ACTIVITY #7 REFLECTION AND INTERFERENCE OF PULSES
(Teacher Notes)

This activity addresses the following content standards and benchmarks[1]:

- Content Standard 5 – 8 Physical Science B Transfer of Energy
- Content Standard 9 – 12 Physical Science B Interaction of Energy and Matter
- Benchmark 6 – 8 and 9 –12 The Physical Setting 4F Motion

The primary objectives of this activity are that the pluses and ultimately waves reflect from barriers either in phase or out of phase. Even though the phase may invert vertically when it strikes a rigid or fixed barrier it does not invert from the front to the back of wave pulse. This is unlike a particle (a bouncing ball). If a two colored ball strikes a barrier perpendicular to the barrier's surface the leading edge of the ball or particle changes.

Secondly waves and pulses can pass through (superimpose) one another without loosing their individual wave properties. During the time of superposition the resulting displacement is the vector combination of the individual displacements. During constructive interference energies add and during destructive interference energies cancel.

To ensure success with the free versus fixed end reflections have the students use at least 2 meters of cord or rope. A Slinky™ appears to be a better medium with which to see the superposition of a longitudinal and a transverse pulse. Often students will believe that the wave pulses hit and reflect if both of the pulses that are used to demonstrate superposition are transverse pulses or longitudinal pulses. Another way to ensure that the students realize that the two pulses pass through, not reflect off, each other, is to have one student on one end of the Slinky™ or coil create a large amplitude pulse while the other student at the other end of the Slinky™ or coil create a small amplitude pulse. Then have the students send the pulses towards each other down the Slinky™ or coil. Whether or not they send the pulses in phase or out of phase, ask the student to play close attention to where the large and small amplitude waves end up after they meet. Prior to having students investigate the property of constructive and destructive.

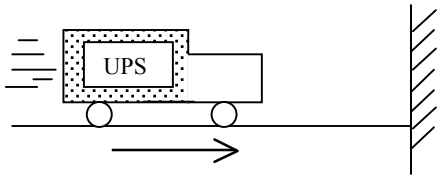
Questions:

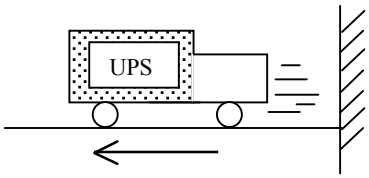
1. Numerically what is the value of the maximum disturbance as compared to the individual disturbances alone?
   The maximum disturbance is equal to the sum of the individual disturbances.

2. A pulse meets a rigid boundary and reflects. Draw the reflected pulse to the right of the diagram below.

[1] National Science Education Standards, National Research Council, 1996

3. A toy car meets a rigid boundary and reflects. Draw the reflected car to the right of the diagram below.





4. What fundamental difference do you see in the two diagrams you drew to answer questions 2 and 3? Explain why this difference occurs.
When a wave reflected the front reflects first and pass through the rest of the wave that is still moving toward the barrier; however, when a particle reflects it all stops and rebounds. Another way to say this is that from waves the leading edge stays the same, but for a particle the reflected object now has the front in the back.