

FEWER DISRUPTIONS = FULLY ENGAGED STUDENTS

Maximize your investment in learning with an Intel® processor-powered Chromebook™

EXECUTIVE SUMMARY

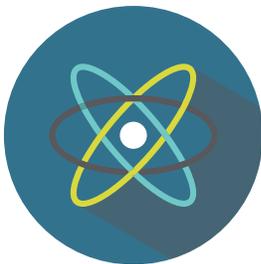
Chromebook™ devices hit the sweet spot for education. They are easy for students to use and affordable for schools. But not all Chromebooks are created equal. Poor performing Chromebooks can lead to distracted or frustrated students, while better performing Chromebooks can keep students more engaged in their learning.

To find out which Chromebooks better engage students while causing the fewest disruptions, our team at Prowess Consulting put two Chromebooks to the test: the ASUS® Chromebook C201, powered by a Rockchip® processor, and the Dell™ Chromebook 11, powered by an Intel® Celeron® processor N2840.

We ran the Chromebooks through two typical classroom scenarios and discovered that the Dell Chromebook 11 consistently outperforms the ASUS Chromebook C201 in the classroom because it offers:

- Full use of the apps that students need now and in the future
- Less wait time so that students can stay focused on learning
- More rugged features that can better support daily student use

GET BETTER VALUE IN THE CLASSROOM WITH THE DELL™ CHROMEBOOK™ 11



Performance to handle
interactive apps



Faster load times
equal more learning time



Tough enough
for classroom use

Which Chromebook Is Best for Your Students?

Chromebooks are taking the education market by storm. They are a great fit for schools for a variety of reasons, including an easy-to-use cloud-based ecosystem, simple collaboration tools, low IT-maintenance requirements, and an affordable price.

The variety of Chromebooks on the market all run the same operating system and might look similar on the outside, but that doesn't mean that all Chromebooks offer the same performance. The biggest differentiator between Chromebooks boils down to what's inside. The processor powering a Chromebook matters more than you might think.

To examine the differences between Chromebook models, our team at Prowess Consulting put two Chromebooks to the test in authentic classroom scenarios. The Chromebooks we tested include:

- ASUS Chromebook C201 powered by a Rockchip processor RK3288C (1.8 GHz)
- Dell Chromebook 11 powered by an Intel Celeron processor N2840 (2.16 GHz)

We ran both Chromebooks through typical classroom scenarios designed for elementary and middle-school students—including interactive science and social-studies lessons. The tests were designed to find out which Chromebook best supports student engagement while causing the least frustration. The test scores are in: the Dell Chromebook 11 scored consistently higher than the ASUS Chromebook C201 in the classroom setting because it offers:

- Full use of the apps that your students need now and in the future
- Less wait time so that students can stay focused on learning
- More rugged features that can better survive daily student use

“ The Dell™ Chromebook™ 11 scored consistently higher than the ASUS® Chromebook C201 in the classroom setting. ”

Full Use of the Apps That Your Students Need Now and in the Future

Educational apps get better every day. They have to if they want to keep up with today's students, who have been using technology since they could walk. To keep these students interested and engaged, apps are becoming increasingly rich in graphics and more interactive. In our test scenarios, we chose at least one graphically rich, interactive app per test. For our science lesson, we tested a 3-D app that lets students virtually dissect a frog. For our social-studies lesson on the history of bridges, we used the Google Maps™ app.

As you will see in the detailed test scenario sections of this paper, both of these apps failed the classroom test on the ASUS Chromebook C201. The 3-D frog-dissection app showed a distorted frog image and not all the functions worked properly. The ASUS device froze up mid-activity and produced a Web Graphics Library (WebGL) error screen. WebGL is a JavaScript® interface that allows you to create real-time rendered, interactive 3-D graphics in a browser without the need to download any plug-ins.

Similarly, the ASUS Chromebook C201 also failed the 3-D bridge activity because it did not support Google Earth™ function in Google Maps. On the ASUS device, students don't have access to the Google Earth application's tilt function that allows them to view the bridge in 3-D. This was a major hindrance to the project because the other exercises in the activity relied on an aerial video of the 3-D bridge.



18%
**faster than the ASUS®
Chromebook™ C201**

In contrast, the Dell Chromebook 11 performed flawlessly with these graphically rich, interactive apps—no errors or work stops. Students can record the 3-D aerial video of the bridge tour and then use it in their class presentation and other activities.

What does all of this mean for your students? The ASUS Chromebook C201, powered by a Rockchip processor, lacks the performance necessary for many of today's learning apps. If your students' experiences with the ASUS are like our experience, they will have problems completing their assignments—which could lead to frustration, loss of focus, and less learning.

If the ASUS Chromebook C201 has trouble with today's learning apps, it probably won't do well with the apps of the future, which will likely be even more interactive and graphical in nature. If you are expecting your Chromebooks to have a lifespan of several years, you need to be thinking not only of what your Chromebooks can do now but also of what they are equipped to handle two or three years from now.

