VAN BUREN SCHOOL DISTRICT
PHYSICS CURRICULUM

DAYS	CHAP	TOPIC	SUB-TOPICS	LABS	FRAMEWORKS	**ACT**
1	1	Math Review	Math the language of science. Math pretest.	Graphing lab		*
1	1	The basics	Physics the most basic of all sciences. The attitude (laws, principles, hypothesis, theory)		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	*
3	2	Linear motion	Motion is relative. Speed Velocity Acceleration (linear & free fall)	Reaction time	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:*	*

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					$a = \frac{v}{t}$ $a_{ave} = \frac{\Delta v}{\Delta t}$ $\Delta x = \frac{1}{2}(v_i + v_f)\Delta t$ $v_f = v_i + a\Delta t$ $\Delta x = v_i \Delta t + \frac{1}{2}a(\Delta t)^2$ $v_f^2 = v_i^2 + 2a\Delta x$ MF.1.P.4 Compare graphic representations of motion: d-t, v-t, a-t 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)	
6	3	Vectors	Graphical solutions. Components of vectors. Projectile motion.	Maximum height of a projectile	MF.1.P.1 Compare and contrast *scalar* and *vector* quantities MF.2.P.1 Calculate the *resultant vector* of a moving object MF.2.P.2 Resolve two-dimensional *vectors* into their *components:* $d_x = d\cos\theta$ $d_y = d\sin\theta$ MF.2.P.3 Calculate the *magnitude* and direction of a *vector* from its *components:* $d^2 = x^2 + y^2$ $\tan^{-1}\theta = \frac{x}{y}$ MF.2.P.5 Solve two-dimensional problems using the	*

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					Pythagorean Theorem or the quadratic formula: $a^2 + b^2 = c^2$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ MF.2.P.6 Describe the path of a projectile as a *parabola* 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 $\Delta x = v_i(\cos\theta)\Delta t$ $v_{y,f} = v_i(\sin\theta) - g\Delta t$ $v_{y,f}^2 = v_i^2(\sin\theta)^2 - 2g\Delta y$ $\Delta y = v_i(\sin\theta)\Delta t - \frac{1}{2}g(\Delta t)^2$ MF.2.P.8 Apply *kinematic* equations to solve problems involving projectile motion of an object launched with initial horizontal velocity $v_{y,f} = -g\Delta t$ $v_x = v_{x.i} =$ *constant* $\therefore v_{y,f}^2 = -2g\Delta y$ $\therefore \Delta x = v_x \Delta t$ $\therefore \Delta y = -\frac{1}{2}g(\Delta t)^2$	
3	4,5,6	Newton's Laws	1st. law (inertia) ch.4 2nd. law (force & acceleration) ch.5 3rd. law (action & reaction) ch.6	Acceleration of carts	MF.1.P.9 Apply Newton's first law of motion to show balanced and unbalanced forces MF.1.P.6 Compare and contrast contact force (e.g., friction) and *field* forces (e.g., *gravitational* force)	*

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					MF.1.P.7 Draw free body diagrams of all forces acting upon an object MF.1.P.8 Apply Newton's first law of motion to show balanced and unbalanced forces MF.1.P.10 Apply Newton's second law of motion to solve motion problems that involve constant forces: $F = ma$ MF.1.P.11 Apply Newton's third law of motion to explain action-reaction pairs MF.1.P.11 Apply Newton's third law of motion to explain action-reaction pairs MF.1.P.12 Calculate frictional forces (i.e., *kinetic* and static): $\mu_k = \frac{F_k}{F_n}$ $\mu_s = \frac{F_s}{F_n}$ MF.1.P.13 Calculate the *magnitude* of the force of friction: $F_f = \mu F_n$	
3	7	Momentum	Impulse Bouncing	Air tracks	MF.5.P.1 Describe changes in momentum in terms of force	*

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			Conservation of momentum. Collisions		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 $\Delta p =$ change in 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	
4	8	Energy	Work Power Potential energy. Kinetic energy. Conservation of energy. Simple machines.	Measuring your power output Pulleys	MF.4.P.1 Calculate net work done by a constant net force: $W_{net} = F_{net} d \cos\theta$ Where $W_{net} = work$ MF.4.P.2 Solve problems relating kinetic energy and 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:	*

