Physics by Discovery Standards 2013-14 (1st Semester)

1. Experiment Skills

1.1	I can explain and identify each pattern (Linear, Quadratic, Inverse, Inverse square)	Describe general mathematical model, what is constant, shape of graph, slope, how doubling x changes y, slope, other characteristics Translate between representations Identify pattern from a graph (w/o LoggerPro) and explain reasoning (state a pattern characteristic and use numbers from the graph to show that the data has that characteristic)
1.2	I can make a quality graph and find a pattern in data	Make quality graph (title, axes labels, units, nice scale, large size) Plot data points accurately Include error bars for uncertainty Draw a best fit line Linear: Calculate slope using two points ON the line; not data points Use a graph and LoggerPro "helper" boxes to find pattern and constant Find the pattern and constant from graph without using Logger Pro Include units with the constant Write a mathematical model to represent the data
1.3	I can make a data-based conclusion and prediction.	Write a conclusion that includes: evidence claim mathematical model explanation of meaning (aim for at least 3 ideas) Determine a predicted value using a graph and mathematical model Write a prediction that includes: predicted value basis for the prediction (whose data?) confidence level with 2 reasons

2. Constant Velocity Particle Model

2.1	I can explain key concepts for constant velocity	Explain position, displacement, distance traveled Explain constant speed and constant velocity Explain vectors and scalars Explain the meaning of specific values for position, displacement, speed, and velocity.
2.2	I can create and interpret different representations of the motion	Create and interpret graphs, motion maps, mathematical models, and verbal descriptions of constant velocity motion. Represent motion with velocity vectors of appropriate length and direction Find velocity from a position-time or velocity-time graph Find displacement from a position-time or velocity-time graph Use different representations to compare speeds, velocities, and positions of more than one object.
2.3	I can use multiple representations to solve constant velocity problems	Draw a picture of situation Represent motion with graph, motion map, and mathematical model Apply displacement, speed, and velocity equations to find unknown Determine when and where two objects will meet

3. Constant Acceleration Particle Model

3.1	I can explain key concepts for constant acceleration.	Explain average speed and average velocity Explain instantaneous velocity and how to find it from a graph Explain the meaning of acceleration, how to find it from a graph, and what its sign means in different situations. Explain speed, velocity, and acceleration during free fall situations.
3.2	I can create and interpret different representations of the motion	Translate between graphs, verbal descriptions, motion maps. Given a position time graph, find instantaneous velocities at different times and make a velocity-time graph. Determine acceleration of an object from its velocity-time graph.
3.3	I can solve problems involving motion with constant acceleration	Apply constant acceleration equations to find an unknown Identify special cases of motion (when initial velocity, final velocity, or displacement is zero, free fall acceleration, conditions for two objects to meet) Show work thoroughly: Draw a picture of situation List variables: given and unknown Identify type of motion occurring Write equation that applies Show substitution Solve for unknown Answer in complete sentence

4. Vector Skills

4.1	I can add and subtract vectors graphically	Choose an appropriate scale Draw a scale diagram showing vector addition and resultant Find magnitude and direction of resultant vector
4.2	I can use vector components	Find resultant of two perpendicular vectors using right triangle properties (Pythagorean theorem and inverse tangent) Resolve a vector into two perpendicular components

5. Projectile Motion

5.1	Explain key concepts for projectile motion	Describe, draw, and give evidence for the horizontal and vertical aspects of a projectile's motion.
5.2	Solve problems involving projectile motion	Set up coordinate system Work with horizontal and vertical components separately Determine horizontal and vertical components of initial velocity Combine horizontal and vertical components to find a final velocity Use characteristics of special points in the motion

6. Balanced Forces Particle Model

BF1	I can identify and diagram forces in a situation.	Draw system schema diagram and identify force pairs Draw a qualitatively accurate Free Body Diagram for an object Represent forces as vectors with appropriate length & direction
BF2	I can explain Newton's 1st Law	Explain Newton's 1st Law: How does an object's type of motion (constant velocity or changing velocity) relate to the forces on the object (balanced or unbalanced)? Explain some situations/motions in terms of Newton's 1st Law Describe experimental evidence for Newton's 1st Law
BF3	I can apply the balanced forces model	Given the forces on an object - determine sum of the forces graphically and using components - determine which force and motion models apply Given an at rest or moving with constant velocity - determine which force and motion models apply - find unknown forces graphically and using components Explain how changing a force in a given situation will affect other forces or the force and motion models that apply.
BF4	I can explain and apply Newton's 3rd Law	Explain Newton's 3rd Law: How many forces are involved in an interaction? How do these forces compare in magnitude? direction? Do these forces act on the same object or different objects? When given one force, identify its Newton's 3rd Law pair Apply N3L in situations to determine unknown forces.
BF5	I can apply the Law of Universal Gravitation	Reason about how doubling distance, masses, etc. affect the force Solve problems involving the Law of Universal Gravitation

7. Unbalanced Forces Particle Model

UF1	I can explain Newton's 2nd Law	Explain Newton's 2nd Law: How are force and acceleration related? How are mass and acceleration related? Reason about how doubling mass, doubling force, etc. affect acceleration Describe experimental evidence for Newton's 2nd Law
UF2	I can solve problems involving unbalanced forces	Recognize when the forces on an object are not balanced Determine sum of forces and direction of acceleration from vector addition diagram Set up an appropriate coordinate system Write sum of forces equations for x and y directions Solve problems involving force and acceleration. Solve multi-step problems involving kinematics and forces
UF3	I can describe friction and solve related problems	Explain meaning of static friction, kinetic friection, coefficients of static and kinetic friction, and how these variables are related. Solve problems involving the static and kinetic friction relationships

8. Linear Momentum

M1	I can apply impulse and momentum relationships	Calculate the momentum and change in momentum of a system Draw a momentum bar chart to represent initial and final momentum Explain the force conditions that cause a system's momentum to change Determine the impulse from force and time information or graph Relate change in momentum to forces applied to a system over time
M2	I can apply conservation of momentum	Define a system so the momentum of the system stays constant Draw a free body diagram of each object during the event Identify the system with a dashed line boundary Write the momentum conservation equation for the system Solve for unknowns

9. Energy

E1	I can determine energy stored and work done	Define a system Identify energy storage modes at different moments Draw energy pie charts and energy bar charts to represent system energy Determine the work done by a force over some distance Use work to determine the energy transferred in or out of a system Calculate kinetic energy, gravitational potential energy, elastic potential energy, and internal energy
E2	I can apply conservation of energy	Define a system Identify energy storage modes and energy transfers in/out of system Identify initial and final moments that will yield a useful energy equation Write an energy conservation equation for an initial and final moment Use energy conservation equation to solve for unknowns