



PROUD PARTNER

### Grade 3-5 STEM Challenge

# Code Makers, Code Breakers

Inspired by Barry, an Information Assurance Analyst in the Indiana Uplands.



Published by Regional Opportunity Initiatives

### GRADE 3-5 STEM CHALLENGE

### **Code** Makers, **Code Breakers**

Inspired by Barry, an Information Assurance Analyst in the Indiana Uplands.

Students will explore how computers communicate using binary code. They will then encode and decode a message.



#### **LESSON TIMELINE**

DAY 60 minutes

- Show the inspiration video, "Barry- Information Assurance Analyst"
- Binary code demonstration
- Encode a secret message

#### DAY 60 minutes

- - Decode a secret message Cybersecurity vocabulary

  - Reflection

#### **Recommended Supplies**

For Binary Code Demonstration:

1 set of Binary Number Cards (included)

For Encode/Decode Activity:

- Student message pages (1 page per student pair)
- Scissors
- Cybersecurity Student Log (1 per student)

#### CAREER CONNECTION AND LESSON OVERVIEW

Barry is an information assurance analyst for TRISTAR Engineering, a defense contractor in southern Indiana. Barry's job is to keep sensitive data secure by protecting computer networks and systems. His role at TRISTAR is especially important because the information he protects belongs to the United States military. He designs systems to allow data to be accurately recorded, safely stored, and also readily accessible for the intended users.

Information security and cybersecurity professionals like Barry work to protect many different kinds of data, including banking information, health records, and people's personal information. Barry started his cybersecurity career with an associate's degree in computer networking and then earned a bachelor's degree in technology management. From there, he joined the Air Force before working for TRISTAR.



### IN THIS CHALLENGE, STUDENTS WILL:

- Explore how computers use binary code to communicate information.
- Encode and decode messages that include key cybersecurity terms and concepts using binary code.
- Survey cybersecurity as a high opportunity career field in the Indiana Uplands.

### **Standards**

#### Science & Engineering Process Standards

SEPS.5 Using mathematics and computational thinking SEPS.8 Obtaining, evaluating, and communicating information

#### English/Language Arts

3.RV.1 Build and use accurately conversational, general academic, and content-specific words and phrases.

4.RV.1 Build and use accurately general academic and content-specific words and phrases.

5.RV.1 Build and use accurately general academic and content-specific words and phrases.

#### **Computer Science Standards**

3-5.DI.2 Demonstrate how a string of bits can be used to represent alphanumeric information and how 1's and 0's represent information.3-5.DI.5 Understand the connection between computer science and other fields.

3-5.IC.2 Identify impact of technology on personal life and society.

#### **Mathematics Process Standards**

PS.1 Make sense of problems and persevere in solving them

#### Employability Skills Standards

3-5.WE.4 Complete tasks or activities with prompting and guidance from adult educators.

3-5.WE.5 Demonstrate perseverance to complete tasks and activities.

3-5.LS.2 Communicate with others by applying a variety of speaking skills.

3-5.LS.3 Communicate with others using a variety of technology.
3-5.LS.4 Relate personal interests, abilities, and leisure time activities to possible occupational choices without stereotyping.
3-5.LS.13 Utilize effective questioning and brainstorming techniques.

2

# Planning and Implementation code makers, code breakers

#### **Essential Vocabulary**

- CYBERSECURITY: Protecting computers and computer systems against unauthorized access or attack.
- DATA: facts or figures, or information that is stored in or used by a computer
- BINARY NUMBER SYSTEM: A system in which information can be expressed by combinations of the digits O and 1.
- BIT: The smallest unit of data in a computer. A binary digit (either 1 or 0).
- BYTE: A series of eight bits (binary digits, either 1 or 0).
- ENCODE: The process of converting information or data into a code, especially to protect it from unauthorized access.
- DECODE: To convert a coded message into an easily understood format.

