Description: Students will learn about the plants, animals, and insects on their campus by first learning about biodiversity and then through phenology, learning the different phenological stages of the plants, animals, and insects. They will practice data visualization through graphs, as well as a final piece that summarizes all of the data collected over the course of the year.
Time Estimates: The initial lessons will be four 50 minute class periods – one each for supporting question 1 and 2, and two class periods for supporting question 3. But the biodiversity surveys and data visualization should be repeated once a quarter (or once a season); could occur in one 90 minute class period.
Learning Target & Success Criteria: Students will take biodiversity surveys throughout the school year to create a map (or phenological calendar) of the school campus.
Standards: HS.L2U3.18, HS+B.L4U1.2, HS.L2U1.19, HS+B.L2U1.3
Where in the curriculum: This unit will probably happen fairly early in the school year, but will be repeated at least four times over the course of the year.

<table>
<tr><th colspan="2">Compelling Question: How and why does our environment change over the course of a (school) year?</th></tr>
<tr><td>Clarity:
Learning Target
Success Criteria
Rationale</td><td>WHAT: I will map the different plants, animals, insects, etc. that are on my school campus over the course of the year, and what state they are in (phenology).

HOW: I'll successfully do this by:
- Learning about urban biodiversity & its importance.
- Learn about phenology and how it applies to different species.
- Taking urban biodiversity surveys of select locations around campus, at least 4 times throughout the school year (but ideally during each of the 5 seasons)
- Create a map, graph, or other data visualization that summarizes the collected data.

WHY: In order to better understand what is living at our school (and how that may change from year to year)</td></tr>
<tr><td>Standards and Practices</td><td>Science Standards:
● HS.L2U3.18 Obtain, evaluate, and communicate about the positive and negative ethical, social, economic, and political implications of human activity on the biodiversity of an ecosystem.
● HS+B.L4U1.2 Engage in argument from evidence that changes in environmental conditions or human interventions may change species diversity in an ecosystem.
● HS.L2U1.19 Develop and use models that show how changes in the transfer of matter and energy within an ecosystem and interactions between species may affect organisms and their environment.
● HS+B.L2U1.3 Use mathematics and computational thinking to support claims for the cycling of matter and flow of energy through trophic levels in an ecosystem.

Science and Engineering Practices:
● Analyzing and Interpreting Data Scientific investigations produce data that must be analyzed in order to derive meaning. Engineering investigations include analysis of data collected in the tests of designs.
● Planning and Carrying Out Investigations Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually.
● Asking Questions and Defining Problems A science practice is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and can be empirically tested.

Crosscutting Concepts:
● Patterns Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.</td></tr>
</table>

Staging the Question	1. Take a walk around the campus, making a note of any plants, animals, insects, etc. that you know/see. It is ok if you don't know a lot of their names! Mark the ones you do know down on a campus map. 2. Pick one area and create a detailed map of all of the plants in that area, even if you don't know what they are called. How many different kinds of plants are there? Did you see any animals or insects? How many and what kind (if you know)? Create a key for your map. 3. Come back together as a class and share your area maps. Which areas of campus are the most diverse (in terms of plants, animals, insects)? Why do you think that is?

Supporting Question 1	Supporting Question 1	Supporting Question 1
What is urban biodiversity?	How can we represent (this) data in a meaningful way?	What is phenology?
Formative Performance Task	**Formative Performance Task**	**Formative Performance Task**
Based on the area maps already created, pick 5 locations around campus to focus on. Take surveys around campus of birds, plants, animals & insects, and any other data that your class feels is important.	Create a graph or some sort of data visualization that makes sense of the urban biodiversity data.	Pick one animal, one plant, one bird, or one insect from the Sonoran Desert and create an infographic showing the phenological stages. Get some information from nature, before using the apps.
Featured Sources	**Featured Sources**	**Featured Sources**
• What Is Biodiversity? | Smithsonian National Museum of Natural History • Can You Name The Birds Around Us Activity | Santa Cruz River Connections • Can You Name The Plants Around Us Activity • iNaturalist | Home • Merlin Bird ID • Ironwood Tree Experience W.A.T.E.R Field Study | BioBlitz Lesson Plan	• Exploring Data Through Art Lesson | Santa Cruz River Connections • Data Detectives: Inquiry and Visualization Lessons | Santa Cruz River Connections • Get to Know You Data Visualization (based on Dear Data) | Santa Cruz River Connections	• Example: Phenological stages of macadamia plant • Why phenology? | USA National Phenology Network • Observe with Nature's Notebook | USA National Phenology Network • National Phenology Network
Extension	**Extension**	**Extension**

