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| **Lesson Title :** Lesson 1:To Grow or Not to Grow…That is the Question | **Unit #:**  1 | **Lesson #:**  1 | **Activity #:**  1 |
| **Activity Title:** Activity 1:Water Transportation: Mini-Hook / Relay Race |

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| **Estimated Lesson Duration:** | 5 Class periods |
| **Estimated Activity Duration:** | 2 Class periods |

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| **Setting:** | Classroom and parking lot (or large outdoor area) |

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| **Activity Objectives:** |

1. Students will draw conclusions and comparisons from the “hook” / mini-race relating to water transportation differences in various countries.
2. Provided with the Big Idea, Water Transportation / Distribution, students will generate an Essential Question.
3. After producing an Essential Question (as a class), students will actively participate (individually, in groups, and as a whole class) in the creation of the Challenge.

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| **Activity Guiding Questions:** |

1. Where does our local water come from?
2. What are the components of transporting water / what is needed?
3. Taking into account the four different countries associated with the water race activity, what conclusions can be drawn relating to different water transportation systems?
4. In what ways are the water transportation systems in developed countries different from those in developing countries?

| **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;
  + Formulate and revise explanations and models using logic and evidence (critical thinking);
  + Recognize and analyze explanations and models; and
  + Communicate and support a scientific argument.
* **Global Environmental Problems and Issues** 
  + Potable water quality, use and availability
  + Sustainability
* **Earth’s Resources** 
  + Water and water pollution
  + Potable water and water quality

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

* 8 Five gallon buckets
* 16 gallons of water
* 4 labels (United States, Europe, Kenya, Honduras)
* 4 containers for water transport, 2 large and 2 small (examples: 2 large cups and 2 spoons)
* Classroom whiteboard and dry erase markers
* About 2 cups of “contaminants” (this can be dirt, crushed Oreos, or chocolate milk).
* Large whiteboards for student groups (about 8 boards, measuring roughly 3 x 4 feet each)
* Dry erase markers (enough for each group)
* Copies of the “[Big Idea to Guiding Questions” worksheet](file:///E:\My%20Unit%20(in%20progress)\Final%20Unit\1.%201.%201c%20How%20Does%20Your%20Garden%20Grow_WaterRace_AParker_072216.docx) (1 per student)

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| **Teacher Advance Preparation:** |

1. Make enough copies of the “Big Idea to Guiding Questions” worksheet so that each student may have their own.
2. Designate a large, empty parking lot or large outdoor area to use for the water races, then set up the area as follows:
   1. On one side of the area, place 4 five gallon buckets in a row, with about 5-10 feet of spacing between each. Place one of the following labels on the bottom of each of the buckets: United States, Europe, Kenya, and Honduras. Fill each of these buckets with 4 gallons of water.
   2. Measure 50 meters away from the first row of buckets, and place the other 4 five gallon buckets, each bucket directly across from one of the full water buckets. These 4 buckets should be empty.
   3. Place the following utensils next the corresponding bucket, on the full-bucket side.
      1. United States: a large container (about 2 cups in size)
      2. Europe: a large container (about 1 ½ - 2 cups in size)
      3. Kenya: a small container (a large spoon)
      4. Honduras: a small container (a large spoon)
   4. Add “contaminants” to the two buckets of water that are labeled as Kenya and Honduras. Some suggested contaminants are dirt, crushed Oreos, or chocolate milk, to give the water a polluted appearance.
3. Write the words: “Water Transportation / Distribution” on the board.

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| **Activity Procedures:** |

**Activity 1, Day 1:** (50 mins) - Introduce the Big Idea, produce the essential questions, identify the Challenge, and brainstorm the guiding questions.