#### In this challenge, students will:

- View the job shadow video "Barry -Information Assurance Analyst," available at https://regionalopportunityinc.org/bar ry/.
- Explore how computers use binary code to communicate information.
- Encode and decode messages that include key cybersecurity terms and concepts using binary code.
- Survey cybersecurity as a high opportunity career field in the Indiana Uplands.

#### Day 1

#### Introduction (15 minutes):

Introduce the field of cybersecurity. Ask if any students have heard the word "cybersecurity" before. Explain that cybersecurity is protecting computers and computer systems against unauthorized access or attack. It might help to compare it to having a secret or a surprise that you only want certain people to know about. If there are security measures in place in your school building, make connections between these and how cybersecurity experts protect information from people who don't have permission to see or use it. Either project the Information Assurance Analyst Career Profile or give a copy to each student. Here they can read more about working in cybersecurity as an information assurance analyst and the education and skills needed to keep data safe. Pose the question, "What types of organizations might want to keep information private? What kind of information would people want to keep secret or safe?" Start a list with the class.

Show "Barry-Information Assurance Analyst" (3:10), available at https://regionalopportunityinc.org/barry/.



How Do Computers Store Information? (25 minutes) In the video, the students heard that knowing how computers store information and communicate is a very important part of a career in cybersecurity. Computers save data through a series of electric switches. These switches are not very complex and can only exist in two states: on and off. The patterns of on and off are represented with the numbers 1 and 0. This system is called the binary number system. Learn more about the binary number system and how computers communicate by watching the video <u>How</u> <u>Computers Work: Binary & Data</u> on the CODE.org YouTube channel.

To further illustrate this concept with your class, select four students to come to the front of the class. Hand each one of them a number card (provided at the end of this lesson plan, pages S7-S9). Have each student hold their card in front of them with the number showing.

- Each student represents a computer switch.
- To indicate that the switch is OFF, the student should turn his or her back to the class.
- To indicate that the switch is ON, the student should face the class.



You, the teacher, will be the programmer.

- You will write a sequence of bits (1's and 0's) on the board
- The students in the front will turn either on or off. Help the students in the front decide if they should be ON or OFF.
- The students in the class will figure out what number you have programmed. To ensure all students have enough thinking time, prompt students to record the answer and reveal them all at once.

Programmer writes:	Student 1 (card 1)	Student 2 (card 2)	Student 3 (card 3)	Student 4 (card 4)	Answer
0010	<b>0</b> (off)	<b>0</b> (off)	<b>1</b> (on)	<b>0</b> (off)	2
1001	<b>1</b> (on)	<b>0</b> (off)	<b>0</b> (off)	<b>1</b> (on)	9
0110	<b>0</b> (off)	<b>1</b> (on)	<b>1</b> (on)	<b>0</b> (off)	6
0101	<b>0</b> (off)	<b>1</b> (on)	<b>0</b> (off)	<b>1</b> (on)	5
1111	<b>1</b> (on)	<b>1</b> (on)	<b>1</b> (on)	<b>1</b> (on)	15

#### Encode (20 minutes)

Cybersecurity experts use encoding to put private information into a code to preserve and protect it. Encoding allows authorized people to have access to the information by using a key to decode it. Encoding usually uses a known code, like binary. Encryption is similar, but requires a secret key to decode. This added step keeps unauthorized people from having access to important information.

### **Binary Decoder Key**

Α	N	
В	0	
C	Р	
D	Q	
E	R	
F	S	
G	Т	
Н	U	
	V	
J	W	
K	Х	
L	Y	
М	Z	

Photo courtesy of S&S Blog

Students will now use the Binary Decoder Key to encrypt a message.