• Do nature journaling while collecting your data.
  ○ Field and Nature Journaling Scaffolds | Santa Cruz River Connection
  ○ Field and Nature Journaling (JM Laws) | Santa Cruz River Connections
• Ironwood Tree Experience W.A.T.E.R Field Study: BioBlitz
	• Become pen pals with someone else (at your school or another school) and share your data via postcards (like in *Dear Data*).	• Have students create more than one infographic; perhaps one from each category
		• Create a food web using the infographics. Use this lesson to help: Desert Dwellers Food Web Activity | Santa Cruz River Connections

<table>
<tr><td colspan="2">• Have students do surveys at their houses, neighborhoods, parks, etc. and report back</td><td></td><td></td></tr>
<tr><td rowspan="3">Compelling Question: How and why does our environment change over the course of a (school) year?</td><td>Summative Performance Task</td><td colspan="2">Option 1: Create a map of the campus for each season, noting the urban biodiversity and phenology. Be sure to include drawings, words, and numbers – this map should be an extension of your Nature Journal. What stage should different plants and animals be in during each season?
Option 2: Create a calendar for the school year that denotes when different plants should be blooming, dropping fruit, animals and insects should be being born/hatching/mating, etc. Make a note of where on campus someone may find these plants, animals, etc.</td></tr>
<tr><td>Featured Resources</td><td colspan="2">• Observe with Nature's Notebook | USA National Phenology Network
• Example Phenology Calendars (attached)</td></tr>
<tr><td>Extension</td><td colspan="2">Create a coloring page based on some of the plants and animals from each season that can be found on the school campus. Use the coloring pages in these School Garden Almanacs as a guide: The Sonoran Desert School Gardener's Almanac</td></tr>
<tr><td>Taking Informed Action</td><td colspan="3">1. Try to increase the urban biodiversity on your school campus by participating in “Creating Urban Habitat” with Pima County.
2. Research what kinds of plants would attract pollinators and birds and create a pollinator garden on campus.
3. Build nest boxes for Lucy’s Warbler</td></tr>
</table>

Lessons

Urban Biodiversity & Phenology	
Supporting Question # 1	What is urban biodiversity?
Learning Target: What am I learning today?	I am learning: the definition and importance of biodiversity & urban biodiversity, how to do a bird/plant/animal survey, how to collect data
Success Criteria: How will I know that I have learned it?	I can: define biodiversity and its importance, do a bird/plant/animal survey, determine the best method for collecting data
Why am I learning this?	This is important because having a diverse ecosystem helps to sustain everything on Earth. Biodiversity supports food security, medicines, pollination, water conservation, etc.
Formative Performance Task	Students (or the teacher) will pick 5 locations around campus to focus on. These areas can range from very diverse to less diverse. Take surveys of the birds, plants, animals & insects, and any other data that your class feels is important. Discuss different methods of data collection.
Sources	Teaching slides – slides #__-__
Additional Sources	● What Is Biodiversity? | Smithsonian National Museum of Natural History ● Can You Name The Birds Around Us Activity | Santa Cruz River Connections ● Can You Name The Plants Around Us Activity ● iNaturalist | Home ● Merlin Bird ID
Extension Activity	Do nature journaling while collecting your data. - Field and Nature Journaling Scaffolds | Santa Cruz River Connection - Field and Nature Journaling (JM Laws) | Santa Cruz River Connections

Do repeat surveys and observations each quarter or each season so that you can slowly build up your data for the calendar or map. Students will need to have at least 3-4 points of data to create a complete picture of the plants, animals, and birds throughout the school year. After each round of surveys and observations, have students find a way to represent the data using different data visualization techniques.

