

MAXIMIZE CHROMEBOOK™ LEARNING

Give your students superior functionality and more app choices

EXECUTIVE SUMMARY

Chromebook™ devices are a favorite among educators because they are practical for everyday student use and are available at a price point that schools can afford. But not all Chromebooks offer the same quality of performance. Some are slower than others or might have functionality breakdowns—both of which can lead to more time waiting and to disengaged students. However, some Chromebooks do offer better performance, so students can spend less time waiting and more time focused on their learning.

To find out which Chromebooks perform best in the classroom, our team at Prowess Consulting put three Chromebooks to the test: the Acer® Chromebook™ 11 C740, powered by an Intel® Celeron® processor 3205U, the Acer Chromebook C730E, powered by an Intel Celeron processor N2840, and the ASUS® Chromebook™ C201, powered by a Rockchip® processor RK3288C.

We ran the Chromebooks through two typical classroom scenarios and discovered that both Acer Chromebooks can consistently outperform the ASUS Chromebook C201 in the classroom in the classroom, because they have greater functionality, are faster, and are more powerful.



Greater Functionality

Better app and feature support means more choices and less frustration



Faster Performance

Faster performance helps students stay focused on learning



More Powerful

More power lets students multitask with ease

Test results showed that the Acer Chromebooks offered greater functionality and speed, and were more powerful than the ASUS Chromebook C201.

How to Decide Between Chromebooks

Chromebooks are continuing to prove their worth in the K-12 education market. They offer students an easy-to-use operating system, a long battery life, easy collaborative tools, and a variety of free educational apps—all for an attractive price. But with so many Chromebook models available, how do you know which one is best for your students?¹

All Chromebooks run on the same Google™ Chrome OS™ operating system, but that doesn't mean that they perform equally. The processor that powers the device is a major differentiator between Chromebooks. Because of the processor, some devices exhibit functionality issues, such as incompatibility with specific apps. Lesser performing processors can also result in more wait time for students. On the other hand, more powerful processors can keep students more engaged because the devices are less prone to functionality breakdowns and lag times.

To find out how much difference the processor really makes, our team at Prowess Consulting tested and compared the following three Chromebooks, each with a different processor:

- Acer Chromebook 11 C740, powered by an Intel Celeron processor 3205U
- Acer Chromebook C730E, powered by an Intel Celeron processor N2840
- ASUS Chromebook C201, powered by a Rockchip processor RK3288C

We ran each device through a series of real-world classroom learning scenarios to see which device performed the best. The scenarios included a middle-school social-studies lesson on ancient civilizations and a high-school creative-writing lesson. After extensive testing on all three devices, the results show that both Acer Chromebooks with Intel® processors outperformed the ASUS Chromebook C201 because the Acer Chromebooks:

- **Have better app functionality**, so educators have more app choices and less frustration
- **Offer faster performance**, so students can stay focused on learning
- **Are more powerful** for handling students' multitasking habits

Two Acer® Chromebook™ Devices, Two Different Intel® Chipsets

With two Acer Chromebooks, how do you know which one is right for your students? It primarily comes down to performance, efficiency, and cost.

The Acer Chromebook C730E is powered by the dual-core Intel® Celeron® processor N2840, which is designed to be highly efficient for a longer battery life and minimal power use.

The Acer Chromebook 11 C740 is powered by the dual-core Intel Celeron processor 3205U, which

uses the Intel Broadwell architecture. It is designed to give you a measurable performance jump, especially when multitasking, without compromising battery life. It features better single and multi-core performance, along with greater memory bandwidth. For a slightly higher up-front investment, the Acer Chromebook 11 C740 offers much faster performance, which can save you time in the classroom, while providing the power that you need to run the increasingly demanding apps of tomorrow.

Enjoy More App Choices

One of the biggest perks of Chromebooks is the wide selection of free educational apps and websites that are available. Teachers from any discipline can find a wide variety of apps to help enhance their lessons. However, some Chromebooks don't have the processing performance required to handle certain apps. Two of the primary apps tested in our scenarios simply didn't work on the ASUS Chromebook C201.

The Senet Online app, which lets students play an ancient Egyptian game, showed a "not compatible" error and wouldn't even install. The Blue Toad Murder Files® app, a mystery solving puzzle game, showed a native client app load-failure error and wouldn't run.² In contrast, both of these apps worked flawlessly on both Acer Chromebooks.

Based on our testing, teachers and students can feel confident in the ability of the Acer Chromebooks to handle a wide selection of education-based apps, websites, and web tools. The devices' more powerful Celeron processors can handle the interactive, graphical nature of today's apps, which means that the Acer Chromebooks are better equipped for the more demanding apps of the future as well. That's important if you're counting on your Chromebooks having a lifespan of three or four years.

