Virginia: Inspiring the next generation of cybersecurity experts







A report detailing Virginia's lea<mark>dership</mark> in finding, motivating, and developing the cyber-capable workforce in the United States.

Dear Governor McAuliffe,

Your insight and leadership in bringing CyberStart to the students of Virginia is already paying dividends for them in the form of learning and scholarships, and it can lead to future job growth and improved cybersecurity in Virginia. Results of the CyberStart pilot program are summarized below. But before you dig into the numbers and see the lists of high-performing Virginia students, please turn to the back cover and the last few pages of this booklet to enjoy personal notes that participating students wrote specifically for you.

Program Highlights:

- Under the remarkable leadership of Karen Jackson, your team was able to sign up 1,980 Virginia students to test their skills, in just three weeks in July.
- Nearly 75% of them solved at least one of the assessment challenges and 43% solved enough to be invited to test their cyber aptitude on the 250+ challenges of the full CyberStart program, which they did during August 2017.
- 10 Virginia high school and college students were in the overall top 20 nationally, and 62 Virginia students won scholarships for more advanced education in cybersecurity.
- As you might guess from the students' notes, they liked CyberStart: 91% rated the game either excellent or very good (and this is a tough crowd!) 93% said they would recommend the program to a friend 97% are considering further cybersecurity training after the program

Please let me know if there is anything I can do to help as you continue to identify talent and grow the next generation of cybersecurity experts in Virginia.





Program Introduction

CyberStart is a forward-thinking skills program designed to supply specialist cybersecurity education to young people across the United States. Using a suite of online challenges, tools and games it aims to inspire the next generation of cybersecurity professionals while identifying the best and most talented young Americans.

We are facing a significant shortage of trained and skilled cybersecurity professionals at a time when online technologies continue to evolve, and cybercriminals are becoming more sophisticated. The only way to solve this problem is to introduce, develop and help young people in high school and college pursue a career in this sector.

Phases

CyberStart Assess is a set of 8 questions that test a student's aptitude and existing knowledge of computer security. Based on identifiable, measurable key skills and traits, it works to find young people who possess the innate qualities of an effective security practitioner. Questions look for traits such as problem solving, logical extrapolation and attention to detail, all of which have been proven to be crucial to succeed in a security career. **CyberStart Game** is where students become exposed to specialist cybersecurity education. Using a suite of online tools, challenges and games, players attempt to solve more than 250 challenges, all of which are realistic examples of tests and threats faced by practicing cybersecurity engineers in their day-to-day lives. The CyberStart Game enables students to start studying security with challenges written by experts who practice these skills in the real world.

Goals

- Supply specialist cybersecurity education
 for 16+year olds.
- Grow the U.S. cyber capable workforce.

Inspire the next generation of cybersecurity experts.

Identify the most elite young talent.

What Do Players Learn?

The CyberStart Game has over 300 hours of content and covers 14 main topic areas. There are two "bases" that make up the game, each containing several levels and challenges that candidates move through: the Headquarters Base and the Moon Base.

Bases

The **Headquarters Base** forms the main part of the game. Players take on the role of a junior agent in the Cyber Protection Agency, where they deploy their forensics and offensive skills to sleuth through challenges and tackle various online cyber criminal gangs. As they work their way up through the organization, their training develops each of the security disciplines.

The HQ Base teaches students skills in:

- Binary
- Cryptography
- Forensics
- Linux
- Open-source intelligence
- Programming
- Web application

The **Moon Base** is where players learn how to program. Players go through a series of challenges, building up progressively, to write their own programs in Python. The aim of the Moon Base is for players to use all the skills they have learned to stop an alien invasion. The Moon Base has three training levels that are step by step guides to the basics of programming.

Later levels teach students skills in:

- Programming cryptography
- Debugging
- Files
- Functions
- Loops
- Sockets
- Strings

CyberStart Scholarship Winners in Virginia

Кеу		
**	In the top 100 and awarded a scholarship	
*	Awarded a scholarship	

Last Name	First Name	School	Top 100/ Scholarship
Akalwadi	Sid	Rock Ridge	**
Al-Kahfah	Ammar	George Mason University	**
Alligood	Timothy	Virginia Western Community College	**
Bannin	Michael	George Mason University	**
Basu	Ankan	New River Community College	**
Bohuk	Roman	University of Virginia	**
Chan	Darren	Virginia Commonwealth University	**
Chenoweth	Thomas	George Mason University	**
Chub	Nikita	George Mason University	*
Cinnamon	Matthew	Forest Park High School	**
Collins	John	George Mason University	**
Colmenares	Danny	Virginia Tech	**
Conroy	Thomas J.	Virginia Tech	**
Dappert	Robyn	Tidewater Community College	*
Davis	Jacen Alexander	Thomas Nelson Community College	**
Fowler	Thomas	Virginia Tech	**
Geier	Christopher	University of Virginia	**
Herrera	Luis	George Mason University	**

