NGSS						
Physics						*NOTES:*
HS-PS2-1						
1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.	a. Newton's second law accurately predicts changes in the motion of macroscopic objects.					The Unity catapult simulation incorporates Newton's second law. Students are asked to do calculations with Force, Mass and Acceleration. Students should gain insight into this law of motion when they manipulate variables to find acceleration.
HS-PS2-2						
2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.	a. If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system					Students will recognize that force is applied from the catapult to create acceleration of the cannonball (a change in momentum), and through their calculations of forces, will come to understand that without a net force, the total momentum is conserved.
HS-PS2-3:						
3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.						Students will have the chance to manipulate forces and to create collisions between the cannonball and a wall of boxes in a free play activity. With low spring force, the catapult will not be able to launch a ball hard enough to knock down the wall.
Energy						
HS-PS3-1:						

1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component (s) and energy flows in and out of the system are known	a. Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms	b. Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system.	c. Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.	d. Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior.	e. The availability of energy limits what can occur in any system	The Unity catapult simulation includes a lesson (lesson 2) on energy that models what occurs when energy moves from potential to kinetic. Students will see elastic potential energy drain into kinetic energy and will be introduced to the conservation of energy.
HS-PS3-2:						
2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects)	a. At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.	b. These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space.				The catapult simulation will allow students to explore the relationship between energy and motion. Students will notice that the gravitational potential energy rises as the ball approaches the peak of the parabola, and subsequently decreases as it descends after the peak.
HS-PS3-3						
3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy	a. Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment					Students will be able to significantly alter the functioning of the catapult throughout the lessons and free play to see how that might impact the conversion of potential energy to kinetic.

ISTE					
Empowered Learner					*NOTES:*
Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.	1c: Students use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.	1d: Students understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies.			The Unity platform gives students the opportunity to take control of the catapult to produce the results they want to see, while still demonstrating their knowledge of physics and problem solving more generally.
Digital Citizen					
Students recognize the rights, responsibilities and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical.	2b:students engage in positive, safe, legal and ethical behavior when using technology, including social interactions online or when using networked devices.				Students will get a chance to work within the Unity editor to make changes to an existing asset package that they've downloaded. Students will be expected to follow detailed instructions to ensure they are using the technology responsibly.
Knowledge Constructor					

Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others	3a:Students plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.	3d: Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.			Students will be able to alter a wide array of variables within the editor, creating unique simulations. The challenges they will face in free play and challenge modes will prompt them to come up with creative solutions.
Innovative Designer					
Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.	4a: Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.	4d: Students exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.			The Unity catapult simulation allows for a variety of solutions to a given challenge, yet it is important for students to keep a design process in mind so that those solutions match the challenge.
Computational Thinker					
Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.	5b: Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.	5c: Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.			Students will need to record data from the editor to be able to plug variables into equations and answer questions. They will need to be systematic in their gathering of data in order to offer effective, organized solutions.
Creative Communicator					

Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.	6a students choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.	6b: Students create original works or responsibly repurpose or remix digital resources into new creations.	6c:Students communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations.	6d: Students publish or present content that customizes the message and medium for their intended audiences.	Students will be expected to express their reasoning in answers both within lessons but also as they make their way through the worksheet. They combine variables in original and unique ways to face the challenges issued to them.

CSTA	
3B-CS-02 11-12	*NOTES:*
Illustrate ways computing systems implement logic, input, and output through hardware components.	The Unity catapult simulation will allow students to see what happens to the cannonball when they manipulate various inputs. They will see how the editor responds to user inputs that change how components function.
3B-DA-07 11-12	
Evaluate the ability of models and simulations to test and support the refinement of hypotheses.	As students change the inputs for mass of the cannonball and spring force, they will follow a trial and error process until they adjust the variables to generate the desired result. They will be able to evaluate how closely this simulation would resemble a real catapult and will be able to investigate the discrepancies.
3B-AP-14 11-12	
Construct solutions to problems using student-created components, such as procedures, modules and/or objects.	Students will see in real-time how their inputs change the functioning of the catapult. They will be refining those inputs until they can complete given tasks or solve given problems, such as the challenge.
3B-AP-15 11-12	
Analyze a large-scale computational problem and identify generalizable patterns that can be applied to a solution.	The Unity catapult simulation involves multiple complex problems where changes in variables can optimize results. In free play mode, students will be attempting to hit a target and also knock over a stack of boxes. The same process of trial and error will be generalizable between both free play modes but also the challenge where students are prompted to score a basket on a basketball hoop.
3B-AP-20 11-12	
Use version control systems, integrated development environments (IDEs), and collaborative tools and practices (code documentation) in a group software project.	Students will be encouraged to collaborate when working through challenges in the Unity editor. Students will get an inside-look at Unity to understand more about the process involved in software development.
3B-AP-21 11-12	

