Unit Lesson Plan – Momentum			
Teacher:	**<Teacher>**	**Time Frame:**	**11 days**
Grade:	**9**	**School:**	**<School>**
Subject:	**PSI Algebra Based Physics**		

NGSS DCI:	• HS-PS2-2. 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. • HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
AP Physics 1 and 2 Standards:	• Enduring Understanding 3.D: A force exerted on an object can change the momentum of the object. • Essential Knowledge 3.D.1: The change in momentum of an object is a vector in the direction of the net force exerted on the object. • Learning Objective (3.D.1.1): The student is able to justify the selection of data needed to determine the relationship between the direction of the force acting on an object and the change in momentum caused by that force. • Essential Knowledge 3.D.2: The change in momentum of an object occurs over a time interval. a. The force that one object exerts on a second object changes the momentum of the second object (in the absence of other forces on the second object). b. The change in momentum of that object depends on the impulse, which is the product of the average force and the time interval during which the interaction occurred. • Learning Objective (3.D.2.1):The student is able to justify the selection of routines for the calculation of the relationships between changes in momentum of an object, average force, impulse, and time of interaction. • Learning Objective (3.D.2.2):The student is able to predict the change in momentum of an object from the average force exerted on the object and the interval of time during which the force is exerted. • Learning Objective (3.D.2.3):The student is able to analyze data to characterize the change in momentum of an object from the average force exerted on the object and the interval of time during which the force is exerted. • Learning Objective (3.D.2.4):The student is able to design a plan for collecting data to investigate the relationship between changes in momentum and the average force exerted on an object over time.

Note that this **exact** Smart Notebook presentation has not been used in the classroom, although all of the material has. The pacing below is approximate based on a 40-45 minute class period. Feel free to adjust as necessary and please provide your feedback!

Essential Questions

(What questions will the student be able to answer as a result of the instruction?)

1. How do we determine the impulse on a physical system when the forces on the system, and the time interval these forces act, are known?
2. What is the difference between elastic and inelastic collisions?

Knowledge & Skills

(What skills are needed to achieve the desired results?)

By the end of this unit, students will know:

- relationship between certain physics quantities related to impulse and momentum.
- fundamental law of physics -conservation of momentum.

By the end of this unit, students will be able to:

- use the following equations in solving problems:

  $P = mv$ Momentum

  $I = \Delta p = mv$ Impulse

Assessment

(What is acceptable evidence to show desired results (rubrics, exam, etc.)? Attach Copy

During the Smart Notebook lesson designed to introduce concepts, students will be continually questioned on these concepts using a combination of class work/homework questions and the SMART Response system. Classwork and Homework questions will be discussed as a class and misconceptions will be addressed by the teacher prior to the formal evaluations listed below.

-

Other assessments on the NJCTL website are optional and can be used as needed.

(What is the sequence of activities, learning experiences, etc, that will lead to desired results (the plan)?

Day	Topic	Classwork	Homework**
1	Momentum	Presentation to slide 12 Problems 1-6	Problems 7-12
2	Momentum Change and Impulse	Presentation to 26 Problems 13-21	Problems 22-28
3	Momentum of a System of Objects & Conservation of Momentum	Presentation to slide 39 Problems 29-31	Problems 32-34 MC 1-10
4	Review Problems & Momentum Quiz and/or Impulse Quiz	Review & Quiz	MC 11-20

5	Perfectly Inelastic Collisions & Explosions	Presentation to slide 52 Problems 35-41	Problems 42-49
6	Elastic Collisions	Presentation to end Problems 50-57 (Optional 66-68)	Problems 58-65 (Optional 69-71)
7	Momentum HT Lab (or other lab)	Lab	Finish Lab and study for Quiz
8	Lab Quiz & General Problems	Quiz & Problem 72	Problem 78 MC 21-25
9	General Problems	Problems 73, 74, 79	Problems 75, 76, 77
10	Review	Review for test	Study for Test
11	Momentum Test	Test	N/A

* It may not be possible to complete labs in the order stated due to lab schedules. Other labs on the NJCTL website are option and can be used as needed.

**HW Problems are currently not scaffolded from least to most difficult, but are instead listed in order of topic. Teacher should pay special attention at the end of each class period when assigning HW so that only problems related to the topic that was taught are being assigned.