


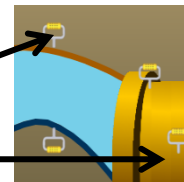
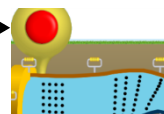
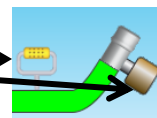
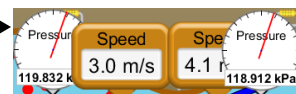
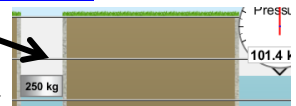


**Tips for controls:**

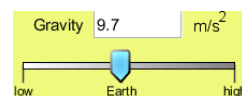
- Try all the different tabs at the top of the simulation. The tabs are designed to help teachers scaffold lessons or make lessons age appropriate by using only some tabs.
- **Reset All** resets only the tab that you are presently using.
- The **Pressure** tab is also available as a single sim called [Under Pressure](#)
- The **Grid** option is provided to help students see relative fluid height easily.
- The masses can only be set on the left column of water.
- Multiple tools can be used to make comparisons.
- You can **Pause**  the sim and then use **Step**  to incrementally analyze.
- The hose on the **Water Tower** tab has 2 controls. The handle moves the hose vertically and the gold knob rotates the nozzle.
- The red button tool allows students to make qualitative observations. Turning off the **Dots**  may be helpful.
- The handles on the **Flow** tab let you change the shape/height of the water tube and end pipes.

**Important modeling notes / simplifications:**

- The **Pressure** tab shows a thin slice of an underground basin with fluid in it. We used an underground situation where the top of the basin is at sea level
- The sensors are very sensitive, so you may expect some variations in answers.
- The **Flow** tab assumes that there is a “pressure head” at ground level.

**Insights into student use / thinking:**

- Because the Gravity slider has few tick marks, it is easy for a student to think they have set the meter back to Earth but not have exactly  $9.8 \text{ m/s}^2$ . For example: Exact values between 1.0 and 20.0 can be typed in the white readout box.

**Suggestions for sim use:**

- For tips on using PhET sims with your students see: [Guidelines for Inquiry Contributions](#) and [Using PhET Sims](#)
- The simulations have been used successfully with homework, lectures, in-class activities, or lab activities. Use them for introduction to concepts, learning new concepts, reinforcement of concepts, as visual aids for interactive demonstrations, or with in-class clicker questions. To read more, see [Teaching Physics using PhET Simulations](#)
- For activities and lesson plans written by the PhET team and other teachers, see: [Teacher Ideas & Activities](#)
- Related sims: [Under Pressure](#), [Density](#), [Buoyancy](#)

Name: \_\_\_\_\_

Period: \_\_\_\_\_

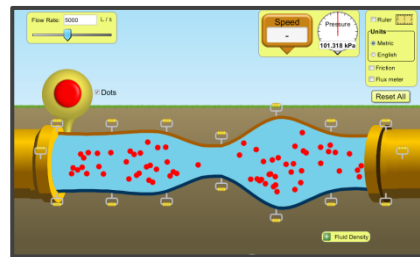
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### Static Fluid Pressure and Fluid Flow

#### Students Will

- Investigate concepts of fluid flow

Head to the following website to investigate fluid pressure. Click 'Run Now!' <http://phet.colorado.edu/en/simulation/fluid-pressure-and-flow>



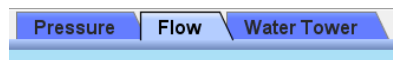
#### Notes for today:

- Use Pascals for your unit of pressure. Remember,  $[Pa] = [\frac{N}{m^2}]$
- For all of your pressures today, use four significant figures for your answers. For example, if the pressure meter gives you 101.325 kPa you can write that as 101,300 Pa.

#### Fluid Flow

##### Setup

- Click on the 'Flow' Tab



We are now going to talk about fluids moving. Begin by record the current time in the space below.

\_\_\_\_\_ : \_\_\_\_\_

Mess around with the simulation for at least 2 minutes. Experiment with every variable you can until you are familiar with the simulation.

Okay. It better be at least 2 minutes later. We're going to talk about **mass flow rate** and **volume flow rate**, which are two ways to talk about fluids flowing.