The Dell Chromebook 11 had no problems handling these 3-D interactive apps. And with its more powerful Intel Celeron processor, the Dell Chromebook 11 is better prepared for the more demanding apps of the future, which will likely rely on WebGL image libraries to create real-time rendered, interactive 3-D graphics. Based on the prices we paid for these Chromebooks, you can purchase the Dell Chromebook 11 for only about \$0.14 more per school day over a three-year device lifecycle.

Table 1. Invest in a Chromebook™ that can handle the apps of today and tomorrow

The Dell™ Chromebook™ 11 gives students full access to apps now and better performance to handle the apps of the future.¹	
The Dell Chromebook was, on average, 18 percent faster at completing lesson tasks than the ASUS® Chromebook. ¹	It costs less than \$0.14 per school day per device to invest in the Dell Chromebook 11 over the ASUS Chromebook C201.*

¹Estimates based on 180-day school year over a three-year device lifecycle. We paid \$169.99 for the ASUS Chromebook C201 on amazon.com® and \$245.15 for the Dell Chromebook 11 on www.dell.com™.

Less Wait Time so That Students Can Stay Focused on Learning

You are surrounded by students on a daily basis, so you know how quickly they can lose focus. Even the smallest distractions can wreak havoc on classroom learning. So why not choose a Chromebook that results in less time waiting for the device to load or to work properly and in more time learning?

Our test results show that the ASUS Chromebook C201 performs slower across the board on almost every task we timed and tested. It could leave students waiting more and learning less. The detailed time charts for each test scenario are in the following sections. Based on the numbers from our timed tests, we did some calculations to help you see how seconds spent waiting can add up quickly.



12.6 hrs.
saved over a 3-year
device life cycle

Table 2 shows estimated time savings for a student using a Chromebook device for just two activities per day (equivalent to the length of the science activity we tested). The time savings from using the Dell Chromebook 11 over the ASUS Chromebook C201

equate to nearly 4.2 hours of lost learning time over one school year and 12.6 hours of lost learning time over the life of the device (based on a three-year lifecycle). That's more than a two full days of instruction that you can gain back by investing in the Dell Chromebook 11.²

Table 2. Even if you use a Chromebook™ device in just two classes a day, you get significant time savings on the Intel® processor-powered Dell™ Chromebook 11²

Estimates based on two Chromebook™ activities per school day over one school year*	Time saved using the Dell™ Chromebook 11 over the ASUS® Chromebook C201
Time saving per week	7 min
Time savings per month	29 min
Time savings per school year	4.2 hours = more than half a school day
Time savings over a 3-year life cycle	12.6 hours = almost two full school days

* Estimates based on National Center for Education Statistics, which shows that the average class time per day in U.S. schools is 6.64 hours and the average number of school days per year as 180. "Schools and Staffing Survey." https://nces.ed.gov/surveys/sass/tables/sass0708_035_s1s.asp.

More Rugged Features That Can Better Support Daily Student Use

Many schools have to keep their devices for at least three years before they can consider a refresh. In some schools, Chromebooks live on a cart that classes check out throughout the day, meaning that they might get non-stop use on any given day.

U.S. Military Standard tested for durability, pressure, humidity, temperature, shock, and vibration

180-degree hinge



Scratch-resistant Corning® Gorilla® Glass touchscreen

Sealed keyboard and touchpad

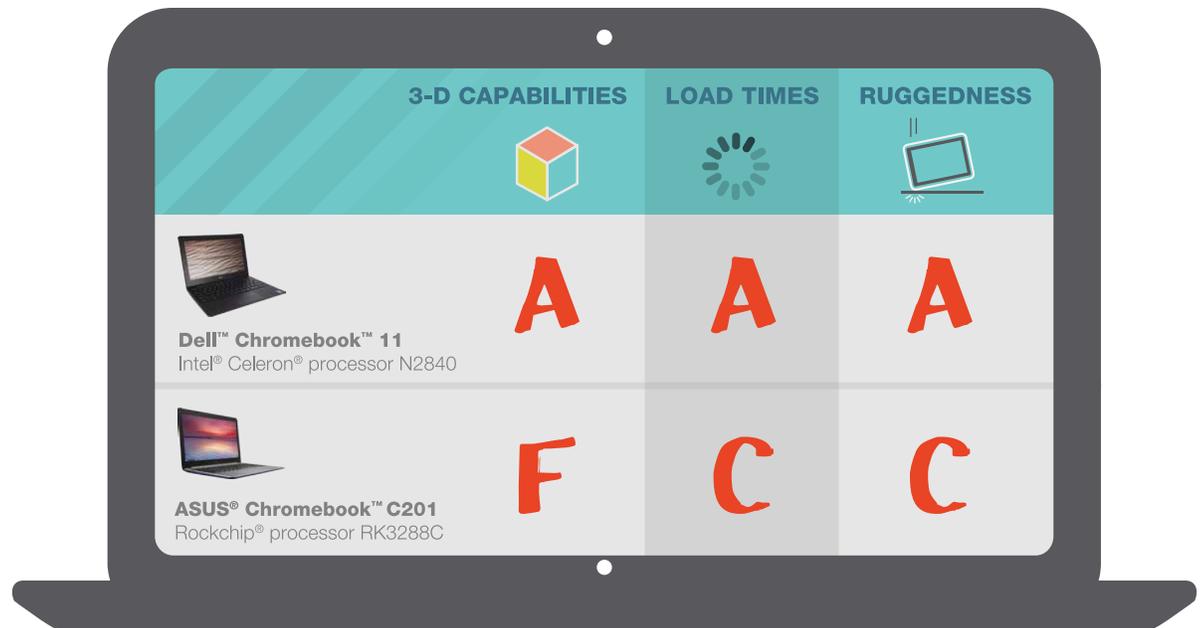
Dell™ Chromebook™ 11 P22T
Intel® Celeron® processor N2840

