



GETTING OUTDOORS WITH PHYSICS: INVESTIGATING VEHICLE EFFICIENCY

Grade 12, Physics, College Preparation, SPH4C

DESCRIPTION

This activity provides students with an opportunity to go outdoors and collect primary data around motion and its applications. Students will record the time required for a vehicle to drive through the drop-off area of a school, which will lead to discussions about commuting, vehicle emissions and fuel efficiency.

CURRICULUM LINKS - PHYSICS, GRADE 12, COLLEGE PREPARATION, SPH4C

Overall Expectations: A1, B1, B2, B3

Specific Expectations: A1.1, A1.2, A1.5, A1.6, A1.8, A1.10-A1.13, B1.1, B2.1-B2.7, B3.1-B3.3

PLANNING NOTES

Background Information

Energy can be transformed from one form to another; however, systems involving energy transformations are never 100 percent efficient. The different processes used to generate usable energy vary in efficiency, as well as in the amount of GHGs they produce. As a result, different energy sources (e.g., coal, petroleum, natural gas, hydro, nuclear) and their resulting energy transformations affect the environment in different ways. Less efficient processes produce high levels of carbon compounds, and more efficient processes produce lower levels of gaseous carbon. Increased efficiency is a factor in reducing the production of GHGs and a device's efficiency can be measured in terms of the size of its carbon footprint.

Recommended Class Time

2-3 periods

Materials

- Stopwatches
- Measuring tape
- Notebooks
- Clipboards
- Pens and/or pencils
- Pylons
- Sticks (flags or bright colours recommended)
- *Vehicle Type, Distance, & Time Recording Sheet* (Appendix 1)

Things to Think About

During this experiment, students will be working in close proximity to vehicles. To ensure student safety:

- Pre-mark the measurement intervals at the drop-off location during slow periods or the day before
- Observe vehicles from a static location
- Only those students timing or recording distance should be close to the drop-off site

TEACHING/LEARNING STRATEGIES

Ignite

1. Introduce the term “carbon footprint” and ask students to share what they know with their peers and then with the whole class.
2. After discussing carbon footprints, ask students to reflect on the following questions:
 - How can we reduce or eliminate GHG emission levels when we generate useable energy?
 - What are energy alternatives?
 - How can efficiency be increased?
3. Discuss and record their ideas and suggestions before explaining the outdoor investigation.

Outdoor Exploration

1. In preparation, select a distance in the school drop-off area that will be appropriate for measurement. The distance will depend on students’ ability to take measurements quickly and efficiently. If cars are traveling slowly, 50-100 m should represent a sufficient measurement distance.
2. Explain to students that they need to mark 5-10 measurement intervals (e.g. every 5 or 10 metres) in order to collect enough data to plot on a graph. (This can also be done ahead of time.)
3. Once outside, students will work in pairs - one will use the stopwatch and one will record using the *Vehicle Type, Distance, & Time Recording Sheet* (Appendix 1). Both students should stand at the mid-point of the measurement distance with interval marks clearly visible.
4. Each pair of students will be responsible for three different vehicles and will record the time it takes for each vehicle to travel across the intervals. In addition to recording the time, ask students to note the vehicle make/model if possible, or vehicle type (i.e. sedan, SUV, van, etc.).

Reflect

1. After recording and observing outdoors, ask students to exchange data with another group (or two) to ensure that different vehicles are represented and that their sample size is larger.
2. Using the data collected, for each vehicle, ask students to create charts or perform calculations to illustrate the following concepts: displacement, average velocity, instantaneous velocity, and acceleration.
3. As a class, discuss the results and what they observed. Was anything surprising? Were some cars more efficient than others? Is there anything they would do differently on a daily basis after having completed this investigation?

EXTENSION

Investigating Efficiency and Vehicle Emissions: Continue exploring CO₂ emissions and vehicle efficiency using the related learning activity. Students will measure commuting distances and compare highway and city driving.

APPENDIX

Appendix 1: *Vehicle Type, Distance, & Time Recording Sheet*