Develop and use a series of test cases to verify that a program performs according to its design specifications.	Free play activities will give students a chance to see what happens when they alter the catapult design by manipulating multiple variables.
3B-AP-22 11-12	
Modify an existing program to add additional functionality and discuss intended and unintended implications (e.g., breaking other functionality).	Students will have complete control over the functionality of the catapult, and will learn that certain changes can result in dysfunction.
3B-AP-23 11-12	
Evaluate key qualities of a program through a process such as a code review.	Students will engage the physics editor within Unity to produce new resultant forces and altered trajectories. Students will note that such changes are occurring within the code underlying the program.
3B-AP-24 11-12	
Compare multiple programming languages and discuss how their features make them suitable for solving different types of problems.	Students will be able to see what programming language has been used in Unity for the catapult, and compare that to any programming languages they may have used in the past. Students will be able to see which features of the code pertain to what element of the simulation.

Common Core				
ELA/Literacy	*NOTES:*	**Mathematics**		*NOTES:*
RST.11-12.3		**N-Q.1**		
Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.	Students will follow the steps outlined in the Unity program and Unity Learn site to fill out the exercise workbook.	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.		When students are manipulating equations, units should also be conserved so they can see how the units of 2 or more variables converts into the unit of the variable they are trying to solve for. E.g. KN/m^2 = Pa
RST.11-12.4		**N-VM.1**		
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.	Students will be required to understand the important definitions associated with the classic kinematic problem of projectile motion such as velocity, acceleration, displacement and time.	Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., v, |v|, ||v||, v).		Students will use component arms of the particle trajectory to break the problem into 2 dimensions and solve for parameters in the x and y directions
RST.11-12.5		**N-VM.3**		
Analyze how the text structures information or ideas into categories or hierarchies, demonstrating an understanding of the information or ideas.	Students will need to understand how completing the problem using forces and energy differs and what the benefits and disadvantages of using a particular technique are.	Solve problems involving velocity and other quantities that can be represented by vectors.		Students will use velocity to solve for acceleration and displacement of particles.
RST.11-12.7.9		**A-SSE.1**		

Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.	Students will use the Unity simulation to reinforce the understanding of the kinematic equations in the context of a real-life scenario.	Interpret expressions that represent a quantity in terms of its context.*	A. Interpret parts of an expression, such as terms, factors, and coefficients	Students will be required to understand how the different terms of the kinematic equations relate to the projectile path : e.g. d= ½*a*t^2+v*t+ d0 is a parabola and what the coefficients mean.
		A-SSE.2		
		Use the structure of an expression to identify ways to rewrite it. For example, see x4 – y4 as (x2)2 – (y2)2, thus recognizing it as a difference of squares that can be factored as (x2 – y2)(x2 + y2).		Students will learn that the Kinematic equations are just rearrangements of other known equations such as vf=vi+ at → a=v/t or using roots of the quadratic equation to solve for time.
		A-SSE.3		
		Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.*		Students will learn how to manipulate the KEs to reveal contextual information such as roots of the parabola.
		F-IF.4		

		For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behaviour; and periodicity*		Students are encouraged to draw out the projectile motion problem to aid in understanding and relate the physical properties of the question to mathematics. Such as the origin of the ball being the intercept of the graph. The roots being where the ball hits the ground and the peak height being the maximum of the parabola.
		G-SR.8		
		Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*		Students will develop an understanding of basic trigonometry is needed in order to break the velocity vector into its respective components and solve for parameters in echc dimension.