Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Hour \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 **“Understanding Car Crashes: It’s Basic Physics”**

**Content Language Objective:** I can identify and apply key concepts in physics.

**Writing Language Objective:** I can apply physics concepts while analyzing comprehension questions.

**Directions:** While viewing the video, fill in the blanks or circle the correct answer.

The video link can be found on Ms. Murphy’s blog.

1. Why did the dummy get left behind? It’s called \_\_\_\_\_\_\_\_\_\_\_, the property of matter that causes it to  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

2. Isaac Newton’s (circle one) **1st 2nd 3rd** Law of Motion states: A body at rest remains at \_\_\_\_\_\_\_\_\_\_\_\_\_\_ unless acted upon by an external \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and a body in \_\_\_\_\_\_\_\_\_\_\_\_\_\_ continues to move at a constant \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in a straight line unless it is acted upon by an external force.

3. Watch as the car crashes into a barrier. The front end of the car crushing and absorbing \_\_\_\_\_\_\_\_\_\_\_\_\_ which slows down the rest of the car.

4. In this case, it is the steering wheel and windshield that applies the \_\_\_\_\_\_\_\_\_\_\_ that overcomes the dummy’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

5. Newton explained the relationship between crash forces and inertia in his (circle one) **1st 2nd 3rd** Law of Motion. (Fill in the blanks to explain what each letter in the formula represents.)

 F = \_\_\_\_\_\_\_\_\_\_\_\_\_\_       F=ma                    m= \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

           A = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 F= mv     v   =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Ft= \_\_\_\_\_\_\_\_\_\_\_\_\_\_       Ft=m v                    mv =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6. Momentum is \_\_\_\_\_\_\_\_\_\_\_\_\_\_ in motion. It is the product of an object’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and its \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

7. Which has more momentum? An 80,000 pound big rig traveling 2 mph or a 4, 000 pound SUV traveling 40 mph? (circle one) **Big Rig  SUV  same**

8. What is it that changes an object’s momentum? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. It is the product of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for which it acts.

9. If the eggs are of equal mass and are thrown at the same velocity they will have the same \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The wall and the sheet both apply equal \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

10. The wall applies a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ force over a \_\_\_\_\_\_\_\_\_\_\_\_\_ time, while the sheet applies a \_\_\_\_\_\_\_\_\_\_\_\_ force over a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ time.

11. With panic braking the driver stops in less time or distance and experiences more \_\_\_\_\_\_\_\_\_\_\_\_\_.

12. The second animated vehicle’s front end is less stiff so it crushes two feet instead of one , causing the deceleration to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

13. Extending the time of impact is the basis for many of the ideas about keeping people safe in crashes. List three applications in vehicle or highway safety.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

14. In a collision of two cars of unequal mass, the occupants of the lighter car would experience much higher \_\_\_\_\_\_\_\_\_\_\_\_\_\_, hence much higher \_\_\_\_\_\_\_\_\_\_\_\_\_ than the occupants of the heavier car.

15. Motion related energy is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Energy due to an object’s position or conditions is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

16. At what point in the pendulum’s swing is its potential energy equal to its kinetic energy? \_\_\_\_\_\_\_\_\_\_\_\_\_ When is its kinetic energy at its maximum? \_\_\_\_\_\_\_\_\_\_\_\_\_\_

17. What is the correct formula for kinetic energy (KE) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Directions Step 2**: After viewing the video, answer the following questions on a separate piece of paper and attach when complete. Be sure to write using complete sentences and a restate.

1. Ever tried to stop a 150 pound cannonball fired towards you at 30 mph? No, probably not. But you may have tried to brace yourself in a car collision. How are the two situations similar?
2. Show mathematically why an 80, 000 pound big rig traveling 2 mph has the SAME MOMENTUM as a 4,000 pound sport utility vehicle traveling 40 mph.
3. During the Egg-Throwing Demonstration, which egg experience the greater impulse, the egg that hit the wall of the bed sheet? (Be careful here) Which egg experienced the greater force of impact? Which egg experiences the greater time of impact?
4. Explain how the fortunate race car drivers survived their high speed accidents.
5. Describe other examples where momentum is reduced by applying a smaller collision force over a longer impact time (or where things “given away” during a collision to less the impact force)?
6. Which would be more damaging to your car: having a head-on collision which an identical car traveling at an identical speed or driving head on into the Vehicle Research Center’s 320,000 pound deformable crash barrier. Explain?
7. The Law of Conservation of Energy States: energy cannot be created or destroyed; it can be transformed from one form to another but the total amount of energy never changes. Car crashes can involve huge amounts of energy. How does the crashworthiness of the car affect the transfer and transformations of the energy and, ultimately, protect the occupants?