Crack the Code

Gr. 5-7 Activity Write Up

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Crack the Code

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About Actua

Actua is Canada’s leading science, technology, engineering and mathematics (STEM) youth outreach network, representing a growing network of over 40 universities and colleges across the country. Each year 350,000 young Canadians in over 500 communities nationwide are inspired through hands-on educational workshops, camps and community outreach initiatives. Actua focuses on the engagement of underrepresented youth through specialized programs for Indigenous youth, girls and young women, at-risk youth and youth living in Northern and remote communities. For more information, please visit us online at www.actua.ca and on social media: Twitter, Facebook, Instagram and YouTube!

Crack the Code

Activity Summary

In this activity, participants will learn about cryptography and how to select devices and online services that protect their data through good encryption and decryption practices. Participants will also learn about how to create strong and memorable passwords.

This activity is part of a series in the cyber smart education suite which includes; Digital Citizenship and You, Being Online, Web Detective, Netiquette, Crack the Code and Secure the Network. Explore Actua's Cyber Smart Educator Handbook to learn how you can bring cyber smart education into your teaching context.

Developed by Actua, 2021.

Delivery Environment	Activity Duration	Intended Audience	Tech
In-Person	1 hour	Grades 5-7 *(Ages 10-13)*	Certain activities will require a laptop/tablet. With modifications, it is possible to run this entire lesson in pairs/groups. **Facilitators should have access to a laptop, projector, speakers, and a screen or blank wall to project onto.** • Projector • Speaker • Screen/Blank Wall • Laptops/Tablets

Learning Outcomes

Following this activity participants will:

- Understand the role of cryptography in privacy management.
- Use and share key strategies to create strong, unique passwords and other strategies to keep personal data secure.

TOOLSETS	SKILLSETS	MINDSETS
Knowledge, resources, and experiences • Cryptography • Encryption • Decryption • Strong, unique passwords	**Digital skills, STEM skills, & essential employability and life skills** • Being safe and responsible online • Numeracy • Critical thinking • Analysis • Problem solving	**Digital intelligence, community action, and computational thinking** • Privacy management • Logical thinking • Computer literacy

Logistics (Timing, Group Sizing, Materials)

Section Title	Est. Time	Group Size	Materials
Opening Hook	10 minutes	*Whole Group*	**Facilitator** • Board & Board Marker **Per Participant** • Paper & Writing Utensil
Section 1: Decrypting the	20 minutes	*Whole Group*	**Facilitator** • The Caesar cipher | Jou...

Section Title	Est. Time	Group Size	Materials
Secret Codes			• Crack the Code Slide Deck **Per Participant** • Paper & Writing Utensil
Section 2: Password Creation	20 minutes	*Individual*	**Facilitator** • #WorldPasswordDay TikTok • Teach Students About I... • Board & Board Marker **Per Participant** • Paper & Writing Utensil
Reflection & Debrief	10 minutes	*Whole Group*	**Facilitator** • Code Breakers Of Bletc...

Safety Considerations

Safety considerations have been provided below to support safety during this activity, however they are not necessarily comprehensive. It is important that you review the activity and your delivery environment to determine any additional safety considerations that you should be implementing for the delivery of these activities.

Emotional Safety

The goal of this Cyber Smart project is to equip participants with the tools and knowledge to understand online behaviours and make safe decisions.

- Facilitators should understand that participants have different lived experiences and prior knowledge about cyber safety, cyber security, and digital citizenship. This activity may involve or lead to discussions of sensitive topics, such as cyberbullying and other online risks. Facilitators should always keep the participants' emotional safety in mind in these discussions, and defer to training from their institution and training received for this project.

- Facilitators should focus on guiding discussions toward an appreciation for healthy and safe online behaviours, and empowering participants to make responsible, informed and smart choices.

Online Safety

Some components of this activity require the use of devices connected to the internet.

- Facilitators should review the provided videos and read/explore provided websites and materials to determine if they are suitable for your participants.
- Where applicable, facilitators should remind participants to stay on task and only use links provided within this activity.
- Facilitators should also model and encourage appropriate online behaviour by all participants in the group (e.g., using chat boxes to answer and ask questions, using positive and encouraging language, using devices for the purpose of the task).

