Newark Charter School
Units/Lessons

Mathematics ~ Grade 8

Newark Charter School Instructional Unit

Unit Title: So You Want to Be a Rocket Scientist!

Content Area: Mathematics

Grade Level(s): Grade 8

Length of Unit: 10 Lessons

Unit Summary:
This unit combines science and math to incorporate physics and graphing skills. The students in this unit will use physics formulas, algebraic expressions, and graphing skills for both math and science. Technology will be integrated into the lesson by using graphing calculators (TI-83 Plus) and Inspiration© software. The students will collect data during skateboarding and rocket launching labs, to create graphs and calculations of speed, acceleration and force. The students will incorporate prior knowledge of Newton's 3 Laws of Motion and solving multi-step equations with formulas.

Common Core State Standards:
CCSS.Math.Content.8.EE.A.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, 32 × 3–5 = 3–3 = 1/33 = 1/27.
CCSS.Math.Content.8.EE.A.2 Use square root and cube root symbols to represent solutions to equations of the form x2 = p and x3 = p, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational.
CCSS.Math.Content.8.EE.A.3 Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. For example, estimate the population of the United States as 3 times 108 and the population of the world as 7 times 109, and determine that the world population is more than 20 times larger.
CCSS.Math.Content.8.EE.A.4 Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology
CCSS.Math.Content.8.EE.B.5 Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.
CCSS.Math.Content.8.EE.B.6 Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation y = mx for a line through the origin and the equation y = mx + b for a line intercepting the vertical axis at b.
CCSS.Math.Content.8.F.A.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.
CCSS.Math.Content.8.F.B.4 Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
CCSS.Math.Content.8.F.B.5 Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch

a graph that exhibits the qualitative features of a function that has been described verbal
CCSS.Math.Content.8.EE.C.8a Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.
CCSS.Math.Content.8.EE.C.8b Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. For example, 3x + 2y = 5 and 3x + 2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6.
CCSS.Math.Content.8.EE.C.8c Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.

Big Ideas:
Math is integrated into physics.
We can learn to represent mathematical functions and relationships in ways that help us solve problems in science.

Enduring Understandings:
Scientific principles such as laws of physics, gravity, velocity, force, etc., are most often figured and represented mathematically

Essential Question(s):
What math formulas and graphing strategies are helpful in preparing to measure a rocket launch?
How do we best organize this type of data to interpret it in a problem solving situation?

Knowledge and Skills:

Students will need to know...
1. Uses and functions of graphing calculators

Student will be able to do...
Concept Objectives
1. The students develop an appreciation for math and science.
2. The students will develop graphing skills to be used across different curriculums.
3. The students will understand how physics relate to everyday activities.

Content Objectives
1. Relations, Functions and Graphs (two variables)
    a. Be able to plot a set of ordered pairs and surmise a reasonable graph of which the points are a part.
    b. Be able to make a reasonable table of ordered pairs from a given function rule, plot the points, and surmise its graph.
    c. Know that the points of intersections of two graphs are simultaneous solutions of the relations that define them and indicate approximate numerical solutions.
2. Quadratic equation and functions
    a. Solve word problems, including physical problems such as the motion of an object under the force of gravity, and combined rate problems.
3. Motion
    a. Velocity and speed: the velocity of an object is the rate of change of its position in a particular direction.
    b. Unbalanced forces cause changes in velocity.
4. Work
    a. In physics, work is a relation between force and distance: work is done when force is exerted over a distance.

Skill Objectives

1. The students will be able to correctly plot and graph on a coordinate plane.
2. The students will communicate valid conclusions and construct graphs and tables to evaluate data.
3. The student will demonstrate that changes in motion can be measured and graphically represented.
4. The students will plan and implement investigative procedures including asking questions and formulating testable hypotheses.
5. The students will construct graphs to organize, examine and evaluate data.

Assessment Evidence

Performance or Transfer Tasks:
Students will transfer the math functions and understandings into a science problem solving situation, giving them practice and confidence for later studies in physics.

