Three Dimensional Learning Plan: **HS-PS2-1**

Grade Level: **High School**

Title	**The Gyro Drop**	Phenomenon/Problem	**Is the video of the Gyro Drop real or fake? Free fall**
Designed by	**Paul Anderson**	Course(s)	**Physics**
Brief Learning Description	**Students will analyze the position/velocity/time data (pulled from a video) of a carnival ride. By graphing the velocity and time graph, students will be able to determine acceleration and compare it to the acceleration due to gravity. Students will defend if this video is real or fake comparing their calculated acceleration to the acceleration due to gravity.**		

Desired Results

Performance Expectation(s)

HS-PS2-1: Newton's Second Law of Motion
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. (Cause and Effect)

Summative Assessment

The Gyro Drop

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
✓ **Analyzing & Interpreting Data** ❑ Asking Questions ❑ Constructing Explanations ❑ Defining Problems ❑ Designing Solutions ❑ Developing & Using Models ❑ Engaging in Argument from Evidence ❑ Mathematics & Computational Thinking ❑ Obtain, Evaluate, Communicate Information ❑ Planning & Carrying Out Investigations	✓ **PS2.A: Forces and Motion**	✓ **Cause & Effect** ❑ Energy & Matter ❑ Patterns ❑ Scale, Proportion & Quantity ❑ Stability & Change ❑ Structure & Function ❑ Systems & System Models

Required Elements			
What new skills (practices) will students need to learn?	What thinking concepts will students need to learn?	What science concepts will students need to learn?	What authentic phenomenon can drive the inquiry?

Analyze data using tools, and/or technologies in order to make valid and reliable scientific claims.
 	
❏ Mathematics & Computational Thinking - Graphing data using Google Sheets and Desmos
❏ Mathematics & Computational Thinking - determining acceleration via slope of v vs t graph.
❏ Developing & Using Models - Free Body Diagrams
❏ Engaging in Argument from Evidence (is the video real or fake, how do you know?)
	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects
	
	❏ Patterns - recognize the patterns of motion when F_{net} is in different directions
	❏ Cause and Effect - determine whether a specific cause (F_{net}) could affect the motion of the object in the way observed.
		Predict changes in the motion of macroscopic objects using Newton's 2nd law
		
		Unit 1 (Prior):
		❏ Def'n of Δx, v, and a
		❏ x vs t graphs
		
		❏ Forces
		❏ Balanced vs unbalanced forces
		❏ Net force
		❏ Free Body Diagrams
		❏ Newton's 2nd Law
		  ❏ v vs t graphs
		  ❏ Recognize constant force creates a constant acceleration
		  ❏ Acceleration is in the direction of the net force
		❏ Free Fall
			❏ Olympic sprinters
			  ○ Usain Bolt vs. Car
			❏ Release of fire-retardant chemicals on wildfires (freefall)
			❏ Stopping distance of different mass vehicles (a=F/m)
			❏ Magic mountain Superman Ride (or other) - county fair
			❏ Apparent weightlessness (vomit comet, Richard Brandston, Jeff Bezos)
			❏ Parasailing
			❏ Skydiving
			❏ Soccer ball video analysis (punting the ball upward)

Activity 1			
Phenomenon or Problem	What will they do? The three dimensions woven together into a single learning performance.	Why is this important? How does this activity help build understanding of the anchoring phenomenon?	How will they do it? Graphic organizers, protocols, scaffolds, labs, mini-lesson, student discourse, etc.
Olympic Sprinters	Students will analyze data using patterns to describe position, velocity, and acceleration of the sprinters.	Olympics athletes are some of the best Many students participate in or watch sports	Examine stop motion images Describe patterns (e.g. "spacing is larger later in the race") Analyze sprinter velocity data set of 20m intervals Sprinter Data WS Describe the motion of a series of stop motion dots of a sprinter

Formative Assessment What information are you collecting to know that they met the target?	• Students can analyze patterns of motion and describe differences in terms of velocity and acceleration. •

