

Gardening and Graphing

By: Jocelyn Muzychko

Topic: Life Science and Measurement

Targeted Grade Level: 3rd grade

Time Needed: 5 months from start to finish

- Introducing phenomenon/stream data and planning for solution (3-30 minute lessons)
- Sowing seeds-30 minutes in late winter-January
- Collecting data bi-weekly (4 classes-February and March -30 minutes each)
- Researching plants, collecting data, discussions (2 classes-40 minutes each)
- Reporting data into graph and sharing (2 classes-30 minute)
- Developing a model (1 class-30 minutes)

Not included in this lesson plan:

Prepping rain garden beds, planting pollinator plants, developing a brochure of PSA, and reevaluating the stream to see if our plan is helping.

Subject Integration: Science, Math, Literacy, Technology

Justification: In New Jersey local pollinators are on the decline. Students learn in 3rd grade that reproduction is essential for a species to continue and how different plants and animals have unique life cycles. Students will be sowing pollinator plant seeds in late winter in the classroom watching the plant life cycle and taking note of its characteristics. Different native seeds will be given: milkweed, cardinal flower, beebalm, and swamp milkweed, and Hollowstem Joe-Pye Weed. This is building off what they learned last year which was the importance of pollinators and different types of pollinator plants. As the plants grow indoors the DCIs from K-2 will be reinforced: plant parts and what plants need to grow. Students will also gather evidence and research each type of plant to determine which plant it is by its inherited traits based on the adult ones that we previously planted in our other pollinator garden. They will also have to research in order to prepare for planting it in the spring. During the growth time students will learn about

various native pollinators and how their plant helps certain types of them. Throughout the activity students will be collecting data on the plants growth by measuring the plant growth bi-weekly and then monthly once they are planted (3rd grade math standard). Students will measure plants to the nearest quarter inch. They will report the data in line plot format combining their data with others in their class and grade for each plant species. After comparing, students will discuss trends in growth of the different species and other findings from the data. Students will use Google Sheets to develop a clear graph to add to their report about the importance of pollinator plants and the correlation between the growth rate to why we need more pollinator plants. Students will then develop a plan to plant their pollinator plants in the rain/pollinator garden considering its needs.

The integration is logical because it is starting with the basis of science and their grade level DCIs and then bridging organically to collecting growth measurement data to the nearest quarter inch and reporting it into a line plot graph to make sense of the data for their understanding of plant traits. Using Google Sheets to develop the graph will incorporate tech standards as well as 21st century skills. Not included in this lesson plan is adding the component of creating a brochure to teach the public about their specific pollinator plant and how it helps the environment will add the last level of communicating ideas.

Standards:

<u>NGSS Performance Expectations</u>		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts:
<p>Planning and Carrying out an Investigation:</p> <p>-Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in</p>	<p>3-LS2C.1: When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others</p>	<p>Patterns- Patterns of change can be used to make predictions.</p> <p>Cause and Effect-Cause and effect relationships are routinely identified, tested, and used to explain change.</p> <p>Scale Proportion and Quality-Standard units are used to measure and describe</p>

<p>which variables are controlled and the number of trials considered.</p> <p>-Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.</p> <p>Analyzing and Interpreting Data:</p> <p>-Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.</p> <p>-Represent data in tables and/or various graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships.</p> <p>-Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings</p> <p>Using Mathematical and Computational Thinking:</p> <p>-Organize simple data sets to reveal patterns that suggest relationships.</p> <p>Obtaining, Evaluating, and Communicating Information:</p>	<p>move into the transformed environment, and some die. (secondary to 3-LS4-4)</p> <p>3-LS1B.1: Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles. (3-LS1-1)</p> <p>3-LS3A.1: Many characteristics of organisms are inherited from their parents. (3-LS3-1)</p>	<p>physical quantities such as weight, time, temperature, and volume.</p> <p>System and System Models-A system can be described in terms of its components and their interactions.</p>
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Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices.

Common Core State Standards:

Math: 3.MD.B.4 Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units— whole numbers, halves, or quarters.

ELA: RI.3.1. Ask and answer questions, and make relevant connections to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers

RI.3.3. Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.

Other Standards

8.2.5.C.4 Collaborate and brainstorm with peers to solve a problem evaluating all solutions to provide the best results with supporting sketches or models

8.1.5.A.4 Graph data using a spreadsheet, analyze and produce a report that explains the analysis of the data.

Measurable Student Learning Objectives:

Students will be able to analyze data in order to determine the stream's health.

Students will research solutions to help reduce the impact of pollution getting into our stream.

