Unit 05: Fundamental Forces II: Electrostatic and Nuclear Forces

Content Area: **Science**
Course(s):
Time Period: **Marking Period 3**
Length: **2-3 Weeks**
Status: **Published**

Summary

In this unit we investigate the remaining three fundamental forces: electrostatic, strong nuclear and weak nuclear forces. Coulombs Law is introduced and its consequences on charged particles and the structure of atoms is explored. The connection between moving electric charges and magnetic fields is discussed and applied to modern electronics . The Strong nuclear and Weak nuclear forces are introduced qualitatively, and the role they place in nuclear reactions is discussed. Applications of all the fundamental forces are examined in the context of stellar evolution.

Revised July 2022

Standards

MA.A-SSE.A.1	Interpret expressions that represent a quantity in terms of its context.
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
MA.A-SSE.B.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
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.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.
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.
LA.RST.11-12.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
LA.RST.11-12.2	Determine the central ideas, themes, or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
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.
8.1.12.AP.5	Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.
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.
LA.WHST.11-12.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
LA.WHST.11-12.9	Draw evidence from informational texts to support analysis, reflection, and research.
LA.SL.11-12.4	Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.
LA.SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
HS-PS2-4	Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.
HS-PS3-5	Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
HS-ESS1-1	Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.
HS-ESS1-2	Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.
HS-ESS1-3	Communicate scientific ideas about the way stars, over their life cycle, produce elements.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
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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- What roles do the electrostatic and strong nuclear forces play in the structure of atoms?

- How are electric and magnetic fields related to one another?

- How are the electrostatic and gravitational forces similar and how do they differ?

- What role does nuclear fusion play in the lifecycle of a star?

Enduring Understanding

- Nuclear fusion in the interior of stars converts mass into energy

- The electrical force binds all matter together and the strong nuclear force holds the nucleus of atoms together

Objectives

- Students will be skilled at determining the electrostatic force between charged objects

- Students will know how insulators and conductors are used in modern electronics

- Students will be skilled at sketching electric fields for a variety of charge arrangements

- Students will know how objects can be charged through conduction, friction and induction

- Students will know how stars produce energy through nuclear fusion

- Students will know how the fundamental forces govern the inner workings of atoms

- Students will know the life cycle of stars

Learning Plan

- Phet Simulation: Electrostatics

- Video: "The Mechanical Universe: Electrostatics"

- Demo: Electrostatics

- Lab: "The electroscope and other stuff"

- Phet Simulation: Electric Fields

- Activity: Sketching electric fields

- Presentation and discussion: The forces within the atom

- Video: "Cosmos: The lives of stars"

- Presentation: The life cycle of stars

- Discussion: Nuclear reactions

Assessment

Formative:

Do Now Questions

Exit Ticket Questions

Whole Class Discussion Participation

Small Group Discussion Participation

Individual Student Questions/Responses

Individual Problem Solving *(Sketching electric fields)*

Lab Experiments *(The electroscope)*

Quizzes

Summative:

Formal Lab Report

Unit Test

Benchmark:

Honors Physics Final Exam

Alternative Assessments:

Guided Formal Lab Report

Unit Study Guide

Materials

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

Cosmos Video Series

Equipment for electrostatic demos

Chromebooks for PhET Simulation

Lab Equipment: magnets, iron filings, trays, water, voltmeters, rulers, markers

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