Course: Physical Science

I. Grade Level/Unit Number: 9 - 12 Unit 1

II: Unit Title: Force and Motion

III. Unit Length: 10 days (based on a 90 minute per day schedule)

IV. Major Learning Outcomes:

Motion

- Describe motion as a change of position.
- Understand that all motion is relative.
- Differentiate between distance and displacement. *(Solve for displacement in simple situations --students are not expected to use trigonometry.)*
- Differentiate between speed and velocity.
- Apply concepts of average speed and average velocity to solve conceptual and quantitative problems.
- Investigate how velocity is a relationship between displacement and time: $\bar{v} = \frac{\Delta d}{\Delta t}$
- Investigate how acceleration is a relationship between velocity and time: $\bar{a} = \frac{\Delta v}{\Delta t}$.
- Using graphical analysis, solve for distance, time, and average velocity. Also analyze conceptual trends in the distance vs. time graphs such as constant velocity and acceleration.
- Using graphical analysis, solve for velocity, time, and average acceleration. Also analyze conceptual trends in the velocity vs. time graphs such as constant velocity and acceleration.
- Investigate acceleration due to gravity as an example of uniformly changing velocity: g = 9.8m/s/s.

Force

- Investigate the property of inertia as related to mass.
- Mathematically and graphically analyze weight as the relationship between the acceleration due to gravity and mass of an object:. $F_g = mg$
- Investigate mathematically and graphically $F = ma$ with respect to acceleration as a change in motion.
- Investigate balanced and unbalanced forces using the equation: $F = ma$. *(Solve for the unbalanced force in simple situations--students are not expected to use trigonometry.)*
- Investigate friction as force that opposes the motion of an object.
- Analyze Newton's Third Law as the relationship described by Force $_{\text{of Object A on Object B}}$ = - Force $_{\text{of Object B on Object A}}$

Work

- Calculate work: $W = F\Delta d$
- Investigate and analyze work and power.
- $P = \frac{W}{\Delta t} = \frac{F\Delta d}{\Delta t}$
- (Students should be familiar with Joules and Newton-meters)

Inquiry

- Develop questions for investigation from a given topic or problem.
- Distinguish and appropriately graph dependent and independent variables.
- Report and share investigation results with others.
- Discuss the best method of graphing/presenting particular data.
- Use technology resources such as graphing calculators and computers to analyze data.
- Use questions and models to determine the relationships between variables in investigations.
- Read and interpret Material Safety Data Sheets (MSDS).
- Read and analyze newspaper, journal, and on-line articles.

V. Content Objectives Included (with RBT Tags) :

Objective Number	Objective	RBT Tag
1.01	Identify questions and problems that can be answered through scientific investigations.	B3
1.02	Design and conduct scientific investigations to answer questions about the physical world. • Create testable hypotheses. • Identify variables. • Use a control or comparison group when appropriate. • Select and use appropriate measurement tools. • Collect and record data. • Organize data into charts and graphs. • Analyze and interpret data. • Communicate findings.	A5 B6

1.03	Formulate and revise scientific explanations and models using logic and evidence to: • Explain observations. • Make inferences and predictions. • Explain the relationship between evidence and explanation.	C5
1.04	Apply safety procedures in the laboratory and in field studies: • Recognize and avoid potential hazards. • Safely manipulate materials and equipment needed for scientific investigations.	C3
1.05	Analyze reports of scientific investigations of physical phenomena from an informed scientifically literate viewpoint including considerations of: • Appropriate sample. • Adequacy of experimental controls. • Replication of findings. • Alternative interpretations of the data.	A4
2.01	Measure and mathematically/graphically analyze motion: • Frame of reference (all motion is relative - there is no motionless frame). • Uniform motion. • Acceleration.	B4 C3
2.02	Investigate and analyze forces as interactions that can change motion: • In the absence of a force, an object in motion will remain in motion or an object at rest will remain at rest until acted on by an unbalanced force. • Change in motion of an object (acceleration) is directly proportional to the unbalanced outside force and inversely proportional to the mass. • Whenever one object exerts a force on another, an equal and opposite force is exerted by the second on the first.	B4
3.01	Investigate and analyze transfer of energy by work: • Force. • Distance	B3

VI. English Language Development Objectives (ELD) Included: NC English Language Proficiency (ELP) Standard 4 (2008) for Limited English Proficiency

Students (LEP)- English Language learners communicate information, ideas, and concepts necessary for academic success in the content area of science.

Suggestions for modified instruction and scaffolding for LEP students and/or students who need additional support are embedded in the unit plan and/or are added at the end of the corresponding section of the lessons. The amount of scaffolding needed will depend on the level of English proficiency of each LEP student. Therefore, novice level students will need more support with the language needed to understand and demonstrate the acquisition of concepts than intermediate or advanced students.

VII. Materials/Equipment Needed:

Activity	Materials
String Activity	String Markers Round objects (Note: The round object should NOT be a ball. Examples: Frisbee, oatmeal box, soda can, etc). Provide at least 2 of the same object so that more than one group will have the same object.)
The (Insert Your School Name) Speedway	Meter sticks (or meter tapes) Masking tape Timers Calculators
Acceleration Lab Activity	Moulding- ¼ round (Suggestion: You can use a board raised at one end by books to make an incline.) Marbles Flat top table Books Meter stick Stopwatch
Book Drop Activity	Textbooks Notebook paper Various objects such as marbles, paper clips, ping pong balls, whiffle balls, chalk, pencils, etc. Ladder
Weight vs. Mass Lab Activity	Spring scales (various sizes) Various objects (for students to weigh)
Inertia Cart Demonstration	Large media cart Clear cup of water (Suggestion: You may also use any kind of round ball)
Inertia Cards Activity	Index cards Beaker (250 ml works well) or plastic cup 1 single penny 5 pennies taped together Clear tape

Newton's Laws Reading/Illustrating Activity	Paper Pens Markers Colored Pencils
Karate Chop Demo	Balsa wood (4" x 1/8" piece) Newspaper
2nd Law Index Card Activity	3" x 5" index cards Scissors Tape Pennies
2nd Law of Motion Problems	Calculators
Law of Motion Activity	Tennis balls Notecards Beakers Pennies 50 g mass 500 g mass 3 carts Small stuffed animals Rulers Pencils Coins
3rd Law of Motion Demo	Wood block (pine or any other soft wood) Hammer Small nail Books
Scales Lab Activity	Spring scales
What Would You Rather Do? Work and Force Activity	Wood blocks with hooks Spring scales Meter sticks Boards for inclined planes Sand paper Calculators Timers

VIII. Detailed Content Description:

Please see the detailed content description for each objective in the Physical Science Support document. The link to this downloadable document is in the Physical Science Standard Course of Study at:

http://www.ncpublicschools.org/curriculum/science/scos/2004/26physical

IX. Unit Notes:

Overview of Unit One:
This unit includes daily lessons and activities for the major topics of force and motion. Specific topics covered are: distance, displacement, motion, frame of reference, speed, velocity, acceleration, Newton's three laws of motion with force and inertia, acceleration due to gravity, free fall, weight, work, and power.

In each unit, Goal 1 objectives which relate to the process of scientific investigation are included. In each of the units, students will be practicing the processes of science: observing, hypothesizing, collecting data, analyzing, and concluding. **Goal 1 objectives are an *integral* part of *each of the other goals*.** In order to measure and investigate scientific phenomena, students must be given the opportunity to design and conduct their own investigations in a safe laboratory. Investigations may also be conducted using simulations.

