UNM Department of Physics and Astronomy

SLOs for all core lecture and lab courses as of Oct 7, 2015

Assessement plans for each course are at
http://physics.unm.edu/pandaweb/undergraduate/core/

ASTR 101

Outcome 1 – Models and Scientific Inquiry: Students will be able to identify models and theories, for example, heliocentric and geocentric models of the universe and the Big Bang theory. Students will be able to recognize how the scientific process was involved in the development and acceptance or rejection of such models and theories.

Relates to NM HED Area III-1: Describe the process of scientific inquiry.

Outcome 2: Knowledge of Basic Laws of Physics Related to Astronomy and Use of Units: Students will be able use basic laws of physics related to astronomy to estimate answers to various problems. Students will be able to recognize metric units and the correct units in which to measure various astronomical properties.

NM HED Area III competency 2 and 4: Solve problems scientifically. Apply quantitative analysis to scientific problems including showing familiarity with the metric system

Outcome 3: Basic Astronomical Phenomena: Students will be able to identify basic everyday concepts like seasons, the rising and the setting of the Moon and its appearance, and our place in the universe. Students will recognize valid explanations of these phenomena.

NM HED Area III competency 3. Communication of scientific information.

Outcome 4: Environmental Issues Related to Astronomy: Students will be able to identify environmental issues that arise in the context of astronomy, namely greenhouse gases, the ozone layer and light pollution.

NM HED Area II competency 2, 3 and 5. Solve problems scientifically. Communicate scientific information. Apply scientific thinking to real world problems.

Outcome 5: Origin and Nature of the Universe: Students will be able to identify the origin and nature of the universe – subjects with relevance to contemporary societal issues.

NM HED Area II competency 3 and 5. Communicate scientific information. Apply scientific thinking to real world problems.

ASTR 101L

Outcome 1: Knowledge of Basic Laws of Physics Related to Astronomy and Use of Units: Students will be able use basic laws of physics related to astronomy to estimate answers to various problems. Students will be able to recognize metric units and the correct units in which to measure various astronomical properties.

NM HED Area III competency 2 and 4: Solve problems scientifically. Apply quantitative analysis to scientific problems including showing familiarity with the metric system

Outcome 2: Basic Astronomical Phenomena: Students will be able to identify the reasons for basic everyday concepts like seasons, the rising and the setting of the Moon and its appearance, and our place in the universe. Students will recognize valid explanations of these phenomena.

NM HED Area III competency 3. Communication of scientific information.

Outcome 3: Origin and Nature of the Universe: Students will be able to explain current theories of the origin and nature of the universe – subjects with relevance to contemporary societal issues.

NM HED Area II competency 3 and 5. Communicate scientific information. Apply scientific thinking to real world problems.

PHYC 102 and 102L

Outcome 1 Students will answer positively on at least 5 questions surveying coverage of topics (Area III Competency 3).

Outcome 2 Students will recognize basic elements of science and the scientific approach to understanding nature at least at the satisfactory level. (Area III Competency 1)

Outcome 3 Students will apply physical models in simple situations at least at the satisfactory level. (Area III Competency 2)

Outcome 4 Students will read and interpret information from graphs at least at the satisfactory level. (Area III Competency 2, 4)

PHYC 105

Outcome 1: The Nature of Scientific Inquiry. Students will be able to articulate that physics, and all natural science is based on observations of nature that can be replicated and scrutinized by others. Students will be able to articulate that scientific theories are logical and thoroughly tested against observations and that those that contradict observations are discarded.

Relates to UNM/HED Area III-1: describe the process of scientific enquiry.

Outcome 2: Waves and Particles. Students will be able to articulate that there are two great intellectual models of the material universe–particles and waves. Students will be able to

articulate how the particle model has led to deep under- standing, not only of the motion of planets, but also of the mechanical, thermal, and optical properties of matter. Students will be able to articulate how the wave model has led to deep understanding of material waves (mechanical vibrations, sound, seismic waves, water waves), electromagnetic waves (radio waves, light, X-rays), and quantum waves.

Relates to UNM/HED Area III-2: solve problems scientifically.

Outcome 3: The Laws of Physics. Students will be able to identify the fundamental laws of physics–laws of mechanics, laws of thermodynamics, laws of electromagnetism, laws of quantum physics, and conservation laws. Students will be able to articulate when these laws are valid and when they are known to fail. Students will recognize the working of these laws in the life of society and in their every-day life.

Relates to UNM/HED Area III-2,5: solve problems scientifically; apply scientific thinking to real world problems.

Outcome 4: Analysis. Students will know how to apply the laws of physics and the rules of logic and simple mathematics to understand simple, realistic physical situations.

Relates to UNM/HED Area III-2,4,5: solve problems scientifically; apply quantitative analysis to scientific problems; apply scientific thinking to real world problems

Outcome 5: Communication. Students will be able to communicate effectively about physics subjects. Relates to UNM/HED Area III-3: communicate scientific information.

