VAN BUREN SCHOOL DISTRICT
HONORS PHYSICS CURRICULUM

TEXT: *College Physics. Wilson, Jerry & Buffa, Anthony. Prentice Hall. 4th Edition. 2000* *revised: 8-29-06*

DAYS	CHAPTER	TOPIC	SUB-TOPICS	LABS	FRAMEWORKS	CORRELATION TO ACT
3	1	Measurements & Mathematics	SI units, length ,mass & time, dimensional analysis, unit conversion, basic problem-solving techniques	Measurement Lab, Graphing Lab	MF.1.P.1 Compare and contrast *scalar* and *vector* quantities NS.16.P.1 Describe why science is limited to natural explanations of how the world works NS.16.P.2 Compare and contrast the criteria for the formation of hypotheses, theories and laws NS.16.P.3 Summarize the guidelines of science: • results are based on observations, evidence, and testing • hypotheses must be testable • understandings and/or conclusions may change as new data are generated • empirical knowledge must have peer review and verification before acceptance	* (SEE NOTE AT END OF PAGE 2)
7	2	Kinematics	Distance, speed(scalar), vector mathematics, velocity, acceleration, free fall, air resistance	Vectors Lab, Velocity Lab, Acceleration Lab	MF.1.P.2 Solve problems involving constant and average velocity:	*

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					$v = \frac{d}{t}$ $v_{ave} = \frac{\Delta d}{\Delta t}$ MF.1.P.4 Compare graphic representations of motion: d-t v-t a-t MF.1.P.3 Apply *kinematic* equations to calculate distance, time, or velocity under conditions of constant *acceleration:* $a = \frac{v}{t}$ $a_{ave} = \frac{\Delta v}{\Delta t}$ $\Delta x = \frac{1}{2}(v_i + v_f)\Delta t$ $v_f = v_i + a\Delta t$ $\Delta x = v_i \Delta t + \frac{1}{2}a(\Delta t)^2$ $v_f^2 = v_i^2 + 2a\Delta x$ MF.1.P.5 Calculate the *components* of a free falling object at various points in motion: $v_f^2 = v_i^2 + 2a\Delta y$ Where $a = gravity$ (g)	
7	3	2-Dimensional Motion	Vector addition and subtraction, projectile motion	Bearing Projectile Lab	MF.1.P.1 Compare and contrast *scalar* and *vector* quantities	*

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					MF.1.P.2 Solve problems involving constant and average velocity: $v = \frac{d}{t}$ $v_{ave} = \frac{\Delta d}{\Delta t}$ MF.1.P.3 Apply *kinematic* equations to calculate distance, time, or velocity under conditions of constant *acceleration:* $a = \frac{v}{t}$ $a_{ave} = \frac{\Delta v}{\Delta t}$ $\Delta x = \frac{1}{2}(v_i + v_f)\Delta t$ $v_f = v_i + a\Delta t$ $\Delta x = v_i \Delta t + \frac{1}{2} a(\Delta t)^2$ $v_f^2 = v_i^2 + 2a\Delta x$ MF.1.P.5 Calculate the *components* of a free falling object at various points in motion: $v_f^2 = v_i^2 + 2a\Delta y$ Where $a = gravity$ (g) MF.2.P.7 Apply *kinematic* equations to solve problems involving projectile motion of an object launched at an angle: $v_x = v_i \cos\theta =$ constant	