The unit guide below contains the activities that are suggested to meet the Standard Course of Study (SCOS) Goals for Unit One. The guide includes activities, teacher notes on how to implement the activities, and resources relating to the activities which include language objectives for ESL (English as a Second Language) students. Teachers should also consult the Department of Public Instruction website for English as a Second Language at: http://www.ncpublicschools.org/curriculum/esl/ to find additional resources. If a teacher follows this curriculum, (s)he will have addressed the goals and objectives of the SCOS. However, teachers may want to substitute other activities that teach the same concept. Teachers should also provide guided and independent practice from other sources.

Reference Tables:
The North Carolina Physical Science Reference Tables were developed to provide essential information that should be used on a regular basis by students, therefore eliminating the need for memorization. It is suggested that a copy be provided to each student on the first day of instruction. A copy of the reference tables can be downloaded at the following URL:

http://www.ncpublicschools.org/docs/accountability/testing/eoc/PhysicalScience/physicalsciencereferencetable.pdf

Essential Questions:
Essential questions for this unit are included with the activities. Essential questions are those questions that lead to student understanding. Students should be able to answer these questions at the end of an activity. Teachers are advised to put these questions up in a prominent place in the classroom. The questions can be answered in a journal format as a closure.

Safety: Students should wear chemical splash goggles during any lab activity involving chemicals. This includes household substances. **It is extremely important for the safety and success of your students that you do ALL activities and labs prior to assigning them to students.** At the beginning of each lab, the teacher should address any specific safety concerns relating to the activity.

Modified Activities for LEP Students:
Those activities marked with a have a modified version or notes designed to assist teachers in supporting students who are English language learners. Teachers should also consult the Department of Public Instruction website for English as a Second Language at: http://www.ncpublicschools.org/curriculum/esl/ to find additional resources.

Computer Based Activities:
Several of the recommended activities are computer based and require students to visit various internet sites and view animations of various biological processes. These animations require various players and plug-ins which may or may not already be installed on your computers. Additionally some districts have firewalls that block downloading these types of files. Before assigning these activities to students it is essential for the teacher to try them on the computers that the students will use and to consult with the technology or media specialist if there are issues. These animations also have sound. Teachers may wish to provide headphones if possible.

Suggested Websites:
Below is a list of suggested websites for various topics discussed in Unit One.

Distance and displacement
http://www.glenbrook.k12.il.us/gbssci/phys/Class/1DKin/U1L1c.html

Average Velocity
http://www.glenbrook.k12.il.us/gbssci/phys/Class/1DKin/U1L1d.html

Acceleration
http://www.glenbrook.k12.il.us/gbssci/phys/Class/1DKin/U1L1e.html

Free Fall
http://www.glenbrook.k12.il.us/gbssci/phys/Class/1DKin/U1L5a.html

Acceleration due to gravity
http://www.glenbrook.k12.il.us/gbssci/phys/Class/1DKin/U1L5b.html

Weight
http://www.exploratorium.edu/ronh/weight/

Inertia Demo
http://www.physicsclassroom.com/mmedia/newtlaws/cci.html

Newton's First Law
http://www.glenbrook.k12.il.us/gbssci/phys/Class/newtlaws/u2l1a.html

Newton's Third Law
http://www.glenbrook.k12.il.us/gbssci/phys/Class/newtlaws/u2l4a.html

Newton's Second Law
http://www.glenbrook.k12.il.us/gbssci/phys/Class/newtlaws/u2l3a.html

Newton's Laws of Motion

http://teachertech.rice.edu/Participants/louviere/Newton/

Third Law Wright Brothers Flight Video
http://www.grc.nasa.gov/WWW/K-12/airplane/newton.html

Work and Power
http://www.physicsclassroom.com/Class/energy/U5L1a.html
http://science.howstuffworks.com/fpte6.htm

Mechanical Advantage
http://library.thinkquest.org/CR0210120/Mechanical%20Advantage.html

X. Global Content: Aligned with 21st Skills:

One of the goals of the unit plans is to provide strategies that will enable educators to develop the 21st Century skills for their students. As much as students need to master the NCSOS goals and objectives, they need to master the skills that develop problem solving strategies, as well as the creativity and innovative thinking skills that have become critical in today's increasingly interconnected workforce and society. The Partnership for 21st Century Skills website is provided below for more information about the skills and resources related to the 21st Century classroom.

http://www.21stcenturyskills.org/index.php?option=com_content&task=view&id=27&Itemid=120

NC SCS Physical Science	21st Century Skills	Activity
	Communication Skills	
Goal 1	Conveying thought or opinions effectively	• Which would you rather do? Activity • Work and power & Mechanical advantage extension
Goal 1	When presenting information, distinguishing between relevant and irrelevant information	• String activity • Distance vs. distance activity • Acceleration lab • 2nd law index card activity
Goals 1-6	Explaining a concept to others	• School name 500 • Book drop activity • 2nd law index card activity
	Interviewing others or being interviewed	
	Computer Knowledge	
Goals 1-6, esp. Goal 1	Using word-processing and database programs	
Goals 1-6, esp. Goal 1	Developing visual aides for presentations	• Distance vs. displacement activity • KWL activity • Concept map activity
Goal 1	Using a computer for communication	
	Learning new software programs	
	Employability Skills	
Goals 1-6	Assuming responsibility for own learning	All activities
Goals 1-6, esp. Goal 1, 2.02, Goal 3, Goal 4, 5.03, 6.02, 6.05	Persisting until job is completed	All activities
Goals 1-6	Working independently	• Velocity problems # 1 • Velocity problems # 2 • 2nd law problems • Work & power problems
	Developing career interest/goals	
Goal 1	Responding to criticism or questions	
	Information-retrieval Skills	

Goal 1	Searching for information via the computer	• Various online extensions as related to the web sites given in suggested web sites
Goal 1	Searching for print information	• Newton's Laws Reading/Illustrating Activity
	Searching for information using community members	
	Language Skills - Reading	
Goal 1-6	Following written directions	Most of the activities can be presented as opportunities for students to follow written directions. The teacher will have to work with most students to develop this skill over time. The following activities are well suited to developing skills in following directions: • String Activity • The (Insert Your School Name) Speedway • Acceleration Lab Activity • Law of Motion Activity • Which would you rather do lab? • Work and power & Mechanical advantage extension
Goals 1-6	Identifying cause and effect relationships	• Book drop demonstration • 2nd law index card activity • Karate chop demonstration • 3rd law demonstration
Goals 1-6	Summarizing main points after reading	• Newton's Laws Reading/Illustrating Activity • Work and power & Mechanical advantage extension
Goal 1	Locating and choosing appropriate reference materials	• Work and power & Mechanical advantage extension
Goals 1-6	Reading for personal learning	• Work and power & Mechanical advantage extension • Newton's Laws Reading/Illustrating Activity
	Language Skill - Writing	
Goals 1-6	Using language accurately	All the activities
Goals 1-6	Organizing and relating ideas when	All the activities

	writing	
Goals 1-6, esp. Goal 1	Proofing and Editing	
Goals 1-6, esp. Goal 1	Synthesizing information from several sources	
Goal 1	Documenting sources	
	Developing an outline	
1.04	Writing to persuade or justify a position	
	Creating memos, letters, other forms of correspondence	
	Teamwork	
Goal 1, 2.02, Goal 3, Goal 4, 5.03, 6.02, 6.05	Taking initiative	• String activity • Distance vs. distance activity • Acceleration lab • 2nd law index card activity • Law's of motion activity • Newton's Laws Reading/Illustrating Activity • Work and power & Mechanical advantage extension
Goal 1, 2.02, Goal 3, Goal 4, 5.03, 6.02, 6.05	Working on a team	Most of the activities are designed to be done and discussed in teams. The following activities are well suited to developing team interdependence skills: • String activity • Distance vs. distance activity • Acceleration lab • 2nd law index card activity • Scales lab • Laws of motion lab • Which would you rather do? Lab • Newton's Laws Reading/Illustrating Activity • Work and power & Mechanical advantage extension
	Thinking/Problem-Solving Skills	
Goals 1-6	Identifying key problems or questions	• Newton's laws reading • Work and power & Mechanical advantage extension

