Green, Yell-ow, Red
How is the timing of a yellow light determined?

Connections to the Next Generation Science Standards

Practice Elements:
- Asking Questions/Defining Problems
- Developing and Using Models
- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Using Math and Computational thinking
- Constructing Explanations and Designing Solutions

Crosscutting Concept Elements:
- Patterns
- Prediction
- System Models
- Energy Conservation
- Structure and Function

Disciplinary Core Ideas:
- Forces and Motion
- Energy
- Conservation of Energy
- Defining and Delimiting Engineering Problems
- Optimizing Design Solution

Lesson Summary

Students will design a series of experiments to determine the ideal timing of a yellow light. Based on relevant factors, students will break the project into measureable components. Each component will have an experimental design, which will be proposed to the class for feedback prior to conducting experiment. Groups will then refine their experiment, execute experiment, analyze data and present results to the whole class, again.

Teacher interaction/guidance is limited. Allow the groups to design any aspect they feel is relevant. Refining design is imperative to the success of this project.

Common teacher guiding question: “How will you use these results as evidence to support your proposed solution?” (Typically, reaction time and stopping time are the two main foci of the project)

The final report will be an analysis of any intersection the group can physically go to (choosing one that is common to their lives makes the project more relevant). In this report, students will use acquired information from the previously designed experiments to determine what their group would actually time the yellow light at. The report will be presented to the class for one more round of feedback; suggestions will be considered and improvements made. The finalized report will be submitted to the local city engineer for consideration, feedback, and assessment.
Specifics

CITY ENGINEER

Including a city engineer will make this project relevant. It will also be engaging to be taking data from an intersection that the students interact with daily. If it isn’t possible to contact a city engineer, contact InTrans @ ISU for a contact who can be the acting city engineer.

SETUP

This project focuses on using variable relationships through graphing. These relationships can be tough for some students to intuitively derive. Front loading, using graphs to solve problems rather than equations, will help them build better models. From these models, students should be able to answer their own questions about how the variables are related. (What measurements are required in order to find a different variable)

OPTIMAL EXTENSIONS

There are multiple opportunities for extending the project based on classroom dynamics. Below are a few examples:

| 1 | Have students get reaction time for a much larger subset. This could be categorized by age to determine how that affects yellow light timing. |
| 2 | Rather than looking up values online, have student’s measure minimum and maximum deceleration rates using police cruiser skidstop (or do this in the one dimensional kinematics unit and reuse the data here). |
| 3 | Include thermal heat transfer to brakes and compare actual temperature of brakes to theoretical temperature of brakes based on conservation of energy brakes get during maximum deceleration. |