Curriculum Links

Each of these activities align with these components found in the Pan-Canadian K-12 Computer Science Education Framework:

Cyber Security

- Starting learners should be able to define cybersecurity and create safe passwords using effective criteria. Proficient learners should be able to describe common cyber attacks and identify malicious content, apply prevention practices and assess the role that people play in creating, preventing, and minimizing the impacts of cyberattacks as well as consider how they affect people and society (p. 24).

Data: Data Governance

- Starting learners should be able to identify ways that their digital or physical activity creates digital data and learn how to adjust privacy settings on commonly used digital tools. Proficient learners should be able to discover

who owns the digital data they produce, as well as assess provincial, national and Indigenous data governance laws/agreements and be able to advocate for their data rights and the rights of others (p. 26).

Technology and Society: Ethics, Safety & the Law

- Starting learners should be able to identify strategies to protect their personal data and identity online. Proficient learners should be able to define and apply basic copywriter principles, explain privacy concerns, and assess the effects of computer crime/hacking on self and society (p. 28).

Activity Procedure

To Do in Advance

Section	Preparation

General	• **Think ahead and be ready to adapt:**
	  ◦ Determine your **delivery method** and leverage ideas from the delivery recommendations and adaptations sections.
	  ◦ While **estimated times** are provided, it will be helpful to think about how much time you would like to spend on different activities and discussions.
	  ◦ While **group sizes** (individual, pairs, groups) are suggested, many activities are flexible for whatever will work in your classroom.
	• **Prepare for the content:**
	  ◦ Have **answers in mind** to share with participants for the various reflection questions asked.
	  ◦ Examine the provided videos and read/explore the provided materials in *Appendix C* to determine if they are **suitable** for your participants.

Section	Preparation

	• **Equipment:**
	  ◦ Ensure device, screen and projector are set up.
	  ◦ Prepare participant devices.

Opening Hook	• Write the message on the board.
Section 1: Decrypting the Secret Codes	• Familiarize yourself with encrypting and decrypting. Try out each of the challenges (especially challenge 1): Crack the Code Slide Deck.
Section 2: Password Creation	• Practice the password creation sequence in step 5.

Opening Hook

1. Write the following message on the board: Protect Your Privacy.
2. Give each participant a pencil and paper to figure out a way to "encode" the message. The idea is that the meaning stays the same, but it has a completely different look that nobody but the person who encrypted the message would be able to understand.
    a. ***Note:*** It may be useful for participants to keep a key to remember what each change is. Some ideas may be to use different symbols, emojis, numbers, or letters.
3. Let them know this is an example of encryption (the art of writing codes). Decryption is the art of solving codes, sometimes referred to as "code cracking/breaking". They will play more with both in the next activity.

Section 1: Decrypting the Secret Codes

1. **"What kind of information would you want to keep a secret (keep private) on the internet?"**

    a. *Possible responses:* passwords (e.g., device lock screen, social media, gaming), family photos, conversations with friends, school, work, location of your vacation home, where you like to shop, your health conditions, etc.
        i. Any kind of personal information, especially data that identifies you, should be kept private - name, age, email address, phone number, photographs of you.
2. Let participants know they will be decrypting messages with the Caesar Cipher. Play this video for participants:

   The Caesar cipher | Journey into cryptography | Computer Science | Khan ...

   (Khan Academy, 0:00-**1:03s**)
3. Facilitate the Crack the Code Slide Deck (see *Speaker Notes* for more information). Give participants a paper and pencil for Challenge 1 - if they need something more challenging, look into the next challenges.
    a. Participants just played with the process of encryption and decryption. The idea here is that messages that are harder to decrypt are better for protecting private information and sensitive data. This is similar to how accounts with passwords that are created to be strong and unique are harder to hack into.

Section 2: Password Creation

The process of encryption (as done in the activity above) is a simple step that creates extra protection for your password while it sits in a server and zooms across the internet. It essentially scrambles your password so it's unreadable and/or unusable by hackers. Encryption is one form of protection, but having a strong password is equally important.