PHYC 151

Outcome 1: Conservation of Energy: Students will be able to solve problems involving the Conservation of Energy. These two laws enable introductory students to solve a wide variety of practical problems. Possible examples of problems include elastic and inelastic collisions and the basic concepts of kinetic energy, gravitational potential energy, thermal energy, and elastic potential energy.

NM HED Area III competencies 2, 4 and 5: Solve problems scientifically, Apply quantitative analysis to scientific problems, and Apply scientific thinking to real world problems.

Outcome 2: Vectors: Students will be able to do simple operations with vectors. These include resolving a vector into components, adding vectors using components, finding the magnitude of a vector given its components and finding the direction of a vector given its components.

NM HED Area III competencies 2, 4 and 5: Solve problems scientifically, Apply quantitative analysis to scientific problems, and Apply scientific thinking to real world problems.

Outcome 3: Motion with Constant Acceleration: Students will be able to solve problems involving motion with constant acceleration. Many everyday type events will be modeled as problems of this type. These include both horizontal motion (examples, an aircraft taking off on

the runway, an automobile coming to a stop) and vertical motion near Earth's surface where the acceleration of gravity can be considered constant (for example, a ball thrown straight up in the air). Projectile motion problems also fall into this category; these involve objects experiencing vertical and horizontal motion at the same time (for example, a baseball hit at an angle of 30 degrees above the horizontal).

NM HED Area III competencies 2, 4 and 5: Solve problems scientifically, apply quantitative analysis to scientific problems, and apply scientific thinking to real world problems.

Outcome 4: Newton's Second Law: Students will be able to solve a variety of problems with Newton's second law. This law which deals with forces, inertial mass and acceleration is a foundation of Newtonian Mechanics and has wide application to science and engineering. Problems of various types (possible examples include effects of forces on objects, circular motion, orbits of planets, inclined planes and motion with friction) will be analyzed.

NM HED Area III competencies 2, 4 and 5: Solve problems scientifically, apply quantitative analysis to scientific problems, and Apply scientific thinking to real world problems.

Outcome 5: Fluids: Students will be able to solve problems involving fluid statics and fluid flow. Applications of fluid statics may, for example, include pressure in a fluid and buoyancy. Use of Bernoulli's equation and the continuity equation are examples of fluid flow.

NM HED Area III competencies 2, 4 and 5: Solve problems scientifically, apply quantitative analysis to scientific problems, and Apply scientific thinking to real world problems.

PHYC 152

Outcome 1 – Coulomb's Law: Students will be able to solve problems using Coulomb's Law. Examples would include understanding the inverse square dependence of Coulomb's law, calculating the total electric force on a charge due to 1 other charge, and using superposition to calculate the total force from two other charges or to combine an electric force with another force such as gravity.

Relates to NM HED Area III-4: Apply quantitative analysis to scientific problems

Outcome 2: Magnetic Fields: Students will be able to identify magnitudes and directions of magnetic fields. Examples would include finding the magnitude and direction of a magnetic force on a moving charge or a current carrying wire, recognizing how we know that a current carrying wire produces a magnetic field, calculating the magnetic field due to a current carrying wire, and determining if a particular field would affect a compass.

NM HED Area III competency 1, 4 and 5: Scientific Process, Apply quantitative analysis to scientific problems, Apply scientific thinking to real world problems.

Outcome 3: Simple Circuits: Students will be able make calculations involving simple circuits. Examples would include recognizing series and parallel resistors, calculating current, resistance,

voltage and power, and showing where a voltmeter or ammeter is connected to a circuit to measure voltage or current.

NM HED Area III Competency 2 and 4. Solve problems scientifically. Apply quantitative analysis to scientific problems.

Outcome 4: Geometric Optics: A student will be able to recognize and draw correct ray diagrams for geometric optics and perform related calculations. Examples would include plane mirrors, spherical mirrors, lenses, and the transitions between materials of differing indices of refraction.

NM HED Area III competency 3. Communication of scientific information.

Outcome 5: Faraday's Law: Students will be able to determine the direction of induced currents and find the magnitude of induced voltages. Examples would include changing B fields andmoving loops. An application example could include the basic concepts pertaining to transformers.

NM HED Area II competency 2, 4 and 5. Solve problems scientifically.Apply quantitative analysis to scientific problems, Apply scientific thinking to real world problems.

PHYC 160

Outcome 1: Motion with Constant Acceleration: Students will be able to solve problems involving motion with constant acceleration. Many practical events will be modeled as problems of this type. These include both horizontal motion (for example, an aircraft taking off on the runway, an automobile coming to a stop) and vertical motion near Earth's surface where the acceleration of gravity can be considered constant (for example, a ball thrown straight up in the air). Projectile motion problems also fall into this category; these involve objects experiencing vertical and horizontal motion at the same time (for example, a baseball hit at an angle of 30 degrees above the horizontal).

NM HED Area III competencies 2, 4 and 5: Solve problems scientifically, Apply quantitative analysis to scientific problems, and Apply scientific thinking to real world problems.

