more fun... open an end...

\[ \lambda \]

amplitude node
presure amplitude

\[ \frac{\lambda_1}{4} \]

\[ \frac{\lambda_1}{4} = L \]
\[ \lambda_1 = 4L \]

\[ f_1 = \frac{v}{4L} \]

tricky

\[ \frac{\lambda}{4} + \frac{\lambda}{2} \]
\[ \frac{\lambda_n + (n-1)\frac{\lambda_n}{2}}{4} = L \]
\[ n\frac{\lambda_n}{2} - \frac{\lambda_n}{4} \Rightarrow \frac{\lambda_n}{4}(2n-1) = L \]
\[ \lambda_n = \frac{4L}{2n-1} \quad n = 1, 2, 3 \]

or
\[ \lambda_m = \frac{4L}{m} \quad m = 1, 3, 5 \]

\[ f_m = \frac{mv}{4L} \quad m = 1, 3, 5 \]

Double open... same as
Double closed...

Recorder

\[ \text{P node} \]

\[ \text{P node} \]

Think of a flag flapping...

Saxophone... one closed

Interference already present in open-ended tube...

Ear responds to pressure, at end of tube, none...
Destructive Interference

Speaker 1

Speaker 2

pressure
wave

\( N/2 \)

\( 180^\circ \) out of phase

by 180° or \( \lambda/2 \)

Hear sound (#1 alone)

nothing (#1 + #2)

\[ \uparrow \]

180°

sound (#2 alone)

Sources \( \lambda/2 \) or 180° out of phase

Where does sound go?
In Phase

amplitude \rightarrow A

Intensity - quadrupoles

More Fun

\#1

\#2

\[ \text{ear} \]