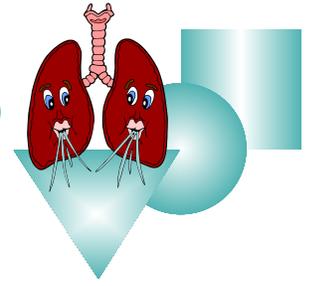


# Pulmo-Park Pom-Pom Shooter: Measuring the Effect of Restricted Breathing on Peak Expiratory Flow (PEF)

## Student Information Page Activity 5D



*Students with asthma or other respiratory problems should not perform the breathing exercises in this activity because they involve repeated maximal inhalations and exhalations and use of a breathing restriction mouthpiece which could leave the students short of breath or, possibly, trigger an asthmatic episode. These students can observe and use data collected by their group.*

### Activity Introduction:

Everybody huff and puff! Well, what you just did was demonstrate your PEF. Yes, you huffed and puffed your PEF! PEF stands for *Peak Expiratory Flow*. It is actually the amount of air you can remove from your lungs in one, fast blast. Why is this important? It is a measure of your ability to push air out of your lungs and is affected by breathing complications related to asthma, bronchitis, emphysema, or other pulmonary diseases. In this activity, you will use your ability to shoot *pom-poms* through a *pom-pom shooter* as a measure of your respiratory health. Sound like fun? Get ready to give up your PEF to the Puff!!

### Activity Background:

Pulmonary disorders are classified into two main categories, *obstructive* and *restrictive*. *Obstructive disorders* represent those in which the **flow** of air is impeded while *restrictive disorders* are those in which the **volume** of air is reduced.

### Common Obstructive Lung Disorders

*Chronic Obstructive Pulmonary Disease (COPD)* – in the United States, *COPD* is defined as consisting of emphysema and chronic bronchitis. The primary cause is smoking, second-hand smoke, and long-term exposure to air pollution.



*Emphysema* – a condition in which the *walls between the air sacs (alveoli) lose elasticity*.

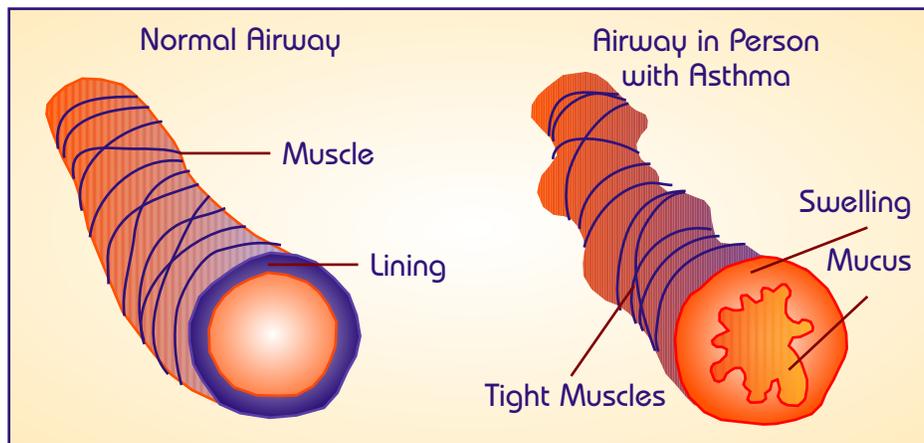
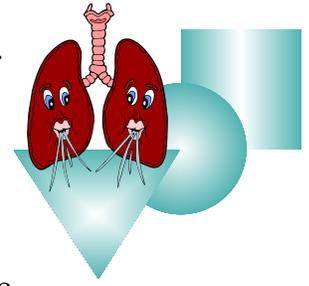
Without elasticity, air becomes trapped in the air sacs, the exchange of oxygen and carbon dioxide is impaired, and support of the airways is lost, causing airflow obstruction. Symptoms include shortness of breath, cough, and a limited exercise tolerance. Smoking is the most common cause.

*Chronic Bronchitis* – airways are *inflamed and thickened*, and an *increase in the number and size of mucus-producing cells occurs*. Therefore, too much mucus is produced, causing cough and difficulty moving air in and out of the lungs. In *chronic bronchitis*, these symptoms last for a long period of time or recur many times. Cigarette smoking and second-hand smoke are the primary causes.



