

Introduction to Kinematics

Module 1

Module 1 Description:

Participants will be introduced to the philosophy, the website and resources of National Math and Science Initiative. They will explore physics lessons that focus on constant and changing motion. Emphasis will be placed on problem solving and practiced using both AP and other types of rigorous problems. Probes and data collection devices will be used to collect and analyze data.

Learner Outcomes:

Participants will

- develop a rich understanding of the philosophy of rigorous instruction in the classroom.
- review and make connections to the Big Ideas of AP Physics.
- examine the Science Practices used with each lesson.
- identify and relate each lesson to Common Core State Standards, Next Generation Science Standards, and AP Physics Curriculum Framework.
- analyze the objectives of the AP exam.
- analyze the attributes of rigorous, college ready types of assessments
- demonstrate an understanding of the science process skills and how they relate to classroom activities.
- demonstrate a deeper content-based knowledge about kinematics.

Developing Skills and Mechanical Waves Module 2

Module 2 Description:

Participants will explore student lessons that focus on both longitudinal and transverse wave motion. Participants will investigate waves in a string, a spring and ripple tank as well as determine the speed of sound in air. This session will also emphasize graphing calculators, graphing skills, problem solving skills and ways to administer and evaluate labs.

Learner Outcomes:

Participants will

- develop a rich understanding of the philosophy of rigorous instruction in the classroom.
- review and make connections to the Big Ideas of AP Physics.
- examine the Science Practices used with each lesson.
- identify and relate each lesson to Common Core State Standards, Next Generation Science Standards, and AP Physics Curriculum Framework.
- analyze the objectives of the AP exam.
- analyze the attributes of rigorous, college ready types of assessments.
- demonstrate an understanding of the science process skills and how they relate to classroom activities.
- demonstrate a deeper content-based knowledge about waves.

Using the Tools - Electricity and Magnetism Module 3

Module 3 Description:

Participants will explore student lessons that introduce electrostatics and electric circuits. Participants will map an electric field and examine equipotential and electric field lines as well as build and investigate various types of circuits involving light bulbs and resistors in both series and parallel circuits. Methods for resolving circuits and for the formulation of Ohm's Law will be discussed and practiced. Emphasis will also be placed on data collection and display devices.

Learner Outcomes:

Participants will

- develop a rich understanding of the philosophy of rigorous instruction in the classroom.
- review and make connections to the Big Ideas of AP Physics.
- examine the Science Practices used with each lesson.
- identify and relate each lesson to Common Core State Standards, Next Generation Science Standards, and AP Physics Curriculum Framework.
- analyze the objectives of the AP exam.
- analyze the attributes of rigorous, college ready types of assessments.
- demonstrate an understanding of the science process skills and how they relate to classroom activities.
- demonstrate a deeper content-based knowledge about electricity and magnetism.

Lures for Learning Module 4

Module 4 Description:

This is the fourth module of any science training series. Unlike the other training modules, it is presented to a mixed audience of middle school and high school teachers. Participants will explore various types and levels of inquiry through hands-on, minds-on activities. The importance of carefully and strategically aligning both content and science process skills and practices is stressed by highlighting the connections in each of the activities. Building successful students starts in the middle grades and progresses throughout the high school years. This vertical emphasis is accomplished by allowing the participants to have the opportunity to explore the process of inquiry, together, through selected activities from middle grades through physics. This also allows participants to examine their own curriculum and determine the best way to integrate lessons obtained at training within their various grade levels or subjects.

Learner Outcomes:

Participants will

- describe what the Science and Engineering Practices look like within the context of a lesson.
- identify and relate each lesson to Common Core State Standards and Next Generation Science Standards.
- review and make connections to the Big Ideas of AP when applicable
- explain how rates describe mathematical patterns.
- calculate and use slope to describe physical slopes.
- manipulate objects to illustrate different types of motion.
- create multiple representations to describe the motion of a beetle.
- model linearization as an analytical tool.
- demonstrate that acceleration is a rate of a rate of change.
- develop a rich understanding of the philosophy of rigorous instruction in the classroom.

