

## Peak Flow Meter Exercise

### Purpose

Students use a peak flow meter to determine their lung capacity and that of their peers in order to demonstrate the concept of peak flow and the variables which impact peak flow both within and across individuals.

### Overview

Students measure their peak flow in pairs or groups as well as other variables (i.e. height, gender, race-ethnic, health status, age, etc). These data are then pooled for the class on a spreadsheet and graphed by hand or using computer software. Hypotheses are generated concerning the effects of various variables on peak flow. The collected data are analyzed in light of the class data results.

### Time

2 two-hour block class period with team homework in between and after.

### Key Concepts

Peak flow is an important concept for understanding lung function.

An individual's peak flow is a function of their height, gender, physical health and race.

Monitoring changes in peak flow is an important aspect of controlling asthma.

Knowing the range of normal peak flow values for an asthmatic individual can help them avoid an acute asthma emergency.

### Skills

Pair or group work

Data collection

Graphing results

Interpretation of data

Generating hypotheses

### Materials

Peak Flow Meters with individual disposable mouthpieces Computer access(optional)

Graphing software such as Excel (optional) or graph paper

Calculator



(<http://www.sh.lsuhsu.edu/fammed/OutpatientManual/PeakFlowMeters.htm>)

### Facilitator Preparation

You will need to divide the students into groups or teams. Knowledge of and facilitating access to the computerized software with training will optimize this session. Prior knowledge of the Teacher's Guide to Air Quality will prepare you for the range of issues addressed in this section.

Teachers should meet with each group to evaluate their progress in collecting information and deciding on formulating a spreadsheet and graphing, as well as generating hypotheses.

### Background

Peak flow measures a person's ability to get air out of their lungs. It is measured as a rate and the units of measure are liters per minute (LPM). As examples of flow, think of a water fountain that barely trickles out the water (i.e. low flow) and a water fountain that spews out the water onto the pavement and is impossible to drink from (i.e. high flow). Another example is blowing out a candle with a lot of force (i.e. high flow) versus barely a whisper (i.e. low flow). With regards to the units of measure, peak flow measures a rate, not a volume (i.e. liters per minute, not just liters).

In obstructive diseases such as asthma, the peak flow is markedly decreased. In other lung diseases such as emphysema and other tobacco related diseases, the peak flow is also affected. The peak flow varies within the individual depending on the time of day (it

is usually larger at night) and their health (for example, in asthma it is reduced but can be improved by the use of asthma inhaler medications) as well as other factors. Between individuals, there is marked variability based on a range of factors including: gender (men > women), age (adults>children), height (tall>short), physical fitness (fit>unfit), respiratory health (health>respiratory illness), race-ethnic category (in the past, although changing with melding of populations, white>black and other minorities). Peak flow is also effort dependent; i.e. the best peak flows are performed after practice and with active coaching.

The measurement of peak flow involves using a simple peak flow meter with individual disposable mouthpieces. The person performing the peak flow blows as hard and as fast as s/he can after forming a careful seal around the mouthpiece and taking a deep breath. The best results are gained if the person is standing up, and is coached by a partner who both instructs and encourages the person to blow as hard and fast as possible. Three attempts are made and recorded, and the best of the three is used as the final individual peak flow.

As noted, other variables can be recorded as well including age, gender, height, respiratory health, physical fitness, and race ethnic category.

### Procedure

Peak flow is a measure of respiratory function. For example, it is used by people with asthma and their healthcare providers to monitor the course of their illness both when they are well and sick.

1. Working in pairs or teams, each person will practice using the peak flow meter as described below to obtain their own individual peak flow measurement. Each person should have 1 disposable mouthpiece that they use when blowing into the peak flow meter; **PEAK FLOW METER DISPOSABLE MOUTHPIECES SHOULD NOT BE SHARED BETWEEN INDIVIDUALS AND SHOULD BE THROWN AWAY AT THE END OF THIS EXERCISE. ONLY THE USER SHOULD HANDLE HIS/HER OWN MOUTHPIECE.** If disposable mouthpieces are not available, the mouthpiece should be wiped down with alcohol between students.