From our research and experience handling these Chromebooks, we found that the Dell Chromebook 11 is designed to be much more rugged than the tested ASUS device. The Dell Chromebook 11 was designed with education in mind; it was built to last and to sustain heavy classroom use. Table 3 highlights the unique durability features of the Dell Chromebook 11 compared to the ASUS Chromebook C201.

Table 3. The Dell™ Chromebook™ 11 is better equipped than the ASUS® Chromebook C201 to survive daily classroom use

Durability Features	ASUS® Chromebook™ C201	Dell™ Chromebook 11
MIL-STD (U.S. Military Standard) tested for durability, pressure, temperature, humidity, shock, and vibration	✘	✔
Fully sealed keyboard and touch pad	✘	✔
180-degree hinge	✘	✔
Rubberized LCD and base trim for drop protection	✘	✔
Scratch-resistant touch screen made with Corning® Gorilla® Glass	✘	✔
Multi-colored lights signal to the teacher when students are online and not participating	✘	✔

Device Report Card



Grade	Criterion
A	Full or greater than 80 percent functionality for tested task
C	Partial (50 to 80 percent) functionality for tested task
F	Missing or less than 50 percent functionality for tested task

Test Scores: Chromebooks Put to the Classroom Test

The following sections compare the classroom experience for students using the two featured Chromebooks in two typical K–12 scenarios: a seventh-grade science project and a fifth-grade social-studies activity. Each scenario explains the student tasks involved in the activity and then gives the highlights of our test results, in addition to the functionality differences and the timed results for performance. For step-by-step test procedures and all timed-test results, see Appendix B.

Scenario 1: Virtual Frog Dissection in a Seventh-Grade Life-Science Class

Maren is a seventh-grade science student.³ For her assignment, she conducts a virtual dissection of a frog and engages in several activities related to learning, manipulating, and presenting the internal anatomy of amphibians. After exploring online videos to learn new content, she uses an educational 3-D model of a frog dissection in the 3DView app. She captures and annotates screenshots using the PicMonkey® app, and then she assembles a deck using Google™ Slides before creating a digital presentation to share with her teacher and peers by using the Movenote® app.

Students Cannot Complete this Scenario on the ASUS® Chromebook

Using the ASUS Chromebook C201, things start going awry for Maren right off the bat. The 3-D rendering of the frog is distorted and shows up in a transparent, bright yellow form. Maren is unable to see what the frog or its organs should look like. In contrast, when Maren uses the Dell Chromebook 11, the 3-D frog image appears correctly, so Maren can rotate the 3-D view and move the organs around as needed.

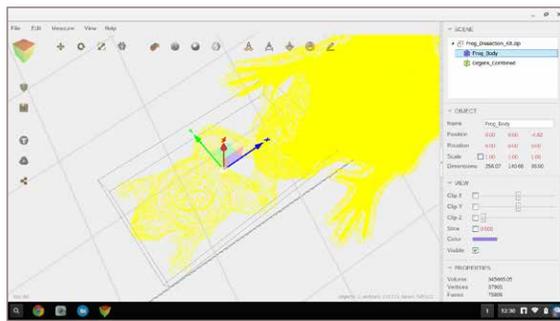


Figure 1. Distorted 3-D view of a virtual frog dissection on the ASUS® Chromebook™ C201 using 3DView



Figure 2. The 3-D view of a virtual frog dissection displayed correctly on the Dell™ Chromebook™ 11 using 3DView

In addition to not rendering the 3-D frog image correctly, the ASUS Chromebook is missing a key function that Maren needs to do her assignment—the “Structural Analysis” function. This function didn’t work at all in our testing, but instead caused the ASUS Chromebook C201 to freeze. When we tried to reload the app, a WebGL error appeared on the screen. At this point, Maren hits a dead-end with her attempts to do the virtual frog dissection on the ASUS Chromebook C201. It simply does not work.