		• Concept map activity • KWL activity
Goals 1-6	Evaluating results	• String activity • Distance vs. distance activity • Acceleration lab • 2nd law index card activity • Scales lab • Book drop activity • Newton's Laws Reading/Illustrating Activity • Work and power & Mechanical advantage extension
Goals 1-4, 5.02, 5.03, Goal 6	Developing strategies to address problems	• Scales lab • Acceleration lab • Which would you rather do? lab • String lab
Goal 1, 2.02, Goal 3, Goal 4, 5.03, 6.02, 6.05	Developing an action plan or timeline	• Scales lab • Acceleration lab • Which would you rather do? Lab

Force & Motion
Day 1

Language (ELP) objectives for Limited English Proficient (LEP) Student:
- *The students will name metric instruments and state the Standard International (SI) unit.*
- *The students will explain to their partner the difference between displacement and distance.*

ENGAGE:

To engage students in the practice of measuring, instruct student to measure group members' feet and height. Ask them to decide which units of measurement would be best for graphing each set of data. Have students to graph their data.

LEP Modifications:
- *Provide graph paper with label axis.*
- *Provide written specific instructions for the activity.*

EXPLORE:
Use this activity (String Activity) to introduce the concepts of: standards, measure, units, accuracy, precision, data table construction, etc. Be sure to include the concepts of dependent and independent variables, graphing, slope, and relationships shown by graph lines. These are essential skills that students will need to exhibit throughout the course.

Essential Question:
Why do we use measurements?

String Activity

Materials: String. Markers, round objects (note: the round object should NOT be a ball. Examples: Frisbee, oatmeal box, soda can, etc). Provide at least 2 of the same object so that more than one group will have the same object. After the activity, the teacher will be able to use the measurements from the 2 groups. The groups will have different measurements for the same object, hence, the importance of a common system of measurement for communication.

1. Give each student (or group of 2 or 3) a length of string and a marker. Have students mark string as a measuring device. The students will determine the size of their units and name them.
2. Tell students to measure the distance around and the distance across the middle of two round objects, one large and one small. Have students divide the distance around by the distance across.
3. While students do their measurements, put data table or prepared transparency on the board. Allow students to fill in the table as they finish.

Object measured	Around (Circumference)	Across (Diameter)	Around/across (Ratio)

LEP Modifications:

- *Model expectations for students.*
- *Give written and oral instructions. Emphasize that the student is making up their own unit of measurements.*

EXPLAIN:

4. Have each group of students present their data collected. Be sure that students use the following terminology in their presentation to the class: standards, measurement, and units. The teacher should facilitate, not lead this discussion. Listen for correct usage of the terms. Show how the same objects have different measurement and discuss the importance of a common system of measurement.

Review metric system measurements and units. Hold up measurement devices or give the drawings. Have students indicate what the device measures and the standard unit for each. Ex: meter stick = length, SI unit is the meter.

LEP Modifications:

- *Have students fill out a chart like the one below as you review measurements and units. Have students come up with definitions.*

	Definition	*Instrument*	*SI Unit*	*Everyday Use*
Length				
Mass				
Solid Volume				

5. Optional: Introduce the concepts of circumference, diameter, and ratio.

ELABORATE:

During this activity (Distance vs. Displacement Activity), students will apply the skill of measurement to differentiate distance and displacement. Introduce this as an inquiry activity. Do not have students research the terms until AFTER they have completed the activity. Instruct students to read the pages in your text pertaining to distance and displacement. Present correct terminology while discussing examples/applications of distance vs. displacement.

Distance vs. Displacement Activity

- Have students stand up and face a wall, lining up so that toes are along a "seam" in the floor.
    - Tell students to move "X" number of blocks toward the wall.
- Ask the students how far they have moved from the starting point.

    - (displacement = X blocks)
- Ask students how far they have traveled.
    - (distance = X blocks)
- Have students turn around and walk X+1 blocks in the opposite direction.
    - Ask students how far they are from the starting point.
        - (displacement = 1 block)
    - Ask students how far they have traveled.
        - (distance = X+X+1 blocks)
- Follow with other examples until students understand the difference between the distance and displacement.
    - Examples

EVALUATE:

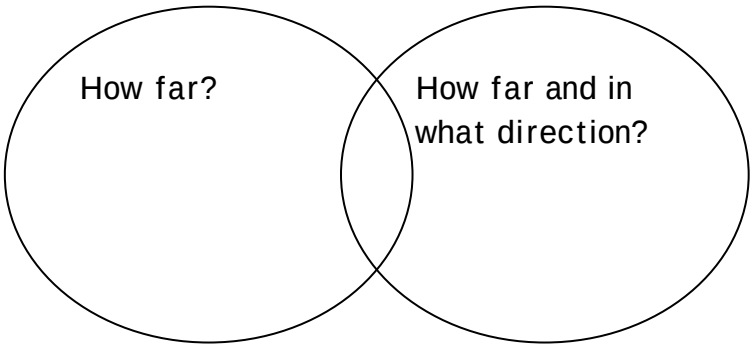
Have students construct a Venn diagram (double bubble map) to contrast distance and displacement. Have partners compare their diagrams and write a compare/contrast paragraph on distance and displacement. Conclude by having student volunteers read their paragraphs.

The teacher should instruct students on how to construct a Venn Diagram.
Examples of Venn Diagrams

LEP Modifications:

- *To check for understanding have students draw a picture to illustrate the difference between distance and displacement.*
- *Have students explain the difference between distance and displacement to their partners.*
- *Then, have students complete a Venn Diagram. Include definitions.*

Venn Diagram Activity



Force & Motion
Day 2

Language (ELP) objectives for Limited English Proficient (LEP) Student:

- *The student will orally define and describe speed, velocity, motion, and time to their neighbor.*

ENGAGE:
Engage students regarding the concept of motion by asking the following question- What are 5 ways that you can "race" or travel a given distance? Record the students' responses. Discuss the "races" with the students, relating them to the concept of motion.

LEP Modifications:

- *Be sure students understand the term RACE. They might associate this term with their ethnic origin. Explain that it is a contest.*
- *You might want to run one race as a class together to model expectations (this depends on the level of students you have).*
- *Check to see if students know how to use a stop watch.*

EXPLORE:
Students will design an experiment [The (Insert Your School Name) Speedway] to answer the following question:

- "What are 5 ways that you can "race" or travel 10m?"

Essential Question:
What is average velocity?

The (Insert Your School Name) Speedway

(Adapted from PRISMS, "The Physics 500")

Materials: meter sticks (or meter tapes), masking tape, timers, calculators

- Give student groups a meter stick, masking tape, and a timer.
  - The teacher should not provide examples. Allow students to determine methods to answer the questions. Examples might include crawling, running, skipping, jumping, crab-crawl, etc.
- Students should measure 10 meters and use tape to mark the beginning and ending points for the race.
- Students will follow their procedure for completing the 10m race and allow students to create their own data table similar to the one below.

