Chromebook powered by an Intel Celeron N4020 processor

Up to
39%
less time to finish instructional tasks[†Δ]

Up to
36%
less time to finish coding tasks[†Δ]

Up to
73%
less time to finish multimedia tasks[Δ]

Get faster Chromebooks™ for your students' coding, collaboration, and multimedia work

An Intel® Celeron® N4020 processor-powered Chromebook completed instructional, coding, and multimedia tasks faster than a Chromebook with an AMD* A4-9120C processor as well as one with a MediaTek* 8173C processor[Δ]

At Principled Technologies, we performed tasks in a variety of education, coding, and multimedia apps using three different Chromebooks:

- An Intel Celeron N4020 processor-powered Chromebook
- An AMD A4-9120C processor-powered Chromebook
- A MediaTek 8173C processor-powered Chromebook

We found that the Intel Celeron N4020 processor-powered Chromebook saved time during 12 tasks across eight different apps.[Δ]

With folks teaching and learning from home to stay safe during the global pandemic, your choice of device has a significant impact on student success. Responsive Chromebooks can help students finish their tasks more quickly than slower devices that require longer wait times and may cause frustration.

[†]Compared to an AMD A4-9120C processor-powered HP Chromebook 11A G6 EE and a MediaTek 8173C processor-powered Lenovo® 100e Chromebook (2nd Gen)

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

Akua L.   Richie Q.   Kaitlyn R.

Plan lessons in less time

When it comes to lesson planning, teachers need all the time they can get. Fast, responsive technologies can help teachers provide a great learning experience for students.

In our tests, the Intel Celeron N4020 processor-powered Chromebook saved time opening presentations and exporting presentation videos in the popular classroom instruction app Explain Everything.^Δ

In this report, text in light green sections represents fictional scenarios based on the results of our testing.

Save up to 1.1s opening a local presentation
with Explain Everything

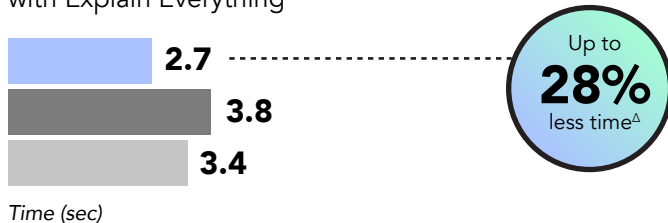|	
2.7	Up to **28%** less time^Δ
3.8	
3.4	

Time (sec)

Figure 1: Opening a local presentation with Explain Everything. Lower is better. Source: Principled Technologies.

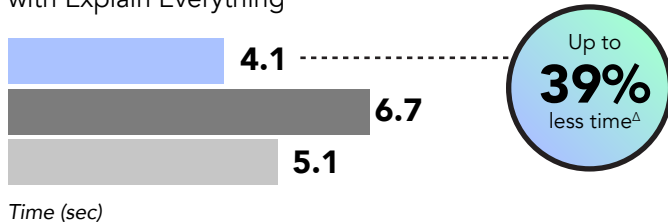## Save up to 2.6 sec exporting a presentation video
with Explain Everything

4.1	Up to **39%** less time^Δ
6.7	
5.1	

Time (sec)

Figure 2: Exporting a presentation video with Explain Everything. Lower is better. Source: Principled Technologies.

- ▮ Chromebook with an Intel Celeron N4020 processor
- ▮ Chromebook with an AMD A4-9120C processor
- ▮ Chromebook with a MediaTek 8173C processor

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

Chromebooks for creative and computer science projects

Hopper Middle School's new one-to-one notebooks—Intel Celeron N4020 processor-powered Chromebooks—arrived early this year to great fanfare. Digital technologies teacher Kathleen Rucha is excited to see how the new Chromebooks will help the students with their first big spring project, which combines coding and art into a multimedia affair.

Ms. Rucha finalizes her class materials, exports a video presentation to post to the class website, and posts everything just in time for the first students to begin logging on for the day.

