Professional Development, Curricula, and Teacher Support

A Summer with AAPT

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WESLEYAN
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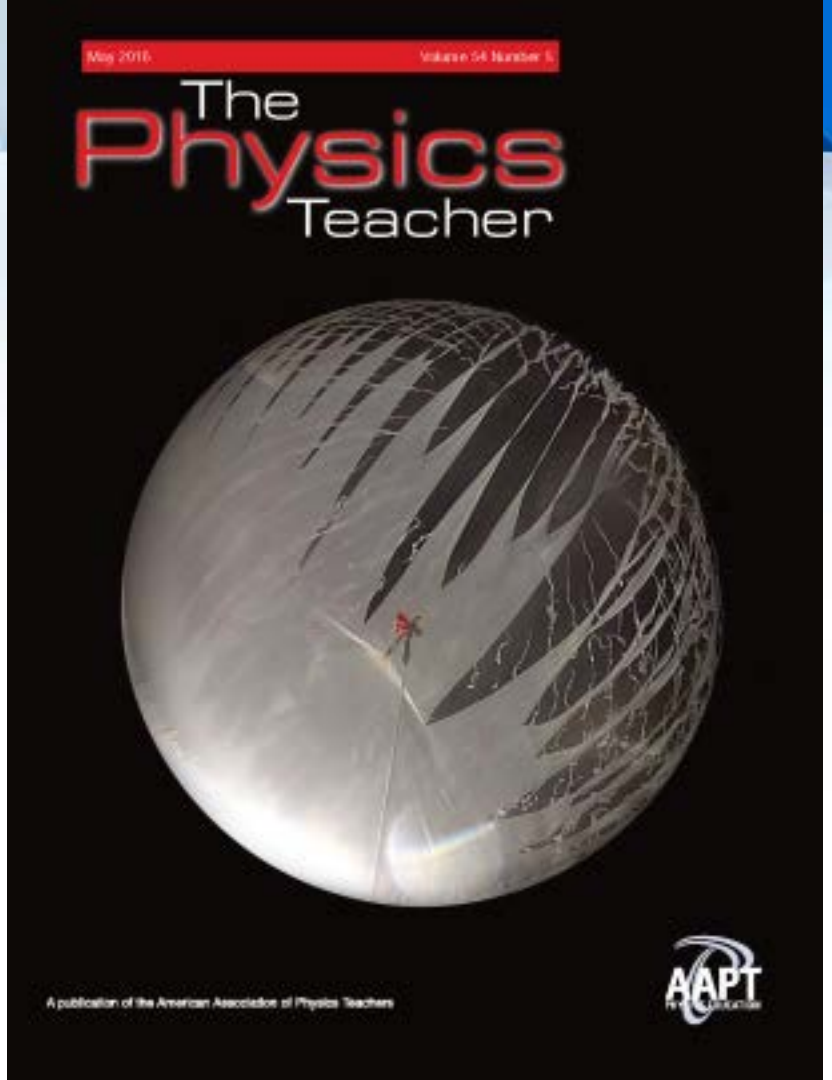
OSA Workshop

Writing Lesson Plans for the AAPT Summer Meeting

- Created 9 lesson plans that could be used from K-8
- Curriculum Development
- Working with Teachers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Lesson Plans on Optics for K-12

- Description
- Purpose
- Materials
- NGSS Connections
- Exercises/Activities

AAPT OSA 100

K-12

Glowstick Science: Glowstick Color Lab

Inspired by The Physics Teacher's

"Glow Sticks: Spectra and Color Mixing" by Jennifer Blake and Ignacio Sosa

and

"As Easy as R, G, B" by Leonard Parsons

Description: Students explore mixing light with glow sticks.

Purpose: Students will observe addition of light with the glow sticks, and will understand the difference between mixing light and mixing pigment.

NGSS Connections:

Disciplinary Core Ideas:
- PS4.B: Electromagnetic Radiation

Crosscutting Concepts:
- Cause and Effect
- Patterns

Science and Engineering Practices:
- Constructing Explanations and Designing Solutions
- Scientific Knowledge is Based on Empirical Evidence

Performance Expectations: Waves and Their Applications in Technologies for Information Transfer (1-PS4)
- 1-PS4-2
- 4-PS4-2

Materials:
- Glow sticks (red, green, and blue)
- Protective latex/non-latex gloves
- Protective goggles
- A toothpick or unbent paper clip
- A pipette/dropper
- A sharp knife
- Transparent plastic overhead sheet
- Yellow, magenta, and cyan highlighters
- Clear or translucent plastic cups
- Various colors of markers
- Optional: Printer ink (cyan, yellow, magenta)

