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## Teacher Guide

## Cyber City Game (Tech) – The Cyber Security Satellite Experience

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# What is Cyber City

## Summary

Cyber City is a virtual city network and environment that simulates various cyber threats and challenges organisations face. It provides a platform for cybersecurity professionals, enthusiasts, and students to learn and practice real-world cybersecurity skills and techniques in a safe and controlled environment. The Cyber City platform includes various scenarios, simulations, and challenges designed to test and enhance participants' skills in network security, cryptography, penetration testing, and incident response. It is an effective tool for preparing individuals and organisations to face and mitigate cyber threats in the real world.

## The Tech

The CyberCity network environment is simulated using MicroPython, an easy-to-learn interpreted language, and Micro:Bit microcontrollers. Microcontrollers are small computers that can be programmed through the browser. They offer audio-visual capabilities with pins for digital output and input and wireless communication. Each simulation may require additional components related to input and output, such as servo motors and various sensors.

The Suggested Learning Sequence

Here is a breakdown of the Cyber City game learning sequence that can be used by teachers in the classroom:

1. Introduce the Initial Problem: Start by presenting the initial problem of the game. Explain to the students that they are part of a team that needs to maintain the pitch of a satellite in orbit to prevent catastrophic failure, which could result in a complete shutdown of the organisation's service.
2. Teach Network Communication and Information Exchange: Teach students the importance of network communication and information exchange. Explain to them that they need to utilise the network hosted by CyberCity to query the current pitch and provide adjustment commands to maintain a nominal orbit.
3. Introduce Cybersecurity and Malicious Motivations: Teach students about cybersecurity and malicious motivations. Explain to them that various cyber criminals and rings are drawn to the possibility of financially gaining or revealing their presence from the satellite's destruction.
4. Teach Prevention of Tampering: Teach students how organisations protect their networks and communication channels. For example, explain to them that the organisation employs a cipher to encrypt the information being transmitted to prevent the criminals from understanding the data being transmitted.
5. Immersing the User: Divide students into two teams - Team A and Team B. Team A will be employed by the organisation to maintain the satellite's pitch, while Team B will be the criminal ring attempting to destroy the satellite.
6. Teach MicroPython and Micro:Bit: Teach students about MicroPython and Micro:Bit, which are used for programming microcontrollers.
7. Assign the Simulation/Narrative: Assign the simulation/narrative to the students, providing them with additional components related to input and output, such as servo motors and other various sensors.
8. Monitor Progress and Facilitate Discussions: Monitor the student's progress and facilitate discussions to ensure that they are on the right track. Encourage them to share their insights and ask questions.
9. Conduct a Debriefing Session: Conduct a debriefing session to discuss the lessons learned and the challenges encountered during the game. Encourage the students to share their experiences and insights.

By following this learning sequence, teachers can successfully deploy the Cyber City game in the classroom and help students develop their problem-solving, critical thinking, and collaboration skills.

# Cyber City Delivery

As a teacher, delivering a complex topic such as Cyber City to students can be challenging. However, by breaking it down into smaller learning sequences and using relevant questions, you can make the topic more engaging and interactive for students. This will improve their understanding and promote active participation in the learning process. In this section, we will outline how teachers can use the learning sequences and questions provided to deliver Cyber City effectively in the classroom.

Online Associate Materials: Cyber City Teacher Delivery resources

* Classroom PowerPoint
* Videos:
  + Teachers Guide\_Cyber City Tech Introduction
  + Teachers Guide - Cyber City Tech\_Intro To The Tech
  + Teachers Guide – Cyber City Tech Setup & Game 1

## Introduction to CyberCity and the Initial Problem

Educator Instruction

* Explain that CyberCity is a virtual city network and environment that simulates real-world scenarios
* Describe the initial problem: a satellite critical to the infrastructure of the city is experiencing orbit decay and requires pitch changes to maintain its orbit's integrity
* Emphasise that maintaining the satellite's orbit is essential to avoid catastrophic failure, which can result in a complete shutdown of the organisation's service that utilises the satellite, causing a major loss of revenue, business, and possibly life if the organisation's service was used in critical situations, such as a flight controller to a series of airlines
* Discuss the importance of network communication and information exchange in maintaining infrastructure and dependent infrastructure

Suggested Student Questions/Discussion

1. Why is the satellite critical to the infrastructure of the city?
2. What happens if the satellite's orbit decays?
3. How does the organisation communicate with the satellite, and why is it important to maintain its orbit?
4. What are the consequences of the organisation's service being shut down?

## Introducing the Cyber City Tech

* Explain the main system requirements, emphasising that MicroPython, an easy-to-learn interpreted language, is used for programming the microcontrollers, which are small computers that follow instructions
* Describe the Micro:Bit microcontroller as a small self-contained pre-built computer that can be flashed/programmed through the browser, offering audio-visual capabilities with the addition of pins for digital output and input, as well as wireless communication
* Discuss that each simulation/narrative may require additional components related to input and output, such as servo motors and other various sensors.

