

Overview:

Lesson routine	Questions	Phenomena/Problems	What we figured out
L1: Garden Observation 1 Anchoring Phenomena Know, Wonder, Learn Authors: Lauren & Rebecca	<ul style="list-style-type: none">• What do you know about gardens, and pollinators?• What do you think these animals are doing on the flowers?	What animals are in the garden and what are they doing? What are the pollinators doing to the flowers?	We observed a variety of animals in the garden. Some of animals observed in the garden are pollinators that carry pollen to and from flowers.
L2: Garden Observation 2 Anchoring Phenomena Know, Wonder, Learn Authors: Lauren & Rebecca	<ul style="list-style-type: none">• Did you see animals travel between flowers?• What do you think these animals are doing?	Why are animals traveling between flowers?	We observed many pollinators travelling to and from flowers.
L3: Bee Observation Authors: Josh & Krista	<ul style="list-style-type: none">• What is the yellow stuff on the bee?• How do pollinators carry pollen?	How is pollen transferred from flower to flower?	Pollinators contain parts that transport pollen. Pollination is when pollen is transferred from one plant to another.
L4: Flower Dissection Author: Josh	<ul style="list-style-type: none">• What are the different parts of a flower?• Where is pollen inside the flower?• How do pollinators get the pollen?	What part of the flower attracts pollinators? The different parts of a flower	Flowers use bright colors to attract pollinators. Plants use pollen for reproduction and to make seeds, and animals can get food from the plant in exchange.

<p>L5: Pollen Transport Game Model</p> <p>Authors: Krista</p>	<ul style="list-style-type: none"> • Why is pollination important? 	<p>How is pollen transferred from flower to flower?</p>	<p>Students will be able to model how pollinators transfer pollen between flowers.</p>
<p>L6: Creating a Pollinator Garden/Garden Improvement 1: Picking and coloring flower</p> <p>Authors: China & Ryu</p>	<ul style="list-style-type: none"> • How can we help the pollinators in our community? • What flowers do the pollinators like best (colors, shapes, etc)? 	<p>How do we combat pollinator decline?</p>	<p>The community suffers from a decline in pollinators, to help the community, a pollinator garden could help attract greater amounts of pollinators to the area and will help sustain future populations.</p>
<p>L7: Creating a Pollinator Garden/Garden Improvement 2: Presenting Flower Choice</p> <p>Authors: China</p>	<ul style="list-style-type: none"> • Why do you want the flower of your choice in the garden? 	<p>How do we combat pollinator decline?</p>	<p>The students will help combat pollinator decline by designing a garden using information learned from previous lessons. Students will practice arguing for their choice.</p>

Lesson 1: Garden Observation 1

Garden Pollinators and Pollinator Declines

Identify the lesson 1. Garden Observation

Framework:			
<p>n: What we are doing now...</p> <p>This lesson introduces the students to the relationship between pollinators and flowers. We start by taking the class to the school garden to observe the animals present. We ask the students what they already know about gardens and the topic of pollination. After observing the animals and their behavior while on the flowers, we start a class discussion on what the class observed trying to guide the children to discuss the topic of pollination.</p>			
Lesson Question	Phenomenon	Lesson PEs	What we figure out (CCC, SEPs, New Questions & Next Steps)
<p>Question:</p> <ul style="list-style-type: none"> What do you know about gardens, and pollinators? What do you think these animals are doing on the flowers? <p>Lesson time: ~45-60 minutes</p> <p>Specific PE: 2-LS2-2: Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating habitats</p>	<p>What are the pollinators doing on the flowers?</p>	<p>Students will be able to investigate (SEP #1) the school garden to determine what the animals (pollinators) (LS4.D) are doing to the flowers.(LS2.A,CCC#1) The class will then go into discussion on what the animals are doing in the garden and what they already know about the animals and plants in the garden (SEP#1).</p> <p>SEP #2: Planning and Carrying Out Investigations CCC#1 Cause and Effect</p>	<p>Students should be able to observe (SEP #1) the pollinators and wonder what they are doing at a flower. After some time observing, the teacher will ask guided questions on what they observed concerning the pollinators and pollen (LS4.D, LS2.A). Questions the students would ask first would be related to what the pollinators are doing at each flower. Then the teacher can guide the discussion by asking how the flowers might benefit from the pollinators presence or how the pollinators benefit from the flower. (CCC#1).</p> <p>The next steps would be to observe pollinator movement and to learn exactly how the pollinators transport the pollen. By doing so the class can further develop the idea behind pollination and be able to model the process of pollination by a garden pollinator.</p>
<p>Next Lesson: Where we're going... The next lesson would cover pollen transport. The students will continue garden observations with the focus on animal movement between flowers.</p>			

Author(s) of first draft: Rebecca Slyngstad and Lauren Lykins

Getting ready: Materials Preparation	
<p>Materials for each class:</p> <ul style="list-style-type: none"> School garden 	Preparation of materials:

Materials for each student: <ul style="list-style-type: none"> ● Lesson 1- Student Activity Sheet (1) ● Magnifying glass 	<ul style="list-style-type: none"> ● Activity sheets must be printed prior to the lesson ● Magnifying glasses must be obtained
Safety: <ul style="list-style-type: none"> ● Awareness of student allergies 	

Author(s) of first draft: Lauren Lykins and Rebecca Slyngstad

Getting Ready: Teacher preparation		
<p>Teacher background knowledge:</p> <p>What is pollination: https://www.fs.fed.us/wildflowers/pollinators/What_is_Pollination/</p> <p>Identification of common garden pollinators (local birds, insects (bees in particular), and bats)</p> <p>Identification of flowers in garden</p> <p>Knowledge about plant structure and function: https://worldoffloweringplants.com/flower-structure-function/</p>	<p>Alternative student conceptions:</p> <p>Only insects can be pollinators</p> <p>Only bees are attracted to flowers</p>	<p>Linking our understanding to scientific terminology:</p> <ul style="list-style-type: none"> ● Observation ● Pollination ● Pollen ● Flowering plants (angiosperms) ● Pollinators ● Bees ● Butterflies

Author(s) of first draft: Lauren Lykins and Rebecca Slyngstad

Learning Plan: Garden Observation (45-60 min)	Teacher support and notes
<p>1.The following day the teacher will begin the lesson by explaining to the class that this morning they saw birds and bugs in the garden and wondered what they were doing there, and that the class will be going out into the garden to investigate. Depending on students knowledge of local animals, the teacher could also show examples/pictures of local pollinators to the class. (10 min)</p> <p>2.The instructor will then lead the students in the KWL activity as a class (on a whiteboard, projector or smartboard): (10min)</p>	<p><u>Common misconceptions to watch for during discussion:</u></p> <ul style="list-style-type: none"> ● Only insects visit (pollinate) plants <p><u>Alternative activity:</u></p> <ul style="list-style-type: none"> ● If the weather does not allow for outdoors observation time or a children cannot be in the garden for whatever reason, an alternative indoor

- Ask students to share what they currently know about flowers, pollinators, and pollination to fill in the “know” column (To expose misconceptions that will be addressed the following lesson).
- Students can also share questions they have about gardens, flowers, bugs and birds to start filling the “wonder” column.

3. The teacher then will then hand out the magnifying glasses and explain what they are for and how to use them. Also hand out the worksheet and tell them to list or draw any animals and flowers they see in the garden. The children will hopefully be familiar with the game BINGO and explanation of that section will be brief. The teacher should tell the students to mark of the animals they observe in the garden on the BINGO sheet (5 min)

4. The teacher will then lead the class out to the garden where students will spend time observing the pollinators in the garden and filling out the observation worksheet (20-30 min).

5. The teacher will take the kids back into the classroom and will lead a reflective discussion on the activity, while filling in the “learn” column (and adding to “wonder”) of the KWL activity. The teacher will probe for misconceptions and will allow kids to find commonality in the answers to their questions. (10 min)

Suggested Question Prompts:

- What animals have you observed in the garden?
 - Insects (bees, butterflies, beetles, snails, etc.), spiders, squirrels, birds, reptiles (frogs), nothing
- Why do you think these animals were visiting the garden?
 - Looking for food, looking for a home, getting pretty things from the garden, meeting others/friends,
- Where did you notice the visitors gathering?
 - Near the flowers, under the leaves, in the soil, under rocks/decaying leaves, etc.

activity can be led by the teacher. Pictures of animals visiting the garden can be placed around the room and the children can investigate the pictures by moving about to the classroom to complete the lesson 1 worksheet.

Suggestions about observation time:

- Tell the students the day prior that they will be going outside so they can dress accordingly.
- Be sure to check weather forecast in advance before beginning the Garden Pollinators and Colony Collapse Disorder lesson set.
- Be sure to explain to the students that they are to respect the garden (not pick the flowers) and to not interfere with the animals visiting.
- Make sure students stay on task by observing the animals along side the students and asking guided questions to ensure the students are observing the pollinators on the flowers.

Teacher notes:

- It is important to establish the presence of any student allergies before entering the school garden.

Math Extension:

- In addition to the animal and flower observation, students could tally and keep track of the type and number of animal visitors. This information can then be transformed into a simple bar graph to show animal diversity in the garden.

KWL Template

Know	Wonder	Learn

Bingo Template - need to fill boxes with animals/flowers that could be seen in the school's garden

B	I	N	G	O
		FREE SPACE		

List/draw worksheet

Draw or list the animals and flowers you see in the garden!

