Fairfax Collegiate

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Newtonian Physics 7-9 Syllabus

Course Goals

1 An Introduction to Physics
Students receive an introduction to what the study of physics entails, relevant applications in every day life, and the methodology of physics.

2 Kinematics
Students are introduced to the basics of kinematics, such as position, displacement, velocity, acceleration, vectors, reference frames, and Galilean relativity. They employ this knowledge by solving one and two-dimensional motion problems using the basic kinematic equations.

3 Dynamics: Newton's Laws
Students explore the importance of Isaac Newton's three fundamental laws, the concept of weight, friction, normal forces, free body diagrams, and circular motion.

4 Newton's Law of Gravitation
Students investigate the mysteries behind gravity: what is it, where does it come from, and how we quantify it. Students also investigate weightlessness in space, the equivalence principle, and a brief introduction to planetary motion.

5 Work, Energy, Momentum
Students delve into the subject of conservation in physics. Students learn the principles of work and energy and their relationship, as well as springs and Hooke's law, escape velocity, and the conservation of momentum in collisions.

Course Topics

1 What is Physics?
Students learn what the study of physics entails, its applications, and the difference between a hypothesis and a theory.

2 SI system
Students learn about the difference between the SI and Imperial measurement systems, meter-kilogram-second (mks) units, unit conversions, numerical prefixes, and measurement uncertainty.

3 One-Dimensional Kinematics
Students learn the about the difference between distance and displacement, position, instantaneous/average velocity, and instantaneous/average acceleration. Using the basic kinematic equations students solve word problems and other real world applications.

4 Two-Dimensional Kinematics
Students expand upon their kinematics knowledge to include two-dimensional problems. Students do activities demonstrating projectile motion, and the use of vectors.

5 Newton's Laws

Students learn about Newton's 3 Laws: 1) The law of inertia 2) force = mass*acceleration 3) For every action there is an equal and opposite reaction. They focus on the application of these laws in solving problems that continue to build on their kinematics knowledge.

6 Applications of Forces
Students see how Newton's laws are applied to problems relating to weight, friction, and normal forces. Students further their understanding by making free body diagrams to solve problems.

7 Newton's Theory of Gravity
Students investigate the mysteries of gravity and its related forces by exploring the quantification of the force of gravity in one and two dimensions. Students learn about how satellites work, weightlessness/free fall, and a brief touch on planetary motion.

8 Circular Motion
Students investigate the basics of circular motion, including radians as a unit of measure, centripetal and centrifugal forces, radial and tangental velocities, tension in a string, angular velocity, angular momentum, and angular frequency.

9 Work and Springs
Students learn about the concept of work and how to quantify it using the equation Work = Force*distance. Students also learn about forces and work associated with springs via Hooke's Law.

10 Work-Energy Theorem
Students learn about the Work-Energy theorem and how the work done on an object is equal to the change in kinetic energy.

11 Laws of Conservation
Students learn the fundamentals of the conservation of energy.

Course Schedule

Day 1

Course Introduction
Students are introduced to the instructor(s), classmates, and class expectations.

Introduction to Physics
Students are introduced to the study of physics, its applications, the difference between a hypothesis and a theory, and receive their course notebooks.

Physics Measurements
Students learn about the different systems of measurement, such as SI or Imperial. Students learn common conversion factors and numerical prefixes.

Measurement Uncertainty Lab
Students learn hands-on about the importance of precise measurement in science and the inherent uncertainty that comes with it.

Day 2

Applications of Physics
Students share the applications of physics they found online the night before for homework with the class.

What is the study of kinematics?
Students learn what the study of kinematics is and what it entails.

Distance, Displacement, and Position
Students learn the difference between distance, displacement, and position.

Velocity and Speed
Students learn the definitions and differences between instantaneous/average velocity and instantaneous/average speed.

Acceleration
Students learn the basics of average acceleration.

Putting it all together
Students use everything that they've learned about position, velocity, and acceleration to solve one dimensional kinematic problems.

Free Falling Objects Lab
Students use the kinematic equations to predict the speed of falling objects at various time intervals and distances.

Day 3

Vectors
Students learn the basics of vectors and vector arithmetic.

Projectile Motion Discussion
Students discuss the concepts behind projectile motion.

Horizontal Projectile Lab
Students employ their knowledge of projectile motion to predict displacement.

Projectile Motion Lab
Students investigate the properties of projectile motions.

Day 4

Newton's Laws Discussion
Students are introduced to Newton's three laws of motion.

Newton's Second Law Lab
In this lab students will demonstrate Newton's second law.

Day 5

Applications of Newton's Laws
Students learn about the applications of Newton's Laws including weight, the normal force, friction, and free body diagrams.

Pulley Demonstration
Students are introduced to the usefulness and functionality of pulley systems.

Friction Calculation Lab
Students calculate the coefficient of static friction for different materials.

Day 6

Force of Gravity Discussion
Student's learn about where the force of gravity comes from and how it is quantified.

Gravity Simulations
Students interactively learn about the effects of gravity on planetary orbits through computer simulations.

Day 7

Circular Motion Discussion
Students learn about the principles behind general circular motion.

Circular Motion Lab
Students discover the relationship between mass, radius, centrifugal acceleration, and centrifugal force in uniform circular motion.

Day 8

Work Discussion
Students learn about the concept of work and how it relates to forces.

Spring Constant Lab
Students calculate the spring constant for 5 different springs.

Work with Simple Machines Demonstration
Students learn how simple machines like the inclined plane help make work easier.

Day 9

Work-Energy Theorem Discussion
Students learn about the basics of the work-energy theorem.

Work-Energy Theorem Lab
Students interactively test the work-energy theorem.

Day 10

Laws of Conservation Discussion
Students learn the basics about the conservation of energy.

Laws of Conservation Lab

Students demonstrate the laws of conservation experimentally.

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