When you look at the costs, you can see that the performance benefits of the Acer Chromebooks come with minimal price differences between the three devices. Based on educational pricing, the price was only slightly higher for the Acer Chromebook C730E compared to the ASUS Chromebook C201.³ This means that for only pennies more per day, you can get a better performing device with the Acer Chromebook C730E. And, if you'd like to boost that performance up another notch, you can invest in the Acer Chromebook 11 C740 for only \$0.13 more per device per school day over a three-year lifecycle (as compared to the ASUS Chromebook C201).⁴

Table 1. For about \$0.10 more per school day, you can get the better performing Acer® Chromebook™ C730E instead of the ASUS® Chromebook™ C201; and you can get even faster performance with the Acer Chromebook 11 C740 for only \$0.13 more per school day over a three-year life cycle (as compared to the ASUS Chromebook C201)

Get more performance for your money with the Acer® Chromebook™ devices powered by Intel® processors	Additional price per device per school day over a three-year life cycle compared to the ASUS® Chromebook™ C201 ^{3,4}
Acer Chromebook C730E	+ \$0.10
Acer Chromebook 11 C740	+ \$0.13

Get More Learning Time with Faster Performance

It doesn't take long for students to lose focus. Even a few seconds of lag time can cause them to get distracted. In our testing, we carefully timed every task so that we could determine wait times for each device. For example, we measured the time it takes to open an image in a photo editing app, edit the photo, and save it to the cloud. We totaled up the time used to run every test and compared results between devices. After tallying the results, the Acer Chromebook 11 C740 came in first place as the fastest of the three devices. The Acer Chromebook C730E was second fastest, and the ASUS Chromebook C201 came in last, with the most wait time. Figure 1 shows the averages of the combined timed tests for both classroom scenarios.

Performance Rankings

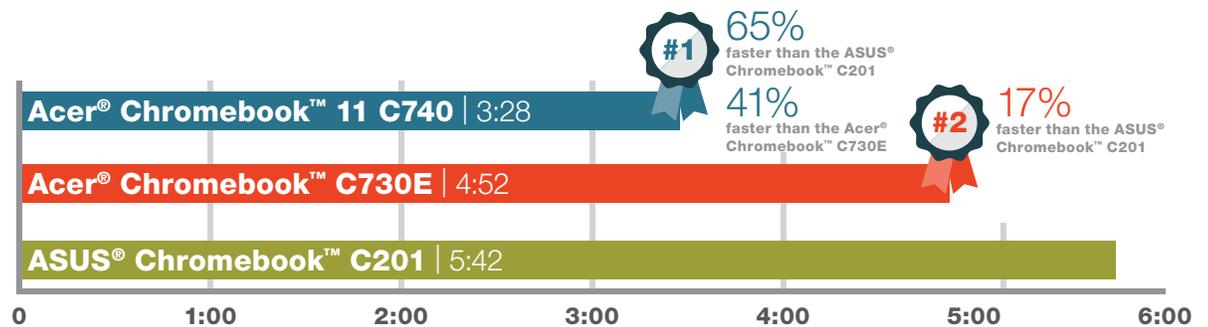


Figure 1. The averages of the combined tests for both classroom scenarios

Now, let's take those percentages and convert them into actual time savings in the classroom. A few seconds here and there might not seem like much, but those seconds can quickly add up into minutes and hours of lost learning time. And if you look at a three-year lifecycle, lost minutes turn into days of missed learning time. Even if you use Chromebooks in just two classes per day, you can get significant time savings from using the Intel processor-powered Acer Chromebooks instead of the ASUS Chromebook.

Table 2. Even if you use a Chromebook™ device in just two classes a day, you can get significant time savings from using the Intel® processor-powered Acer® Chromebook™ devices instead of the ASUS® Chromebook™ C201⁴

Estimates based on two Chromebook™ activities per school day over one school year*	Acer® Chromebook™ C730E powered by an Intel® Celeron® processor N2840 compared to the ASUS® Chromebook™ C201	Acer Chromebook 11 C740 powered by an Intel Celeron processor 3205U compared to the ASUS® Chromebook C201
Time saving per week	8.3 minutes	22.3 minutes
Time savings per school year	5 hours = 0.75 school days	13.4 hours = 2 school days
Time savings over a 3-year life cycle	15 hours = 2.25 school days	40.2 hours = more than 6 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.

Provide Students with the Power to Multitask

Next time you see a teenager with a device, count how many browser tabs she has open. Chances are, it's several. It's habitual these days for students to keep multiple tabs open at a time, in order to keep up with the demands of the modern classroom. In a typical day, a student might research multiple sites, play an interactive game, check email, and periodically access Google apps, all on separate tabs within the browser window.

Because of this, we decided to test how the three Chromebooks would perform with more than one tab open at a time in the Google™ Chrome™ browser. Our test involved opening one tab at a time using only the apps selected in the two classroom scenarios. All three devices performed the same until opening the sixth tab: a YouTube™ video about ancient Egypt. The YouTube video took an average of nearly 32 seconds to load on the ASUS Chromebook C201. In addition, during that wait time, two of the other tabs showed errors and stopped working.

In contrast, the YouTube video opened immediately on both of the Acer Chromebooks, and all of the other tabs ran seamlessly without slowing down or showing errors of any kind. If your students are in the habit of having multiple tabs open at a time, the Intel processor–powered Acer Chromebooks are better equipped to handle their multitasking needs.

Device Report Card

Taking all tests into account, this is the report card given by Prowess testers based on app functionality, the time students have to wait for their devices to load, and the browser performance with multiple tabs open. The Acer Chromebook 11 C740 gets straight As across the board with great app functionality, fast load times, and slick multitasking capabilities. Second, the Acer Chromebook C730E does almost equally well, except with slightly slower load times. The ASUS Chromebook C201 comes in with the lowest grades, a D for poor app functionality because so many apps failed to work, a C for slower load times, and an F for browser performance with multiple tabs open, because half of the tabs either had errors or problems loading.