LESSON 5  
ACTIVITY 5D

**Asthma** – a chronic disease characterized by *inflamed, swollen airways*. Inflammation makes airways sensitive so they react to allergens and irritants. When airways react, they get narrower, so less air flows to the lungs. Narrowed airways cause symptoms like *wheezing, coughing, chest tightness*, and *trouble breathing*, especially at night and in the morning. During an asthma attack, muscles around the airways tighten, making the airways narrower so less air flows through. Inflammation increases, and the airways become swollen and even narrower. Cells in the airways may also make more mucus than usual. This extra mucus also narrows the airways. *See Figure 1 Asthma.*



*Image adapted from the National Heart, Lung and Blood Website*

**Figure 1 Asthma**

**Lung cancer** – cancer is *abnormal, uncontrolled cell growth*; when it occurs in the lungs, it is lung cancer. Lung cancer is divided into two types, *non-small cell lung cancer* and *small cell lung cancer*, and each type looks different under a microscope. Each type of lung cancer grows and spreads in different ways and is treated differently. The main cause of lung cancer is cigarette smoking and second-hand smoke.

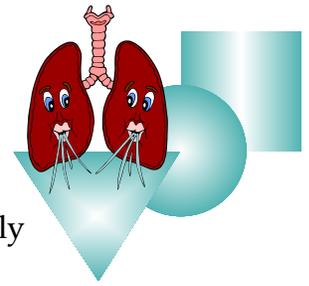
**Cystic Fibrosis** - *inherited disease of mucus and sweat glands*, affecting primarily the respiratory and digestive systems of your body. Typically, mucus is thin and watery, and keeps the linings of certain organs moist. Moisture is important to keep some organs from drying out and from getting infected. People with cystic fibrosis have an *abnormal gene that causes mucus to become thick and sticky*.

This thickened mucus builds up in the airways, causing blockage, bacterial growth, and repeated lung infections. Over time, these infections can cause serious damage to the lungs. The thick, sticky mucus can also block tubes, or ducts, in your pancreas and causes sweat to become extremely salty. Loss of salt through sweat can cause a heat emergency.



## Common Restrictive Lung Disorders

**Neuromuscular Disease** – affects breathing in people with neuromuscular disorders such as muscular dystrophy, ALS (Lou Gehrig 's disease), Guillain-Barri Syndrome, Polio, Myasthenia Gravis and many others. Breathing problems include *frequent lung infections, difficulty coughing and clearing mucus, shortness of breath, and shallow breathing (hypoventilation)* particularly during sleep.



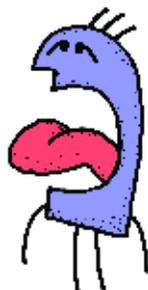
**Obesity** – *reduced thoracic space due to increased mass in the abdomen and thorax.*

Breathing becomes harder because the size of the lungs becomes smaller and the chest wall is heavy and difficult to lift during breathing. Obesity does not cause asthma or bronchitis, but it interferes with breathing and may aggravate attacks. For severely obese people (over 350 pounds), *obesity hypoventilation* causes high levels of carbon dioxide in the blood.

**Asbestosis** – caused by *inhaling asbestos fibers*. When these fibers collect in the lungs they cause *scarring of lung tissue and reduced lung capacity*. The effects of asbestosis don't appear until years after exposure. As the condition progresses, it can lead to disability and even death.

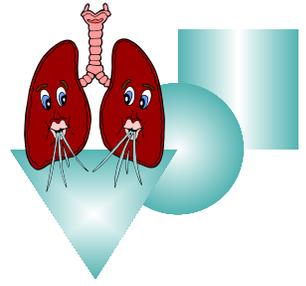
**Sarcoidosis** - due to *inflammation* and can attack any organ in the body, although 90% of cases occur in the lungs. Small areas of inflamed cells occur, usually in the lungs. In the lungs, it causes reduced lung volume and loss of elasticity. The disease is thought to be an immune system disorder, but the cause is unknown. The effects of sarcoidosis include dry cough (without sputum), shortness of breath, and mild chest pain.