Flowers

Animals

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Lesson 2: Pollen Transport Game (Model) Garden Pollinators and Pollinator Decline

Identify the lesson 4. Pollen Transport game

Previous Lesson: Where we've been... Students have observed bees and where they store pollen on the bees.			
Lesson: What we are doing now . . . This is the model portion of our lesson. By participating in a play-based learning activity, the students will mimic a pollinator moving pollen between flowers. Students will model pollination by becoming the pollinators.			
Lesson Question	Phenomenon	Lesson PEs	What we figure out (CCC, SEPs, New Questions & Next Steps)
<p><u>Question:</u> Why is pollination important?</p> <p><u>Estimated Total Time:</u> 45 minutes</p>	<p>How is pollen transferred from flower to flower?</p>	<p>Students will participate in a game, in which they will model the movement of pollen from flower to flower. They will mimic pollinators to learn that some pollinators only pollinate specific flowers and see how pollen is transferred.</p> <p>Students will be able to take the information from the bee observation (SEP #1) and use that to create a model, in the form of a game (SEP #2). (LS2.A, LS4.D CCC #1)</p> <p><i>DCIs :</i> <i>LS2.A: Interdependent Relationships in Ecosystems</i> <i>LS4.D: Biodiversity in Humans</i> SEP #1: Developing and Using Models SEP #2: Planning and Carrying Out Investigations CCC#1 Cause and Effect</p>	<p>Students will be prompted to participate in a game in which they will be able to create the rules in order to mimic a pollinator. Students will use chalk to simulate pollen. This pollen will be put onto flowers which can be drawn on a wall with chalk, or on a piece of butcher paper (CCC#1).</p> <p>Questions:</p> <ul style="list-style-type: none"> - What is pollination? - How easy was it to get the pollen (chalk) onto the flower? - Did the pollen (chalk) mix together on the flowers? <p>Conclusions: Students will be able to model the transfer of pollen by participating in the game.</p> <p>Next Steps:</p> <ul style="list-style-type: none"> - Conduct a flower dissection in order to identify different parts of a flower.
<p><u>Specific PE:</u> 2-LS2-2. Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.</p>			
Next Lesson: Where we're going... Now that students have modeled how pollen moves from flower to flower, they will identify the parts of the flower that make pollen, and will learn the basic parts of each flower presented.			

Getting ready: Materials Preparation	
<p>Materials for each class</p> <ul style="list-style-type: none"> ● Sidewalk chalk (multicolor) ● Cotton balls or Q-tips ● Butcher paper ● Paper cups/bowls 	<p>Preparation of materials</p> <ul style="list-style-type: none"> ● Sidewalk chalk (of various colors) must be broken down into a fine powder.

<ul style="list-style-type: none"> • Tape 	<ul style="list-style-type: none"> • Count of enough cotton balls or Q-tips so that each student can have 2-3 each. • Butcher paper should have flowers drawn on it for the kids to “pollinate” (however many colors of chalk used = the color of flowers drawn) <ul style="list-style-type: none"> ○ If there is time, kids can draw the flowers on the butcher paper themselves ○ Cups should be placed in the center of the flowers. (This will be where students try to place the pollen.) • There should be enough cups or bowls for each team of students. • Weather reports should be checked in advanced
<p>Materials for each student:</p> <ul style="list-style-type: none"> • Cotton balls or Q-tips • Lesson 4 activity sheet 	
<p>Safety</p> <ul style="list-style-type: none"> • Precautions if the activity is to be done outside. <ul style="list-style-type: none"> ○ Note the risk for pushing and shoving during the model. ○ Seasonal allergies amongst students ○ Weather warnings 	

Getting Ready: Teacher preparation		
<p><u>Background knowledge</u></p> <p>What is a plant, and what is an animal.</p> <p>What animals pollinate plants.</p> <p>What pollen looks like (color, where it is found on bees).</p>	<p><u>Alternative student conceptions</u></p> <p>Pollen is only yellow, or yellow orange.</p> <p>Only insects pollinate plants.</p> <p style="padding-left: 40px;">Bees are the only pollinators.</p>	<p><u>Linking our understanding to scientific terminology</u></p> <p>Pollination- Insects that take pollen from one plant to another (modeled in game)</p> <p>Pollen- Pollen is the yellow puff that gets stuck to insects.</p> <p>Both plants that grow flowers (angiosperms) and plants that do not grow flowers (gymnosperms) produce pollen.</p> <p>Bees- Type of insects that help to pollinate plants.</p> <p>Butterflies- Another type of insects that carry pollen and help pollinate plants.</p>