Kinematics-2 Dimensional Motion-Impulse and Momentum Module 5

Module 5 Description:

Participants will investigate kinematics, 2 dimensional motion, momentum and impulse. Experiments exploring acceleration in one and two dimensions will be performed emphasize graphing and vector activities to enhance understanding and development of concepts. Exercises that strengthen problem solving and analysis of motion will be examined and practiced. Additional problem solving activities and assessments will be provided in order to show the expected levels for a rigorous physics course and the relationship to AP* Physics.

Learner Outcomes:

Participants will

- develop a rich understanding of the philosophy of rigorous instruction in the classroom.
- review and make connections to the Big Ideas of AP Physics.
- examine the Science Practices used with each lesson.
- identify and relate each lesson to Common Core State Standards, Next Generation Science Standards, and AP Physics Curriculum Framework.
- analyze the objectives of the AP exam.
- analyze the attributes of rigorous, college ready types of assessments.
- demonstrate an understanding of the science process skills and how they relate to classroom activities.
- demonstrate a deeper content-based knowledge about kinematics, 2-dimensional motion, impulse, and momentum.

Dynamics-Work, Power and Energy

Module 6

Module 6 Description:

Participants will explore dynamics, Newton's laws, free body diagrams, work, power and energy. Teachers will perform experiments using carts and ramps and use technology to investigate Newton's 2nd Law and the effects of friction. A roller coaster lab will be used to develop concepts of work, power and energy. The day will include practice with free body diagrams and their importance in problem solving.

Learner Outcomes:

Participants will

- develop a rich understanding of the philosophy of rigorous instruction in the classroom.
- review and make connections to the Big Ideas of AP Physics.
- examine the Science Practices used with each lesson.
- identify and relate each lesson to Common Core State Standards, Next Generation Science Standards, and AP Physics Curriculum Framework.
- analyze the objectives of the AP exam.
- analyze the attributes of rigorous, college ready types of assessments.
- demonstrate an understanding of the science process skills and how they relate to classroom activities.
- demonstrate a deeper content-based knowledge about work, power, and energy.

Waves and Sound-Light and Optics

Module 7

Module 7 Description:

Participants will examine the concepts of waves, sound, light and optics. Labs will be performed to determine the speed of sound in the laboratory and to investigate wave properties of reflection, refraction and diffraction of waves and light. These will involve optics experiments using lenses, mirrors and water. Practice with ray diagrams and computer simulations for lenses and mirrors will be included in the day's activities. Example homework activities will be provided as well as a discussion of assessments and the relation of the day's activities to AP Physics.

Learner Outcomes:

Participants will

- develop a rich understanding of the philosophy of rigorous instruction in the classroom.
- review and make connections to the Big Ideas of AP Physics.
- examine the Science Practices used with each lesson.
- identify and relate each lesson to Common Core State Standards, Next Generation Science Standards, and AP Physics Curriculum Framework.
- analyze the objectives of the AP exam.
- analyze the attributes of rigorous, college ready types of assessments.
- demonstrate an understanding of the science process skills and how they relate to classroom activities.
- demonstrate a deeper content-based knowledge about sound, light, and optics.

Electricity, Magnetism, and Modern Physics

Module 8

Module 8 Description:

Participants will investigate electricity, magnetism and modern topics. Labs will include building a capacitor and measuring its capacitance, constructing a circuit involving resistors and capacitors, and the effects of current on magnetic fields. Exercises on right hand rules and a discussion of magnetic fields and their effect on moving charges will be included. Example homework activities will be provided as well as a discussion of assessments and the relation of the day's activities to AP Physics.

Learner Outcomes:

Participants will

- develop a rich understanding of the philosophy of rigorous instruction in the classroom.
- review and make connections to the Big Ideas of AP Physics.
- examine the Science Practices used with each lesson.
- identify and relate each lesson to Common Core State Standards, Next Generation Science Standards, and AP Physics Curriculum Framework.
- analyze the objectives of the AP exam.
- analyze the attributes of rigorous, college ready types of assessments.
- demonstrate an understanding of the science process skills and how they relate to classroom activities.
- demonstrate a deeper content-based knowledge about electricity, magnetism, and modern quantum theory.

