Unit 7: *Linear Momentum*

This unit will take approximately 3 weeks. The pace is always determined by the ability of your students. Some areas can be skipped or used as enrichment, while other areas include more challenges to those more advanced students. If you find the pace is too quick for your students, you may want to insert some "processing time" for them.
This timeline is based on 55-minute periods.

Outline	Teacher Notes
Day 1 ***Objective***: Introduce examples where momentum and impulse play a role. ***Activity***: Framing Questions ***Due***: None ***QOD***: Most of you have heard the word "Momentum". What does it mean to you?	Framing Questions: Remember, students aren't supposed to know these answers, just start thinking about the concepts that will be coming up. Try to identify any misconceptions in the discussions as this will help you overcome these later in the unit.
Day 2 ***Objective***: I can identify what happens in a collision. ***Activity***: Exploring Collisions Lab ***Due***: Lab write up at the end of the hour. ***QOD***: What types of things can happen when two objects collide?	Students are to move from station to station identifying different types of collisions as well as vocabulary associated with collisions, i.e., motion and types of motion. Be sure to discuss these stations in class. Whiteboard or whole class discussion.
Day 3 ***Objective***: I can define an impulse and how it relates to a collision. ***Activity***: Reading page Impulse. ***Homework***: Practice 7.1 Impulse ***Due***: None ***QOD***: How are the forces different in the use of a car crash dummy hitting an air bag (vs. not) in a car crash test?	Start by reviewing the post lab from yesterday. Identify the types of motion as a result of a collision. Go through the reading page, "Impulse" and show students how force and time are related in a fast collision vs. a slow collision. You will need to show students units of impulse, and some conversions: milliseconds – seconds, as well as how to find the area under a curve geometrically.
Day 4 ***Objective***: I can define and calculate the linear momentum of a system. ***Activity***: Reading page: Linear Momentum ***Due***: Practice 7.1 ***Homework***: Practice 7.2 Calculating Linear Momentum ***QOD***: Which one has the most momentum: a heavy truck traveling slow or a small light car traveling fast?	Briefly review practice 7.1 to make sure everyone understands momentum. Show students that momentum is defined as ***p***, and that it is dependent on two things they've already identified, mass and velocity. This will give them the equation. Go through the linear momentum reading page, and do some of the practice problems from practice 7.2. Assign the rest as homework.

Outline	Teacher Notes
Day 5 ***Objective***: I can calculate momentum and change in momentum for an object or system. ***Activity***: Whiteboard practice 7.2 ***Due***: Practice 7.2 ***QOD***: If a heavy truck slams into a small parked car, which one receives the greater **force**? Truck or car?	Quickly review linear momentum and impulse. Whiteboard practice 7.2. Quiz #1
Day 6 ***Objective***: I can describe how impulse and momentum are connected. ***Activity***: Lab: Connecting Impulse and Momentum ***Homework***: Practice 7.3 ***Due***: None ***QOD***: Why do you think they put those yellow water barrels in front of highway support posts? (show picture if you have one)	Review Quiz #1 Tough day! In this lab, students will see that momentum and impulse are directly connected. You will need to help students write this relationship in mathematical form. This can be tricky, so take your time. You may choose to do this qualitatively depending on the mathematical ability of your students. You may also do some of the homework problems in class. Problem 6, and 8 would be good examples.
Day 7 ***Objective***: I can connect change in linear momentum to impulse force and time of contact. ***Activity***: Whiteboard homework 7.3 ***Due***: Practice 7.3 ***QOD***: Playing baseball, which would be worse: getting hit by a bouncy ball, or bean bag baseball of the same weight thrown at the same speed?	Whiteboard the homework 7.3. Review Linear momentum, change in momentum, impulse, force and time. At the end of class, show examples of why there are air bags, water barrels, guard rails, etc. to reduce the force experienced in a collision.
Day 8 ***Objective***: I can differentiate between an elastic and inelastic collision. ***Activity***: Elastic and Inelastic Collisions Lab ***Due***: None ***QOD***: You have two bumper cars involved in an accident, would that be better or worse (for the passengers) if they stuck together, or bounced off each other?	Billiard balls (used) can be acquired from a billiard company, tracks can be made of wood. The big idea here is to establish the differences between elastic and inelastic collisions. Including explosions.

Outline	Teacher Notes
Day 9 ***Objective***: I can identify examples of elastic and inelastic collisions. ***Activity***: Whiteboard post lab questions ***Due***: Post lab questions ***QOD***: How does an explosion relate to a collision?	Whiteboard the post lab questions. Ask questions here that would apply to everyday situations. Review with the reading page, Type of Collisions.
Day 10 ***Objective***: In a collision, I can identify what stays the same. ***Activity***: Pre-lab, Momentum in Collisions Lab ***QOD***: In a collision, is there anything (that you can think of) that stays the same?	Quiz #2 first. Then start the pre-lab discussion of the "Momentum in Collisions lab." Whiteboard the pre-lab discussion
Day 11 ***Objective***: I can calculate the linear momentum of a system as well as the linear momentum of the individual objects involved in the collision. ***Activity***: Momentum in Collisions Lab ***Due***: Pre-lab ***QOD***: When a heavy ball strikes a lighter (stationary) ball, how will the light ball move after the elastic collision?	Review Quiz #2 Review the pre-lab discussion for Momentum in Collisions lab. Break this lab up to save time. Don't expect to get done in one class period.
Day 12 ***Objective***: I can find the total momentum of a system before and after a collision. ***Activity***: Post lab- Momentum of Collisions ***Due***: Post lab questions ***QOD***: What is the difference in the total momentum, before and after, of two objects in an inelastic collision?	Finish lab and whiteboard the post lab questions. Be sure to ask a lot of questions and have all students understand the concepts presented by the other groups.
Day 13 ***Objective***: I can distinguish between the linear momentum of a system and the linear momentum of a single object in a system. ***Activity***: Finish Lab, Momentum of Collisions ***Homework***: Practice 7.4 ***Due***: Lab ***QOD***: When Captain Jack Sparrow shoots a cannon ball from a cannon why is it important not to stand directly behind the cannon?	Finish/Review the lab and reinforce their thinking using the reading page, "Conservation of Linear Momentum". Apply this to everyday scenarios. Do some of the Practice 7.4 problems in class. Assign the rest for homework.

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Day 14 ***Objective***: I can describe when linear momentum is conserved and when it is not. ***Activity***: Whiteboard practice 7.4 ***Due***: Practice 7.4 ***QOD***: If Captain Jack's cannon has a mass of 200kg and shoots a 5kg cannonball at 20m/s, how fast will the cannon recoil?	Whiteboard the practice 7.4 Review the big ideas of the unit. Go back to the framing questions and review.
Day 15 ***Objective***: Unit 7 - Linear Momentum assessment	Unit 7 - Linear Momentum assessment