Rubrics:
See appendices

Other Evidence:
See appendices

Student Self-Assessment:
See appendices

Learning Plan

Key Learning Events:

Lesson One: Tell us what you know: graphing and formulas. (Day 1)

A. Daily Objectives
1. Concept Objective(s)
   a. The students develop an appreciation for math and science.
   b. The students will develop graphing skills to be used across different content.
   c. The students will understand how physics relate to everyday activities.
2. Lesson Content
   a. Basic review of graphing
   b. Basic review of formulas
   c. Initial assessment
3. Skill Objective(s)
   a. Label axes of a graph
   b. Plot ordered pairs
   c. Determine slope
   d. Determine y-intercept
   e. Put equations in the form $y = mx + b$
   f. Recognize independent and dependent variables
   g. Graph a line
   h. Graph using a t-chart
   i. Answer questions from a graph

j. Calculate speed, acceleration and velocity
k. Recognize units of measurement
l. Correct usage of physics formulas in word problems

B. Materials

1. Graph paper
2. Power Point presentation of formulas
3. Graphing Activity (Appendix 1a)
4. Practice with graphing and physics word problems (Appendix 1b)
5. TI-83 Graphing Calculators
6. Finding Speed, Velocity and Acceleration (Appendix 1c)

C. Key Vocabulary

1. Coordinate plane – the plane containing the x and y axes
2. X-axis – the horizontal number line
3. Y-axis – the vertical number line
4. Ordered pairs – pairs of numbers used to locate points on a coordinate plane (x , y)
5. X-intercept – the coordinate at which a graph intersects the y-axis
6. Y-intercept – the coordinate at which a graph intersects the y-axis
7. Quadrants – the four regions into which the x and y axes separate the coordinate plane
8. Linear equation – an equation whose graph is a line
9. T-chart – a table/chart that is used to show the x and y coordinates of a line
10. Independent variable – the variable in a function whose value is subject to change. It affects the value of the dependent variable
11. Dependent variable – the variable in a function whose value is determined by the independent variable.
12. Linear graph – formed from an equation whose graph is a line
13. Speed – the distance traveled divided by the time of travel
14. Distance – the entire path an object travels
15. Displacement – the distance and direction between starting and stopping position
16. Velocity – the distance traveled divided by time
17. Acceleration – force divided by mass
18. Velocity – displacement of distance divided by the time

D. Procedures/Activities

1. Hand each student a piece of graph paper as they enter the classroom.
2. Go through a series of oral directions, including a quick review of how to graph on graphing calculators.
3. Divide students into groups of 4. Each group needs graph paper and writing utensils.
4. Have one person from each group come to the front and pick up a Graphing Game card.
5. In their groups, the students will create graphs for their card, then check each graph with a graphing calculator.
6. Groups will present and explain the graphs to the class.
7. Monitor graphing activity and presentations.
8. After graphing activity, hand each group the Graphing Activity sheet.
9. Have each group follow the directions and begin activity.
10. Have class come back together and summarize the graphing and formula activities.
11. Finding Speed, Velocity and Acceleration word problems for homework.

E. Assessment/Evaluation

1. Finding Speed, Velocity and Acceleration word problems sheet
2. Teacher observations

LESSON TWO: (Day 2)

A. Daily Objectives

1. Concept Objective(s)
    a. The students develop an appreciation for math and science.
    b. The students will develop graphing skills to be used across different content.
    c. The students will understand how physics relate to everyday activities.
2. Lesson Content
    a. Basic principles of friction
    b. Graphing and calculations
    c. Completion of friction graph and corresponding lab report
    3. Skill Objective(s)
        a. The students will demonstrate safe practices during field and laboratory investigations.
        b. The students will communicate valid conclusions and construct graphs and tables to evaluate data.
        c. The student will demonstrate that changes in motion can be measured and graphically represented.