1. Play this #WorldPasswordDay TikTok (OnlineKyne, 0:30s) created by Kyne Santos to show the math behind why this is important.
2. Consider some of the questions below to use as discussion prompts:
    a. **“Why do we have passwords?”**

i. *Possible responses:* to help protect our personal information, to keep others from accessing our stuff, to stop strangers from logging onto our games online, to protect our identity because it verifies who we are online, to keep people out of our systems (e.g., Xbox or home Wi-Fi).

ii. ***Note:*** As a prompt for participants who might not know what passwords are/have no experience with passwords, you can make a connection to locks (e.g., locks for bikes or diaries) and why locks are useful. Connections to strong passwords can include; ensuring that you have a different key to each lock you use, or for combination locks, not always using the same code or having a lock with a longer combination.

b. **"What kind of accounts do you have/might have in the future that need passwords?"**

i. *Possible responses:* school emails, email account, online bank accounts, gaming accounts, Facebook, Instagram, Snapchat, TikTok, devices (your phone and laptop/computer should also be password protected).

c. **"Why is it important to create strong, unique passwords or authentication features?"**

i. E.g., authentication features: fingerprint reader, face ID, PIN login, pattern login.

3. Start a brainstorm on the board with the answers to participants' responses to: **"What methods can be used to create strong passwords and keep our information secure?"** (see Background Information in Appendix B for more information).
4. Play this video for participants:
   Teach Students About Internet Safety and Privacy (Google for Education, 4:00s). Ask if participants have other strategies they'd like to add to the list.
5. Go through this sequence of password steps one-by-one with the class as an example of how to turn a weak password into a strong password (the word chosen is just a random word). Write them out on a board. Ask them what

changes were made to the final password edit to make it the strongest version.

   a. **treasure (*Note*: This is the weak, starting password)**
   b. Treasure **chest filled with gold** (+ make it into a phrase)
   c. **T**reasure**C**hestfilledwith**G**old (+ strategically assign uppercase letters)
   d. TCfwG (+ create an abbreviation - only keep the first letter of every word)
   e. TCfwG**01**d (+ add number(s) using a method that you will remember)
   f. TCfw*****G01d***** (+ add symbols(s) using a method that you will remember)

6. Have participants try! Give them a paper, pencil and random word and have them create a strong password out of it by using the steps done in the previous step (e.g., turning it into a phrase, mixing upper and lower case letters, adding symbols, etc.)
   a. Examples: star, tree, math - how might each be made stronger?

Reflection & Debrief

1. **"What are important reminders for ourselves, other participants and our families to keep passwords secure?"**
   a. *Possible responses: have different passwords for all accounts, log off of websites when you're done using it, never share your password or write it down, use a password keeper tool, etc.*
2. **Career Connection:** Play video Code Breakers Of Bletchley Park (CBS, *0:00-**1:09s**). This video highlights the critical role women played during World War 2 as well as in this field in general.
3. Encourage participants to be a Cyber Smart Ambassador and share their learnings from this activity with their friends and family.

Delivery Recommendations

How might you deliver this content in different settings? Every activity has been designed for in-person delivery. Here, we provide recommendations for remote learning (online) or unplugged (no tech).

Remote (Online)	Unplugged (Low/No Tech)
General	
• Encourage participants to unmute themselves or type in the chat based on what is easiest for them to communicate. • Leverage a tool where participants can all participate online during discussion (e.g., Mentimeter, Jamboard, etc). • Make note of any links that need to be shared and be prepared to share them in the chat. • Use polls or other group interactions to check in and keep up engagement.	• Leverage boards to do brain storms/write down participant responses.
Opening Hook	
• Enlarge the encoded message on the screen.	• Teach about encryption and decryption with Lemon Secret Writing: https://www.spymuseum.org/education-programs/educators/lesson-plans-activities/