**Tuberculosis (TB)** – chronic *infection* with TB bacteria, *Mycobacterium tuberculosis*. *Mycobacterium tuberculosis* is spread through the air and usually affects the lungs, although other body organs can be affected as well. Many people infected with *M. tuberculosis* carry the bacterium without symptoms, but some (1 in 10) develop active TB disease. Symptoms of active TB include weight loss, fever, night sweats, and loss of appetite. With antibiotic drugs over a course of 6 to 12 months, TB can be cured in most people.



# Measuring Peak Expiratory Flow

*Peak expiratory flow* (PEF) rate is a measure of how quickly a person can exhale air and is an indicator of how well your airways work. PEF is measured using a *Peak Flow Meter*, which is a hand-held device used to measure your ability to push air out of your lungs in one “fast blast”. Using the *Peak Flow Meter*, a personal peak PEF can be established.



## Activity Materials:

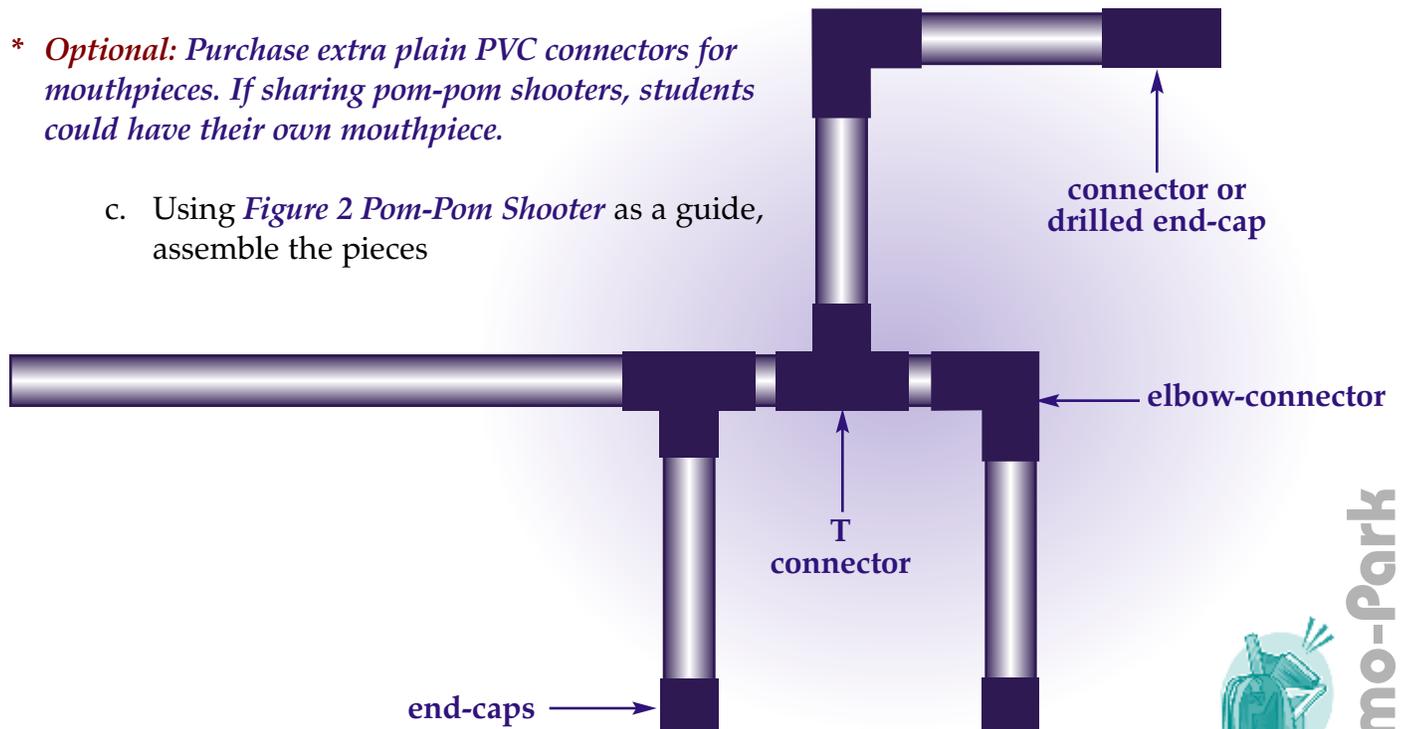
Your materials list is included in the *Station Instruction Card* provided by your teacher at each station through which you will rotate during this activity.

