LINKING SCIENCE & LITERACY FOR ALL LEARNERS

Flight of the Bumblebee: Ecosystems

Teacher
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I have been teaching middle school science for 14 years. I have a Bachelor's degree in Biology and a masters in Curriculum and Instruction. I am certified in middle school science, math, and language arts. I currently teach seventh grade mathematics and eighth grade Life Sciences at South Callaway Middle School in Mokane Missouri.

This unit was created for use during my Ecosystems unit.

This unit was implemented with four 8th grade Life Science Classes. The classes ranged from 7-23 students and are of mixed abilities. I used reading materials that were matched to their reading levels as a scaffold to support them with the anchor text.

Multimodal Text Set

Source	Title	Type	Grade Level/ Lexile
ANCHOR			
	Flight of the Bumblebee: Using Acoustics to Eavesdrop on Bees and Pollination	ANCHOR TEXT	7, 8

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SCAFFOLDS			
Self made	Flight of the Bumblebee CER document	worksheet	6-8
online	Claims, Reasons, and Evidence Explanation Page	worksheet/notes	6-8
online	Darwin's Finches	worksheet	6-8
Readworks[1]	Sound – Article-a-day set	Text	3
CK-12 – online	Sound Waves	Text	7,8
CK-12 – online	Frequency and Pitch of Sound	Text	7,8
CK-12 - online	Mechanical Waves	Text with videos	7,8
Explore Sound and Acoustics (Acoustics Society of America)	What is Sound; What is Acoustics?	Text with videos	6-8
YouTube National Geographic	Time Lapse: Watch Flowers Bloom Before Your Eyes	video	
Readworks	Worldwide Loss of Bees a Growing Concern	article	7
Ck-12	Importance of Plants	article	4,5
Ck-12	Plant Reproduction	article	4
Readworks	Seeing the Invisible	article	8
Readworks	Insects and Animals that Pollinate Plants	article	2
TeachWithFergy.com	Trading Food for Fertilization (3 min version)	Video	6-8
YouTube	Trading Food for Fertilization (11 min version)	Video	6-8

[1] Free log in necessary to access resources

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Book	Flowers are Calling by Rita Gray	Text	6,8
CalAcademy	Flowers Seeking Pollinators: Datasheet	Text	6-8
CalAcademy	Flowers Seeking Pollinators: Pollinator Profile	Text	6-8
CalAcademy	Flowers Seeking Pollinators: Constructing Explanations	Text	6-8
Readworks	Who Needs a Better Mousetrap?	Text /Audio	5
NPR	Honeybees help farmers, but they don't help the environment	Text	6,8
YouTube	TEDEd: The Power of Creative Constraints	Video	
YouTube	Engineering Design Process: A Taco Party	Video	
Readworks	The Problem Solvers	Text/Audio	6
Readworks	Developing Possible Solutions	Text/Audio	8
FOTB Original	Letter to the Scientists	Text	900-1000 Lexile
FOTB Original	Robo-Bees Assignment	Text	
YouTube Bozeman Science	CER- Claim Evidence Reasoning	Video	
BrainPOP (Subscription Needed)	Critical Reasoning	Video	

Unit Overview

Lesson	Outcome(s)	Connections to Standards (MLS, CCSS, NGSS)

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1	Students will be able to identify claims, evidence, and reasons. Students will be able to make a claim, support it with evidence, and describe how the evidence supports the claim.	**ELA** **Missouri Learning Standard 8.W.2.A:** Develop argumentative writing by introducing and supporting a claim with clear reasons and relevant evidence; acknowledging counterclaims, and establishing relationships among claims, counterclaims, and supporting evidence. **Missouri Learning Standard 8.SL.1.B:** Delineate a speaker's argument and claims, evaluating reasoning and sufficiency of evidence in order to pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas. **CCSS.ELA-Literacy.RST.6-8.1:** Cite specific textual evidence to support analysis of science and technical texts. **CCSS.ELA-Literacy.W.8.1.A-B:** Write arguments to support claims with clear reasons and relevant evidence. **CCSS.ELA-Literacy.SL.8.3:** Delineate a speaker's argument and specific claims, evaluating the soundness of the reasoning and relevance and sufficiency of the evidence and identifying when irrelevant evidence is introduced. **Science** While Claims, Evidence, and Reasoning is not a standard in NGSS or MLS, it is incorporated into several other standards. Information about this can be found on the NGSS website under **Science and Engineering Practices**.
2	Analyze how scientific writing is organized and how the structure contributes to its meaning.	**ELA** **Missouri Learning Standard 8.R.1.B:** Determine the meaning of words and phrases as they are used in the text, including figurative, and connotative, and meanings using context, affixes, or reference materials. **Missouri Learning Standard 8.R.1.C:** Interpret visual elements of a text including those from different media and draw conclusions from them (when applicable). **Missouri Learning Standard 8.R.2.A:** Analyze how an author's choice concerning a text's organization or overall structure contributes to meaning. **Missouri Learning Standard 8.R.3.A:** Compare and contrast information presented in different mediums and analyze how the techniques unique to each medium contribute to