Remote (Online)	Unplugged (Low/No Tech)
Section 1: Decrypting the Secret Codes	
• Use the laser pointer option when facilitating the slide deck. • Activity can be done as-is online. For brainstorming, consider doing a verbal discussion or use a collaborative tool (e.g., Jamboard, Google Doc, Mentimeter).	• Instead of using the slide deck, write out an example on the board. On a large paper pad, write out the challenges for participants (*see slide deck*).
Section 2: Password Creation	
• Use break out rooms; have participants do tasks individually and share their made up password phrases in the chat to see whose is the strongest.	• Do the "test your password" game: participants will take steps based on a statement called out about password protection: https://curriculum.code.org/csf-19/coursec/2/#powerful-passwords4
Reflection & Debrief	
• Activity can be done as-is online. For brainstorming, consider doing a verbal discussion or use a collaborative tool (e.g., Jamboard, Google Doc, Mentimeter).	• Activity can be done as-is unplugged.

Delivery Adaptations

How might you adapt the time, space, materials, group sizes, or instructions to make this activity more approachable or more challenging? **Modifications** are ways to make the activity more accessible, **extensions** are ways to make the activity last longer or more challenging.

Modifications

GENERAL

- Ensure captions are on during videos played.
- Provide computer mouses where laptops are in use.
- Use pairs/groups instead of having participants work individually.

SECTION 1: DECRYPTING THE SECRET CODES

- Only focus on challenges 1-2 in the slides.
- Provide participants with partial solutions to their given codes to help guide them.
- Provide participants with additional time to decipher their message.
- Have students work in groups and give each group a print out of the alphabet.

Extensions

SECTION 1: DECRYPTING THE SECRET CODES

- Participants can use this "Simple Encryption" activity created for Hour of Code.

SECTION 2: PASSWORD CREATION

- Have participants evaluate their personal passwords using the Government of Canada's Evaluation.
    - As a follow up question, you can ask participants to share how they will improve their passwords after using this evaluation.
- Test your password game (call out statements about password protection and take steps based on each statement).

- Play the password cracking challenge on Nova Lab's Cyber Lab (participants will need to complete the first virus attack challenge before being able to choose the password cracking challenge which will discuss hacking using guessing and brute force).
    - ***Note:*** Works best with Google Chrome.

REFLECTION & DEBRIEF

- Participants can create a Canva Poster to share strategies with their friends and families on what cyber smart steps we can take when interacting with new users online. Share this link with them https://www.canva.com/posters/templates/campaign/. It will be helpful to explore Canva to get an idea of how to use this resource yourself.
    - Quickly show them how to create a new project and the different editing features they can use. If helpful, choose a suitable Canva template rather than have them find one themselves/have them draw it out.
    - Participants can draw their creations on paper rather than on Canva.
    - If time permits, have participants share their work.

References & Gratitude

Binance Academy. (2020, December). *History of Cryptography*. https://academy.binance.com/en/articles/history-of-cryptography

Betterteam. (2019, May 16). *Mathematician Job Description*. https://www.betterteam.com/mathematician-job-description

CBS. (2008, December 8). *Code Breakers Of Bletchley Park* [Video file]. https://www.youtube.com/watch?v=2458QZmNxRY

Cisco. (n.d.) *What is Multi-Factor Authentication?* https://www.cisco.com/c/en/us/products/security/what-is-multi-factor-authentication.html

Cyber Security Jobs. (n.d.) *Cryptographer Jobs & Careers*. https://www.cybersecurityjobs.net/cryptographer-jobs/

Google. (n.d.) *Create a strong password & a more secure account*. https://support.google.com/accounts/answer/32040?hl=en#zippy=%2Cmake-your-password-longer-more-memorable

Google for Education. (2017, June 25). *Teach Students About Internet Safety and Privacy* [Video file]. https://www.youtube.com/watch?v=25G4tLVH1JE&t=2s

Government of Canada. (2020, January 15). *How strong is your password? Five ways to evaluate*. https://www.getcybersafe.gc.ca/en/blogs/how-strong-your-password-five-ways-evaluate

Government of Canada. (2020, March 2). *Passphrases, passwords and PINs*. https://www.getcybersafe.gc.ca/en/secure-your-accounts/passphrases-passwords-and-pins

Khan Academy. (2012, March 27). *The Caesar cipher | Journey into cryptography | Computer Science | Khan Academy* [Video file]. https://www.youtube.com/watch?v=sMOZf4GN3oc