DATA TABLE:

RACE	DISTANCE	TIME	HOW FAST

EXPLAIN:

Allow students to present their data to the class. Record each groups' data on the board.

Questions:

1. Which "race" was the fastest?
2. How do you know?
3. Calculate how fast each "race" was.
4. What is the unit of measure for "how fast?"
5. Does it matter if the same person ran each race?

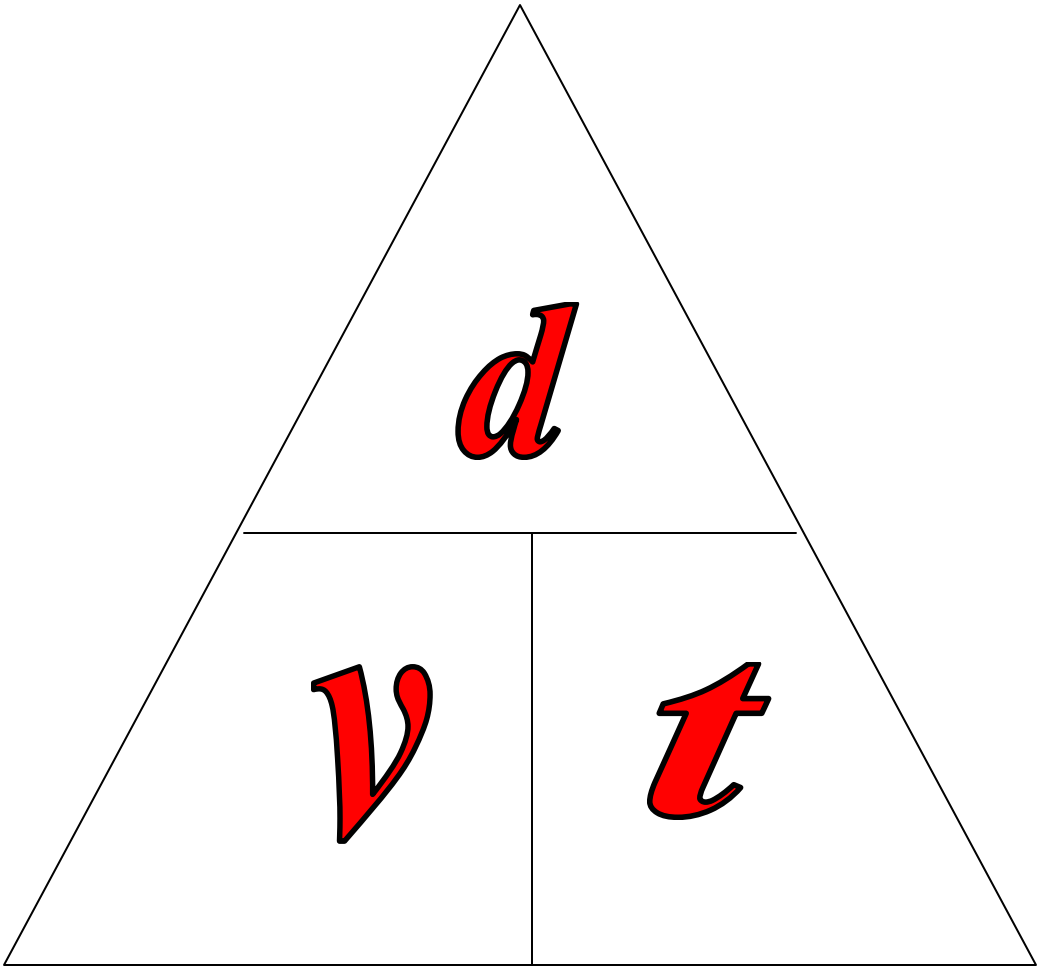
LEP Modifications:

- *Introduce and explain the vocabulary words; velocity, speed, motion, and time. Have students help you come up with definitions.*
- *Have students write the definitions in their notebooks.*
- *Write the equation for velocity on the board. Include units.*

ELABORATE:

Present guided practice (Velocity Problems # 1)

The triangle below may be used to solve any three variable formula. Have students place their finger over the unknown variable. If the remaining variables are side by side, that means to multiply. If the variables appear one over the other, that means to divide the top variable by the bottom variable. Give students other 3 variable formulas and have them create a chart for them. A challenge is kinetic energy. Clue, change the ½ to 0.5 and place it in the same space as mass and remember that velocity is squared.



Use the **velocity formula :** $\bar{v} = \frac{\Delta d}{\Delta t}$

Make sure students can solve for all three variables.
Be sure to include direction due to the nature of velocity being how fast and in what direction. Explain the vector nature of velocity and relate to frame of reference by using examples such as moving upstream or downstream in a river. Answer the questions that came to mind and discuss relevant examples with applications. Explain the use of controls and identify different types of variables.

LEP Modifications:

- *Write all three formulas (how to find velocity, how to find time, how to find distance) on the board for students to copy.*

Velocity Problems # 1

Student
Name_____Date_____Period_____

Read each problem to identify the unknown. Read the problem again and list all given information. Make sure you use the units to help identify the quantities. Look at the symbols in the "given" list and choose a formula. State the formula, substitute the values, and calculate. Show the answer with the correct unit.

LEP Modifications:

- *Complete the first problem together as a class.*
- *Have the students turn to a neighbor and explain how to complete the second problem.*
- *Have the students complete the rest on their own. When they are finished have them compare their answers with a neighbor.*

1. An airplane flew 1000km in 4h. What was the airplane's speed?

2. A car travels 50km east in 30min. What is its velocity in km/h?

3. How long will it take a ball to roll 26m if its velocity is 2.0m/s to the right?

4. If you shout, your voice travels at the speed of sound (340m/s) to a surface and back, and you hear an echo. If you hear an echo 4.8s after you shout, how far away is the surface from which the sound bounces?

5. If a runner is moving with a speed of 1.5m/s and changes her speed to 2.1m/s over a time period of 3s, what is her average speed?

Independent Practice

Velocity Problems # 2

- Make sure students use the proper units when completing all word problems.
- Point out the use of direction when solving for specific quantities.

Velocity Problems # 2

Average Velocity = Distance / Time

$$\bar{v} = \frac{\Delta d}{\Delta t}$$

1. A car moved 60 meters West in 2 hours. What is its average velocity?
2. A moon rock is dropped from a cliff and it takes 2 seconds for the rock to fall 6.6 meters. What is the moon rock's average speed?
3. A car travels 1000 meters in 5 seconds. What is its average velocity?
4. A boy walks 500 meters in 10 seconds. What is his average velocity?
5. Jane rolled a ball 600 meters. What was her average velocity if it took her 10 seconds?
6. What is the average velocity of a dog that runs 7500 meters that in 10 seconds?
7. What is the average velocity of a car that coasts 3000 meters in 300 seconds?
8. What is the average velocity of a student who runs 1600 meters in 78 seconds?
9. What is the average velocity of a student who walks 800 meters in 78 seconds?
10. What is average velocity of a dog who walks 100 meters in 20 seconds?
11. An object travels at a velocity of 18.99 m/s for a time period of 15.63 seconds. What is its displacement?
12. An object travels at a velocity for a time period of 12.19 seconds over a displacement of 10.56 meters. What is the value of this constant velocity?
13. An object travels at a constant velocity of 14.23 m/s for a time period of 11.19 seconds. What is its displacement over this time?
14. An object travels at an average velocity of 15 m/s fro 23 seconds. What is its displacement over this time?
15. How long will a dog run at a pace of 2 m/s over 12 meters?
16. How far will a horse trot at a velocity of 4 m/s for 1 minute?
17. What is the average velocity of a cat that runs 2.3 meters in 1.2 seconds?

