime set app. Less time is better. Source: Principled Technologies.

[Δ]See the **science behind this report** for detailed system configurations and benchmark results.

Learn, play, and create with LEGO Education sets and Chromebooks powered by an Intel Celeron N4020 processor and an Intel Core i5-10210U processor

Study commissioned by Intel

December 2020 | 4

MINDSTORMS for enthusiasts

Rachel is an accountant, an avid runner—and a huge LEGO enthusiast. The bright-colored building blocks have been a big part of her imagination ever since she got her first set for Christmas at age six.

Rachel has been having a ton of fun creating with her new LEGO MINDSTORMS EV3 set. The gentle learning curve of the MINDSTORMS software means that Rachel's limited coding knowledge isn't a barrier for engaging with the system. Plus, her Intel Core i5-10210U processor-powered Chromebook provides a smooth experience for interfacing with the MINDSTORMS kit.

ΔSee the **science behind this report** for detailed system configurations and benchmark results.

Learn, play, and create with LEGO Education sets and Chromebooks powered by an Intel Celeron N4020 processor and an Intel Core i5-10210U processor

Study commissioned by Intel

December 2020 | 5

The Intel Core i5-10210U processor-powered Chromebook may be better suited to enthusiasts like Rachel who wish to run more complex tasks. We found that this Chromebook needed less time to complete certain Linux-related tasks than the Intel Celeron N4020 processor-powered Chromebook. For example, the Intel Core i5-10210U processor-powered Chromebook saved 35 seconds when installing Linux® Beta for ChromeOS.

Complete MINDSTORMS EV3 tasks in less time
With an Intel Core i5 processor-powered Chromebook

