Richmond Public Schools

Department of Curriculum and Instruction
Curriculum Pacing and Resource Guide – Unit Plan

Course Title/ Course #: Physics / 2900

Unit Title/ Marking Period # (MP): Application, Acceleration, Velocity, Displacement, and Time / MP1

Start day: 31

Meetings (Length of Unit): 2 weeks

Desired Results ~ What will students be learning?

Standards of Learning/ Standards

PH. 1 a-g

PH.4 The student will investigate and understand how applications of physics affect the world. Key concepts include
a) examples from the real world; and
b) exploration of the roles and contributions of science and technology.

PH.5 The student will investigate and understand the interrelationships among mass, distance, force, and time through mathematical and experimental processes. Key concepts include
a) linear motion;

Essential Understandings/ Big Ideas

The concepts developed in standard PH.4 include the following:

- Discoveries in physics, both theoretical and experimental, have resulted in advancements in communication, medicine, engineering, transportation, commerce, exploration, and technology.
- Journals, books, the Internet, and other sources are used in order to identify key contributors and their contributions to physics as well as their impact on the real world.

The concepts developed in standard PH.5a include the following:

- Linear motion graphs include
  - displacement (d) vs. time (t)
  - velocity (v) vs. time (t)
  - acceleration (a) vs. time (t)
- Position, displacement, velocity, and acceleration are vector quantities.
- Motion is described in terms of position, displacement, time, velocity, and acceleration.
- Velocity is the change in displacement divided by the change in time. A straight-line, position-time graph indicates constant velocity. The slope of a displacement-time graph is the velocity.
- Acceleration is the change in velocity divided by the change in time. A straight-line, velocity-time graph indicates constant acceleration. A horizontal-line, velocity-time graph indicates zero acceleration. The slope of a velocity-time graph is the acceleration.

Key Essential Skills and Knowledge

In order to meet standard PH.4, it is expected that students will

- be aware of real-world applications of physics, and the importance of physics in the advancement of various fields, such as medicine, engineering, technology, etc.

In order to meet standard PH.5a, it is expected that students will

- construct and analyze displacement (d) vs. time (t), velocity (v) vs. time (t), and acceleration (a) vs. time (t) graphs.
- solve problems involving displacement, velocity, acceleration, and time in one and two dimensions (only constant acceleration).

Vocabulary

Displacement	Distance	Velocity	Speed	Elapsed time
Instantaneous Velocity	Average Velocity	Acceleration	Gravity	Free-Fall
Position				

Assessment Evidence ~ What is evidence of mastery? What did the students master & what are they missing?

Assessment/ Evidence

Use http://www.problem-attic.com/ to create a multiple choice or free response quiz or test.

Students should construct and analyze displacement (d) vs. time (t), velocity (v) vs. time (t), and acceleration (a) vs. time (t) graphs.

- Given a displacement-time or velocity-time graph, students write a real world story that accurately reflects the motion shown in the graph. Alternatively, they may create a motion-time graph based on a provided real world situation.
- Complete a graph-matching exercise using motion detectors and probeware, in which they must move in a certain way in order to reproduce a provided motion graph.

Students should solve problems involving displacement, velocity, acceleration, and time in one and two dimensions (only constant acceleration).

- Given a real world word problem involving displacement, velocity, acceleration, and/or time, students solve for a requested unknown with potentially useful equations provided.

Learning Plan ~ What are the strategies and activities you plan to use

Learning Experiences / Best Practice

Complete "I do, we do, you do" cycles in the classroom for dimensional analysis / conversion problems and linear motion problems involving average velocity, displacement, and time elapsed.

Students may determine and explain or justify safe driving guidelines using evidence-based kinematic relationships and concepts.

- Using actual maximum deceleration rates from various car models, students can calculate stopping distances and times from a variety of initial speeds. They can then write a short paper or discuss how this information should inform and influence their own driving habits, including the dangers of:
    - speeding
    - following too close
    - distracted driving
    - driving while intoxicated

Students may solve problems and complete experiments related to free-falling objects, such as:

- Back and Forth Motion Vernier Lab
- Cart on a Ramp Vernier Lab

- Ball Toss Vernier Lab
- Picket Fence Free Fall Vernier Lab
- Determining g on an Incline Vernier Lab
- Bungee Jump Accelerations

When completing labs and experiments, students may try to complete all steps of the inquiry process, from determining the scientific problem to be investigated through developing an experimental procedure and analyzing data and drawing conclusions appropriately.

- Students may benefit from an inquiry guide to help them complete various steps in the scientific process. These steps do not necessarily need to be completed in order.
- Scoring guides may be used to further help students understand expectations and guide a teacher's evaluations of student work.

Technology Integrations

- Students may use electronic probeware, such as Vernier equipment, to make digital measurements of position and time.
- Students may use Logger Lite (free) or Logger Pro ($$) software to analyze data electronically.
- Students may use Microsoft Excel to organize and analyze data, Microsoft Word to write lab reports, and Microsoft PowerPoint to plant and present experimental plans, results, and conclusions.
- Online simulations, including Gizmos, PhET, and Concord Consortium
- Students may use scientific or graphing calculators to aid them in complex mathematical calculations during problem solving.

Resources

For online simulations:

- At least enough computers for each pair of students or a computer, projector, and screen / SMART Board
- Simulation guides (e.g. Explore Sheets)

For hands-on lab experiences

- Stopwatches
- Meter sticks or rulers
- Motion Detectors
- Vernier tools, such as Ramp and Cart apparatuses, Accelerometers, Picket Fences, etc.
- Ring stands

- Graphing Calculators
- Vernier LabQuests or other probeware interfaces (calculators, computers, etc.)

Gizmos
- Free Fall Laboratory

PhET Simulations
- The Moving Man

Physics Lab Online: Kinematics – Graphs

Physics Lab Online: Kinematics - Equations

The Physics Classroom
- Tutorial: 1-D Kinematics
- Interactives: 1-D Kinematics
- Problem Set: 1-D Kinematics

Khan Academy: Acceleration

Khan Academy: Kinematic Equations and Projectile Motion

Cross Curricular Connection

- Mathematical operations and problem-solving skills are needed to solve problems involving displacement, velocity, acceleration, and time.
- Technical and persuasive writing techniques are necessary for writing well-supported scientific conclusions.
- Linear motion has clear applications to everyday situations such as driving, sports and recreation, and many other real-world situations.