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		meaning. **CCSS.ELA-Literacy.RI.8.1:** Cite textual evidence that strongly supports an analysis of what the text says explicitly as well as inferences drawn from the text. **CCSS.ELA-Literacy.RI.8.4:** Determine the meaning of words and phrases as they are used in a text, including figurative and connotative meanings; analyze the impact of specific word choices on meaning and tone, including analogies or allusions to other texts. **CCSS.ELA-Literacy.RI.8.5:** Compare and contrast the structure of two or more texts and analyze how the differing structure of each text contributes to its meaning and style. **CCSS.ELA-Literacy.RST.6-8.5:** Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic.
3	Visualize sound so as to determine its properties and features of the source	**Science** **Missouri Learning Standard 6-8.PS4.A.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. **Missouri Learning Standard6-8.PS4.2:** Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. **NGSS 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. **NGSS MS-PS4-2:** Develop and use model to describe that waves are reflected, absorbed, or transmitted through various materials. **ELA** **Missouri Learning Standard 8.RI.1.A:** Draw conclusions, infer, and analyze by citing the textual evidence that most strongly supports an analysis of what the text says explicitly as well as inferences drawn from the text. **Missouri Learning Standard 8.RI.1.B:** Determine the meaning of words and phrases as they are used in the text, including figurative, connotative, and content-specific meanings using context, affixes, or reference materials.

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		Missouri Learning Standard 8.RI.1.D: Explain the central/main idea(s) of a text and analyze its development over the course of a text; provide an objective summary of the text. **CCSS.ELA-Literacy.RI.8.1** **CCSS.ELA-Literacy.RI.8.4** **CCSS.ELA-Literacy.RST.6-8.1** **CCSS.ELA-Literacy.RST.6-8.2:** Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
4	Specialized plant structures affect the probability of plant reproduction.	**Science** **Missouri Learning Standard 6-8.LS1.B.1**: Construct an explanation for how characteristic animal behaviors as well as specialized plant structures affect the probability of successful reproduction of animals and plants respectively. **Missouri Learning Standard 6-8.LS1.B.2:** Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. **Missouri Learning Standard 6-8.LS2.A.1:** Analyze and interpret data to provide evidence for the effects of resource availability on individual organisms and populations of organisms in an ecosystem. **NGSS MS-LS1-4:** Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. **NGSS MS-LS1-5:** Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. **NGSS MS-LS2-1:** Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. **ELA** **Missouri Learning Standard 8.R.1.B** **Missouri Learning Standard 8.R.1.D** **Missouri Learning Standard 8.R.3.D:** Read and comprehend informational text independently and proficiently. **Missouri Learning Standard 8.W.3.A.e:** Use technology, including the internet, to produce

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		and publish writing, present the relationships between information and ideas efficiently, and interact and collaborate with others. **Missouri Learning Standard 8.SL.2.A:** Speak audibly and to the point, use conventions of language as appropriate to task, purpose, and audience when presenting including appropriate volume, clear articulations, and accurate pronunciation at an understandable pace. **Missouri Learning Standard 8.SL.2.C:** Plan and deliver appropriate presentations based on the task, audience, and purpose integrating multimedia into presentations to clarify information, strengthen claims and evidence, and add interest. **CCSS.ELA-Literacy.RI.8.1** **CCSS.ELA-Literacy.RI.8.2:** Determine the central idea of a text and analyze its development over the course of the text, including its relationship to supporting ideas; provide an objective summary of the text. **CCSS.ELA-Literacy.RI.8.4** **CCSS.ELA-Literacy.RST.6-8.1** **CCSS.ELA-Literacy.RST.6-8.2** **CCSS.ELA-Literacy.RST.6-8.4:** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.
5	Discover that flowers are adapted to specific pollinators. Practice constructing explanations grounded in scientific data. Learn that many plants depend on animals for pollination and many pollinators depend on plants for food.	**Science** **Missouri Learning Standard 6-8 LS1.B.1** **Missouri Learning Standard 6-8.LS1.B.2** **Missouri Learning Standard 6-8.LS2.A.2:** Construct an explanation that predicts the patterns of interactions among and between the biotic and abiotic factors in a given ecosystem. (Symbiosis) **NGSS MS-LS1-4** **NGSS MS-LS1-5** **NGSS MS-LS2-2:** Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