The best way to obtain a good peak flow measurement is to practice the following with the partner or group:

- ❖ Make sure the peak flow meter reads “zero.”
- ❖ Stand up straight.
- ❖ Fit the individual disposable mouthpiece snugly in the peak flow meter.
- ❖ Form a tight seal with the lips around the mouthpiece.
- ❖ Take a deep breath.
- ❖ Blow as hard and as fast as the person can until all the air is gone from their lungs.
- ❖ If the student coughs or makes a mistake, just repeat.
- ❖ In between each attempt, make sure the peak flow meter reads “zero.”
- ❖ The partner or group should coach the person verbally to blow the air as hard and fast as they can.
- ❖ Take some deep breaths between peak flow attempts; **IF THE PERSON FEELS DIZZY, STOP THE TESTING AND SIT DOWN FOR FEW MINUTES BEFORE CONTINUING.**

- ❖ Practice this several times.
  - ❖ When the person is ready, the partner or group should record the liters per minute (LPM ) of air off the peak flow meter of 3 separate attempts.
  - ❖ The best of these attempts (i.e. highest reading in LPM) is recorded as the personal peak flow.
2. At the same time, the following information can be collected by the partner or group for each individual performing the peak flow:
    - ❖ Name, or use initials or an identification number (to protect confidentiality)
    - ❖ Age
    - ❖ Gender
    - ❖ Height
    - ❖ Weight
    - ❖ Physical fitness
    - ❖ Respiratory health (for example, does the person have a history of asthma, does the person have cold right now, is the person taking any medications?)
    - ❖ Race-ethnic group
    - ❖ Date and time of testing
    - ❖ Effort in making the peak flow
    - ❖ Recent exposure to cigarette smoke
    - ❖ Can the students think of any other variables they would like to collect which could affect peak flow?
  3. Create a spreadsheet to enter all these variables for the pairs or groups or entire data of the class, including the best individual peak flow measurement.
  4. Formulate hypotheses as to which variables collected could affect the peak flow measurements among all the individuals of the class. For example, should taller persons have a greater or smaller peak flow measurement compared to shorter persons and why? Write these hypotheses down.
  5. Graph the data entered into the spreadsheet. First look at just the range of the peak flows among the classmates. Discuss the hypotheses. Graph the data to look at different hypotheses. For example, see if the tall people as a group tend to have larger peak flows than shorter persons. Interpret these graphs and discuss in light of the hypotheses.
  6. Write the results and interpretation of the data, taking into account the hypotheses.
  7. Each group can present these data and be prepared to discuss them with their peers..

### **Additional Activities**

If there are enough peak flow meters, students can take them home to evaluate their own intra-individual variability over time (for example, morning and evening, under different weather conditions, under different respiratory health conditions), and repeat the same exercise but over several days and under different conditions.

If different types of peak flow meters are available, the students can compare their peak flow using the different peak flow meter types.

The peak flow data can be analyzed further, for example instead of taking the best individual peak flow, the average and standard deviation of each individual based on 3 attempts can be calculated; variation can be explored by evaluating the effect on the standard deviation by increasing the number of peak flow attempts.

If willing, students with asthma or other respiratory diseases can discuss their condition in relation to peak flow, pulmonary function and risk and benefit factors.

The class can research and discuss the effects of toxic respiratory exposures (such as tobacco smoke, occupational exposures such as asbestos) on peak flow and lung function.

Websites on peak flow::

<http://www.lungusa.org/asthma/astpeakflow.html>

<http://www.actionasthma.co.uk/actionasthma/home/community.asp>

<http://www.lungusa.org/asthma/astpeakchrt.html>

<http://www.njc.org/wizard/ch8pg2.html>

<http://www.sh.lsuhs.edu/fammed/OutpatientManual/PeakFlowMeters.htm>

[http://www.merck.com/disease/asthma/managing\\_asthma/peakflow1.html](http://www.merck.com/disease/asthma/managing_asthma/peakflow1.html)

### Follow-up Activities

The class could visit a pulmonary function laboratory and talk with a pulmonologist (lung doctor or respiratory therapist (specialist in evaluation and treatment of lung disease) or have them come to class as a guest speaker.

Students can create educational materials (brochures, videos, fact sheets, posters) on respiratory health and risk issues.

### Student Assessment

Give the following components to each student group as a guide:

- ❖ In pairs or groups, practice obtaining an optimal individual peak flow.
- ❖ With pair or group coaching, obtain and record 3 peak flow measures, and select the best.
- ❖ Record other variables with possible influence on peak flow.
- ❖ Formulate written hypotheses as to the effects of these variables on peak flow.
- ❖ Design a spreadsheet to collect and calculate the data.
- ❖ Graph the data and evaluate.
- ❖ Decide if the results are consistent or not with the hypotheses, and why.
- ❖ Present the data and results as written and/or oral presentation.

Assign points for the following components of the group project:

- ❖ Were the data (both peak flow and other variables) collected for each individual
- ❖ Were the original hypotheses clearly formulated?
- ❖ Was the spreadsheet appropriately constructed?
- ❖ Were the graphs appropriate constructed?
- ❖ Did all members of the group collect data?

- ❖ Were data entered appropriately into the spreadsheet?
- ❖ Were proper science terms used in the written interpretation of the hypotheses?