Table 3. Report card with a breakdown of the grades for each device based on Prowess testing

	APP FUNCTIONALITY Features performing as expected	LOAD TIMES Time waiting for apps and tasks to run	BROWSER PERFORMANCE Ability to run apps with multiple tabs open
 Acer® Chromebook™ 11 C740 Intel® Celeron® processor 3205U	A	A	A
 Acer® Chromebook™ C730E Intel® Celeron® processor N2840	A	B	A
 ASUS® Chromebook™ C201 Rockchip® processor RK3288C	D	C	F

***Grade Criterion:**
A: Full or greater than 90 percent functionality for tested task
B: 80–90 percent functionality
C: 70–80 percent
D: 60–70 percent functionality
F: Missing or less than 60 percent functionality

Classroom Test Scenarios and Results

The following sections compare the classroom experience for students using the three featured Chromebooks in two typical K-12 scenarios: a middle-school social-studies lesson and a high-school creative-writing 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.

Classroom Scenario 1: Middle-School Social-Studies Lesson on Ancient Civilizations

Adam is an eighth-grade social-studies student.⁵ His class is studying ancient civilizations, and his teacher has assigned them an in-class activity using Chromebooks to learn more about ancient Egypt. First, Adam learns about Egyptian traditions by deciphering the game of the pharaohs, Senet. He then takes a virtual field trip using the Google Maps™ app to visit ancient pyramids and other sites around the world. He records and annotates a virtual aerial tour of one of his favorite pyramids using the Screencastify app, and then he uploads his recording to YouTube.

Next, Adam visits the Google Cultural Institute website to check out a 3-D artifact of a sphinx statue. He can zoom in, rotate the sphinx, and study it in great detail. He takes screenshots of the statue from various angles, edits them in the PicMonkey® app, and saves them to Google Drive™. Next, Adam plays an online educational game about ancient Egyptian artifacts, and he then watches part of a YouTube video on ancient Egypt. When he is finished, he uses the WeVideo® app to compile a video report summarizing what he’s learned. The students get together in groups and share their videos with each other.

STUDENTS HAVE LIMITED APP FUNCTIONALITY ON THE ASUS CHROMEBOOK C201

When we follow Adam more closely through this activity, we discover that he runs into problems right away on the ASUS Chromebook C201. The Senet Online app with the game of the pharaohs won’t even install on the ASUS Chromebook C201. It shows a “not compatible” error (see Figure 2). Adam spends a few minutes trying to troubleshoot the problem, but that only leads to frustration. The same frustration would likely be felt by the other 20+ students in the class, leaving the teacher with a very disrupted lesson and a hole in her series of student tasks.

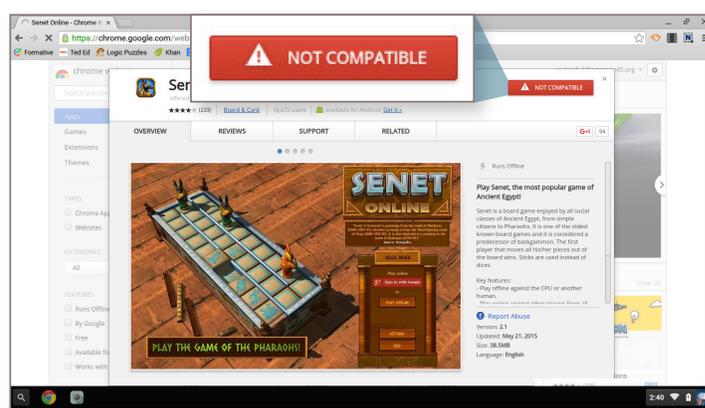


Figure 2. The Senet Online app is not compatible with the ASUS® Chromebook™ C201; students cannot do this activity at all

In contrast, the Senet Online app is fully compatible with both Acer Chromebooks (see Figure 3). Adam has no problem opening the app and playing the game on either of the Acer Chromebooks. He plays a fun game that the pharaohs used to play, and he learns more about ancient Egyptian culture. He has no delays or frustrations, and his learning is not disrupted.



Figure 3. The Senet Online app in action on the Acer® Chromebook™ C730E; the Senet Online app is fully supported by both of the Acer Chromebooks

STUDENTS RUN INTO MULTITASKING PROBLEMS ON THE ASUS CHROMEBOOK C201

Adam opens several browser tabs for the various activities in this lesson, which allows him to refer to each of them as he prepares his summary video. However, this becomes problematic on the ASUS Chromebook C201. When he opens his sixth browser tab with a YouTube video about ancient Egypt, two of the other tabs stop working completely, and the video takes up to 45 seconds to even start playing.

