

**COSMOS Experiment-Interference of Waves**

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| **Grade 9-12** |  |
| **Topic:** **Wave Phenomena** | **Materials:*** Laptops
* COSMOS Toolkit
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| **Science & Engineering Practices (SEPs)**A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. (HSPS4-3) | **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)**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-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model (quantum theory), and that for some situations one model is more useful than the other. [Clarification Statement: Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect.] [Assessment Boundary: Assessment of the photoelectric effect is limited to qualitative descriptions.]  |
| **Essential Question:** How do waves interfere?  |
| **Learning Target** | I can explain why using nearby frequencies simultaneously adversely affect communication. |
| **Engage** | A student drives a radio-controlled car from start line to finish line. Have another student drive another rc car with the same frequency. Would the car be able to reach the finish line? Explain the observations. |
| **Explore** | In this experiment, students send a large file over the wi-fi on one channel from one group to another group. Simultaneously, students send a large file on a nearby channel (nearby frequency) from third group to the fourth group. Repeat the experiment with two channels farther apart. Do this experiment with four other different groups. After data is collected, students in concert with their teacher compare the data rate of transfer under the two different conditions. |
| **Explain** | Students will explain that interference is the combination of two concurrent waves. |
| **Extend**  | How do we improve our data rate of our internet connection at home? |
| **Evaluate** | Give a few examples of wave interference. Which case will have a faster internet connection? Channels 2 and 4, or Channels 1 and 7 |
| **Differentiation** | Students who demonstrated mastery of the skills will write an real-life example of wave interference.Students who have troubles with the skill will continue to be involved in the whole-class discussion of how waves interfere. |