Activity 2			
Phenomenon or Problem	**What will they do?** The three dimensions woven together into a single learning performance.	**Why is this important?** How does this activity help build understanding of the anchoring phenomenon?	**How will they do it?** Graphic organizers, protocols, scaffolds, labs, mini-lesson, student discourse, etc.
Falling VW vs Porsche	Students will determine the forces acting (cause) on the cars and determine the effect of the balanced/unbalanced forces. Students will ask questions to help them answer the driving question: "What factor limited the maximum speed of each vehicle?"		Driving Question: What factors limit the maximum speed of each vehicle?
Formative Assessment What information are you collecting to know that they met the target?		•	

Activity 3			
Phenomenon or Problem	**What will they do?** The three dimensions woven together into a single learning performance.	**Why is this important?** How does this activity help build understanding of the anchoring phenomenon?	**How will they do it?** Graphic organizers, protocols, scaffolds, labs, mini-lesson, student discourse, etc.
Velocities of olympic athletes			
Formative Assessment What information are you collecting to know that they met the target?		•	

Activity 4

Phenomenon or Problem	What will they do? The three dimensions woven together into a single learning performance.	Why is this important? How does this activity help build understanding of the anchoring phenomenon?	How will they do it? Graphic organizers, protocols, scaffolds, labs, mini-lesson, student discourse, etc.
Motion Sensor Graph Matching			
Formative Assessment What information are you collecting to know that they met the target?		•	

Activity 5

Phenomenon or Problem	What will they do? The three dimensions woven together into a single learning performance.	Why is this important? How does this activity help build understanding of the anchoring phenomenon?	How will they do it? Graphic organizers, protocols, scaffolds, labs, mini-lesson, student discourse, etc.
Formative Assessment What information are you collecting to know that they met the target?		•	

Activity 6

Phenomenon or Problem	What will they do? The three dimensions woven together into a single learning performance.	Why is this important? How does this activity help build understanding of the anchoring phenomenon?	How will they do it? Graphic organizers, protocols, scaffolds, labs, mini-lesson, student discourse, etc.
Formative Assessment What information are you collecting to know that they met the target?		•	

Activity 7

Phenomenon or Problem	What will they do? The three dimensions woven together into a single learning performance.	Why is this important? How does this activity help build understanding of the anchoring phenomenon?	How will they do it? Graphic organizers, protocols, scaffolds, labs, mini-lesson, student discourse, etc.
Release of fire-retardant chemicals on wildfires https://www.youtube.com/watch?v=SiAbcw5s9_8 Falling VW vs Porsche	Students will obtain information using	Santa Barbara is prone to fires. Knowing how to make an air drop most effective can save lives, money, and environment.	How to drop a payload on a target Read article on Drop Testing Air Tankers. Explain how scientists used the cup and grid method to determine the effectiveness of the air drop.
Formative Assessment What information are you collecting to know that they met the target?		•	

Activity 8			
Phenomenon or Problem	What will they do? The three dimensions woven together into a single learning performance.	Why is this important? How does this activity help build understanding of the anchoring phenomenon?	How will they do it? Graphic organizers, protocols, scaffolds, labs, mini-lesson, student discourse, etc.
Formative Assessment What information are you collecting to know that they met the target?		•	

Activity 9			
Phenomenon or Problem	What will they do? The three dimensions woven together into a single learning performance.	Why is this important? How does this activity help build understanding of the anchoring phenomenon?	How will they do it? Graphic organizers, protocols, scaffolds, labs, mini-lesson, student discourse, etc.

Formative Assessment What information are you collecting to know that they met the target?	•
Summative Assessment What information are you collecting to know that they met the target?	•

Materials / Resources

Vocabulary
Newton's law of motion
Macroscopic object
Net force
Mass
Acceleration
Cause and Effect

Mini Lessons
Causation Level 6 - Causation & Correlation

Differentiation / Modifications