Students will be able to identify the life cycle of the 5 different pollinator plants and explain how they are able to reproduce.

Students will demonstrate how to use a ruler in order to measure plants to the nearest quarter inch and compile the data into a line plot graph to show growth rate of different plants and identify them according to various traits.

Students will be able to research and gather information on various pollinators and attributes of different plants in order to construct an information paper/brochure about their pollinator plant (choose one that they grew).

Students will be able to use Google Sheets to develop a graph to add to their informational report about their plant.

Nature of STEM: These lessons address the nature of Science, Technology, Engineering and Math by utilizing real world problems and collecting authentic data. Students will be helping our community with developing another pollinator garden. By doing this they are helping solve an even bigger problem of our local stream being polluted. This garden will be placed in an area where rain and water enters our stream. Students will be developing the plans to help solve this problem along with collecting the data to support their research on the importance of certain pollinator plants. They will be using their data and knowledge to build awareness in our community about the problem and possible solutions with their brochures on their particular plant species. Everything the students are doing has a real purpose and ties in with their curriculum standards in a very real way.

Engaging Context/Phenomena: Our Stream behind our school is showing signs of pollution (62 out of the 70 macroinvertebrates collected last year from the stream were pollution tolerant macros). Pollinators are on the decline in New Jersey. To help with both problems students will design and create a pollinator garden using seeds from our current garden. The seeds will be mixed up and students will have to use data they collect on the plant growth to determine which plant is what species.

Data Integration: Students will be collecting data on various pollinator plant growth (observations and measurement) in order to analyze the data to identify the pollinator plant species. They will also be using that data in their brochure about their plant species to talk about growth rate and appearance.

Students will look at data on the decline of pollinators through articles about the decline of popular NJ fruits and vegetable crops not producing as much (<https://nj1015.com/decline-of-bees-threatens-crop-yields-across-nj-and-the-u-s/>, <http://www.conservewildlifenj.org/protecting/projects/pollinators/>) and climate changes (https://climate.nasa.gov/climate_resources/41/video-sting-of-climate-change/) . The data will be used to provide further information about the decline, what we can do to help and why it is so important to do so.

Differentiation of Instruction: These lessons will be student-driven and will be able to be differentiated by providing different modalities to learn information and output the information: readings/text (different levels), recording of readings, voice to text usage, allowing for online formats for videos presentation of information, scaffolding for collecting data (rulers with clearer markings, graphic organizer for collecting data, step-by-step guidance to create data graphs using Google Sheets)

Real-life Connection: The real life connection is that this STEM unit addresses a real world problem and a current community problem. In New Jersey, pollinators are on the decline. Blueberries, cranberries, peaches, tomatoes, bell peppers, eggplant, cucumbers, apples, spinach, squash, and asparagus are major agricultural products grown in New Jersey. Without pollinators those items will become harder to find and more expensive. Also, our back stream is showing signs of pollution based on a stream assessment (collecting, identifying, and analyzing macroinvertebrates) done Spring 2021 and will be done again by 5th grade Fall 2021. It was suggested by our Watershed Ambassador to develop a pollinator garden/rain garden to help. The students play in the stream and woods after school. They feel very protective over their area.

Possible Misconceptions:

All Macroinvertebrates mean a stream is unhealthy

Pollution tolerant vs pollution intolerant...Which do we want to see more of?

All plants grow at the same rate and need the same amount of light, water, and space.

Every plant species looks exactly alike.

Using a ruler you start at the end of it.

Line plot graphs tell you how many plants.

Lesson Procedure: This 5E plan is only for the first part of the unit.

5E Model	5E Objectives
<p><u>Engage</u></p>	<p>Procedure:</p> <ol style="list-style-type: none"> 1. Teacher introduces the problem/anchor phenomenon: The 5th grade completed a stream assessment last year (May 2021) and collected 70 macroinvertebrates. Macroinvertebrates are small organisms that do not have a backbone that can be seen without the use of a microscope. Macroinvertebrates can tell us a lot about a stream's health. The findings reveal interesting information about our stream. 62 of the 70 collected were pollution tolerant/pollution sensitive. 2. Group students and provide macroinvertebrate data. 3. Students look at the data and make true statements based on what they notice. Students will complete a T chart to help interpret the data: What do I see? What does it mean? 4. Class discussion of data. What did they discover through looking at the data? 5. Next, students write down researchable/testable questions they have? Possible questions: What does it mean to be pollution sensitive/tolerant/intolerant? What happened to the pollution intolerant macroinvertebrates? How did the stream become polluted? How can we make the stream healthier? <p>Modifications: Teacher will lean into student discussions to help facilitate conversation. Asking probing questions: what does _____ mean? How do you know _____?</p> <p>Standards Addressed:</p> <p>3-LS2C.1: When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to</p>