B. Materials

1. Graph paper
2. One skateboard per lab group
3. 5 m piece of rope per lab group
4. One stopwatch per lab group
5. One meter stick per lab group
6. Force of Friction Skateboard Lab(Appendix 2a)

C. Key Vocabulary

1. Friction – force that resists motion between two surfaces that are touching
2. Rolling friction – force that enables a wheel to roll past a surface
3. Sliding friction – occurs when two surfaces slide past each other
4. Static friction – hinders a stationary object from moving on a surface when a force is applied to the object

D. Procedures/Activities

1. Each student will pick up their lab report which includes graph paper, when they enter the room.
2. Present a short overview of what friction is and the different types of friction.
3. The materials manager from each lab group will pick up the materials for the group.
4. Review the safety precautions and lab procedures before going outside.
5. When outside, each group will split up and begin measuring 10m on the surface they will use first.
6. After grass, sidewalk and asphalt have been tested, everyone will go inside to test the tile surface.
7. Each group will go one at a time to test their friction on tile. (This eliminates hallway distractions with other classrooms.)
8. After all groups have completed gathering their data, we will discuss what they observed in their lab and how friction affected their speed on the skateboard.
9. The students will transfer their data to graph paper and write their conclusions in their lab report.

E. Assessment/Evaluation
1. Force of Friction Skateboard Lab
2. Teacher observations

LESSON THREE: So you want to be a rocket scientist? (Days 3 -4)

A. Daily Objectives
1. Concept Objective(s)
a. The students develop an appreciation for math and science.
b. The students will develop graphing skills to be used across different content.
c. The students will understand how physics relate to everyday activities.
2. Lesson Content
a. Basic flight patterns of airborne objects
b. Basic characteristics of rocket design
c. Completion of bottle rocket
3. Skill Objective(s)
a. The students will plan and implement investigative procedures including asking questions and formulating testable hypotheses.
b. The students will represent the natural world using models and identify their limitations.
c. The students will design a model to solve a problem.

B. Materials
1. Empty, 16 – 20 oz. water bottle per student
2. One piece of cardstock per student
3. Clear, packaging tape
4. Scissors
5. Markers
6. Ruler
7. Rocket Science Lab Write-Up (Appendix 3a)

C. Key Vocabulary
1. Nose cone – forward most section of a rocket
2. Rocket fins – a fixed or movable airfoil used to stabilize a projectile inflight.
3. Aerodynamic – anything designed with rounded edges so as to reduce wind drag

D. Procedures/Activities
1. Before students come into class, have materials out on the demonstration table.
2. As the students come into class, hand each student the directions for the construction of their rocket.
3. Before the construction of the rockets, show sample rockets and discuss with the class possible designs to use.
4. Explain to the class what the requirements are for each rocket and what characteristics of rockets enable them to fly well.
5. Have each student pick up their needed materials from the demonstration table and begin constructing rockets.
6. Complete Part A of Rocket Science Lab Write-Up.

E. Assessment/Evaluation
1. Teacher observations
2. Completion of Part A of Rocket Science Lab Write-Up

LESSON FOUR: Making Height-O-Meters (Day 5)

A. Daily Objectives

1. Concept Objective(s)
    a. The students develop an appreciation for math and science.
    b. The students will develop graphing skills to be used across different content.
    c. The students will understand how physics relate to everyday activities.
2. Lesson Content
    a. Practice measurements of classroom objects and the flag pole height.
    b. Comparison of measurements from the Height-O-Meters to the measurements of objects using a meter stick.
    c. Completion of Height-O-Meter
3. Skill Objective(s)
    a. The students will collect data by observing and measuring.
    b. The students will make a model to solve a problem.
    c. The students will represent the natural world using models and identify their limitations.
    d. The students will analyze information using tools including meter sticks and protractors.

B. Materials

1. Cardstock with Height-O-Meter pattern copied onto them; one piece per student (http://www.lhsgems.org/GEMSpdf/HeightOMeters2.pdf)
2. What have you learned so far? Quiz (Appendix 4a)
3. One metal brad per student
4. Scissors
5. Meter sticks
6. One pencil/pen per student
7. Tape
8. Stapler

C. Key Vocabulary

1. Height-O-Meter – a handheld instrument used to determine the angular height of an object
2. Angular height – the angle between a horizontal line at eye level and the direction they must look to see the object.
3. Eye level – measurement from ground to a person's eyes

D. Procedures/Activities

1. The class will take the 'What have you learned so far?' quiz to review the previous day's concepts.
2. Explain to the class what the Height-O-Meters will be used for.
3. The students will have the opportunity to pick a color of card stock for their Height-O-Meters.
4. Explain how the students will cut out the two pieces of their Height-O-Meter and begin cutting.
5. Put the Height-O-Meter together as a class using the metal brad.
6. Show the class where the 'Sight Folds' are on the Height-O-Meters and fold them upwards.
7. Use tape or stables to affix the "handle" to a pencil or pen for stability.
8. Demonstrate how the Height-O-Meters need to "freely swing" on the brad and assist students who are having trouble with their Height-O-Meters .
9. In their table groups, each group help measure everyones eye level and record on the Height-O-Meters.

