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Sound and Waves: An Integrated K–8 Hands-On Approach Supporting the NGSS and CCSS ELA

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Overview of the Presentation

1. Background: **Integration of Science** and **Literacy**
2. Excitement in Learning/Teaching Sound & Waves:
 - for students
 - for instructors
 - for both
3. An instructional Plan to integrate
Science content + Hands-on activities + Literacy strategies



Why Science and Literacy Integration?

NGSS Practices	CCSS ELA Practices
<p>S1. Ask questions and define problems</p> <p>S2. Develop and use models.</p> <p>S3. Plan and carry out investigations.</p> <p>S4. Analyze and interpret data.</p> <p>S5. Use mathematics and computational thinking.</p> <p>S6. Construct explanations and design solutions.</p> <p>S7. Engage in argument from evidence.</p> <p>S8. Obtain, evaluate and communicate evidence.</p>	<p>E1. Demonstrate independence in reading complex texts, and writing and speaking about them.</p> <p>E2. Build a strong base of knowledge through content rich texts.</p> <p>E3. Obtain, synthesize, and report findings clearly and effectively in response to task and purpose.</p> <p>E4. Construct viable arguments and critique reasoning of others.</p> <p>E5. Read, write, and speak grounded in evidence.</p> <p>E6. Use technology and digital media strategically and capably.</p> <p>E7. Come to understand other perspectives and cultures through reading, listening, and collaborating</p>

Preparing College/Career Readiness through Integrating Science Learning with Literacy in Grades 4-12 (6-12)

A LEA-IHE-Business Partnership Initiative Supported by TN DOE MSP and THEC ITQ Grants (2015-18)



Local Education Agents

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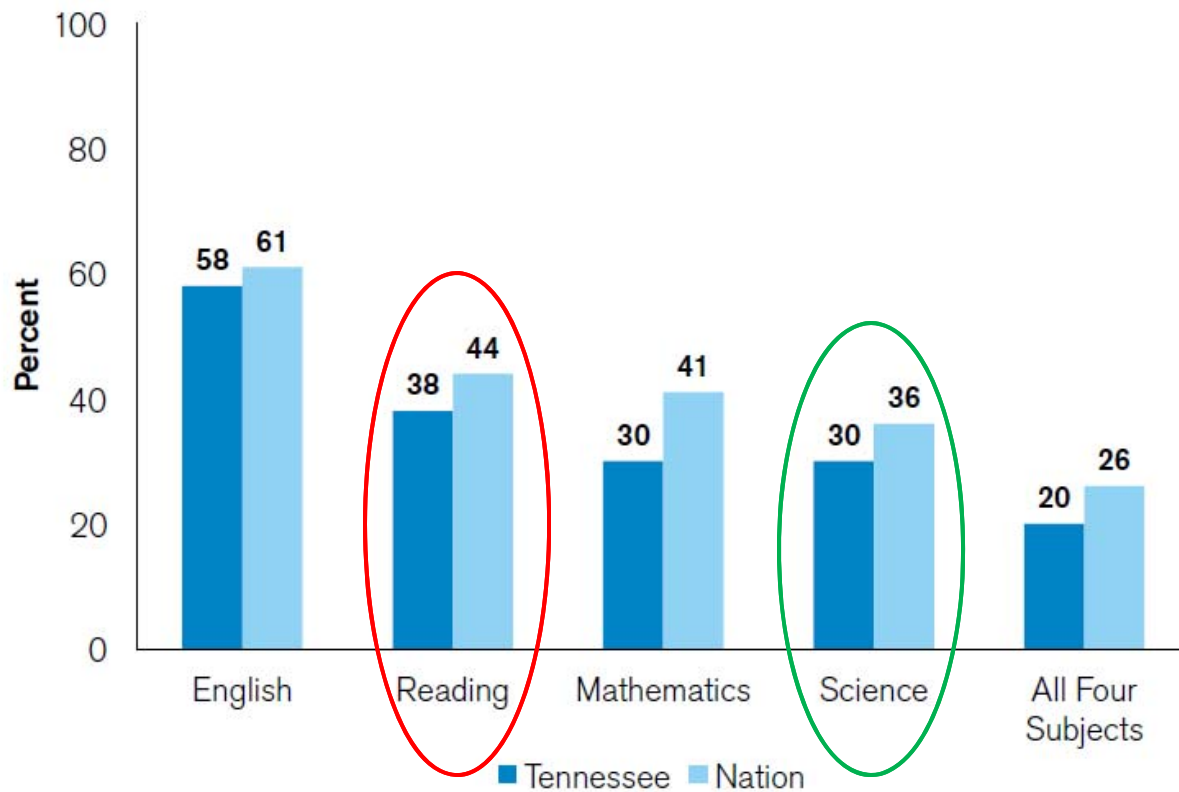
GREENEVILLE CITY SCHOOLS