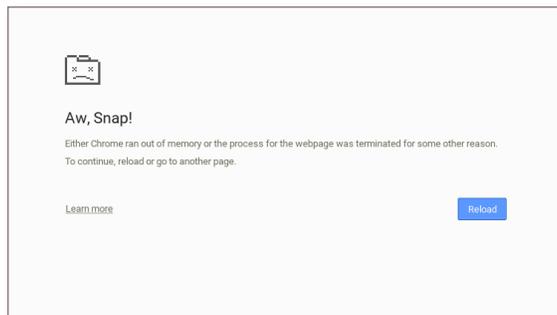


Figure 4. The Google Maps™ site freezes and shows this error on the ASUS® Chromebook™ C201 when multiple browser tabs are open; students must reload the tab to get it to work again

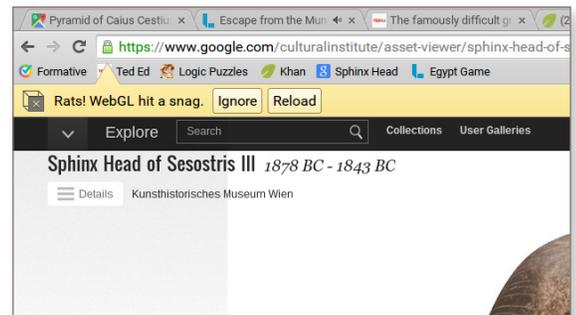


Figure 5. The 3-D web app stops working and shows a WebGL error on the ASUS® Chromebook™ C201 when multiple browser tabs are open; students must reload the tab to get it to work again

The Google Maps app disappears completely showing the following error: “Aw, Snap! Either Chrome ran out of memory or the process for the webpage was terminated for some other reason.” (See Figure 4). The Google Cultural Institute app with the 3-D sphinx head shows a Web Graphics Library (WebGL) error (see Figure 5); WebGL is a JavaScript® interface that allows users to create real-time-rendered, interactive 3-D graphics in a browser without the need to download any plug-ins. In addition, the YouTube video shows the following error: “If playback doesn’t begin shortly, try restarting your device.” (See Figure 6). To move forward, Adam has to reload both of the other tabs to get them to work, and then each time he goes back to the video, he has to wait for it to load again. This is both frustrating and disruptive.

On the Acer Chromebooks, Adam can easily open the same six browser tabs with no disruptions in any of the sites on the tabs. His YouTube video loads and plays instantly, so he doesn't have to wait at all. He can seamlessly switch between tabs with no wait times or reloading, which makes it easier to create his report-summary video.

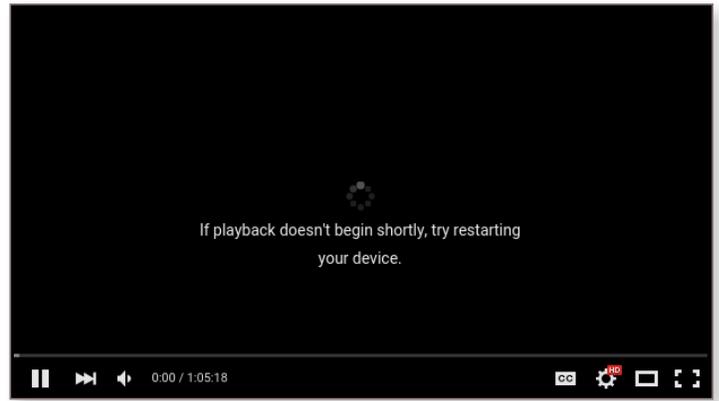


Figure 6. The YouTube™ video takes up to 45 seconds to load and shows this playback error on the ASUS® Chromebook™ C201 when multiple browser tabs are open

STUDENTS SPEND LESS TIME WAITING WHEN USING THE INTEL PROCESSOR-POWERED ACER CHROMEBOOKS

All in all, Adam has a difficult time completing his social-studies activities on the ASUS Chromebook C201. The Senet Online app doesn't work at all, the Google Maps app doesn't give him the 3-D flyover views that he needs, and when he tries to multitask, the browser tabs start crashing. In addition, he ends up waiting more on the ASUS Chromebook C201 than on the other two devices. The Acer Chromebook C730E is, on average, 16 percent faster than the ASUS Chromebook C201 at completing all the tasks associated with this activity. The Acer Chromebook 11 C740 is an average of 64 percent faster than the ASUS Chromebook C201 for completing the tasks. Fewer and shorter wait times mean that Adam can stay more focused and engaged in his learning.

Table 4. Results of the combined timed tasks for the social-studies lesson scenario; full task list and times are in Appendix B

Social-Studies Assignment Tasks	Acer® Chromebook™ C730E compared to ASUS® Chromebook™ C201	Acer Chromebook 11 C740 compared to ASUS Chromebook C201
Open Google Maps™, record video in Screencastify, and upload to YouTube™	10% faster	36% faster
Go to the Google Cultural Institute, open the Sphinx Head website, take screenshots, and then edit and save files in PicMonkey®	22% faster	88% faster
Open the Ancient Egyptian Artifacts game from the Liverpool Museum	5% faster	54% faster
Open the WeVideo® app, and then create, edit, and save a video	Equal	41% faster
Total time for all tasks combined	16% faster	64% faster

Classroom Scenario 2: Creative-Writing Lesson in a High-School English Class

Sarita is a high school sophomore.⁵ Her English class is studying creative writing, and the students have been assigned a Chromebook activity designed to help them think more critically and to understand logic's role in writing. First, she gets to play a fun, interactive mystery game called Blue Toad Murder Files as part of her homework assignment.² The humorous game guides students through solving a mystery while playing different types of puzzles. The next day in class, Sarita and the other students get to make guesses about who is guilty and have a discussion about it.

