Dear parents or guardians,

Your son's or daughter's science class will soon begin exploring a unit entitled "Forces and Motion". In this unit, students will learn about the nature of forces and how forces act on objects to impact their motion. By the end of the unit, students should demonstrate a clear understanding of the unit's main ideas and should be able to discuss the following topics:

1 the relationship between motion and a reference point

- *Motion can be thought of as a change in position from a specific reference point. Motion is a relational measurement, which means that an object cannot be said to be "in motion" without having a reference point to which it is moving towards or away from*

2 two factors that speed depends on

- *An object's speed depends on the distance it travels and the time it travels*

3 the difference between speed and velocity

- *Speed and velocity are essentially the same except velocity includes the direction the object is moving.*

4 the relationship of velocity to acceleration

- *Acceleration is the change in velocity over time. Any change in velocity results in an increase or decrease in speed.*

5 how to interpret a graph showing acceleration

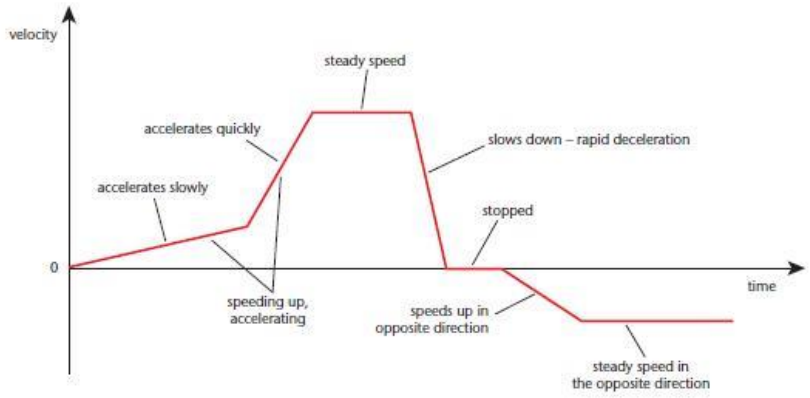


Fig. 9.2 A velocity–time graph.

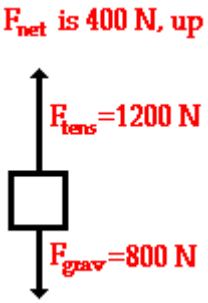
6 examples of different kinds of forces

- *Normal force (the force of an object pushing up against you or another object), applied force, gravity, air resistance, friction, electrical, magnetic*

7 how to determine the net force on an object

- *An object at rest tends to stay at rest and an object in motion tends to stay in*

motion with the same speed and in the same direction unless acted upon by an unbalanced force. An unbalanced force is commonly called a net force *acting. The net force is the vector sum of all the forces that act upon an object. Here is an example:*



8 the differences between balanced and unbalanced forces

- *Balanced forces are equalized and do not result in a change of motion of an object. Unbalanced forces (like in the diagram above) are not equal and result in a change in an object's motion.*

9 why friction occurs

- *Friction occurs when two surfaces come into contact with each other*

10 the types of friction and examples of each type

- *Rolling friction- wheels of a car on the pavement*
- *Sliding friction- moving a box across a floor*
- *Fluid friction- ice skates melt ice into a thin layer of water over which they glide*
- *Static friction- acts of objects when they are resting on a surface (i.e. between your feet and the floor)*

11 the ways in which friction can be harmful and the ways in which it can be helpful

- *Helpful: Static friction between our feet and the ground allow us to walk without slipping; the brakes on our car bring us safely to a stop*
- *Harmful: a lot of friction between the parts of a machine could cause it to break*

12 the definition of *gravity*

- *gravity is the force that attracts any body towards any other body that has mass*

13 the law of universal gravitation

- *every object in the universe attracts every other object in the universe. The amount (force) of the attraction depends on the mass of the object and the distance between them.*

14 the difference between mass and weight

- *mass is a measure of how much matter is in something. Weight is the measure of gravity pulling down on that matter.*

15 how gravity and air resistance affect the acceleration of falling objects

- *Gravity pulls objects toward the surface of the Earth. If there were no air resistance (the force of air against the object), objects would fall at the same acceleration (9.8 meters per second per second). This is called free fall. However, objects do experience air resistance depending on their surface area and speed, which causes negative acceleration (slowing down).*

16 why objects in orbit appear to be weightless

- *Objects in orbit are not weightless and are actually falling. But they don't fall **to** the Earth because of their huge orbital velocity. Instead, they fall **around** Earth. Objects in Earth orbit have to travel at least 28,160 km/h (17,500 mph). So, as they accelerate towards the Earth, the Earth curves away beneath them and they never get any closer and hence appear to be weightless*

17 how an orbit is formed

- *Orbits are the result of a perfect balance between the forward motion of a body in space, such as a planet or moon, and the pull of gravity on it from another body in space, such as a large planet or star. An object with a lot of mass goes forward and wants to keep going forward; however, the gravity of another body in space pulls it in.*

18 projectile motion

- *Projectile motion is the motion of a "thrown" object (baseball, bullet, or whatever) as it travels upward and outward and then is pulled back down by gravity. It is a combination of vertical motion with constant acceleration (free fall that we have already discussed) and horizontal motion with constant velocity.*

19 Newton's laws of motion and how these laws apply to the world

- *First Law of Motion [Law of Inertia] An object at rest will remain at rest and an object in motion will remain in motion, with constant velocity, unless acted upon by an external, non-zero force.*
    - *When driving in your car, if you slam on the breaks, you continue to move forward in motion, unless your seatbelt acts upon you to change your motion (stop you from moving forward)*
- *Second Law of Motion [F = ma] The acceleration of an object is directly proportional to the net force acting on the object and indirectly proportional to the mass of the object.*
    - *It takes longer to negatively accelerate (slow down) a Ford F150 than a Smart car.*

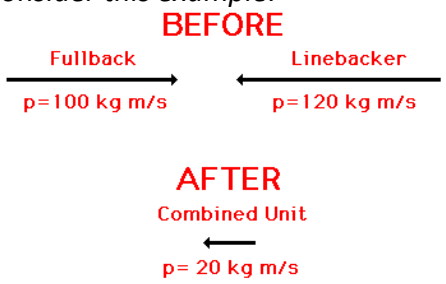
- *Third Law of Motion [Force Pairs] When 2 objects interact, the force exerted by the 1st object on the 2nd is equal in magnitude, but opposite in direction to the force exerted by the 2nd object on the 1st .*
    - *When you kick a soccer ball, your foot exerts a force on the ball and the ball exerts an equal and opposite force on your foot.*

20 the momentum of different objects

- *Momentum describes how much motion an object has. Objects at rest have no momentum. Lighter or slower objects have less momentum than heavier or faster objects.*

21 the law of conservation of momentum and how it applies to the world

- *The total momentum of a system remains constant, meaning the momentum of the two or more objects in a system is the same before the collision as after the collision. Consider this example:*



Questions to Ask Along the Way

You should encourage your kids to generate and investigate their own questions about forces and motion as you work with them. As needed, you can facilitate this process by asking them questions like the ones below:

- What forces allow the space shuttle to orbit the Earth?
- When you throw a ball at a target why should you aim above the target?
- Is speed the same thing as acceleration?
- What is a newton?
- How does friction help you walk around?
- Why are the definitions for “mass” and “weight” so confusing?

Thank you for your time and interest. Your participation in your child’s education is a sure way to encourage learning!