# Force Area and Pressure Lab

*Piston area and pressure from a fixed load*

Name _____ Period _____ Date _____

Compare piston loads, then investigate how face area changes pressure. Linearize the results and determine the applied load.

**Time 50 minutes • Open buildphysics.com/?experiment=fluid-force-area**

### Model and measurements

The massless piston is in equilibrium. Keep the liquid settings unchanged. Pressure from load is the added pressure ΔP, not absolute pressure.

$$P = \frac{F}{A}$$

F is total downward load and A is piston face area. Convert kPa to Pa for calculations: 1 kPa = 1,000 Pa.

### Predict before running

If piston area doubles while its load stays fixed, will added pressure double or halve? Predict and explain.

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### Part A Compare loads at one area

1. In Explore this setup, set Piston face area to 1.0 m². Test the Piston loads below.
2. Open Properties → Loaded piston → Live values. Read Face area, Total downward load, and Pressure from load.
3. Record the readings while paused. Convert pressure from kPa to Pa.

| Set load (N) | Read load F (N) | Read A (m²) | Added ΔP (Pa) |
|---|---|---|---|
| 50 | | | |
| 100 | | | |
| 200 | | | |

A1. Use two trials to compare the load ratio with the added-pressure ratio.

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A2. Why must the same load produce greater pressure when it acts over a smaller area?

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## Part B  Design and collect

Suggested time 16 minutes

**Investigation question  How does added pressure depend on piston face area at a fixed load?**

Keep Piston load at 100 N. Choose at least five Piston face areas from 0.40 to 1.80 m², 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. Which pressure reading isolates the piston load, and how will you obtain it?

B5. Write a procedure another group could follow.

**Record your measurements**

Total downward load F = 100 N  Same liquid and pressure boundary

| Trial | Face area A (m²) | Added ΔP (Pa) |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| Extra | | |

## Part C  Build and analyze a linear graph

Suggested time 14 minutes

C1. The relationship is $\Delta P = \frac{F}{A}$. Describe how ΔP depends on A when F stays fixed.

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 F from your fit and interpret the intercept.

## Part D  Explain and predict

Suggested time 8 minutes

D1. A student claims, “Doubling piston area doubles the pressure from the load.” Evaluate the claim using your model and data.

D2. Does your graph support the pressure model? Compare graph-based F with 100 N and discuss the intercept.

D3. Choose an unused face area within your range. Predict added pressure from your fit, then measure Pressure from load at that area and compare.

| New A ($m^2$) | Predicted ΔP (Pa) | Measured ΔP (Pa) |
|---|---|---|
| | | |

Comparison