During class the next day, students hone their critical thinking skills by playing logic puzzles online and learning about brain teasers on the Khan Academy® site. They also watch a TED-Ed® video called “Can you solve this logic puzzle?” and visit the Formative® website to take a logic quiz. Next, students work in teams to craft their own unique mystery games using Google™ Slides and Google™ Drawings. They create presentations using Google Drawings and Google Slides, and then they post their work to a RealtimeBoard location to share their presentations with their peers.

STUDENTS RUN INTO ANOTHER APP FAILURE ON THE ASUS CHROMEBOOK C201

When we follow Sarita more closely through this activity, we see that she is unable to complete the entire assignment on the ASUS Chromebook C201 because the Blue Toad Murder Files app doesn't work. The following error appears along the top of the screen: “NaCl [native client app] module load failed: manifest: no version of program given for current arch and no portable version found.” (See Figure 7). Sarita has to skip that part of the assignment on the ASUS Chromebook C201. Her teacher is also frustrated because she didn't know that the app wouldn't work on the ASUS Chromebook C201 until her students started complaining.



Figure 7. The Blue Toad Murder Files® app won't run on the ASUS® Chromebook™ C201; the error on the top of the screen reads: “NaCl module load failed: manifest: no version of program given for current arch and no portable version found.”

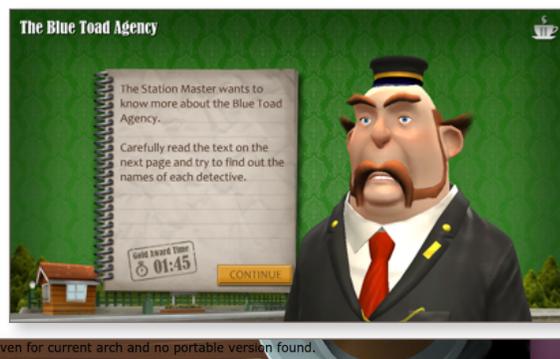


Figure 8. The Blue Toad Murder Files® mystery game works on the Acer® Chromebook™ C730E and the Acer Chromebook 11 C740

Conversely, if Sarita uses either of the Acer Chromebooks, she has no problem running the app (see Figure 8). She has a lot of fun playing the game and is excited to talk about it in class the next day. Her teacher is also relieved that the app works flawlessly on the Acer Chromebooks so she doesn't have to worry about frustrated students.

STUDENTS CAN OPEN MORE BROWER TABS FOR EASIER MULTITASKING ON THE ACER CHROMEBOOKS

To complete the various tasks for this assignment, Sarita needs to have more than one browser tab open at a time. But when she opens the fifth tab on the ASUS Chromebook C201 to watch the TED-Ed talk, the video screen goes black and the entire device freezes for a few seconds (see Figure 9). At the same time, another tab with a brain-teaser activity also freezes up and has to be reloaded (see Figure 10). Sarita tries opening the tabs in a different order, but the result is always the same: the ASUS Chromebook does not support these five tabs working at once.

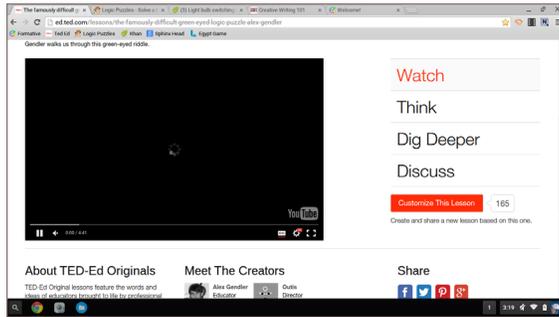


Figure 9. The TED-Ed® video freezes up with five tabs open on the ASUS® Chromebook™ C201

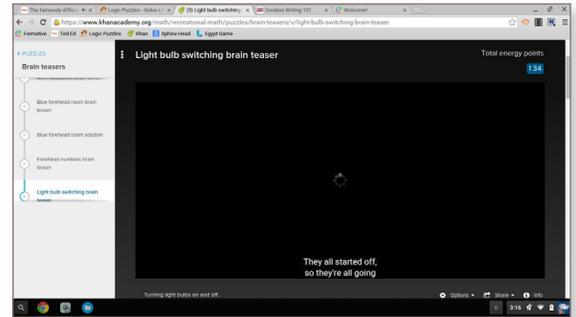


Figure 10. The Khan Academy® brain-teaser screen freezes up and has to be reloaded when five browser tabs are opened on the ASUS® Chromebook™ C201

In contrast, on the Acer Chromebooks, Sarita can open five or more tabs with no functionality problems at all. All of the sites, including those with videos and games, continue to run flawlessly. The videos play instantly with no delays. Sarita can multitask and easily complete her assignment while jumping between the browser tabs.

STUDENTS HAVE LONGER WAIT TIMES ON THE ASUS CHROMEBOOK C201

In addition to the Blue Toad Murder Files app not working and the multitasking problems, Sarita also ends up waiting longer in general to complete all of the tasks involved in her creative-writing activity on the ASUS Chromebook C201. Creating her assignment using Google Drawings, Google Slides, and RealtimeBoard takes longer on the ASUS device. By using the Acer Chromebook C730E, she is able to complete the entire activity a total average of 29 percent faster compared to the ASUS Chromebook C201. By using the Acer Chromebook 11 C740, she can increase that benefit to 68 percent faster compared to the ASUS Chromebook C201. That means less time to get bored, distracted, or frustrated, and more time to spend learning.

