

Fast-Paced High School Physics (PHYW)

CTY Course Outline

		What	How
Day 0	Study Hall	<ul style="list-style-type: none"> • Introductions. • Assessment of previous knowledge. • Signing of safety forms and Honor Code 	<ul style="list-style-type: none"> • Fast-Paced Physics pre-test. • Informal written survey with questions like (“Have you taken any high school physics before?”)
Week 1			
Day 1	Morning	<ul style="list-style-type: none"> • Explain the goals of course. Want students to: <ul style="list-style-type: none"> ○ Learn physical <i>laws</i> (E.g. Newton’s Laws) ○ Practice problem solving <i>techniques</i> (esp. mathematical ones) ○ Acquire ability to <i>communicate</i> scientific results to a general audience. • Kinematics: <ul style="list-style-type: none"> ○ Concepts of displacement, distance, and vector quantities. ○ Velocity, Acceleration, graphical methods in kinematics. ○ Equations of uniform acceleration. ○ Free fall. 	<ul style="list-style-type: none"> • Show quick (~1 min) video of NASA scientist who has trouble explaining concepts in an interview. • “Clicker” questions, “Aliens on Earth” worksheet. • Outdoor “vector walk” activity. • Short video of astronaut Dave Scott dropping a hammer and a feather on the moon.
	Afternoon	<ul style="list-style-type: none"> • Consolidation of kinematic concepts. 	<ul style="list-style-type: none"> • Free fall lab for working out “g”. • “Measuring reaction time” lab.
	Study Hall	<ul style="list-style-type: none"> • Further consolidation of kinematic concepts. 	<ul style="list-style-type: none"> • Problem solving.

		What	How
Day 2	Morning	<ul style="list-style-type: none"> • Quick (~2 minute) refresher of kinematics. • Newton's Laws: <ul style="list-style-type: none"> ○ Different types of forces (weight, gravitational force, normal reaction force, tension, spring forces, friction) ○ Newton's 1st Law. ○ Forces in equilibrium. ○ Newton's 2nd Law. 	<ul style="list-style-type: none"> • Short Apollo 13 clips illustrating inertial motions of objects in space. • "Tablecloth from below a set table" demo. • Elevator lab. • "The sound of friction" song.
	Afternoon	<ul style="list-style-type: none"> ○ Inclined planes. ○ Circular Motion. ○ Newton's 3rd Law. 	<ul style="list-style-type: none"> • Circular motion lab. • "Physics Dance" • "Push off each other while on wheelie chairs" demo. • Quick showing of X-men clip for "what's wrong with the movie physics?" activity
	Study Hall	<ul style="list-style-type: none"> • Consolidation of dynamical concepts 	<ul style="list-style-type: none"> • Problem solving.
Day 3	Morning	<ul style="list-style-type: none"> • Quick (~2 minute) refresher of dynamical concepts. • Kinematics in 2D: Projectile motion 	<ul style="list-style-type: none"> • Short clip of Alan Shepard playing golf on the moon. • Water-balloon lab.
	Afternoon	<ul style="list-style-type: none"> • 15-20 minute quiz. • More projectile motion. • Orbits 	<ul style="list-style-type: none"> • Water rockets lab.
	Study Hall	<ul style="list-style-type: none"> • Quiz review. • Consolidation of projectile motion concepts. • Momentum conservation. 	<ul style="list-style-type: none"> • Problem solving. • Short Apollo 13 clip illustrating the concept of impulse. • Physics of Spiderman comic strips – why did Gwen Stacy die?

