Subject: Physics	Grade: 11-12	Unit #: 1	Title: Intro to Motion and Experiment Design

UNIT OVERVIEW

STAGE ONE: Identify Desired Results

Established Goals/Standards

NYS Standards

P.I. 5.1 - Students can explain and predict different patterns of motion of objects (e.g., linear and uniform circular motion, velocity and acceleration, momentum and inertia). (P.I. 5.1)

Long-Term Transfer Goal

At the end of this unit, students will use what they have learned to independently…

Use mathematical modeling to explain and predict patterns of motion in one dimension.

Meaning

Enduring Understandings
Students will understand that…

NYS:
5.1a The motion of an object is always judged with respect to some other object or point. The idea of absolute motion or rest is misleading.

5.1b The motion of an object can be described by its position, direction of motion, and speed (rate of change).

5.1d An object in linear motion may travel with a constant velocity* or with acceleration*.

5.1e An object in free fall accelerates due to the force of gravity. Friction and other forces cause the actual motion of a falling object to deviate from its theoretical motion.
(Note: Initial velocities of objects in free fall may be in any direction.)

Active Physics

Motion can be described in terms of position, velocity and acceleration

Motion can be described both algebraically and graphically

Complex phenomena can be mathematically modeled

Essential Questions
Students will consider such questions as…

How can we develop and use mathematical models and diagrams to describe and predict the motion of an object in 1D?

Active Physics

How can motion be described using the concepts of position, velocity, and acceleration?

How are measurements crucial for understanding the motion of a vehicle?

How is velocity defined and how is it measured?

How can motion be represented graphically?

Acquisition

What knowledge will students learn as part of this unit?

- Distance (m) - describes change in position regardless of direction
- Displacement (m) – describes change in position relative to a point and direction

What skills will students learn as part of this unit?

- construct and interpret graphs of distance vs time
- determine and interpret slopes
- use classical kinematics equations to calculate distance, velocity and time

		• Speed (m/s) – describes how distance changes as time goes by • Velocity (m/s) – describes change in position over time.	• use meter sticks to appropriately measure distance or length in meters and centimeters • use appropriate units in order to describe physical quantities (m, m/s, s) • analyze data in order to define patterns and trends. • apply the concepts of physics and scientific reasoning to find the solution to a complex problem

STAGE TWO: Determine Acceptable Evidence	
	Assessment Evidence
Criteria for to assess understanding: *(This is used to build the scoring tool.)* Students demonstrate understanding of the relationship between distance, time and speed (velocity) both conceptually and mathematically Students can design and carry out experimental procedures that allow them to measure the average speed of a series of cars in order to answer an experimental questions Students can perform mathematical analysis (graphical and calculations) of data. Students can use analysis to reach and support an evidence based conclusion.	Performance Task focused on Transfer: Practice Transfer • Students design procedures and chose data analysis techniques in order to figure out the average speed of "a series of moving objects such as constant speed carts and free falling tennis balls • Design an experiment to find out the acceleration due to gravity Summative Transfer Task • Develop an experiment that would help you figure out if there is a speeding problem in a neighboring street. Students will need to write a letter to the department of transportation with recommendations based on their findings. Other Assessment Evidence: • Daily Bellwork, Summary and Closure activities • Homework • Written formative feedback on experimental designs • Quizzes • Model Standardized Test

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T, M, A *(Code for Transfer, Meaning Making and Acquisition)*	**STAGE THREE: Plan Learning Experiences**	
	Intro to motion - M 1. Introduce final project 2. Motion stations activity – students experience different kinds of motion **Intro to Distance, time and average speed - M** 3. Revisit final project 4. Distance vs time lab – students collect distance and time data of another student in motion. Students graph this data and use graphs to figure out how they can be used as models of motion **Distance and Time Graphs - M** 5. Interpret distance vs time graphs 6. Move it activity – students use what they have learned so far to try to predict what distance vs time graphs would look like for different kinds of linear motion (i.e constant speed, standing still and accelerating) **Motion Story/Formalizing Concepts – A/T** 7. Notes. Students construct formal definitions for the concepts they have experienced so far 8. Practice Problems 9. Practice Interpreting graphs 10. Motion story activity – Students use distance vs time graphs as a reference to write a story that matches the type motion represented by the graph – (**T)** **Calculating Speed - A** 11. Using v = d/t 12. Students practice use of the average speed formula **Writing Procedures/Electric Cart Speed – M/A** 13. Students first experience with the *experimental design grading rubric*. I will explain criteria and sample procedures for students to evaluate 14. Students take their first stab at writing procedures for an investigation	Evidence of learning: *(formative assessment)* ***Daily Closure questions aimed at assessing the day's learning targets*** *Sample Closure questions* 1) Which of the following cars do you believe moved the fastest? • Car A – moved between the 25km and the 27km marker in 5 seconds • Car B – moved between the 30km and the 35km marker in 5 seconds Explain your reasoning and show any work you may need to do to answer the question 2) Which of these graphs represents the motion of your "fastest" trial? Explain why 3) Regents Style question – Based on graphical info students' answer the question "If all these cars are going to the same place and they all take the same path, which will get there first? Explain

	15. Students design an investigation that will help them figure out the speed of a "constant speed" cart **Analyzing Data/End Electric Cart Speed – M/A** 16. Students look at feedback on procedures and make necessary changes based on feedback 17. Students Carry out procedures and organize data and make relevant calculations **Speeding Problem Investigation begins - T** 18. Students independently design and carry out investigation in order to figure out if there is a speeding problem in the neighboring street **Speeding Problem Day 2 – T** 19. Students analyze collected data, reach conclusions and finish their written reports	