1. At the start of the class, as the students come into the room, have the following words written on the board: “Water Transportation / Distribution.” When all of the students are seated, announce to the class that the next topic that will be covered is “Water Transportation / Distribution. Then, split the class into 4 even groups and take the class to the pre-determined location for the “hook” activity.
2. On the side of the parking lot (or large outdoor area) that has the 4 buckets containing water, have each group of students line up behind one of the buckets. Provide them with the following instructions: “In your four groups, we are going to have a water race today. Please make careful observations throughout the entire race, as you will need these details for the second part of today’s activity. When I say “go,” the first person from each group will start to transport the water from the full bucket to their corresponding bucket on the other side of the large area, dump the water into the bucket, and run back to their group to pass the transportation tool to the next person in line. You may walk or run as fast as you want, but only one person may travel at a time and each group can only use the transportation tool provided to them. Some people might need to go more than once to get all of the water to the other side. When all four groups have completed the race, each group needs to measure the amount of water that they actually transported to their second bucket.”
3. As the students begin the race, the teacher needs to carefully record the finish order of the four groups. When all four groups have completed the race, have each group read the country name on the bottom of their original water bucket, and then take the class back into the classroom to reflect on the activity.
4. As the students return to the classroom, instruct them to divide their large group from the race into two smaller groups, and to then sit together and wait for your next instruction.
5. After all of the groups are seated, pass out the “Big Idea to Guiding Questions” worksheet to each student, then provide the class with 5 minutes of silent time to read the directions and fill in the first box by themselves. At the end of the 5 minutes, give the students an additional 5-10 minutes to share their ideas with the rest of their group and fill in the second box on their Big Idea Sheets.
6. Have one student from each group share with the entire class what they and their partner came up with relating to the Big Idea and the Water Race. It may be helpful to foster conversation in the groups with the following questions:
   1. Why did the water in the buckets of two of the groups look different than the other groups’ water?
   2. Why were there country names on the bottom of the starting buckets and how do these names relate to the other details you observed?
   3. Did all of the groups complete their water transportation in the same amount of time, or did some finish much faster than others? If so, what contributed to this difference?
7. Following the class discussion, give the groups 5 more minutes to brainstorm and record “Essential Questions.”
8. Circulate the room and listen to the groups working. If necessary, help plant some ideas for the groups, if they seem completely lost. Some possible “Essential Questions” that they may come up with include:
   1. How do we efficiently and sustainably transport water to where it is needed for agricultural purposes?
   2. What are some reasons that water needs to be transported from one location to another?
   3. Where does water come from and where does it go (more specifically, OUR water)?
   4. How is the efficiency of water transportation different in first world vs third world countries?
   5. In what ways can we make water transportation more efficient?
   6. Why is the efficiency of water transportation different in first world vs third world countries?
   7. Why do some countries have cleaner water to transport than others?
9. Through class discussion, come up with a class list of essential questions (and display this list on the board). Use the Big Idea worksheet to record and organize any important background information on the unit Big Idea.
10. Use guiding mechanisms to help the students come up with the essential question that will serve as the backbone for their challenge: How do we efficiently and sustainably transport water to where it is needed for agricultural purposes? This question may have slightly different wording, but the general theme should be consistent. Be sure to have the students record this Essential Question on their worksheets.
11. Have the students discuss possible real-world challenges that they could solve relating to this essential question. Guide the students to the following design Challenge: Design and build a way to transport enough water to water the new community garden to ensure plant growth. The system designed and built by the students will be tested on a “model” of the garden, constructed by the teacher. Students will test, evaluate, and redesign their systems to improve efficiency. A final PowerPoint will be created for presentation to the PTA Garden Committee and / or School Board of their proposed solution for a watering system for the community garden. Realistically, the additional constraints of the Challenge will likely need to be expressed by the teacher (These can be found in the complete unit plan. Due to time allotments, the Challenge may need to be described in more detail, including the constraints, on Day 2).

**Activity 1, Day 2:**

1. As students enter the room, instruct them to get out their “Big Idea to Guiding Questions” sheets from Day 1 and to sit with their groups.
2. Refresh the class about the Challenge they selected on Day 1 and give them about 3 minutes to review the notes they took the day prior.
3. As a class, on the large white board, brainstorm constraints and limitations. Try to lead the class to the constraints and limitations listed on the unit plan. If needed, make sure to introduce the missing constraints and limitations so that the students have a comprehensive list before beginning the Challenge.
4. Give each group 1 large whiteboard and a few dry erase markers. Have the students brainstorm at least 5 guiding questions for the Challenge. What do they need to know in order to complete this Challenge? (Give the groups about 5-10 minutes before moving on to the next step).
5. Share the questions as a class to produce a final class list of guiding questions for the Challenge. Make sure that all of the members in each group complete their Big Idea to Guiding Questions handout before collecting them at the end of class.

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

1. Observations of students actively engaging in the Essential Questions 🡪 Challenge 🡪 Guiding Questions process.
2. Student “[Big Idea to Guiding Questions” worksheets](file:///E:\My%20Unit%20(in%20progress)\Final%20Unit\1.%201.%201c%20How%20Does%20Your%20Garden%20Grow_WaterRace_AParker_072216.docx), showing development of all parts listed above.

**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 were used in 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. |

* Instructions prior to the “hook” and results of brainstorming after were discussed out loud (for auditory learners) and were recorded on the white board (for visual learners).
* Two students with 504 plans (specifically for mobility issues) served as the directors for their groups, rather than being a part of the relay race. They still had an active role, without causing any major issues with their peers.

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

* Successes:
  + Despite my initial worries, the majority of the students really got into the “hook.” Some students even surprised me by running with the water!
  + I was also surprised by the ability of the students to think outside of the box and “engineer” a way to speed up their group’s transfer of the water (this came in the form of borrowing resources from other “countries”).
  + The students quickly connected the “hook” to the Big Idea of Water Transfer and the class brainstormed relatively quick all of the analogous details.
  + The Big Idea to Guiding Questions sheets were very helpful in structuring the post-hook discussion.
* Shortcomings:
  + Students were really creative (and borderline cheated) toward the end of the hook. I could prevent this by reviewing the rules more than once.
  + The relay race took place on the back parking lot, which was relatively close to the school building. It was very difficult to keep the energized, but also keep their volume low enough to not distract the nearby classes with open windows.
  + The students struggled to follow instructions when asked to brainstorm / list a few ideas on their own first, before consulting their groups. They wanted to skip that step, and just jump right to the group discussion portions. This tends to be a reoccurring issue with my students.
  + “Europe” was accidently used as a country name. Next time I teach this unit, I will replace Europe with another first world country, such as Canada.