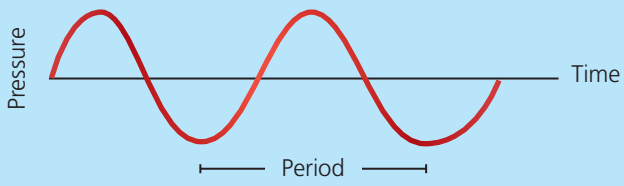
Newspapers In Education and the Puyallup Fair Presents

PHYSICS AND THE PUYALLUP FAIR

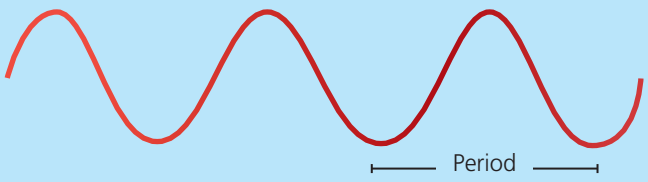
Chapter 3: The Sights and Sounds of the Fair

Sound

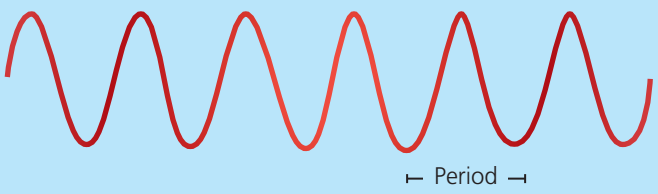
Sinusoidal Wave



Low Frequency Wave



High Frequency Wave



Sound is created by a vibrating object, and it travels in waves. A sound wave is a mechanical wave that travels through solids, liquids and gases, and transports energy from one location to another. The source of the sound could be the vibration of a person's vocal cords (like Selena Gomez as she sings on stage), a string on a violin (from the concertmaster in the Tacoma Symphony Orchestra) or the vibrating tines of a tuning fork. A sound wave is made up of different properties including frequency, wavelength and amplitude.

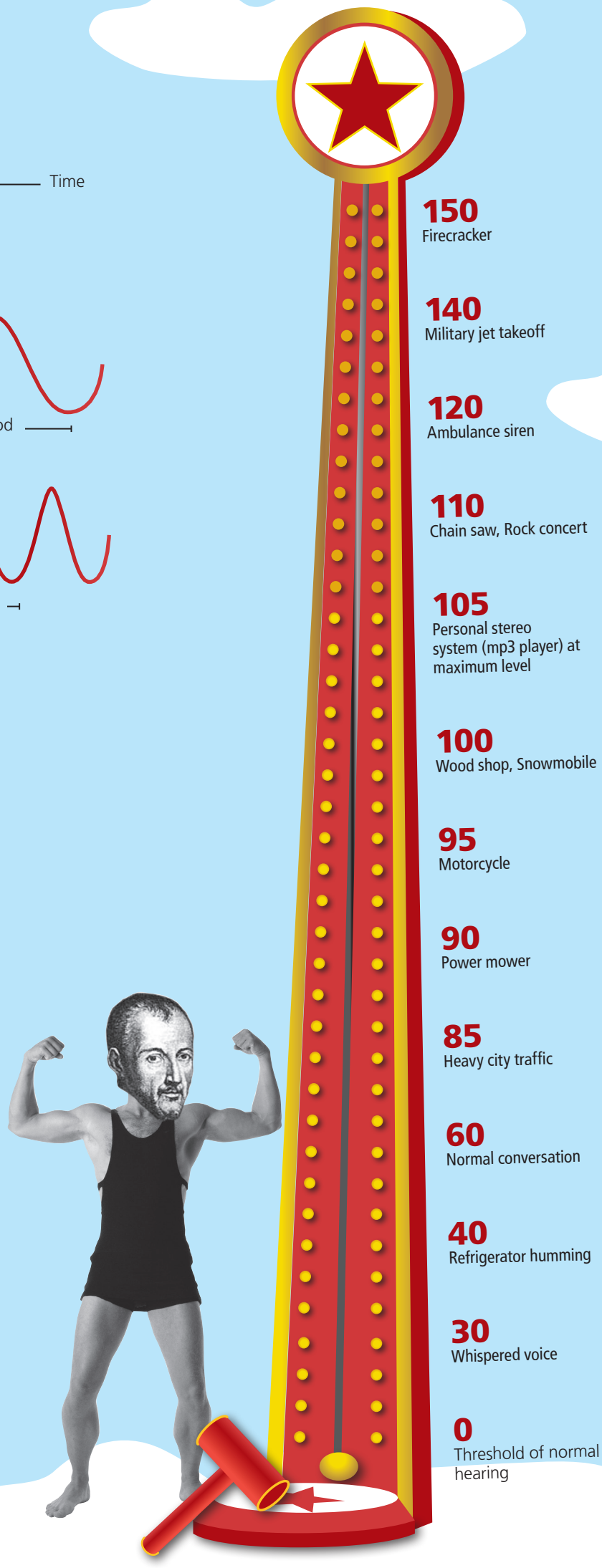
Frequency is the rate at which something occurs or is repeated over a particular period of time. The frequency of a wave is measured in the number of complete back-and-forth vibrations of a particle per unit of time. It is measured in hertz.

