

**Vocabulary:** Doppler shift, frequency, pitch, sonic boom, sound waves, wavelength

Highlight your answers in either **GREEN** / **BLUE** / OR **YELLOW**

**Prior Knowledge Questions** (Do these BEFORE using the Gizmo.)

*Have you ever heard a siren on a moving ambulance, fire truck, or police car? If so, what happens to the sound as the vehicle passes by?*

*Sometimes when cars are passing I usually hear the car running and sometimes I hear the horn of the car.*

The change in the sound that you hear is called the **Doppler shift**.

### Gizmo Warm-up

The Doppler Shift Gizmo illustrates why the Doppler shift occurs. The Gizmo shows a vehicle that emits **sound waves** and an observer who will hear the sounds.

- Click the **PLAY SAMPLE** button (  ). (Check that the Gizmo's sound and your computer's speakers are on.)

**What do you hear?**

*I hear I police siren*

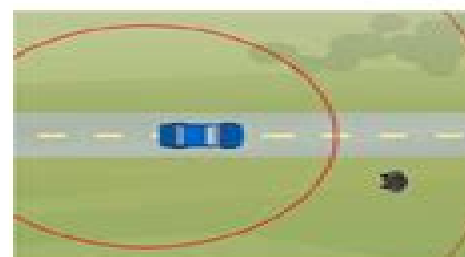
- Click **Play** (  ) and observe the sound waves emitted from the moving car. Click **Pause** (  ) and compare the sound waves in front of and behind the car. **What do you notice?**

*Something that I notice is the length between them is about 900cm*





- Use the **Ruler** to measure the **wavelength**, or the distance between the lines, of the waves in front of and behind the car. (Note: The red circles represent every thousandth wave.)

Wavelength in front of car: 600 cm

Wavelength behind car: 900 cm



Why do you think the waves in front of the car have a shorter wavelength than the waves behind the car? *I think that the reason that the front is shorter than the back is because the car is chasing the waves and the waves in the back are running away from the car.*

<b>Activity A:</b> The Doppler shift	<p><u>Get the Gizmo ready:</u></p> <ul style="list-style-type: none"> <li>Click <b>Reset</b> (  ).</li> <li>Check that <math>f_{\text{source}}</math> is set to 500 Hz and <math>v_{\text{sound}}</math> is set to 340 m/s, close to the actual speed of sound.</li> <li>Set <math>v_{\text{source}}</math> to 0 m/s.</li> </ul>	<div> <math>f_{\text{source}}</math> (Hz)  </div> <div> <math>v_{\text{source}}</math> (m/s)  </div> <div> <math>v_{\text{sound}}</math> (m/s)  </div>
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# Answers For Doppler Shift Gizmo Answers

**Florian Ion Petrescu**

A red circular graphic with a gradient, appearing as a semi-circle or a partial circle, located to the right of the author's name.

## Answers For Doppler Shift Gizmo Answers:

*Away (Vol 1: Beginnings & Vol 2: Keepers of the Alliance)* Norman Oro, 2013-04-26 For the first time ever the complete *Away* saga Volume 1 *Beginnings* and Volume 2 *Keepers of the Alliance* is now available in one book Spanning over fifty years *Away* chronicles the adventures of quantum physicist Alberto Rys Stumbling upon a scientific breakthrough that could revolutionize the transportation of people resources goods and even information around the globe Dr Rys begins a quest to realize the discovery's full potential He's eventually joined by a group of equally brilliant and idiosyncratic souls who help him to rapidly develop the technology However as they near their goal they find themselves suddenly entangled in a web of deceit that shatters their team and inadvertently brings Dr Rys to the faraway world of Onav There he encounters the ghostly remnants of a once mighty interstellar alliance and learns of the invincible race of predators who almost destroyed it the Grell Dr Rys is then asked to make a choice that will reverberate throughout humanity Will Earth join the struggle against the Grell or will the disembodied spirits of Onav forever be all that remains of the Alliance Car and Driver, 1980 **The Doppler Effect** Thomas Perrott Gill, 1965 A New Doppler Effect Florian Ion Petrescu, 2012 The Doppler effect or Doppler shift named after Austrian physicist Christian Doppler who proposed it in 1842 in Prague is the change in frequency of a wave for an observer moving relative to the source of the wave It is commonly heard when a vehicle sounding a siren or horn approaches passes and recedes from an observer The received frequency is higher compared to the emitted frequency during the approach it is identical at the instant of passing by and it is lower during the recession The relative changes in frequency can be explained as follows When the source of the waves is moving toward the observer each successive wave crest is emitted from a position closer to the observer than the previous wave Therefore each wave takes slightly less time to reach the observer than the previous wave Therefore the time between the arrival of successive wave crests at the observer is reduced causing an increase in the frequency While they are travelling the distance between successive wave fronts is reduced so the waves bunch together Conversely if the source of waves is moving away from the observer each wave is emitted from a position farther from the observer than the previous wave so the arrival time between successive waves is increased reducing the frequency The distance between successive wave fronts is increased so the waves spread out For waves that propagate in a medium such as sound waves the velocity of the observer and of the source is relative to the medium in which the waves are transmitted The total Doppler Effect may therefore result from motion of the source motion of the observer or motion of the medium Each of these effects is analyzed separately For waves which do not require a medium such as light or gravity in general relativity only the relative difference in velocity between the observer and the source needs to be considered The Laser Doppler Technique L. E. Drain, 1980

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