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		ELA **Missouri Learning Standard 8.RI.1.A:** Draw conclusions, infer, and analyze by citing textual evidence that most strongly support analysis of what the text says explicitly as well as inferences drawn from the text. **Missouri Learning Standard 8.W.1.A:** Conduct research to answer a question, drawing on several sources; integrate information using a standard citation system. **CCSS.ELA-Literacy.RST.6-8.7:** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). **CCSS.ELA-Literacy.RST.6-8.1**
6	Understand the basic elements that need to be addressed in a “problem-solving” process. Identify claims and cite evidence to support claims. Identify a potential solution that considers the complexity of the ecosystem as a way to address the declining crop productivity. Evaluate and critique a solution in response to the problem of declining crop productivity.	**Science** **Missouri Learning Standard 6-8.LS2.C.1:** Construct an argument supported by empirical evidence that explains how changes to physical or biological components of an ecosystem affect populations. **Missouri Learning Standard 6-8.LS2.C.2:** Evaluate benefits and limitations of differing design solutions for maintaining an ecosystem. **Missouri Learning Standard 6-8.ETS1.A.1:** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. **Missouri Learning Standard 6-8.ETS1.B.1:** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. **NGSS MS-ETS1-1:** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. **NGSS MS-ETS1-2:** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

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		NGSS MS-LS2-5: Evaluate competing design solutions for maintaining biodiversity and ecosystem services. **ELA** **Missouri Learning Standard 8.RI.1.A** **Missouri Learning Standard 6.RI.2.D:** Identify an author's argument in a text and distinguish claims that are supported by reasons and evidence from claims that are not **Missouri Learning Standard 8.RI.2.D:** Evaluate an author's argument, assessing whether the reasoning is evidence is relevant and sufficient to support the claims. **Missouri Learning Standard 8.W.1.A** **Missouri Learning Standard 6.W.2.A.c:** Develop argumentative writing by introducing and supporting a claim with clear reasons and relevant evidence. **CCSS.ELA-Literacy.RST.6-8.1** **CCSS.ELA-Literacy.RST.6-8.8:** Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. **CCSS.ELA-Literacy.RST.6-8.9:** Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

Unit Lesson #1

Guiding Questions	How do scientists use evidence and reason to support their claims?	
	Key Idea	**Learning Activities**

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Engage	A claim is a statement of belief that can be argued against.	Have a picture on the board that will spark questions. (I included an example below from the New York Times.) Next to the picture, have the following questions: What are three things you notice? What are two things you infer? What is one question you have? Write some or all of their responses on the board. You will come back to these later. Make sure you keep the responses to each question separate.
Explore	Claims, Reason, and Evidence are connected to each other.	Give students the Claims, Reason, and Evidence explanation page. Instruct students to highlight the definitions in three different colors. Have students read the definitions and examples with their table partners and then come up with their own examples for each definition.
Explain	Identify claims and evidence. Determine which types of evidence best support a claim.	Put the picture back on the board and direct students to look at their answers to the questions on the board. Think about the definitions and examples you just looked at. What do you notice about these lists? The three things you notice are evidence. The two things you infer could be claims. Look at one of the claims they made about the picture. Which pieces of evidence support that claim? Do this for a couple of the claims so that they see the connection. Can all of the claims be supported with evidence? Not all claims are STRONG claims. After this activity, tell the students what is actually happening in this picture! Was anyone able to figure it out?
Elaborate	Identify a claim based on the evidence given.	This activity is designed to get students thinking about solid evidence. Divide students into groups of 2-4. Give each group 5 notecards. One of the cards needs to be marked “Claim”. Give each group a Super Secret Question. Each question needs to have a number on it. (Question suggestions below.) Make sure you tell them that they can’t let any other groups know what their question is. Post directions on the board:

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		Look at the question that your group has been given. **Use the internet to research the answer to your question.* **Make a CLAIM based on the evidence that you found. Write your claim on the "Claim" notecard.* **Have every member contribute at least one piece of evidence on the note cards provided. You can write it or draw it.* **After everyone has their evidence, you will be going on a tour to see evidence presented by other groups. You will try to guess their claim based only on their evidence.* (Teacher note: It is important to tell them what the end goal is going to be so that they can begin with the end in mind.) Allow 30 minutes for research. Some groups may need less. Some groups may need help figuring out what to type into their search bar. After everyone has their claim and evidence cards ready, have students place their evidence cards on their tables next to a Post-It note that indicates their question number. They need to hide their questions and claims for now. Have students take their notebooks with them as they travel from table to table and try to figure out what the claims are based on the evidence on the table. After students have seen several evidence cards and recorded their guesses about the claims, have everyone sit back down and discuss what their guesses were as a class. Ask each group to describe which cards that they looked at and what their claim guesses were. Have the owners of the cards announce the actual claim they were trying to represent with their evidence. This may lead to a discussion about how some evidence is better than other evidence when it comes to backing up a claim. Ask questions like, "how could that evidence be changed so that it helps the reader understand the claim? What types of evidence were the best? Was there any evidence that didn't match the group's claim?" OPTION: If your class does not have internet access/devices, you can provide multiple pieces of printed evidence to each group. Try to provide multiple views if possible. Suggested Questions for Activity: 1. Do athletes deserve to make more money than the average person?

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		2. Do people have a right to internet access? 3. Is social media making people less social? 4. Should children have restricted limits on the amount of screen-time they have? 5. What is the best thing that all households should do to conserve energy? 6. Do violent video games make people more likely to be violent in real life? 7. Is the earth flat? 8. Is homework harmful or helpful? OR Is homework effective? 9. Given what we now know about the effects of smoking, should smoking still be legal? 10. Which sport is the most dangerous to play?
Evaluate	Identify claim, evidence, and reasoning. Make a claim and support it with evidence.	Now that they have definitions and examples of Claims, Evidence, and Reasoning, give them the text Darwin's Finches. Work with a partner to find the Claim, Evidence, and Reasoning in this writing. Read through the directions with the students. They need to make a claim about what will happen to the finches, and then back it up with evidence and reason. After you write your paragraphs, use your highlighters to highlight your CER the same colors as your definition page. Teacher Note: There are actually a few different claims that could be made with the evidence in this small article. Discuss how the claims can be different as long as there is solid evidence to back it up! For instance, some students will say that the populations of large beaked finches will decrease, some will say that all of the populations of finches will decrease, and some may say that the numbers will dip but will come back up again because the finches will adapt just like they did in the first place. All of these could be backed up with evidence and reasoning with this document.

Optional Resources for Lesson 1:

If your students need more support for understanding, you can try these resources to supplement the lesson.

CER - Claim, Evidence, Reasoning by Bozeman Science

Critical Reasoning video on BrainPOP (requires a subscription)

Unit Lesson #2

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Guiding Questions	How is scientific writing organized? How does the organization of scientific writing help us to understand the content?	
	Key Idea	**Learning Activities**
Engage	Scientific writing comes in a variety of styles.	At the start of class, have several types of scientific writing out on the desks for students to look at. Make sure to put out a few about topics they will be drawn to. Put out at least one eye-catching article about a topic they will want to read about (like flat Earth, video games, etc.).
Explore	Scientific writing is organized in similar ways.	On the board post the question, 'In what ways is scientific writing organized? Do you see similarities/ differences between these pieces of writing?' Give students 8-10 minutes to look through and read the items on their desk. Tell them to write down their answers to the questions in their notebook and be prepared to share with the class.
Explain	Scientists organize their writing in a way that makes it easier for the readers to find key information.	At the end of 8 minutes, have each group share what they discovered. Have them come up and write it on the board themselves. Sometimes you have to help them word their answer in a way that will fit with this lesson better. When everyone has shared everything they want to share, write a new question on the board. 'Why do you think scientists structure their writing like this?' If students are stuck, give them an example. For instance, 'If I needed to find Monarch Butterflies in this Insect Field Guide, how would I do that?' Help them remember that a table of contents, index, and glossary are available in some texts and can help you find information quickly. Headings also help you find the information you are looking for quickly. Students may also notice the use of graphics. This helps keep the reader interested and helps you to visualize what they are talking about.
Elaborate	Now that you know how scientific writing is organized, you can use that to determine what a complex text is about.	Hand out a copy of the Anchor Text **Flight of the Bumblebee: Using Acoustics to Eavesdrop on Bees and Pollination**. Tell students they need to figure out what the text is about based on the organization. Look at the headings and titles, graphics, and captions. What do these tell you about the topic of the text AND what the researchers discovered? What was the experiment about? What did they learn? How did the organization of the document help you to understand its content?
Evaluate		Exit Ticket:

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		What are some ways that scientists organize their writing? Why do they organize it like that?