Launch MINDSTORMS app   Create new program   Download and run complex program

18.4 sec

26.6 sec

Up to
37%
less time△

- 10th Generation Intel Core i5-10210U processor-powered Chromebook
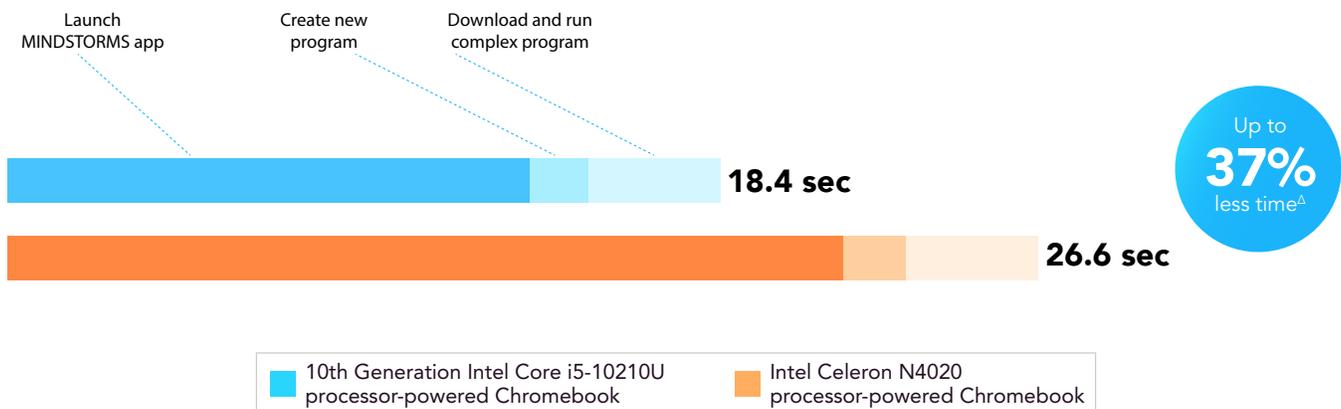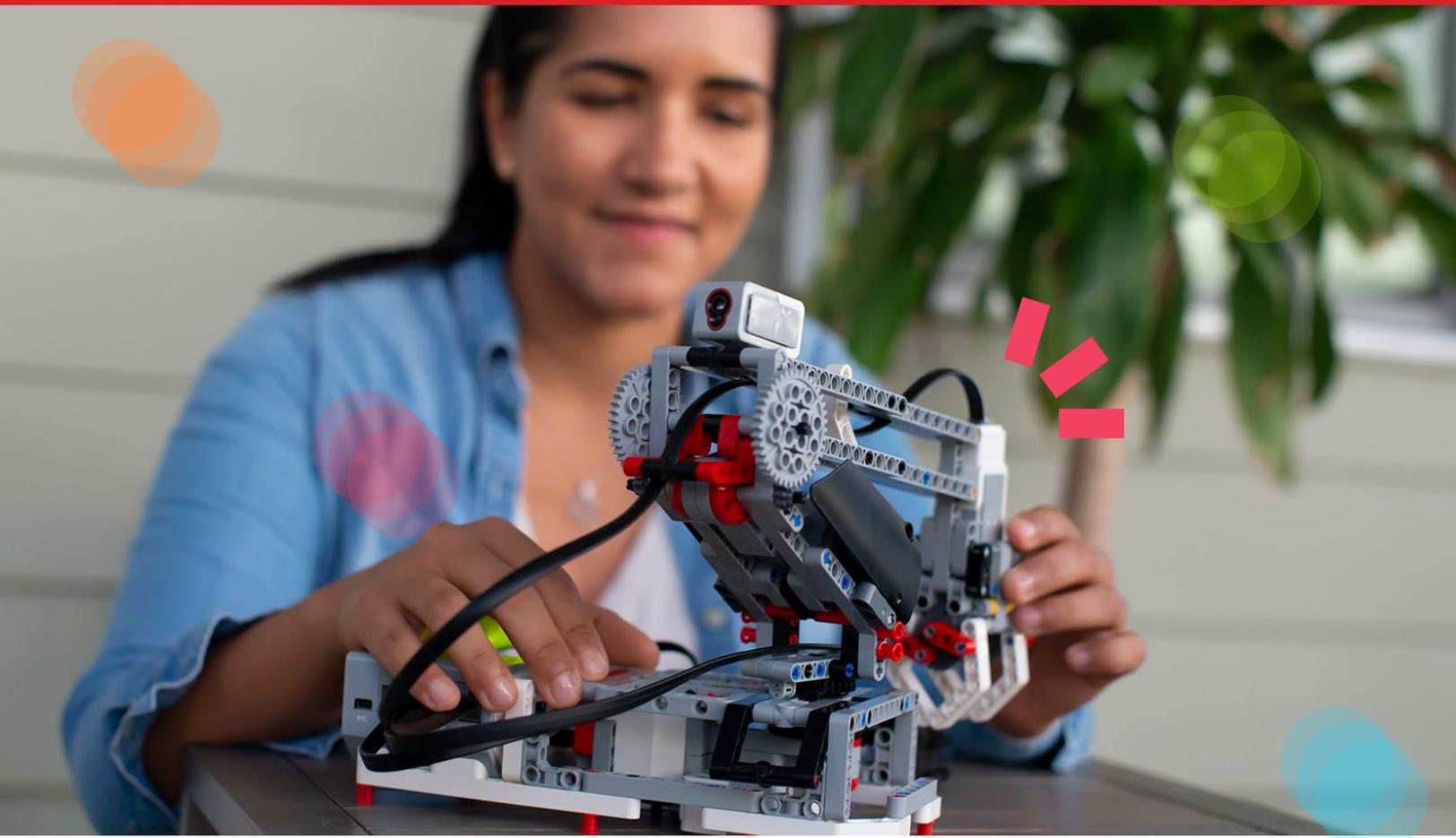- Intel Celeron N4020 processor-powered Chromebook

Figure 2: Total time (in seconds) to complete a non-sequential group of tasks in the MINDSTORMS EV3 app. Less time is better. Source: Principled Technologies.