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Picture of College Readiness

Percent of 2016 ACT-Tested High School Graduates Meeting ACT College Readiness Benchmarks by Subject



Research Questions

- **RQ1**: How does cross-discipline instruction benefit and enrich each subject discipline?
- **RQ2**: How does integration of science learning with literacy in G4-12 impact students' learning in schools?



Excitement in Learning Sound & Waves (learners)

What do you feel excited about sound?

- Celebrations (5th grader)
- Pretty (2nd grade)

What do you feel excited about waves?

It is cool when you see it change because it is like it is a show in front of you and it is also like something you never seen before and never did before and also the first person to do it and it is also like the coolest thing ever. I think it is really cool to do the light's and really cool to do sound and waves.

A second grader
Interviewed in 2016



Excitement in Teaching NGSS PS4 (for instructors)

K- 2 (1)

- **Sound** can make matter **vibrate**, and vibrating matter can make sound

G3-5 (4)

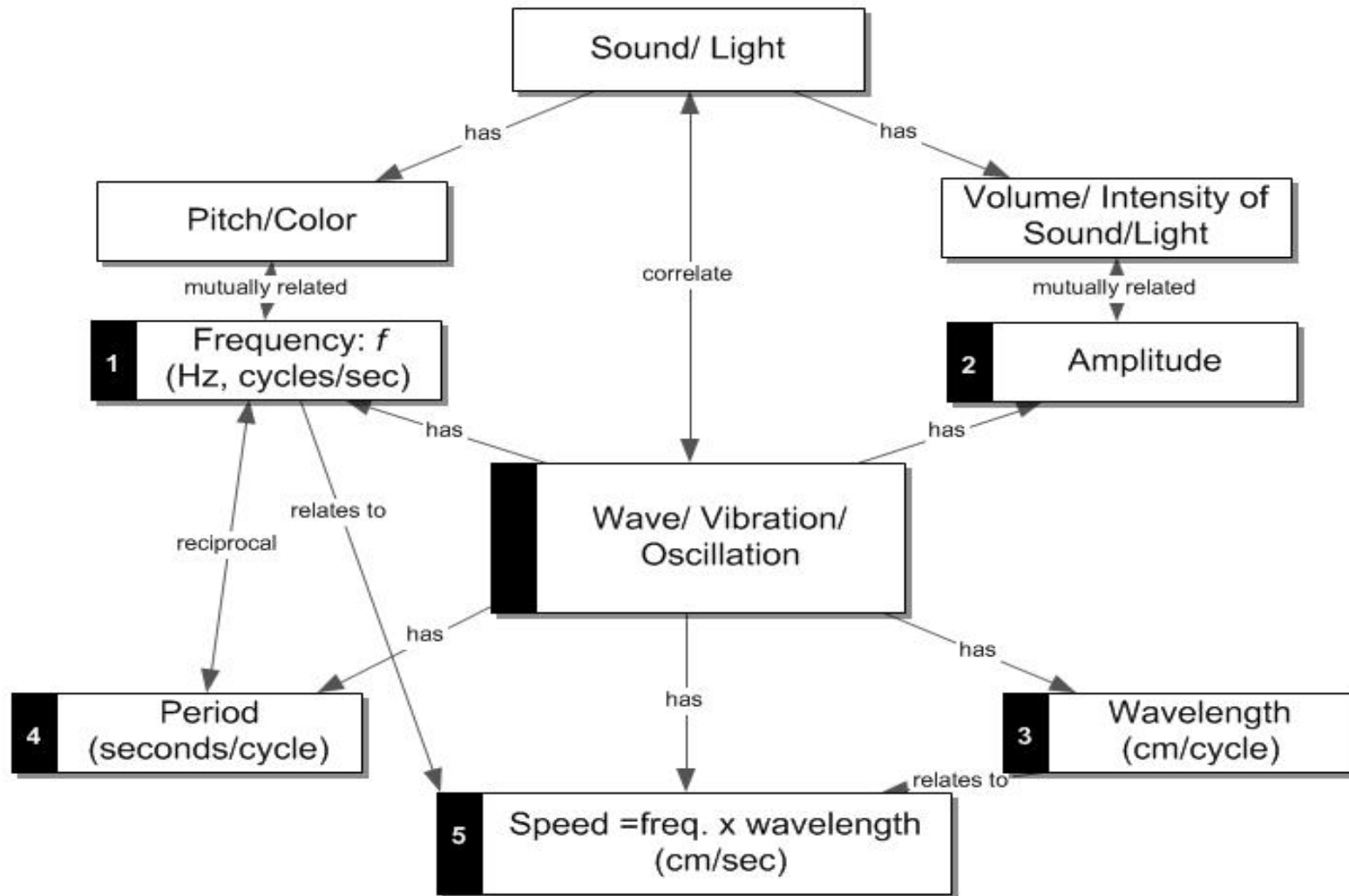
- **Waves** are regular **patterns** of motion, which can be made in water by disturbing the surface. Waves of the same type can differ in **amplitude** and **wavelength**. Waves can make objects move.