MinuteVideos. (2017, January 30). *Cryptography and privacy. An easy explanation on how to create a key for encryption* [Video file]. https://www.youtube.com/watch?v=MU1Scwxc_RU

National Institute of Standards and Technology. (2019, December 9). *Back to basics: Multi-factor authentication (MFA)*. https://www.nist.gov/itl/applied-cybersecurity/tig/back-basics-multi-factor-authentication

Nord. (2020). *Top 200 most common passwords of the year 2020*. https://nordpass.com/most-common-passwords-list/

OnlineKyne. (2021, May 6). *#WorldPasswordDay* [Video file]. https://www.tiktok.com/foryou?is_copy_url=1&is_from_webapp=v1&item_id=6959281467310624006#/@onlinekyne/video/6959281467310624006

The Canadian Encyclopedia. (2018, July 16). *Cree Code Talkers*. https://www.thecanadianencyclopedia.ca/en/article/cree-code-talkers
University of Ottawa. (2020). *The Importance of passwords*. https://it.uottawa.ca/security/identity-authentication-theft

Appendices

Appendix A: Career & Mentor Connections

ROYAL CANADIAN MOUNTED POLICE: CYBERCRIME INTELLIGENCE ANALYST

- A cybercrime intelligence analyst specializes in cybercrime, and uses that knowledge to develop strategies to identify criminal trends and patterns. They use this information to design strategic intelligence products, and provide expert advice on complex criminal investigations.

CYBER SECURITY PROFESSIONAL (INFORMATION SECURITY PROFESSIONAL)

- A cyber security professional identifies threats and vulnerabilities in various systems and softwares. They apply their knowledge to design security measures and implement solutions to defend against cybercrime, such as hacking and malware. These measures come in the form of technology and organizational processes.

CYBER SECURITY ANALYST (INFORMATION SECURITY ANALYST)

- A cyber security analyst monitors a company's computer networks and systems. In order to further protect the company from threats and breaches, they plan and implement security measures.

CRYPTOGRAPHER

- A cryptographer develops security systems using algorithms and ciphers to encrypt data. They ensure that important and sensitive data (e.g., financial, personal, business, etc.) is safe from unwelcomed eyes.

CRYPTANALYST

- A cryptanalyst analyzes and decrypts information in cipher texts and encrypted data (think of them as the opposite role of a cryptographer).

MATHEMATICIAN

- A mathematician supports organizations by using mathematical theories and techniques (e.g., collecting, analyzing and presenting data) to solve practical problems in various fields, like engineering, science, business and government.

Appendix B: Background Information

CRYPTOGRAPHY

Cryptography is the process of taking text written in regular everyday language and converting it into a secure code that can only be unlocked by someone it is meant for. In the modern world there are many ways to do this, most of which involve complex mathematical formulas. Cryptography is concerned with the entire process of secure communications and is the larger system that includes the smaller subsystems of encryption and decryption.

Some Historical Uses of Cryptography

- Egypt (3,900 years ago): Symbol replacement (the most basic form of cryptography) appears in ancient Egyptian and Mesopotamian writings. The earliest known example of this was found in the tomb of an Egyptian noble.
- Ancient India & Greek City-State of Sparta (later periods of antiquity): cryptography widely used to protect important military information
- Romans: creation and use of the Caesar Cipher - the most advanced cryptography in the ancient world
- American Military (as late as WWII): Thomas Jefferson in the 1790s invented the cipher wheel, a concept so advanced it was leveraged for American military cryptography until as late as WWII. Code talkers were employed by the military (WWI & WWII) to create an encryption system using words and phrases from Indigenous languages. These Indigenous soldiers used their knowledge of their native languages to encrypt and decrypt sensitive information during wartime.

ENCRYPTION/DECRYPTION

Encryption for the purposes of this activity means to encode a message so that it is unreadable to everyone except for who it is meant for. Decryption is the action of actually decoding that message so that it is readable. There are many different types of encryption, most of which use complex mathematical formulas to protect data. In this project we will be looking at two simple ciphers as a method of encryption. To learn more about what encryption is visit: https://www.w3schools.in/cyber-security/modern-encryption/

Caesar Cipher

The Caesar Cipher, named after Julius Caesar, is the simplest form of encryption.