Explain Everything

Explain Everything is an interactive whiteboard app that lets teachers and students can collaborate in real time.[1] According to TechCrunch, the Los Angeles public school district installed it on 70,000 educational tablets. In 2014, the software could be found on 50 percent of all educational iPads in the UK.[2]

Online collaboration and multitasking

Now that students are learning from home, they rely on their devices to help them both finish assignments and get through class periods. Some classrooms are using Google Meet to conduct lessons outside of the classroom.

The Intel Celeron N4020 processor-powered Chromebook enabled us to preview a large PDF from Google Drive and to open a large .csv file in Google Sheets quickly—all while the Google Meet app was running simultaneously.

Save up to 1.8 sec previewing a large PDF from Google Drive
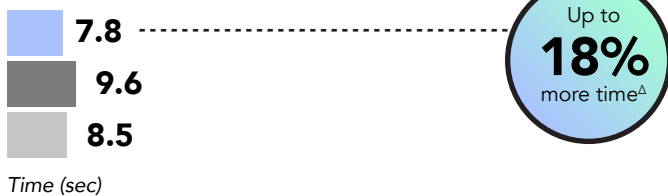while multitasking with Google Meet

7.8

9.6

8.5

Up to
18%
more time[Δ]

Time (sec)

Figure 3: Previewing a large PDF from Google Drive while multitasking with Google Meet. Lower is better. Source: Principled Technologies.

Save up to 43.6 sec opening a large CSV in Google Sheets
while multitasking with Google Meet

18.6

29.9

62.0

Up to
70%
more time[Δ]

Time (sec)

Figure 4: Opening a large CSV in Google Sheets while multitasking with Google Meet. Lower is better. Source: Principled Technologies.

- Chromebook with an Intel Celeron N4020 processor
- Chromebook with an AMD A4-9120C processor
- Chromebook with a MediaTek 8173C processor

Google Meet

Google has made their premium video conferencing product free and available to the general public. According to Google, the app is used in schools, governments, and companies worldwide.[3]

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

Complete coding tasks in less time

Students who live rich extracurricular lives will greatly appreciate a device that enables them to finish work quickly so they can move onto the next thing. The Intel Celeron N4020 processor-powered Chromebook enabled us to complete coding tasks in two apps faster than the AMD A4-9120C processor-powered Chromebook or the MediaTek 8173C processor-powered Chromebook.[Δ]

When all the students have logged onto Google Meet, Ms. Rucha explains the new assignment: The students will collaborate in groups to create simple apps to track healthy habits in each student's household.

The computer science class will also pair up with Ms. Rucha's multimedia class to create presentation videos to showcase the app and highlight each student's efforts to stay healthy while at home.

Save up to 1.7 sec opening the Switch Case Challenge
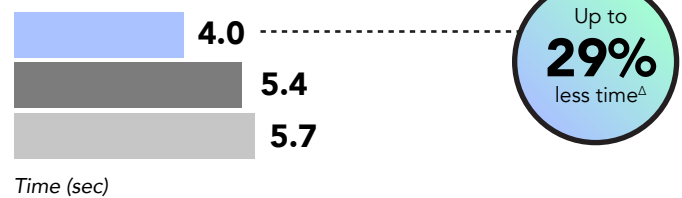with Trinket

Up to **29%** less time[Δ]

Time (sec)

Figure 5: Opening the Switch Case Challenge with Trinket. Time (sec). Lower is better. Source: Principled Technologies.
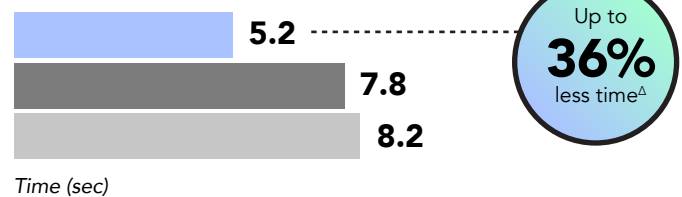
Save up to 3.0 sec opening the Java Editor
with Repl.it

Up to **36%** less time[Δ]

Time (sec)

Figure 6: Opening the Java Editor with Repl.it. Time (sec). Lower is better. Source: Principled Technologies.