Learning Plan: How is pollen transferred from flower to flower? (45 min)	Teacher support and notes
<p>1. (10 min) Start explaining to the class that they will be participating in an activity where they pretend to be pollinators. Guide questions to review concepts from the bee observation activity. (A)</p> <p><u>Listen for student responses: (B)</u></p> <ul style="list-style-type: none"> - The yellow stuff was pollen. - The flowers had pollen on a part of them. <p><u>Suggested Question Prompts:</u></p> <ul style="list-style-type: none"> - Let's think back to the bee observation. What was the yellow powdery substance on the bees legs? - When you were dissecting the flowers did you notice any pollen? - Now think back to when you were in the garden, did you see pollen on the flowers in the garden? <p><u>Possible Student Answers:</u></p> <ul style="list-style-type: none"> - The yellow stuff on the bees was pollen. - I had orange colored powdery stuff. Is that pollen? - I can't remember if I saw pollen in the garden. <p>2. (1-2 min) Break the students into teams.</p> <p>3. (10 min) Material Preparation. At this point a few students from each team can begin to help with the preparation of the materials, such as the drawing of flowers on butcher paper, and setup of the game area. (C)</p> <ul style="list-style-type: none"> - One or two students from each team can draw flowers on the butcher paper. - A few students can set up the bowls with the crushed chalk. (Would recommend chalk being crushed before-hand to avoid too much mess.) - One student can set up the cotton balls and q-tips for each team. <p>4. (5-10 minutes) Design of the rules. Several rules should be put into place before the game:</p> <ul style="list-style-type: none"> - Groups must take turns in who the pollinator is - Students must respect one another and the teacher - Must get the "pollen" onto the flower 	<p><u>Alternative:(A)</u> This modeling activity could be explained in the garden. This would give room for students to find examples of pollen in the garden, especially if it has been a few days since the garden observation was done.</p> <p><u>Common misconceptions to watch for during discussion: (B)</u> Only insects pollinate plants. Pollen is only yellow, not any other colors. Note: Misconceptions can't be explained away, but it can be a good way to lead discussion as well as focus the lesson based on student knowledge. Students can work through their misconceptions throughout their education.</p> <p><u>Alternative Activity: (C)</u> If weather is bad, the activity can be done on the classroom chalkboard, if the classroom has a chalkboard. If not butcher paper can be attached to the white board and desks can be moved to the side. Game rules are designed to give students agency on which flowers they want to pollinate. Some suggestions for game rules:</p> <ul style="list-style-type: none"> ● Group 1 can pollinate flowers that are red or white (similar to bird pollination). ● Group 2 can pollinate all flowers but they must do it in this order (i.e. red, yellow, blue, white). ● Group 3 can pollinate yellow and white flowers after group 1 or 2 has pollinated them.

- Students can help design other aspects of the game

5. (10 minutes) Execution of the game. Now students are ready to play the game. A quick review of the rules so that the students understand and allow them to get ready

(5 minutes) Self reflection/Debrief. After the game is finished have the students write two things they learned about on their activity sheet after a class discussion focused on the things they learned.(drawing pictures are highly recommended).

- Suggested question prompts (with answers):
 - What were you doing during the game?

*We ran back and forth between our team and the flowers on the board. Try to lead to a connection between what they observed in the gardens (lesson 1) to the game, leading them to understand that they were mimicking pollinators.

- Do you think pollinators have certain “rules” they must follow?

*Yes- give examples of how in nature certain animals only go to specific plants (birds like red flowers, butterflies like white flowers, etc.)

- What was the most challenging part of being a pollinator?

- Group 4 has to pollinate 3 blue flowers.
- Group 5 can pollinate any flower but have to do a waggle dance for their group before doing the next flower (waggle dance moves can be made by the kids).
 - Can be decided by the teacher before hand
 - Can be decided by making patterns and tying them to straws which would be drawn beforehand
 - Students design patterns beforehand and then vote on the ones they want.

Teachers notes:

- Game rules for pollinating flowers are designed to give students the understanding that not all pollinators pollinate every flower. The rules should consist of different patterns that can have overlap or not. The overall goal is to show students that some flowers have specific pollinators and/or require specific factors in order to be pollinated.
- Before giving the cotton ball/q-tip to the other team members, students must do a waggle dance beforehand (similar to how bees do a waggle dance to show where flowers are)

Note: Each partner in pollination (the flower, and the pollinator) are not in it to be a better flower or pollinator. They are “in it for themselves”, in order to gain the direct/indirect benefits of pollination.

Teachers notes:

- This game can get chaotic. If it gets too chaotic have it be a race against the clock:
 - Have one group go at a time in the same fashion (1 student will be the

*Following the rules, getting the pollen on the flowers

- What was the easiest part about being a pollinator?