1. *Encrypting* a message involves taking a message along with a key and shifting the characters over right in the alphabet by the number indicated by the key.
2. To *decrypt* the message, you use the key again and shift the characters left instead.

For Example: Our message is the word “JIM”.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T

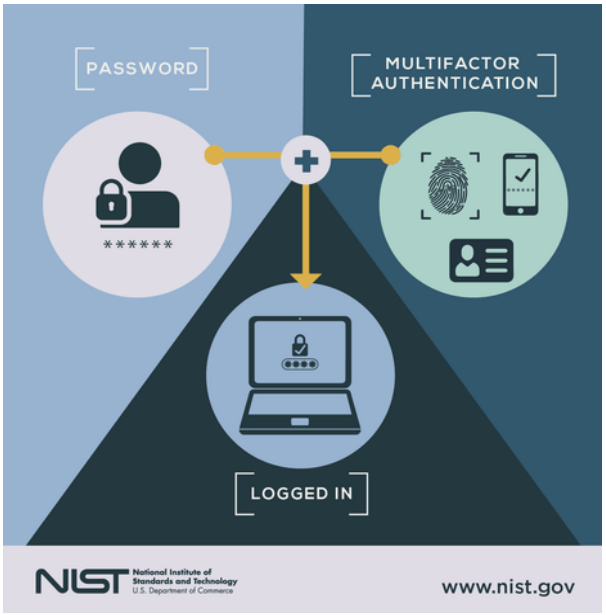
Now let’s say we want to encrypt that message with a key of 3. The characters in our code would shift right three spots like this:

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T

The encrypted message is now “MLP”:

- “J” shifted three spots over right to “M”,
- “I” moves three spots to the right to “L”
- “M” shifts three spots to the right to “P”.

If instead you were given “MLP” with the Key: 3 then you would do the opposite and shift the characters three spots left in the alphabet. To learn more visit: Caesar Cipher



GOOD PRACTICES FOR STRONG PASSWORDS

- **Computer Science Connection:** Something that complements the strength of passwords is the emergence of biometric data (face, fingerprint, voice and now DNA).
- Use a unique password for every account.
- The longer the password, the better (phrase based passwords).
- At least 8 characters long, including lowercase and uppercase letters, numbers and symbols.
- Do not use personal information (e.g., birthdates, name, address).
- Always log off/sign out when leaving a site, especially when using public Wi-Fi or shared devices.
- Avoid entering passwords when connected to unsecured Wi-Fi connections (e.g., coffee shop Wi-Fi).
- Never tell anyone your password or write your password down.
- Avoid allowing your internet browser to “remember your passwords”.
- Make sure nobody is watching when you type in your password.
- Enable 2-factor (or even better, multi-factor) authentication.

MULTI-FACTOR AUTHENTICATION

This is a security process that asks for more than one factor of authentication from: something you know, something you are, and something you have.

- Something you know could be a password or access code.
- Something you are could be a biometric like a fingerprint or voice print.

- Something you have could be a phone or token.

Some examples could be:

- When logging into an email on a new device, you will need to have the password (something you know) and you will receive a prompt on your phone with a special code (your phone is something you have).
- When entering a secure building you may need an access code (something you know) and a security badge (something you have).
- To open your device you may need your fingerprint (something you are) and your password (something you know).

Appendix C: Additional Resources

SECTION 1: DECRYPTING THE SECRET CODES

Activity Slide Deck(s)

- Crack the Code Slide Deck

Video(s)

- The Caesar cipher | Journey into cryptography | Computer Science | Khan ... (Khan Academy, 0:00-1:03s)

SECTION 2: PASSWORD CREATION

Video(s)

- #WorldPasswordDay TikTok (OnlineKyne, 0:30s)
- Teach Students About Internet Safety and Privacy (Google for Education, 4:00s)

REFLECTION & DEBRIEF

Video(s)

- Code Breakers Of Bletchley Park (CBS, *0:00-1:09s)