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					$ME_i = ME_f$ $\frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f$ 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	
2	9	Circular Motion	Tangential speed vs. rotational speed Centripetal & centrifugal force Simulated Gravity	Water sling	Solve problems involving *tangential speed:* $v_t = r\omega$ Solve problems involving *tangential acceleration:* $a_t = r\alpha$	*
2	10	Center of Gravity	Center of gravity vs. center of mass Toppling & stability			*
2	11	Rotational Mechanics	Torque Rotational inertia Angular momentum & conservation.	Moments of inertia of rotating objects	Solve problems using *kinematic* equations for angular motion: $\omega_f = \omega_i + \alpha\Delta t$ $\Delta\theta = \omega_i\Delta t + \frac{1}{2}\alpha(\Delta t)^2$ $\omega_f^2 = \omega_i^2 + 2\alpha(\Delta\theta)$ $\Delta\theta = \frac{1}{2}(\omega_i + \omega_f)\Delta t$	*

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1	12	Universal Gravitation	The falling apple; the falling moon; the falling earth Gravitational constant Inverse Square Law		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 $G = 6.673\times10^{-11}\frac{N\cdot m^2}{kg^2}$	*
1	13	Gravitational Interactions	Gravitational fields, weight & weightlessness, ocean tides, black holes		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 $G = 6.673\times10^{-11}\frac{N\cdot m^2}{kg^2}$	*
2	18	Solids	Crystal structure (density, elasticity, compression & tension)			*
2	19	Liquids	Pressure (ch.5) Buoyancy Archimedes' Principle Pascal's Principle	Constructing a hydraulic lift (syringes)	Calibrate the applied buoyant force to determine if the object will sink or float: $F_B = F_{g(displacedfluid)} = m_f g$ Apply Pascal's principle to an enclosed *fluid* system: $P = \frac{F_1}{A_1} = \frac{F_2}{A_2}$	*
3	20	Gases	Atmosphere (pressure, barometer) Boyle's Law Buoyancy (ch.19) Bernoulli's Principle	Balloon in a vacuum	Apply Bernoulli's equation to solve *fluid*-flow problems: $p = \frac{1}{2}\rho v^2 + \rho gh = \mathit{constant}$ Where ρ = density	*
4	21	Temperature, Heat, & Expansion	Temp. & kinetic energy Heat measurement Specific heat capacity Expansion & contraction (the special case of water)	Specific heat	HT.7.P.1 Perform *specific heat capacity* calculations: $C_p = \frac{Q}{m\Delta T}$	*

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					Perform calculations involving *latent heat:* $Q = mL$	
3	22	Heat Transfer	Conduction Convection Radiation		HT.7.P.1 Calculate heat energy of the different phase changes of a substance: $Q = mC_p\Delta T$	*
2	23	Change of Phase	Evaporation Condensation Boiling Freezing		HT.7.P.4 Calculate heat energy of the different phase changes of a substance: $Q = mC_p\Delta T$ $Q = mL_f$ $Q = mL_v$ Where L_f = Latent heat of fusion; L_v = Latent heat of vaporization	*
2	24	Thermo-dynamics	Absolute zero 1st. Law of thermo. (adiabatic process) 2nd. Law of thermo. (heat engines) Entropy		HT.8.P.2 Describe how the first law of thermodynamics is a statement of *energy* conversion Calculate heat, work, and the change in internal *energy* by applying the first law of thermodynamics: $\Delta U = Q - W$ HT.8.P.3 Where $\Delta U =$ *change in system's internal energy* $Eff = \frac{W_{net}}{Q_h} = \frac{Q_h - Q_c}{Q_h} = 1 - Q_c$	*