△See the **science behind this report** for detailed system configurations and benchmark results.
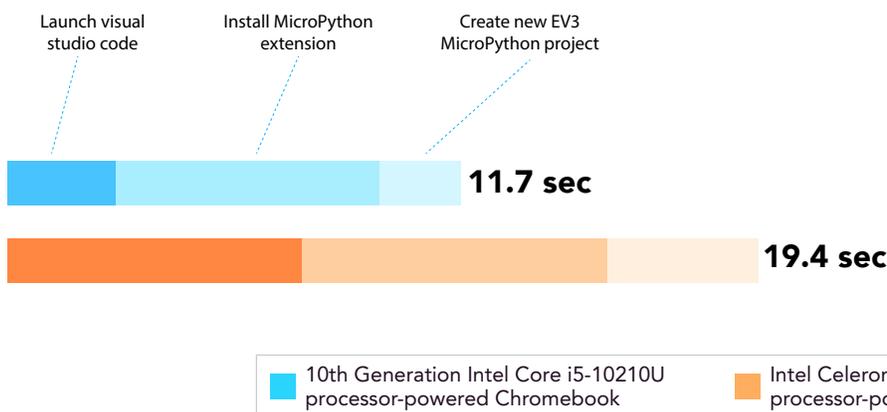
Installing Linux Beta is part of the process for using PyBricks, which is free and open-source software that enables users to run code directly on LEGO hubs rather than transmitting instructions via Bluetooth or USB. With her Intel Core i5-10210U processor-powered Chromebook, Rachel can perform these tasks quickly, as Figure 3 illustrates.

While she may not be an expert coder (yet!), Rachel is delighted with her LEGO MINDSTORMS EV3 set, and happy that her Intel Core i5-10210U processor-powered Chromebook provides a fast platform to engage with it.

Complete Linux-related tasks in less time
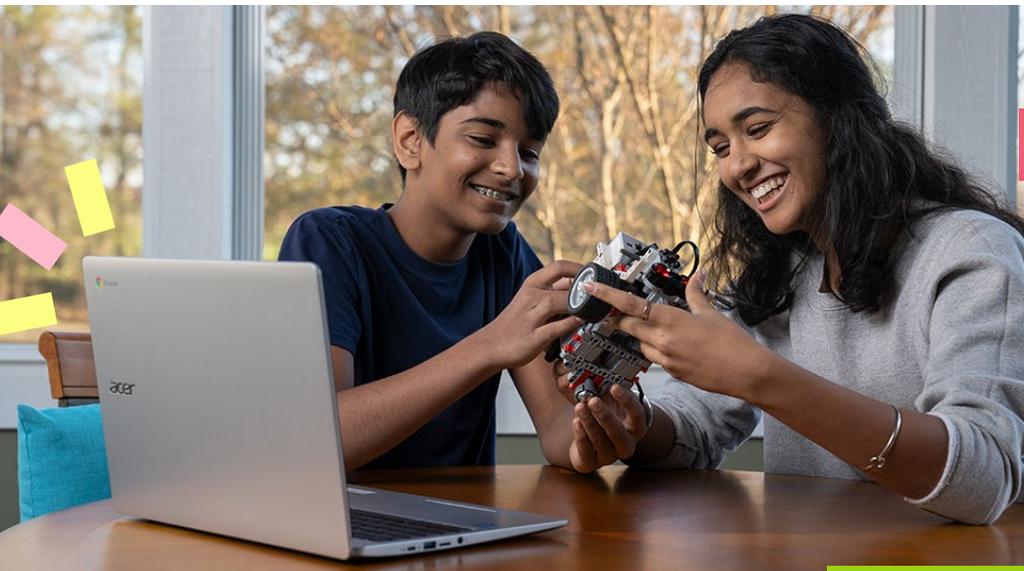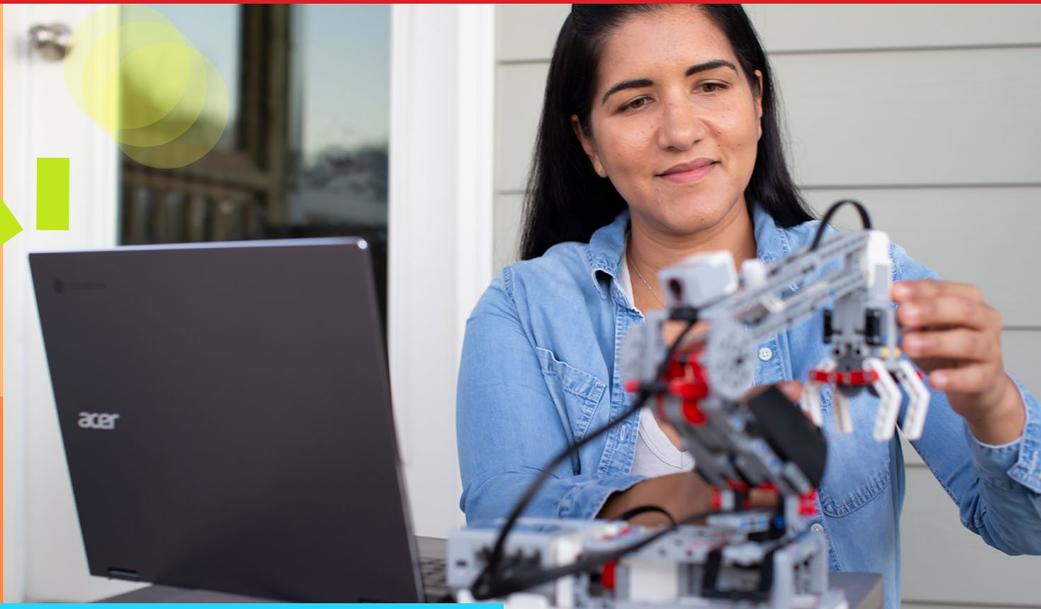With an Intel Core i5 processor-powered Chromebook