Relationships Module 9

Module 9 Description:

Participants will discuss methods for data analysis and practice determining relationships from data. Labs will be included which not only develop skills and concepts germane to a college ready physics course, but will also increase analysis of data strategies that can be implemented to facilitate student success. Further study of kinematics, two dimensional motion, dynamics and the concept of physical and mathematical constants will be included in the laboratory activities.

Learner Outcomes:

Participants will

- develop a rich understanding of the philosophy of rigorous instruction in the classroom.
- review and make connections to the Big Ideas of AP Physics.
- examine the Science Practices used with each lesson.
- identify and relate each lesson to Common Core State Standards, Next Generation Science Standards, and AP Physics Curriculum Framework.
- analyze the objectives of the AP exam.
- analyze the attributes of rigorous, college ready types of assessments.
- demonstrate an understanding of the science process skills and how they relate to classroom activities.
- demonstrate a deeper content-based knowledge about determining relationships that occur among variables in experiments. The emphasis for this training will be on relationships developed in mechanics investigations.

Gathering and Manipulating Data Module 10

Module 10 Description:

Participants will engage in a discussion of misconceptions and discrepant events that impede student's ability to understand physics concepts. Teachers will investigate aspects of work, power and energy, impulse and momentum through laboratory exercises and discussions. Included will be further emphasis on data analysis and the use of curve fitting, data smoothing and additional techniques.

Learner Outcomes:

Participants will

- develop a rich understanding of the philosophy of rigorous instruction in the classroom.
- review and make connections to the Big Ideas of AP Physics.
- examine the Science Practices used with each lesson.
- identify and relate each lesson to Common Core State Standards, Next Generation Science Standards, and AP Physics Curriculum Framework.
- analyze the objectives of the AP exam.
- analyze the attributes of rigorous, college ready types of assessments.
- demonstrate an understanding of the science process skills and how they relate to classroom activities.
- demonstrate a deeper content-based knowledge of data manipulation, curve straightening, and circular motion.

Data Analysis

Module 11

Module 11 Description:

Participants will continue the theme of gathering and analyzing data using technology and traditional methods. Ways to ensure that all students are given instruction in terms of their needs and individual requirements will be discussed along with ways to build physics and other science programs to include a larger and more diverse group of students. Lab activities will include an emphasis on thermodynamics and fluids.

Learner Outcomes:

Participants will

- develop a rich understanding of the philosophy of rigorous instruction in the classroom.
- review and make connections to the Big Ideas of AP Physics.
- examine the Science Practices used with each lesson.
- identify and relate each lesson to Common Core State Standards, Next Generation Science Standards, and AP Physics Curriculum Framework.
- analyze the objectives of the AP exam.
- analyze the attributes of rigorous, college ready types of assessments.
- demonstrate an understanding of the science process skills and how they relate to classroom activities.
- demonstrate a deeper content-based knowledge about gathering and analyzing data with an emphasis on thermodynamics, gas laws, and fluids.

Extending Physics to Modern Topics

Module 12

Module 12 Description:

Participants will explore lessons and activities relating to electricity and magnetism such as Faraday and Coulomb's Laws. Also, concepts in modern and particle physics will be discussed and investigated in laboratory experiences. In addition, time will be spent analyzing and evaluating the components of a rigorous lesson or lab activity and participants will have the opportunity to apply those components to an activity that they can take back to their classroom

Learner Outcomes:

Participants will

- develop a rich understanding of the philosophy of rigorous instruction in the classroom.
- review and make connections to the Big Ideas of AP Physics.
- examine the Science Practices used with each lesson.
- identify and relate each lesson to Common Core State Standards, Next Generation Science Standards, and AP Physics Curriculum Framework.
- analyze the objectives of the AP exam.
- analyze the attributes of rigorous, college ready types of assessments.
- demonstrate an understanding of the science process skills and how they relate to classroom activities.
- demonstrate a deeper content-based knowledge for extending physics to modern topics.