COMMUNITY UNIT SCHOOL DISTRICT 200

Physics
High School – Grades 11, 12
Advanced Level – Two Semesters

1. Subject Expectation (State Goal 11)	**The student will understand the processes of scientific inquiry and technological design, investigate questions, conduct experiments, and solve problems.**

Essential Learning 1 (Learning Standard A)	**Know and apply the concepts, principles, and processes of scientific inquiry (all units)**

Critical Content

11.A.5a a. formulate hypothesis referencing prior research and knowledge
- consult previous models
- apply previous models to new situation

11.A.5b b. design procedures to test the selected hypotheses
- consult available technologies
- analyze technologies for advantages and disadvantages

11.A.5c c. conduct systematic controlled experiments to test the selected hypotheses
- identify all variables
- choose an independent variable
- limit dependent variables to those of interest
- control all other variables

11.A.5d d. apply statistical methods to make predictions and to test the accuracy of results
- utilize graphical analysis software
  - Logger Pro
  - Graphical Analysis
  - Microsoft Excel
  - Data Studio
- construct mathematical models
  - linear
  - quadratic
  - inverse
  - combination
  - exponential
- test the mathematical models for validity

11.A.5e e. report, display and defend the results of investigations to audiences that may include professionals and technical

experts

- prepare whiteboard summaries
- present results and conclusions to peers or appropriate audience
  - PowerPoint Presentation
  - Written Lab Reports
  - Oral Lab Reports
- defend procedures, results, and conclusions
- justify conclusions with statistical error analyses
  - Mean Square Error
  - Correlation Coefficient

Essential Learning 2 (Learning Standard B)	**Know and apply the concepts, principles, and processes of technological design (all units)**

Critical Content

11.B.5a a. identify a design problem that has practical applications and propose possible solutions, considering such constraints as available tools, materials, time and costs

- design and analyze a lab experiment using the appropriate technological tools
- design and analyze a long-term experimental project
  - Bridge Building Project
  - Digital Video Analysis
  - Long Term Extended Lab Analysis

11.B.5b b. select criteria for a successful design solution to the identified problem

- use interactive software to investigate different simulations
  - graphs & tracks
  - projectile launcher
  - collisions
  - interactive physics
  - electric field hockey
  - roller coaster simulator
  - field plotter
- choose from alternative technologies being aware of the advantages and disadvantages of each technology
  - ultrasonic motion detectors
  - force probes
  - photo gates & picket fences
  - smart pulleys
  - rotational motion probes
  - current/voltage probes
  - light sensors
  - magnetic field probes
  - sound sensors
- consult professional reference sources for design ideas
  - West Point Bridge Building Simulator
  - various internet sources

11.B.5c c. build and test different models or simulations of the design solution using suitable materials, tools and technology
- practical hands – on engineering experience

11.B.5d d. choose a model and refine its design based on the test results
- deploy models to a wide range of situations
- articulate the application of the model to different situations
- refine the model in post-lab discussions

11.B.5e e. apply established criteria to evaluate the suitability, acceptability, benefits, drawbacks, and consequences for the tested design solution and recommend modifications and refinements
- apply previous models to new situations
- refine the model if necessary or develop a new one
- appropriate use of SI units
- use dimensional analysis for:
  - development of new units
  - checking of equation validity

11.B.5f f. using available technology, prepare and present findings of the tested design solution to an audience that may include professional and technical experts
- prepare whiteboard summaries
- present results and conclusions to peers or appropriate audience
- defend procedures, results, and conclusions
- justify conclusions with statistical error analyses
- PowerPoint presentations

2. Subject Expectation (State Goal 12)

The student will understand the fundamental concepts, principles, and interconnections of life sciences, physical and earth/space sciences.

Essential Learning 1 (Learning Standard D)	**Know and apply concepts that describe force and motion and the principles that explain them**

Critical Content 12.D.5a a. analyze factors that influence the relative motion of an object (The Kinematical Models)
- the constant velocity model
  - Linear Curve Fit
  - Slope Intercept Equation Analysis
  - Meaning of Slope
  - Meaning of Area
  - Meaning of X & Y Intercept
- the constant acceleration model
  - Linear Curve Fit
  - Slope Intercept Equation Analysis
  - Meaning of Slope
  - Meaning of Area

- Meaning of X & Y Intercept
- the two-dimensional motion model
  - Linear Curve Fit
  - Slope Intercept Equation Analysis
  - Meaning of Slope
  - Meaning of Area
  - Meaning of X & Y Intercept
- the work-change in energy model
  - Linear Curve Fit
  - Slope Intercept Equation Analysis
  - Meaning of Slope
  - Meaning of Area
  - Meaning of X & Y Intercept
  - Bar Graph Analysis of Energy Flow
- the impulse-change in momentum model
  - Linear Curve Fit
  - Slope Intercept Equation Analysis
  - Meaning of Slope
  - Meaning of Area
  - Meaning of X & Y Intercept

12.D.5b b. analyze the effects of gravitational, electromagnetic and nuclear forces on a physical system (The Causal Models)

- the Newtonian free particle model
  - Newton's First Law
  - Newton's Third Law
  - Force Diagrams
  - Vector Analysis
- the Newtonian constant force model
  - Newton's Second Law
  - Newton's Third Law
  - Force Diagrams
  - Vector Analysis
- the linear binding force model
  - Force Diagrams
  - Vector Analysis
- the central force model
  - Centripetal Force
  - Force Diagrams
  - Vector Analysis
- the impulsive force model
  - Collisions & Explosions
  - Force Diagrams
  - Vector Analysis
- the Universal Law of Gravity model
  - Satellite & Planetary Motion
  - Historical perspective on the Universe
  - Force Diagrams
  - Vector Analysis
- the point charge electrostatic force model
  - Coulomb's Law
  - Force Diagrams
  - Vector Analysis

- the electrodynamics circuit model
  - Voltage
  - Current
  - Resistance
  - Power
  - Ohm's Law
  - Joule's Law
  - Capacitors
  - RC Circuits

3. Subject Expectation (State Goal 13)	**The student will understand the relationships among science, technology, and society in historical and contemporary contexts.**

Essential Learning 1 (Learning Standard A)	**Know and apply the accepted practices of science**

Critical Content

13.A.5a a. design procedures and policies to eliminate or reduce the risk in potentially hazardous science activities
- safety contract
- safety instruction
- safety assessment

13.A.5b b. explain criteria that scientists use to evaluate the validity of scientific claims and theories
- sample size
- range of independent variable data
- numbers of trials
- types and limits of errors
- precision of measurement tools

13.a.5c c. explain the strengths, weaknesses and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling and statistical studies
- effects of naïve beliefs, preconceptions, and misconceptions on data collection and investigative outcomes
- the utter honesty required for research to be deemed scientific

13.A.5d d. explain, using a practical example (e.g., cold fusion), why experimental replication and peer review are essential to scientific claims
- consensus within a group – group lab reports
- consensus within a class – the whiteboard presentations

Essential Learning 2 (Learning Standard B)	**Know and apply concepts that describe the interaction between science, technology, and society**

Critical Content	13.B.5e	a.	assess how scientific and technological progress has affected other fields of study, careers and job markets and aspects of everyday life