Advanced Preparation:
- The chemicals inside of glow sticks can cause mild inflammation with direct contact to the skin. Ensure that children wear gloves, and wash their hands thoroughly after performing this activity. Contact poison control immediately if the liquid swallowed.
- The chemicals in this lab do stain clothing, so it might be advisable to let children (and parents) know ahead of time, so that they wear something appropriate.
- Immediately before class, thoroughly prepare an appropriate number of glow sticks by cracking the tube inside them, shaking vigorously, and then cutting off the end with your knife and pouring the liquid into a cup. Each group should have one cup each with red, green, and blue liquid. If

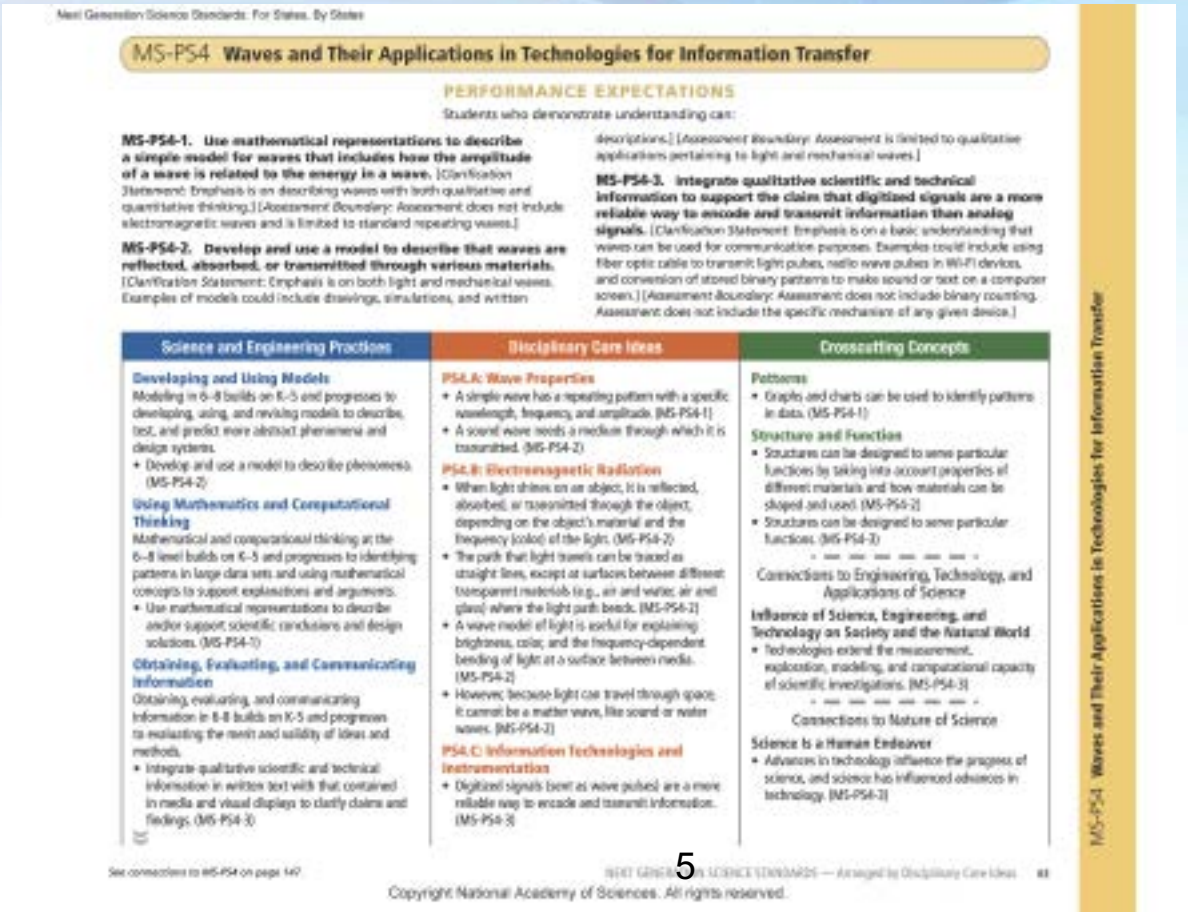
Find more lessons, a modifiable document, and a "Digital Kit" on aapt.org/K12/PTSeasons.cfm

Lesson framework developed by Simon Wright: swright@aapt.org

Next Generation Science Standards

Main Sections:

- Performance Expectations
- Science and Engineering Practices
- Disciplinary Core Ideas
- Crosscutting Concepts



Next Generation Science Standards: For States, By States

MS-PS4 Waves and Their Applications in Technologies for Information Transfer

PERFORMANCE EXPECTATIONS

Students who demonstrate understanding can:

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. [Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.] [Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.]