Chromebook with an Intel Celeron N4020 processor
Chromebook with an AMD A4-9120C processor
Chromebook with a MediaTek 8173C processor

Trinket

Trinket allows users to create, run, and share code from their device and browser of choice. The company offers free support for educators who wish to use the web application for classroom instruction.[4]

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

Repl.it

Repl.it is an online programming environment that allows users to create applications, tools, and more all from within their browser.[5] According to TechCrunch, Repl.it supports "virtually every programming language you can think of," and has over 200,000 active weekly users.[6]

Finish multimedia tasks in less time

Tasks in video and audio apps often consume a great deal of computing resources. For students and teachers who regularly perform such creative work, investing in an Intel Celeron N4020 processor-powered Chromebook could help them move through their tasks quickly.[Δ]

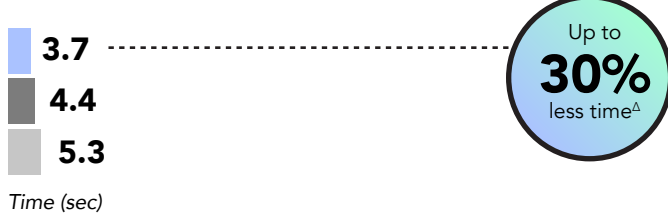## Save up to 1.6 sec loading the design gallery
with Tinkercad

	Time (sec)
▮	3.7
▮	4.4
▮	5.3

Up to **30%** less time[Δ]

Time (sec)

Figure 7: Loading the design gallery with Tinkercad. Time (sec). Lower is better. Source: Principled Technologies.

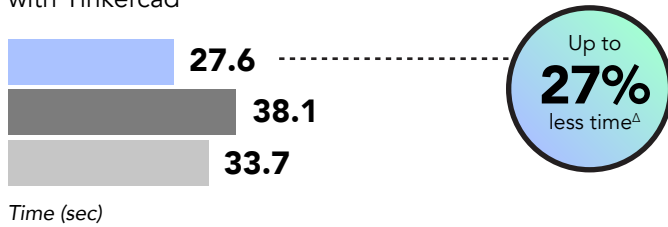## Save up to 10.5 sec opening the Retail Row model
with Tinkercad

	Time (sec)
▮	27.6
▮	38.1
▮	33.7

Up to **27%** less time[Δ]

Time (sec)

Figure 8: Opening the Retail Row model with Tinkercad. Time (sec). Lower is better. Source: Principled Technologies.

▮ Chromebook with an Intel Celeron N4020 processor

▮ Chromebook with an AMD A4-9120C processor

▮ Chromebook with a MediaTek 8173C processor

Ms. Rucha's multimedia students are excited to work with the computer science kids on their healthy habits project. The creative apps they've learned to use, such as Tinkercad, Soundtrap, and WeVideo Video Editor, all run quickly, enabling the students to iterate on their video drafts frequently and with minimal hassle.

Tinkercad

Tinkercad is a browser-based program for computer-aided design.[7] Common Sense Education® gave Tinkercad a 4 out of 5 star rating, enthusiastic about the app's pedagogical implications.[8]

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

Save up to 132.9 sec rendering a video
with WeVideo

48.5		
74.4		
181.4		

Up to 73% less time[Δ]