Last Name	First Name	School	Top 100/ Scholarship
Но	Anita	Thomas Jefferson High School for Science and Technology	**
Hoon Heo	Chea	George Mason University	**
Huang	James	Woodgrove High School	*
lssing	Chris	George Mason University	**
Jenkins	Wesley	Luray High School	**
Joseph	Doreen	George Mason University	*
Kanuri	Aditya	Virginia Tech	**
Karincic	Erwin	Virginia Commonwealth University	**
Kotnana	Aneesh	Thomas Jefferson High School for Science and Technology	**
Krantz	Nicole	George Mason University	*
Kulak	Andrew	Virginia Tech	**
Ma	Wade	NVCC Alexandria	**
MacDonald	Douglas	George Mason University	*
Mah	Anthony	Virginia Tech	**
McReynolds	Jeremiah	College of William and Mary	**
McWhorter	Jason	John Tyler Community College	**
Miller	Payton	Smithfield High School	**
Mulyar	Andriy	Virginia Commonwealth University	**
Nguyen	Peter	Northern Virginia Community College	**
Nguyen	Tran	George Mason University	*
Nguyen	Catherine	George Mason University	*
Oxford	Alex	University of Virginia	*

Last Name	First Name	School	Top 100/ Scholarship
Patel	Parth	Forest Park High School	**
Raidl	Zachary	Old Dominion University	**
Ramirez	Daniela	George Mason University	*
Sanders	Antioch	Thomas Jefferson High School for Science and Technology	**
Saylor	Christian	George Mason University	**
Shay	Keily	Virginia Polytechnic Institute and State University	*
Smith	Jake	University of Virginia	**
Sparrow	Travis	University of Richmond	*
Sudol	Alec	Lake Braddock Secondary School	**
Sun	Eric	Carnegie Mellon University	**
Thumma	Apoorva	George Mason University	*
Tran	Peter	Virginia Commonwealth University	**
Tran	Michelle	Riverside High School	*
Weissman	Jonah	Charlottesville High School	**
Wiencko	Anthony	Millbrook High School	**
Windley	Nathan	Tidewater Community College	**
Winters	Mike	Boston University	**
Yang	Alexander	BASIS Independent McLean	**
Yoke	Connor	George Mason University	*
Yu	Caleb	George Mason University	**
Zamory	Steve	George Mason University	**
Zhang	Kimberly	Carnegie Mellon University	**

Strengths & Weaknesses

Strengths			
Headquarters Base	Moon Base		
Open-source intelligence	Debugging		
Cryptography	Functions		
Web application	Strings		

Weaknesses			
Headquarters Base	Moon Base		
Linux	Cryptography		
Programming	Sockets		
Binary	Files		

The above tables show that Virginia students were strongest at open-source intelligence in the Headquarters Base and debugging in the Moon Base.

The weakest topic in the Headquarters Base was forensics however, please note that weaker areas do not imply under achievement, merely that those areas provide opportunities to further develop.



Student Feedback - Previous Knowledge

A survey sent to everyone who played the CyberStart Game asked players for feedback on their previous knowledge, what they had learned, and what they enjoyed most about the program.





Example of Majors of CyberStart Participants:

- Computer science
- Computer engineering
- Cybersecurity
- Math
- IT security
- Engineering
- Physics

These charts demonstrate that most students who played the CyberStart Game in Virginia had never been exposed to a Capture the Flag style teaching method. Furthermore, 20% of students had never taken any courses in relevant cybersecurity subject areas. Knowing this, it is encouraging that 43% of players made it through to the CyberStart Game.

However, some players from Virginia did have quite a lot of experience in other relevant cybersecurity subject areas - in particular computer systems. One of the benefits of CyberStart is that it engaged with this group and in turn is likely to accelerate their entry into the profession and fast-track Virginia's next generation of cybersecurity experts.

It is encouraging to see that students who had no previous experience were able to engage with the tool and progress as well as students already interested in the industry and with a basic foundation of knowledge.

Student Feedback on CyberStart





The response to the tool has shown that the training and teaching in CyberStart has engaged the instinctive ways people learn and identified those who naturally think like a cybersecurity practitioner. These encouraging results reflect the enormous success of the program in engaging with a variety of ages, genders and skill level.

The students' response to the game has been exciting: 91% of students rated the game either "excellent" or "very good" with 93% saying they would recommend the program to a friend. Not a single player said it was unlikely they would recommend it to a friend.



Students in Virginia were most engaged with web attack and cryptography challenges.

Student Feedback - Career Impact





"no" to considering cybersecurity in the past are now considering further

The aim of the CyberStart program is to grow Virginia's cyber-capable workforce and promote cybersecurity as an exciting and recognized career. These graphs support our mission and present a group of young people who are now on the right path to a cybersecurity career.

Of the CyberStart participants in Virginia, 83% had previously considered a career in cybersecurity. After the program, this number increased and 97% of players are now considering further training. This is encouraging when looking at the future of cybersecurity professionals in the state.

In addition, 17% of students had never considered a career in cybersecurity before playing the CyberStart Game. After completing challenges in a variety of cybersecurity disciplines, 87% of those students are now considering further training in the area. This is an exciting program result which shows a real step change in reducing the skills gap in Virginia.