- Students will work with a partner for this activity.
- Provide each pair of students with a message page and the Binary Decoder Key. Four message pages are provided. Some groups will have the same message.
  - A filled-in square symbolizes a binary '1' or a wire that is turned ON.
  - An outlined square symbolizes a binary '0' or a wire that is turned OFF.
- Students should work in a space where other groups can not see the message they are encrypting. When each pair is finished with the encoding activity, have them cut along the dotted line to separate the code from the message. The message should then be put away (in a folder, desk, etc.)

6

#### Day 2

#### Decoding (20 minutes)

To begin the decoding activity, each pair of students should trade their encoded message with another group.

- Each message has an icon on it (star, moon, sun, or puzzle piece). If students trade with a group that has a different icon, they will receive a new message to decode.
- Student pairs will use the Binary Decoder Key to decode the message and record it on the Cybersecurity Student Log.
  - Each letter is represented by eight bits (eight squares).
  - Each letter is separated by a larger space.
  - A black, vertical line indicates the end of a word.
- When student pairs have finished decoding their message, bring the class back together.
  - Have students check their decoding skills by matching the icons on the separated message pages.

#### Cybersecurity Terms (20 minutes)

There was a lot of new vocabulary in these activities! To reflect on the new terms, students will complete a short vocabulary activity. Students can work in pairs or individually.

- Either prompt students to choose one of the vocabulary terms on their Cybersecurity Student Log or assign a word to each student or group (all terms should be represented).
- Students will write a definition of their term in their own words and then create an illustration that represents that term.
- When students are finished, ask for volunteers to share their work (at least one volunteer per term).



#### **Reflection (20 minutes)**

Students will fill out the reflection section at the end of the Cybersecurity Log. Students will reflect on the following questions:

- What is something new you learned during this challenge?
- What more do you want to know about computer science or cybersecurity?

Have each student share with a classmate what was challenging about this activity and what they learned.

#### **Career Exploration and Extension**

Prompt students to think about and research what a career as an information assurance analyst or cybersecurity specialist might entail.

- What does someone in this career field do all day?
- What kind of training would a student need to have a job like Barry's? Training can include high school classes, short training programs after high school, 2-year college degrees, and 4-year college degrees.



### **Cybersecurity Log**

#### Part 1: How Do Computers Save Information? Encoding & Decoding Using Binary Numbers

Computers save information through a series of electric switches. The switches are not very complex and can only communicate by turning on and off. The patterns of on and off are represented with the numbers 1 and 0. This system is called the binary number system.

Use the Binary Decoder Key to encode your assigned message.

- A filled-in square symbolizes a binary '1' or a switch that is turned ON.
- An outlined square symbolizes a binary '0' or a switch that is turned OFF.

Α	N	
В	0	
С	Р	
D	Q	
E	R	
F	S	
G	Т	
Н	U	
I	V	
J	W	
K	Х	
L	Y	
M	Z	

#### **Binary Decoder Key**

After you have traded encoded messages with another group, use the Binary Decoder Key to decode the message. Record your new message below:

Photo courtesy of S&S Blog



Name:

#### Part 2: Cybersecurity Terms

Whew! That was a lot of new vocabulary! Circle one of the new words.

cybersecurity	bit	decode
binary number system	byte	encode

Write a definition of the term you chose above in your own words.

\_\_\_\_\_

\_\_\_\_\_

Draw a picture or diagram explaining the term below:

#### Part 3: Reflection

What is something new you learned during this challenge?

What more do you want to know about computer science or cybersecurity?



You nau a uata preacn

## Student Message 2

Your da	ta is safe	
		Λ
		$\smile$



cybersecurity expert	



computer programmer			
			202

















### ACKNOWLEDGEMENTS

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### **IMAGE AND CONTENT CREDITS**

#### Images

Stock photography courtesy of Canva.com Still video images from Barry - Information Assurance Analyst, https://regionalopportunityinc.org/barry/ Binary Decoder Key courtesy of S&S Blog

#### Content

Activities inspired by and adapted from "CS Principles 2019-2020, Unit 1: Lesson 5: Binary Numbers," available at http://www.code.org



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