Time (sec)
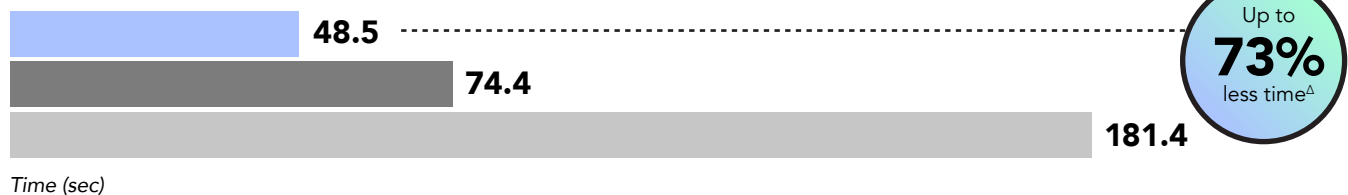
Figure 9: Rendering a video with WeVideo.
Time (sec). Lower is better. Source: Principled Technologies.
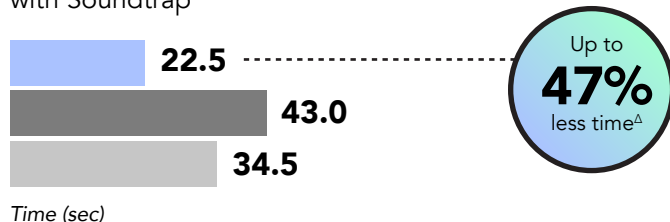
Save up to 20.5 sec merging tracks
with Soundtrap

22.5	
43.0	
34.5	

Up to 47% less time[Δ]

Time (sec)

Figure 10: Merging tracks with Soundtrap.
Time (sec). Lower is better. Source: Principled Technologies.

For example, when rendering a 1-minute video clip, the Chromebook powered by the Intel Celeron N4020 processor saved us more than 2 minutes compared to the Chromebook powered by the MediaTek 8173C processor and more than 25 seconds compared to the Chromebook powered by the AMD A4-9120C processor.[Δ]

■ Chromebook with an Intel Celeron N4020 processor
■ Chromebook with an AMD A4-9120C processor
■ Chromebook with a MediaTek 8173C processor

WeVideo Video Editor

Featured on tech journalism sites such as TechCrunch, Wired, CNET, and more, the WeVideo Video Editor enables users to create "beautiful videos" and share them with the world.[9] In February 2018, the Video Editor app earned the distinction of an Android Excellence App.[10]

Soundtrap

Soundtrap is a web application for creating digital audio creations such as music, podcasts, language studies, and more.[11] According to Soundtrap, more than 10,000 teachers worldwide trust their educational program.[12]

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

Battery life

We used the CrXPRT 2 benchmark to measure the battery life for the three Chromebook systems in this study. In our tests, the Intel Celeron N4020 processor-powered Chromebook had a battery life of 12 hours, 40 minutes, which was longer than the 11 hour, 10 minute battery life of the AMD A4-9120C processor-powered Chromebook and the 11 hour, 50 minute battery life of the MediaTek 8173C processor-powered Chromebook.[Δ]

The battery life of the Intel Celeron N4020 processor-powered Chromebook could enable students to take their work outside for some much-needed sunshine.

Up to 90 minutes longer battery life
using CrXPRT 2

	Time
	12:40
	11:10
	11:50

Up to **11%** more time[Δ]
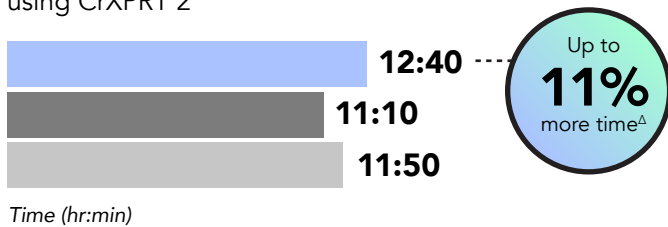
Time (hr:min)

Figure 11: Battery life using the CrXPRT 2 benchmark. Time (hr:min). Higher is better. Source: Principled Technologies.

Some of Ms. Rucha's students take their devices outdoors to record videos of their families exercising in their yards for their videos. Even though some of the students haven't charged their devices all day, the long battery life of the Intel Celeron N4020 processor-powered Chromebook enables them to record without a care.

