

**COSMOS Experiment-Digital and Analog Signals**

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| **Grade 9-12** | |  | |
| **Topic:**  **Digital and Analog Waves** | | **Materials:**   * Laptops * COSMOS Toolkit | |
| **Science & Engineering Practices (SEPs)**  Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science. - Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-PS4-3) | **Disciplinary Core Ideas (DCIs)**  Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. (HS-PS4-2),(HSPS4-5) | **Crosscutting Concepts (CCs)**  Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (HSPS4-2) Modern civilization depends on major technological systems. (HS-PS4-2),(HSPS4-5) Mathematical representations can be used to identify certain patterns. (HSPS4-6) |  |
| **New York State P-12 Science Learning Standards**  **HS-PS4-2.** Evaluate questions about the advantages of using a digital transmission and storage of information. [Clarification Statement: Examples of advantages could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft.] | | | |
| **Essential Question:**  How are digital and analog signals different? | | | |
| **Learning Target** | I can explain why digital signal is more resilient than the analog signal. | | |
| **Engage** | Students play a music file “transmitted by digital method” and also play the music file “transmitted by analog method” With the digital method, an introduction of noise may terminate the music. With analog method, an introduction of noise will make the music much less like the original music but the song still plays.  Questions: How would you describe the differences between digital music and analog music.  How are digital and analog signals different? | | |
| **Explore** | Students will receive a tray and on the tray there is a number line from zero to 9. The students place a button on the number to be sent to another faraway group. The other group will record the number that they received. Upon completion, teacher polls the numbers sent and the number recorded, and in collaboration with students review the fidelity of the communication. After the review of the first experiment, students in each group will get a sheet of paper on a tray. 1 is labeled on the top of the paper and 0 is labeled at the bottom of the paper. They will place a button on the number 0 or 1 and send the number on the tray to a faraway group of students in the room. When all teams are finished, teacher will poll the results of the students’ experiments. In concert with the students, teacher examines the results of this experiment and compares the fidelity of the analog transmission and digital transmission. | | |
| **Explain** | Students will explain that digital information is discrete values such as 0 and 1. Analog information can take on any value within a range such as [0, 1] | | |
| **Extend** | Students contemplate how digital signal affects the way people find out information. | | |
| **Evaluate** | Explain how the button activity shows that digital signal is more reliable than analog signal. | | |
| **Differentiation** | Students who demonstrated mastery of the skills will write a comparison of digital and analog signals.  Students who have troubles with the skills will continue to be involved in the whole-class sharing of how digital and analog signals differ. | | |