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| **Authors:** | Jodie Napier, Rhonda Bishop, Maegan Trent |
| **Title:** | City Park Challenge |
| **Grade level(s):** | 7th Grade |
| **Time Required:** | 3-5 class periods |
| **Subject(s):** | Math and Science |
| **Standards:** | 08-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on theEnvironment MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking intoaccount relevant scientific principles and potential impacts on people and the natural environment that may limit possiblesolutions.MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria andconstraints of the problem7.RP.1 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.7.G.1 Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.6.RP.2 Understand the concept of a unit rate a/b associated with a ratio a:b with b ≠ 0, and use rate language in the context of a ratio relationship6.EE.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. |
| **Science and Engineering Practices, Cross-cutting Concepts and Standards for Mathematical Practice** | Science and Engineering Practices:1. Asking questions (for science) and defining problems (for engineering) 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations (for science) and designing solutions (for engineering)8. Obtaining, evaluating, and communicating informationCross-Cutting Concepts:2. Cause and effect: Mechanism and explanation.3. Scale, proportion, and quantity.Standards for Mathematical Practice:1. Make sense of problems and persevere in solving them2. Reason abstractly and quantitatively4. Model with mathematics5. Use appropriate tools strategically6. Attend to precision7. Look for and make use of structure8. Look for and express regularity in repeated reasoning |
| **Objectives:** | Students can determine distance and speed.Students can determine appropriate dimensions using a scale/scale factor.Students understand the human impacts upon the environment. |
| **Materials List:** | Ozobots, markers, rulers, graph paper, poster paper, copies of walking trail |
| **Safety Concerns:** | None |
| **Accommodations for Learners with Special Needs (ELL, Special Ed, 504, GT, etc.):**  | Group students based on ability level |
| **References:** | <http://education.ky.gov> ;  |

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| **ENGAGEMENT Time:10-20 Minutes** |
| **What the Teacher Will Do** | **Probing/Eliciting Questions** | **Student Responses and Misconceptions** |
| **The teacher will present students with the following scenario: “The City Park Planning Committee is holding a contest for making improvements to local park’s established trail. They have received complaints from community members stating that they would like to have trails that are shorter and trails that are longer to complete. They also complained there wasn’t much variety in the trail in order to provide accessibility to everyone. The current walking trail takes an hour to complete a lap, by beginning and ending at the parking lot.”** | * **How could we vary the trail and still start and end at the same place?**
* **What within the park might cause foot traffic not to be allowed?**
 | * **You could cut through the middle of it.**
* **Landscape, trees, water, protected habitats, camping areas, etc.**
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| **Evaluation/Decision Point Assessment** | **Assessment** | **Student Outcomes** |
| **Assessments will be formative based on dialogue where students exhibit understanding of restrictions based on scenario** | **Questions above and other guiding questions as needed** | **Students realize that parks aren’t always open spaces with nothing in the middle.****Students are beginning to make sense of task at hand.** |

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| **EXPLORATION Time: 90 Minutes** |
| **What the Teacher Will Do** | **Probing/Eliciting Questions** | **Student Responses and Misconceptions** |
| **Students will be given a sketch of the current park with the walking trail emphasized. They will be given the following criteria for the contest*** **One new trail must add 30 minutes without backtracking at all.**
* **One new trail must reduce the original time by 30 minutes without backtracking.**
* **The trail may not pass through restricted areas, due to human and environmental impact.**

