Fluid Parcels and Pressure Forces

Follow a parcel through a narrowing pipe

Name _____ Period _____ Date _____

Compare the parcel's speed, pressure forces, and acceleration as it moves through the pipe.

About 25 to 30 minutes | buildphysics.com/?experiment=fluid-parcel-forces

Compare locations in the pipe

1. Work while paused. Keep Volume flow rate at 0.080 m^3/s, Outlet area at 0.020 m^2, and Parcel volume at 0.010 m^3.

2. Select the orange Tapered pipe parcel. Open its properties. Position along pipe runs from 0 at the left end to 1 at the right end.

As the parcel moves toward the narrower end, do you expect it to speed up, slow down, or keep the same speed?

3. Set Position along pipe to each value below. Read Speed, Net force, and COM acceleration in Live values. COM means center of mass.

Position along pipe	Speed (m/s)	Net force (N)	COM acceleration (m/s^2)
0.20			
0.50			
0.80			

4. What happens to speed and acceleration toward the narrower end?

5. Read Parcel mass at each position. Does the parcel's mass change as its length changes?

Add the pressure forces

6. Return Position along pipe to 0.50. Record the force readings with their signs. Positive is toward the right.

Reading	Force (N)
End-cap pressure force	
Wall pressure force	
Combined pressure force	
Weight along pipe	
Net force	

7. Add the end-cap and wall pressure forces. Compare your sum with Combined pressure force. Allow for rounding.

8. Would the end-cap pressure force alone give the correct net force? Explain using your readings.

Check the acceleration

$$F_{net} = ma$$

9. Record Parcel mass. Use Net force to calculate the acceleration. Compare with COM acceleration.

10. In steady flow, readings at a fixed location stay constant. How can a parcel still accelerate as it passes through the pipe?