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Sound and Waves (PS4): An Integrated K–8 Hands-On Approach Supporting the NGSS and CCSS ELA

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First TN Math and Science Partnership

STEM and LIteraCy in Education (SLICE)

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Rationales- STEM and Literacy

1. More research is needed to determine how the **thinking and practices** associated with science, mathematics, literacy and technology are similar and different and how they might complement each other in the service of learning.
2. **Cross-disciplinary patterns** of thought might advance students' understanding of core concepts and engage them in cross-disciplinary critical thinking, reasoning, argumentative and communication skills.

Practices and Crosscutting Concepts

CCSS ELA Practices	Math Practices	NGSS Practices	Crosscutting Concepts
E1. Demonstrate independence in reading complex texts, and writing and speaking about them. E2. Build a strong base of knowledge through content rich texts. **E3. Obtain, synthesize, and report findings clearly and effectively in response to task and purpose.** E4. Construct viable arguments and critique reasoning of others. E5. Read, write, and speak grounded in evidence. E6. Use technology and digital media strategically and capably. E7. Come to understand other perspectives and cultures through reading, listening, and collaborating	M1. Make sense of problems and persevere in solving them. **M2. Reason abstractly and quantitatively.** M3. Construct viable arguments and critique reasoning of others. M4. Model with mathematics. M5. Use appropriate tools strategically. M6. Attend to precision. M7. Look for and make use of structure. M8. Look for and express regularity in repeated reasoning.	S1. Ask questions and define problems S2. Develop and use models. S3. Plan and carry out investigations **S4. Analyze and interpret data.** S5. Use mathematics and computational thinking. **S6. Construct explanations and design solutions.** S7. Engage in argument from evidence. S8. Obtain, evaluate and communicate evidence.	C1. Patterns **C2 Cause and effect: Mechanism and explanation** C3. Scale, proportion and quantity C4. Systems and system models C5. Energy and matter: Flows, cycles and conservation C6. Structure and function C7 Stability and change

STEM and LIteraCy in Education (SLICE)

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

Local Education Agents

Institute of Higher Ed

Business Partners

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?

Framework for K-12 Science Education- PS4.A

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.

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Framework for K-12 Science Education- PS4.A

K- 2 (1)

- Sound, vibrate

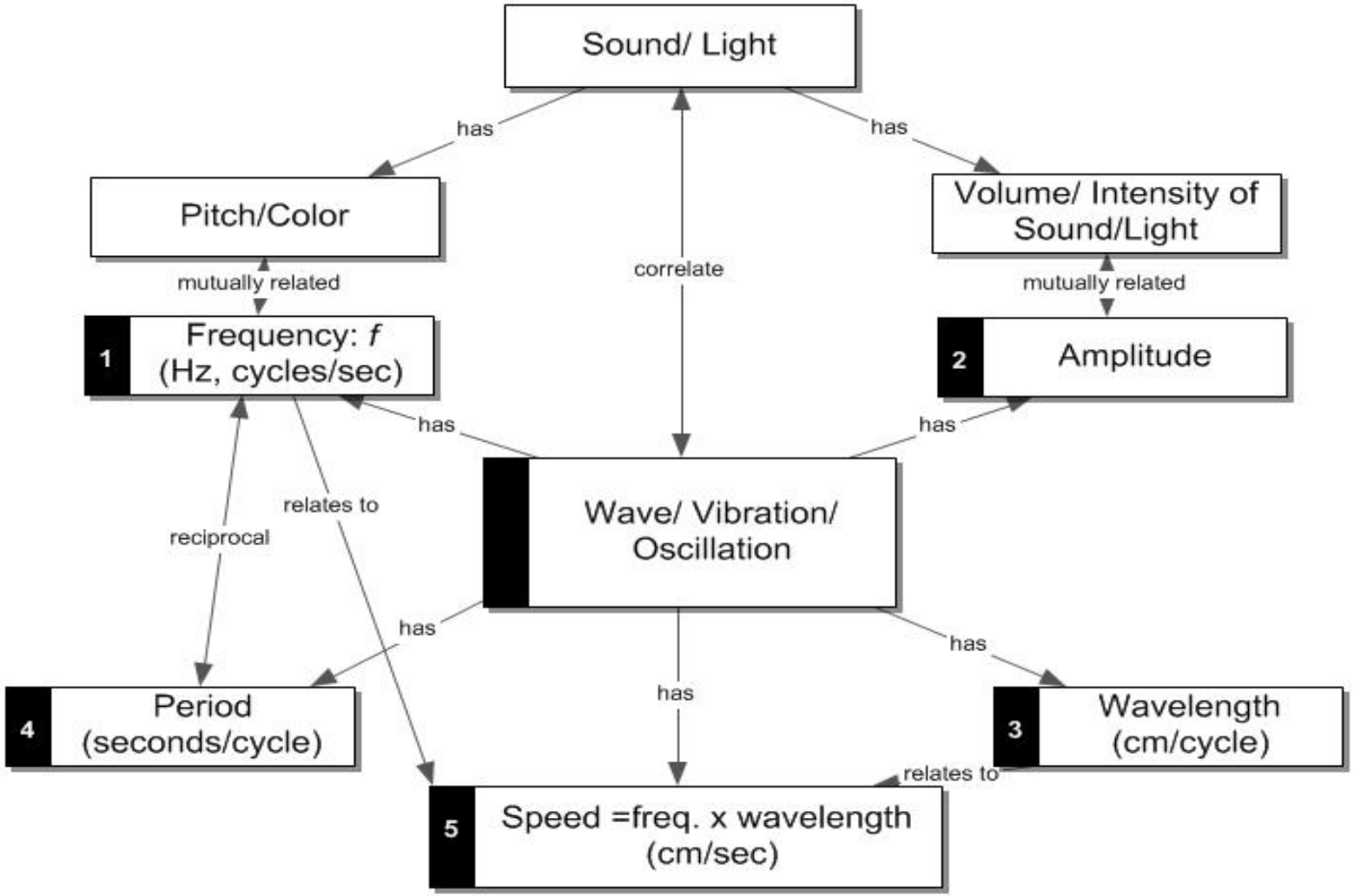
G3-5 (4)

