Accomack County Public Schools

High School Science

Learning Plans

These plans are also available on our website:

www.accomack.k12.va.us

Please note: The online portion of these plans is optional.

Activities to Support Instruction During Extended School Closures

The purpose of this document is to provide an overview of suggested activities available to ACPS students. These suggestions can be used by families to support the continuity of education. The learning experiences developed and provided will give students opportunities to go deeper into concepts, ideas, and skills independently. These activities do not require copies or additional supplies.

ACTIVITY #1: NEWTON'S LAWS REVIEW PART I

Online option:

Go to the Forces and Motions: Basics simulation at phet.colorado.edu (it is under Simulations>HTML5).
Click on the play button on the sim.
For each of the following, compose your responses to underlined portions in Google docs or on a piece of paper. For each, label your answers in the following format: **Part 1, a:

Part 1 - Newton's First Law

- Choose the "Motion" window to start the simulation.
- Make sure the boxes that say "Force", "Values" and "Speed" are checked!
    a. Apply a force of 50 N right to the box. Describe the motion of the box using physics terms (i.e. velocity, acceleration, displacement). Refer to the speedometer in your answer.
    b. Reset the scenario (don't forget to check forces, speed again). Apply a force of 50 N to the right for about 5 seconds then reduce the applied force to zero (the man should stop pushing). Don't reset the scenario. Describe the motion of the box. Refer to the speedometer in your answer.
    c. Reset the simulation. Apply a force of 50N to the left. Describe the motion of the box.
    d. Get the box moving to the left at a constant velocity. Make the box stop. Explain the exact steps needed to make the box come to a stop.
    e. **Summary:** Newton's First Law of Motion States "An object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force." Explain how your observations in a - d support this Law.

Part 2 - Newton's Second Law

a. Reset the sim, don't forget to check force, values and speed again. Remove the box and place a garbage can on top of the skateboard. Using your timer/phone, measure the amount of time it takes to reach maximum speed using a force of 50 N. Try this again with forces of 100N, and 200N. Record data in the table below (or copy the table into your Google doc and record data there.)
b. Reset the sim, check force, values, speed and the masses boxes this time. Set the applied force to 200 N Right. Using your timer/phone, measure the amount of time it takes to reach maximum speed. Repeat with two crates, one crate and a garbage can, and a refrigerator. Record your data below.

Data for part a		Data for part b	
Applied Force (N)	**Time To Max Speed (s)**	**Object – Mass (kg)**	**Time To Max Speed (s)**
50		50	
100		100	
200		150	
		200	

c. Go to desmos.com/calculator and then watch this video, which describes how to create a line of best fit. Create a graph of time vs mass for part b, with a line of best fit. Sketch this graph on your paper or capture the image and paste it into your Google doc.
d. **Summary:** Newton's Second Law states "The acceleration of an object as produced by a net force is directly proportional to the magnitude of the net force, in the same direction as the net force, and inversely proportional to the mass of the object." Explain how your observations in both a and b support this Law.

Part 3 - Friction's Effects

The behavior of the skateboard in Part 1 and Part 2 were not very realistic because friction was not present. At the bottom of the screen is a simulation that includes friction. Select this simulation.

a. Set friction to “none”. Notice how the screen changed. Why do you think the app designers did that?
b. Make sure that only the speed box is checked.
    i. Apply a force to get the box to about half of its maximum speed, then remove the force.
    ii. While the box is moving, move the friction slider to 1/2 way.
    iii. What happened to the box?
    iv. **Summary** Is friction a force? What evidence do you have?

Offline option:
Broom Ball @ Home Activity

Official Broom Ball Rules & Regulations:

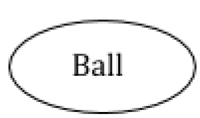
- Create a course in your house that requires you to start a point in your house, and move across the floor to another room.
- Course should include a straight area where you define as a “**No Touch Zone**”, an object you have to completely circle, and at least one 90 degree turn, a start spot, and finish spot where the ball starts and finishes at rest.
- Activity requires you to race other people, so please recruit parents, guardians, and siblings.
- The object of the game is to navigate the course from start to finish in as little time as possible (**avoiding time penalties!**)
- Player must only touch the ball with the bristles of the broom. Using any other part of the broom is a 5 second time penalty!
- Ball must start from rest in the Start box. Ball must be brought to rest at the end in the same box.
- Any ball moving across the side boundary of the “**No Touch Zone**” must be brought back to the **beginning of that “No Touch Zone”** and must successfully navigate that zone before proceeding.

