Tank Outflow and Jet Range Lab

Liquid above an outlet and horizontal jet range

Name _____ Period _____ Date _____

Compare outlet areas, then investigate how liquid height above the outlet changes jet range. Linearize the data and determine the jet's vertical drop.

Time 50 minutes • Open buildphysics.com/?experiment=fluid-tank-outflow

Model and measurements

Keep the tank surface open to atmosphere, the outlet horizontal, and the collector in its prepared position. The jet lands at the collector rim; g = 9.8 m/s².

$P + \frac{1}{2}\rho v^2 + \rho g y = constant$ $x_f = x_0 + v_x t$

h is Liquid above outlet, not total fill height. R is Horizontal range from the outlet to the collector. Y is the outlet-to-rim vertical drop; prepared Y = 1.05 m.

Predict before running

If liquid height above the outlet doubles while Y stays fixed, will jet range double? Predict and explain.

Part A Compare outlet areas

1. Set Source liquid fill height to 1.60 m and Outlet height above tank bottom to 0.40 m. In Properties → Source tank, choose Fixed level under Liquid level mode.
2. Test the Outlet areas below. In Properties → Outlet 1 → Live values, read Exit speed, Volume flow rate, and Horizontal range.
3. Record the readings while paused. Run briefly to observe the jet reaching Collector.

Outlet A (m²)	Exit v (m/s)	Flow Q (m³/s)	Range R (m)
0.001			
0.003			
0.006			

A1. Use two trials to explain which readings changed when outlet area increased.

A2. Why can outlet area change the volume flow rate without changing the jet's speed or range?

Part B Design and collect

Suggested time 16 minutes

Investigation question How does horizontal range depend on the liquid height above a fixed outlet?

Keep outlet height at 0.40 m, Outlet area at 0.002 m², and the source in Fixed level mode. Choose at least five Source liquid fill heights from 1.00 to 1.80 m, spread across the range.

B1. Identify the independent and dependent variables.

B2. What will you keep constant? How will you do this?

B3. List your settings. Why is this set useful?

B4. How will you obtain the relevant liquid height and the range to the same landing level?

B5. Write a procedure another group could follow.

Read Liquid above outlet and Horizontal range at Outlet 1 while paused. Check that Receiver is Collector.

Record your measurements

Fixed outlet and collector Vertical drop Y = 1.05 m

Trial	Fill height (m)	Read h (m)	Range R (m)
1			
2			
3			
4			
5			
Extra			

Part C Build and analyze a linear graph

Suggested time 14 minutes

C1. The relationship is $R = 2\sqrt{hY}$. Describe how R depends on h for the same vertical drop Y.

C2. Choose quantities for a straight-line graph. Label the table with your choices and units, and calculate the transformed values.

Trial	_____ Units _____	_____ Units _____
1		
2		
3		
4		
5		
Extra		

C3. Plot your transformed data and draw a best-fit line. Label both axes with quantities and units.



C4. Find slope and units using two separated points on your fitted line. Determine Y and interpret the intercept.

Part D Explain and predict

Suggested time 8 minutes

D1. A student claims, “Doubling liquid height above the outlet doubles the jet range.” Evaluate the claim using your model and data.

D2. Does your graph support the range model? Compare inferred Y with 1.05 m and discuss the intercept.

D3. Choose an unused fill height within your range. Find h from the fixed outlet height and predict R from your fit. Set the fill height and measure R. Compare.

New fill (m)	Predicted R (m)	Measured R (m)

Comparison