

**COSMOS Experiment- Waves in Internet Technology**

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| **Grade 9-12** | |  | |
| **Topic:**  Application of Waves in Technology | | **Materials:**   * Laptops * COSMOS Toolkit * Internet connection | |
| **Science & Engineering Practices (SEPs)**  Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and reliability of the claims, methods, and designs.  • Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible. (HS-PS4-4)  • Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HSPS4-5) | **Disciplinary Core Ideas (DCIs)**  [From the 3–5 grade band endpoints] Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) (HS-PS4-3) | **Crosscutting Concepts (CCs)**  Influence of Engineering, Technology, and Science on Society and the Natural World  • Modern civilization depends on major technological systems. (HS-PS4-2),(HSPS4-5)  • Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (HSPS4-2) |  |
| **New York State P-12 Science Learning Standards**  HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.\* [Clarification Statement: Examples could include Doppler effect, solar cells capturing light and converting it to electricity; medical imaging; and communications technology.] [Assessment Boundary: Assessments are limited to qualitative information. Assessments do not include band theory.] | | | |
| **Essential Question:**  How does the internet carry our messages to our intended recipients? | | | |
| **Learning Target** | I can explain how the internet is designed to facilitate communication between computers. | | |
| **Engage** | Students get to talk about their ideas of how the internet works. They also get to write down their ideas for later comparison with their exit slips. | | |
| **Explore** | In this experiment, students will send an image file to a test bed. The computers on the test bed will do some processing of the image and pass the data to different nodes on the network before sending the modified image file back to the students. After students receive the processed file from the test bed and the time stamps. Teacher and students will use a computer program to look at how information is relayed from one computer to the end-point computer. Teacher will walk the students through the ideas behind network layers:  Examples:  The application layer trusts the system of networks can send the information correctly to the final destination, so the application layer just focuses on fetching the information and sending the information off to the internet. Now the face of the internet to the application layer is the transport layer. The transport layer trusts that each network can correctly transfer information to the next network, so the transport layer is focused on whether the information is passed intact from one network to the next network.  The network layer trusts that each computer (node) can send information correctly to the next computer (node), so the network layer only focuses on how to choose the most efficient path to route the information across a network.  The data link layer trusts that the physical waves are formed correctly and just focuses on gleaning the data (bytes) from the waveforms.  The physical layer is entrusted with the task of forming the correct waveforms and converting waves correctly to bits. | | |
| **Explain** | How does abstraction make it easier to design and build the internet? Why was the internet created? | | |
| **Extend** | How does the internet work at home? | | |
| **Evaluate** | Explain how the information is sent correctly from your home to school? | | |
| **Differentiation** | Students who demonstrated mastery of the skills will write an real-life example of waves being used in internet technology.  Students who have troubles with the skill will continue to be involved in the whole-class discussion of how waves are used in the internet. | | |