- Waves, patterns, amplitude, wavelength, move.

G6-8

- repeating patterns, wavelength, frequency, amplitude, sound, light, 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?	• Kazoo straws • Wine glasses • Ukuleles	**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**?	• Pulse of air	
III. Types of waves: transverse vs. longitudinal	• Ropes/ slinkies • Group of people • Wave gadgets	
IV. Application: from noises to music	• Kazoo straws • Straw flute	

What IS Sound/ How Is Sound Made

A. Kazoo Straws (video)

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

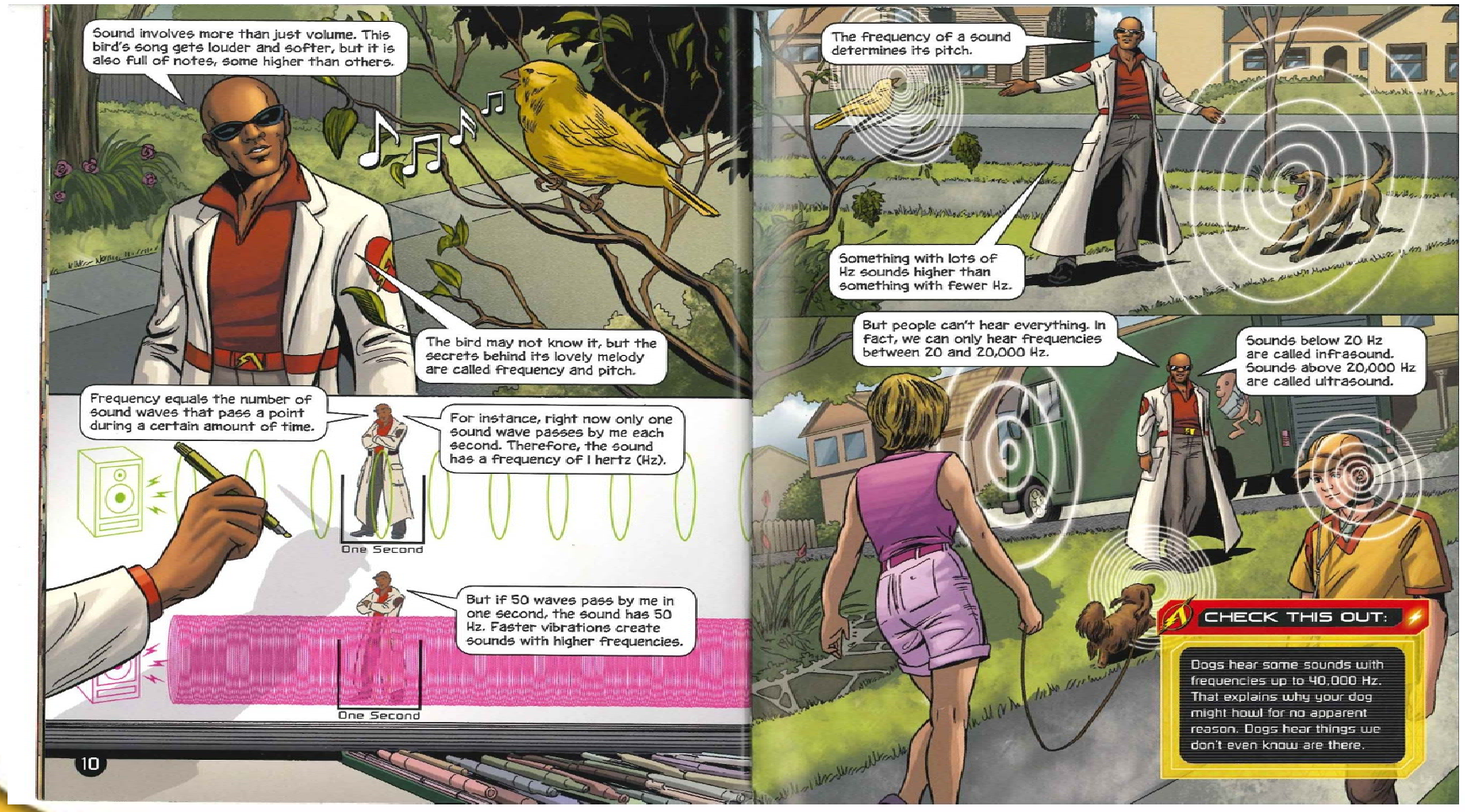
- How is the use of text changing in the science classroom?

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)

Graphic Novel: Adventures in Sound with Max Axiom Super Scientist



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.

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
• Ropes	• 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

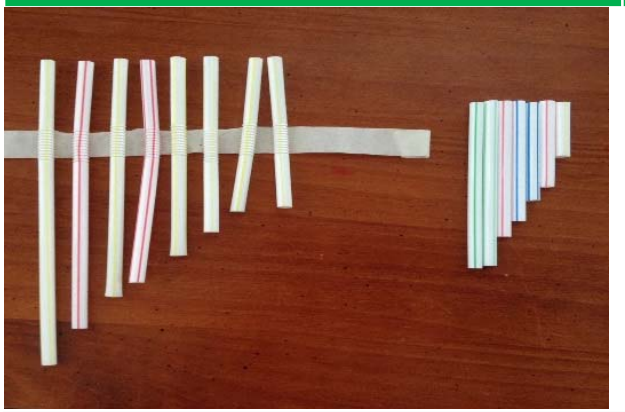
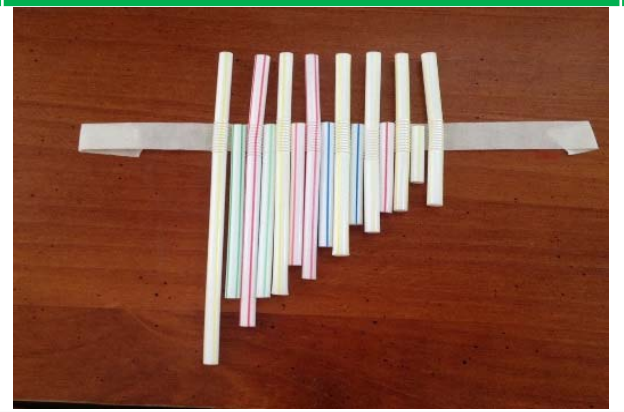
A. Components of a wave movement