Urban Biodiversity & Phenology	
Supporting Question #3	How can we represent (this) data in a meaningful way?
Learning Target: What am I learning today?	I am learning: how to visualize data in interesting and unique ways
Success Criteria: How will I know that I have learned it?	I can: analyze data and represent it visually – either graphically or in a unique way.
Why am I learning this?	This is important because learning different ways to present data will aid in comprehension and communication. It also allows us to be creative in the ways that we present our data.
Formative Performance Task	Create a graph or some sort of data visualization that makes sense of the biodiversity data.
Sources	Teaching slides – slides #__-__
Additional Sources	• Exploring Data Through Art Lesson | Santa Cruz River Connections • Data Detectives: Inquiry and Visualization Lessons | Santa Cruz River Connections • Get to Know You Data Visualization (based on Dear Data) | Santa Cruz River Connections
Extension Activity	Become pen pals with someone else (at your school or another school) and share your data via postcards (like in *Dear Data*). The data could be related to the campus surveys or they can be about different topics.

Do repeat surveys and observations each quarter or each season so that you can slowly build up your data for the calendar or map. Students will need to have at least 3-4 points of data to create a complete picture of the plants, animals, and birds throughout the school year. After each round of surveys and observations, have students find a way to represent the data using different data visualization techniques.

Urban Biodiversity & Phenology	
Supporting Question #2	What is phenology?
Learning Target: What am I learning today?	I am learning: the definition of phenology, about the different phenological stages of animals, plants, and insects of the Sonoran Desert
Success Criteria: How will I know that I have learned it?	I can: define phenology, identify examples of different phenological stages of common plants and animals
Why am I learning this?	This is important because phenology helps us track climate change and its affect on the plants and animals in our environment. Phenology also helps us with agriculture; knowing when things are happening in our environment will help determine which plants to plant, harvest, etc.
Formative Performance Task	Pick one animal, one plant, one bird, or one insect from the Sonoran Desert and create an infographic showing the phenological stages. Get some information from nature, before using the apps.
Sources	Teaching slides – slides #__-__
Additional Sources	• Example: Phenological stages of macadamia plant • Observe with Nature's Notebook | USA National Phenology Network • National Phenology Network • Why phenology? | USA National Phenology Network
Extension Activity	• Create a food web using the infographics. Use this lesson to help: Desert Dwellers Food Web Activity | Santa Cruz River Connections

Do repeat surveys and observations each quarter or each season so that you can slowly build up your data for the calendar or map. Students will need to have at least 3-4 points of data to create a complete picture of the plants, animals, and birds throughout the school year. After each round of surveys and observations, have students find a way to represent the data using different data visualization techniques.

Before completing the summative task, be sure that students have at least 3-4 points of data so that they can create a complete picture of the plants, animals, and birds throughout the school year.

Urban Biodiversity & Phenology	
Compelling Question	How and why does our environment change over the course of a (school) year?
Learning Target: What am I learning today?	I am learning: about urban biodiversity, phenology, and data visualization.
Success Criteria: How will I know that I have learned it?	I can: show the progression (phenological stages) of the different plants, animals, and birds on my school's campus; determine biodiversity data trends from one quarter/season to the next & visually represent it.
Why am I learning this?	This is important because having a better understanding of the plants, animals, and birds that are on our campus will allow us to identify ways to increase biodiversity. And understanding the phenological stages will help us be better gardeners as well as be better stewards of the land since climate change is slowly affecting the timing of the phenological stages.
Summative Performance Task	• Option 1: Create a map of the campus for each season, noting the biodiversity and phenology. Be sure to include drawings, words, and numbers – this map should be an extension of your Nature Journal. What stage should different plants and animals be in during each season? • Option 2: Create a calendar for the school year that denotes when different plants should be blooming, dropping fruit, animals and insects should be being born/hatching/mating, etc. Make a note of where on campus someone may find these plants, animals, etc.
Featured Resources	• Observe with Nature's Notebook | USA National Phenology Network • Blank Templates: Phenology Wheel | Practical Pages
Extension Activity	Create a coloring page based on some of the plants and animals from each season that can be found on the school campus. Use the coloring pages in these School Garden Almanacs as a guide: The Sonoran Desert School Gardener's Almanac
Taking Informed Action	1. Try to increase the biodiversity on your school campus by participating in "Creating Urban Habitat" with Pima County. 2. Research what kinds of plants would attract pollinators and birds and create a pollinator garden on campus. 3. Build nest boxes for Lucy Warbler's
Sources for Taking Informed Action	1. Field Study Trips & Classroom Programs | Pima County, AZ 2. Habitat at Home Program Resources ⋆ Tucson Bird Alliance; How to design your Tucson pollinator garden 3. Lucy's Warbler Plans