Table 5. Results of the combined timed tasks for the creative-writing lesson scenario; full task list and times are in Appendix B

Creative-Writing Assignment Tasks	Acer® Chromebook™ C730E compared to ASUS® Chromebook™ C201	Acer Chromebook 11 C740 compared to ASUS Chromebook C201
Load logic-puzzle video, quiz, and games	28% faster	34% faster
Create a Formative® quiz	25% faster	69% faster
Create new Google Docs™ assignments including using Google™ Drawings and Google™ Slides	24% faster	88% faster
Create a new RealtimeBoard location and insert a presentation	8% faster	58% faster
Total time for all tasks combined	20% faster	68% faster

Acer® Chromebook™ C730E: Rugged by Design

The Acer Chromebook C730E includes several features that can help it stand up to punishing use in the classroom, including the following:



- Spill-resistant keyboard and touchpad
- Anti-microbial coating on the palm-rest cover
- Reinforced metallic hinge for the front cover
- Strengthened body, built to withstand pressure up to 132 pounds
- Reinforced corners to absorb shock from accidental drops

Acer® Chromebook™ Devices Powered by Intel® Processors Better Engage Students

The Acer Chromebooks powered by Intel processors are better equipped to handle students' daily classroom needs compared to the ASUS Chromebook C201 powered by a Rockchip processor. The Acer Chromebooks provide full app functionality, so teachers are not limited in their app choices. The Acer Chromebooks also performed consistently faster in all the tasks that we tested associated with the scenarios' classroom activities, so students have less wait time and can better focus on the task at hand with fewer disruptions. In addition, the Acer Chromebooks have more processing power to better accommodate multitasking habits, so students can have multiple tabs open at once with no interruptions.

When looking at the big picture, you can see that for just \$0.10 more per device per school day over a three-year lifecycle (compared to the ASUS Chromebook C201), you can get the Acer Chromebook C730E, which offers ruggedness with better performance over the ASUS Chromebook C201 (for more information, see the callout, "Acer Chromebook C730E: Rugged by Design"). And for only \$0.03 more per device per school day over a three-year lifecycle (compared to the Acer Chromebook C730E), you can get the Acer Chromebook 11 C740, which offers more processing power to better handle the needs of your students today and in the future. The bottom line is that no matter which of these two Acer Chromebooks you choose, you'll help your students maximize learning in the classroom.

Don't limit your students' choices and functionality by choosing a lesser-performing Chromebook™ device.

Appendices

Appendix A: Test Environment

Hardware			
	ASUS® Chromebook™ C201	Acer® Chromebook™ C730E	Acer Chromebook 11 C740
Reg. Model	C201P	C730E	C740
OS	Google™ Chrome OS™	Chrome OS	Chrome OS
Processor	Quad-core Rockchip® processor RK3288C (1.8 GHz)	Intel® Celeron® processor N2840 (2.16 GHz)	Intel Celeron processor 3205U (2.16 GHz)
Storage	16 GB solid-state drive (SSD (embedded MultiMediaCard [eMMC]))	16 GB SSD (Serial ATA [SATA])	16 GB SSD (SATA)
Memory	2 GB LPDDR3	2 GB DDR3L SDRAM	2 GB DDR3L SDRAM
Battery	Up to 13 hours of use	Up to 8.5 hours of use	Up to 9 hours of use
Display	11.6" (1,366 x 768)	11.6" (1,366 x 768)	11.6" (1,366 x 768)
Graphics	Integrated Rockchip® Mali™ T764	Intel® HD Graphics	Intel® HD Graphics
Card Reader	Micro-SD, micro-SDXC, micro-SDHC	SD card	SD card
Camera	HD web camera	HD web camera	HD web camera
Interface	1 x 3.5 mm audio jack 2 x USB 2.0 port(s) 1 x micro HDMI 1 x AC adapter plug	HDMI 1 x USB 2.0 port 1 x USB 3.0 port	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)	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)	IEEE 802.11a/b/g/n/ac	10/100 Mbps Intel® Dual-Band Wireless-AC 7260 802.11a/b/g/n Bluetooth 4.0
Weight	2.16 lbs	2.43 lbs	2.87 lbs
Price at Time of Purchase ³	\$177.55	\$229.99	\$249.99

Software and Websites	
Name	Version Tested
Google™ Chrome OS™	47.0.2526.80
Blue Toad Murder Files®	2.026
Google Docs™	0.9
Google™ Slides	0.9
Google™ Drawing	1.1
RealtimeBoard	1.38.1.6
Senet Online	2.1
Google Maps™	5.4.1
PicMonkey®	1.6
Screencastify	1.12.5
WeVideo®	4.3.0

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	23.59 Mbps
Download Speed	66.07 Mbps

Appendix B: Test Procedure and Results

Scenario 1: Ancient Civilization

Senet Online

1. From the bottom-left of the screen, click the **Search** icon.
2. Click **All Apps**.
3. Find **Senet Online**, and then click to open.

