

# Physics Reading Article Bundle – Grade 8 and Up

## Scientific Reading Comprehension Articles

- Improve your students Scientific Literacy
- Use as an Emergency Substitute Plan
- Tackle literacy and Science
- Each reading comes with comprehension questions as well as critical thinking, connecting, and open-ended questions



# Each reading contains 3-5 pages of text followed by comprehension and extension questions.

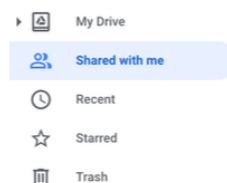
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| <h3>Automobile Safety</h3> <p><b>Automobile Crashes</b></p> <p>Worldwide, almost 1.3 million people die in road accidents a year, which comes out to an average of 3,287 deaths per day. In the United States alone, more than 37,000 people die in traffic accidents. Automobile crashes injure or disable a further 20-50 million people worldwide and 2.35 million in the United States annually. While those are large numbers, they would be larger without airbags and seat belts, which prevent additional deaths and injuries. Moving vehicles are dangerous because of the amount of <b>momentum</b> they possess.</p> <p><b>What is Momentum?</b></p> <p>Momentum is a vector quantity, meaning that it has both <b>magnitude</b> (size) and direction. Simply put, it is the movement of <b>mass</b> (stuff) in a direction. Any object that is made of stuff and is moving has momentum. How much momentum an object possesses is determined by its mass and <b>velocity</b> (speed in a direction). In fact, momentum (<math>p</math>) is the product of mass (<math>m</math>) and velocity (<math>v</math>)</p> $p = m \times v$ <p>A larger moving object has more momentum than a smaller moving object. However, a smaller moving object has more momentum than a stationary larger object. According to Newton's first law, unless an outside force acts upon a moving object, it will continue moving at the same speed and in the same direction (the same velocity). So, until a force acts on a moving object, it will keep its momentum.</p> <p>When a moving object collides with another object, the force of the impact changes the velocity, and thus the momentum, of the moving object. However, the momentum of the moving object - we'll call it object A - combines with that of the other object - object B - because momentum is conserved. This means that the total momentum of the two objects doesn't change, but the individual momentums of each object do. So, if object A is a 1000-kg car traveling east at 20 m/s and object B is a 1000-kg car traveling west at 20 m/s, their momentums will combine to fully stop both cars. This, in an isolated system (one on which no external forces act):</p> $P_{A1} + P_{B1} = P_{A2} + P_{B2}$ | <p>The concept of conservation of momentum is used in pool as well as Newton's cradle desktop toys.</p> <p>The force of a collision acts over some period of time, and the product of these (force (<math>F</math>) and time (<math>t</math>)) is called <b>impulse</b> (<math>I</math>). This impulse is equivalent to the change in momentum experienced by an object.</p> $I = F \times t$ $\Delta p = m \times \Delta v$ $F \times t = m \times \Delta v$ <p>The greater the momentum, the greater the impulse required to stop it. Breaking this down, the larger or faster an object is moving, the more force and/or time is required to stop it. Greater force requires less time, while a longer duration of time results in less force felt by the object.</p> <p><b>What Happens in an Automobile Crash?</b></p> <p>When a vehicle crashes into another vehicle, wall, guardrail, or other object, it loses forward momentum or gains reverse momentum very quickly. This means that it experiences a lot of force. This force acts on the vehicle itself as well as everything inside the vehicle, including passengers. Airbags and seat belts work together to minimize the force experienced by passengers. The force a passenger would experience without any safety features would come in the form of striking the dashboard or windshield (retrocurves), headfirst. Nearly all automobile-related deaths are due to such strikes, called <b>blunt force trauma</b>.</p> <p><b>How Do Airbags and Seat Belts Protect Passengers?</b></p> <p><b>Airbags</b> minimize force, both airbags and seat belts lengthen the time over which the force is experienced. They accomplish this in different ways.</p> <p>Airbags are nylon sacks coated with powder and folded into a compartment in the center of the steering wheel and the passenger-side dashboard. Some cars have additional side airbags in the seat and door. One end of the bag is attached to a small chamber with an explosive chemical and a heating element. An electrical circuit connects the heating element with a sensor that detects the vehicle's speed, and, by extension, any sudden deceleration. It is programmed to trigger the heating element when the vehicle decelerates at the rate it would upon impact with a brick wall from a speed of 16-24 km/hr (10-15</p> | <p>mi/hr). The heating element ignites the explosive chemical, which blasts gas into the bag, rapidly inflating it. Airbags inflate at up to 322 km/hr (200 mi/hr), forcing off the plastic compartment cover and ballooning out in front of the steering wheel. Impact to inflation takes about 1/25 of a second. As mentioned previously, an object will remain in motion unless something stops it. When a vehicle crashes into something and stops, everything within the vehicle that isn't strapped down will continue moving at the original velocity of the vehicle. This includes passengers' heads. When a person hits the airbag, tiny holes in the fabric allow gas to escape slowly, lengthening the duration of the impact and reducing the force the person feels.</p> <p><b>Seat belts</b> are a little different. They serve two functions. The first is to keep passengers' bodies connected to the vehicle so they don't fly through the windshield in a collision. The second is, as mentioned, to lessen the force felt by passengers in a crash. When the vehicle stops suddenly, the seat belt allows some forward motion, but there is a little give. This increases the duration of impact with the belt itself while keeping passengers strapped in.