Outcome 2: Newton's Second Law: Students will be able to solve a variety of problems with Newton's second law. This law which deals with forces, inertial mass and acceleration is a foundation of Newtonian Mechanics and has wide application to science and engineering. Problems of various types (possible examples include effects of forces on objects, circular motion, orbits of planets, inclined planes and motion with friction) will be analyzed.

NM HED Area III competencies 2, 4 and 5: Solve problems scientifically, Apply quantitative analysis to scientific problems, and Apply scientific thinking to real world problems.

Outcome 3: Newton's Universal Law of Gravity: Students will be able to solve problems involving Newton's Universal Law of Gravity. Gravity is one of the 4 fundamental forces in the universe and is therefore one of the most important foundation topics for the future physics and engineers who take this course. Possible examples may include planetary orbits, calculation of the acceleration of gravity on a planet, derivation of Kepler's 3rd law and calculation of forces that masses attract each other.

NM HED Area III competencies 2, 4 and 5: Solve problems scientifically, Apply quantitative analysis to scientific problems, and Apply scientific thinking to real world problems.

Outcome 4: Conservation of Energy and Momentum: Students will be able to solve problems involving the Conservation of Energy and Momentum. These two laws enable introductory students to solve a wide variety of practical problems. Possible examples of problems include elastic and inelastic collisions and the basic concepts of impulse, momentum, kinetic energy, gravitational potential energy and elastic potential energy.

NM HED Area III competencies 2, 4 and 5: Solve problems scientifically, Apply quantitative analysis to scientific problems, and Apply scientific thinking to real world problems.

Outcome 5: Rotational Motion: Students will be able to solve problems involving Rotational Motion. Many concepts and their application can be included in rotational motion; possible examples include angular momentum, moment of inertia, conservation of angular momentum, angular velocity, angular acceleration and torque.

NM HED Area III competencies 2, 4 and 5: Solve problems scientifically, Apply quantitative analysis to scientific problems, and Apply scientific thinking to real world problems.

PHYC 161

Outcome 1 – Electric Force and Field: Student will be able to solve problems involving electric forces and electric fields. Examples would include problems such as calculating forces using Coulomb's Law, using superposition to add forces, using Gauss' Law to solve for electric fields or charge distributions, and interpreting information from sketches of electric field lines.

Relates to NM HED Area III-3 and 4: Communicate scientific information. Apply quantitative analysis to scientific problems

Outcome 2: Magnetic Fields: Students will be able to identify magnitudes and directions of magnetic fields. Examples would include finding the magnitude and direction of a magnetic force on a moving charge or a current carrying wire, recognizing how we know that a current carrying wire produces a magnetic field, calculating the magnetic field due to a current carrying wire, and determining if a particular field would affect a compass.

NM HED Area III competency 1, 4 and 5: Scientific Process, Apply quantitative analysis to scientific problems, Apply scientific thinking to real world problems.

Outcome 3: Ohm's Law and Simple Circuits : Students will be able make calculations involving simple circuits. Examples would include recognizing series and parallel resistors, calculating current, resistance, voltage and power, and showing where a voltmeter or ammeter is connected to a circuit to measure voltage or current.

NM HED Area III Competency 2 and 4. Solve problems scientifically. Apply quantitative analysis to scientific problems.

Outcome 4: Faraday's and Lenz' Laws: Students will be able to determine the magnitude and direction of induced currents and voltages.   Examples of applications could include generators or transformers.

NM HED Area II competency 2, 4 and 5. Solve problems scientifically. Apply quantitative analysis to scientific problems. Apply scientific thinking to real world problems.

Outcome 5: Thermodynamics: Students will be able to recognize and apply the first and second law of thermodynamics. Examples for the First Law of Thermodynamics would include the connection between heat, work and the conservation of energy, specific heat, phase changes, PV diagrams and thermodynamic graphs, and the determination of the
amount of heat and work added to a system for various processes.   Examples for entropy and the Second Law of Thermodynamics would include understanding entropy at a conceptual level as disorder, calculating changes in entropy for several processes, recognizing the Second Law of Thermodynamics in several forms, and stating whether a particular process violates the second law of thermodynamics.

NM HED Area III Competency 2, 3, 4 and 5. Solve problems scientifically. Communication of scientific information. Apply quantitative analysis to scientific problems. Apply scientific thinking to real world problems.

PHYC 151L and 160L

Measured Hake Gain on the Force and Motion Conceptual Evaluation (FMCE) will be compared with national averages. Hake Gains on the specific topics of velocity, acceleration, Newton's laws, and energy will also be compared. Any significant deficiency compared to national averages or downward trends with time will be examined and a plan for improvement implemented.

NM HED Area III Competency 2 and 5. Solve problems scientifically. Apply scientific thinking to real world problems.

PHYC 152L and 161L

Measured Hake Gain on the Conceptual Survey in Electricity and Magnetism (CSEM) will be compared with national averages. Any significant deficiency compared to national averages or downward trends with time will be examined and a plan for improvement implemented.

NM HED Area III Competency 2, 3, 4 and 5. Solve problems scientifically. Apply quantitative analysis to scientific problems. Apply scientific thinking to real world problems.