- ▉ Chromebook with an Intel Celeron N4020 processor
- ▉ Chromebook with an AMD A4-9120C processor
- ▉ Chromebook with a MediaTek 8173C processor

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

Conclusion

After a month of hard work, the students and many of their families gather around the Chromebooks to watch each group's final video presentations and see their apps in practice. The Intel Celeron N4020 processor-powered Chromebook supported the students' work and enabled them to explore new concepts for the class project.

The pandemic has changed a lot about the way we teach and learn, but the fundamentals are still the same: students need access to tools that will help them achieve academic success. In our tests, an Intel Celeron N4020 processor-powered Chromebook completed tasks in several education apps (including Google Meet) faster than the AMD A4-9120C processor-powered Chromebook and the MediaTek 8173C processor-powered Chromebook.[Δ]

For more information, visit https://www.intel.com/content/www/us/en/education/right-device/chromebooks-for-education.html.

1   "Explain Everything | Interactive Whiteboard With Real-Time Communication," accessed April 23, 2020, https://explaineverything.com/.

2   John Biggs, "Explain Everything, the digital whiteboard, raises $3.7 million to bring learning to the iPad," accessed April 23, 2020, https://techcrunch.com/2016/12/15/explaineverything-the-digital-whiteboard-raises-3-7-million-to-bring-learning-to-the-ipad/.

3   Javier Soltero, "Google Meet premium video meetings—free for everyone," accessed June 3, 2020, https://www.blog.google/products/meet/bringing-google-meet-to-more-people/.

4   "Trinket," accessed April 23, 2020, https://trinket.io/.

5   "Repl.it – The world's leading online coding platform," accessed April 23, 2020, https://repl.it/.

6   Frederic Lardinois, "Repl.it lets you program in your browser," accessed April 23, 2020, https://techcrunch.com/2018/03/15/repl-it-lets-you-program-in-your-browser/.

7   "Tinkercad –Chrome Web Store," accessed April 23, 2020, https://chrome.google.com/webstore/detail/tinkercad/bhggmehigifnpflipbkdfcjiacpcgidn.

8   "Tinkercad Review for Teachers | Common Sense Education," accessed April 23, 2020, https://www.commonsense.org/education/website/tinkercad.

9   "Video Editor – Apps on Google Play," accessed April 23, 2020, https://play.google.com/store/apps/details?id=com.wevideo.mobile.android.

10   "WeVideo Awarded as Android Excellence App by Google," accessed April 23, 2020, https://www.wevideo.com/news/WeVideo-Awarded-as-Android-Excellence-App-by-Google.

11   "Soundtrap –Make Music Online –Google Play Store," accessed April 23, 2020, https://play.google.com/store/apps/details?id=com.soundtrap.studioapp.

12   "Soundtrap – Make Music Online," accessed April 23, 2020, https://www.soundtrap.com/edu/.

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

We concluded our hands-on testing on May 29, 2020. During testing, we determined the appropriate hardware and software configurations and applied updates as they became available. The results in this report reflect configurations that we finalized on May 20, 2020 or earlier. Unavoidably, these configurations may not represent the latest versions available when this report appears.

Our results

Table 1: Time to complete tasks in various apps. We present time in seconds below.