10. Demonstrate how to find measurements using the Height-O-Meter using classroom objects, i.e. door frame, window, and student. (You will pre-measure each object with a meter stick before class.)
11. Take the class outside to measure the height of the flag pole. (You will have previously measured this to use as a comparison.)
12. Review some experimental design flaws of the Height-O-Meter versus the measurements using meter sticks.
13. Review how to use the Height-O-Meters correctly.

E. Assessment/Evaluation
1. Teacher observations
2. Completion of the 'What have you learned so far?' Quiz
3. Completion of Height-O-Meter

LESSON FIVE: (Days 6-7)

A. Daily Objective
1. Concept Objective(s)
a. The students develop an appreciation for math and science.
b. The students will develop graphing skills to be used across different content.
c. The students will understand how physics relate to everyday activities.
2. Lesson Content
a. Brief introduction into actual NASA launches and Newton's Laws of Motion
b. Observation of class rocket launch
c. Accurately using Height-O-Meters for finding height of rocket's height
d. Accurately calculate time of flight
e. Completion of rocket launch
3. Skill Objective(s)
a. The students will demonstrate safe practices during field investigations.
b. The students will collect date by observing and measuring.
c. The students will collect information using Height-O-Meters, meter sticks and stop watches.
d. The students will represent the natural world using models and identify their limitations.
e. The students will evaluate the model rocket and make recommendations for improving the model.
f. The students will demonstrate how unbalanced forces cause changes in the speed or direction of an object's motion.

B. Materials
1. PVC pipe/U-Tube rocket launcher (Appendix 5a)
2. Electric Air Compressor
3. Extension cords
4. Meter sticks
5. Height-O-Meters
6. Rocket Science data chart (Appendix 3a)
7. Student rockets
8. NASA video clip (http://www5.unitedstreaming.com/index.cfm)

C. Key Vocabulary

1. Baseline measurement – the distance between where the observer is standing and the place on the ground directly under the rocket launcher
2. Newton's First Law of Motion – an object will remain at rest or continue in a constant speed and direction unless an outside force acts on the object.
3. Newton's Second Law of Motion – an object will accelerate in the direction of the applied force
4. Newton's Third Law of Motion – for every action, there is an opposite and equal reaction

D. Procedures/Activities

1. Review Newton's three laws of motion and give specific examples of each at the beginning of class.
2. Show a short video clip of a NASA rocket launch to give the students a visual tool to relate to their rocket launch.
3. Review the safety practices that must be demonstrated once the class is outside at the rocket launch.
4. Show the students the U-Tube rocket launcher and explain how it works.
5. Review proper use of the Height-O-Meters.
6. Explain to the students what their baseline measurement will be and how they will assemble themselves around the rocket launcher at the correct baseline measurement.
7. Once outside, have students begin measuring their baseline measurement around the rocket launcher.
8. Launch two practice rockets so the students can get a "feeling" of where their Height-O-Meters need to be positioned at the start of each rocket launch.
9. Pick a couple of students to take turns recording the time of each launch.
10. Begin the rocket launch and recording times and angles off of the Height-O-Meters.
11. Stress to the students how important it is to not use another student's measurement due to different eye level distances.
12. Give the opportunity for students to launch their rockets if they are comfortable launching them.
13. Make sure the area is free from empty bottles and bottle lids before coming inside once the launch is completed.

