**Science Practices Continuum – Students’ Performance**

This continuum is intended for teachers and administrators to use in guiding and evaluating student performance in the science practices. The levels reflect increasingly sophisticated engagement in the practices and are not grade-level specific; students can engage in the practices in developmentally appropriate ways at any of these levels. Appendix F in the NGSS provides significantly more detail for each practice (that should be integrated as both students and teachers develop greater fluency with each practice). The practices are grouped into the “Investigating” “Sensemaking” and “Critiquing” practices.

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<thead>
<tr>
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<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
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<tbody>
<tr>
<td>1</td>
<td><strong>Asking questions</strong></td>
<td>Students do not ask questions.</td>
<td>Students ask questions. Students’ questions are both <strong>scientific</strong> and <strong>non-scientific</strong> questions (i.e., not answerable through the gathering of evidence or about the natural world).</td>
<td>Students ask questions. Students’ questions are typically <strong>scientific</strong> (i.e. answerable through gathering evidence about the natural world). Students <strong>do not evaluate</strong> the merits and limitations of the questions.</td>
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<td>3</td>
<td><strong>Planning and carrying out investigations</strong></td>
<td>Students do not design or conduct investigations.</td>
<td>Students conduct investigations, but these opportunities are typically <strong>teacher-driven</strong>. Students do not make decisions about experimental variables or investigational methods (e.g. number of trials).</td>
<td>Students <strong>design or conduct</strong> investigations to gather data. Students make decisions about experimental variables, controls or investigational methods (e.g. number of trials).</td>
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<td>5</td>
<td><strong>Using mathematics and computational thinking</strong></td>
<td>Students do not use mathematical skills (i.e., measuring, estimating) or concepts (i.e., ratios).</td>
<td>Students use mathematical skills or concepts but these are <strong>not connected to answering a scientific question.</strong></td>
<td>Students use mathematical skills or concepts to <strong>answer a scientific question.</strong></td>
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<tr>
<td>Sensemaking Practices</td>
<td>Students do not create or use models.</td>
<td>Students create or use models. The models focus on <em>describing</em> natural phenomena rather than predicting or explaining the natural world. Students <em>do not evaluate</em> the merits and limitations of the model.</td>
<td>Students create or use models focused on <em>predicting</em> or <em>explaining</em> the natural world. Students <em>do not evaluate</em> the merits and limitations of the model.</td>
<td>Students create or use models focused on <em>predicting</em> or <em>explaining</em> the natural world. Students <em>do evaluate</em> the merits and limitations of the model.</td>
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<td>2. Developing and using models</td>
<td>Students do not create or use models.</td>
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<td>Students may record data, but do not analyze data.</td>
<td>Students work with data to organize or group the data in a table or graph. However, students <em>do not recognize patterns or relationships</em> in the natural world.</td>
<td>Students work with data to organize or group the data in a table or graph. Students make sense of data by recognizing patterns or relationships in the natural world.</td>
<td>Students <em>make decisions</em> about how to analyze data (e.g. table or graph) and work with the data to create the representation. Students make sense of data by recognizing patterns or relationships in the natural world.</td>
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<tr>
<td>4. Analyzing and interpreting data</td>
<td>Students may record data, but do not analyze data.</td>
<td>Students work with data to organize or group the data in a table or graph. However, students <em>do not recognize patterns or relationships</em> in the natural world.</td>
<td>Students work with data to organize or group the data in a table or graph. Students make sense of data by recognizing patterns or relationships in the natural world.</td>
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<td>Students do not create scientific explanations.</td>
<td>Students attempt to create scientific explanations but students’ explanations are <em>descriptive</em> instead of explaining how or why a phenomenon occurs. Students <em>do not use appropriate evidence</em> to support their explanations.</td>
<td>Students attempt to create scientific explanations but students’ explanations are <em>descriptive</em> instead of explaining how or why a phenomenon occurs. Students <em>use appropriate evidence</em> to support their explanations.</td>
<td>Students construct explanations that focus on explaining <em>how or why a phenomenon occurs</em> and <em>use appropriate evidence</em> to support their explanations.</td>
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<td>Critiquing Practices</td>
<td>7. Engaging in argument from evidence</td>
<td>Students do not engage in argumentation.</td>
<td>Students engage in argumentation where they support their claims with evidence or reasoning, but the discourse is primarily teacher-driven.</td>
<td>Students to engage in student-driven argumentation. The student discourse includes evidence and reasoning to support their claim. Students also agree and disagree, but rarely engage in critique.</td>
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<td>8. Obtaining, evaluating, and communicating information</td>
<td>Students do not read text for scientific information.</td>
<td>Students read text to obtain scientific information, but do not evaluate this information. Students also do not compare or combine information from multiple texts considering the strengths of the information and sources.</td>
<td>Students read and evaluate text to obtain scientific information. Students do not compare or combine information from multiple texts considering the strengths of the information and sources.</td>
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<thead>
<tr>
<th>Classroom Culture Prioritizing Science Practices</th>
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<tr>
<td>Less ---------------------------------------------------------------------------------------------------</td>
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<tr>
<td>Connected to the Natural World</td>
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<tr>
<td>Focused on Scientific Evidence</td>
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<tr>
<td>Student Directed and Collaborative</td>
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<tr>
<td>Informed by Critique</td>
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Lesson Adaptation Activity: Developing and Using Models