G6-8

- A simple wave model has a **repeating pattern** with a specific **wavelength**, **frequency**, and **amplitude**, and mechanical waves need a medium through which they are transmitted. This model can explain many phenomena including **sound** and **light**. Waves can transmit **energy**.



A Concept Map of Sound and Waves in K-12



An Integration Plan for A Cognition Architect

Science Content	Hands-on activities	ELA Strategies
I. What is sound? How is sound made?	<ul style="list-style-type: none"> • Kazoo straws • Wine glasses • Ukuleles 	<ol style="list-style-type: none"> 1. Graphic novels 2. Text evidence 3. Cite and justify evidence 4. Use evidence in writing 5. Use technology to support literacy and content knowledge
II. How does sound travel?	<ul style="list-style-type: none"> • Pulse of air 	
III. Types of waves: transverse vs. longitudinal	<ul style="list-style-type: none"> • Ropes/ slinkies • Group of people • Wave gadgets 	
IV. From noises to music	<ul style="list-style-type: none"> • Kazoo straws • Straw flute 	



What IS Sound/ How Is Sound Made

A. Kazoo Straws ([videos](#))

1. Let's do it. First play one straw then make another one according to your sitting area (see right).
2. Q: How to make a kazoo straw with a higher pitch? Why?

Stage	
16cm	8cm
12cm	14 cm

B. Two wine glasses w/ different amount of water

1. Which one has a higher pitch? Why?
(Use feedback detector)
2. How is sound made?

C. A ukulele with frequency detector app

1. Does a bigger sound have a higher pitch?



Using Graphic Novels to Understand Science

- How is the use of text changing in the science classroom?



Why Graphic Novels?



EGMONT

- Globalization has led to an emergence of greater reliability on visual modes of communication.
- New technologies make interactive, nonlinear, and hypertextual forms of communication possible.
- Graphic novels increase motivation.
- Graphic novels may help students connect with content that they struggle comprehending from their textbook.
(Hassett & Schieble, 2007; Jimenez & Meyer, 2016)



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Graphic Novel: Adventures in Sound with Max Axiom Super Scientist

Sound involves more than just volume. This bird's song gets louder and softer, but it is also full of notes, some higher than others.

The bird may not know it, but the secrets behind its lovely melody are called frequency and pitch.

Frequency equals the number of sound waves that pass a point during a certain amount of time.

For instance, right now only one sound wave passes by me each second. Therefore, the sound has a frequency of 1 hertz (Hz).

But if 50 waves pass by me in one second, the sound has 50 Hz. Faster vibrations create sounds with higher frequencies.

One Second

One Second

10

The frequency of a sound determines its pitch.

Something with lots of Hz sounds higher than something with fewer Hz.