LEP Modifications:

- *You might want to only assign half of these problems for the students to complete. Say only odds or only evens.*

EVALUATE:

The teacher should provide a mini-quiz containing questions regarding motion.

Force & Motion
Day 3

Language (ELP) objectives for Limited English Proficient (LEP) Student:
- *The students will listen to directions for the laboratory activity.*
- *The students will explain their answer to the laboratory questions to their neighbor.*

ENGAGE:
To engage students for the topic of acceleration, ask students to raise their hand if they have ever ridden a roller coaster. Show a brief video or film clip showing a roller coaster ride. After the video, explain that objects that are changing their speed or their direction are said to be accelerating. The rate at which the speed or direction changes is referred to as *acceleration*. Some amusement park rides (such as roller coasters) are characterized by rapid changes in speed and or direction. These rides have large accelerations. Rides such as the carousel result in small accelerations; the speed and direction of the riders change gradually.

Video clips can be found at the following websites:

Top 10 Fastest Roller Coasters in the World
http://www.weshow.com/top10/en/leisure/top-10-fastest-roller-coasters-in-the-world

Building America's Most Extreme New Roller Coaster
http://www.libertyforum.org/showflat.php?Cat=&Board=news_science&Number=296291588

EXPLORE:
Students will be studying acceleration by observing marbles on inclined planes. The goal of this lab (Acceleration Lab Activity) is to determine the acceleration of a marble using an inclined plane at different angles. The lab will show how graphs of displacement versus time and velocity versus time can be used to find acceleration.

If possible, have students complete the pre-lab for this activity at home and check it the next day in class. If not, it can be completed before the lab actually begins.

Essential Question:
What causes objects to accelerate?

Acceleration Lab Activity

Materials: Instead of moulding, you can use a board raised at one end by books to make an incline.

Acceleration Pre-lab

1. What are my goals for this lab? What am I trying to accomplish or learn?
2. What do I believe my teacher's goals are for this lab?

3. Describe how your group will collect data for the acceleration of the marble? What needs to be done to accomplish this task? Who will be responsible for each task?

4. Fill in the chart. HINT: Use the reference tables to calculate the missing information.

Time (s)	***Run 1 Position (cm)***	***Run 2 Position (cm)***	***Run 3 Position (cm)***	***Average Position (cm)*** *(Run 1+Run 2+ Run 3)/3*	***Distance traveled in 1 sec****	***Velocity (cm/s)*** *Avg pos/time*
1	*10*	*9*	*11*			
2	*30*	*28*	*32*			
3	*60*	*55*	*63*			
4	*100*	*95*	*105*			

* to calculate distance traveled in one second, subtract the average position from the average position above it. In second one you would subtract zero. In second two you would subtract the average position at one second from the average position from two second.

LEP Modifications:

- *Complete the first row with the class explaining how to make calculations along the way.*

ACCELERATION
The Rate of Change in Velocity

$$a = \frac{v_f - v_i}{\Delta t}$$

Teams will consist of 3 members.
Your team should decide on tasks necessary and who will do each. List each team member and his/her task below.

_____

_____

_____

Note to Teacher: Circulate the room and check each team member's assignment. Ask each member to explain his/her role and how it relates to the purpose of the lab.

Purpose

In this lab, you will be studying acceleration due to gravity by observing marbles on inclined planes. Your goal will be to determine the acceleration of the marble with the inclined plane at different angles. The lab will show how graphs of displacement versus time and velocity versus time can be used to find acceleration.

Materials

- Marble
- Flat table top
- Books
- Meter stick
- Stopwatch
- Quarter round molding
- Reference tables

Procedure

Part A

1. Raise one end of the inclined plane (outside corner moulding) by placing one book under the legs of the table at one end.

2. Trial run:
   Have the marble holder hold the marble at the top of the ramp. When the marble holder releases the car, have the timer begin timing. The timer should call out one-second intervals. Have the distance markers mark the position of the marble with a finger for each interval. Record the data below:

LEP Modifications:
- *Complete the trial run as a demonstration. Have students come up to the front of the room and help.*

Time (s)	Position (cm)	Position (cm)	Position (cm)
1			
2			
3			
4			

Table 1- Using one book

3. If you were not able to obtain the position at the end of each time interval, try until you have a system that enables you to get all four positions.

4. Check that your data is valid and logical. This is done by comparing the three markers at 1 second. Are they similar? If not, is there a reason for the difference? Compare the three markers for 2 seconds. Are they similar? Do they make sense in connection to second 1? Etc…

Note to Teacher: Circulate the room to ensure that each group has obtained logical data. If not, redirect students' procedures.

Part B

5. You will now repeat this procedure using two different heights of the desk. For each height, you will do at least three trials and average your data. Be sure to check for valid data (data that makes sense when compared to other obtained data)

6. First raise one end of the desk. Place two books underneath two legs on one end. You just created your ramp.

7. Let the marble run down the ramp while timing at least 3 times. Record your data in table 2. Calculate the average position for each time and enter it into the table. Then for each time interval, calculate the distance traveled in 1 second. To calculate this, it will be the average position minus the previous average position. For the first time it is the average position minus zero. Be sure to measure the distance in centimeters.

8. Calculate the velocity for each time interval by taking the displacement divided by the time interval (The interval is 1 second).

Time (s)	***Run 1 Position (cm)***	***Run 2 Position (cm)***	***Run 3 Position (cm)***	***Average Position (cm)***	***Distance traveled in 1 second***	***Velocity (cm/s)***
1						
2						
3						
4						

Table 2- Using two books

9. Repeat this exact procedure, except this time raise the table up by using three books under the two legs.

Time (s)	***Run 1 Position (cm)***	***Run 2 Position (cm)***	***Run 3 Position (cm)***	***Average Position (cm)***	***Distance traveled in 1 second***	***Velocity (cm/s)***
1						
2						
3						
4						

Table 3- Using three books

Questions to Guide Analysis

1. Create a velocity versus time graph. Graph the velocity and time data from Tables 2 & 3 on the same grid. Use different colors to distinguish each graph. You will be asked to compare the graph lines later.

LEP Modifications:

- *Have the graph pre-made so the students only need to plot their data.*
- *Have students label the graphs.*

2. There are to ways to determine acceleration. Calculate the acceleration of the marble for each height using the formula. You can also determine acceleration by finding the slope of the graph lines. (m= rise/run; a = change in velocity/ time) Show your work both ways.:

$a = \frac{v_f - v_i}{t}$ v_f =velocity final v_i = velocity initial t= time a= acceleration

LEP Modifications:

- *Depending on the level of students, complete this question both ways,* ***together*** *as a class. You can call on student volunteers to come up to the board to help.*
- *You might want to complete this whole worksheet as a class using student volunteers.*

3. What is the main difference between the acceleration graph lines for Tables 2 and 3?

4. How does the angle of the table affect the acceleration of the marble?

5. What are some sources of error in this lab?

6. Using the above formula for acceleration answer the following word problems. Be sure to show ALL work.

   A. A car on a freeway ramp accelerates from 12 meters/second to 24 meters/second in 9 seconds. What was the average acceleration of the car?

   B. A car traveling 30 kilometers/hour hits a deer and stops in 3 seconds. What is the average acceleration of the car?

EXPLAIN:

Have students to work in groups to complete questions. Have students to explain their answers to questions 3-5 to the class.

