



Lesson 1: What is Happening to the Rusty Patched Bumblebee?

Lesson Overview: In this lesson students are introduced to the phenomenon of the decline of the Rusty Patched Bumblebee (RPB) population. A clip of the video “Gone but not Forgotten: The Rusty Patched Bumblebee” and the citizen science project “Bumblebee Watch” are used to introduce this native pollinator. Students record their observations as they review and generate questions that will guide their investigations in subsequent lessons. Students make an initial model of the components and interactions of the RPB ecosystem based on the information provided in this introduction.

Materials

- Lesson 1 Slide Deck
- Internet enabled devices for students to access Bumblebee Watch
- Driving Question Board
- Sticky Notes
- Summary Chart

Time Estimate: 2 class periods

Before the lesson begins

- Create a log in for Bumblebee Watch
 - Go to <https://www.bumblebeewatch.org/>
 - Familiarize yourself with the project
 - Select “sign up” from the upper right hand side of the webpage
 - Create a username and password that you will share with your class
 - Complete the rest of the information (only the username and password will be shared with students)
 - Insert username and password into Slide 7 of the Slide Deck.
- Organize Space for Driving Question Board
 - Use the [Unit Preface](#) to familiarize yourself with the Driving Question Board tool.

- The Driving Question Board should remain visible throughout the duration of the unit. Find a place where it can be easily visited by students.
- Each class engaged in the unit should have its own Driving Question Board
- Organize Summary Chart in the Classroom
 - Use the [Unit Preface](#) to familiarize yourself with the Summary Chart tool and protocol.
 - The summary chart can be developed either digitally or on paper.
 - Each class should have its own Summary Chart
- Prepare for Students Models
 - If new to modeling these resources from [STEM Teaching Tools](#) and [Ambitious Science Teaching](#) are a great way to get started.
 - Students create their initial model in this lesson. They add on to this model at various times throughout the unit as new information is learned.
 - Provide each student with a large enough piece of paper to eventually model the entire RPB ecosystem.
 - Decide where these individual models will be stored so that they can be accessed throughout the unit.

Three Dimensional Learning

Science and Engineering Practices		
<u>Element</u>	<u>How it is used</u>	<u>Where it is used</u>
Asking Questions and Defining Problems <i>Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.</i>	Students use this 6-8 element at grade level in this lesson. If this practice has not been previously developed, further support may be needed to ensure that all students can engage in this practice. One such support could be the use of the Question Formulation Technique from the Right Question Institute .	Students generate questions based on observations from video, Bumblebee Watch information, and the “Petition to List” document Students refine or organize these questions using the Crosscutting Concepts.
Developing and Using Models	Students use this 6-8 element in this	Students develop a model of the RPB

<i>Develop and/or use a model to predict and/or describe phenomena.</i>	lesson. If this practice has not been previously developed, further support may be needed to ensure that all students can engage in this practice. One such support could be to use a class consensus model.	system. They use the model to help them identify questions they need to answer in order to make sense of the phenomenon.
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Disciplinary Core Ideas		
<u>Element</u>	<u>How it is used and prior knowledge</u>	<u>Where it is used</u>
LS2.C: Ecosystems Dynamics, Functioning, and Resilience <i>Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations (MS-LS2-4).</i>	This 6-8 element is being developed in this lesson. Students are not expected to be proficient in their understanding and use of this element at this point in the unit.	Students generate questions that will be used to guide their investigation of how the ecosystem of the RPB has changed over time.
LS2.A: Interdependent Relationships in Ecosystems	This 6-8 element is being developed in this lesson. Students are not expected to be proficient in their understanding and use of this element at this point in the unit.	Students list the components of the RPB ecosystem and their interactions using evidence from the video, Bumblebee Watch, and the “Petition to List” document. They do not categorize factors

<i>Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors (MS-LS2-1) .</i>		as living and nonliving at this point. Students generate questions that will be used to guide their investigation of how the living and nonliving factors in the RPB ecosystem interact
ESS3.C: Human Impacts on Earth's Systems <i>Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things (MS-ESS3-4).</i>	This 6-8 element is being developed in this lesson. Students are not expected to be proficient in their understanding and use of this element at this point in the unit.	Students generate questions that will be used to guide their investigation of how human activities have changed the ecosystem of the RPB.

Crosscutting Concepts		
<u>Element</u>	<u>How it is used</u>	<u>Where it is used</u>
Systems and System Models <i>A system can be described in terms of its components and their interactions.</i>	Students develop this 3-5 element in this lesson. They will develop their ability to use this CCC in later lessons.	Students are given a definition of a system and asked to identify the components and interactions of the RPB system.