		What	How
Day 4	Morning	<ul style="list-style-type: none"> • Quick (~2 minute) refresher of momentum conservation. • Conservation of energy. <ul style="list-style-type: none"> ○ Different forms of energy. ○ Elastic vs. inelastic collisions. 	<ul style="list-style-type: none"> • Reading from Feynman Lectures on Physics: “Denis the Menace indestructible blocks analogy”. • “Would you bet your life on physics?” pendulum demo. • Colliding spheres demo. • Colliding braneworlds visualization. • Ballistic pendulum lab.
	Afternoon	<ul style="list-style-type: none"> • Work and power. • Quiet study/review session for test. 	<ul style="list-style-type: none"> • Problem solving.
	Study Hall	<ul style="list-style-type: none"> • Test. 	
Day 5	Morning	<ul style="list-style-type: none"> • Test review. • Quick (~2 minute) refresher of energy conservation. • Thermal energy: <ul style="list-style-type: none"> ○ Kinetic theory. ○ States of matter. ○ Ideal gas law. ○ Specific heat. ○ Phase transitions. 	<ul style="list-style-type: none"> • Fire syringe demo.
	Afternoon	<ul style="list-style-type: none"> • Applications of the specific heat equation. 	<ul style="list-style-type: none"> • Lab: measure the temperature of the sun.
	Study Hall	<ul style="list-style-type: none"> • Consolidation of thermodynamic concepts. 	<ul style="list-style-type: none"> • Problem solving.

What		How	
Week 2			
Day 6	Morning	<ul style="list-style-type: none"> • Quick (~2 minute) refresher of thermodynamics. • Simple harmonic oscillation. • Wave phenomenology: <ul style="list-style-type: none"> ○ Definition of a wave. ○ Examples of waves. ○ Vocabulary (wavelength, frequency, period, longitudinal, transverse, amplitude). ○ Speed of a wave. ○ Wave behavior: reflection, refraction, diffraction, interference. 	<ul style="list-style-type: none"> • Poster-paper illustration of wave speed formula. • Ripple-tank water wave demonstrations. • Slinky lab.
	Afternoon	<ul style="list-style-type: none"> ○ Sound. ○ Beats. ○ Doppler effect, sonic booms. ○ Standing waves. 	<ul style="list-style-type: none"> • Computer recordings varying speed (to illustrate relationship between pitch and frequency). • Scotch tape unwinding standing waves demo. • Speed of sound lab with resonance tubes and tuning forks. • Speed of light lab with marshmallows, chocolate, and microwave oven.
	Study Hall	<ul style="list-style-type: none"> • Consolidation of wave concepts • Preparation for light. 	<ul style="list-style-type: none"> • Problem solving. • Color and light worksheet.

		What	How
Day 7	Morning	<ul style="list-style-type: none"> • Quick (~2 minute) refresher of waves. • Optics <ul style="list-style-type: none"> ○ Optical phenomenology (colors etc.) ○ Reflection: <ul style="list-style-type: none"> ▪ Plane mirrors. ▪ Specular reflection vs. diffuse reflection. ▪ Curved mirrors. ○ Refraction: <ul style="list-style-type: none"> ▪ Index of refraction. ▪ Snell's Law. 	<ul style="list-style-type: none"> • “Why the sky is blue/why sunsets are red” milk demo. • Color filters. • Chalk and laser reflection demo. • Snell's Law song. • Snell's Law lab. • Outdoor walking Snell's law demo.
	Afternoon	<ul style="list-style-type: none"> ▪ Total internal reflection. ▪ Various examples (sunsets, mirages, etc). ▪ Lenses (concave, convex etc.) ▪ Gravitational lensing. 	<ul style="list-style-type: none"> • Optic fiber demos. • Rainbow in sprinkler demo. • Lens your favorite physicist simulation. • Candle Lab
	Study Hall	<ul style="list-style-type: none"> • Consolidation of optics 	<ul style="list-style-type: none"> • Problem solving.
Day 8	Morning	<ul style="list-style-type: none"> • Quick (~2 minute) refresher on optics. • More optics: <ul style="list-style-type: none"> ○ Fermat's Principle of Least Time. ○ Diffraction. ○ Interference. ○ Doppler effect here if not covered on day 6. 	
	Afternoon	<i>4th of July lab: The Amazing Race: Fast-Paced Physics Edition.</i>	
	Study Hall	<ul style="list-style-type: none"> • Consolidation of diffraction and interference. • 15-20 minute quiz. 	<ul style="list-style-type: none"> • Problem Solving.