Related NGSS Performance Expectation:

2-LS2-2. Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.* (*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea).

Lesson Description

Ms. Mitchell’s 2nd grade class is in the middle of a unit on ecosystem interactions. In this particular lesson, students are developing a model to reflect the role of animals in plant reproduction (ex: dispersing seeds or pollinating plants). Students spent previous lessons researching and watching video clips to investigate the role of animals involved in seed dispersal and plant pollination.

Lesson Adaptation A

Ms. Mitchell: So we’ve been studying how plants and animals work together to survive. You all spent some time researching how animals play a role in seed dispersal and plant pollination. Could someone remind us what the word dispersal and pollination mean?

Allegra: Animals disperse seeds when they spread them away from the plant. So the seeds are spread in new places.

Ms. Mitchell: Excellent. What about pollination?

Joseph: Bugs land on flowers and the pollen sticks to them. Then they move the pollen to other flowers when they visit them.

Ms. Mitchell: Great, who can give us some examples of animals involved in seed dispersal?

Jamal: Squirrels bury acorns. Birds eat fruit with seeds.

Ms. Mitchell: Very good. What about pollination?

Gisella: Bees and butterflies get nectar from flowers and bring pollen to other flowers.

Ms. Mitchell: Wonderful. Today we are going to learn more about the role of animals in plant pollination and seed dispersal. We are also going to develop a model to show this. First, we are going to watch a few short video clips and read about these processes in your textbook and take notes.
After watching the video clips, students take turns reading information out loud. Ms. Mitchell prompts students to share out important information they learned from reading each section. Ms. Mitchell takes notes on their answers on the board and students copy the information down.

Ms. Mitchell: You all shared some great information. Now, we are going to work on developing our models for pollination and seed dispersal. Please flip back to page 52 in your textbook. Do you all see the diagram of the flower on the page? You are going to draw this diagram in your notebooks. Before we start, why do you think we are drawing a diagram of a flower? How is this going to help our model?

Austin: We need to have a flower diagram because flowers have pollen and seeds.

Ms. Mitchell: Right, so we are going to draw this first and then you and your group members are going to pick an animal that is involved in pollination or seed dispersal to include in your drawing. First, let’s draw the flower diagram together. We want to make sure to use proper labels for a scientific drawing.

Ms. Mitchell draws the flower diagram from the textbook on the board. She reminds them that the anther produces the pollen and the ovary produces the seeds.

Ms. Mitchell: Great job, students. You have drawn a scientific diagram of a flower. Now decide on which animal you and your group are going to include in your model. You can use the computers to find a labeled diagram of the animal. Please get started.

Students start working. They find pictures of animals on the internet (examples below) and draw them next to the flower diagram in their notebooks.