Unit Lesson #3

Guiding Questions	How can computers be used to understand sound and its source? How can sound waves be used to identify animals?	
	Key Idea	**Learning Activities**
Engage	We have developed different ways to "hear" or "describe", or "record" sound, which depend upon the individual, the sound, the circumstances and available technologies.	Students watch, listen and read these pieces about the sounds made by bees: • https://www.youtube.com/watch?v=pt480pC37DQ • To Make a Prairie (*Emily Dickinson)* To make a prairie it takes a clover and one bee — One clover, and a bee, And revery. The revery alone will do, If bees are few. • Students free-write about what they have heard, observed and read, and share with each other (in pairs or groups). • The teacher elicits discussion of how visualizing sounds helps us understand them, and of related topics, by prompting: ○ In the first two pieces, how do hearing and seeing help you understand and describe the sounds made by bees? ○ How would you change what you described if you could not both hear and see? *(Attend to students who are visually or hearing impaired.)* ○ What is Emily Dickinson saying about the sounds made by bees? What mental images do you form of these sounds upon reading "To Make a Prairie", and how do these affect you? Give students the **Claim, Evidence, and Reason document** for this unit. Read through the

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		phenomenon with students and introduce the question. Can acoustics (sound) be used to monitor bees? Write a claim that answers the question. Examples: Scientists can monitor bees with acoustics because… or Scientists cannot monitor bees with acoustics because... Explain that they will be returning to the document throughout the unit to record your evidence. NOTE: Students will not have a very deep understanding of acoustics yet and that is okay. We want them to make a claim based on what they CURRENTLY know. They will be finding evidence and then re-visiting their claims later.
Explore	Sound waves can be visualized and modeled using computers to help understand their properties, and properties of the source of the sound.	In this activity we will use a computer application (app) to visualize and analyze sound. Although the app SpectrumView™ is designed for iOS on the iPad, this activity will work with several other sound analysis apps on different platforms (Mac, PC) and versions suitable for Chromebooks are being tested. We will use two self-produced sounds: a whistle and the phrase “to make a prairie”. While you perform this activity, keep three fingers on your throat to feel what happens when you speak and make noise. 1. First, open SpectrumView™ to the Spectrogram view, and colors will begin to move across the screen. It is not recording yet, (not saving the data you see), but take advantage of this moment to look at the x- and y-axis. If there are ambient sounds or you are talking, briefly notice these cause changes on the screen. 2. Locate the Recording button and get ready to record! Once you begin recording (touch the circle to record) it should automatically put you back to Spectrogram View. With your three fingers on your throat, whisper “*to make a prairie*”, then speak “To Make a Prairie”, then shout “TO MAKE A PRAIRIE”. *(You will have 15 seconds to record. You should be able to say all three versions within the 15 seconds. If there is too much of a delay before you speak, you may run out of time. If this occurs simply hit the record button again and start over.)* 3. Now make a recording of a whistle. Try to whistle as high as you can, and then again, lower, and a third time as low as you can, within the 15 seconds. Be creative. The main point is to try to get a range and hold a single note for a couple of seconds. 4. Both of these tracks should be within your window of your Spectrogram view *(hit the Pause button in the lower left after the 15 seconds for the whistle track are up to freeze this frame in*

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		your view). Keeping in mind the axes and the types of sound you have produced, look at the graph and discuss with another participant what you see. How are the two tracks similar? How are they different? ● Record any key features you discussed about these sounds on a large piece of paper. In one section have a chart keeping tabs on the similarities and differences. 5. If there is time, let's try one more view. Go to Playback and select the first track where you said three times "to make a prairie". Hit Play and then immediately select the Spec Analyzer on the bottom. Watch it play and then again, take a look at your x- and y-axis. What were you seeing? What information is this giving you? 6. Play the whistle track and look at the same view. What did you notice this time? What is similar? What is different? 7. Add any new features you noticed in the SpecAnalyzer view to your list. Add or make changes to your list of similarities and differences based on this alternative view. 8. Share with the group what you have come up with as key features of these two types of sound and how you might categorize these two sounds based on your lists of similarities and differences. NOTE: What students should be able to see with this activity is that the louder a sound is, the higher the decibel reading. They can see this on their graphs on the app. The other thing they can see is that pitch changes the frequency. Higher pitches have a higher frequency, lower pitches have a lower frequency.
Explain	Sound waves can be visualized and modeled using computers to help understand their properties, and properties of the source of the sound.	● In pairs, students read several short articles or watch/listen to videos suitable for their comprehension. Some pertinent resources are listed below, but others, such as classroom textbooks, etc. can/should be included, ● As students go through the material, they are to use a Rolling Journal to identify key vocabulary and major concepts. Discussion: After students have had time to record key concepts and vocabulary in their **Rolling Journal**, discuss these and other pertinent questions: 1. What is sound energy and how is it created? (cite source/ evidence) 2. How does sound travel, and how is it affected by the medium through which it travels? (cite source/ evidence) 3. What type of wave is sound? (cite source/ evidence)