Launch visual studio code

Install MicroPython extension

Create new EV3 MicroPython project

11.7 sec

19.4 sec

Up to **63%** less time$^\Delta$

| | 10th Generation Intel Core i5-10210U processor-powered Chromebook | | Intel Celeron N4020 processor-powered Chromebook |

Figure 3: Total time (in seconds) to complete a non-sequential group of tasks in the MINDSTORMS EV3 app and Visual Basic Studio (for tasks related to PyBricks Linux scripts). Less time is better. Source: Principled Technologies.

$^\Delta$See the **science behind this report** for detailed system configurations and benchmark results.

10th Generation Intel Core i5-10210U processor-powered Chromebook

Intel Celeron N4020 processor-powered Chromebook

Conclusion

LEGO Education sets can provide children and adults alike with the opportunity to engage in skill-building play. We carried out a hands-on investigation of two LEGO Education sets—SPIKE Prime and MINDSTORMS EV3—to see how each interfaced with two Chromebooks: one powered by an Intel Celeron N4020 processor, and the other powered by an Intel Core i5-10210U processor. We found setup to be easy and straightforward, and both Chromebooks enabled us to quickly perform various tasks in each Education set's app. The Intel Core i5-10210U processor-powered Chromebook required less time to complete certain tasks in the MINDSTORMS EV3 app and certain tasks related to Linux scripts. We experienced no issues while using the Intel Celeron and Intel Core i5 processor-powered Chromebooks to perform these tasks.

For more information about the Chromebooks we tested, visit https://intel.com/Chromebooks.

△See the **science behind this report** for detailed system configurations and benchmark results.

Learn, play, and create with LEGO Education sets and Chromebooks powered by an Intel Celeron N4020 processor and an Intel Core i5-10210U processor

Study commissioned by Intel

December 2020 | 8

1 UNICEF, "Learning through play: Strengthening learning through play in early childhood education programmes," accessed October 27, 2020,
https://www.unicef.org/sites/default/files/2018-12/UNICEF-Lego-Foundation-Learning-through-Play.pdf

2 "LEGO Education SPIKE Prime Set," accessed October 27, 2020,
https://education.lego.com/en-us/products/lego-education-spike-prime-set/45678#spike%E2%84%A2-prime

3 The first iteration of the MINDSTORMS set, LEGO Robotics Invention System, was released in 1998. https://brickset.com/sets/9719-1/Robotics-Invention-System.

4 "Bringing Best-in-Class STEM and Robotics Tools to the Classroom with LEGO MINDSTORMS Education EV3 for High School!" Accessed October 27, 2020,
https://education.lego.com/en-us/middle-school/intro/mindstorms-ev3

Read the science behind this report at http://facts.pt/NDWHvup ▶

Principled Technologies®

Facts matter.®

This project was commissioned by Intel.