Photo credit: www.exploringnature.org and https://www.fs.fed.us/wildflowers/pollinators/Monarch_Butterfly/habitat/index.shtml
**Lesson Adaptation B**

**Ms. Mitchell:** So we’ve been studying how plants and animals work together to survive. You all spent some time researching how animals play a role in seed dispersal and plant pollination. Could someone remind us what the word dispersal and pollination mean?

**Allegra:** Animals disperse seeds when they spread them away from the plant. So the seeds are spread in new places.

**Ms. Mitchell:** Excellent. What about pollination?

**Joseph:** Bugs land on flowers and the pollen sticks to them. Then they move the pollen to other flowers when they visit them.

**Ms. Mitchell:** Great, who can give us some examples of animals involved in seed dispersal?

**Jamal:** Squirrels bury acorns. Birds eat fruit with seeds.

**Ms. Mitchell:** Very good. What about pollination?

**Gisella:** Bugs land on flowers and the pollen sticks to them. Then they move the pollen to other flowers when they visit them.

**Ms. Mitchell:** Wonderful. Today we are going to learn more about the role of animals in plant pollination and seed dispersal. You will work with your group members to develop a model to show one of these processes. First your group must decide on whether you want your model to illustrate pollination or seed dispersal. Please see the websites posted on our class website for information on animal traits for pollination and seed dispersal.

**Gisella:** Let’s show the process of how hummingbirds pollinate flowers.

**Maeve:** Sounds good to me. Here is a website that talks about hummingbirds. They are active during the day.

**Joseph:** They also have a low sense of smell and eyesight like humans. They can see the color red—that’s different from bees. I remember we learned that bees couldn’t see red.

**Maeve:** Oh, yeah, I remember that too. Look-- their wings flap around 50 times per second! That’s crazy. They also have a long bill and tongue to get the nectar.

**Gisella:** Yeah, and look-- It also says that they don’t need to land on the flower, they hover over it to get nectar. That makes sense. They can flap their wings so fast they don’t need to land on the flower.

*Ms. Mitchell checks in with the class.*

**Ms. Mitchell:** It looks like your groups are doing excellent research to prepare to make your
Before you move on to researching the types of flowers that your animals are attracted to, think about the animal’s traits. For example, if you’re doing a model on insect pollination of flowers, what types of flowers do you think your animal is attracted to based on its traits? Write down your predictions in your group.

Ms. Mitchell puts a sentence starter on the board for students to use if needed.

We predict _______ (animal) will be attracted to ___________ (describe the type of flower or seed) because _______________________________________________________________ (include traits of animal that make it attracted to this particular type of flower or seed).

Gisella, Joseph, and Maeve’s group comes up with these predictions:

- Hummingbirds will be attracted to red flowers because bright colors like red tell them that they have nectar. They can also see the color red. Hummingbirds will like flowers that are open in the day. They are most active during the day. Hummingbirds cannot smell well so the flowers they are attracted to do not to smell a lot.

After students share out their predictions, Ms. Mitchell instructs students to develop models to illustrate the process of pollination using their research and predictions.
**Lesson Adaptation C**

**Ms. Mitchell:** So we’ve been studying how plants and animals work together to survive. You all spent some time researching how animals play a role in seed dispersal and plant pollination. Could someone remind us what the word dispersal and pollination mean?

**Allegra:** Animals disperse seeds when they spread them away from the plant. So the seeds are spread in new places.

**Ms. Mitchell:** Excellent. What about pollination?

**Joseph:** Bugs land on flowers and the pollen sticks to them. Then they move the pollen to other flowers when they visit them.

**Ms. Mitchell:** Great, who can give us some examples of animals involved in seed dispersal?

**Jamal:** Squirrels bury acorns. Birds eat fruit with seeds.

**Ms. Mitchell:** Very good. What about pollination?

**Gisella:** Bugs land on flowers and the pollen sticks to them. Then they move the pollen to other flowers when they visit them.

