THE LAWRENCE HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA, BERKELEY

Lawrence Hall of Science has new instructional materials that address the Next Generation Science Standards!

Check out these Middle School Units…

As just one example, compare Middle School units from three different Hall programs. See for yourself how each program goes about addressing the Middle School NGSS Physical Science Standards, and choose the approach that best meets the needs of your school district.

MS NGSS Performance Expectations: Waves and Electromagnetic Radiation

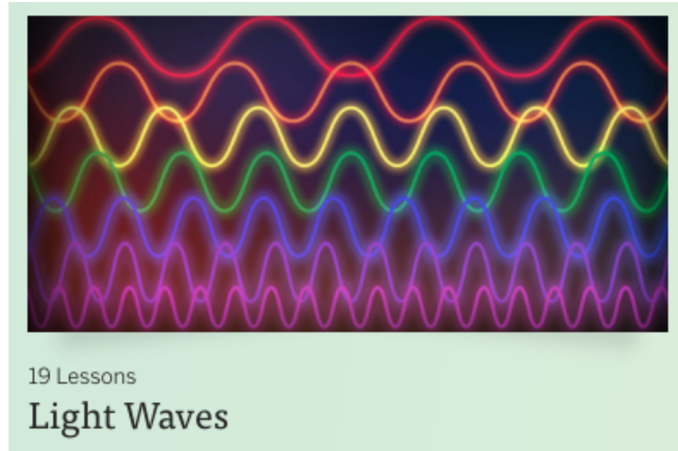
- MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
- MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
- MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.

Sample Units from Three Different Hall Programs

- Amplify Science—*Light Waves: Skin Cancer in Australia*
- FOSS Next Generation—*Waves*
- SEPUP—*Issues and Physical Science: Waves*

Description of a Middle School unit from Amplify Science

Light Waves: Skin Cancer in Australia



Grade 6-8 Unit — requiring at least 19 45-minute class sessions

(one of 27 Middle School Amplify Science units)

The Problem: Why is there a higher rate of skin cancer in Australia than in other parts of the world? More than half of the people who live there will be diagnosed with skin cancer in their lifetime.

Students' Role: In their role as student spectroscopists, students gain a deeper understanding of how light interacts with materials and how these interactions affect our world, from the colors we see to changes caused by light from the sun, such as warmth, growth, and damage. Students use what they learn about light to explain the causes of Australia's skin cancer problem.

What Students Figure Out:

How does light from the sun cause skin cancer? In Chapter 1, students investigate the effect of light on water, a solar-powered toy, and a material that changes color when exposed to light. They watch a documentary video about a light scientist. They test which materials are affected by sunlight in the Light Waves digital simulation. Finally, they create visual models showing their understanding of how light causes skin cancer.

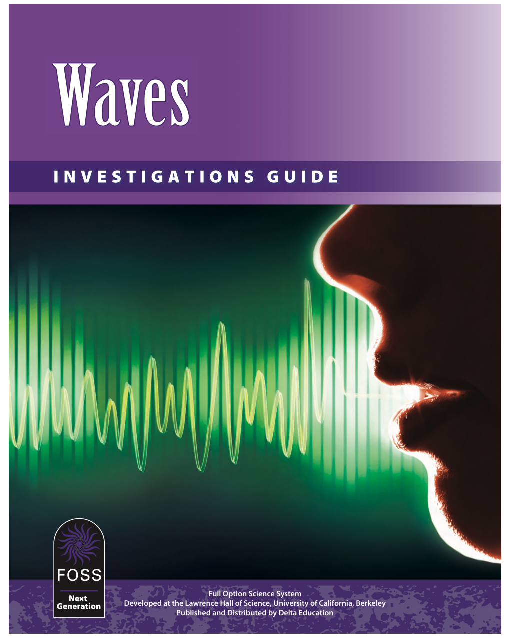
How can the same amount of sunlight cause different rates of skin cancer? In Chapter 2, they investigate the effects of light from a normal flashlight and a UV flashlight on materials and read an article about photosynthesis and solar power. They watch a video about waveforms. They investigate different types of light in the Light Waves digital simulation, and observe their effects on skin cells. They analyze and write about evidence related to melanin and skin cancer. They create models showing their understanding of the factors affecting skin cancer in Australia.

Why does Australia get more ultraviolet light than other parts of the world? In Chapter 3, students use a laser obstacle course to investigate transmission and reflection. They read an article explaining how eyes detect light in order to see. They investigate absorption, transmission, and reflection in the Light Waves digital simulation and read an article about how digitized signals can be sent using light waves. They analyze evidence about how light interacts with different gases in the atmosphere and model the effect of the ozone hole on light reaching Australia. They model and write their final explanations of the skin cancer problem in Australia.

They apply what they learn to a new question: Students consider whether a particular type of crab can see the plankton they eat near the ocean floor. They consider evidence about light transmission, reflection, and absorption in ocean water, and evidence about the crab and the plankton to determine if it is possible for the crab to detect light reflecting off the plankton or if the crab must detect its prey in a different way. They engage in oral argumentation in a student-led discourse routine called a Science Seminar and then write final arguments.

