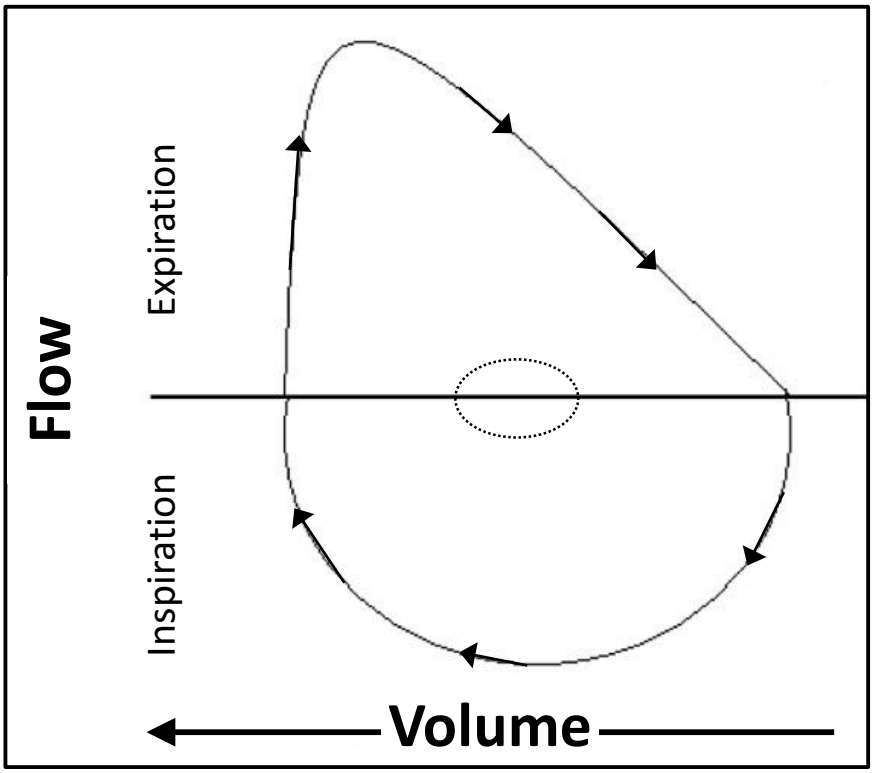
Effect of Pulmonary Diseases on Ventilation

We can examine pulmonary function using a spirometer to measure how much air a person can exchange during ventilation. The results of one such pulmonary function test is depicted below as a flow-loop diagram, which shows lung volume during forced maximum inspiration and exhalation, as well as the rate at which ventilation occurred (i.e. how quickly air was inhaled and exhaled). Use the diagram to answer the following questions.



1. Which side of the diagram, left or right, represents a lung full of air?

2. Knowing that the solid line with arrow heads attached to it represents one cycle of maximum exhalation and inhalation, what does the smaller dotted circle represent?

3. Label the following measures on the above diagram.
   a. **Tidal Volume** (**V_T**) is the volume of air moved during a normal inhalation/exhalation.
   b. **Forced vital capacity** (F**VC**) is the total amount of air that can be voluntarily forced into or out of the respiratory system with one breath.
   c. **Residual volume** (**RV**) is the air volume remaining in the lungs after maximal expiration.
   d. **Total lung capacity** (**TLC**) is the maximum volume of air that the lungs can hold.
   e. **Peak expiratory flow rate** (**PEFR**) is the maximum rate at which air can be forced out of the lungs upon exhalation.

4. **Restrictive lung diseases** decrease lung compliance, meaning that the ability of the lungs to stretch upon inhalation is reduced. People afflicted with this condition often have to exert energy in order to inhale, and even then they are incapable of breathing deeply. One cause of this condition is scarring within the lung tissue from a prior respiratory disease.

   Obstructive lung diseases result in increased resistance in the airways, meaning that the ability of the lungs to exchange used air is reduced. People afflicted with this condition often have difficulty fully exhaling air from the lungs, and sometimes wheezing can be heard if the obstruction occurs in one of the main airways. One cause of this condition is asthma, where upper airways are constricted due to excess mucus production and swollen tissues.

   Using this knowledge, predict how the following measures will be affected (increased, decreased, or unaffected) by these two pulmonary conditions. Then, use these predictions to draw a flow-loop diagram for a person with restrictive lung disease and a person with obstructive lung disease on the diagram below.

Measure	Restrictive	Obstructive
Forced vital capacity		
Residual volume		
Total lung capacity		
Peak expiratory flow rate		
Peak inspiratory flow rate