	<p>new locations, yet others move into the transformed environment, and some die. (secondary to 3-LS4-4)</p> <p>Formative/Summative Assessments: Students will be formatively assessed on their questions they are going to investigate making anecdotal notes on the types of questions. Is the question researchable or testable? Does it make sense with the phenomenon? (evaluating the practice of asking questions and defining problems: Identify scientific (testable) and non-scientific (non-testable) questions).</p> <p>Resources: Macro Data, WIS/WIM chart, chromebooks, journal</p>
<p><u>Explore</u></p>	<p>Procedure:</p> <ol style="list-style-type: none"> 1. Students will use their researchable/testable questions to begin collecting information about the problem. Students will use their chromebooks to begin researching ideas:jerseyyards.org, Newgarden.org, https://www.nj.gov/dep/gi/pdf/gi_rain_gardens.pdf, https://youtu.be/s8vv_wHdUcQ 2. While students are researching, the teacher is leaning in and talking with students about what they are researching. Guiding students to start to think about solutions that are manageable and can help solve another problem. 3. Class discussion of findings to questions...pause on the stream problem. Explain to students that sometimes when we solve one problem we can create another but on the flip side we can also be more forward thinkers and solve two problems with one solution. 4. Introduce the second problem/phenomena with our local ecosystem: Native pollinators are on the decline. Read pollinator article: https://nj1015.com/decline-of-bees-threatens-crop-yields-across-nj-and-the-u-s/, http://www.conservewildlifenj.org/protecting/projects/pollinators/ <p>Introduce that research being done at NASA with climate change and honeybees: https://climate.nasa.gov/climate_resources/41/video-sting-of-climate-change/</p>

5. Class discussion: How are these two problems connected (stream health and decline of pollinators)? What are others doing to solve the problem? Last year we developed a pollinator garden. What was the purpose of that? Brainstorm solutions...leading students to thinking more about rain/pollinator garden solutions.

Day 2 of Explore:

1. Explain how we are going to use seeds from our pollinator garden we developed last year to create another one that will also act as a rain garden. When seeds were collected they got mixed up. Seeds were collected from: beebalm, hollow stem joe-pye weed, cardinal flower, common milkweed and swamp milkweed.
2. Students will be given 10-20 seeds, observe them and will sort them by traits. Students will need to be placed in 5 groups. Each cluster will have 10-12 **like** seeds to investigate and determine the species.
3. Students will plan out an investigation to determine which plant is what species (ex:sowing the seeds, making observations, comparing the plant growth to adults). In order to plant it in our pollinator/rain garden we need to know about its growing needs.
4. Students can start researching traits of each of the 5 plant species on Jerseyyards.org to gain background knowledge of its appearance, growth rate, and the types of native pollinators it attracts.

Day 3 of Explore:

1. Students will begin collecting quantitative data along with their qualitative observational data about their plant growth by measuring it to the nearest quarter inch and recording the data. Students will measure the plants bi-weekly. All plants should be receiving what it needs for growth water and light. For now students can report the data: date and height of plants. It would be helpful to label plants a,b,c,d for measurement purposes. Students may need to be shown how to use a ruler to measure accurately.

2. Students will use the data from observations (adult plants), measurement data, and plant research information to start to try to identify the plant species. Students should continue to research to learn more about the native plant.

3. Facilitate group discussions: What are your findings? What is your data telling you? What observations have you made? How do you know that your plant species is _____? What evidence do you have to support that?

Modifications: partner students accordingly, reading support, scaffolding questions to help lead a better discussion and better planning of investigation. Provide rulers with the markings for quarter of an inch clearly marked. Provide a graphic organizer for collecting data.

Standards Addressed:

NGSS:

3-LS1B.1: Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles. (3-LS1-1)

3-LS3A.1: Many characteristics of organisms are inherited from their parents. (3-LS3-1)

ELA:

RI.3.1. Ask and answer questions, and make relevant connections to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers

8.2.5.C.4 Collaborate and brainstorm with peers to solve a problem evaluating all solutions to provide the best results with supporting sketches or models

Math:

3.MD.B.4 Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters.