Figure 3. The screen of the ASUS® Chromebook™ freezes up when trying to use the Structural Analysis feature in the 3DView app

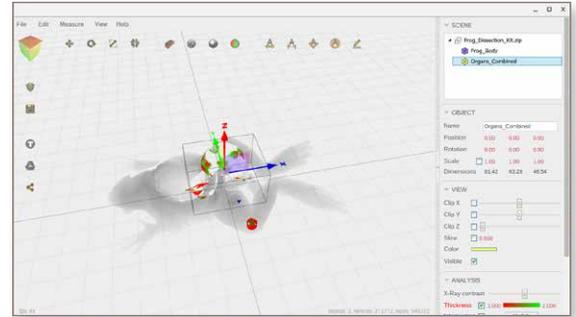


Figure 4. Structural Analysis function of 3DView working correctly on the tested Dell™ Chromebook™ 11

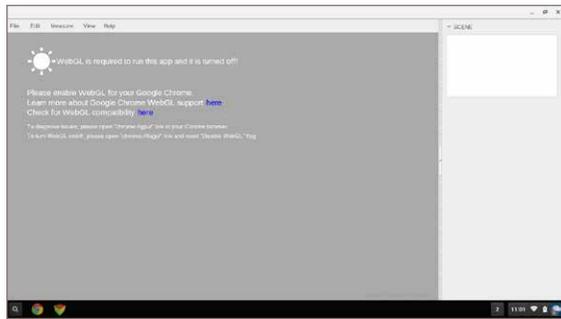


Figure 5. A WebGL error appears on the ASUS® Chromebook™ when trying to reload the 3-D frog image in 3DView

The Dell™ Chromebook™ 11, powered by an Intel® processor, gives students better app capabilities now and performance to handle the apps of the future.

The 3-D frog dissection app isn't the only app that failed to work properly on the ASUS Chromebook C201. Maren also has a lot of trouble with the Movenote app, which fails multiple times while trying to record a presentation on the ASUS Chromebook C201.

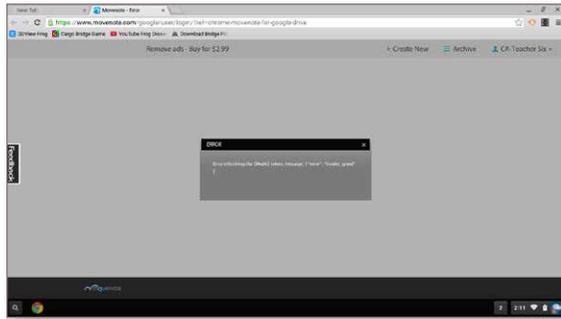


Figure 6. An error message that appeared repeatedly on the ASUS® Chromebook™ when running Movenote®

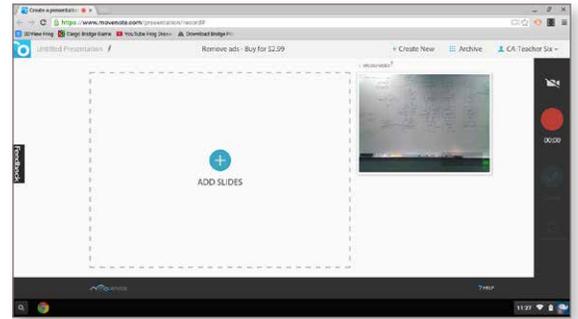


Figure 7. The Movenote® app recording a presentation on the tested Dell™ Chromebook™ 11

Maren and her classmates hit two major roadblocks in their assignment when using the ASUS Chromebook C201—the virtual frog dissection and the Movenote presentation recording. In addition, these students end up waiting longer for the ASUS Chromebook C201 to perform the other tasks for this project. Creating and working on a Google™ Slides presentation and opening 3-D files and photos for editing all take longer on the ASUS Chromebook C201 than on the Dell Chromebook 11.

Table 4 shows how much faster the Dell Chromebook 11 completed the individual tasks. Adding up all the timed tasks for the entire science activity, the Dell Chromebook 11 ends up being 12 percent faster than the ASUS Chromebook C201. Faster loading times mean less time waiting and fewer opportunities for distraction, which can equate to more time for student learning.

Table 4. Results of six of the fourteen timed tasks for the science lesson scenario. Full task list and times are in Appendix B.

Science-Lesson Tasks	Dell™ Chromebook™ 11 performed faster than the ASUS® Chromebook C201
Open Google™ Slides	33% faster
Create Google™ Slides presentation with YouTube® video	28% faster
Open 3DView app	6% faster
Open frog-dissection file in 3DView app	14% faster
Open PicMonkey® photo editing app	45% faster
Add photos to Google Slides presentation	25% faster
Total time for anatomy lesson	12% faster

Scenario 2: History-of-Bridges Lesson in a Fifth-Grade Social-Science Class

Quinn is a fifth-grade student working on a social-studies project that explores the history and design of prominent bridges.³ After choosing a bridge that he wants to focus on for his class presentation, he looks up the bridge in the Google Maps app and records a virtual aerial tour of the bridge using the Screencastify app. He then uploads the video to YouTube®. He takes screen shots of the bridge while viewing the YouTube video and edits them in the Autodesk® Pixlr® Touch Up photo editing app. Next, Quinn uses Canva, a web-based poster-creator app, to make an infographic for his presentation. He posts his infographic into a collaborative whiteboard space on the RealtimeBoard app. Then, for the last few minutes of the lesson, his teacher lets the students play an online bridge-design game to learn more about bridge engineering.