		What	How
Day 9	Morning	<ul style="list-style-type: none"> • Quiz review. • Quick (~2 minute) refresher on optics. • Electrostatics: <ul style="list-style-type: none"> ○ Static electricity (like/unlike charges, conductors, insulators, conservation of charge, charging by friction, by induction) ○ Coulomb's Law. <ul style="list-style-type: none"> ▪ Comparison with gravity. ○ Electric Fields. 	<ul style="list-style-type: none"> • Demos with friction rods, pith balls, balloons. • Van de Graff generator. • “Stinky field” analogy. • Electric field simulations.
	Afternoon	<ul style="list-style-type: none"> • Consolidation of electrostatics 	<ul style="list-style-type: none"> • Problem Solving (first hour devoted to electrostatics, second hour devoted to test review).
	Study Hall	<ul style="list-style-type: none"> • Test. 	
Day 10	Morning	<ul style="list-style-type: none"> • Test review. • Quick (~2 minute) refresher on electrostatics. • Current • Kirchoff's Laws • Circuit Analysis 	<ul style="list-style-type: none"> • Circuit lab.
	Afternoon	<ul style="list-style-type: none"> • Consolidation of current electricity 	<ul style="list-style-type: none"> • Problem solving.
	Study Hall	<ul style="list-style-type: none"> • Magnetostatics: <ul style="list-style-type: none"> ○ Permanent magnets. ○ Magnetic Fields. 	<ul style="list-style-type: none"> • Magnetic field visualizations. • Giant magnet and iron filings demo.
Week 3			
Day 11	Morning	<ul style="list-style-type: none"> • Quick (~2 minute) refresher on current electricity and magnetostatics. • Connection between magnetic fields and electric fields. <ul style="list-style-type: none"> ○ Electromagnets. ○ Lorentz Force Law. 	<ul style="list-style-type: none"> • Draw concept map relating electricity and magnetism. • Thomson e/m experiment.

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	Afternoon	<ul style="list-style-type: none"> • Electromagnetic induction. <ul style="list-style-type: none"> ○ Motor effect. ○ Lenz's Law. ○ Connection to light. 	<ul style="list-style-type: none"> • Build your own motor lab. • Lenz's law demo.
	Study Hall	<ul style="list-style-type: none"> • Consolidation of electromagnetism. 	<ul style="list-style-type: none"> • Problem solving.
Day 12	Morning	<ul style="list-style-type: none"> • Medium length (1 hour) quiz/test. • Quick (~2 minute) refresher on electromagnetism. • Photoelectric effect. 	
	Afternoon	<ul style="list-style-type: none"> • Introduction to quantum concepts. <ul style="list-style-type: none"> ○ Wavefunctions. ○ Heisenberg's Uncertainty Principle. ○ Tunneling. 	<ul style="list-style-type: none"> • Violin string demo of uncertainty principle.
	Study Hall	<ul style="list-style-type: none"> • Quiz/test review. • Consolidation of quantum concepts. 	<ul style="list-style-type: none"> • Problem solving.
Day 13	Morning	<ul style="list-style-type: none"> • Quick (~2 minute) refresher on quantum concepts. • Atomic models. • Radioactivity. 	<ul style="list-style-type: none"> • Use cut-up transparencies to demonstrate Bohr-Sommerfeld quantization rule. • Flipping coins demo of radioactivity.
	Afternoon	<ul style="list-style-type: none"> • Consolidation of atomic and nuclear physics. • (Optional): bonus lecture on cosmology 	<ul style="list-style-type: none"> • Problem solving.
	Study Hall	<ul style="list-style-type: none"> • Test preparation. 	<ul style="list-style-type: none"> • Problem solving.
Day 14	Morning	<ul style="list-style-type: none"> • Test preparation. <p>OR</p> <ul style="list-style-type: none"> • Introduction to Special Relativity. 	<ul style="list-style-type: none"> • Question and answer session. • Independent review.
	Afternoon	<ul style="list-style-type: none"> • Test preparation. 	<ul style="list-style-type: none"> • Question and answer session. • Independent review.
	Study Hall	<ul style="list-style-type: none"> • Post-test. 	
Day 15	Morning	<i>Physics movie: either Apollo 13 or two episodes from "From the Earth to the Moon"</i>	