</p> <p><b>How Effective Are Airbags and Seat Belts?</b></p> <p>A 2015 estimate suggests that frontal airbags save 29% of drivers and 30% of front-seat passengers (13 and older) in vehicle crashes. Seat belts reduce the likelihood of death by 45%. The combination of airbags and seat belts raises this number to 51%. It is estimated that frontal airbags had prevented 44,869 deaths by 2015. Side airbags saved 2,252 lives by 2012 and are most effective (in terms of reducing death risk) in sport utility vehicles (SUVs).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <p><b>Reading Comprehension Questions:</b></p> <ol style="list-style-type: none"><li>1. How many people die in road accidents worldwide each year?</li><li>2. How many people are injured or disabled in traffic accidents worldwide each year?</li><li>3. What is momentum?</li><li>4. What is a vector quantity?</li><li>5. What does Newton's first law tell us about momentum?</li><li>6. What is impulse?</li><li>7. What do airbags and seat belts work together to do in a crash?</li><li>8. Simply, how do airbags and seat belts minimize force?</li><li>9. What impact equivalent is the sensor programmed to respond to?</li><li>10. How do airbags lengthen the duration of impact?</li><li>11. What are the two functions of seat belts?</li><li>12. By what percent is the risk of death in a crash reduced by airbags and seat belts together?</li></ol> <p><b>Extension Questions</b></p> <ol style="list-style-type: none"><li>13. Imagine you have a friend who doesn't like to wear their seat belt. What would you tell them? How would you explain the importance of seat belts? Use physics!</li><li>14. Think of one or two additional safety measures for automobiles to further reduce the risk of death in a crash. How would they work?</li><li>15. Create a diagram showing how airbags work. Check out <a href="http://caveira.com">caveira.com</a> for templates.</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p><b>Reading Comprehension Questions: Answer Key</b></p> <ol style="list-style-type: none"><li>1. How many people die in road accidents worldwide each year? ~1.3 million</li><li>2. How many people are injured or disabled in traffic accidents worldwide each year? 20-50 million</li><li>3. What is momentum? The movement of mass in a direction; the product of mass and velocity.</li><li>4. What is a vector quantity? A quantity that has both magnitude and direction.</li><li>5. What does Newton's first law tell us about momentum? A moving object will keep its momentum unless it is acted on by an outside force.</li><li>6. What is impulse? The product of force and time; a force acting over an amount of time.</li><li>7. What do airbags and seat belts work together to do in a crash? Minimize the force experienced by passengers.</li><li>8. Simply, how do airbags and seat belts minimize force? By lengthening the duration of time over which the impact (force) is felt.</li><li>9. What impact equivalent is the sensor programmed to respond to? A vehicle crashing into a brick wall at a speed of 16-24 km/hr.</li><li>10. How do airbags lengthen the duration of impact? By slowly deflating upon impact with a person.</li><li>11. What are the two functions of seat belts? To strap passengers in and increase the time of impact with the belt itself by stretching a little.</li><li>12. By what percent is the risk of death in a crash reduced by airbags and seat belts together? 51%</li></ol> <p><b>Extension Questions</b></p> <ol style="list-style-type: none"><li>13. Imagine you have a friend who doesn't like to wear their seat belt. What would you tell them? How would you explain the importance of seat belts? Use physics! <b>Various answers; they must demonstrate an understanding of the concepts presented in the reading.</b></li><li>14. Think of one or two additional safety measures for automobiles to further reduce the risk of death in a crash. How would they work? <b>Various answers.</b></li><li>15. Create a diagram showing how airbags work. Check out <a href="http://caveira.com">caveira.com</a> for templates. <b>Various answers.</b></li></ol>                                                                                                                            | <p><b>References</b></p> <p>Association for Safe International Road Travel. (2017) "Road Crash Statistics." <i>Road Safety Facts</i>. Retrieved 13 Dec 2017 from <a href="http://iaia.org/initiatives/initiative-road-safety/">http://iaia.org/initiatives/initiative-road-safety/</a></p> <p>Rutala, M.L. (2016) "Forensic Autopsy of Blunt Force Trauma." <i>Pathology</i>. Retrieved 13 Dec 2017 from <a href="http://www.ncbi.nlm.nih.gov/pmc/articles/PMC5019777/">http://www.ncbi.nlm.nih.gov/pmc/articles/PMC5019777/</a></p> <p>BBC. (2014) "Conservation of momentum." <i>Bitesize</i>. 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Retrieved 13 Dec 2017 from <a href="http://www.physicsclassroom.com/mmedia/newtonsws/c114.cfm">http://www.physicsclassroom.com/mmedia/newtonsws/c114.cfm</a></p> <p>Woodford, G. (2017) "Airbags." <i>Explains The Stuff</i>. Retrieved 13 Dec 2017 from <a href="http://www.explainsstuff.com/airbags.html">http://www.explainsstuff.com/airbags.html</a></p> |

# Buyer Comments From My Science Comprehension Readings

- "I hesitated to buy this, but bit the bullet and did it anyway. It has been my GO TO homework! As a science teacher, it can be really hard to find reading that holds their attention and improves reading skills. Thanks!"
- "Excellent balance of articles. I was looking for some good readings to teach science reading comprehension. Liked the variety of questions."
- "I use these as once a week assignments in my science class and they are great. Thank you for putting this all together."
- "I love these readings"
- "Awesome, awesome, awesome bundle!"
- "These are so professional looking with great information! Thanks for the great offer!"
- "EXACTLY what I NEEDED! Thank you!!!! AWESOME job!!! Great rigor and flexibility!"
- "Thanks, this is a great addition to my science and health units."

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