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					Where Q_h = *energy added as heat* ; Q_c = *energy removed as heat* Distinguish between *entropy* changes within systems and the *entropy* change for the universe as a whole	
4	25	Vibrations & Waves	Transverse waves Longitudinal waves	Simple harmonic motion (pendulum)	Explain how force, velocity, and *acceleration* change as an object vibrates with *simple harmonic motion*	*
3	26	Sound	Vibrating objects cause sound Natural frequency Resonance Interference (beats)	Oscilloscope	WO.9.P.4 Differentiate between *pulse* and *periodic waves* WO.9.P.5 Relate *energy* and *amplitude* Calculate the *period* and frequency of an object vibrating with a *simple harmonic motion:* $T = 2\pi\sqrt{\frac{L}{g}}$ $f = \frac{1}{T}$	*
2	27	Light	Early concepts Speed of lights (Albert Michelson) Electromagnetic radiation Polarized light & 3-D		WO.10.P.1 Calculate the frequency and wavelength of electromagnetic radiation	*
2	28	Color	Spectrum Color (by reflection, by transmission) Mixing colored light	Light boxes		*

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			Mixing colored pigment Why (blue sky, red sunset, green-blue water)			
3	29	Reflection & Refraction	Law of reflection (light & sound) Refraction Total internal reflection (fiber optics)	Light boxes	WO.10.P.2 Apply the law of reflection for flat mirrors: $\theta_{in} = \theta_{out}$ WO.10.P.3 Describe the *image*s formed by flat mirrors WO.10.P.4 Calculate distances and *focal lengths* for 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.7 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	*
2	30	Lenses	Convex & Concave Images (ray diagrams) Optical instruments	Light boxes	WO.10.P.5 Draw ray diagrams to find the *image* distance and *magnification* for curved mirrors WO.10.P.6 Solve problems using Snell's law: $n_i(\sin\theta_i) = n_r(\sin\theta_r)$ WO.10.P.8	*

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					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	
1	31	Diffraction & Interference	Lasers Hologram			*
2	32	Electrostatics	Forces & Charges Coulombs Law Charging		Calculate *electric force* using Coulomb's law: $F=k_c(\frac{q_1 \times q_2}{r^2})$ Where k_c = Coulomb's constant $8.99\times10^9 N \bullet \frac{m^2}{c^2}$	*
3	33	Electric Fields & Potential	Electric fields Shielding Potential		Calculate *electric field* strength: $E=\frac{F_{electric}}{q_0}$	*

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					Draw and interpret *electric field* lines	
4	34	Electric Current	Flow of charge Current Resistance Ohm's Law AC & DC Electric power	Ohm's Law	EM.12.P.4 Construct a *circuit* to produce a pre-determined value of an Ohm's law variable Compute the electric potential for various charge distributions: $\Delta V = \frac{\Delta PE_{electric}}{q}$ Calculate the *capacitance* of various devices: $C = \frac{Q}{\Delta V}$	*
4	35	Electric Circuits	Simple circuits (series & parallel) Schematic diagrams Compound circuits	Series and parallel lights	Construct a *circuit* to produce a pre-determined value of an Ohm's law variable	*
2	36	Magnetism	Magnetic poles Magnetic fields Magnetic fields & moving charged particles Meters Motors		Determine the strength of a *magnetic field* Use the *first right-hand rule* to find the direction of the force on the charge moving through a *magnetic field* Determine the *magnitude* and direction of the force on a *current*-carrying wire in a *magnetic field* Calculate the induced electromagnetic 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*	*
1	37	Electromagn-etic Induction	Faraday's Law Generators Motors		Calculate the *capacitance* of various devices:	*

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			Transformers		$C = \frac{Q}{\Delta V}$	
1	38	Atoms & Quantum Theory	Models of the atom Light quanta		Calculate *energy* quanta using Planck's equation: $E = hf$ Calculate the de Broglie wavelength of matter: Heisenberg's *uncertainty* Distinguish between classical ideas of measurement and *principle* Research emerging theories in physics, such as string theory	*
1	39	Atomic Nucleus & Radioactivity	Atomic nucleus Decay Half-life Radiation and you		Calculate the binding *energy* of various nuclei Predict the products of nuclear decay Calculate the decay constant and the *half-life* of a radioactive substance	*
1	40	Nuclear Reactions	Fision Fusion			*

*This course correlates to the ACT during the entire term by always exposing the following areas.

Interpretation of data; Data representation; Identification in patterns, trends, and Relationships of data; Purpose of experimental procedures; Process of scientific investigation; Identification of conclusions, hypothesis, models, or predictions.