	<p>Formative/Summative Assessments: Students will be evaluated on class participation, peer interaction, and collaboration. Students will also be evaluated on the practice: Planning and conducting an investigation- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. Collect anecdotal notes on students' development as they work through the process.</p> <p>Resources: chromebooks, websites listed in procedure shared with students, journals to collect data and take notes, seeds from: beebalm, hollow stem joe-pye weed, cardinal flower, common milkweed and swamp milkweed, soil, cups, grow lamps, magnifying glasses, rulers, water</p>
<p>Explain</p>	<p>Procedure:</p> <ol style="list-style-type: none">1. Facilitate group discussions/presentation: What are your findings? What is your data telling you? What observations have you made? How do you know that your plant species is _____? What evidence do you have to support that? What pollinators are attracted to your plant?2. Other groups are actively listening and asking questions to help learn more about the other plant species to help with planning where to plant their species. The plants in the garden will work together just as we are working together. Some plants will provide shade for other plants as they grow.3. Allow time for group collaboration after discussion and presentation of information to discuss what their plants needs are and planting goals. <p>Modifications: Provide students with a list of questions (noted about) they need to be able to answer from the data they collected. Use WIS/WIM</p> <p>Standards Addressed:</p> <p>NGSS:</p>

	<p>3-LS1B.1: Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles. (3-LS1-1)</p> <p>3-LS3A.1: Many characteristics of organisms are inherited from their parents. (3-LS3-1)</p> <p>ELA:</p> <p>RI.3.1. Ask and answer questions, and make relevant connections to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers</p> <p>Formative/Summative Assessments: Journal review (rubric) of student data: note taking, measurement data, observation data</p> <p>Resources: Journals and data</p>
<p><u>Elaborate</u></p>	<p>Procedure:</p> <ol style="list-style-type: none">1. Students in the group will create 3 line plot graphs of measurement data to the nearest quarter on 3 separate dates of data collection (beginning growth, middle growth, and current growth).2. Students will use google sheets to create the graphs (measurement along the Y axis and amount/number of plants that were that height along the X axis). How to create charts on google sheets: https://youtu.be/UOoH0Lb4dc43. Students will then complete a WIS/WIM looking at all three data points.4. Share findings with the class about data and how it correlates with your plant species. <p>Modifications: teacher support, step-by-step directions</p> <p>Standards Addressed:</p>

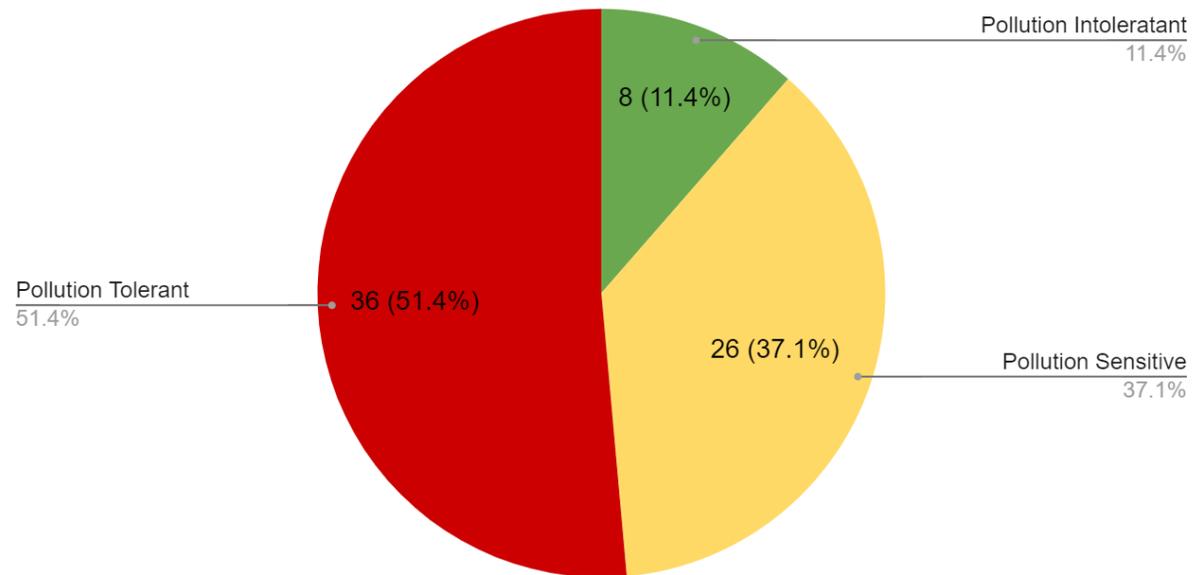
	<p>Math:</p> <p>3.MD.B.4 Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters.</p> <p>8.1.5.A.4 Graph data using a spreadsheet, analyze and produce a report that explains the analysis of the data.</p> <p>Formative/Summative Assessments: graphing data on google sheets and WIS/WIM sheet</p> <p>Resources: chromebooks and data</p>
<p><u>Evaluate</u></p>	<p>Procedure:</p> <p>1. Assessment: Students will develop a model of their plant species and where it should be planted based on its growing needs.</p> <p>-The model should include how their plants will help solve both the pollinator problem and the stream problem.</p> <p>-The model should include arrows to show relationships and cause and effect.</p> <p>-Include any other important information you learned about your plant species into your model. For example its traits and special qualities like what type of pollinators it attracts, growth rate, and other needs</p> <p>Modifications: Check off list of what model needs to include, allowing partners to complete the model together, model can be 3-D, 2-D or done electronically on jamboard or another platform</p> <p>Standards Addressed:</p>