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					$\Delta x = v_i(\cos\theta)\Delta t$ $v_{y,f} = v_i(\sin\theta) - g\Delta t$ $v_{y,f}^2 = v_i^2(\sin\theta)^2 - 2g\Delta y$ $\Delta y = v_i(\sin\theta)\Delta t - \frac{1}{2}g(\Delta t)^2$ MF.2.P.6 Describe the path of a projectile as a *parabola* MF.2.P.8 Apply *kinematic* equations to solve problems involving projectile motion of an object launched with initial horizontal velocity $\therefore v_{y,f}^2 = -2g\Delta y$; $\therefore \Delta x = v_x\Delta t$ $v_{y,f} = -g\Delta t$; $v_x = v_{x.i} =$ *constant* $\therefore \Delta y = -\frac{1}{2}g(\Delta t)^2$	
4	4	Force & Motion	Force vs. net force, Newton's First Law (inertia), Newton's Second Law, Newton's Third Law, friction	Force Table Lab, Friction Lab	MF.4.P.1 Calculate net work done by a constant net force: $W_{net} = F_{net} d \cos\theta$ Where $W_{net} = work$	*
7	5	Work & Energy	Work-Energy Theorem, potential energy, conservation of energy, power	Work-Energy Theorem Lab	MF.4.P.2 Solve problems relating kinetic energy and	*

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					potential energy to the *work-energy theorem:* $W_{net} = \Delta KE$ MF.4.P.3 Solve problems through the application of conservation of mechanical energy: $ME_i = ME_f$ $\frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f$ MF.4.P.4 Relate the concepts of time and *energy* to power MF.4.P.5 Prove the relationship of time, *energy* and power through problem solving: $P = \frac{W}{\Delta t}$ $P = Fv$ Where P = power; W = work; F = force; V = velocity; T = time	
7	6	Momentum: Collision & Conservation	Linear momentum, impulse, conservation of linear momentum, elastic and inelastic collisions	Cart Conservation Lab	MF.5.P.1 Describe changes in momentum in terms of force and time MF.5.P.2 Solve problems using the impulse-momentum theorem: $F \Delta t = \Delta p$ or $F\Delta t = mv_f - mv_i$ Where Δp = change in	*

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					momentum; $F \Delta t = impulse$ MF.5.P.3 Compare total momentum of two objects before and after they interact: $m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$ MF.5.P.4 Solve problems for perfectly inelastic and elastic *collisions*: $m_1 v_{1i} + m_2 v_{2i} = (m_1 + m_2) v_f'$ $m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$ Where v_f is the final velocity	
2	7,8	Gravity & Circular Motion	Uniform circular motion, centripetal force	Equal Areas Lab	MF.1.P.6 Compare and contrast contact force (e.g., friction) and *field* forces (e.g., *gravitational* MF.3.P.8 Apply Newton's universal law of gravitation to find the gravitational force between two masses: $F_g = G \frac{m_1 m_2}{r^2}$, Where $G = 6.673 \times 10^{-11} \frac{N \cdot m^2}{kg^2}$ MF.2.P.9 Calculate *rotational motion* with a constant force directed toward the center: $F_c = \frac{mv^2}{r}$ MF.2.P.10 Solve problems in circular motion by using	*

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					centripetal acceleration: $a_c = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$ MF.3.P.1 Relate radians to degrees: $\Delta\theta = \frac{\Delta s}{r}$ Where Δs = *arc length; r = radius* MF.3.P.2 Calculate the *magnitude* of *torque* on an object: $\tau = Fd(\sin\theta)$ Where $\tau = torque$ MF.3.P.3 Calculate angular speed and *angular acceleration:* $\omega_{ave} = \frac{\Delta\theta}{\Delta t}$ $\alpha = \frac{\Delta\omega}{\Delta t}$ MF.3.P.4 Solve problems using *kinematic* equations for angular motion: $\omega_f = \omega_i + \alpha\Delta t$ $\Delta\theta = \omega_i\Delta t + \frac{1}{2}\alpha(\Delta t)^2$ $\omega_f^2 = \omega_i^2 + 2\alpha(\Delta\theta)$ $\Delta\theta = \frac{1}{2}(\omega_i + \omega_f)\Delta t$ MF.3.P.5 Solve problems involving *tangential speed:* $v_t = r\omega$	