But people can't hear everything. In fact, we can only hear frequencies between 20 and 20,000 Hz.

Sounds below 20 Hz are called infrasound. Sounds above 20,000 Hz are called ultrasound.

CHECK THIS OUT:

Dogs hear some sounds with frequencies up to 40,000 Hz. That explains why your dog might howl for no apparent reason. Dogs hear things we don't even know are there.

How Does Sound Travel/ How Does Waves Move

A. A pulse of air

1. Hypotheses about how sound travels.

B. Types of waves

Transverse	Longitudinal
<ul style="list-style-type: none">• Ropes	<ul style="list-style-type: none">• Slinkies

- Q: How to use a group of people/kids to simulate two types of waves?

C. Wave gadgets (also next page)

- Standing waves to visualize wave movement



How Does Waves Move

A. Components of a wave movement

1. Frequency
2. Wavelength
3. Amplitude

B. Wave movement demonstration (transverse type)

- Frequency (Hz) activity using flash strobos
- Identify/ describe a wave movement
- Find wavelength and amplitude of a wave



Your Task in Small Groups

1. Read the pages of the graphic novel provided.
2. As a group, fill in the empty speech bubble with text that illustrates concepts of wave movement.
3. Discuss why you choose the particular piece of text you inserted.
4. Compare your text to that of the original author's text.



From Noises to Music

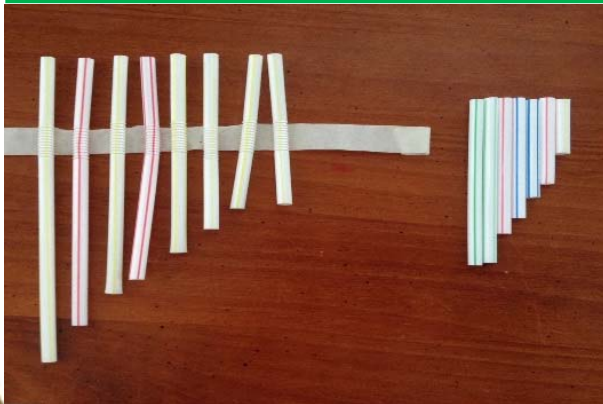
A. Kazoo Straws ([videos](#))

Let's resume our Kazoo activities and cheer up!

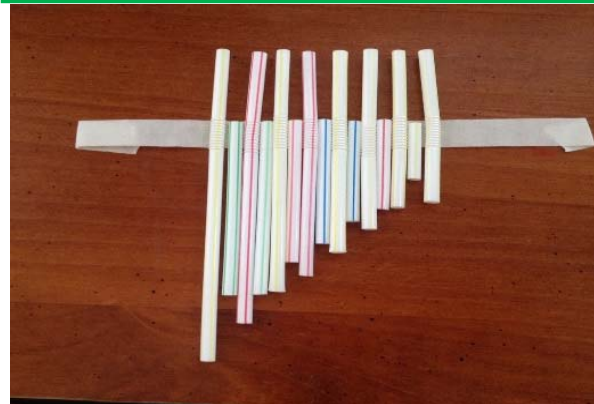
Stage	
16cm	8cm
12cm	14 cm

B. Make a straw flute instrument (see bags, handouts)

Step 1



Step 2



Step 3



Math in Straw Flute (optional)

1	2	3	4	5	6	7	8
19.0	16.9	15.0	14.1	12.7	11.3	10.0	9.5
cm	cm	cm	cm	cm	cm	cm	cm
Do	Re	Mi	Fa	So	La	Si	Do

Ration of Lengths

#1/#5	#2/#6	#3/#7	#1/#8	#1/#4
3/2	3/2	3/2	2/1	1.347

Two combinations

- Do + So (Harmonic)
- Do + Fa (Dissonant)

Twinkle, Twinkle Little Star

11 55 66 5 44 33 22 1

55 44 33 2 55 44 33 2

11 55 66 5 44 33 22 1

Connecting graphic novels to writing and technology- Story Visualizer

Tasks that provide opportunities for students to use spatial skills to imagine, visualize, and create lead us towards multimodal and multidimensional literacy (Spellman, Jones, & Katsio-Loudis, 2014).



Concluding Video

The Secrets of Sound and Waves

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Questions and Comments

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