Students Experience Major Disruptions on the ASUS Chromebook C201

Using the ASUS Chromebook C201, Quinn is dramatically limited with the Google Maps app because the device does not support Google Earth, which has the 3-D tilt function that could give Quinn a rich, 3-D view of the bridge from all angles. He is only able to view the bridge from above (see Figures 8 and 9). His learning and workflow are hindered significantly by missing out on this 3-D view. His aerial video can only include a top view of the bridge, which makes it impossible to really learn about the bridge structure from various angles.

In contrast, on the Dell Chromebook 11, Quinn can experience the full 3-D functionality of the Google Maps app. He can record an aerial video that captures various views of the bridge and the surrounding areas. His screenshots and screencasts can include the 3-D views, which makes his infographic and class presentation much more visually interesting and informative.

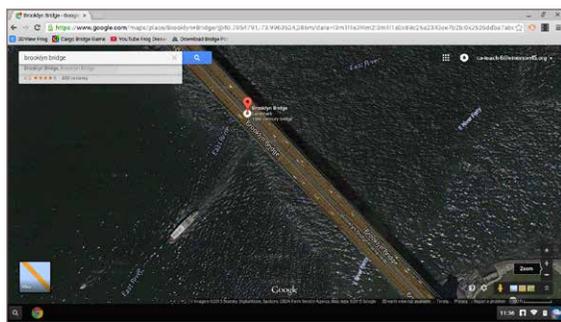


Figure 8. The Google Maps™ view on the ASUS® Chromebook™—note that there is no Google Earth™ 3-D tilt function available

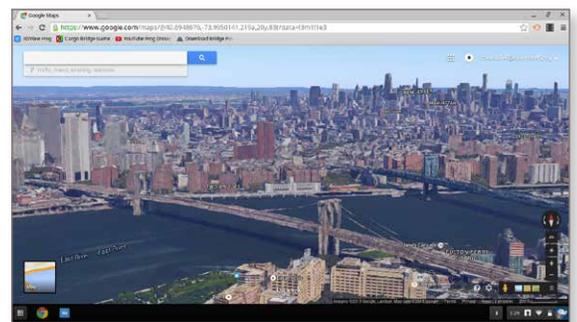


Figure 9. The Google Maps™ view of the bridge on the Dell™ Chromebook™ 11 using the 3-D tilt function in Google Earth™

After taking screenshots of the Google Maps image, Quinn uses the Pixlr Touch Up app to edit the photos to the way he wants them to look in his infographic for his class presentation. On the ASUS Chromebook C201, Quinn runs into a variety of problems and errors trying to add text or change effects. These disruptions not only cause a lot of frustration for Quinn, but could completely derail his efforts to prepare his infographic for his class presentation, which would negatively impact his learning experience.

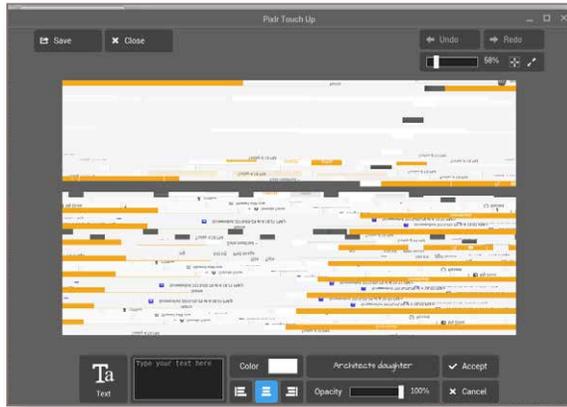


Figure 10. Error on the ASUS® Chromebook™ when adding text to a photo in Autodesk® Pixlr® Touch Up

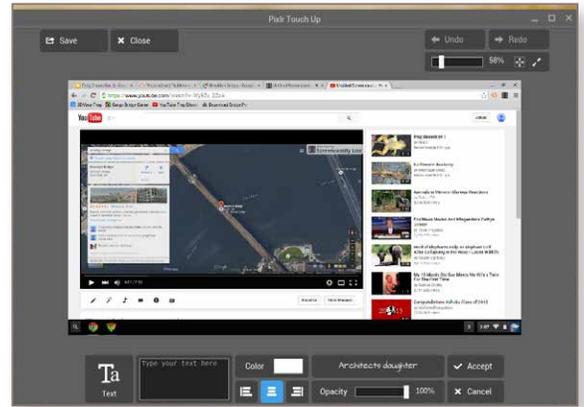


Figure 11. The Dell™ Chromebook™ 11 screen when adding text to a photo in Autodesk® Pixlr® Touch Up

In contrast, on the Dell Chromebook 11, he can make all of his edits with no errors or problems using the Pixlr Touch Up app. He can modify the photos to his liking and insert them into his infographic, positively impacting his learning experience.