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					MF.3.P.6 Solve problems involving *tangential acceleration:* $a_t = r\alpha$ MF.3.P.7 Calculate *centripetal acceleration:* $a_c = \frac{v_t^2}{r}$ $a_c = r\omega^2$	
2	9	Solids & Fluids	Solids and basic kinetic theory, fluid, pressure and Pascal's Principle, buoyancy and Bernoulli's Equation, surface tension, viscosity		MF.6.P.1 Calibrate the applied buoyant force to determine if the object will sink or float: $F_B = F_{g(displacedfluid)} = m_f g$ MF.6.P.2 Apply Pascal's principle to an enclosed *fluid* system: $P = \frac{F_1}{A_1} = \frac{F_2}{A_2}$ Where $P = pressure$ MF.6.P.3 Apply Bernoulli's equation to solve *fluid*-flow problems: $p = \frac{1}{2}\rho v^2 + \rho gh =$ *constant* Where ρ = density	*
4	10,11	Temperature & Heat	Unit measurements, gas laws and absolute temperature, thermal expansion, kinetic theory of gases, specific heat, phase change and latent heat, heat transfer	Specific Heat Lab, Thermal Expansion Lab	MF.6.P.4 Use the ideal gas law to predict the properties of an ideal gas under different conditions PHYSICS | CHEMISTRY	*

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<tr><th>DAYS</th><th>CHAPTER</th><th>TOPIC</th><th>SUB-TOPICS</th><th>LABS</th><th>FRAMEWORKS</th><th>CORRELATION TO ACT</th></tr>
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<table>
<tr><td>$PV = Nk_BT$</td><td>$PV = nRT$</td></tr>
<tr><td>N = number of gas particles</td><td>n = number of moles (1mole =6.022x10^{23} particles)</td></tr>
<tr><td>k_b = Boltzmann’s constant (1.38x10^{-23} J/k)</td><td>R = Molar gas constant (8.31 J/mole K)</td></tr>
<tr><td>T = temperature</td><td>T = temperature</td></tr>
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HT.7.P.1
Perform specific heat capacity calculations:
$C_p = \frac{Q}{m\Delta T}$
HT.7.P.2
Perform calculations involving latent heat:
$Q = mL$
HT.7.P.3
Interpret the various sections of a heating curve diagram
HT.7.P.4
Calculate heat energy of the different phase changes of a substance:
$Q = mC_p\Delta T$
$Q = mL_f$
$Q = mL_v$
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					Where L_f = Latent heat of fusion; L_v = Latent heat of vaporization	
3	12	Thermodynamic Laws	Systems and processes, First Law of Thermodynamics, Second Law and entropy		HT.8.P.1 Describe how the first law of thermodynamics is a statement of *energy* conversion HT.8.P.2 Calculate heat, work, and the change in internal *energy* by applying the first law of thermodynamics: $\Delta U = Q - W$ Where $\Delta U =$ *change in system's internal energy* HT.8.P.3 Calculate the efficiency of a heat engine by using the second law of thermodynamics: $Eff = \frac{W_{net}}{Q_h} = \frac{Q_h - Q_c}{Q_h} = 1 - Q_c$ Where $Q_h =$ *energy added as heat* ; $Q_c =$ *energy removed as heat* HT.8.P.4 Distinguish between *entropy* changes within systems and the *entropy* change for the universe as a whole	*

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9	13	Vibrations & Basic Waves	Simple Harmonic Motion Equation, wave motion and properties, standing waves and resonance	Hook's Law Lab	WO.9.P.1 as an Explain how force, velocity, and *acceleration* change object vibrates with *simple harmonic motion* WO.9.P.2 Calculate the spring force using Hooke's law: $F_{elastic} = -kx$ Where $-k$ = *spring constant* WO.9.P.3 Calculate the *period* and frequency of an object vibrating with a *simple harmonic motion:* $T = 2\pi\sqrt{\frac{L}{g}}$ $f = \frac{1}{T}$ Where $T = period$ WO.9.P.4 Differentiate between *pulse* and *periodic waves* WO.9.P.5 Relate *energy* and *amplitude*	*
4	14	Sound	Sound waves, speed of sound, sound intensity, the Doppler Effect, music and sound characteristics	"2-Way Radio" Lab, Speed of Sound Lab	WO.9.P.4 Differentiate between *pulse* and *periodic waves* WO.9.P.5 Relate *energy* and *amplitude*	*