Note to teacher: If the students explain the answers to their group, the teacher should circulate to each group to ensure the accuracy of the explanations.

Force & Motion
Day 4

Language (ELP) objectives for Limited English Proficient (LEP) Student:

- *Students will orally explain how air resistance affects gravity.*
- *Students will complete a KWL chart in complete sentences.*
- *Students will create and read their book about Newton's Laws.*

ELABORATE:

This lab serves to illustrate the change in velocity, or acceleration and the effect of gravity on various objects when in free fall. This can be used to introduce gravity as a force, weight, mass, acceleration due to gravity, and friction (Friction = Air resistance). The concept of force is very well introduced in this activity as you can ask, "Who knows what pulls the books and paper downward?" They all usually know it is gravity. You can then use this as a starting point to introduce the motion of falling objects.

Book Drop Activity

Essential Question:

What causes objects to accelerate?

- Ask them to explain what caused the objects to hit at the same time as well as why the paper had to be altered in order to hit at the same time.

Book Drop Activity

Do not discuss concepts as they perform the activity!

Materials: Textbooks, notebook paper, various objects such as marbles, paper clips, ping pong balls, whiffle balls, chalk, pencils, etc.

- Students should choose several objects from the room with a variety of masses (be careful that they are not breakable).
- Have a student volunteer stand on a supported ladder and hold two objects at the same height.
- Have the rest of the students predict which will hit first when dropped.
- Drop the pairs of objects several times in order to replicate their results of both hitting the ground at the same time.

- Then have the student volunteer stand on the ladder holding a single piece of paper and a textbook at the same height.
- Have the rest of the students predict which of these will hit first when dropped. Drop book and paper at the same time.
- Ask students why the paper took longer to reach the floor.
- Ask the class how to alter the paper so that it will fall faster.
- Have the student volunteer alter the paper as the class suggested and again drop with book from the same height as before.
- Have the student volunteer a piece of paper on top of the book this time (not altering it in any form) and drop them from the ladder again.
- Ask the students to explain why the paper fell at the same rate as the book rather than slower as before.

After the activity, have the students form small groups and discuss what caused the objects to hit the floor at the same time. Also, have the students to discuss why the paper had to be altered in order to fall like the other objects.

KWL Activity

- This activity allows students to brain storm the reasons behind the rate of acceleration for objects, the effect of air resistance and mass on various objects.

KWL Activity

Use a KWL to determine what they already know about forces.

- A KWL chart is simple to make with your class. Have them take a piece of notebook paper and make a tri-fold. (It does not matter if they fold vertically or horizontally) The K section stands for "I Know" and is used before the activity for students to list everything they think they know about the topic. After the demonstration or activity they can fill in the W section which is "I want to know" to list things they may have questions about. At the end of the day or even further into the unit they can do the L section which is "I have Learned" section to summarize their learning.

LEP Modifications:
- *Have students complete the L section using complete sentences.*
- *Have students take turns reading their L section to the class.*

The teacher should introduce the concepts to the class at this time. There are several concepts that could be mentioned as a result of this activity:

- The concept of force is very well introduced in this activity. For example, the books and paper is pulled down by the force of gravity.
- Air resistance as a force that opposes motion in the opposite direction of the original force.
- Mass and acceleration due to gravity.
- Air resistance as a special type of friction.
- Introduce the students to the laws of motion.

LEP Modifications:
- *Have students write vocabulary words and their definitions. It is better if you and the students come up with your own definitions.*
- *Have the students take the above vocabulary words and make a concept map.*

Newton's Laws Reading/Illustrating Activity

Reading Reinforcement Activity

- Allow students to freely express their ideas in this activity.
- Make sure misconceptions are properly handled at this point in the lesson.
- Do not go too in depth as you are still discovering Newton's Laws.

Newton's Laws Reading/Illustrating Activity

1. Have students read related pages in their textbooks.
2. Have the students illustrate the examples given in the text in their notebooks. They may make up their own examples.

3. Working impairs, have students compare their illustrations of the forces described in the text with those of their partner.
4. Have students write a short description of their partner's illustrations, such as in a comic strip.

LEP Modifications:

- *Have the students work in pairs and read the text to each other.*
- *Have students create a book about the three laws of motion.*
  - *Include explanations and illustrations.*
  - *Present the book to the class.*

FORCE AND MOTION
Day 5 – Newton's First Law of Motion

SAFETY: wet floor (clean up)

Materials: large media cart, clear plastic cup of water (any kind of round ball can be substituted)

Inertia Cart Demonstration
As an introduction to Newton's laws, and specifically inertia, the following demonstration can be used to engage students.

Place a half filled cup of water on a media cart. Be sure to use an unbreakable cup. Have the students observe as you give the cart a good push, ie., force. Have the cart directed at a solid surface such as a wall. Initially, the water will slide back (choosing to stay in place) demonstrating the first part of the law of inertia. Then the water moves in the same direction as the cart and the cup keeps moving as well. This demonstrates that the static friction of the cart on the cup overcomes the inertia. The cart hits the wall and stops, because it hits a larger force applied. (Newton's 2^{nd} law which says an object will accelerate in the direction of the greater force). The water and then the cup keep moving forward until they too encounter a larger force. This can be used as an opener or hook.

Teacher Notes:
As you perform this demonstration ask the students what they know about how objects move as a function of their masses. This serves to introduce them to several concepts: force, net force, applied force, balanced force, inertia, acceleration, constant velocity, etc. Ask the students to identify as many of the concepts as possible that you have already studied in the beginning of this unit on motion.

2. Inertia cards

Materials: index cards, empty plastic beaker or clear plastic cup. 1 single penny, 5 pennies taped together, Scotch tape

Have students place an index card on top of an empty container (a beaker works well) or plastic cup. Before students do this activity, have them record what they think will happen to the penny if the card is removed. Students will lay a penny on top of the card over the middle of the container. Apply a force to the index card with your finger, ie, "flick" the card with your finger. Repeat this step several times so they see the penny consistently fall into the cup directly underneath where it was located on the index card. Have students record what happened. Now, use the 5 pennies taped together and repeat the process. Next, place 5 pennies that are taped together on the index card at the same place as the single penny. Have students predict what will happen when they apply the same amount of force to the index card under the 5 pennies. Ask students to hypothesize what caused the pennies to fall into the container and to explain why the penny fell straight down into the container.

Teacher Notes: it is very important to allow the students to see what is happening themselves! Do not tell them what is going on! This activity gives them the chance to think and hypothesize about inertia in a practical manner. You can extend this activity by having the students to actually try to move a single penny by itself versus the 5 taped pennies. They will actually feel that it takes more force to move the single penny than the 5 pennies. Have them relate the amount of matter in 1 penny versus 5 pennies. Then relate this to the concept of inertia.

FORCE AND MOTION

Day 6

Language (ELP) objectives for Limited English Proficient (LEP) Student:

-Students will read, listen, and write laboratory results and observations.

LEP Modifications:

- *Complete as a class demonstration and lead students in a class discussion on how force, mass, and acceleration are related.*
- *Have students role play an activity that shows Newton's Second Law of Motion.*

2nd Law Index Card Activity

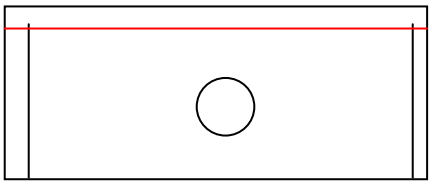
- After the activity, lead students in a class discussion on how force, mass, and acceleration are related.
- Discuss of why a = F/m.
- This also is a good point to compare unbalanced forces, balanced forces and net force. The values will not be exact but the students can get a good idea of actually what a balanced force feels like as opposed to an unbalanced force as they pull (apply a force) on the index card.