E. Assessment/Evaluation

1. Teacher observations
2. Completion of Rocket Science Data Chart

LESSON SIX: So, how high did you fly? (Days 8-9)

A. Daily Objective

1. Concept Objective(s)
    a. The students develop an appreciation for math and science.
    b. The students will develop graphing skills to be used across different content.
    c. The students will understand how physics relate to everyday activities.
2. Lesson Content
    a. Height calculations of rockets
    b. Compose and interpret a graph of recorded data
    c. Composition of objective conclusion
3. Skill Objective(s)
    a. The student will organize, analyze, evaluate and make inferences from direct and indirect evidence.

b. The student will communicate valid conclusions.
c. The students will construct graphs to organize, examine and evaluate data.
d. The students will represent the natural world using models and identify their limitations.
e. The students will make recommendations for improving their model.
f. The students will demonstrate how unbalanced forces cause changes in the speed or direction of an object's motion.
g. The students will organize their findings in a conclusion about the rocket launch.

B. Materials
1. Rocket Science data chart
2. Height Finder chart
3. Ruler
4. Rocket Write-Up checklist (Appendix 6a)
5. Graph paper

C. Key Vocabulary
1. Baseline measurement – the distance between where the observer is standing and the place on the ground directly under the rocket launcher
2. Newton's First Law of Motion – an object will remain at rest or continue in a constant speed and direction unless an outside force acts on the object.
3. Newton's Second Law of Motion – an object will accelerate in the direction of the applied force
4. Newton's Third Law of Motion – for every action, there is an opposite and equal reaction
5. Angular height – the angle between a horizontal line at eye level and the direction they must look to see the object.
6. Eye level – measurement from ground to a person's eyes

D. Procedures/ Activities
1. Go over requirements of final lab write-up at the beginning of class.
2. Review how to calculate height with the Height Finder chart on the overhead projector.
3. Review how to set up the x and y axis on the graph with an overhead transparency.
4. Have students complete the lab write-up for the rocket launch lab.

E. Assessment/Evaluation
1. Completed Rocket Lab Write-Up
2. Teacher observations

LESSON SEVEN: Unit Wrap-up (Day 10)

A. Daily Objective
1. Concept Objective(s)
a. The students develop an appreciation for math and science.
b. The students will develop graphing skills to be used across different content.
c. The students will understand how physics relate to everyday activities.
2. Lesson Content
a. Review information gained from the skateboard lab and the rocket
b. Making concept maps using Inspiration software
c. Summarizing information from skateboard lab and rocket launch lab
d. Utilize knowledge of graphing and calculations of formulas
3. Skill Objective(s)

a. The students will construct concept maps using computers to organize and evaluate data.
b. The students will interpret situations in terms of given graphs or create situations that fit the graphs.
c. The students will use problem solving to collect and organize data, make graphs, decisions and critical judgments.
d. The students will demonstrate how unbalanced forces cause changes in the speed or direction of an object's motion.

B. Materials
1. Inspiration Software
2. Computer
3. Student's previous notes and work from the unit
4. Unit Assessment Directions (Appendix 7a)

C. Key Vocabulary
1. Concept map - a type of diagram which shows various relationships between concepts

D. Procedures/Activities
1. Hand out directions for the Inspiration project as students come into the lab.
2. Briefly review how to use Inspiration software.
3. Monitor student's progress during the class period.
4. Students will print final assessment, their concept map, at the end of the class period.

E. Assessment/Evaluation
1. Teacher observations
2. Final assessment (concept map)

CULMINATING ACTIVITY
At the end of this unit, we will invite the science classes to watch our rocket launch demonstration. Students will fill out an observation form/survey about the rocket launches and what they think the math students should do to improve their rocket launch.

Resources:

Handouts:
A. Lesson One: Tell us what you know: graphing and formulas
1. Appendix 1a (Graphing Activity)
2. Appendix 1b (Graphing Game)
3. Appendix 1c (Finding Speed, Velocity and Acceleration)
B. Lesson Two: Rolling with the homies...
1. Appendix 2a (Force of Friction Skateboard Lab)
C. Lesson Three: So you want to be a rocket scientist?
1. Appendix 3a (Rocket Science)
D. Lesson Four: Making Height-O-Meters
1. Appendix 4a (What have you learned so far? quiz)
2. Height-O-Meter template and Height Finder Chart (located at: http://www.lhsgems.org/GEMSpdf/HeightOMeters2.pdf)
E. Lesson Five: Flying with the big dawgs!
1. Rocket Launch: http://www5.unitedstreaming.com/index.cfm
2. Appendix 5a (U-Tube/Rocket Launcher Materials)