**Ms. Mitchell:** Wonderful. Today we are going to learn more about the role of animals in plant pollination and seed dispersal. You will work with your group members to develop a model to show one of these processes. First your group must decide on whether you want your model to illustrate pollination or seed dispersal. Please see the websites posted on our class website for information on animal traits for pollination and seed dispersal.

*Gisella, Maeve and Joseph decide to show the process of how hummingbirds pollinate flowers. They gather information on the website about hummingbird traits that relate to pollination.* **Ms. Mitchell checks in with the class.**

**Ms. Mitchell:** It looks like your groups are doing excellent research to prepare to make your model. Before you move on to researching the types of flowers that your animals are attracted to, think about the animal’s traits. For example, if you’re doing a model on insect pollination of flowers, what types of flowers do you think your animal is attracted to based on its traits? Write down your predictions in your group.

**Ms. Mitchell puts a sentence starter on the board for students to use if needed.**

We predict _______ (animal) will be attracted to ___________ (describe the type of flower or seed) because ____________________________ (include traits of animal that make it attracted to this particular type of flower or seed).
Groups of students work together to generate predictions before developing their models. After students finish their models, Ms. Mitchell addresses the class.

Ms. Mitchell: Great job, everyone. Now you all get to show off your models to your classmates. I am going to give you post-it notes with sentence starters to write feedback to your classmates. Remember to include both positive and constructive feedback on their models. (Sentence starters include: I like..., I like how you..., Good job..., One thing you might change...)

Feedback from students on model on the left:
- Good job writing about the traits of the hummingbird and flower
- I like your picture
- One thing you might change is explain why it’s a red flower
- One thing you might change is explain why the hummingbird have a long bill and tongue

Feedback from students on the model on the left:
- I like how you explained how the bird’s traits help it get nectar.
- I like how you explained how the hummingbird moves pollen to other flowers.
- One thing you might change is explain why the hummingbird won’t go to pink flowers
- One thing you might change is label is not pointing to the wings
Lesson Adaptation D

Ms. Mitchell: So we’ve been studying how plants and animals work together to survive. You all spent some time researching how animals play a role in seed dispersal and plant pollination. Could someone remind us what the word dispersal and pollination mean?

Allegra: Animals disperse seeds when they spread them away from the plant. So the seeds are spread in new places.

Ms. Mitchell: Excellent. What about pollination?

Joseph: Bugs land on flowers and the pollen sticks to them. Then they move the pollen to other flowers when they visit them.

Ms. Mitchell: Great, who can give us some examples of animals involved in seed dispersal?

Jamal: Squirrels bury acorns. Birds eat fruit with seeds.

Ms. Mitchell: Very good. What about pollination?

Gisella: Bugs land on flowers and the pollen sticks to them. Then they move the pollen to other flowers when they visit them.

Ms. Mitchell: Wonderful. Today we are going to learn more about the role of animals in plant pollination and seed dispersal. You will work with your group members to develop a model to show one of these processes. First your group must decide on whether you want your model to illustrate pollination or seed dispersal. Please see the websites posted on our class website for information on animal adaptations for pollination and seed dispersal.

Joseph: What process do you all want to show?

Gisella: Let’s show the process of pollination.

Maeve: Sounds good to me. Let’s look up traits for hummingbirds and the flowers they are attracted to.

Gisella: Here is a website that talks about hummingbirds. They are active during the day.

Joseph: They also have a low sense of smell and eyesight like humans. They can see the color red.

Maeve: They hover over the flower to get nectar. They also have a long bill and tongue.

Gisella: It also says they’re smart.
Maeve: Let's look at the type of flowers they are attracted to.

Joseph: It says they’re attracted to flowers with lots of nectar. They like red flowers.

Gisella: I think we have enough information for our model.

Students then work together to draw a model of a hummingbird on a flower (below). When all students are finished, they do a gallery walk to look at each other’s work.

![Hummingbird drawing](image)

<table>
<thead>
<tr>
<th>Ordering of Adaptations</th>
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<tbody>
<tr>
<td><strong>Directions</strong>: Order the four adaptations (A-D) along the Science Practice Continuum (Levels 1-4) for the Developing and Using Models practice.</td>
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