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		4. How can you describe frequency and amplitude of sound waves? How is the pitch of sound related to the frequency of sound waves? (cite source/ evidence) 5. What is the volume of sound? How is volume related to the amplitude of sound waves? (cite source/ evidence) **6.** How does a sound start? (cite source/ evidence)
Elaborate	Sound frequency and amplitude vary with the source and can help to identify it.	Categorizing audio by sound properties and using sound as an identification tool (est. 20min) <u>Option 1:</u> In this activity, groups of students will listen to and view a set of bird songs. 1. Open the three Bird Song Files in Google Drive *[1) Bird Song – Pitch; 2) Bird Song – Tones; 3) Bird Song – Patterns]* . 2. Copy to the SpectrumView™ app. All three files should appear under the Playback section. 3. Play "Bird Song – Pitch" in the Playback window (listen to the songs). 4. Draw frequency graphs for what you hear. 5. After drawing and taking a brief look at each other's work, switch to the Spectrogram view to see what these songs look like. ● Did your frequency graphs reflect what you can see plotted in the Spectrogram? ● Discuss what you heard vs. what you can see about these songs. 6. Next play "Bird Song – Tones." Watch these in Spectrogram view as they play. ● What do you notice about these songs? ● Do they remind you of the differences you saw in the earlier activity between the whistle and the spoken phrase? What is that telling you about their properties? 7. If there is time, play "Bird Song – Patterns" and watch it play in Spectrogram view. *(Press pause in the lower left to see the earlier fast "trill" songs before the final 3 repeated).* ● Have you noticed how different and how similar the bird songs look for the different species and the different categories they've been placed in? ● Thinking about the different sound properties you are now aware of, could you identify these birds based on their song (i.e. their sound properties)? <u>Option 2:</u> Play a video on YouTube of a mosquito buzzing and have a student record the sound on SpectrumView. Do the same with a honeybee sound and a bumblebee sound. Compare the sound waves that each of these animals produced. Would you be able to tell them apart based on the properties of their spectrograms? Compare the two as a class. Can we see the difference between

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		these two? What differences do we notice? This will help them make a better decision about whether or not acoustics can be used to monitor bees.
Evaluate		Students work together in groups/pairs to develop posters or other means to explain factors that define and can influence sound, using bird species from the list as examples. Posters should include visual representations with key sound properties identified, including frequencies and amplitudes. Students should reflect upon how visualizing sound might be used to identify the bird, and its properties and behavior. **COLLECT EVIDENCE**: Go back to your Claim, Evidence, and Reasoning worksheet and go to the **Lesson 3 Evidence** section. What evidence have you discovered to explain how sound could be used to distinguish between different species of bees? **Exit Ticket: (give to students)** Here is a chart of different types of bees in North America. Thinking about what you have read and experienced, draw a frequency graph for the "buzzes" three different types of bees might produce. Write 2-3 sentences explaining what you drew and why.

Unit Lesson #4

Guiding Questions	What is the purpose and function of plants? Are they important? What is the purpose and function of flowers? Are they important?	
	Key Idea	**Learning Activities**
Engage	The function of a flower is to produce offspring. All flowers have pollen and come in different colors and shapes in order to attract pollinators.	Students watch the slow motion video of flowers blooming as they walk into class. When everyone is settled in, post these questions on the board: 1. What is the purpose (function) of flowers?, 2. What are some of the similarities that you observed between flowers?, 3. How is the structure of the flower well suited for its functions? Watch the video again and have students write the answers to the questions in their journals. Have a class discussion about the answers.