F. Lesson Six: So, how high did you fly?
    1. Appendix 6a (Rocket Write-Up Checklist)
G. Lesson Seven: Unit Wrap-Up
    1. Appendix 7a (Unit Assessment Directions)

Bibliography:

A. Books

Boyd, Cindy J. Algebra 1: Integration, Applications, Connections. Columbus, OH: Glencoe/McGraw-Hill. 2000. ISBN 0-02-825329-9.

B. Internet Resources

Lawrence Hall of Science. LHS GEMS, Height-O-Meters. October 13, 2005. http://www.lhsgems.org/GEMSpdf?HeightOMeters2.pdf

Harrison, Slater. Build Air Rocket. October 14, 2005. http://www.sciencetoymaker.org/airRocket/asmblLaunch.html

Discovery Education: United Streaming. Newton's Third Law of Motion: How Rockets Work. 2005. http://www5.unitedstreaming.com/index.cfm .

Differentiation:

Plan partner students or set small groups up to address students who are needing extra help or support with any aspect of this unit.

Technology Integrations:

Smart lessons could be prepared from these plans, if the Smart Board technology is available.

Content Connections:

Students till find numerous connections with their studies in science over the years, and in preparation for studying physical science and earth science in high school.

Appendix 1a
Graphing Activity

Graphing Activity

1. Central Middle School is having a mouse trap car racing contest. The following chart has the distance each car traveled, and the time per car. Plot the information from the chart on a graph (distance vs. time).

Distance (m)	Time (s)
10m	3s
15m	5s
5m	3s
25m	4s
10m	5s
30m	8s
7m	4s
12m	4.5s
17m	5.5s
3m	6s

2. Based on the above information, calculate the average speed for each mouse trap car. Which mouse trap car traveled the fastest? The slowest?

3. Overall, which mouse trap car had the best "racing style"? What could you determine about the cars, based on their speed, distance and time?

Appendix 1b
Graphing Game

Graphing Game

In your group, graph the following lines:

$Y = 3x + 2$
$Y = x + 4$
$Y = 2x + 10$

Graphing Game

In your group, graph the following lines:

$Y = x - 5$
$Y = 2x - 4$
$Y = 3x + 3$

Graphing Game

In your group, graph the following lines:

$Y = 4x - 2$
$Y = 2x - 5$
$Y = 3x + 4$

Graphing Game:

In your group, graph the following lines:

$Y = 4x - 3$
$Y = 2x - 1$
$Y = x + 6$

Graphing Game

In your group, graph the following lines:

$Y = 6x - 2$
$Y = 2x - 5$
$Y = x + 1$

Graphing Game:

In your group, graph the following lines:

$Y = 2x - 7$
$Y = 3x + 5$
$Y = x + 6$

Appendix 1c
Finding Speed, Velocity, and Acceleration

Name _____ Date _____ Class _____

Finding Speed, Velocity and Acceleration

Directions: Using the correct formulas, complete the following word problems.

1. A swimmer takes 25 s to swim 90 m. What is his or her average speed?

2. A horse canters at 14 m/s. It takes 10 s to reach a gallop of 30 m/s. Find the acceleration.

3. How much net force is required to accelerate a 1000 kg car at 5.00 m/s2?

4. If you apply a net force of 1 N on a 200g book, what is the acceleration of the book?

5. What is the net force on 200 g ball when it hits a wall with acceleration of 10 m/s^2?

6. You are lowering a 12-kg bucket with an acceleration of 0.5 m/s^2. Find the force being used.

7. **Carol walks at 0.6 m/s for 60 s. How far does she go?**

8. **A 50-N force acts on a 4-kg object. What is the acceleration of the object?**

9. **If you were to travel 1 km east in 0.5 h., what would be your velocity?**

10. **A football has a speed of 0.5 m/s for 30 s. How far does the football go?**

Appendix 2a
Force of Friction Skateboard Lab

Name _____ Date _____ Class _____

Force of Friction Skateboard LAB

How do various surfaces affect your speed while you're on the skateboard?

