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| **Lesson Title :** To Grow or Not to Grow…That is the Question | **Unit #:**1 | **Lesson #:**1 | **Activity #:**2 |
| **Activity Title:** Plant / Agricultural Needs |

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| **Estimated Lesson Duration:** | 5 Class Periods |
| **Estimated Activity Duration:** | 3 Class Periods |

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| **Setting:** | School Community Garden and Classroom  |

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| **Activity Objectives:** |

1. I can determine the permeability for different provided substances and create my own “permeability scale”.
2. I can determine the permeability of the soil for each of the different garden beds in the school’s community garden and rank them, using my “permeability scale.”
3. I can analyze rain gage data for Ohio to determine the estimated and expected rainfall for the determined time period.
4. I can synthesize the Ohio rain gage data and the permeability of the different garden beds to determine the amount of rain needed to achieve the desired soil saturation for the plants.

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| **Activity Guiding Questions:** |

1. What is the necessary level of soil saturation needed for the types of plants in our school community garden?
2. What is the water demand of the community garden space, to achieve this desired level of soil saturation?
3. What is the average rainfall for the designated time period?

| **Next Generation Science Standards (NGSS)**  |
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| **Science and Engineering Practices (Check all that apply)**  | **Crosscutting Concepts (Check all that apply)** |
| ☒ Asking questions (for science) and defining problems (for engineering) | ☐ Patterns |
| ☐ Developing and using models | ☐ Cause and effect |
| ☒ Planning and carrying out investigations | ☒ Scale, proportion, and quantity |
| ☒ Analyzing and interpreting data | ☒ Systems and system models |
| ☒ Using mathematics and computational thinking | ☐ Energy and matter: Flows, cycles, and conservation |
| ☒ Constructing explanations (for science) and designing solutions (for engineering) | ☐ Structure and function.  |
| ☐ Engaging in argument from evidence | ☐ Stability and change.  |
| ☒ Obtaining, evaluating, and communicating information  |  |

| **Ohio’s Learning Standards for Science (OLS)** |
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| **Expectations for Learning - Cognitive Demands (Check all that apply)** |
| ☐ Designing Technological/Engineering Solutions Using Science concepts **(T)** |
| ☒ Demonstrating Science Knowledge **(D)** |
| ☒ Interpreting and Communicating Science Concepts **(C)** |
| ☒ Recalling Accurate Science **(R)** |

| **Ohio’s Learning Standards for Math (OLS) and/or** **Common Core State Standards -- Mathematics (CCSS)** |
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| **Standards for Mathematical Practice (Check all that apply)** |
| ☐ Make sense of problems and persevere in solving them | ☐ Useappropriate tools strategically |
| ☐ Reason abstractly and quantitatively | ☐ Attendto precision |
| ☐ Construct viable arguments and critique the reasoning of others | ☐ Look for and make use of structure |
| ☐ Model with mathematics | ☐ Look for and express regularity in repeated reasoning |

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| **Unit Academic Standards (NGSS, OLS and/or CCSS):** |

**Ohio Learning Standards**

* Scientific Inquiry and Application
	+ Identify question and concepts that guide scientific investigations;
	+ Design and conduct scientific investigations;
	+ Use technology and mathematics to improve investigations and communications
* **Global Environmental Problems and Issues**
	+ Potable water quality, use and availability
	+ Sustainability
	+ Food production and availability
* **Soil and Land**
	+ Mass wasting and erosion
	+ Land use and land management (including food production, agriculture and zoning)

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| **Materials**: (Link Handouts, Power Points, Resources, Websites, Supplies) |

1. 8 oz cups and plastic spoons (enough for each group to have one cup and spoon per garden bed).
2. Sharpie markers
3. White sticky labels
4. Plain white paper
5. Teacher computer or laptop and projector or Smart Board for youtube video
6. Video link: <https://www.youtube.com/watch?v=pLRAsAo5l0o>
7. Precipitation data from various sources (enough copies for each group). Select as many / few as desired from the list below:
	1. <http://www.srh.noaa.gov/ffc/?n=rainfall_scorecard>
	2. <http://www.vieuxinc.com/cincinnati/gauges>
	3. <http://water.weather.gov/precip/>
	4. <https://www.wunderground.com/>
	5. <https://rainfall.weatherdb.com/l/104/Cincinnati-Ohio>
8. Large sheets of butcher block paper and markers or large 3 x 2.5’ whiteboards with dry erase markers
9. Permeability Lab materials (per group of 3-4 students):
	1. Graduated cylinder
	2. Large beaker
	3. Spoon
	4. Timer / stopwatch
	5. Two paper cups
	6. Small amount of 5 different samples (labeled A – E) (Gravel, sand, silt, clay, and potting soil).
10. [Student Handouts](file:///E%3A%5CMy%20Unit%20%28in%20progress%29%5CFinal%20Unit%5C1.%201.%202d%20How%20Does%20Your%20Garden%20Grow_Permeability_AParker_072216.docx) (1 per student)

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| **Teacher Advance Preparation:** |

1. Separate cups, spoons, labels, and sharpies into bags or containers to make distribution to the lab groups go more smoothly (optional).
2. Set up the computer / laptop and the Smart Board / projector and test the youtube video to ensure that it plays fully and can be understood.
3. Locate precipitation data from various sources and make enough copies for each group.
4. Gather supplies for the permeability lab.