**The most creative trail will be implemented in the park.****The final product will be on a larger presentable paper utilizing a scale factor of 2.****Student will work in groups of 3-4 with Ozobots to determine the time and ultimately speed of the different trails.** | * **How can we add variety to additional trails?**
* **How would curves and hills impact the time it takes to complete the trail?**
* **Would curves add or reduce time?**
* **How do we determine a scale factor of 2?**
* **What would you have to do to the Ozobots to have them compensate for the topography and stay away from protected areas?**
 | * **Curves and hills could be included.**
* **Trees, plants and flowers could be added but need to be avoided.**
* **Up a hill will slow down, down a hill will speed up.**
* **Curves would add time.**
* **Multiply everything by 2.**
* **Use the codes to make it slow down, speed up, turn around.**
* **Draw curves to avoid restricted areas.**
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| **Evaluation/Decision Point Assessment** | **Assessment** | **Student Outcomes** |
| **If students are understanding how to find scale, as well as utilizing the ozobot to represent various speed and topography** | **Observation of blue prints and dialogue with student groups. Appropriate equations represented.** | **Students will appropriately determine that in the final design, time and distance will be multiplied by 2. Students will be able to determine distance and speed by using the equations d=rt. Students will grasp an understanding that some areas in a park must be restricted due to human and environmental concerns.**  |

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| **EXPLANATION Time: 45 Minutes** |
| **What the Teacher Will Do** | **Probing/Eliciting Questions** | **Student Responses and Misconceptions** |
| **Explain the relationship between distance, rate and time and how to use the equation to determine the speed.** **Explain how to find scale factor.** **Explain why you would need to avoid certain areas of the park.** | **If d=rt, and we know the distance and the time, how can we find the rate?****How can we use the ozobot to determine the speed?****How can foot traffic through the park affect the wildlife and environment depending on it?** | **Divide the distance by time.****Measure the length of the track and then time the ozobot. Then find the rate by using the formula.** **People will step on the organisms and kill them.****People might spray graffiti on various items.** |
| **Evaluation/Decision Point Assessment** | **Assessment** | **Student Outcomes** |
| **Assess understanding of using the equation.** **Assess understanding of applying a scale factor.****Assess understanding of human impact on the environment.**  | **Through conversation with students, individually and in groups, we will assess if they can accurately find the needed information for the track (rate and size based on scale factor).** | **Students can manipulate the d=rt equation and appropriately use scale factor when determining their walking path lengths.** |

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| **ELABORATION Time: 45 Minutes** |
| **What the Teacher Will Do** | **Probing/Eliciting Questions** | **Student Responses and Misconceptions** |
| **The teacher will remind students that they are in a contest. Discussion will occur as to what additions could be made to make their trail more appealing. As students continue to work on making additions, the teacher will circulate and assist students in placement of additions.** | **What are some things you need to consider when making your trail the most appealing one?****How do you decide which materials would be best for the environment and durability of your track?****How do decide where place the additions, such as bathrooms, benches, lights, etc.?****Why would we want the benches and lights spread out?** | **Materials, landscaping, restrooms, benches, lighting, bike accessible.****The cost of the material will be a factor.** **Are the materials environmentally friendly/renewable?****Benches and lights would need to spaced out along the trails.****Restrooms would need to be at the entrance.** **People might get tired at different spots.** **If it’s dark then you don’t want dark spots on the trail.** |
| **Evaluation/Decision Point Assessment** | **Assessment** | **Student Outcomes** |
| **If students are understanding how and where to place appealing additions.** | **Through conversations with students and observation of blueprints.** | **Students will be able to understand that benches, lights, restrooms, etc. are placed strategically in parks.** **Students will be able to realize that small things can change the appeal.** |

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| **EVALUATION Time: 5-10 Minutes at the end of 2 or 3 class periods.** |
| **What the Teacher Will Do** | **Probing/Eliciting Questions** | **Student Responses and Misconceptions** |
| **Throughout the scenario, students will be given various exit slips to determine their ability to find speed and distance; dimensions given a scale factor; and ways humans impact the environment. The teachers will also look the students’ final products to determine if criteria of original task is met.** | **What would the speed be of a person who walked 3 miles in 2 hours?****If a person walks at a rate of 2 miles per hour, and they walk for 1.5 hours, how far have they walked?****If the distance on a diagram of a model car from front to back is 4 inches and the actual car is built with a scale factor of 2, how long will the car be?****List 3 ways that humans impact the environment.**  | **Speed would be 1.5 miles per hour****The person will have walked 3 miles.****The model car will be 8 inches long.****Pollution; graffiti; destruction of habitats; erosion from irrigation; endangering animals; etc.** |

