Multipage Template Example Tied to NGSS Standards

Design Questions | Stage 1: Identify Evidence-Based Claim

Establish Evidence	Hands-on Activities	Standards Connections
• What evidence-based experience will students have that allow them to construct a scientific claim?	*Students investigate how changing the force and mass separately in an investigation can influence a car's speed.*	SEP Checklist[1]: ○ Asking questions and defining problems ○ Planning and carrying out investigations ○ Constructing explanations (for science) ○ Analyzing and interpreting data CCs Checklist[2]: • Patterns • Cause and effect
Materials	• *Cars, Ramps, Tracks, Photogate Timers, Added Mass, and String.*	
Procedures • What procedural explanations might teachers need to explain (NOT mini-content explanations)?	• *Students will roll cars on level track and use a pull force to move the car. Students can tie a string to the front of the car and add mass. The spring and mass are looped through a pulley. When the mass is released, it falls to the ground and pulls the car.*	
Safety	• *Wear sanitized, indirectly vented chemical splash safety goggles* • *Use caution when working when dropping masses to propel the car. Both the dropped mass and car could injure students.* • *Have direct adult supervision if you are working cars and ramps* • *Wash your hands with soap and water after completing this activity*	

Establish Content	Minds-on Activities	Disciplinary Core Ideas (DCIs)[3]
• What content will students make a claim about and serve as the context for science learning?	Students create evidence-based claims (1) when the pull force is constant, adding mass, makes the car's speed slower. (2) when the pull force is increased, and the mass is constant, the car's speed increases.	Newton's second law accurately *predicts changes in the motion of macroscopic objects*.

NGSS Performance Expectation[4]

- What specific components of the PE does the evidence-based experience target?

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 (HS-PS2-1; NGSS Lead States).

[1] Activities directly relate to helping students gain proficiencies of SEPs
[2] Students think logically by using CCs to make sense of data related to content.
[3] Students develop a conceptual understanding of the DCI
[4] Students understanding of the conceptual ideas undergirding the PE are used to develop mathematical understanding.

Design Questions | Stage 2: Pinpoint Phenomena that Hook Learning		
Components	Instructional Activities	Connection to NGSS[5]
Situate Learning: • How can teachers motivate students and captivate their attention using science phenomena or relevant life experiences? Prior Knowledge: • What specific ideas or misconceptions can teachers pre-assess during the engage phase? Learning Targets: • What are the content-based learning targets for the lesson? • What are the SPE learning targets for the lesson?	*Formative assessment probe used to assess student's knowledge of how force and mass are involved in the speed of a bike racer.* *Follow-up assessment item asking students about where their ideas came from.* *Students have incomplete understandings of how forces and motion are related (Driver, Squires, Rushworth, and Wood-Robinson 1994)* *Students will learn how force, mass, and speed are related?* *Students will learn how to perform a valid and reliable investigation of force and motion*	SEP Checklist: • Asking questions and defining problems • Planning and carrying out investigations CCs Checklist: • Patterns • Cause and effect DCIs: Newton's second law accurately *predicts changes in the motion of macroscopic objects*

[5] Activities is pivotal in building an understanding of SEPs, CCs, and DCIs (activity on their own do not wholly and explicitly accomplish goals of Standards).

Design Questions | Stage 2: Use Authoritative Explanations to Extend Learning

Components	Instructional Activities	Connection to NGSS
Scientific Principles What underlying principles do teachers need to help students formulate?	*Acceleration is a change in speed or change in direction* *Newton's Second Law (F=MA)*	SEP Checklist[6] • Constructing explanations (for science) CCs Checklist[7] • Cause and effect DCIs[8] Newton's second law accurately predicts changes in the motion of macroscopic objects
Concepts and Facts What "terms" and "concepts" do teachers need to introduce that are essential for understanding?	*Acceleration*	
Non-Essential Ideas What other terms or ideas are related to the content and considered "nice to know," non-essential topics OR ideas that will be important in another unit?	*Slope*	

[6] Activity creates the conceptual underpinnings necessary to develop mathematical understanding
[7] Explanations help develop the causal relationship of the variables in Newton's Second law
[8] Explanation helps students learn how mathematical relationships and understanding variables can allow them to predict the outcomes of an interaction.

Design Questions | Stage 2: Provide Transferring Practice		
Components	Instructional Activities	Connection to NGSS
New and Different Situations • What hands-on investigation can students have to test the idea in a new situation or build a new idea in a similar situation?	*Students determine whether cars speed up on the level and sloped track and whether changing the pull force and mass of the car is related to whether a car accelerates*	SEP Checklist[9] • Asking questions and defining problems • Planning and carrying out investigations • Constructing explanations (for science) and designing solutions (for engineering) • Using mathematics and computational thinking • Analyzing and interpreting data CCs Checklist[10] • Patterns • Cause and effect • Scale, proportion, and quantity DCIs[11] Newton's second law accurately predicts changes in the motion of macroscopic objects

[9] Elaboration activities allow students to test their abilities to do science using SEPs validly and reliably.
[10] Students think logically about their data using CCs in a more independent way to construct understanding
[11] Activities promote the application of mathematical thinking to students' firsthand experiences with data

Design Questions | Stage 2: Include growth indicators for students and teachers		
Components	Instructional Activities	Connection to NGSS[12]
Reflecting on thinking • How will students think about their developing knowledge?	*Students to fill in the blanks for these starter prompts: At first, I thought_____, but now I think _____ , because _____.*	SEP Checklist • Obtaining, evaluating, and communicating information CCs Checklist • Patterns • Cause and effect DCIs Newton's second law accurately predicts changes in the motion of macroscopic objects.
Evaluating Learning • What assessment will be used to determine whether students have gained the necessary abilities and knowledge?	*Students evidence-based claims from the acceleration lab*	

[12] Students must show their developing understanding using a metacognitive approach and demonstrate that they have gained a more accurate understanding.