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| **Activity Procedures:** |

Part 1:

1. Give each group of students a stack of 8 oz cups and a handful of plastic spoons (enough so that there is one cup and spoon for each of the garden beds). Instruct the groups to place a white label on each cup and then use a sharpie maker to identify the garden bed assigned to that cup.
2. Take the students out to the school community garden and direct each group to take a sample of dirt (about half of the cup) from each of the garden beds. When every group has retrieved their soil samples, return to the classroom.
3. Leave these samples in a dry corner of the room to be used later in this activity.

Part 2:

1. Have students run a permeability lab with 5 different substances with generally known permeability. (Follow the handout for more specific instructions).
2. Using the results from the lab, create a “permeability scale” on a sheet of plain white paper, using these 5 items as points of reference.

Part 3:

1. Have each of the groups retrieve their soil samples (from Part 1) and sit as a group at a table (or their pushed-together desks.
2. Each group will test the soil to determine the permeability of each garden bed and rank it, using their “permeability scale.”

Part 4:

1. Discuss rain gages and play the following video: https://www.youtube.com/watch?v=pLRAsAo5l0o
2. Provide students with rain gage / other precipitation data for our area of Ohio (or Ohio as a whole). The greater the variety of data that you can provide to students, the better. Multiple suggested links for precipitation data are listed in the Materials section.
3. In groups, the students will compare the precipitation data and look for discrepancies. Each group will construct a precipitation vs month graph for Ohio and chart the data for each on the line graph, making a key to identify each year. These line graphs can either be created on large sheets or drawn on large 3 x 2.5’ whiteboards. (If you are running behind schedule, have students research this for HW and discuss / share their results with the class the following morning as a warm-up / bell ringer activity.)
4. Have students set up their graphs around the room, and then have the students “poster-walk” around the room and examine other groups’ graphs.
5. Lead a class discussion about precipitation in Ohio over the years, and draw conclusions as a class to predict the average precipitation for the garden.

**Formative Assessments:** Link the items in the Activities that will be used as formative assessments.

1. Student constructed “permeability scales”
2. Student rankings of the garden bed soils using their “permeability scale” (exhibited through [student handout](file:///E%3A%5CMy%20Unit%20%28in%20progress%29%5CFinal%20Unit%5C1.%201.%202d%20How%20Does%20Your%20Garden%20Grow_Permeability_AParker_072216.docx))
3. Student conclusions from Ohio rain gage data (exhibited through group graphs)
4. Student predictions of the amount of rain needed to achieve the desired soil saturation for the plants (exhibited through class discussion)

**Summative Assessments:** These are optional; there may be summative assessments at the end of a set of Activities or only at the end of the entire Unit.

No summative assessments for this activity.

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| **Differentiation:** Describe how you modified parts of the Lesson to support the needs of different learners.Refer to Activity Template for details. |

* Student ability levels were taken into account when grouping students (I paired highs with mediums, and mediums with lows), which successfully allowed the higher of the two in each group to help guide and bring the lower to a higher level of understanding and mastery.
* A few students in the class have diagnosed issues with fine motor skills, so (without pointing out these issues) I designated these students as the “director” of their groups. This allowed them to take an active role in an auditory way rather than in a hands-on way, which may have prevented the progression of the group.
* An engineering college student from a local university was specially designated to assist the lower-achieving students and provide leading questions and redirection, as needed.
* Two students in the class are classified as Alternatively Assessed and are legally required to have shorter or partially verbal assessments. These two students took a more active, hands-on role in the lab, rather than being the designated “recorders.”

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| **Reflection:** Reflect upon the successes and shortcomings of the lesson. |

* Successes:
	+ Grouping my students by academic ability level and social / behavioral tendencies successfully allowed the higher of the two in each group to help guide and bring the lower to a higher level of understanding and mastery. I intentionally provided more assistance for medium / low groups, to additionally scaffold the learning.
	+ Parts 2 and 3 were very successful. The students had clear step by step instructions to follow to analyze their soil samples.
	+ The students really liked doing the “poster walk” in Part 4, because it allowed them to get up, walk around, and interact with each other’s’ work. Students could visit the work that interested them the most first.
* Shortcomings:
	+ In Part 1, not all of the soil samples were completely dry by the time we were ready to use the soil. This affected the accuracy of the data that the students collected. In the future, I would have the students collect the soil samples right after the “hook” in Activity 1.
	+ Although Parts 2 and 3 were highly successful in terms of learning, in future implementations, I would have students cover their tables / desks with sheets of plastic (large trash bags or ponchos could easily work for this too) before beginning parts 2 and 3, to prevent the extent of cleanup needed.
	+ Part 4 (Analysis of Precipitation data for Southwestern Ohio) was a struggle for my students, mostly due to lower math levels and a lack of skills with the organization, graphing, and analysis of data.
	+ In future implementations, I will likely provide a model of how the precipitation data for a different region can be organized, graphed, and assessed.