*Refer to teacher and student video resources*

*Student/classroom exercises*

* *Install Thonny IDE*
* *Connect Micro:Bit V2*
* *Upload Cyber City Software*
* *Students fly satellite in an offline environment: Team A\_Offline\_Satellite*

## Malicious Motivations

* Explain that cybercriminals and rings are drawn to the possibility of financially gaining or revealing their presence from the satellite's destruction
* Describe how these cybercriminals can infiltrate the organisation's network to gain remote access to the data being transmitted between the network controller and satellite
* Emphasise that by intercepting/sniffing the packet/data transmitted. They can attempt to destroy the satellite with the data and information they know
* Discuss the need for cybersecurity to prevent threats and the methodology for causing a failure, exposing both sides of cybersecurity

Suggested Student Questions/Discussion

* *What are some examples of cyber threats and attacks?*
* *Why do cybercriminals attempt to destroy the satellite?*
* *How do cybercriminals infiltrate the organisation's network?*
* *What is "sniffing," and how does it work?*
* *Why do cybercriminals send a command ordering the satellite to pitch up repeatedly?*
* *How does the destruction of the satellite impact the organisation's service?*

*Student/classroom exercises*

* *Teacher to fly satellite: TeamA\_Unencrypted\_Satellite*
* *With a series of sat IDs, students are to sniff the network, locate satellites and interpret communication data*
* *Student uploads Cyber City Software to listening microbit: TeamB\_Unencrypted\_Listener*
* *Upon success of listening – students to* 
  + *Fly Satellite: Team A\_Offline\_Satellite Student/classroom exercises*

## Prevention of Tampering

* Explain that the organisation's satellite is destroyed, but luckily, they launched a backup satellite two weeks prior
* Describe how the organisation employs the use of a cipher to encrypt the information being transmitted to the backup satellite, preventing the criminals from understanding the information being transmitted as they cannot read the data being sent
* Emphasise that the software is constantly evolving, and the threat always looms, so consistently updating and improving encryption is necessary to increase the difficulty for the criminals who are actively attempting to decrypt the information being transmitted and crash the satellite

Suggested Student Questions/Discussion

* How does the organisation protect its networks and communication channels?
* Why is encryption important, and how does it work?
* What is a Caesar cipher, and how is it used to encrypt information?
* How does the organisation prevent the cybercriminals from decrypting the information being transmitted to the backup satellite?
* Why is it important to constantly update and improve encryption methods?

*Student/classroom exercises*

* *Students Fly Satellites with encryption: TeamA\_Encrypted\_Satellite*

## Immersing the User

* Divide students into two teams: Team A and Team B
* Assign Team A the task of utilising the provided infrastructure code and network controller code to send commands that maintain the pitch of the satellite
* Assign Team B the task of utilising the HackNode code to listen to the data being transmitted along with the network, making judgments on what is important and what the information means
* Explain that Team B attempts to destroy the satellite with the information they have collected, by writing a program that causes the satellite to move out of nominal orbit, by rapidly adjusting the pitch via sending the satellite commands
* Emphasise that Team A attempts to implement cipher encryption to prevent destruction and that students will make a Caesar cipher, which shifts each letter along with the alphabet a specified amount dictated by a key; A, shift 3, becomes D
* Explain that with their new cipher in place, Team B must then implement a counter cipher that decrypts the information, revealing its true form in plain text; non-encrypted, for example, writing a program that reverses the cipher

*Student/classroom exercises*

* Round 1
  + Team A fly encrypted satellite (teacher to take note of all ids): *TeamA\_Unencrypted\_Satellite*
  + *Team B to find a Satellite on the network and execute a command to override the satellite pitch:*
    - *TeamB\_Unencrypted\_Listener*
    - *TeamB\_Unencrypted\_Command*

*Team B should successfully disable the satellite.*

* *Round 2*
  + *Team A* fly encrypted satellite (teacher to take note of all ids): *TeamA\_Encrypted\_and\_Manual\_Satellite*
  + *Team B to find a Satellite on the network, decode and execute command with a ceaser cipher script to override satellite pitch:*
    - *TeamB\_Unencrypted\_Listener*
    - *TeamB\_Unencrypted\_Command*
  + Team A to change 'key' in ceaser ciper script
  + Team B to watch and try and deciper.

# Cyber City Summary

In summary, the Cyber City experience offers students the opportunity to immerse themselves in a virtual city and explore its technological systems. Through interactive simulations and real-world scenarios, students will gain a deeper understanding of how these systems are interconnected and how they impact the overall functionality and sustainability of the city.

By following the provided learning sequence and utilising the discussion questions, teachers can guide their students through a meaningful and engaging learning experience that will develop critical thinking skills, promote teamwork, and encourage curiosity about the world of technology and infrastructure. We hope that this guide has provided you with the tools and resources necessary to successfully implement Cyber City in your classroom and inspire your students to pursue their interests in Place-Making, STEM and Cyber Security fields.