Overview for Mechanical Waves

The teacher's notes for each model contains a detailed story line. The mechanical waves units unfold as follows:

Oscillating Particle Model

Masses oscillating on springs
Kinematic and dynamic relationships
Energy relationships

Mechanical Waves in One Dimension

Coupled oscillating particles
Speed of propagation of pulses on springs
Reflection and Transmission of pulses on springs
Interactions of pulses
Periodic and Standing Waves on springs
Standing Waves on strings
Resonance

Longitudinal Waves and Sound

Transverse vs. longitudinal waves
Speed of sound waves
Resonance and standing waves
Characteristics of sound
Harmonics and beats
The Doppler Effect

Mechanical Waves in Two Dimensions

Reflection of waves in a ripple tank
Refraction of waves in a ripple tank
Diffraction of waves in a ripple tank
Interference of waves in a ripple tank
Methods of determining wavelength using interference
Two-source interference with sound
Two-source interference with light

Overview Elaboration

We begin by studying an oscillating particle. Students examine the behavior of a mass oscillating on a spring to develop its causal force model, the restoring force. At the same time we develop its kinematical model, simple harmonic motion or the harmonic oscillator. To help understand the models we develop graphical and mathematical representations of the harmonic oscillator. Conservation of energy is revisited in this unit. This unit covers one of the 6 basic particle models in Newtonian mechanics and it is probably the most neglected model in high school physics.

In the second unit we model a wave traveling through a material as an oscillation traveling through a string of particles, each coupled to the next with a spring. We find that the speed of the wave depends on the force between the particles and the mass of the particles. Most of the unit is spent on studying transverse waves.

In the third unit we build the model of sound being a pressure wave caused by longitudinally oscillating particles. We study the concept of resonance and factors necessary for it in tubes, on strings and on rods.

In the fourth unit we study we study wave behavior in two-dimensions. Reflection, refraction, diffraction and two source interference are studied using ripple tanks to develop two dimensional behaviors. The wave model is used to explain these behaviors. We use light in many of the experiments and see that it exhibits the same characteristics as oscillating particle waves. This is not meant to infer that light is coupled particles, but show that it behaves as a wave.