

NASA Resources for Physics classes

For NC Obj. Phy.1.1 Analyze motion of objects.

- **Lesson Plan: Vectors from A to B** - This is an activity about vectors and velocity. It outlines the addition and subtraction of vectors, and introduces the application of trigonometry to describing vectors.
http://cse.ssl.berkeley.edu/SEGwayed/lessons/exploring_magnetism/earths_magnetic_personalit_y/guide_activity15.pdf
- **Lesson Plan: THEMIS Magnetometer Line-Plots** - Learners will make several paper 3D vector addition models, watch podcasts on how to analyze magnetometer data, and employ 3D vector plots to create a model of the 3D magnetic field in the location of the magnetometer closest to their town. This is a multi-step activity with corresponding worksheets for each step and requires access to a computer with an internet connection.
http://cse.ssl.berkeley.edu/SEGwayed/lessons/exploring_magnetism/earths_magnetic_personalit_y/guide_activity16.pdf

For NC Obj. Phy.1.2 Analyze systems of forces and their interaction with matter.

- **Lesson Plan: LUNAR LANDING** - Students will apply equations of motion and force to solve for unknowns in this real world application about human exploration missions to the Moon.
https://www.nasa.gov/audience/foreducators/mathandscience/exploration/Prob_LunarLanding_detail.html#.UgU2IbZ57xY
- **Lesson Plan: Two Versions of Gravity: Newton and Einstein** - The lesson plan below assumes that students have been taught both theories, but it could easily be modified to incorporate an independent research approach to covering Einstein's theory. This lesson illustrates how the scientific process allows a new, more complete theory to take the place of an older theory that does not produce accurate results for a new discovery.
https://imagine.gsfc.nasa.gov/educators/programs/cosmictimes/downloads/lessons/1919/two_gravity.pdf This lesson is part of the Cosmic Times series found here:
<https://imagine.gsfc.nasa.gov/educators/programs/cosmictimes/educators/guide/1919/index.html>

- **Lesson Plan: Newton's Law of Gravitation** - Student Activity pages give students the opportunity to learn aspects of the Law of Gravitation in a way that they will find interesting and fun. Notes about each activity appear in the Notes to Teachers section. Activity one explores why outer planets take so much longer to complete an orbit than the inner planets. Activity two explores how any object under the influence of an inverse square law force (such as gravity) must have a curved path that is part of conic sections.
http://swift.sonoma.edu/education/newton/newton_4/htmlgrav/Newtongravity.html
- **Lesson Plan: Launch Speed** - This example is a simple application showing how Newton's laws of motions are used on aircraft carriers. As with any practical application of physics, it is important to be aware of your units of measure, and the meanings of all the terms in the equations. https://pumas.nasa.gov/files/03_23_02_1.pdf

For NC Obj. Phy.1.3 Analyze the motion of objects based on the principles of conservation of momentum, conservation of energy and impulse.

- **Lesson Plan: Ion Propulsion: Using Spreadsheets to Model Additive Velocity**
The [Dawn mission](#) and its use of ion propulsion gives students a unique opportunity to study the relationship between mass, force, acceleration, distance and time as described by Newton's Laws of Motion. Students reinforce their knowledge of Newton's Laws by applying them to a real-world problem: determining the velocity and distance traveled by a hypothetical spacecraft similar to Dawn, and graphing the data they generate.
<https://www.jpl.nasa.gov/edu/teach/activity/ion-propulsion-using-spreadsheets-to-model-additive-velocity/>

For NC Obj. Phy.2.2 Analyze the behavior of waves.

- **Lesson Plan: What the Doppler Effect Tells Us About Distant Stars & Planets** - Experience the Doppler Effect for sound, first hand. Demonstrate the cosine effect on the Doppler shift as the plane of a source's orbit changes with respect to the line of sight. Students can compute the frequency change for motion along the line of sight (LOS) and determine the vector LOS component for motions not exactly on it. https://pumas.nasa.gov/files/06_09_05_1.pdf
- **Lesson Plan: Alien Bandstand** - This activity is one of several in which students are required to access an online website and analyze actual data from NASA missions, including video "interviews" with real NASA scientists, to solve a mystery. In this mystery, students are challenged to determine if a signal from space has a natural origin, or if it actually is a message from aliens. Student link: http://mystery.sonoma.edu/alien_bandstand/game/htmlout/index.html and Teacher guide book: <http://mystery.sonoma.edu/resources/teachers/smteachgd.pdf>

For NC Obj. Phy.3.2 Explain the concept of magnetism.

- **Lesson Plan: Magnetic Math** - Students explore magnetic forces using more sophisticated mathematical tools. <https://spacemath.gsfc.nasa.gov/SMBooks/MagMathV3.pdf>

- **Lesson Plan: Induction in an Aluminum Can** - In this activity, Lenz's Law is demonstrated. Lenz's Law states that an induced electromotive force generates a current that induces a counter magnetic field that opposes the magnetic field generating the current. http://cse.ssl.berkeley.edu/SEGwayed/lessons/exploring_magnetism/magnetism_and_electromagnetism/Guide_activity4.pdf This is part of a series found here: http://cse.ssl.berkeley.edu/SEGwayed/lessons/exploring_magnetism/magnetism_and_electromagnetism/

Other Resources:

Propellantless Space Travel - A concept paper on using Recycled Kinetic Energy. Directly transferring KE from one spacecraft to another by purely mechanical means is impractical. Instead, the KE of an arriving spacecraft is converted into electrical energy using a highly efficient process commonly used in the electric automobile industry named regenerative braking.

https://www.nasa.gov/pdf/376503main_044%20-%2020090724.5.Herakles%20Architecture%2007%20Propellantless%20Space%20Travel.pdf

The Basics of Radioastronomy - This training module assumes you have an understanding of high-school-level chemistry, physics, and algebra. This workbook includes both learning materials and evaluation tools.

https://www2.jpl.nasa.gov/radioastronomy/radioastronomy_all.pdf

Article: Who Hits Harder: The Nordic Skier or Aerial Jumper? - Using basic principals of physics, the flight trajectories of two forms of competitive ski jumping, Freestyle Aerialist and Nordic Jumpers, were modeled and the landing shocks compared. https://pumas.nasa.gov/files/05_10_99_1.pdf

Exploring Magnetism in Solar Flares - Four activities are included in this guide. Solar flares are caused by sudden changes of strong magnetic fields in the Sun's corona. The changing magnetic field converts magnetic potential energy into kinetic energy by accelerating charged gases (plasmas) in the corona. http://cse.ssl.berkeley.edu/SEGwayed/lessons/exploring_magnetism/in_Solar_Flares/

Launchpad: The Fermi Gamma Ray Space Telescope - Get an overview of the electromagnetic spectrum and see how scientists are using the new Fermi Gamma Ray Space Telescope to look at the inconceivable amounts of energy produced by phenomena in space.

<https://nasaclips.arc.nasa.gov/video/launchpad/launchpad-the-fermi-gamma-ray-space-telescope>