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| **Lesson Title : Traffic Flow** | **Unit #:**  **1** | **Lesson #:**  **2** | **Activity #:**  **4** |
| **Activity Title: Give An Intersection a Makeover** |

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| **Estimated Lesson Duration:** | **6 days** |
| **Estimated Activity Duration:** | **4 days** |

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| **Setting:** |  |

Honors Algebra I class; activity will take place in my classroom

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| **Activity Objectives:** |

Students will create a traffic flow graphical model for the intersection of Queen City and Harrison Avenues; model should allow for efficient flow of traffic.

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| **Activity Guiding Questions:** |

Students will be guided by the following questions throughout this activity:

1. How can we minimize the number of people/vehicles waiting in a service line (intersection)?
2. What are the benefits of improving intersection?
3. What are the benefits of improving traffic flow?
4. What measures can be enforced that impact safety of traffic flow?
5. How can an intersection be improved to move cars at a more constant rate?

| **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 New Learning Standards for Science (ONLS)** |
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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)** |

| **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, ONLS and/or CCSS):** |

**CCSS.Math.Content.HSA.CED.A.1**

Create equations and inequalities in one variable and use them to solve problems.

**CCSS.Math.Content.HSG.MG.A.1**

Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).\*

**CCSS.Math.Content.HSG.MG.A.3**

Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).\*

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

Graph paper, rulers, compasses, protractors. I also purchased large sheets of graph paper posterboard for students to complete the challenge; along with scrapbook paper with bicycles, grass, water, etc. –anything that I thought the students would want to use to decorate their models.

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| **Teacher Advance Preparation:** |

Generate a list of possible websites for researching intersection design models.

<http://www.fhwa.dot.gov/publications/research/safety/04091/03.cfm>

<http://d2dtl5nnlpfr0r.cloudfront.net/tti.tamu.edu/documents/0-4365-S.pdf>

<http://nacto.org/publication/urban-street-design-guide/intersections/intersection-design-principles/>

<http://www.fhwa.dot.gov/environment/publications/flexibility/ch08.cfm>

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| **Activity Procedures:** |

First day procedures:

1. Students will be placed into their groups.
2. Each student will take about 20-30 minutes to research the internet on ideas for intersection designs. Students will take screen shots of their intersections and paste on their activity sheets.
3. Within their groups, each student will take 5 minutes to present their findings.
4. Group will decide at this point the approach they want to take for their design.
5. The assignment at the end of this first day will be for students to discuss their design approach with their parents (or preferably someone that drives that route each week) and write down any comments/suggestions.
6. Show video on the lick run project http://projectgroundwork.org/downloads/cof-5min.f4v

Second day procedures:

1. Students will share their “homework” results with their groups. At this point, students may decide to change the design plan.
2. Students will be assigned jobs for the project:
   1. Lane construction for vehicles/ stop signals
   2. Metro lanes and stops
   3. Pedestrian walkways and signals/ bicycle path
   4. Intersection Aesthetics
3. For each job specific dimensions need to be calculated. Students will search the internet for ideas pertaining to their specific jobs.

Third (+) day procedures:

1. Students will begin to draw map out their designs. Students will use graph paper to plan out their intersections. These plans are required to be turned in at the end.
2. After students have their initial design, they will test different scenarios using the speed of cars and stop light times. Students will need to consider cars making right/left hand turns, bicycle/pedestrian traffic and Metro bus stops.
3. Students will refine their designs after they test 10 different scenarios (cars traveling in different directions, pedestrians using crosswalks, bicycle traffic, bus traffic).
4. Once groups have refined their intersection, they will create a graphical model of their intersection. Model should be drawn to scale and should be properly labeled (signs, lanes, lights). Intersection aesthetics will also be important to show on model.

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

Individually, students will be assessed of their internet searches for possible intersection designs and for their job tasks. For the internet search students will complete a record sheet where they will illustrate their 3 ideas and they will state their justifications for their designs. This form will be due at the beginning of day 2 of the Challenge. Students will also need to complete a task form for their assigned jobs. Groups will be required to submit preliminary designs and drawings as they progress through the Challenge. These designs should note justifications for additions/deletions. The group will be assessed on their final model as to how it meet the specifications of the Challenge. Models should show well developed ideas using necessary geometric shapes with the proper areas. Students will also be assessed by how well their intersections enable vehicles to move through using the equations for arrival rate and departure rate from the previous activity.

**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.

At the end of the Challenge, each group will present their project to the class. Each member of the group will need to explain their position within the group and explain what they contributed most to the final project.

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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. |

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

These are my reflections about the challenge;

* Giving the students direction with the websites was very helpful in getting them started on the challenge (though some students did not research as much as they needed to)
* Having the materials readily available for the students helped keep the students on task though I think I should wait 1 full day into the challenge so students are gathering the information needed to solve challenge before implementation
* Groups need to be more carefully selected. Some students take complete control which bothers some students since their ideas are not being considered but it also is okay with other students because they do not want to do the work. I need to make more students accountable for keeping involved in the challenge. I know having better defined jobs within the challenge would help. Also surveying the groups throughout the process would be helpful also.
* Next year I will insist that a “rough draft” be completed and turned in to me before final challenges can be completed. I think I will have students present their rough draft to me and I will ask questions and offer suggestions.
* I especially enjoyed how creative students were with their designs. The intersection that the students were asked to reconstruct is in a very poor neighborhood. Their models showed parks, playgrounds, tennis courts, basket courts, etc. –-“stuff” that we all want available in our local parks.
* Presentations went well for the challenge; the only change I might make is to invite other people in for the presentations (administrators, teachers, parents).