Cause and Effect <i>Cause and effect relationships are routinely identified, tested, and used to explain change.</i>	Students develop these 3-5 elements in this lesson. They will develop their ability to use this CCC in later lessons.	Students ask questions to ultimately determine the cause of the RPB population decline.

Objectives: Students ask questions to determine the cause and impact of the decline of the Rusty Patched Bumblebee (RPB) range and population. Students develop models of the interaction of the components within the RPB ecosystem.

Meet the Rusty Patched Bumblebee	
Phenomena Natural Phenomena are observable events that occur in the universe and that we can use our science knowledge to explain or predict. The goal of building knowledge in science is to develop general ideas, based on evidence, that can explain and predict phenomena.	Students are introduced to the concept of phenomena Say, “We are going to take a look at a couple of different resources to introduce you to the phenomena we are going to try to figure out in this unit. As our definition tells us, we hope we can build our science knowledge to explain and predict this phenomena.”

"Forgotten But Not Gone: The Rusty Patched Bumblebee"



Students watch the video, ["Gone but not Forgotten: The Rusty Patched Bumblebee"](#)

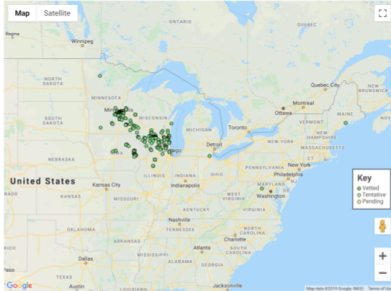
- The video stops at 2:00 mins. when he says, "In early 2013 we filed a petition with the fish and wildlife service to have the Rusty Patched Bumblebee listed as an endangered species."
- As students watch the video clip, have them record observations and things they learn about the RPB on the "What do you notice" box of their Lesson 1 Worksheet.

In March 2017 the Rusty Patched Bumblebee was the first bumblebee species listed as endangered.

Students learn that the RPB was placed on the endangered species list

- Use the slide to inform students that the RPB was indeed placed on the endangered species list in 2017.

Xerces Society: Bumble Bee Watch (*Bombus affinis*)

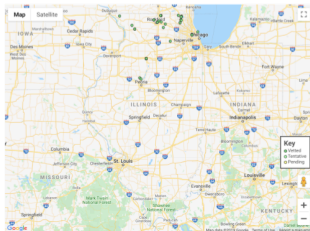


Xerces Society: Bumblebee Watch

Students see all sightings of the RPB as part of Bumblebee Watch.

- Explain to students that “Bumblebee Watch” is a collaborative effort to track and conserve North America’s bumblebees
- Citizen scientists can upload photos and other information of bumblebees they observe to the website. The species of bumblebee is then verified by experts.
- This helps researchers determine the status and conservation needs of bumblebees, locate rare or endangered populations of bumblebees and learn about bumblebees, their ecology, and ongoing conservation efforts
- This map shows all of the sightings of the RPB recorded through the project from 2011-2019.

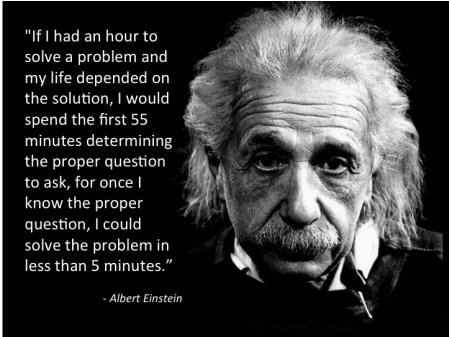
Bumble Bee Watch (*Bombus affinis*)



Students see a map of recent (2011-2019) sightings of RPB in Illinois.

- This map shows all of the sightings of RPB in Illinois.
- Explain that each sighting includes other additional information about the bumblebee sighting and that it would be helpful to take a look at some of this information to see if we can learn anymore about the RPB

Bumble Bee Watch (<i>Bombus affinis</i>) 1. Go to www.bumblebeewatch.org 2. Sign in: Username _____, Password _____ 3. Click on the “Map” tab at the top of the screen and select “Bumble Bee Sightings.” 4. Choose State: Illinois, Species: affinis/Rusty Patched Bumble Bee, Year: 2019, 2018, 2017, 2016, 2015, 2014, 2013, 2012, 2011 5. Click “Search”	Students log on to Bumblebee Watch • Use the directions from the Slide Deck to guide students in logging into Bumblebee Watch
Bumblebee Watch • Each green dot represents a verified sighting of a Rusty Patched Bumblebee • Click on the green dots to get more information about each sighting • Record any patterns or other observations you notice in the ‘What Do I Notice?’ section of your worksheet	Students explore information and record observations using Bumblebee Watch • Have students follow the directions to add observations to their “What Do I Notice?” section of their worksheet. • Circulate while students are working and encourage students to notice habitats, floral hosts, and time of year RPB sightings were made.
Share with a Partner • What did you notice in these resources? • Pick a partner to share what each group has learned about the RPB with the class.	Students share their observations • Have students share their observations from the “What Do You Notice” box of their Lesson 1 Worksheet with a partner. • Have students share what they have learned about the RPB with the class. • Introduce the Summary Chart to students. Lead a discussion to fill in the “What did we do” and “What did we learn” from student contributions.