Google Maps™

1. From the bottom-left of the screen, click the **Search** icon.
2. Click **All Apps**.
3. Find **Google Maps**, and then click to open.
4. From the bottom-left of the screen, click the **Earth** view.
5. In the search field, type **Egyptian Pyramid**, and then press Enter.
6. From the top-right of the screen, click **Screencastify**.
7. Click **Start Recording** to record the video.
8. Record a 1-minute video.
9. Click **Stop Recording** to stop recording the video.
10. Click **Share**, and then click **YouTube > Channel > Privacy**.
11. Click **Upload**.

Google Cultural Institute

1. Find and click **Chrome** to open a browser window.
2. Click the **Sphinx Head** bookmark to open the website.
3. Press Ctrl plus the window-switcher key to take a screenshot of the head. Do this three times for three different screenshots.
4. From the bottom-left of the screen, click the **Search** icon.
5. Click **All Apps**.
6. Find **PicMonkey®**, and then click to open.
7. Click **Collage**.
8. Select all three screen captures of the head, and then click **Open**.
9. Click each image and drag it into the collage.
10. Click **Edit**, and then click **Open in Editor**.
11. Select **Didact Gothic**, and then click **Add text**.
12. Type **Sphinx**, and then move the text to the top of the collage.
13. Click **Effects**.
14. Click **Dusk**.
15. Click **Save**.
16. In the **File name** field, type **SphinxHeadCollage**.
17. Select **Roger** for quality.
18. Click **Save to my computer**.

Ancient Egyptian Artifacts Game

1. Find and click **Chrome** to open a browser window.
2. Click the **Egypt Game** bookmark to go to the website.

Scenario 1: Ancient Civilization (Continued)

WeVideo®

1. From the bottom-left of the screen, click the **Search** icon.
2. Click **All Apps**.
3. Find **WeVideo**, and then click to open.
4. Click **Upload Media**.
5. Click **Browse to select**.
6. Select all three sphinx-head screen shots using Ctrl+click, and then click **Open**.
7. Click **Upload**.
8. Click **Create a video**.
9. Click **Theme, Memories**, and then click **Use this theme**.
10. Click **Music, Free music, Exploring, Time Pressure**, and then click **Use this track**.
11. Click **Voice**, and then record a 15-second intro.
12. Type **Sphinx Head** as the title for video.
13. Click each image, and then click **+** to add a voice to be voiceover.
14. At the top of the page, click **Name of Video**, and then type **Sphinx** to rename the video.
15. Click **Finish**, select **720p HD**, and then click **Finish Video** to render the video.

History Documentary

1. Find and click **Chrome** to open a browser window.
2. Open six tabs.
3. On the sixth tab, play a YouTube video on Egyptian history.

Scenario 1 total time (for tests that all three devices were capable of running)

ASUS® Chromebook™ C201	Acer® Chromebook™ C730E	Acer Chromebook 11 C740
4 minutes 26 seconds	3 minutes 49 seconds	2 minutes 43 seconds

Scenario 1 Results

Test	ASUS® Chromebook™ C201 (Rockchip® processor RK3288C)	Acer® Chromebook™ C730E (Intel® Celeron® processor N2840)	Acer Chromebook 11 C740 (Intel Celeron processor 3205U)
Senet Online			
Open Senet Online	Not applicable (NA)	7.37 seconds	5.43 seconds
Total	NA	7.37 seconds	5.43 seconds
Google Maps™ (NA indicates functionality tests that were not time-based)			
Open Google Maps	3.41 seconds	3.20 seconds	2.32 seconds
Change to earth view	NA	NA	NA
Screencastify: Capture video of flyover	2.61 seconds	1.94 seconds	1.22 seconds
Upload video to YouTube™	4.82 seconds	4.70 seconds	4.41 seconds
Total	10.84 seconds	9.84 seconds	7.95 seconds
Google Culture Institute			
Open Sphinx Head website	5.12 seconds	4.43 seconds	2.49 seconds
Open PicMonkey®	1.89 seconds	1.55 seconds	1.31 seconds
Select file to edit	7.34 seconds	5.20 seconds	3.12 seconds
Add text (Sphinx)	1.82 seconds	1.40 seconds	0.98 seconds
Add effect (Dusk)	1.99 seconds	1.91 seconds	0.94 seconds
Save as Roger quality	2.31 seconds	2.25 seconds	2.03 seconds
Total	20.47 seconds	16.74 seconds	10.87 seconds

Scenario 1 Results (Continued)

Test	ASUS® Chromebook™ C201 (Rockchip® processor RK3288C)	Acer® Chromebook™ C730E (Intel® Celeron® processor N2840)	Acer Chromebook 11 C740 (Intel Celeron processor 3205U)
Ancient Egyptian Artifacts			
Open Egyptian game website	2.54 seconds	2.41 seconds	1.65 seconds
Total	2.54 seconds	2.41 seconds	1.65 seconds
WeVideo®			
Open WeVideo	6.45 seconds	4.76 seconds	4.02 seconds
Create video	14.11 seconds	13.73 seconds	10.13 seconds
Finish video	180.49 seconds	181.63 seconds	128.03 seconds
Total	201.05 seconds	200.12 seconds	142.18 seconds
History Documentary			
Start a YouTube video with six tabs open	31.50 seconds	0.00 seconds	0.00 seconds
Total	31.50 seconds	0.00 seconds	0.00 seconds

Scenario 2: Mystery Puzzles

Playing Blue Toad Murder Files®

1. From the bottom-left of the screen, click the **Search** icon.
2. Click **All Apps**.
3. Find **Murder Files**, and then click to open.
4. From the bottom-right of the screen, click **Press to continue**.
5. Click **Episode 1** to choose the episode to play.
6. Click **Play Story**.
7. Select a character, and then click the character's picture.