*Getting the pollen at the start

- Did the pollen mix?*

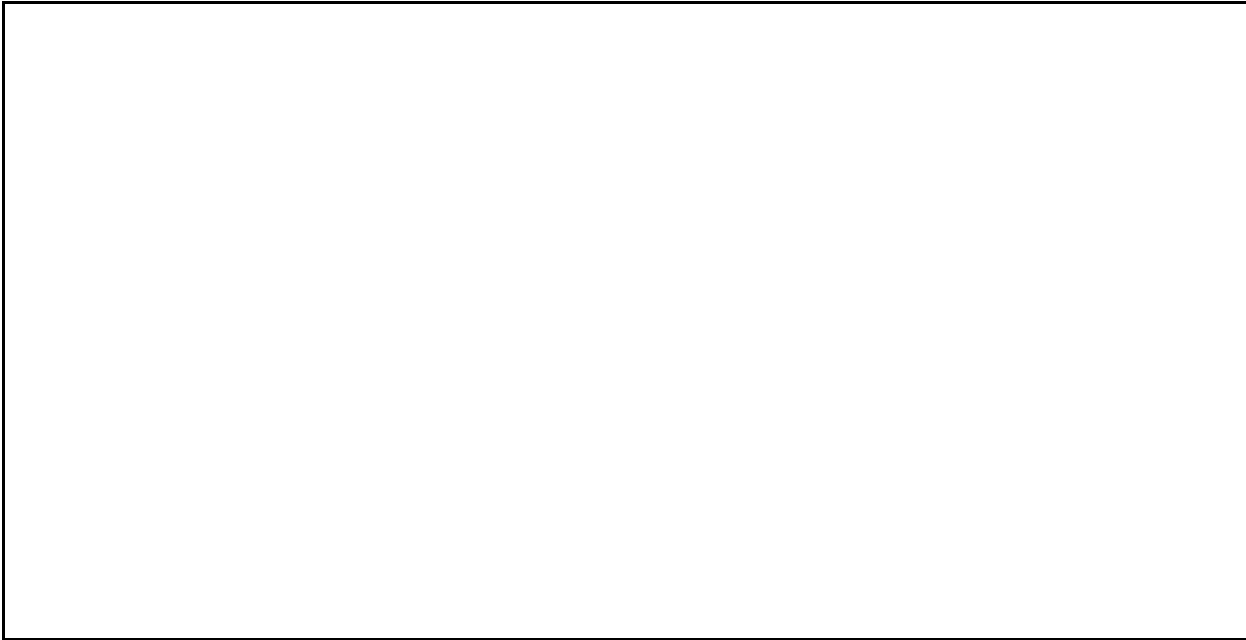
* This question can lead to students asking about cross-pollination which is not specially covered in this lesson.

pollinator the others will wait in their hive).

- That student will run and pollinate one flower before returning
- Students will race against the clock (1-2 minutes per group)
- Group that pollinates the most flowers will be deemed the best pollinators (prize optional)

Lesson 4—Student Activity Sheets: Pollen Transport Game Garden Pollination

After our class talk, write about 2 things that you learned from modeling pollination (Playing the pollination game). Draw a picture to show how you put the chalk into the cup.



If you need more space, continue writing on the back!

Lesson 3: Creating a Pollinator Garden/Garden Improvement 1: Picking and coloring flower *Garden Pollinators and Pollinator Decline*

Identify the lesson 6. Creating a Pollinator Garden/Garden Improvement

<p>Previous Lesson: Where we've been... Students have finished participating in the pollinator game and are familiar with flowers that will attract pollinators.</p>			
<p>This Lesson: What we are doing now... In order to tie all the lessons together, this lesson uses what was taught in previous activities and could be used as a final assessment. In this lesson, the students will be planning the layout of a potential butterfly garden or improving an already established garden. In doing so, students are able to become familiar with how structuring a pollinator garden can help pollinators in the area. Since they have learned about how different flowers attract different pollinators, they will be able to structure their classroom garden however they please. Encourage students to explain why they put a certain flower in that specific area.</p>			
Lesson Question	Phenomenon	Lesson PEs	What we figure out (CCC, SEPs, New Questions & Next Steps)
<p>Question Why are we improving or creating a pollinator garden?</p> <p>Time: 45-60 mins</p> <p>Build toward → 2-LS2-2: Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating habitats</p>	<p>How do we combat pollinator decline?</p>	<p>Students will be cutting out different flowers that were investigated in the previous lesson (Activity 3). As a class, they will be able to develop a garden that they believe would best attract various pollinators (SEP#1,LS-2A, CCC#1).</p> <p>SEP #1: Developing and Using Models CCC#1: Cause and Effect</p>	<p>From the knowledge learned from the previous lesson, students will be able to design or improve a pollinator garden (SEP#1). With reason, they will be able to choose how they think it would be best to arrange the garden (CCC#1).</p> <p>Questions during lesson:</p> <ul style="list-style-type: none"> • Will this really attract the pollinators? • Are there going to be lots of them that visit the garden when we're done? <p>Next steps: - Making the garden</p>
<p>Next Lesson: Where we're going... Now that they have created a layout for the garden, the teacher can further make the decision to improve or generate a pollinator garden if able to.</p>			

Getting ready: Materials Preparation	
<p>Materials for each class:</p> <ul style="list-style-type: none"> • Colored pencils, crayons, markers, scissors, a large sheet of paper 	<p>Preparation of materials:</p> <ul style="list-style-type: none"> • The sheet of paper should be large enough that each student has enough space to place their flower on it
<p>Materials for each student:</p> <ul style="list-style-type: none"> • Student Activity Sheet: Lesson 3 	