People Pull

- One student per group will be traveling 10 m on:
  - →tile
  - →asphalt
  - →sidewalk
  - →grass

- The time will be measured and speed will be determined.

material	distance (m)	time (s)	speed (m/s)
tile			
asphalt			
sidewalk			
grass			

- Explain how the force of friction changed the student's speed on the skateboard.

- Attach a graph comparing your time versus your speed using all four surfaces. Each line graph for each surface needs to be a different color and labeled.

Rocket Science

Part A: My rocket looked like this:

(label body, fins and nose cone)

Part B: Observations:

(label your rocket's flight and where your rocket landed)
(label where the farthest rocket landed)

Results

name/rocket design	distance (m)	approx. time (s)

Appendix 4a
What have you learned so far? Quiz

What have you learned so far?
Physics Quiz: Formulas and Vocabulary

1. Sound travels 1129 feet per second through the air.
   a. Write an equation that represents how many feet sound can travel in 5 seconds though the air.

   b. Now, solve the equation

2. The formula $d = vt + \frac{1}{2} at^2$ is the formula for distance d, given the initial velocity v, the time t, and the acceleration a. Suppose that a biker going 4.5 meters per second passes a lamppost at the top of a hill and then accelerates going down the hill at a constant rate of 0.4 m/s^2 for 12 seconds. How far does the biker go down the hill during this time?

3. A swimmer takes 35 s to swim 100 m. What is the swimmer's average speed?

4. If your dog's mass was 20kg, what would his weight be? Is this a big dog, or a small dog?

5. If you were to run 5km west in .75 h., what is your velocity?

6. What is rolling friction? Give an example.

7. What is sliding friction? Give an example.

8. What is a nose cone? Describe the uses for a nose cone.

9. Describe what effect fins can have on a rocket.

10. What does it mean when you say an object is aerodynamic?

Appendix 5a
U-Tube Rocket Launcher Pieces

U-Tube Rocket Launcher Pieces

1 - 1/8" mipt tank valve
1 - 1/8" mipt center back mount pressure gauge (0 psi to 60 psi)
1 - 3" slip pvc cap
1 - 3" slip x slip pvc coupler
2 - 3" slip x slip pvc elbows
1 - 3" slip x 2" slip pvc bushing
1 - 2" slip x 3/4" fipt bushing
1 - 3/4" 90 degree pvc street elbow (mipt x slip)
1 - 3/4" 90 degree pvc street elbow (mipt x fipt)
1 - 3/4" slip x 1/2" slip pvc bushing
1 - 3/4" x 4" pvc schedule 80 pipe nipple
1 - 3/4" threaded pvc ball valve
1 - 3" x 12" schedule 40 pvc pipe
2 - 3" x 6" schedule 40 pvc pipe
1 - 1/2" x 15" schedule 40 pvc pipe
1 - 21/64 drill bit
1 - 1/8" npt pipe tap

NOTE: These are the materials used to make the U-Tube Rocket Launcher. However, this particular design is not necessary to receive similar results. An easier version can be made. The directions are on the following link:

http://www.sciencetoymaker.org/airRocket/asmblLaunch.html

Appendix 6a
Rocket Write-Up Checklist

To be included in COMPLETE Rocket Launch Lab:

1. completed Rocket Science WS
2. graph (on graph paper)
3. conclusion (in paragraph form)

Graph

distance(m) on y
time (s) on x
line graph

Conclusion

1. Explain how the rockets were launched
2. Explain data on graph
3. Identify two experimental design flaws and resolve them
4. Identify one specific thing to change on your rocket
5. Relate the rocket launch to all three of Newton's laws

Appendix 7a
Unit Assessment Directions

Unit Assessment Directions

Objective: Use the data and notes from the Unit to make an Inspiration Software Concept Map highlighting the main skills and objectives.

Directions: Use your notes and data recorded from the Unit's labs to create an Inspiration concept map. This concept map will include the main ideas, examples and illustrations of the unit.

This will count as a test grade for the final assessment of the unit.

The concept map must be printed and turned in at the end of the class period.