Lesson 8 Teacher Reference Timeline Development

In this lesson, students work to build timelines of collision events accompanied by velocity data. Take time to familiarize yourself with the development of the timelines below and the space required to build the timelines. Make sure that you have an easily erasable space to build these timelines, as students will adjust based upon new data in each step. Further instructions on how to build the timelines can be found in the Lesson 8 *Teacher Guide*.



Next, students will add ideas about velocities of the vehicle and the occupants systems. Record the initial and final and changes in velocities for the vehicle and the occupants in a table near your initial timeline. Note that "occupants" is used to reduce confusion later, since we will be switching between the people in the video and the crash test dummy in the animation.

Develop Vehicle Timeline (animation)

Play the animation for the students (https://youtu.be/R7rlShd7aKk). Use the time ticker on the video to determine the timing of the events.

Start by creating a new timeline for the vehicle. Draw this line longer than the previous timeline and across the upper part of the board so that two more timelines will fit below it. Record the times for when the vehicle hits the wall (approximately 0.558 s) and when the vehicle comes to a stop (approximately 0.620 s). Be sure to leave space after the vehicle stops so that the time scales on the next timelines can line up.

	Vehicle	Occupants	
Initial velocity	40 mph	40 mph	
Final velocity	city <mark>0 mph</mark> 0 m	0 mph	
Change in velocity	-40 mph	-40 mph	



It is OK if student timings are off the suggested timings by a hundredth of a second or so. Don't force students to choose the exact suggested time.

Develop Crash Test Dummy Timeline

Students will then collectively construct the timeline for the crash test dummy with seat belt and airbag. Use the same timescale as the vehicle timeline, placing the new events relative to the times on the vehicle timeline.

Approximate times for events

- 0.88 s Crash test dummy collides with seat belt
- 0.92 s Crash test dummy collides with airbag
- 0.94 s Crash test dummy starts to move backwards
- 0.99 s Crash test dummy stops moving

Compare Vehicle Timeline without Safety Features

Compare vehicle timings with and without safety features. Play the animation without safety features (https://youtu.be/rjICpd7SkIA) and ask students to specifically pay attention to the timing of the vehicle to see how





Play the animation without safety features (https://youtu.be/rjlCpd7SkIA) and ask students to focus on the timing for the crash test dummy. Add these events to the third timeline:	Vehicle Timeline with and without seat belt and airbag	0.558 s vehicle hits wall	0.620 s vehicle stops			
 0.619 s Crash test dummy collides with steering wheel 0.624 s Crash test dummy stops moving 	Dummy Timeline with seat belt and airbag	0.563 s 0.600 s dummy dumm collides collide with airbag seat belt	s 0.634 s y dummy starts s with to move backwards	0.690 s dummy hits seat	0.762 s dummy stops	
	without seat belt and airbag	0.619 s dummy collides wit ste <mark>e</mark> ring wheel	0.624 s dummy th stops			
Add Velocity Data to Timelines After discussing the velocity data and observations as a class, come to a consensus about what velocity data would be helpful to include on the timeline and add this information. The example to the right shows the option of adding changes in velocity between events. Take a moment to note that in order to						

between when the crash test dummy Vehicle Timeline 40 mph 0 mph collides with the seat belt and when it with and without comes to a stop before starting to seat belt 0.558 s 0.620 s move backwards when looking at the and airbag vehicle stops vehicle hits wall safety features timeline. **Dummy Timeline** 40 mph 35 mph 0 mph -29 mph 0 mph with seat belt and airbag 0.563 s 0.600 s 0.634 s 0.690 s 0.762 s dummy dummy dummy starts dummy dummy collides collides with to move hits seat stops with airbag backwards seat belt **Dummy Timeline** 0 mph 40 mph without seat belt and airbag 0.619 s 0.624 s dummy dummy collides with stops steering wheel **Create Poster of Timelines** After your class has finished developing the timelines, create a reference copy of the timelines on a piece of chart paper as a classroom artifact. Title the poster "Vehicle Collision Timelines". The chart paper version won't be easily readable from across the room, but it will serve as a reminder, and students can reference their science notebooks

for details. When creating the poster,
focus on making the differences in
timing with and without safety features
clearly visible.