1 Hz = 1 vibration/second

Frequency corresponds to pitch. When a sound wave has a higher frequency, we hear it as a higher pitch.

Amplitude is the maximum extent of a vibration or oscillation, measured from the position of equilibrium. Amplitude corresponds directly to the intensity of a sound wave; the greater the amplitude, the greater the intensity. If you are in the dairy cattle barn at the Puyallup Fair, stop and listen to the different cows. When the cows moo quietly, the amplitude of the sound wave is smaller than when they moo loudly. Can you determine which cow's moo has the greatest amplitude?

Wavelength is the length of one complete wave cycle.



About 1640, French mathematician Marin Mersenne discovered how to measure the speed of sound through the air. If you scream at the top of the ferris wheel, how long before your mom hears the sound down on the ground?

How loud is too loud?

The intensity of sound is measured in decibels (dB). Human ears can hear sound that is as quiet as a single leaf moving, to sound as loud as a jet engine. The decibel scale is based on multiples of 10. If near silence is measured at 0 dB, a sound ten times more powerful than that is measured as 10 dB, a sound 100 (10*10) times more powerful than that is measured as 20 dB, and a sound 1000 (10*10*10) times more powerful than that is measured as 30 dB.

Humans can experience hearing loss when they are exposed to any sound above 85 dB. Hearing loss is related to both the length of exposure to the sound and the intensity of the sound. For example, you may experience more damage if you listen to a rock concert for 30 minutes instead of just one minute, or you may experience more damage from one minute at the rock concert than you would if you listened to a power mower for five minutes.

Generally speaking, if you have to raise your voice to be heard by someone else, the sound is over 85 dB. Hearing loss caused by noise is permanent. You can protect your hearing by wearing ear plugs when you attend concerts, turning down the sound on your personal music player and purchasing quieter products.

Use the sound scale to determine what decibel levels you hear while walking around the Puyallup Fair. Specifically, record the approximate decibels for a conversation with friends, walking by a ride and at a concert.

The Procrastinators:

photo credit: Philip Palermo

While you are at the Puyallup Fair this year, you can watch the Procrastinators perform (or you can check them out on YouTube before you go). The Procrastinators are a percussion group that uses water bottles for drums. Listen to them play, either live at the Puyallup Fair or on YouTube, and record what types of sounds you hear.

- Can you determine the relative frequencies and amplitudes of the different sound waves you hear?
- If you were to fill all of the bottles with water, how would the sound change?
- Which bottle would have a higher pitch, the bottle that is nearly full of water or nearly empty? Why? Try this at home with plastic bottles and see if you are correct.

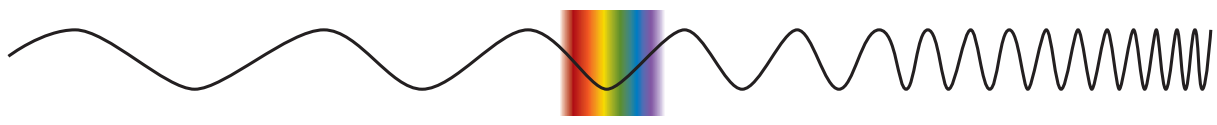
Light

Light travels in electromagnetic waves, meaning it can travel through solids, liquids, gases and through a vacuum. The electromagnetic spectrum is the continuous range of wavelengths over which electromagnetic radiation extends. Our eyes can only detect a small section of this spectrum; the light we can see falls into the visible light portion of the spectrum. The range of light we can see falls between wavelengths of 780 nanometers and 390 nanometers. Sir Isaac Newton did experiments using prisms that separated visible light into its many colors. Each color corresponds to a particular wavelength range. The color we can see with the longest wavelength is red. The color we can see with the shortest wavelength is violet.

You can remember the order of colors (from longest to shortest wavelength) as ROYGBIV. That stands for Red, Orange, Yellow, Green, Blue, Indigo and Violet.

While you are at the Puyallup Fair, record items you see that are each of the colors (ROYGBIV). Try to find at least three items for each color.

The Electromagnetic Spectrum



	Radio	Microwave	Infrared	Visible	Ultraviolet	X-ray	Gamma Ray
Wavelength in meters	←1	1 to 10^{-3}	10^{-3} to 10^{-6}	$8x10^{-7}$ to $4x10^{-7}$	$3x10^{-7}$ to 10^{-8}	10^{-8} to 10^{-12}	10^{-12} →
About the size of	Buildings	Grains of sugar	Protozoans	Bacteria	Molecules	Atoms	Atomic nuclei

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Teachers: For more information and activities, please see our teacher's guide: www.thefair.com/education/

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- Gate admission is free for students! The Puyallup Fair offers free tickets to most schools in western Washington, so if you're a student just ask your teachers or principal for your ticket. Last year, schools in the Puget Sound region received a total of 675,272 free passes to the Puyallup Fair.
- The Puyallup Fair Foundation has created the Traveling Farm, a classroom on wheels that provides an educational experience about agriculture and healthy food choices for K-3rd grade students. To learn more about a free visit to your school, visit http://www.thefair.com/education/traveling-farm.php.