Unit 07: Momentum and Impulse

Content Area: **Science**
Course(s):
Time Period: **Marking Period 4**
Length: **4-5 Weeks**
Status: **Published**

Summary

The concept of momentum and it's relation to force is examined. The principle of The conservation of momentum is discussed and its consequences on the world are explored. Collisions and other interactions are analyzed using this principle.

Revised July 2022

Standards

9.4.12.CI	Creativity and Innovation
MA.N-Q.A.1	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.
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
MA.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
8.1.12.DA.5	Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.
MA.A-CED.A.1	Create equations and inequalities in one variable and use them to solve problems.
MA.A-CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
MA.A-CED.A.3	Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.
MA.A-CED.A.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
LA.WHST.11-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
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.
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP11	Use technology to enhance productivity.
CRP.K-12.CRP12	Work productively in teams while using cultural global competence.
TECH.8.1.12.A.5	Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.

Essential Questions

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- How does Newton's 2nd Law relate the concepts of force and momentum?

- What is the principle of The conservation of momentum and what are its consequences?

- What is the concept of center of mass and why is it useful?

- What is impulse and how is it related to momentum?

Enduring Understanding

- In the absence of outside forces, the total momentum of system remains constant

- The duration (time) of a collision determines the size of the forces experienced

- Elastic collision involve a conservation of total momentum and kinetic energy

Objectives

- Students will be skilled at predicting the final velocity of objects after a collision

- Students will be skilled at calculating the change in kinetic energy a system undergoes during a collision

- Students will be skilled at analyzing the motion of rockets using the conservation of momentum

- Students will be skilled at adding and subtracting motion vectors

- Students will know that impulse is a force acting over a finite period of time

- Students will know to minimize the forces involved in a collision

- Students will know the difference between elastic and inelastic collisions

- Students will know how to calculate the centers of mass of objects

Learning Plan

- Teacher presentation: Momentum and Newton's 2nd Law

- Phet simulation: Collisions in 1D

- Conservation of momentum demos: Air-Track, Roller blades, objects pushing off, perfectly inelastic collisions etc

- Powerpoint: The conservation of momentum

- Video: "The Mechanical Universe - The conservation of momentum"

- Lab: Elastic Collisions

- Cooperative problems solving: collisions

- Class discussion: Impulse-Momentum and collisions

- Video: "Relaxing with impulse"

- Demos and discussion: Airbags, helmets, pads etc

- Project: The egg protection device

- Presentation and demos: Center of Mass

- Lab: Calculating centers of mass

Assessment

Formative:

Do Now Questions

Exit Ticket Questions

Whole Class Discussion Participation

Small Group Discussion Participation

Individual Student Questions/Responses

Cooperative Problem Solving *(Collisions)*

Lab Experiments *(Inelastic collisions)*

Quizzes

Summative:

Formal Lab Report

Unit Test

Egg Drop Project

Benchmark:

Honors Physics Final Exam

Alternative Assessments:

Guided Formal Lab Report

Unit Study Guide

Materials

Textbook PHYSICS: PRINCIPLES WITH APPLICATIONS 6th Edition GIANCOLI, PEARSON

Mechanical Universe Video Series

Video: Relaxing with Impulse

Cosmos Video Series

Equipment for momentum demos

Chromebooks for PhET Simulation

Materials for Egg Drop Project

Lab Equipment: ramps, ball bearings, stopwatches, slotted masses, meter sticks, bricks

Computer / Smart board

¼ inch graph paper

Integrated Accommodation and Modifications

FOR SPECIAL EDUCATION STUDENTS , ELL, AT RISK AND STUDENTS GIFTED STUDENTS

https://docs.google.com/spreadsheets/d/1XVU7bji7iOgH8W9w9PLxDox44Da1R1oCxiSeoIztRGQ/edit?usp=sharing