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		Possible Answers: *The function of a flower is to produce new plants/seeds. *All flowers have pollen. *Flowers have different colors and shapes to attract pollinators.
Explore	Option 1: Different types of flowers attract different types of pollinators. Option 2: Pollinators are required for seed production in sunflowers.	Option 1: Take a tour of the greenhouse or nearby garden. What types of plants are there? What types of pollinators do you see? Take pictures of different types of plants, flowers, and pollinators that we see. You can use the plant pictures later to discuss what type of pollinators might visit them. When you come back inside, have students share some of their pictures with the class. Determine how many types of flowers you saw on your walk. Why are there so many or so few here? Think about the way the flower looks. Why do you think it looks this way? How is it attracting pollinators? *If you do not have cameras you could collect samples of flowers or have students draw pictures of the types of flowers that they find. You can also look up wildflowers of Missouri and look at the varieties we have locally. Option 2: Dissect harvested sunflowers from our experiment and count their seeds. Which groups had more/less seeds? Sunflower Experiment *Students should see that sunflowers that were pollinated have more seeds than those that were not.
Explain	Flowers use sexual and asexual reproduction to reproduce. The purpose of a flower is to attract pollinators and to create pollen for reproduction.	Students are assigned to read one of the assigned articles (see Rolling Journal for links) and fill out a "Fabulous Four" Rolling Journal . (These articles come in a variety of reading levels. Assign articles to readers based on their abilities. Do not tell them you are doing this.) Read your assigned text and determine the 4 words that best show the central idea of the text. Next use your 4 words to write about the most important ideas of the text. Be ready to share your words and sentences. As you hear about other texts, add to your words and ideas. This can also be done as a shared Google Doc. Each group is assigned an article based on reading level and they complete a slide about their article. When it is complete, groups share with the class.
Elaborate	The purpose of a flower is to attract pollinators and to create pollen for reproduction.	Lead the class in a discussion that revisits the original questions. What did you discover about the purpose/function of plants? Flowers? **COLLECT EVIDENCE**: Go back to your Claim, Evidence, and Reasoning worksheet and go to **Lesson 4 Evidence** section. What evidence have you discovered to explain why flowers are important?

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Evaluate		Exit Slip: (I do this on Schoology or GoFormative.com) Are plants important? Defend your answer. Do you still have questions? Anything you're still wondering about?

Unit Lesson #5

Guiding Questions	How are flowers adapted to attract specific pollinators? What is the relationship between pollinators and plants?	
	Key Idea	**Learning Activities**
Engage	Pollinators serve an important role in our lives.	Have snacks on the table or counter at the beginning of class. On the board, have the question, "Why do we need pollinators?" Or "Why are pollinators important?" After a brief discussion, point to the snacks and ask the class what they think all of these snacks have in common. Pollinators! You could also remove all of the snacks and say, "without pollinators, none of these snacks exist." Ask the students the following questions: What are your favorite flowers? Why do plants have flowers?
Explore	Flowers are in a symbiotic relationship with pollinators. Flowers are designed to attract specific pollinators. Pollinators are attracted to specific traits that flowers have.	Ask the students the following questions before watching the video: Do you think all flowers are trying to attract the same pollinators? Why are there so many types of flowers? Watch the video Trading Food for Fertilization. While you watch, write in your journals. What are some facts that you learned from the video? Be prepared to share. After the video, allow time for sharing their video facts. Ask them if they would like to add to or modify their answers to the questions: Do you think all flowers are trying to attract the same pollinators? Why are there so many types of flowers?

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		Pass out the Pollinator Observation Data Sheets from Part One of Flowers Seeking Pollinators. Assign each group a pollinator (there are 6 choices). Briefly explain what this chart is about and how it is organized. Look at the question on the back. Explain to the class that they need to look at which flower or flowers that their pollinator visited the most. Some pollinators clearly visit one flower more than any other. Other pollinators may visit more than one flower. On the paper, list the 3 flower traits that you think attract your pollinator.
Explain	Flowers are designed to attract specific pollinators. Pollinators are attracted to specific traits of flowers.	Pass out the Constructing Explanations sheet from Part Two of Flowers Seeking Pollinators. Also pass out the Pollinator Profile cards. Have a student read the directions. Use the Pollinator Profile card and your Datasheet to help you complete this assignment. Using all of the information, what are 3 traits that you think attract your pollinator? Find evidence on your card or data sheet to support your claims.
Elaborate	There are many types of flowers and pollinators. Flowers are designed to attract specific pollinators.	Post the following questions on the board: What is the author's purpose? What is something new you learned from this book? How does this book add to what you learned already? What new questions does it raise? Explain that you will be reading a book to them and that they need to answer those questions in their notebooks. Be prepared to share at least one thing from your notes with the class. Show them the front of the book. What do you think the title means? Read the book The Flowers are Calling by Rita Gray. After reading, have students share from their notes. If students have new questions you can also take a moment to research the answers.
Evaluate		Part Three of Flowers Seeking Pollinators "Imaginary Garden". Students will think about the traits that their pollinator looks for in a flower. They will look through several fake flowers and decide which one their pollinator is attracted to the most. Once the group has decided on their flower, they need to create a presentation for the class. The presentation should explain to the class why their pollinator is attracted to that flower. They could create a Keynote, Google Slide show, or Clips App presentation about their pollinator. The presentation could also require them to show two-three other flowers that their pollinator is attracted to. Explain why your pollinator is attracted to each of those flowers.

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		COLLECT EVIDENCE: Go back to your Claim, Evidence, and Reasoning worksheet and go the **Lesson 5 Evidence** section. What evidence have you discovered to explain why pollinators are important?

