GRAVITY QUIZ REVIEW

The most surprising and misunderstood aspect of free fall is that light objects can fall at the same rate as much heavier objects. In a vacuum, a feather falls as quickly as a hammer! But why do objects of different weight fall at the same rate? Suppose a rock is 100 times more massive than a pebble. It would take 100 times as much force to move the rock as it would take to move the pebble. If the gravitational forces on the two objects were equal, the pebble would fall more quickly. But the force of gravity is not the same on all objects. The force of gravity on an object, also called its weight, is proportional to the object’s mass. Therefore, the rock is being pulled by 100 times as much force as the pebble, and they will fall at the same rate. In air, the motion of falling objects is opposed by the frictional force of air resistance. Air resistance depends on the surface area of the falling object. If two objects have the same mass, air resistance will slow the object with larger surface area more. The faster an object is moving, the greater the air resistance. This resistance cancels some of the gravitational force so the object does not speed up quite as much. As the object goes faster and faster, air resistance cancels more and more of the gravitational force, so it speeds up less and less. It gets closer and closer to terminal velocity. An object never actually reaches terminal velocity, but it does not take long for it to get very close to it. Two objects with the same surface area, such as a golf ball and a ping pong ball, experience the same force of air resistance. But the less massive object (the ping pong ball) is slowed down more. Massive objects, such as runaway trains, take a lot of force to stop! This explains why the golf ball falls more quickly than the soccer ball without a parachute but more slowly with a parachute. Without a parachute, the soccer ball has much greater air resistance than the golf ball, so it is slowed more than the golf ball. With a parachute, the air resistance of each ball is about the same. The golf ball, which is lighter, is slowed down more.

What kinds of objects seem to fall more quickly in air? Slowly? • What happens in a vacuum? Why do you think that is? • Why does it hurt more if you jump from a roof than if you jump from a chair? (This question gets at the concept of objects accelerating as they fall.) • What two factors affect the terminal velocity of an object? • Without a parachute, a golf ball falls more quickly than a soccer ball. With a parachute, the soccer ball falls more quickly. Why is this?

Activity A – Students discover that all objects fall at the same rate in a vacuum. • Activity B – Students explore the concepts of air resistance and terminal velocity. • Activity C – Students determine how parachutes affect air resistance and terminal velocity.