1. Frequency
2. Wavelength
3. Amplitude

B. Wave movement demonstration (transverse type)

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

From Noises to Music- Magic Flute

Step 1	Step 2	Step 3
		
<u>Step 1:</u> Arrange the **bendy straws** (main) from **longest to shortest** with tapes. Leave a small space between each other (see left). Arrange the spacing straws (without bendy part) from longest to shortest (see right)	**<u>Step 2</u>:** Place the **spacing straws** between the bendy straws from longest to shortest.	**<u>Step 3</u>: Wrap up** your straw instrument and **mark** it from **1 (longest) to 8 (shortest)**

1	2	3	4	5	6	7	8
19.0 cm	16.9 cm	15.0 cm	14.1 cm	12.7 cm	11.3 cm	10.0 cm	9.5 cm

NSTA Got Talent

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

Math in Straw Flute (optional)

1	2	3	4	5	6	7	8
19.0 cm	16.9 cm	15.0 cm	14.1 cm	12.7 cm	11.3 cm	10.0 cm	9.5 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)

PBL Example: Summer PD and School Implementation

Project-Based Learning: Summer PD and School Implementation

Summer PD at ETSU (Jun/17)
- Water PBL project
- E-documentation

Curriculum/PD Implementation (Fall 17)
- Sulphur Springs School (120 G7-8 students)
- Vance MS (500 G7-8 students)

A. Implementation Sulphur Springs, (9/28/17)

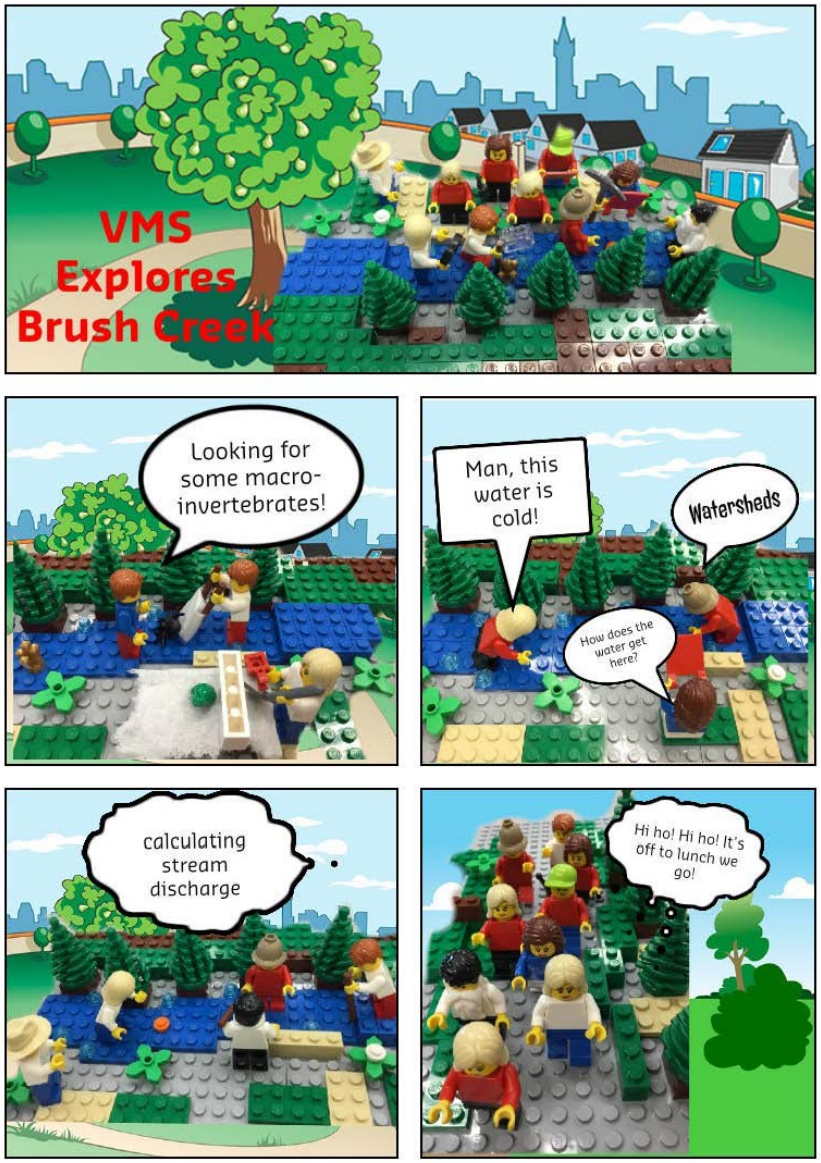
B. Presentation Sulphur Springs (10/5/17)

