Name: ______________________________ Date: ____________________

Gizmo Activity: Reflection (Part 2)

Wave reflection… A closer look
In the previous activity, you should have found that the pressure at the open end of the tube remained nearly constant throughout. The reason for this is that the outside air is at atmospheric pressure. There is a very large volume of air immediately outside the relatively tiny open end of the tube, so any difference in air pressure is diluted very quickly.

When a burst of higher-than-average pressure comes out of the tube, it pushes on the air just outside the opening. For a very short time, this makes it harder for the air outside to go into the tube. The effect, as you saw in the part 1 of this activity, is that a low pressure region forms at the opening nearly immediately after the high-pressure region moves out.

High pressure at *Z* hinders outside air from entering the tube, causing a lower pressure at *Y*.

1. Where do you think the air particles in region *X* will tend to move? Explain. ______________

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2. Based on your answer to number 1, how will the pressure in region *X* change? __________

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3. How will air particles at *W* respond to this change in pressure at *X*? ___________________

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4. How will this affect the pressure at *W*? ____

Two types of reflection
The net effect is that when a high-pressure region hits the end of an open tube, it creates a low-pressure region that reflects back. Similarly, when a low-pressure region hits the end of an open tube, a high-pressure region bounces back. Normally, the pressure in a region changes as a cycle from high-pressure to low-pressure. The open end made the pressure skip half of a cycle, going directly from the very top (high-pressure) to the very bottom (low-pressure) of its cycle. Scientists describe this half-cycle change by saying the wave reflected with a **phase change** of 180 degrees.

1. Use the information in the previous paragraph to trace the evolution of a pressure wave through a flute that is 67 cm long.

   A. Assume a high pressure region begins at the left end of the flute and moves to the right end. After it has gone a little less than 67 cm, it is near the right end but has not reached it. Fill in the blanks below describing the wave at this point.

      The pressure is ______ (high or low) and moving toward the ________ (left or right).

   B. Describe the wave after it has reflected from the right end.

      The pressure is ______ (high or low) and moving toward the ________ (left or right).

   C. Describe the wave after it has moved nearly 67 centimeters back toward the left end, but has not reached the end.

      The pressure is ______ (high or low) and moving toward the ________ (left or right).

   D. Describe the wave after it has reflected off the open left end of the cylinder.

      The pressure is ______ (high or low) and moving toward the ________ (left or right).

   Use the Gizmo to check your answers.

2. The last two exercises show that pulses in an instrument move in cycles, like someone swinging on a swing or a planet moving around the Sun. A cycle must end with conditions similar to how it began. For example, in discussing someone swinging on a swing, you could say a cycle starts "At the left end of her swing, when her velocity is zero, and she is about to move back to the right." The next cycle would start when the swinger is once again at the left end of her swing with a zero velocity, about to move back toward the right.

   The pulse you studied started its cycle with three starting conditions:

   - It started its cycle as a high-pressure pulse (not a low-pressure pulse).
   - It started its cycle at the left end of the tube.
   - It started its cycle as a pulse moving to the right.

   Based on your work in number 1, how far must a pulse go before it satisfies once again all these conditions at the same time, allowing it to start a new cycle?

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3. When studying Jean on a swing, you found that the best way to increase Jean's energy was to give her a push exactly one time every cycle, so that the pushes matched the natural frequency of the Jean-swing system. What gives the air in a clarinet an external push?

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