Physics - Unit 7 - Waves and Sound

Unit Focus

Students will continue building on their understanding of waves to apply it to understanding musical instruments and everyday technologies like Doppler effect. Students will start by exploring the mechanics of sound in wind and stringed instruments and relate instrument design to pitch. They will continue by exploring harmonic frequencies and their relationship to the instruments' quality and timbre. Ultimately students will qualitatively analyze the Doppler effect and relate the increase apparent frequency to an object (moving vehicle or a moving galaxy) approaching and the apparent decrease in frequency to an object going away from the observer.

Stage 1: Desired Results - Key Understandings

Standard(s)

Next Generation Science Standards (DCI)
Science: 11

- The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. *PS4.9.A1*
- Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. *PS4.9.A2*
- Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. *PS4.9.C1*

Madison Public Schools Profile of a Graduate
Collaboration/Communication

- Collective Intelligence: Working respectfully and responsibly with others, exchanging and evaluating ideas to achieve a common objective. (POG.3.1)

Transfer

T1 Create models to explore complex systems, show mastery of key science concepts, and/or develop solutions through creation of a product open to testing and redesign.

Meaning

Understanding(s)	Essential Question(s)
U1 Waves are used in scientific applications and everyday purposes. **U2** Information can be converted into a digital form so that it can be stored or transmitted through waves. **U3** Some waves (sound) require a medium to travel through. Other waves (light or electromagnetic) do not require a medium. **U4** Wavelength, frequency, and amplitude are properties of a wave that determine its characteristics such as pitch, color, sound and energy.	**Q1** Why do different instruments sound the way they do? **Q2** How are waves used to transfer energy and transmit information? **Q3** How is sound created? How does it travel?

Acquisition of Knowledge and Skill

Knowledge	Skill(s)
K1 Every object has its own resonant frequency based on its physical parameters **K2** Instruments have various harmonic frequencies, multiples of the fundamental frequency, based on their physical characteristics **K3** That the properties of an electromagnetic wave are related to each other by the wave equation v=Lf (v=velocity, L=wavelength and f= frequency).	**S1** Calculating the speed of sound knowing its frequency and its wavelength. **S2** Designing and constructing a successful wireless messaging device. **S3** Applying principles of physics to develop a design or model.