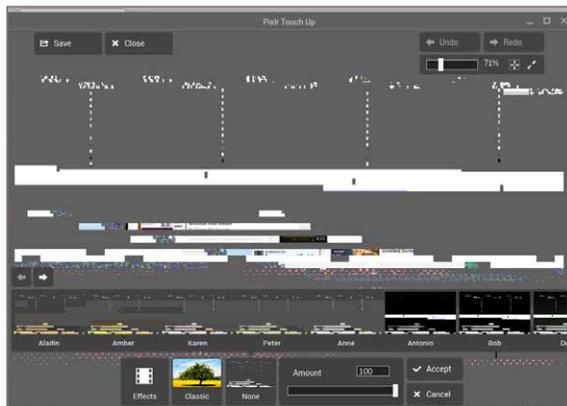


Figure 12. Error on the ASUS® Chromebook™ when adding an effect to a photo in Autodesk® Pixlr® Touch Up



Figure 13. The Dell™ Chromebook™ 11 screen when adding an effect to a photo in Autodesk® Pixlr® Touch Up

In addition to the issues with Google Maps and Pixlr Touch Up on the ASUS Chromebook C201, Quinn also finds that almost all of the activities in this lesson take significantly longer on the ASUS device than on the Dell device. Faster speeds mean less time waiting—which means less time for students to get distracted, bored, or frustrated.

The timed test results for this scenario are shown in Table 5. According to the total times, a student like Quinn could complete all of the tasks for this lesson 37 percent faster on the Dell Chromebook 11 than on the ASUS Chromebook C201.

Table 5. Results of seven of the thirteen timed tasks for the social studies lesson scenario. Full task list and times are in Appendix B.

Times for Social-Studies Activities	Dell™ Chromebook™ 11 performs faster than the ASUS® Chromebook C201
Open Google Maps™	60% faster
Download poster image from web	136% faster
Open Canva app	29% faster
Upload screenshot in Canva	30% faster
Open RealtimeBoard app	27% faster
Upload infographic in RealtimeBoard	21% faster
Play bridge-design game	138% faster
Total time for bridge lesson	37% faster

Faster speeds mean less time waiting—which means less time for students to get distracted, bored, or frustrated.

Head of Class: Dell Chromebook 11 Powered by an Intel Processor

The Dell Chromebook 11 earned top grades in our book as the Chromebook that will best enhance your students' learning experiences. In addition to being more durable in the classroom than the ASUS Chromebook C201, the Dell Chromebook 11 performed better than the ASUS device, proving that what's inside your students' Chromebooks really does matter.

The ASUS Chromebook C201 had difficulty running several critical apps in the student scenarios, causing serious disruptions in the workflow of activities and lower-quality final results. Students would likely be frustrated in these scenarios and could easily lose focus with so many learning disruptions.

In contrast, the Dell Chromebook 11 had no problems with these same critical apps, and the activities flowed smoothly from one to another, with the expected final results. It also performed faster on almost every task, so students can spend less time waiting and more time learning.

In summary, the Dell Chromebook 11, powered by the Intel Celeron processor N2840, offers the performance necessary to keep students engaged. Students not only spend less time waiting for the device to perform but also get full access to the functionality of the graphically rich, interactive apps powered by WebGL that they want to use today and in the future—increasing the lifespan of your investment.

You can get all this in the Dell Chromebook 11 for approximately \$0.14 more per device per school day over the life of the machine.² The Dell Chromebook 11, powered by an Intel processor, is a smart way to invest in the learning of your students.



Dell™ Chromebook™ 11 P22T
Intel® Celeron® processor N2840

Maximize your investment in learning by choosing
Chromebook™ devices powered by Intel® processors.

Appendices

Appendix A: Test Environment

	ASUS® Chromebook™ C201	Dell™ Chromebook 11
Reg Model	C201P	P22T
OS	Google™ Chrome OS™	Chrome OS
Processor	Quad-core Rockchip® processor RK3288C (1.8 GHz)	Intel® Celeron® processor N2840 (2.16 GHz)
Storage	16 GB SSD (eMMC)	16 GB SSD (eMMC)
Memory	2 GB LPDDR3	2 GB DDR3L
Battery	2 cells, 38 Wh	Up to 10 hours of use
Display	11.6" (1,366 x 768)	11.6" (1,366 x 768)
Graphics	Integrated Rockchip Mali T764	Intel® HD Graphics
Card Reader	Micro-SD, micro-SDXC, micro-SDHC	SD card
Camera	HD web camera	HD web camera
Interface	1 x combo audio jack 2 x USB 2.0 ports 1 x micro-HDMI 1 x AC adapter plug	HDMI 1 x USB 2.0 port 1 x USB 3.0 port
Audio	2 built-in speakers and digital microphone	4 W internal stereo speaker (min 2 W x 2)
Networking	Integrated 802.11a/b/g/n/ac Bluetooth® 4.1 support (on WLAN+ Bluetooth 4.1 combo card)	10/100 Mbps Intel® Dual-Band Wireless-AC 7260 802.11/a/b/g/n Bluetooth 4.0
Weight	2.16 lbs	2.91 lbs
Price at Time of Purchase	\$169.00 (amazon.com®)	\$245.15 (www.dell.com™)

Software

Name	Name
3DView	RealtimeBoard
Autodesk® Pixlr® Touch Up	Screencastify
Movenote®	Google™ Slides
Google Maps™	PicMonkey®
Canva	

Network Speed

Unless otherwise indicated, our tests were performed while devices were connected to an 802.11n wireless network. Network throughput fluctuates continually. We recorded network speeds at several points during the testing, and averaged the results. Averages are shown here.