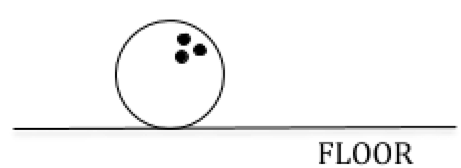
Penalties:
5 seconds - Ball moves across side border of “No Touch Zone”
5 seconds – Ball is touched inside of “No Touch Zone”
5 seconds – Ball touches any wall, lab station, or lab station leg in the classroom
5 seconds – The Ball overshoots the finish line
5 seconds – Ball is touched by something other than the bristles of the broom

Discussion Questions: (Answer on paper.)

1. Describe the motion of the ball as you navigated the course from start to finish. In your description make sure you describe the ball’s direction of motion, speed, velocity, and acceleration. Specifically describe the motion for the following:
    - At rest in the Start box
    - Starting the ball into motion
    - Through the first no touch zone
    - Around an obstacle
    - Through the third no touch zone
    - Right before you enter the Finishing Spot
2. For each of the bulleted stages of in #1, describe what you had to do to produce that motion.
3. For each of the bulleted stages of motion in #1: define the system, draw the system schema (a concept map that defines what all acts on the object), and draw a force diagram. (Example appears below.)

System | System Schema | Force Diagram





4. What can you conclude about the relationship between the motion of the bowling ball and the forces acting on the bowling ball based on your answers to #’s 1, 2, and 3 above?

ACTIVITY #2 - NEWTON'S LAWS REVIEW PART II

Online option:

Go to the Forces and Motions: Basics simulation at phet.colorado.edu (it is under Simulations>HTML5).
Click on the play button on the sim.
For each of the following, compose your responses to underlined portions in Google docs or on a piece of paper. For each, label your answers in the following format: **Part 4, a:

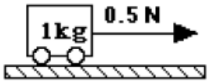
Part 4 - Back to Newton's Second Law

- Reset the Friction app. Make sure Forces and Speed are checked.
  a. Apply a force of 50 N. Describe the movement of the box.
  b. Apply a force of 100 N. Describe the movement of the box.
  c. Apply a force of 150 N. Describe the movement of the box.
  d. Check the box that says "Sum of Forces". Repeat procedures a, b, and c. What was different about c?
  e. Summary: Newton's Second Law states "The acceleration of an object as produced by a net force is directly proportional to the magnitude of the net force, in the same direction as the net force, and inversely proportional to the mass of the object." Explain how your observations relate to the underlined portion of this Law (hint, you might want to look up the definition of the word "net").

Part 5: Friction in Detail

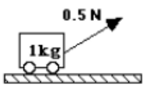
a. Reset the app. Check the force and speed box. Apply 50 N of force to the crate. Slowly click (in 50 N increments) to increase the amount of applied force until the crate starts to move/accelerate. Note the range of force values when the crate first started to move. Record this range (e.g. "starts moving somewhere between 0 and 50 N").
b. Reset the app. Repeat the steps in "a". Once you have just made the crate move do not adjust the force any higher. Allow the block to move with this constant force for 2.0 seconds. Now reduce the force by 50 N. How does the crate behave immediately after reducing the force by 50 N? Did it keep accelerating? Move at a constant speed or decelerate? Does this behavior surprise you based on your knowledge of Newton's 1st and 2nd Law. Why do you think the crate behaves this way?
c. Reset the app. Check the speed, force, sum of forces and values boxes. Adjust the value of the applied force using single Newton increments to determine the exact force required to make the crate move. Mentally note the value of this force so you can record it after in the space below. Now keep increasing the value of the applied force in large 50 N or small single Newton increments. What happens to size of the friction force? What is the value of the friction force now? Why does the friction force behave this way?
d. Repeat step c and after the block has accelerated for 3.0 seconds reduce the applied force to 0 N. What happens to the size of the friction force after the applied force goes to 0 N? How does the crate behave?
e. Reset the app. Check the forces, values and speed boxes. Place another crate on top of the first. Determine the minimum amount of force required to move the crates. Determine the minimum amount of force required to keep the blocks moving at a constant speed. Record these values.
   i. How do these values compare to the values found for one crate? What does this tell you about the affect of mass on friction?
f. Reset the app. Check the force and values boxes. Apply 50 N of force to the crate. What is the value of the force of friction now? Record this. Increase the applied force and note how the friction force behaves. Record this behavior.
g. Summary: Make four or more general statements about the force of friction based on your observations in parts a – f.