Is there anything you would like to say to the governor sponsoring the program?

"Thank you for offering this program to the students in Virginia. It has been a great learning experience so far, it has really improved my cybersecurity skills. I love the fact I can build upon my existing knowledge in programming and networking from school and apply it to solve challenging technical problems that I have never faced before. Overall, I am very impressed, this has been a fantastic experience."

Matthew Cinnamon, Forest Park High School, Grade 12

"Thank you for enabling Virginians the opportunity to not only challenge their own cyber abilities, but also give them the chance to further learn the various domains of cybersecurity. I'd very much like to serve Virginia any way possible for allowing me to participate in CyberStart."



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Thomas Gorman, Virginia Commonwealth University, College Senior



"Thank you for sponsoring this program! It is a DEFINITE NECESSITY for our future!" Jessica Billings, Virginia Highlands Community College

Thank you for taking the time to sponsor and promote the CyberStart program. I think it is fantastic to see more organizations and people supporting cybersecurity education. Cyber programs really haven't received a lot of attention until recently, despite the overwhelming need for security professionals around the nation. I would love to see more opportunities become available, especially for college students like me looking for a good challenge"

Christian Saylor, George Mason University, College Sophomore



"Thank you so much for bringing this challenge to our area. It has opened up an entire world that was previously closed to me."

Laura Garman, Briar Woods High School, Grade 11

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"Thank you!! I really appreciate what you have done for us students to gain some knowledge and fuel our brains to keep running during the summer. I hope you keep sponsoring programs such as this one, so many others will get the chance to get involved with their future careers."

Cristian Romero, Northern Virginia Community College, College Senior

"Thank you so much for giving us this opportunity. I am a student who is trying to find the correct major for my future. Having this change of practicing my skill is helping me to see (another window in cybersecurity. I hope this opportunity can be open to other states to help other students to keep going for their future."

Sharoon Reyes, Northern Virginia Community College, College Junior

"Thank you for giving me and many other individuals an opportunity to see their true potential in the field of computers and cybersecurity."

Mohammad Bahjat, Lee High School, Grade 12



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"I am so grateful that the state sponsored this program and let me do this, it was incredibly informative, and I learned so much!!! I recommend spreading word about this more, so that more people can try this out as well."

Nabil Saad, Virginia Tech, College Senior

"It's the most fun I have had learning."

Adam Wilson, Patrick Henry Community College, College Freshman

"We need more programs like this one. I wish I had had this in high school, it would have given me a much clearer direction of where I see my future. There are too few programs in high school that reward creativity while at the same time provide skills that could be used to land a well-paid position at a company"

Jordan Mays-Rowland, Virginia Commonwealth University, College Senior

"Thank you so much for this opportunity and I appreciate the initiative of making this available for the students, like me, who want and are willing to learn more."



Ialla Khalil, Northern Virginia Community College, College Junior



"I would like to take the time to thank the governor for sponsoring the program, it was a challenge that I enjoyed greatly."

Devin Woodward, George Mason University, College Sophomore

"I would like to say thank you for not only giving people the opportunity to explore the world of cyber security but also for making it a priority to educate individuals on the subject especially the day and age we live in now."

Zachary Raidl, Old Dominion University, College Junior



"I'd like to thank the governor for allowing me to have an opportunity to try a new field of work, especially as a high school senior I still need to figure out my major. This definitely helped me get on the right track."

Aria Gupta, John Champe High School, Grade 12

"Thank you. I found this program to be very helpful and I would like to see it expanded upon in the future. Please continue to dedicate resources to this program, so future students can benefit as I have."

Jason McWhorter, John Tyler Community College, Graduate



"This was amazing. Even as a 5th year computer science student I was learning new things. I especially liked how it encouraged you to do the research necessary to solve the problems: it didn't just teach you how to do everything."

Jordan Newton, George Mason University, College Senior



"Thank you for sponsoring this program. It has not only given me a glimpse of what I may face out in the field and increased my desire to learn more, but has offered hope for those that never considered cybersecurity to now pursue it as a profession. I just hope that you will continue sponsoring future programs such as this one."

Jordan Quinn, Old Dominion University, College DRHS

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"This program sparked a hidden interest of mine in cybersecurity and I'm sure it has for other students across the nation. I think that these government-provided opportunities are helping secure students with future internships, jobs, and education. That in itself is a blessing and should tell you this program is working wonderfully"

Peter Hadeed, Germanna Community College, College Sophomore

"A million times THANK YOU! This program has taught me a lot about cybersecurity and got rid of the thoughts that cybersecurity was impossible to learn. The program is obviously worth the money because I learned so much that I have not learned in my college IT classes."

Mariana, Northern Virginia Community College, College Sophomore

"Yes, decode the following: Bhwc: Ejraop ikna ej Inkcnwio hega pdeo pk whhks opqzajpo pk bqnpdan wzrwjya pdaioahrao ej Yuxanoayqnepu"



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