Task	HP Chromebook x360 11A G3 EE with an **Intel Celeron N4020 processor**	HP Chromebook 11A G6 EE with an **AMD A4-9120C processor**	Lenovo 100e Chromebook with a **MediaTek 8173C processor**	**Percentage win HP Chromebook x360 11A G3 EE vs. HP Chromebook 11A G6 EE**	**Percentage win HP Chromebook x360 11A G3 EE vs. Lenovo 100e Chromebook**
Explain Everything					
Open local presentation	2.7	3.8	3.4	**28%**	**20%**
Export presentation video	4.1	6.8	5.1	**39%**	**19%**
Google Meet					
Launching the app	1.8	2.4	2.7	**25%**	**33%**
Launching a new meeting	3.0	3.7	3.6	**18%**	**16%**
Multitasking with Google Meet					
Previewing a large PDF from Google Drive	7.8	9.6	8.5	**18%**	**8%**
Opening a large CSV in Google Sheets	18.6	29.9	62.0	**37%**	**70%**
Trinket					
Opening the From Block to Code "Lesson"	6.6	7.1	7.5	**7%**	**12%**
Opening the Switch Case Challenge	4.0	5.4	5.7	**25%**	**29%**
Repl.it					
Opening the Java editor	5.2	7.8	8.2	**33%**	**36%**
WeVideo					
Render one-minute video	48.5	74.4	181.4	**34%**	**73%**
Tinkercad					
Loading the design gallery	3.7	4.4	5.3	**15%**	**30%**
Opening the Retail Row model	27.6	38.1	33.7	**27%**	**18%**
Soundtrap					
Merging tracks	22.5	43.0	34.5	**47%**	**34%**

Table 2: Battery life testing. We present time in minutes below.

CrXPRT 2 Elapsed time (minutes)	HP Chromebook x360 11A G3 EE with an Intel Celeron N4020 processor	HP Chromebook 11A G6 EE with an AMD A4-9120C processor	Lenovo 100e Chromebook with a MediaTek 8173C processor	Percentage win HP Chromebook x360 11A G3 EE vs. HP Chromebook 11A G6 EE	Percentage win HP Chromebook x360 11A G3 EE vs. Lenovo 100e Chromebook
Run 1	750	660	690		
Run 2	780	680	740		
Run 3	740	660	710		
Median	**760**	**670**	**710**	**11%**	**6%**

System configuration information

Table 3: Detailed information on the systems we tested.

System	HP Chromebook x360 11A G3 EE	HP Chromebook 11A G6 EE	Lenovo 100e Chromebook
Processor	Intel Celeron N4020	AMD A4-9120C	MediaTek 8173C
Processor frequency (GHz)	1.1	1.6	2.1
Processor cores	2	2	4
Memory (GB)	4	4	4
Storage (GB)	32	16	32
Bluetooth	5	4.2	4.1
USB	2x USB 3.1 Type-C, 2x USB 3.1 Gen 1	2x USB 2.0, 2x USB Type C	1x USB 3.0, 1x USB Type C
Battery type	Lithium-Ion	Lithium-Ion	Lithium-Ion
Battery capacity (Wh)	47	47	42
Display	11.6" 1366x768	11.6" 1366x768	11.6" 1366x768
OS (version)	81.0.4044.94	81.0.4044.94	81.0.4044.94
System weight (lbs.)	3.19	2.80	2.68

How we tested

Creating the background workload

To simulate typical Chromebook use, we ran a combination of news, email, chat, music, document viewing, and social media websites in the background. For websites that required accounts, we created test profiles and logged in the users on each device.

1. From the shelf, open Chromebook settings.
2. Navigate to the On Startup section of the settings.
3. Select Open a specific page or set of pages.
4. Insert the following URLs, and click OK.

    - Forbes.com
    - Markets.ft.com/data
    - Arstechnica.com
    - mail.google.com
    - slack.com (logged into Slack chat, #general channel)
    - drive.google.com
    - docs.google.com (viewing document)
    - youtube.com/feed/music
    - drive.google.com (viewing document)
    - sheets.google.com (viewing spreadsheet)
    - twitter.com
    - facebook.com

5. Restart the Chromebook. Before testing, navigate through each tab to ensure that both devices have fully loaded the same content.

Testing the applications

Explain Everything

Open local presentation
1. From the Google Play store, install Explain Everything. Pin the app to the shelf.
2. Launch the Explain Everything app from the shelf.
3. Simultaneously start the timer and click the test project.
4. When the test project fully loads, stop the timer.

Exporting a presentation as a project
1. From the shelf, launch the Explain Everything app.
2. Click the test project.
3. Click Share, and click Export.
4. On the Export project screen, select Project.
5. For the source, click Local storage.
6. Simultaneously start the timer and click Export.
7. When the Export successful message appears, stop the timer.