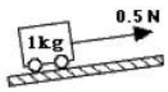
Offline option: Solve each of the following problems. For questions 1-8, consider the cart on a track below. A force is applied acting to the right. Assume that friction can be ignored.



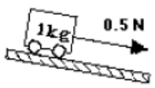
For each question, one or more features of the system has been changed. You are to indicate **what effect the change will have on the acceleration: Will the acceleration *increase*, *decrease*, *remain the same*, or *is it impossible to tell the effect on acceleration*?**

1. The mass of the cart is increased to 2 kg.
2. The towing force is increased to 1.0 N.
3. *Both* the mass of the cart and the towing force are doubled.
4. The 0.5 N towing force is applied at an angle as shown.



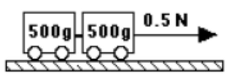


5. The track is inclined as shown.
6. The *length* of the towing string is increased.



7. The track is inclined as shown.

8. The 0.5 N force is applied to two *500 g* carts hooked together as shown.



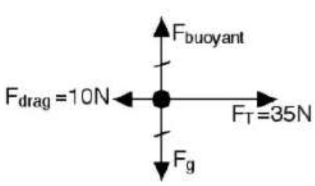
$v_f = at + v_i$ $\quad$ $\Delta x = \frac{1}{2}a\Delta t^2 + v_i\Delta t$ $\quad$ $v_f^2 = v_i^2 + 2a\Delta x$

$\sin\theta = \text{opp/hyp}$ $\quad$ $\cos\theta = \text{adj/hyp}$ $\quad$ $\tan\theta = \text{opp/adj}$

$P = F/A$ $\quad$ sum of forces $= F_{net} = ma$ $\quad$ $F_{friction} = \mu F_{normal}$

<u>Show your work</u>:

9. The force diagram is for a 10 kg object. Determine its acceleration.



10. A horizontal force of 750 N is needed to push a 250 kg crate across a level floor at constant speed. What is the coefficient of friction?

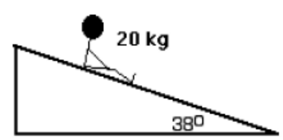
11. A 700 kg car accelerates from rest to a speed of 45 m/s in 9.0s. Determine the net force on the car.

12. A football player hits a 75 kg training sled with 200 Newtons of force applied parallel to the ground. The coefficient of friction, μ, is 0.20.
    a. Draw a qualititative force diagram for the sled.
    b. Calculate the acceleration of the training sled.
    c. The player maintains 200 N of force on the sled for 5 seconds. How fast will the sled be moving after 5 s if it started from rest?

13. You push your lawnmower (mass = 15 kg) across the lawn at constant speed. To do so, you must exert 120 N of force on the handle. The handle makes a 35° angle with the horizontal.
    a. Make a big **qualititative** force diagram for the lawnmower.
    b. Calculate the horizontal component of the force you apply.
    c. How does size of the horizontal component of the force you apply to the lawnmower compare to the size of frictional force on the lawnmower? Briefly explain why.
    d. Write an equation for all of the vertical forces on the lawnmower.
    e. Calculate the size of the normal force.

14. A 70 kg box is pulled by a 300 N force at an angle of 30° above the horizontal. The frictional force is 140 Newtons.
    a. <u>Draw a qualititative force diagram!!</u>
    b. Find the acceleration of the box in the horizontal direction.
    c. Find the normal force on the box.

15. A 20 kg child slides down a hill where the coefficient of friction is 0.25.



    a. Draw a qualititative force diagram for the child.
    b. Determine the acceleration of the child. Show your work.
    c. Determine the value of the coefficient of friction that would give the child an acceleration of 0.5 m/s^2.