##### Setup

- Click on the 'Reset All' button

Reset All

**Mass flow rate**,  $\frac{\Delta m}{t}$ , is the mass of the fluid passing through a pipe in a given second.

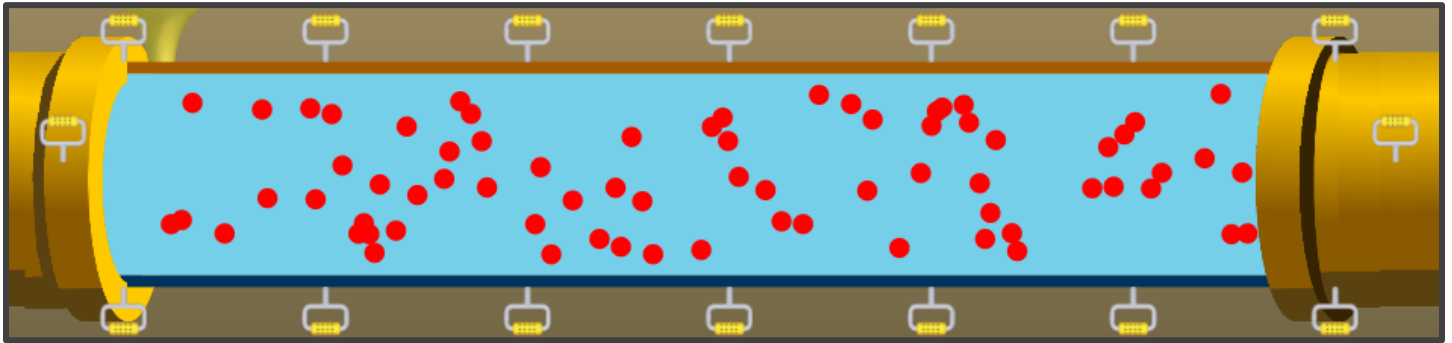
In physics, **mass flow rate** is measured in  $\frac{kg}{s}$

**Volume flow rate**,  $\frac{\Delta V}{t}$ , is the volume of the fluid passing through a pipe in a given second

What do you think volume flow rate is measured in in physics?



Ask Mr. Templin if you are correct.



In the current simulation, the volume flow rate is 5000 L/s, or 5 m<sup>3</sup>/s. This means that 5 cubic meters of water are passing through the pipe in a second. If the density of this water is 1000 kg/m<sup>3</sup>, answer the following questions.

What is the volume of water that flows through the pipe in 6 seconds?

What is the mass flow rate of the water?

What is the mass of the water that flows through the pipe in 6 seconds?

## Continuity

The mass flow rate and the volume flow rate are always the same in a closed pipe. Why do you think that has to be the case? (Try and think about what might happen if the rates were *not* the same). \_\_\_\_\_

### Setup

- Select the 'Flux meter' option
- Drag the pipe so that you have areas of  $12.5 \text{ m}^2$ ,  $10.0 \text{ m}^2$ ,  $5.0 \text{ m}^2$ ,  $2.5 \text{ m}^2$ , and  $1.0 \text{ m}^2$

Flux meter

What do you notice about the volume flow rate at different points along the pipe? \_\_\_\_\_

What do you notice about the speed of the water at different points along the pipe? When is the water the fastest? The slowest? \_\_\_\_\_

Use the simulation to fill in the table below.

Area ( $\text{m}^2$ )	Speed ( $\text{m/s}$ )	Volume Flow Rate ( $\text{m}^3/\text{s}$ )
1.0		
2.5		
5.0		
10.0		
12.5		

Determine the **continuity formula**, which relates two points where fluid flows in a closed pipe.

Answer the questions below about water moving through a closed pipe.

Determine the speed at which water would flow through a point in the pipe that has a cross sectional area of  $0.25 \text{ m}^2$  and a volume flow rate of  $5.0 \text{ m}^3/\text{s}$ .

Determine the speed at which water would flow through a point in the pipe that has a cross sectional area of  $0.25 \text{ m}^2$  and a volume flow rate of  $10.0 \text{ m}^3/\text{s}$ .

Determine the speed at which water would flow through a point in the pipe that has a cross sectional area of  $1.0 \text{ m}^2$  and a volume flow rate of  $10.0 \text{ m}^3/\text{s}$ .

Determine the speed at which water would flow through a point in the pipe that has a cross sectional area of  $1.0 \text{ m}^2$  and a volume flow rate of  $20.0 \text{ m}^3/\text{s}$ .