Unit Lesson #6

Guiding Questions	How do you solve a design problem?	
	Key Idea	**Learning Activities**
Engage	The two basic elements, or phases, of the problem solving process are establishing the criteria, and determining the constraints.	Have a picture on the board of different types of mouse traps along with the question "Which mouse trap is the best?" The Design Process: Have the students read the following article: Who Needs a Better Mousetrap? Using the article, share ideas and develop a class graphic organizer that outlines the basic elements (or phases) of the "problem solving process." Ensure that the graphic organizer is large enough to add a new row of information related to the problem the students will engage in for this learning cycle. What are "criteria"? What are "constraints"? Watch the video TEDEd Creative Constraints. Ask students, what are the constraints discussed in this video? When have you been given criteria and constraints? Do you ever do projects at school? Do your teachers tell you the criteria? What are the constraints of the project?
Explore	Before you can solve a problem, you must identify what the problem is.	Identifying a Problem: Provide students with a copy of the "Letter to the Scientists". Inform the students that they are the scientists. After the students have read the letter, have them break up into small groups or pairs to respond to the following questions: What is the problem that the farmers are facing? Why might the farmers be facing this problem?

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		What might happen if the problem continues? For each question, highlight/underline on the letter your “evidence” for your response. (Make sure the students place a number beside what they underline to indicate the connection between the evidence and the question.) Share responses with the whole class. After sharing, add information to the problem-solving process graphic organizer related to the problem. Discuss each element identified to ensure a shared understanding of each.
Explain	Use evidence from text to identify a problem and establish criteria and constraints.	Criteria and Constraints: Break students up into small groups of 3 or 4. Provide the students with a copy of the anchor text Anchor Text - Flight of the Bumblebee: Using Acoustics to Eavesdrop on Bees and Pollinators and Honeybees help farmers, but they don’t help the environment (NPR). The students are to read both articles, however, for the anchor text, instruct the students to read the sections: “Background,” and the “Discussion” portion of the text. You can also have students listen to the NPR online and read along from the transcript of the show as you listen. In the small groups, have the students use the information that they have been provided with to identify possible criteria and constraints of the problem that they are solving. For the criteria and constraints (the claims), they are to provide supporting evidence (a statement/sentence from the articles.) They are to create a table in their notebook to record the information.
Elaborate	There are many ways to solve a design problem.	Developing Solutions: Explain to students that once a problem is understood, the next step is to develop a solution. But what are some things that we should know to help facilitate the development of a solution? Watch the video Engineering Design Process: A Taco Party. Instruct the students to write down what they think the steps should be for design problems while they watch the video(s). Provide the students access to the articles: The Problem Solvers and Developing Possible Solutions. Have the students choose 1 article to read. After they have read the article, have the students respond to the following prompt on a piece of paper: What are three steps that may occur during a solution phase? After they have written their

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		response, have them crumple up the paper and “toss” into a common area (Commit & Toss). Each student is to get one piece of paper (not their own) and, in a small group, discuss the steps identified. Add to the graphic organizer the different steps that may occur during the solution phase. Do a whole class brainstorm of possible solution pathways for the dilemma the farmers are facing. Encourage the students to draw on and think about what they have heard and read during the course of the inquiry. Once you have a list of ideas, pick ONE. Divide students into two groups. Choose one group to support the solution and the other to oppose the solution. As a group, they are to write two claims in defense of their position and provide evidence for those claims. Have each group share their claims and evidence and then discuss as a group. One possible way to share this is to have a team member from each group share the claims and evidence in a Google Doc that everyone in class can see. This document can also be displayed on the board. You can also take a vote as to which position was the strongest. You could create a Kahoot, Survey Monkey, or other type of online survey tool to get quick, anonymous results.
Evaluate		Critiquing a Possible Solution: Individually complete the “Robo-Bees” activity. It may also be helpful to print these articles so that students can look at a physical copy. Exit Slip: At the end of each instructional session, have the students write to the following prompt: What are the actions you would need to take to solve a design problem? Give students the Anchor Text: Flight of the Bumblebee. Students can read this alone or you can have them read it with a partner and discuss. Can acoustics be used to monitor bee behavior? Is it the most reliable method? **COLLECT EVIDENCE**: Go back to your Claim, Evidence, and Reasoning worksheet and go to the **Lesson 6 Evidence** section. What evidence have you discovered to explain how scientists could monitor bee behavior? **Revisit your claim? Do you need to revise it based on the evidence you have collected during this unit?** **Reasoning: Explain how your evidence supports your claim. What scientific laws/rules support your claim?**

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