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2	15	Electric charge, Force & Conductors	Electric charge, electric force, insulators and conductors	Electric Field Lines Lab	EM.11.P.1 Calculate *electric force* using Coulomb's law: $F = k_c(\frac{q_1 \times q_2}{r^2})$ Where k_c = Coulomb's constant $8.99 \times 10^9 N \bullet \frac{m^2}{c^2}$ EM.11.P.2 Calculate *electric field* strength: $E = \frac{F_{electric}}{q_0}$ EM.11.P.3 Draw and interpret *electric field* lines	*
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2	16	Potential, Energy & Capacitance	Potential energy, energy difference, capacitance		EM.12.P.1 Calculate electrical potential *energy*: $PE_{electric} = -qEd$ EM.12.P.2 Compute the electric potential for various charge distributions: $\Delta V = \frac{\Delta PE_{electric}}{q}$ EM.12.P.3 Calculate the *capacitance* of various devices: $C = \frac{Q}{\Delta V}$	*

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2	17	Current & Resistance	Direct current, resistance and Ohm's Law, electric power	Ohm's Law Lab	EM.12.P.4 Construct a *circuit* to produce a pre-determined value of an Ohm's law variable	*
3	18	Series & Parallel Circuits	Resistance in series, parallel, and series-parallel, ammeters and voltmeters	Series/ Parallel Circuit Lab	EM.12.P.4 Construct a *circuit* to produce a pre-determined value of an Ohm's law variable	*
2	19	Magnetism	Magnets and magnetic fields, field strengths and measurements, current-carrying wire and magnetism, electromagnetism	Magnetic Field Lines Lab	EM.13.P.1 Determine the strength of a *magnetic field* EM.13.P.2 Use the *first right-hand rule* to find the direction of the force on the charge moving through a *magnetic field* EM.13.P.3 Determine the *magnitude* and direction of the force on a *current*-carrying wire in a *magnetic field* EM.13.P.4 Describe how the change in the number of *magnetic field* lines through a *circuit* loop affects the *magnitude* and direction of the induced *current*	*
1	20	Electromagnetic Inductance	Faraday's Law, transformers, electromagnetic waves		EM.13.P.3 Determine the *magnitude* and direction of the force on a *current*-carrying wire in a *magnetic field* EM.13.P.4 Describe how the change in the number of *magnetic field* lines through a *circuit* loop affects the *magnitude* and direction of the induced *current* EM.13.P.5 Calculate the induced electromagnetic	*

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					field (*emf*) and *current* using Faraday's law of *induction:* $emf = -N \frac{\Delta[AB(\cos\theta)]}{\Delta t}$ Where N = number of loops in the *circuit* WO.10.P.1 Calculate the frequency and wavelength of electromagnetic radiation	
1	21	Basic AC Circuits	AC circuit resistance		EM.12.P.4 Construct a *circuit* to produce a pre-determined value of an Ohm's law variable	*
6	22	Reflection & Refraction	Wave fronts, reflection, refraction, total internal reflection and fiber optics, dispersion	Snell's Law Lab	WO.10.P.6 Calculate the *index of refraction* through various media using the following equation: $n = \frac{c}{v}$ Where n = index of refraction; c = speed of light in vacuum; v = speed of light in medium WO.10.P.6 Solve problems using Snell's law: $n_i(\sin\theta_i) = n_r(\sin\theta_r)$	*
5	23,24	Mirrors & Lenses	Plane mirrors, spherical mirrors, lenses and equations, lens aberrations, diffraction, polarization, color	Focal Point Determination Lab, Build-a-scope Lab	WO.10.P.2 Apply the law of reflection for flat mirrors: $\theta_{in} = \theta_{out}$ WO.10.P.3 Describe the *images* formed by flat mirrors WO.10.P.4 Calculate distances and *focal lengths* for	*