For more about Amplify Science and information about purchasing units from this NGSS-designed K-8 program: https://www.amplify.com/curriculum/amplifyscience

Description of a Middle School course from FOSS Next Generation Edition



Waves

Grade 8 Course — requiring at least 30 45-minute class sessions

(One of 12 FOSS Grade 6-8 courses)

Anchor phenomenon: How can information be transmitted by waves?

The FOSS Waves Course proceeds from the most concrete observations, those of physical properties of mechanical waves, to the most abstract concepts, by which students develop a model of electromagnetic waves. They manipulate springs and lasers to determine properties that eventually will be used to explain how their cell phones work. Students interpret data from phenomena to build explanations and develop science language in their writing and through sense-making discussions. Students will also delve into engineering applications and real-life connections along the way. Students leave this course with a greater appreciation and understanding of modern communications technology and a solid foundation for high school and college physics.

Investigation 1: Make Waves
Students monitor their heart rate under different circumstances to think about frequency. They create waves using metal springs. They use these simple waves to explore the fundamental properties of waves: wavelength, frequency, and amplitude.

Investigation 2: Wave Energy
Students learn about wave energy and compare energy in waves with different properties. They then look at an engineering failure and consider the work engineers must do to achieve a successful design. Finally, students use these ideas to develop a chamber that can effectively block sound waves.

Investigation 3: Light Waves
Students use mirrors to explore reflection. Students use spectroscopes to analyze spectra of visible light and learn more about the electromagnetic spectrum. They use filters to change the spectrum of a light source and to learn about color and determine how refraction changes the path of light rays as they travel between media.

Investigation 4: Communication Waves
Students learn how information can be encoded and sent as digital waves to transfer information efficiently. They test properties of fiber optic cables to develop an understanding of how total internal reflection allows data transfer by light. Students learn how data is encoded and sent as modulated waves to a recipient for demodulation.

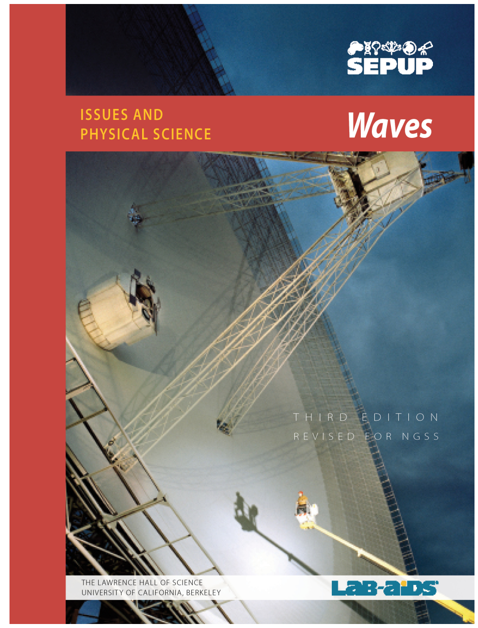
For more about FOSS Next Generation and information about purchasing units from this NGSS-aligned K-8 program:
https://www.deltaeducation.com/foss/how-foss-works

Description of a Middle School course from SEPUP

Issues and Physical Science: Waves

Grade 6-8 Unit — requiring between 16 and 23 45-minute class sessions

(one of 17 Middle School Issues and Science units)



The *Waves* unit is part of the Third Edition of the Issues and Science middle school program produced by the Science Education for Public Understanding Program (SEPUP) at the Lawrence Hall of Science. Third edition units include both units newly developed for the Next Generation Science Standards (NGSS) and units revised from the second edition for the NGSS. The units use personal and societal issues and problems to provide thematic continuity for student investigations and observations. In Waves, students examine how waves can be helpful and how they can be harmful.

Activities 1 to 4:
The unit begins with a focus on sound waves. Students initially use mathematical representations to analyze data and identify patterns in the intensity of various sounds. In doing so they learn that intense sounds carry sufficient energy to cause noise-induced hearing loss. Students then experiment with producing noises of varied intensity and frequency as they begin to build an understanding of the properties of sound waves. They apply this understanding to developing and using models of sound waves as they investigate how the intensity of a sound correlates to amplitude and frequency. Students complete this part of the unit by analyzing fictitious profiles and developing a list of strategies to reduce the risk of noise-induced hearing loss.

Activities 5 to 9:
Students model how noise interference affects the transmission and reception of analog and digital signals. They find that digitized signals, sent as wave pulses, provide a more reliable way to encode and transmit information. Transverse waves are introduced as students investigate the relationship between frequency and wavelength, and between amplitude and energy. Wave behavior is studied as students plan and carry out experiments on the reflection and refraction of light.

Activities 10 to 15:
Students explore the nature of light by investigating the colors of the visible spectrum and how different films transmit and absorb light. They learn that invisible waves are present at both ends of the visible spectrum. After being introduced to electromagnetic waves through a reading, students conduct an investigation to compare the reflection and absorption of sunlight using different surfaces. Next, students design an experiment that compares the effects of sunblock and moisturizing lotion on transmitting, reflecting, or absorbing ultraviolet. In the last activity of the unit, students analyze a series of fictitious profiles to determine the relative risk of cataracts and skin cancer for each case. After analyzing these narratives, each student determines his or her own relative exposure risk from ultraviolet, and then creates a personal protection plan.

For more about Issues and Science and information about purchasing units from this NGSS-designed 6-8 program: http://lab-aids.com