<p>Safety:</p> <ul style="list-style-type: none"> Working with scissors 	<ul style="list-style-type: none"> The sheet of paper should have the essentials of a garden and pollinator on it before the lesson. (examples: a water source for pollinators, a shelter for pollinators, etc)
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Author(s) of first draft: Ryu Barrett

<p>Getting Ready: Teacher preparation</p>		
<p><u>Basic Knowledge</u></p> <ul style="list-style-type: none"> Knowledge of the flowers and what pollinators they attract 	<p><u>Alternative Conceptions</u></p> <ul style="list-style-type: none"> Insects are the only pollinators Only insects are attracted to flowers 	<p><u>Scientific Terminology</u></p> <ul style="list-style-type: none"> Pollen - powder that sticks to pollinators, tend to be yellow. Pollinators - animals that moves pollen from flower to flower Angiosperm - a plant that has flowers

Author(s) of first draft: Ryu Barrett

<p>Learning Plan: Creating a Pollinator Garden/Garden Improvement (45-60 min)</p>	<p>Teacher support and notes</p>
<ol style="list-style-type: none"> The lesson will start off with the teacher handing out the activity sheet to each student. The teacher will then explain the lesson for today. (5 mins) Each student is given access to coloring utensils and scissors to complete their activity sheet. The students are to color the plants and cut them out. (20 mins) <ul style="list-style-type: none"> The flowers on the activity page should be familiar since they were covered in the flower dissection lesson. After each student colors and cuts out their flowers, the class as a whole works together to paste their flowers on the large sheet of paper. The class discusses where certain flowers should be placed and what pollinators would be attracted to the flowers. (20 mins) 	<p>Talk about pollinator decline and the benefits of creating or designing a garden</p> <p>Ask them about how the flowers looked during the dissection.</p> <p>Try to create discussion by asking why or how they would like the garden to look</p> <ul style="list-style-type: none"> Ask the students to give reason when backing up their ideas Answers will vary on the type of flower students picked.

4. Wrap up the lesson by reflecting upon the lesson and what they learned. Present to the class the completed poster. (10 mins)

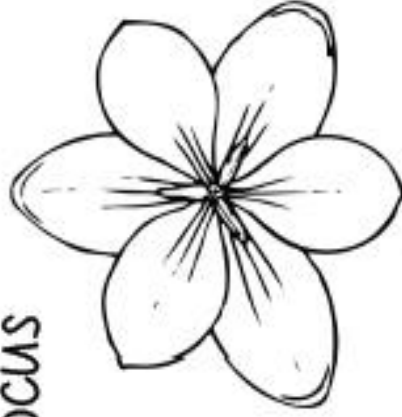
- The poster could be hung up somewhere in the classroom.

Supervision is needed to make sure every student can voice their opinion.

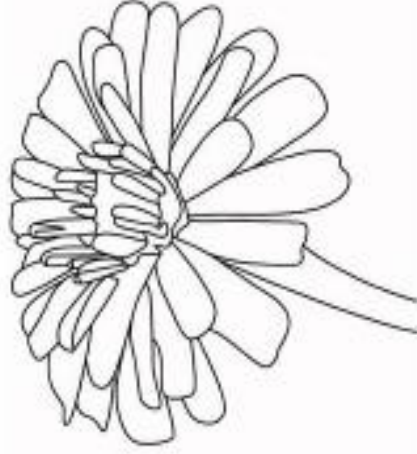
- Deeper Thinking: Instead of already setting up the necessities for the pollinators and garden on the paper, the class as a whole can collaborate and brainstorm on what else the garden needs besides flowers.

As a follow up to this lesson, the plants that were covered during this lesson could be planted in the school garden.

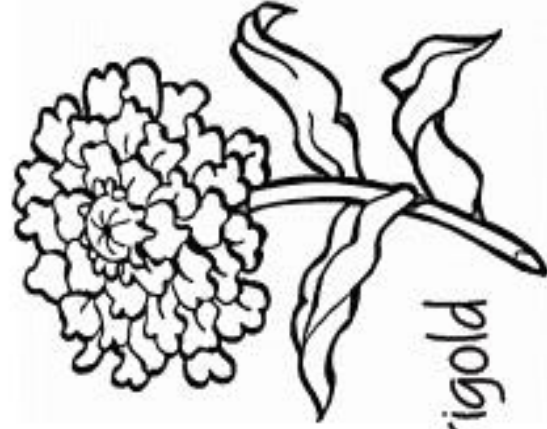
Crocus



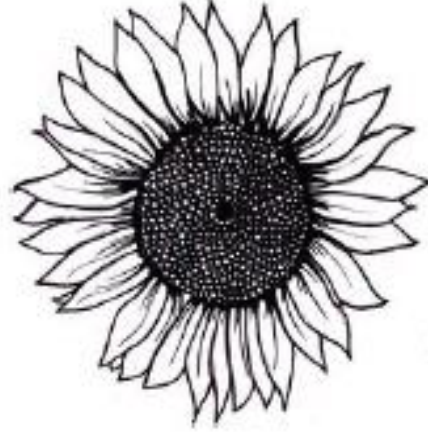
Zinnia



Anemone



Marigold



Sunflower



Snowdrop

Appendix:

2. Interdependent Relationships in Ecosystems

Names: Josh Higa, Krista Tebo, Lauren Lykins, Ryu Barrett, China Carlos, Rebecca Slyngstad

Specific PE:

2-LS2-2.

Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.*

2-LS4-1.

Make observations of plants and animals to compare the diversity of life in different habitats. (Emphasis is on the diversity of living things in each of a variety of different habitats)

SEPs:

Developing and using models:

Develop a simple model based on evidence to represent a proposed object or tool. (2-LS2-2)

Planning and Carrying Out Investigations:

Make observations (firsthand or from media) to collect data which can be used to make comparisons. (2-LS4-1)

Connections to Nature Science

Scientific Knowledge is Based on Empirical Evidence:

Scientists look for patterns and order when making observations about the world. (2-LS4-1)

DCIs:

LS2.A: Interdependent Relationships in Ecosystems

- Plants depend on animals for pollination or to move their seeds around.

LS4.D: Biodiversity and Humans

- There are many different kinds of living things in any area, and they exist in different places on land and in water. (2-LS4-1)

(Added) ETS1.B: Developing Possible Solutions

- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (*secondary to 2-LS2-2*)

CCCs: [HSL1]

Structure and Function:

The shape and stability of structures of natural and designed objects are related to their function(s). (2-LS2-2)

DCI Summary & Expected Understanding (China & Krista)

The life science disciplinary core ideas for students in the second grade are to be able to recognize the interdependent relationships in ecosystems and life in diverse places. Examples of interdependent relationships that these students should be able to identify are the needs for plants to grow and also how plants depend on animals for pollination or as a means to move their seeds around. Second graders are expected to know that there are many different kinds of living things in a various areas like on land and in water. The idea that these disciplinary core ideas focuses in is being able to notice and observe the ecosystem

around them and to interpret the biodiversity and vast relationships going on. Students are expected to understand how animals are able to pollinate plants or spread seeds around and with this understanding. They are also expected to be able to create models that depict the pollination, or seed spreading by animals. Students are also expected to be able to make observations of plants and animals and begin to describe how their diversity varies depending on their habitat and location they are in.

The addition of an earth and space science systems DCI was noted. In this case students will be able to create sketches, drawings or physical models in order to develop possible solutions. These are then used in order to convey these solutions to others. While the use of these are helpful in conveying the solutions to others, they also help the student better understand the material that they are working with, in order to make connections. This DCI is secondary to 2-LS2-2, which is focused on developing and using models to represent an object or tool.

DCI Rationale (Lauren)

The life science disciplinary core ideas for second grade students are in place to develop preliminary knowledge about the natural world in regards to the ecosystem and the life that inhabits it. More specifically for second grade students there are two disciplinary core ideas in life science; interdependent relationships in ecosystems and biodiversity and humans. The first disciplinary core idea; interdependent relationships in ecosystems, is considered an LS2 topic. LS2 topics include topics that relate to ecosystems: interactions, energy, and dynamics. For this disciplinary core idea, second grade students are required to understand that plants depend on animals for pollination or to move their seeds around. The rationale for this core idea is to gain an overarching understanding of the complexity of an ecosystem and to begin to understand the interdependent relationships that are required for the ecosystem to be sustained. There are three primary reasons supplied by the NGSS as to why ecosystems are a disciplinary core idea. Firstly, they hope that it will help students understand and appreciate the natural world. Secondly, they hope to emphasize the importance of ecosystems in providing a variety of resources that sustain life (ecosystem services). And lastly, they hope to demonstrate to students that the ecosystem is constantly changing and that disturbances both natural and created by humans can have varying effects. The primary goal of a disciplinary core idea on ecosystems is to create informed citizens that can use their science-based knowledge to make environmentally conscious decisions. By exploring the relationship between animals and plants, it illustrates to young students that there is this interdependence required for an ecosystem to exist. This disciplinary core idea relates to both of the performance expectations for second grade students. The second disciplinary core idea for second grade students in life science is biodiversity in humans. This is considered an LS4 topic. LS4 topics include topics that relate to biological evolution: unity and diversity. The rationale for this disciplinary core idea is to help students make sense of unity and diversity in the natural world through evolutionary principles. They want students to develop a deeper understanding of the interconnectedness of all living things on Earth. For the topic, biodiversity in humans, they want students to understand that humans are part of the natural world and their survival depends on it. They want students to know what biodiversity is and its relationship with humans. Second grade students by the end of the year are expected to understand that there are different kinds of living things in any area, and they exist in different places on land and in water. This disciplinary core idea relates to both of the second-grade performance expectations in life science.

