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| **Lesson Title : Summarizing Network Traffic with Statistics** | **Unit #:**  **1** | **Lesson #:**  **1** | **Activity #:**  **1** |
| **Activity Title: Hacking Drones with Packets** |

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| **Estimated Lesson Duration:** | **50min** |
| **Estimated Activity Duration:** | **50min** |

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| **Setting:** | **On the school football field / In classroom** |

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| **Activity Objectives: Hook students on the concept of cybersecurity.**  **I will describe how information is transferred across the internet.** |

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| **Activity Guiding Questions:**  **How is information transferred over the internet?**  **How is WIFI connection different than Ethernet connection?**  **How can we be sure that our information is only going to the person we intend?**  **Are there ways for “Hackers” to collect or alter the information being transmitted?** |

| **Next Generation Science Standards (NGSS)** | |
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| **Science and Engineering Practices (Check all that apply)** | **Crosscutting Concepts (Check all that apply)** |
| Asking questions (for science) and defining problems (for engineering) | Patterns |
| Developing and using models | Cause and effect |
| Planning and carrying out investigations | Scale, proportion, and quantity |
| Analyzing and interpreting data | Systems and system models |
| Using mathematics and computational thinking | Energy and matter: Flows, cycles, and conservation |
| Constructing explanations (for science) and designing solutions (for engineering) | Structure and function. |
| Engaging in argument from evidence | Stability and change. |
| Obtaining, evaluating, and communicating information |  |

| **Ohio’s Learning Standards for Science (OLS)** |
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| **Expectations for Learning - Cognitive Demands (Check all that apply)** |
| Designing Technological/Engineering Solutions Using Science concepts **(T)** |
| Demonstrating Science Knowledge **(D)** |
| Interpreting and Communicating Science Concepts **(C)** |
| Recalling Accurate Science **(R)** |

| **Ohio’s Learning Standards for Math (OLS) and/or**  **Common Core State Standards -- Mathematics (CCSS)** | |
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| **Standards for Mathematical Practice (Check all that apply)** | |
| Make sense of problems and persevere in solving them | Useappropriate tools strategically |
| Reason abstractly and quantitatively | Attendto precision |
| Construct viable arguments and critique the reasoning of others | Look for and make use of structure |
| Model with mathematics | Look for and express regularity in repeated reasoning |

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| **Unit Academic Standards (NGSS, OLS and/or CCSS):**  Model how a device on a network sends a message from one device (sender) to another (receiver) while following specific rules. |

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| **Materials**:  Kali Linux Live USB Drive – Follow directions on <https://docs.kali.org/downloading/kali-linux-live-usb-install> *4GB+ Flash drive needed for this process*  Laptop with Wireless Card Capable of Switching to Monitoring Mode  -Most new laptops have this capability. If nothing shows up when you perform the airodump-ng  command, then you will need to purchase a USB wireless card. [The Panda PAU05](https://www.amazon.com/Panda-300Mbps-Wireless-USB-Adapter/dp/B00EQT0YK2/ref=sr_1_3?ie=UTF8&qid=1530626483&sr=8-3&keywords=panda+pau05&dpID=41GU9uQcYPL&preST=_SX300_QL70_&dpSrc=srch) is inexpensive  and works well.  Drone (Controlled over WIFI)  -There are several different drones that will work for this activity. The only requirement is that they must be able to be controlled by a phone over Wi-Fi. A relatively cheap and available drone that works well for this activity is the Parrot AR.Drone 2.0 |

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| **Teacher Advance Preparation:**   * The teacher must prepare a USB Drive with a bootable version of Kali Linux on it. It is advised that the teacher attempts several times before * Teachers must have fundamental knowledge of the internet and Networks. They should also be comfortable discussing Packet transfer and Protocols. A video series produced by code.org can be found at <https://www.youtube.com/playlist?list=PLzdnOPI1iJNfMRZm5DDxco3UdsFegvuB7> to prepare teachers who are unfamiliar with these concepts. |

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| **Activity Procedures:**  The day before this activity, have students write a brief reflection, answering the question: How does WIFI work?  To ensure this activity “hooks” students, it is critical that they remain unaware that the teacher is going to be “hacking” the drones. On day 1, the teacher should start class by taking students outside and telling them that they are going to be conducting an experiment to determine which sex (male or female) is “better” at flying drones. One student from each group should keep a timer, and record the time it takes for each subject to fly the drone and land it in the center circle, starting at the end zone. The instructor should allow the students to carry out the experiment for some time before opening up his or her laptop and taking over the drone with the following commands in Kali Linux:  airmon-ng start wlan0  airmon-ng check kill  airodump-ng wlan0mon   * During this step, it is important to note the ESSID (name) of the victim drone, the channel it is on and the MAC Address of the phone connected to the drone. When this information is noted, press control + c.   airmon-ng stop wlan0mon  airmon-ng start wlan0 <insert channel # of victim drone>  aireplay-ng -0 0 –e <ESSID of victim drone> -c <MAC address of connected phone> wlan0mon   * At this point, the phone will become disconnected from the drone, and the instructor will be able to connect to the drone with his or her own phone and start flying around erratically. After the group whose drone has been hacked realizes what just happened, it is critical that they do not share what has just happened with the other group.   This process should be repeated so that both groups have their drone “hacked.” After both groups understand that their drone was taken over by the teacher’s computer, the drones should be landed, and the class should move back into the classroom. This demonstration should take about one 50- minute class period.  On the next class day (Day 2), the teacher will give a brief lecture covering the concept of networks, the internet and packet transfer. At this point, the class should begin to derive the essential questions and the challenge. The teacher should use guiding questions to aim the discussion in the direction of other possible vulnerabilities within networks. Discussion should include national security and intrusion detection, as well as traffic monitoring and data analytics. At the end of the discussion, the teacher should ask students to individually write down an essential question that they have regarding cybersecurity and statistics.  The teacher should inform the class that he or she is going to take the questions home and generate a challenge for them to complete. This challenge will be presented in the final activity of this unit. |

**Formative Assessments:** Written Reflection – How does the WIFI work? (Before and After)

**Summative Assessments:** None

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| **Differentiation:** No differentiation is necessary for this activity. |

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| **Reflection:** This lesson was exciting and definitely get students interested in the unit. I was surprised at how little students knew about the Internet and computers given they grew up with access to both. The only disappointing aspect of this lesson was that many students did not learn as much as I wanted them to about packet transfer and WIFI protocol. I believe that this was partially because the class was so large, and students had a difficult time focusing. If this lesson were delivered in a smaller class, I believe it would be extremely effective. |