Logic Quizzes

1. Click **Chrome** to open a browser window.
2. Click the **TED-Ed®** bookmark to open the website.
3. Click **Play** on the "Can you solve this logic puzzle?" video to load the video.
4. Click the **Logic Puzzles** bookmark to open the website.
5. Click the **Khan Academy®** bookmark to open the website.

Formative® Quiz

1. Click **Chrome** to open a browser window.
2. Click the **Formative** bookmark to open the website.
3. Click **Dashboard** to load the dashboard.
4. Click **New Assignment!** to create a new quiz.

Google Docs™

1. From the bottom-left of the screen, click the **Search** icon.
2. Click **All Apps**.
3. Find **Google Docs**, and then click to open.
4. Click **+** to create a new blank document.
5. From the bottom-left of the screen, click the **Search** icon.
6. Click **All Apps**.
7. Find **Google™ Drawings**, and then click to open.
8. From the bottom-left of the screen, click the **Search** icon.
9. Click **All Apps**.
10. Find **Google™ Slides**, and then click to open.
11. Click **+** to create blank presentation.

Scenario 2: Mystery Puzzles

Recording a Presentation

1. From the bottom-left of the screen, click the **Search** icon.
2. Click **All Apps**.
3. Find **RealtimeBoard**, and then click to open.
4. Click **Create** to create a board.
5. Click **Continue without a template** to create a board without a template.
6. Click **Insert** to load a file on the board.
7. Click **Google Drive** to select a file.
8. Select **Logic presentation**, and then click **Open** to open the file.

Scenario 2 total time (for tests that all three devices were capable of running)

ASUS® Chromebook™ C201	Acer® Chromebook™ C730E	Acer Chromebook 11 C740
1 minutes 16 seconds	1 minutes 3 seconds	45 seconds

Scenario 2 Results

Test	ASUS® Chromebook™ C201 (Rockchip® processor RK3288C)	Acer® Chromebook™ C730E (Intel® Celeron® processor N2840)	Acer Chromebook 11 C740 (Intel Celeron processor 3205U)
Play Blue Toad Murder Files®			
Open Blue Toad Murder Files	NA	24.51 seconds	16.05 seconds
Start new game	NA	18.67 seconds	14.49 seconds
Total	NA	43.18 seconds	30.54 seconds
Logic Quizzes			
Open TED-Ed® website	5.19 seconds	2.85 seconds	3.97 seconds
Load "Can you solve this logic puzzle?" video	1.69 seconds	1.58 seconds	1.14 seconds
Open Logic Puzzles website	1.86 seconds	1.87 seconds	1.42 seconds
Open Khan Academy® website	2.43 seconds	2.40 seconds	1.78 seconds
Total	11.17 seconds	8.70 seconds	8.31 seconds
Formative® Quiz			
Open Formative website	2.32 seconds	1.89 seconds	1.49 seconds
Load dashboard	2.89 seconds	2.17 seconds	1.76 seconds
Create new assignment	5.17 seconds	4.27 seconds	2.88 seconds
Total	10.38 seconds	8.33 seconds	6.13 seconds
Google Docs™			
Open Google Docs	4.64 seconds	4.43 seconds	2.49 seconds
Create new document	5.91 seconds	3.04 seconds	2.48 seconds
Open Google™ Drawings	7.18 seconds	6.61 seconds	4.08 seconds
Open Google™ Slides	5.72 seconds	4.57 seconds	3.09 seconds
Start new presentation	10.61 seconds	8.78 seconds	5.93 seconds
Total	34.06 seconds	27.43 seconds	18.07 seconds
RealtimeBoard			
Open RealtimeBoard	8.86 seconds	8.35 seconds	4.96 seconds
Create board	7.27 seconds	6.85 seconds	4.97 seconds
Insert presentation	3.88 seconds	3.41 seconds	2.70 seconds
Total	20.01 seconds	18.61 seconds	12.63 seconds

¹ Based on Chromebook™ models listed by Google as of January 2016. <https://www.google.com/chromebook/find/>.

² Blue Toad Murder Files® is rated “Guidance Suggested” on the Amazon® Kindle® Store, as opposed to more stringent levels, “Mature” and “Adult.” The “Guidance Suggested” rating indicates “the app may include account creation, location detection, user generated content, advertisements, infrequent or mild references to violence, profanity, or crude themes, or other content not suitable for all ages.” However, this game is actually a mild game with no profanity, graphic violence, or other mature content. For more information, see <http://www.amazon.com/gp/help/customer/display.html?nodeId=201357550>.

³ Educational prices pulled January 12, 2016 from www.cdwg.com. ASUS® Chromebook™ C201: \$177.55; Acer® Chromebook™ C730E: \$229.99; Acer Chromebook 11 C740: \$249.99.

⁴ The National Center for Education Statistics (NCES) 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.

⁵ Adam and Sarita are fictional characters used as an example to explain the test results from a student’s perspective.



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

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