	<p>3-LS2C.1: When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. (secondary to 3-LS4-4)</p> <p>Formative/Summative Assessments: Modeling rubric which can be converted into I can do statements for modifications.</p> <p>Resources: chromebooks, journals, poster paper, markers, crayons, rubric and directions</p>
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Teacher Background:

- Have DCIs, practices, and cross cutting concepts that will be used in this unit posted in the room in student friendly language
- Information on Macroinvertebrates from Watershed
- Knowledge of plant growth of 5 species listed
- Familiarize yourself with websites and resources
- How a rain garden works (see link in the procedure for resources for students to use-Explore)
- How to create a google sheets data chart (see link in the procedure)
- How pollution gets into our waterways (see envirascape youtube video listed in procedure)

Macroinvertebrates from Stream Assessment



70 Macros were collected:

Pollution Tolerant Macros found:

- Mayflies
- Stoneflies
- Gilled Snails

Pollution Sensitive Macros Found:

- Alderflies
- Damselflies
- Dragonflies
- Crane Flies
- Sow Bugs

Pollution Intolerant Macros Found:

- Black Flies
- Midge Flies
- Lunged Snails
- Worms
- Leeches

WIS/WIM Organizer

Directions: Look at the data. Make statements about what you see and then answer the question of what it means.
(Ex: I see a red pie piece. That means 36 of the macros were pollution tolerant)

What I see?

What it means?

Student Journal Rubric:

	Scientific Process	Uses Science Knowledge to understand phenomenon	Group Participation	Organization/ Understanding
Meeting Expectations (3)	Student shows evidence of questions, predictions and results. Data and observations are labeled and contain accurate information.	Student uses DCIs and data to accurately communicate investigation or activity.	Student worked cooperatively with partners and groups communicating ideas respectfully.	Journal is organized, quite accurate and demonstrates concept understanding.
Approaching Expectations (2)	Evidence of questions, predictions and results may be missing or incomplete. Data and observations lack detail or accurate information.	Student uses DCIs or data inaccurately to communicate investigation or activity	Student participated with reminders, but was at times unfocused.	Scientific principles not well understood. May contain errors in thinking.
Not Meeting Expectations (1)	Written observations are missing. Few if any data and observations complete. Details and labels information.	DCIs are not used which leads to major misconceptions of investigation or activity.	Student was troublesome in class and with partners and groups. Unfocused and uncooperative.	Content lacks detail and shows little understanding.

Develop a model of your plant species and where it should be planted based on its growing needs.

-The model should include how your plants will help solve both the pollinator problem and the stream problem.

-The model should include arrows to show relationships and cause and effect.

-Include any other important information you learned about your plant species into your model. For example its traits and special qualities like what type of pollinators it attracts, growth rate, and other needs

-Everything in your model should have a purpose.

	Not Meeting Expectations (1)	Approaching Expectations (2)	Meeting Expectations (3)
<p>Developing and Using Models: Develop a diagram or simple physical prototype to convey a proposed object, tool, or process</p> <p>Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.</p> <p>Develop and/or use models to describe and/or predict phenomena.</p>	<p>Student develops a model with limited data provided and does not explain the cause and effect relationships.</p>	<p>Student develops a model that has data on one to two parts: growth, pollinators and traits. The model has arrows but there may be incorrect relationships between elements highlighted.</p> <p>Most parts in the model have a purpose.</p>	<p>Student develops a model that has data on two to three parts growth, pollinators and traits. The model has arrows that show the relationship between various elements (rain water to roots and pollinators to flowers). Everything in the model has a purpose.</p>