Trinket

Opening the "From Block to Code" lesson

1. From the Chrome browser, navigate to trinket.io.
2. Sign in with your Google account.
3. Click Learn.
4. Simultaneously start the timer and click Let's Go under From Blocks to Code.
5. When the project editor fully loads, stop the timer.

Opening the Switch Case Challenge

1. From the Chrome browser, navigate to trinket.io.
2. Sign in with your Google account.
3. Click Learn.
4. Simultaneously start the timer and click Switch Case Challenge.
5. When the project editor fully loads, stop the timer.

Repl.it

Opening the Java editor

1. From the Chrome browser, navigate to repl.it.
2. Sign in with your Google account.
3. Click the red plus icon, and select All languages.
4. Simultaneously start the timer and click Java.
5. When the project editor fully loads, stop the timer.

WeVideo Video Editor

Render a 720p video for free

1. From the Google Play store, install WeVideo. Pin the app to the shelf.
2. Launch the WeVideo app from the shelf.
3. Click the green plus icon.
4. Delete the six-second title text.
5. Click the blue plus icon.
6. Click Gallery.
7. Click Allow to enable access to device media storage.
8. From the folder browser, select the test footage, and click the green checkmark icon.
9. Click the paper airplane icon.
10. Simultaneously start the timer and click Save with watermark.
11. When the video fully renders, stop the timer.

Tinkercad

Loading the design gallery

1. From the Chrome browser, navigate to tinkercad.com.
2. Simultaneously start the timer and click Gallery.
3. When the page fully loads, stop the timer.

Opening the Modern House model

1. From the Chrome browser, navigate to tinkercad.com.
2. Click Gallery.
3. Click the Retail Row design.
4. Simultaneously start the timer and click Copy and Tinker.
5. When the model fully loads, stop the timer.

Soundtrap

Merge tracks

1. From the Google Play store, install Soundtrap. Pin the app to the shelf.
2. Launch the Soundtrap app from the shelf.
3. From the template selection screen, click Dubstep DEMO.
4. From the horizontal dropdown menu, click Settings, and click Merge Tracks…
5. Select all of the instrument tracks.
6. Simultaneously start the timer and click Merge.
7. Stop the timer when merging completes.

Multitasking with Google Meet

To conduct our multitasking tests, we opened Google Meet in the Chrome web browser, and joined a four-participant video meeting. We docked the Google Meet browser window to one half of the screen, and used the other half of the screen to complete the following scenarios. Our Chrome tab contained the background workload we described at the beginning of this section.

Joining a meeting

1. With Chrome open, open a new tab, and enter the meeting URL.
2. Click to join the meeting, and ensure video is connected. For our testing, to ensure the video content was roughly the same across devices, we pointed each Chromebook's camera at a blank ceiling.
3. Dock the Chrome tab to the right side of the screen, and dock the other Chrome window to the left side of the screen.
4. In the left-docked Chrome window, complete the scenarios below.

Previewing a large PDF from Google Drive

1. From the Chrome browser, navigate to drive.google.com.
2. Right click the test document and simultaneously start the timer and click Preview.
3. When the preview has fully loaded, stop the timer.

Opening a large CSV In Google Sheets

1. From the Chrome browser, navigate to drive.google.com.
2. To preview the CSV test document, double-click its icon.
3. Simultaneously start the timer and click Open with Google Sheets.
4. When the new document has fully loaded, stop the timer.

Measuring battery life

CrXPRT 2

1. From the Google Play store, install CrXPRT 2. Pin the app to the shelf.
2. Launch the CrXPRT 2 app from the shelf.
3. From the CrXPRT 2 main menu, select Battery life test, and click Next.
4. Ensure the device is charged to 100%, the brightness is set as close to 200 nits as possible, and that the device's volume is set to 50%.
5. Disconnect the test system from AC power, and click Start. Record the results after the full battery run-down is complete.

This project was commissioned by Intel.

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