CCC Rationale/Importance (Josh)

Crosscutting concepts, or a CCC are fundamental to understanding science and engineering. Crosscutting concepts are groups of overlapping concepts that can be found in multiple fields of science and engineering.

Crosscutting concepts have been divided into several different categories determined by the New K-12 Science Education Standards and Research Council National Framework for K-12 Science Education. For our given lesson, the PE's we were asked to focus on only one has one crosscutting concept connection. Our PE, which is to develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants, major crosscutting concept is structure and function. Structure and function is, "the way in which an object or living thing is shaped and its substructure determine many of its properties and functions" (New K-12 Science Education Standards). By understanding the function of animals in the distribution of plant species, students can determine their place in the overall structure of the given ecosystem. This process of thinking gives students insight into how different parts of an ecosystem function and how they are connected to a grander system. Simplifying the process of determining the relationship between the function of an organism and the larger scheme of things can be applied to multiple systems. Things like the human body, ecosystems, food chains, and robotics can have this application. By being able to think about the roles of how animals distributing seeds and pollinating plants it makes students think about how different organisms have developed specific functions (niches) and their place in larger systems. Crosscutting concepts is included in the NGSS because it shows that at its most basic level, many scientific studies share similar concepts of understanding. By making students think about how to relate examples to one another it becomes easier for connections to be made between concepts.

SEP Rationale/Importance (Rebecca)

By teaching science and engineering practices (SEP), students gain the fundamental science skills and techniques needed to be proficient in science related activities in their future schoolwork and possibly their jobs. The SEP for 2-LS2-2 is to develop a simple model based on evidence to represent a proposed object or tool. Scientific models "allow scientists and engineers to better visualize and understand a phenomenon under investigation or develop a possible solution to a design problem" (Pratt and Bybee, 56) and usually take the form of diagrams, replicas, or some other form of simplified representations of a concept. They help scientists visualize and communicate their ideas. By having second graders practice this skill by making a simple model of the role of animals in plant reproduction, they both learn more about the world around them as well as practice a skill that scientists use every day.

The second DCI, 2-LS4-1, has students make observations of plants and animals to compare the diversity of life in different habitats. One SEP that they learn from this is to use observations to collect data which can be used to make comparisons. By comparing the types of life in different habitats, they practice data collection, which is a large part of what scientists do every day. They also practice making connections between differences in the environments and how those could translate into different organisms living in the two places, which is an important step in data analysis and turning scientific data into scientific concepts. Also, in making observations of plants in animals in a certain habitat, they practice finding patterns in the data, and this SEP helps scientists to analyze and interpret their results, make generalizations about their findings, and effectively communicate their results.

Misconceptions (Ryu)

The performance expectations were established in order to demonstrate that the students have met the standards. The two PE's we are focusing on are developing a simple model that explains how animals disperse seeds or pollinate plants and making observations of plants and animals to compare the diversity of life in different habitats. Students who are taught new concepts use their prior knowledge to help understand the new concepts presented and this may lead for misconceptions to occur.

A common misconception for 2-LS2-2 would be that only bees or insects play a role in pollination. Bees are known for being pollinators and would be the first idea that pops into many students' minds. The students may ignore all other animals and see bees or insects as the only pollinators when in fact there are many other animals besides bees and insects that are important pollinators such as birds, bats, and other animals. Young students may also believe that animals intentionally pollinate however pollination occurs randomly by pollen clinging to animals. Misconceptions may also occur on the topic of seed dispersion. Students may believe that seed dispersal is impossible since plants cannot move or that they are only dispersed by fruits. Animals however play a huge role in seed dispersion and many vertebrates take part in the role.

Misconceptions will also occur in 2-LS4-1 when taught to the students. When students are taught about animal and plant diversity in different habitats, some might consider animals most familiar to them to be present in habitats where they do not belong. Students may struggle with properly fitting the correct animal or plant in the proper environment especially if they only apply their knowledge of the environment they grew up in.

Resources:

"What Is Pollination?" *US Forest Service*. Accessed 2018

<https://worldoffloweringplants.com/flower-structure-function/>

WoFP. "Flower Structure and Function." *World of Flowering Plants*, World of Flowering Plants, 11 Feb. 2018, worldoffloweringplants.com/flower-structure-function/.

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Duncan, Ravit Golan, et al. *Disciplinary core ideas: reshaping teaching and learning*. Ch 7, NTSA, National Science Teachers Association, 2017.

Pratt, Harold, and Rodger W. Bybee. *The NSTA readers guide to a framework for K-12 science education: practices, crosscutting concepts and core ideas*. NSTA Ch 3-4, 6, and 9, Press, 2013