	<i>Formative Assessment: At this point students should demonstrate an understanding:</i> • <i>Scientists began to notice that the RPB population and range were declining in the 1990's.</i> • <i>RPB have been sighted in Illinois</i> <i>Action Steps: If students do not demonstrate these understandings, you can:</i> • <i>Find students who have noticed this and have them share these ideas with the class.</i> • <i>Go back and rewatch the "Gone But Not Forgotten" video</i> • <i>Discuss RPB sighting information as a class.</i>
	Students formulate questions about the RPB • Explain to students that over the course of the next couple of days we plan to investigate the RPB. • To begin to do this, we must identify the questions we must answer in order to understand what is going on with the RPB. • Give students 5 minutes to write questions they have about the RPB in the "What Do You Wonder" boxes of their Lesson 1 Worksheet. (They will complete the CCC section later.)
Systems and System Models A system is an organized group of related objects or components: models can be used for understanding and predicting the behaviour of systems • What components are part of the RPB ecosystem? • What other components in the RPB system does each component interact with?	Students list components in the RPB system. Class makes a common list of components. • Tell students that you want to hear what they think is happening to the RPB, but you know that it is a complicated phenomenon. It would be helpful to create a model to show what they are thinking. • Explain that the RPB, like all living things, are one part of a larger system and that describing and thinking in systems is one way that

	scientists make sense of phenomena and design solutions. For living things this system is called an ecosystem. ● Explain to students what a system is using the definition on the slide. ● Explain that models are made up of components, or parts, that interact with each other. The purpose of our model will be to show how these components interact. ● Have students use their observations from the Lesson 1 Worksheet to list the components of the RPB system and other components they interact with.
Model of the RPB System Develop a model of the RPB system. Your model should describe how all of the components in the RPB system interact with each other. To create you model you can use pictures, words, and symbols. When you are done with your model, share your model with a partner. Use your model to share ideas for why the population and range of the RPB has declined. Add new questions to your "What Do I Wonder" section.	Students create a model of the RPB system and add to their questions. ● Have students follow the directions on the slide to create their own individual model. They should make this model on a blank sheet of paper. They will add to this model frequently throughout the unit. ○ If students are new to developing models, consider creating a class consensus model. ○ Also, these examples will show students how models communicate science ideas. ● Have students share their model with a partner. They should also share ideas for why the RPB population has declined. ● Students may wonder at this point how the components fit into the system. It is a good time to revisit their, "What do I Wonder?" box to add questions. Encourage students to use their model to help them identify productive questions to investigate. ● Have partners share their ideas for why the RPB population has declined with the class. <i>Formative Assessment:</i> Students models should include:

	• Rusty Patched Bumble Bees • Flowers • Humans The interactions between these components may be unclear or lead to some questions at this point. <i>Action Steps:</i> If a student does not have these components in their model, have them review the model of a student that does.
Cross Cutting Concepts • Patterns • Cause and Effect • Scale, Proportion and Quantity • Systems and System Models • Energy and Matter • Structure and Function • Stability and Change	Students categorize and refine their questions • Say to students, “One of the uses of the Crosscutting Concepts is to make sure we are asking the right questions to help us make sense of phenomena and problems.” • Have students review their questions and label each question with a Crosscutting Concept • In groups, ask students to compare their questions. • Some of their questions may be vocabulary questions. For example: “What is a pollinator?” Have them label these as vocabulary • Encourage students to record questions to make them more clear.
What questions will be most useful in order to make sense of our phenomenon?	Class shares questions and organizes a Driving Question Board • Using the questions from the “What do you Wonder? box, have groups of students identify the most important questions that, if answered, will help them thoroughly make sense of the RPB population and range decline. • Have groups of students write their most useful questions, along with the CCC, on a notecard or sticky note. ○ Only one question per notecard or sticky note. • Have students share their questions with the class one at a time.

	• They should add their question to the Driving Question Board. • Organize questions by CCC on the driving question board.
Where is the best place to start?	Class determines next step • After constructing and reviewing the Driving Question Board, discuss with the class the best place to start to figure out why the RPB became endangered. • Steer the conversation towards learning more about the system of the RPB and answering the questions labeled "System and System Models' ' from the DQB.