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					curved mirrors: $\frac{1}{p}+\frac{1}{q}=\frac{2}{R}$ Where p = object distance; q = image distance; R = radius of curvature WO.10.P.5 Draw ray diagrams to find the *image* distance and *magnification* for curved mirrors WO.10.P.8 Use a ray diagram to find the position of an *image* produced by a lens WO.10.P.9 Solve problems using the thin-lens equation: $\frac{1}{p}+\frac{1}{q}=\frac{1}{f}$ Where q = image distance; p = object distance; f = focal length WO.10.P.10 Calculate the *magnification* of lenses: $M=\frac{h'}{h}=-\frac{q}{p}$ Where M = magnification; h' = image height; h = object height; q = image distance; p = object distance	
3	26	Relativity & Einstein	Classical relativity, The Michelson-Morley Experiment, Postulates of Special Relativity, length contraction and time dilation, General Relativity		NP.14.P.3 Distinguish between classical ideas of measurement and Heisenberg's *uncertainty principle*	*

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3	27,28	Quantum Physics	Planck's Constant, light quanta and the photon, The Bohr Theory, quantum numbers, The Heisenberg Uncertainty Principle		NP.14.P.1 Calculate *energy* quanta using Planck's equation: $E = hf$ NP.14.P.2 Calculate the de Broglie wavelength of matter: $\lambda = \frac{h}{p} = \frac{h}{mv}$ NP.14.P.3 Distinguish between classical ideas of measurement and Heisenberg's *uncertainty principle* NP.14.P.4 Research emerging theories in physics, such as string theory	*
2	29,30	Nuclear Physics	Nuclear structure and force, radioactivity, decay and half-life, nuclear stability, nuclear reactions, nuclear fission, Unification Theories		NP.15.P.1 Calculate the binding *energy* of various nuclei NP.15.P.2 Predict the products of nuclear decay NP.15.P.3 Calculate the decay constant and the *half-life* of a radioactive substance	*
Daily			The nature of science frameworks are interjected daily during the class period in lecture, labs and research.		NS.17.P.1, Develop the appropriate procedures using controls and variables (dependent and independent) in scientific experimentation NS.17.P.2, Research and apply appropriate	

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					safety precautions (ADE Guidelines) when designing and/or conducting scientific investigations NS.17.P.3, Identify sources of bias that could affect experimental outcome NS.17.P.4, Gather and analyze data using appropriate summary statistics (e.g., percent yield, percent error) NS.17.P.5, Formulate valid conclusions without bias NS.18.P.1, Recognize that theories are scientific explanations that require empirical data, verification and peer review NS.18.P.2, Research historical and current events in physics NS.19.P.1, Use appropriate equipment and technology as tools for solving problems (e.g., balances, scales, calculators, probes, glassware, burners, computer software and hardware) NS.19.P.2, Manipulate scientific data using appropriate mathematical calculations, charts, tables, and graphs NS.19.P.3, Utilize technology to	

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					communicate research findings NS.20.P.1, Compare and contrast the connections between *pure science* and *applied science* as it relates to physics NS.20.P.2, Give examples of scientific bias that affect outcomes of experimental results NS.20.P.3, Discuss why scientists should work within ethical parameters NS.20.P.4, Evaluate long-range plans concerning resource use and by-product disposal for environmental, economic, and political impact. NS.20.P.5, Explain how the cyclical relationship between science and technology results in reciprocal advancements in science and technology	
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HONORS PHYSICS CORRELATES TO THE ACT THROUGHOUT THE YEAR IN THE FOLLOWING AREAS:

Interpretation of Data; Data Representation; Identification of Patterns, Trends, and Relationship of Data;
Purpose of Experimental Procedures; Process of Scientific Investigation; Identification of Conclusions, Hypotheses, Models or Predictions