## Activity Instructions:

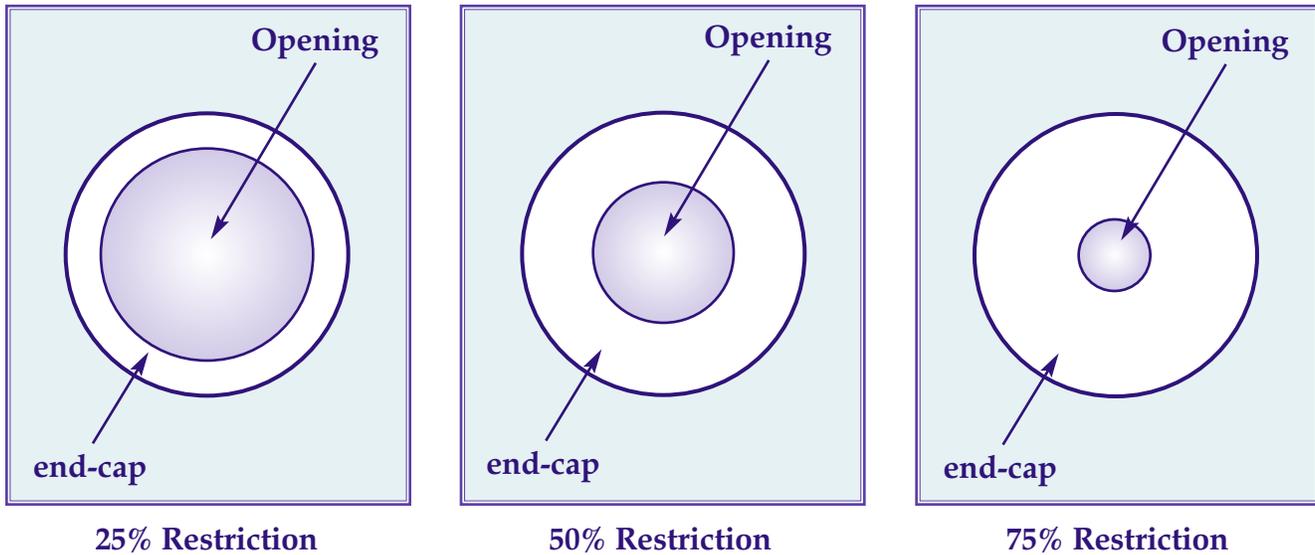
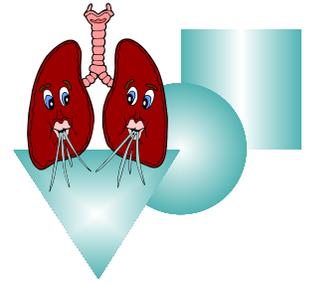
1. If the *pom-pom shooter* is not already assembled, you can construct it using the following directions.
  - a. Using a PVC pipe cutter, cut a 27” length\* of 1/2” PVC pipe into the following pieces:
    - 4 4” pieces of 1/2” PVC pipe
    - 2 2” pieces of 1/2” PVC pipe
    - 1 7” piece of 1/2” PVC pipe
  - b. Assemble the following connectors:
    - 2 elbow connectors for 1/2” PVC
    - 2 T connectors for 1/2” PVC
    - 3 end-caps for 1/2” PVC, drilled to restrict air flow
      - 1 25% restriction (drill hole with 7/16” bit)
      - 1 50 % restriction (drill hole with 3/8” bit)
      - 1 75% restriction (drill hole with 1/4” bit)

\* *Optional: Purchase extra plain PVC connectors for mouthpieces. If sharing pom-pom shooters, students could have their own mouthpiece.*

- c. Using *Figure 2 Pom-Pom Shooter* as a guide, assemble the pieces



**Figure 2 Pom-Pom Shooter**



**Figure 3 Size Restrictions**

2. Complete *Section 1* of your *Student Data Page* before collecting data.
3. You will work in groups to rotate through five stations during this activity. Follow the directions at each station, making sure to collect your data from each station before moving to the next. Be sure everyone in the group has his or her *Student Data Page* complete.
4. After your group completes all five stations, each person from the group will record his or her data *averages* on the *Class Data Table 2*. Your teacher will provide instructions for completing this step.