2nd Law Index Card Activity

Materials: 3" x 5" index cards, scissors, tape, pennies

Procedure:

1. Have students cut a 3" x 5" index card on each end down to the red line on the bottom. The cut should be about an 1/8th of an inch from each end.
2. Pull each cut side to the side with a balanced force. The strips are surprisingly hard to pull off the index card.
3. Then, accelerate one side and the strip comes off easily.
4. Next, tape a single penny in the middle of the card.



5. Cut the sides again.
6. Repeat the same process, with students recording their predictions in their notes.
7. Next, have students tape 5 pennies that are taped together on top of the single penny.
8. Predict the ease by which the ends will come off.
9. Repeat the same process one more time.
10. Have students explain why the ease of tearing off the ends of the card changed as the mass of the card changed.

LEP Modifications:

- *Read directions orally, model, and complete as a class.*
- *Made a chart for the students to fill out like the one below.*

	Both sides pulled at once	*One side pulled faster*	*One penny*	*Five pennies*
Prediction				
Observation				

- *Have students share their results.*

Second Law of Motion Problems

- Be sure to point out that acceleration as the change in velocity from 0 m/s to really fast is relevant.

- Make sure students are comfortable using formulas as provided on the Support Documents provided by NCDPI.

- Make sure students can solve for all three variables in this formula, $F = ma$.

LEP Modifications:

- *Explain how to solve for all variables, write them on the board.*
- *Review units.*
- *Complete the first practice problem as a class. Ask students to tell you which formula to use, how to set up the problem, and which units to use.*

LEP Modifications:

- *This would be a good time to review all formulas and their units.*
  - *Speed, velocity, acceleration, force*
- *Write the variables and units on index cards. Have students define the variables on the other side of the index cards.*
- *Have students manipulate the variables.*

Second Law of Motion Problems

$$F = ma$$

1. How much force is exerted when a mass of 10 kilograms has an acceleration of 3.0 ms^2?

2. How much force is exerted when a mass of 40 kg is accelerated at 1.5 m/s^2?

3. What is the mass of a rock that has an acceleration of 2.3 m/s^2 after a force of 2300 Newtons has hit it?

4. What is the mass of a cat that accelerates at 1.0 m/s^2 after a force of 100 Newtons has hit it?

5. What is the acceleration of a dog with a mass of 15kg that has a force of 300 Netwons?

Third Law of Motion- Demonstration

Relate this to padding in cars, sports equipment, etc.

SAFETY: hammer and nails

Materials: soft wood block (pine) hammer, small nail, books

1. Place a small nail into a soft piece of wood (pine) by just lightly hammering it into to start it into the wood.
2. Place the wood on 3 or 4 textbooks and put all of this on an object on the table.
3. Have a student that you trust help hold the books on the object and have another student hammer the nail into the wood.
4. This is a 3rd law example as the force of the hammer on the nail is the same force as the nail on the hammer but in the opposite direction.
5. Discuss application of 3rd law in sports equipment, padding, etc. (relevance)

Karate Chop Demo

- This serves as a good example of how the third law is misunderstood.
- The kids will expect the newspaper to fly upwards as the "karate chop" is delivered to the balsa wood.
- Explain that the force of your hand on the wood is equal but opposite to the force of the wood on your hand.
- It also serves as an example that even though we cannot "see" air, it is a mixture of gases that have enough mass to keep the wood from flying upward as the wood is hit in the downward direction.

LEP Modifications:

- *Complete this activity as a demonstration.*
- *Have students read their text book and look at illustrations explaining Newton's Third Law of Motion,*
- *Have students get into groups and create a model to explain the third law.*
- *Present the model to the class.*

Materials: 4” x 1/8” piece of balsa wood, newspaper
Procedure:

1. Place a 4” x 1/8” piece of balsa wood (3 feet long or so) on a lab table.
2. Cover the balsa with a single opened newspaper.
3. With about 4 inches of the balsa sticking out from under the paper and overhanging the lab table, execute a very quick “karate” chop.
4. Follow through as your hand hits the wood and it will break cleanly.
5. Have students explain why the wood breaks in terms of acceleration.
6. Relate a paper cut to them and how it happens.

Scales Lab

- Make sure students calibrate scales to ensure correct readings.
- Allow students to hook more than 2 scales together in order to illustrate this concept.

1. Students have a pair of spring scales.
2. Before they hook the scales together, have students predict what the reading on each scale will be when they are pulled in opposite directions.
3. Have them hook the scales together so that the scales are pulled in opposite directions.
4. Students record the reading on each scale.
5. Repeat so that a series of at least 3 spring scales are attached together and read.
6. Each scale will have the same force reading.

LEP Modifications:

- *Model this activity with a student volunteer.*
- *Explain what spring scales are and what they are used for.*

Laws of Motion Activity

These are station based activities to further explore the Laws of Motion.
You may modify these, as well as other activity files, to suite your lesson.

Laws of Motion Activity

Materials

Station 1- tennis ball

Station 2-notecard, beaker, penny

Station 3- 50 g mass, 500 g mass, 2 carts

Station 4-small stuffed animal, cart

Station 5- ruler, pencil, coin

Safety- remind students to not throw the tennis ball, masses can hurt if dropped on foot

Teacher Notes- have the stations set up around the room and have each group stay at their station until all groups have finished and then call out for them to move to the next station. The student pages follow.

LEP Modifications:

- *Review the three laws of motion.*
- *Read all directions to each lab station. Ask if there are any questions.*
- *Allow students to work in groups.*

Laws of Motion Activities

STATION 1

Drop a tennis ball.

OBSERVATIONS:

EXPLANATION: (include which law(s) apply)

RELATED EXAMPLE:

STATION 2

Put the notecard on top of the beaker and place a penny on the notecard. Hit the notecard from the side in a horizontal motion, quickly and forcefully.

OBSERVATION:

EXPLANATION: (include which law(s) apply)

RELATED EXAMPLE:

STATION 3

Place 1 50 g mass in one cart and a 500 g mass in another cart. Place both carts about 1 meter away from the wall. Push both carts with the same amount of force.

OBSERVATIONS:

EXPLANATION: (include which law(s) apply)

RELATED EXAMPLE:

STATION 4

Place a small stuffed animal in the car. Place the cart & animal about 1 meter away from a wall. Push the cart with enough force for it to crash into a wall.

OBSERVATION:

EXPLANATION: (include which law(s) apply)

RELATED EXAMPLE:

STATION 5

Take a ruler and pencil and place a coin on one end of the ruler. (The pencil is used under the ruler in the center point to create a seesaw.) Now, drop a coin on the other end of the ruler. The other coin already placed on the ruler will jump. Try again, dropping the coin from the same height, but making it strike the ruler at a greater distance from the pencil pivot.
OBSERVATIONS:

EXPLANATION: (include which law(s) apply)

RELATED EXAMPLE:

As a conclusion to Newton's Laws allow students to conduct the following reading reinforcement activity (Newton's Laws Reading / Illustrating Activity).

Newton's Laws Reading / Illustrating Activity
Reading Reinforcement Activity

- Allow students to freely express their ideas in this activity.
- Make sure misconceptions are properly handled at this point in the lesson.
- Do not go too much in depth as you are still discovering Newton's Laws.