Upload Speed	22.20 Mbps
Download Speed	71.66 Mbps

Appendix B: Test Procedure and Results

Scenario 1: Frog Anatomy Lesson

Creating a new presentation

1. From the bottom-left of the screen, click the **Search** icon.
2. Click **All Apps**.
3. Find **Google™ Slides**, and then click to open.
4. From the bottom-right of the screen, start a new presentation by clicking the **+** button.
5. Click **OK** to choose the default theme.
6. Click **Click to add title** and then type **Virtual Frog Dissection**.
7. Click **Slide > New Slide**.
8. Click **Insert > Video**, and then type **Frog Anatomy**.
9. Tap **Enter**, click the second video (part 2), and then click **Select**.
10. Double-click the image on the slide to start the video, and then click the pause button on video.
11. Click **File > Rename**, type **Frog Dissection**, and then click **OK**.

Dissection of a frog

1. From the bottom-left of the screen, click the **Search** icon.
2. Click **All Apps**.
3. Find **3DView** and click to open.
4. Click **File > Thingiverse**.
5. In the search bar, type **Frog Dissection**.
6. Click **The Frog Dissection Kit** to open.
7. Click **Download this Thing**.
8. Click **Download All Files**.
9. Click **Close**.
10. From the right-hand side, in the **Scene** pane, click the down arrow for the **Frog_Dissection_Kit.zip**.
11. Rotate the view by clicking and dragging.
12. From the top, click the **Structural Analysis** button to change the view.
13. From the top, click the **Structural Analysis** button to change the view back.
14. On the right-hand side, in the **Scene** pane, click **Organs_Combined**.
15. Click and drag organs by clicking the square in the middle of the organs.
16. Press **Ctrl+Shift+the Window** button to take a selection screenshot.
17. Select the area for which you wish to take a screenshot.

Scenario 1: Frog Anatomy Lesson (Continued)

Create an image for your presentation

1. From the bottom-left of the screen, click the **Search** icon.
2. Click **All Apps**.
3. Find **PicMonkey**[®], and then click to open.
4. Click the **Edit for free** link.
5. Click **Open**.
6. Select the image you wish to open, and then click **Select**.
7. From the left-hand side, click the **Text** button.
8. Click **Add Text**.
9. Click in the text box, and then type **Organs**.
10. From the left-hand side, click the **Effects** button.
11. Select **Soften**, and then click **Apply**.
12. From the top, click the **Save** button.
13. In the **File Name** field, type **Organs**.
14. In the **Quality** field, select **Sean**.
15. Click **Save to my computer**, and then click **Save**.
16. Click the **Slides** tab to make it active, and then click **Slide > New Slide > Image**.
17. Click **Choose an image** to open a new window, and then select **Organs.jpg**.
18. Click **Open**.

Recording a presentation

1. From the bottom-left of the screen, click the **Search** icon.
2. Click **All Apps**.
3. Find **Movenote**[®], and then click to open.
4. Click the **+ (Add Slides)** button.
5. Click **Google Drive**[™] > **Frog Presentation** > **Select**.
6. If necessary, from the **Adobe**[®] **Flash**[®] **Player Settings**, click **Allow**, and then click **Close**.
7. Click the **Start recording** button and record a 30-second presentation.
8. Click **Done** to export.
9. Click **Share** to email the file.

Scenario 1 total time

ASUS [®] Chromebook [™] C201	Dell [™] Chromebook 11
6 minutes 7 seconds	5 minutes 36 seconds

Scenario 1 Results		
Test	ASUS® Chromebook™ C201 (Rockchip® processor RK3288C)	Dell™ Chromebook 11 (Intel® Celeron® processor N2840)
Creating a new presentation		
Open Google™ Slides	4.97 seconds	3.75 seconds
Start new presentation	8.68 seconds	7.19 seconds
Create new slide	0.80 seconds	0.69 seconds
Add YouTube® video	1.51 seconds	1.26 seconds
Play video in app	2.33 seconds	1.45 seconds
Total	18.29 seconds	14.34 seconds
Dissection of a frog		
Open 3DView	2.46 seconds	2.31 seconds
Open frog-dissection file	36.80 seconds	32.23 seconds
Navigate app: click different icons and layers and change views	N/A	N/A
Take screenshot	N/A	N/A
Total	39.26 seconds	34.54 seconds
Create an image for your presentation		
Open PicMonkey®	2.56 seconds	1.76 seconds
Select file to edit	2.37 seconds	2.16 seconds
Add text	N/A	N/A
Add effect	N/A	N/A
Save as “sean” quality	2.73 seconds	3.29 seconds
Add to Google™ Slides	3.77 seconds	3.01 seconds
Total	11.43 seconds	10.22 seconds
Recording a presentation		
Open Movenote®	2.21 seconds	3.38 seconds
Add slides	6.04 seconds	5.19 seconds
Record 30-second presentation	N/A	N/A
Export by selecting done	17.80 seconds	17.44 seconds
Total	26.05 seconds	26.01 seconds