See video

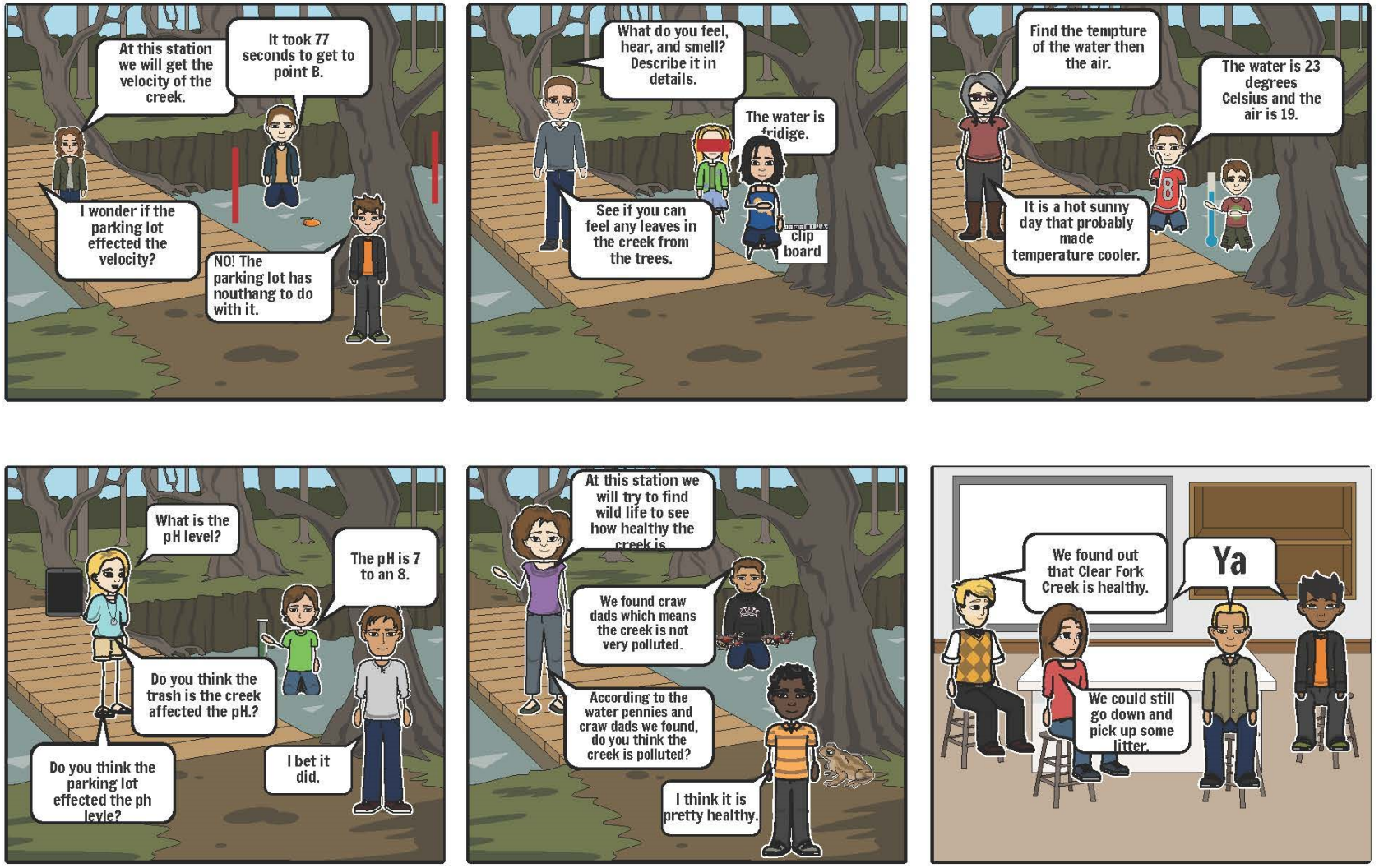
Connecting graphic novels to writing and technology- Story Visualizer

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).

Comic Book Example- Teacher Version



Comic Book Example- Student Version



Questions and Comments

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