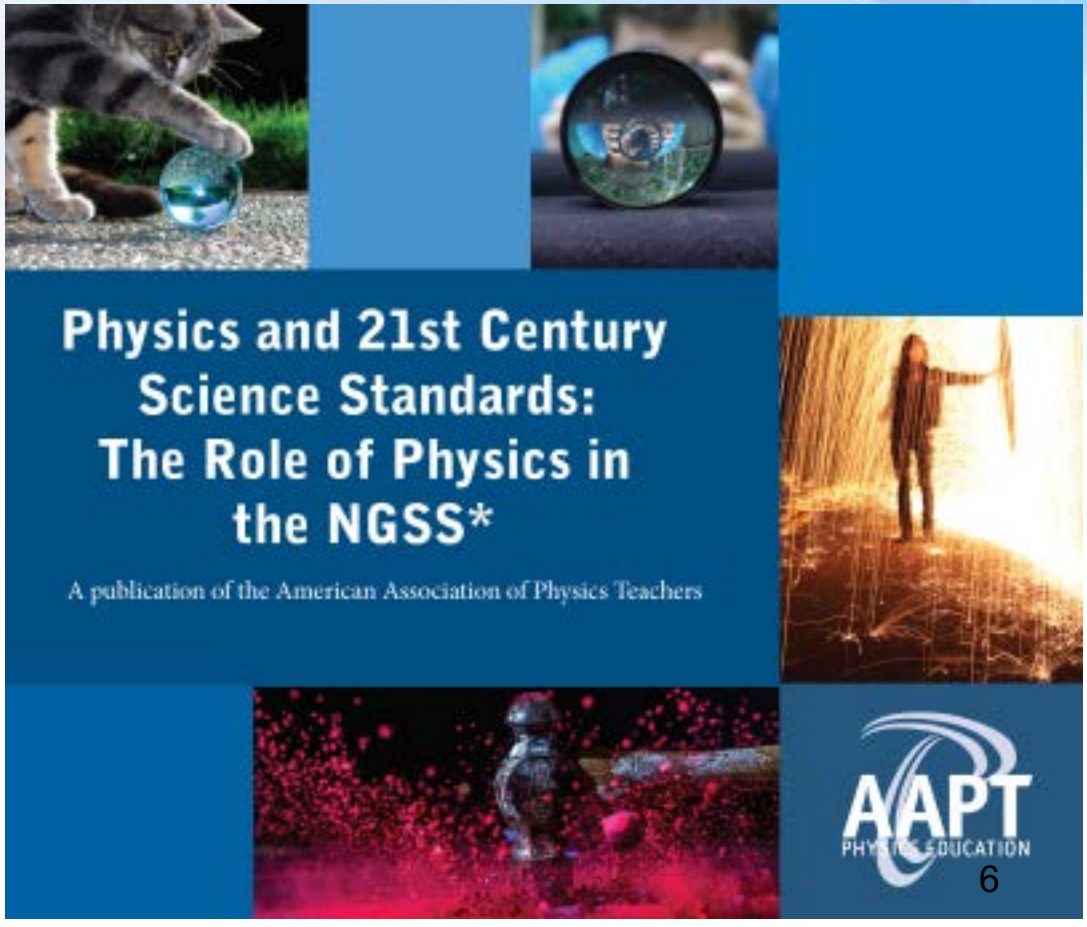
MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. [Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.] [Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.]

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. [Clarification Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in Wi-Fi devices, and conversion of stored binary patterns to make sound or text on a computer screen.] [Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.]

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6–8 builds on K–5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and use a model to describe phenomena. (MS-PS4-2)	**PS4.A: Wave Properties** • A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1) • A sound wave needs a medium through which it is transmitted. (MS-PS4-2)	**Patterns** • Graphs and charts can be used to identify patterns in data. (MS-PS4-1)
Using Mathematics and Computational Thinking Mathematical and computational thinking at the 6–8 level builds on K–5 and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Use mathematical representations to describe and/or support scientific conclusions and design solutions. (MS-PS4-1)	**PS4.B: Electromagnetic Radiation** • When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (MS-PS4-2) • The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS-PS4-2) • A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2) • However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2)	**Structure and Function** • Structures can be designed to serve particular functions by taking into account properties of different materials and how materials can be shaped and used. (MS-PS4-2) • Structures can be designed to serve particular functions. (MS-PS4-3) Connections to Engineering, Technology, and Applications of Science **Influence of Science, Engineering, and Technology on Society and the Natural World** • Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. (MS-PS4-3) Connections to Nature of Science **Science is a Human Endeavor** • Advances in technology influence the progress of science, and science has influenced advances in technology. (MS-PS4-3)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods. • Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings. (MS-PS4-3)	**PS4.C: Information Technologies and Instrumentation** • Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)	

See connections to MS-PS4 on page 147

NGSS Booklet



OSA Workshop Lesson Plans

- 9 lessons
  - Light & Color
  - Geometric Optics
- K-8, with extensions to HS and beyond
- Easily modifiable
- Reference to NGSS
- Cheap/accessible materials

AAPT
PHYSICS EDUCATION
aapt.org

SPS

HS Physics Teachers' Lounge

Other Projects

- Physics Master Teacher Leader Taskforce
- NASA Heliophysics Grant
- Bootstrap for Physics
- K-12 Portal

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