1. Have students read related pages in their textbooks.
2. Have the students illustrate the examples given in the text in their notebooks. They may make up their own examples.
3. Working in pairs, have students compare their illustrations of the forces described in the text with those of their partner.
4. Have students write a short description of their partner's illustrations, such as in a comic strip.

FORCE AND MOTION
Day 7 - Work and Power

Which takes more work, walking slowly or walking quickly up a set of steps?

SAFETY: remind students to be careful when going up the steps, also remind them to use the meter sticks for measure only!

Materials: Meter sticks, timers, calculators

1. Divide students into groups of 2 or 3. Take the class to the gym or stadium. Give each group a meter stick and timer. Direct each group to design an experiment, including a data table, to answer the following questions:
    - How high are the steps?
    - How much time does it take to walk slowly up the steps?
    - How much time does it take to walk quickly up the steps?
    - Which takes more work?
    - Are you sure?
    - Does it matter if two different people do the walking?
    - Why? *or* Why not?

LEP Modifications:
- *Have students write their questions on an index card.*
- *Exchange index cards with a neighbor.*
- *Have students answer each other questions.*

2. Go back to the room and take a quick survey of student's answers to the questions. Next have students read the pages in the text pertaining to work and power, write questions they may have, and write one question they can ask someone else.

3. After students have finished reading and writing, ask again, "Which takes more work, walking slowly or quickly up a set of steps?"
   Talk about changes they may have had since reading about the topics.
   Answer any questions they may have, being sure to distinguish between work and power.

4. Present guided practice for work and power, taking time to show and emphasize the units of joule and watt. You can use the data from the activity to calculate for guided practice. Include problems to show weight as the force when lifting as well as problems to show that no motion equals no work.

5. Give independent practice for work and power. Move around the room checking for students who need help. Allow students to compare answers as they finish. Go over answers and have students put work on board as needed, or do it yourself.

6. Instruct students to write a paragraph about what they have learned, have them share with a partner, and then discuss as a class.

Work and Power Problems

- Make sure students can use the following formulas:
  - o $P = \frac{W}{\Delta t}$
  - o $W = F\Delta d$

Work and Power Problems

Read each problem to identify the unknown. Read the problem again and list all given information. Make sure you use the units to help identify the quantities. Look at the symbols in the "given" list and choose a formula. State the formula, substitute the values, and calculate. Show the answer with the correct unit.

1. How much work is done when a 500N object is moved a distance of 120m?

2. How much work is done when you lift a 5kg bag of groceries 1.5m?

3. 50J of work is done on a 100N object. How far does the object move?

4. You push a 15kg table across the floor for a distance of 8m. You exert a horizontal force of 18N. How much work was done?

5. A 480N student climbs the stairs from the second floor to the fourth floor, 16m above, in 22s. How much power did she generate?

6. A 14kg mass is lifted a height of 6.0m in 3 s. How much power is generated?

LEP Modifications:

- *After all students have completed practice problems. Have students go to the board and show their work.*
- *Have students check each others work.*

FORCE AND MOTION
Day 8 – Force, Work (and Mechanical Advantage)

Language (ELP) objectives for Limited English Proficient (LEP) Student:
- *Students will read the text about work and power.*
- *Students will write questions about work and power.*

What Would You Rather Do? (Work and Force Activity)

SAFETY: Make sure that blocks are smooth and without splinters.

Materials: wood blocks with hooks, spring scales, meter sticks, boards for inclined planes, sand paper

Problem: If you had to lift a heavy crate from the ground to the back of a truck, would you rather do it yourself or use a machine?

1. Divide the class into groups of 2 or 3.
2. Give each group the following items: wooden block with a hook in one end (representing a heavy crate), spring scale, meter stick, board to use as inclined plane.
3. Have students design an experiment to answer the following questions:

LEP Modifications:
- *Review the steps to the scientific method and how to design an experiment.*
- *Give examples; help students get started.*

   a. What is the weight of the block?
   b. How much work is done when lifting the block straight up through a distance of 10cm?
   c. How can you use this equipment to help you lift the block through the same height?
   d. How much force is used to move the block when using the equipment?
   e. How much work is done to move the block when using the equipment?
   f. Which takes more force, lifting the block with or without the equipment?
   g. Which takes more work, lifting the block with or without the equipment?
   h. How many times more work does it take?

4. As an extension, have the students vary the length of the ramp or the height of the ramp to investigate how these factors affect the input force

and the amount of work. You can also wrap the block with sandpaper to illustrate the effects of friction on force and work.

Work and Power and Mechanical Advantage Extension

Essential Question: How does mechanical advantage make our lives easier?

- Discuss the applications of machines in everyday life.

Relate the processes that use machines in order to increase efficiency.

1. Have students read the pages in the text pertaining to machines and mechanical advantage.
2. Write questions they may have about the subject.
3. Write one question they can ask someone else.
4. After students have finished reading and writing, ask about changes they may have to the questions about “more force” and “more work.”
5. Emphasize the fact that machines multiply force, not work.
6. Discuss efficiency of machines as well as their applications in everyday life.
7. Answer any questions students may have about mechanical advantage.

Concept Map Activity

Make sure students understand the differences made by using machines in everyday life.

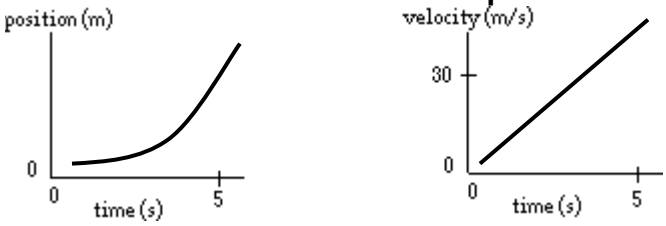
1. Have students construct a concept map to contrast doing work with a machine and doing work without a machine.
2. Share with the class orally or circulate to choose one or two to have students to put the solution(s) on the board.

A quiz on work, power, and mechanical Advantage to check student understanding is an option at this point.

FORCE AND MOTION
Day 9 – Review

FORCE AND MOTION
Day 10 – Test

EVALUATE:
Sample Assessment Questions for Unit 1

Unit	Goal/ RBT Tag	Questions
1	2.01 C3 B4	**1. What is the time it takes a student to run at a velocity of 10.0 m/s over a distance of 200 meters?** a. 10.0 seconds b. 20.0 seconds c. 200 seconds d. 2000 seconds **2. What is the motion that is represented in the graphs below?**  a. the object is accelerating during the entire time b. the object is moving at constant velocity during the entire time c. the object is accelerating initially then moving at a constant velocity d. the object is not moving during anytime time interval
1	2.02 C3 B4	**1. What is the acceleration experienced by a 2 kilogram stone that is hit with a force of 10 Newtons?** a. 20 m/s^2 b. 5 m/s^2 c. 2 m/s^2 d. 0 m/s^2 **2. A book and a sheet of notebook paper are both dropped at he same time from the same height above the level floor. Which of the following best describes the reason why the paper takes**

		longer to hit the floor? a. The paper has more mass than the book. b. The book has less air resistance than the paper. c. The paper and the book both hit the floor at the same time because they have the same air resistance. d. The paper and the book both hit the floor at the same time because they have the same mass.

1	3.02 B4 C3	**1. A rock has a force of 50 Newtons applied to it for one hour. How much work is done on the rock if the rock never moves?** a. 3000 Joules b. 300 Joules c. 50 Joules d. 0 Joules **2. How much power is generated by a 0.50 kilogram book that is lifted 3.50 meters in 4.2 seconds ?** a. 136. Watts b. 7.20 Watts c. 4.08 Watts d. 0.42 Watts