Google Maps™

1. From the bottom-left of the screen, click the **Search** icon.
2. Click **All Apps**.
3. Find **Google Maps™** and click to open.
4. From the bottom-left of the screen, click the **Satellite** view.
5. In the search field, type **Brooklyn Bridge**, and then tap Enter.
6. Click and drag to rotate the view.
7. From the top-right of the screen, click **Screencastify**.
8. Click **Start Recording** to record the video.
9. Record a 3-minute video.
10. Click **Stop Recording** to stop recording the video.
11. Click **Share**, and then select **YouTube® > Channel > Privacy**.
12. Click **Upload**.
13. From the bottom-left of the screen, click the **Search** icon.
14. Click **All Apps**.
15. Find **YouTube** and click to open
16. From the left-hand side, click **My Channel**, and then click the **Video** link.
17. Click on the video just created. Pause the video and hold Ctrl+the Window button to take a screenshot.

Adding text to image

1. From the bottom-left of the screen, click the **Search** icon.
2. Click **All Apps**.
3. Find **Autodesk® Pixlr® Touch Up** and click to open.
4. Click **My Computer**.
5. Select a file, and then click **Open**.
6. Click **Type**, and then type **Map** in the text box.
7. Click **Accept**.
8. Click **Effects > Classic > Vintage**, and then click **Accept**.
9. Click **Save**, and then type the name **BridgeMap**.
10. Click the **Download Bridge Poster** bookmark, which directs to <https://multco.us/bridges/news/downloadable-multnomah-county-bridge-posters>.
11. Scroll to the bottom of the page, and then click the **Hawthorn Bridge Poster** link.
12. Click the **Save** icon, and then click **Save**.

Scenario 2: Bridge Building Lesson (Continued)

Export image

1. From the bottom-left of the screen, click the **Search** icon.
2. Click **All Apps**.
3. Find **Canva** and click to open.
4. Click **Poster**.
5. Click **Uploads**, select **BridgeMap.jpg**, and then resize the image.
6. Click **Text**, then click the first option to add text.
7. Resize and move the text.
8. Click **Background**, and then select the first cell in the third row to add background.
9. Click **Download**, and then select **As an image**.

Load RealtimeBoard

1. From the bottom-left of the screen, click the **Search** icon.
2. Click **All Apps**.
3. Find **RealtimeBoard** and click to open.
4. Click the **Bridges** board to load.
5. Click the **+** button to add files.
6. Click **Upload** (move to Downloads if you need to).
7. Click **Untitled Design.jpg** to upload, and then click **Open**.
8. In the URL bar, type <http://armorgames.com/play/3999/cargo-bridge> (or click the **Cargo Bridge Game** bookmark).
9. Click **Start**, and then click **Start Game** to start the game.

Scenario 2 total time

We did not compare overall times for these steps because the Pixlr Touch Up problems on the ASUS® Chromebook™ C201 disrupted the timing sequence for every run-through.

Scenario 2 Results

Test	ASUS® Chromebook™ C201 (Rockchip® processor RK3288C)	Dell™ Chromebook 11 (Intel® Celeron® processor N2840)
Google Maps™		
Open Google Maps	3.71 seconds	2.32 seconds
Change to earth view	N/A	0.56 seconds
Screencastify: Capture video of flyover	1.31 seconds	1.01 seconds
Upload video to YouTube®	4.80 seconds	4.53 seconds
Take screenshot	N/A	N/A
Total	9.82 seconds	8.42 seconds

Scenario 2 Results (Continued)		
Test	ASUS® Chromebook™ C201 (Rockchip® processor RK3288C)	Dell™ Chromebook 11 (Intel® Celeron® processor N2840)
Adding text to image		
Open in Autodesk® Pixlr® Touch Up	1.55 seconds	3.79 seconds
Add text	N/A	N/A
Add effect	N/A	N/A
Conduct online research: download poster from https://multco.us/bridges/news/downloadable-multnomah-county-bridge-posters	1.77 seconds	0.75 seconds
Total	3.32 seconds	4.54 seconds
Export image		
Open Canva	3.83 seconds	2.98 seconds
Upload screenshot	3.09 seconds	2.37 seconds
Export design as image	19.42 seconds	18.12 seconds
Total	26.34 seconds	23.47 seconds
Load RealtimeBoard		
Open RealtimeBoard	9.09 seconds	7.14 seconds
Load board	10.57 seconds	6.69 seconds
Upload infographic (1.6 MB file)	20.10 seconds	16.60 seconds
Play bridge building game at http://armorgames.com/play/3999/cargo-bridge	4.19 seconds	1.76 seconds
Total	43.95 seconds	32.19 seconds

¹ Percent calculated from combined times for both classroom scenarios we tested.

² Estimates based on National Center for Education Statistics, which shows that the average class time per day in U.S. schools is 6.64 hours and the average number of school days per year as 180. "Schools and Staffing Survey." https://nces.ed.gov/surveys/sass/tables/sass0708_035_s1s.asp.

³ Maren and Quinn are fictional characters used as examples to explain the test results from students' perspectives.



The analysis in this document was done by Prowess Consulting and commissioned by Intel.

Results have been simulated and are provided for informational purposes only. Any difference in system hardware or software design or configuration may affect actual performance.

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