After completing Physics 101, you should be able to:

1. Work with Units: (chapter 1)
    a. Convert units using conversion factors.
    b. Check solutions and equations using Unit Analysis.
    c. Check solutions using estimation.
    d. Select an appropriate Value and Range for a measured quantity and back up your selection with appropriate reasoning. Report using the format Value +/- Range.

2. Observe, Analyze and Report the Motion of an Object: (chapter 2)
    a. Operationally define position, displacement, time instant, time interval (elapsed time), average velocity, and average acceleration.
    b. Describe what effect a coordinate system change will have on kinematic quantities.
    c. Explain the difference between initial/final velocity, average velocity, change in velocity and instantaneous velocity.
    d. Use all of the motion (kinematic) quantities and equations to solve motion problems.
    e. Draw Motion Diagrams and use them to solve motion problems.
    f. Draw motion graphs from lab data or other representations of motion.
    g. Interpret motion graphs using coordinates, intercepts, slope and area.
    h. Know how to calculate the average value for:
        – A set of random values
        – A constantly changing set of values (such as 3, 6, 9, 12, … 39)

3. Work with Vectors: (chapter 3)
    a. Find the components of a vector given its magnitude and direction.
    b. Convert from the component description of a vector to the magnitude and direction description of that vector.
    c. Add and subtract any two vectors using the graphical (drawing) method.
    d. Using a tabular format, add and subtract any two vectors using the component (calculation) method.
    e. Understand that position, displacement, velocity and acceleration are vectors. Know how to manipulate them to find related vector quantities.

4. Analyze 2-D Motion: (chapter 3, 7, 8, 9)
    a. Break the motion into components.
    b. Draw Motion Diagrams for 2-D (projectile) motion.
    c. Use the kinematic (motion) equations in component form to solve problems.
    d. Use the perpendicular component method to find the cross-product of two vectors in terms of finding Torque.
    e. Use kinematic variables to describe the motion of objects in uniform circular motion.
    f. Recognize the meaning of the tangential and radial components of the acceleration vector.
    g. Draw FBD's for objects moving in Curved Paths. Be sure that you can select the correct directions for your coordinate system.

5. Work with Forces and Free-body-diagrams (FBDs): (chapters 4)
    a. Differentiate between mass and weight.
    b. Identify 3rd Law force pairs.
    c. Draw a FBD for a given physical situation (using the conventions discussed in class).
    d. Write Newton's 2nd Law equations in component form from a FBD
    e. Translate between motion information represented in different representations (FBD, Motion Diagram, Equations, Words).
    f. Solve problems involving the following:
        - Gravitational forces
        - Tension forces
        - Normal forces
        - Forces due to springs
        - Friction forces

6. Analyze Systems in terms of Work and Energy: (chapter 5)
    a. Recognize situations involving kinetic energy, gravitational potential energy, and spring potential energy.
    b. Describe how the law of conservation of energy applies to situations involving moving objects.
    c. Draw Energy Bar Charts for initial and final situations for an identified system.
    d. Use the Energy Bar Charts to write Work-Energy equations and solve problems
    e. Use the parallel component method to find the dot-product of two vectors in terms of finding Work.
    f. Translate between motion information represented in different representations (FBD, Motion Diagram, Equations, Words, Energy Bar Charts).

7. Analyze motion in terms of momentum change. (chapter 7)
    a. Use vector addition methods to solve conservation of momentum problems in 1-Dimension and 2-Dimension situations.
    b. Identify collisions as either elastic or totally inelastic.
    c. Describe the quantity, Impulse and its relationship to Newton's 2^{nd} Law.
    d. Solve motion problems involving collisions.

8. Analyze situations involving simple rotational motion. (chapters 7, 8)
    a. Convert between degrees and radian measure.
    b. Recognize and describe the difference between translational and rotational motion.
    c. Analyze motion involving arc length, rotational velocity, and rotational acceleration.
    d. Show similarities in working with equations of motion for rotation and the equations of motion for linear motion.

9. Carry out a lab experiment from design to report phase.

Purpose:

a. Suggest a question that would lend itself to be answered through carrying out a laboratory experiment. Students should choose variables to be explored that can be measured or derived and consider situations that allow the control of other variables.

b. When the experiment involves the discovery or comparison of a relationship, students should be able to write a purpose specifying the quantities involved, use the term "relationship" appropriately, and refer to the comparison when appropriate.

Theory:

a. Write statements that describe what led to the question asked in the purpose (discovery lab).

b. Using reasoning from fundamental principles, give predictions (where possible) for values, graphs, equations, and patterns.

Procedure:

a. Write a procedure in step form.

b. Where appropriate include diagrams, initial conditions, and factors to ensure repeatability.

Data:

a. Observe and record both qualitative and quantitative data (including units).
b. Appropriately report data for quantities that have many values (such as table of position and time data) and quantities that are measured only once (such as initial values).
c. Report uncertainty for measured data in the form Value +/- Range. Give reasoning to support this uncertainty.

Analysis

a. Write statements that compare results to each item from the theory section.
b. Calculate derived data and derived uncertainty from measured data and uncertainty when necessary. Then report in the appropriate form for formal lab reports (tables and graphs).
c. Write the equation of a best-fit line (when possible) and explain the physical meaning of each term.
d. Predict a result based on lab analysis and test the prediction.

Conclusion

a. Write a conclusion statement based upon qualitative and quantitative observations that provide an answer to the question posed in the purpose.
b. Suggest alternate experimental questions that have resulted from the lab.