Preparation for discussion: The larynx and phonation

Pictures and videos related to the larynx and phonation (voicing) are available on the course website. Link from the Ling 520 home page, or go directly to:

http://www.unc.edu/~jlsmith/ling520/larynx.html

To prepare for class discussion, be ready to answer questions (1)–(4).

1. **The structure of the larynx**

The larynx is a valve that closes off the trachea (windpipe), blocking the flow of air to and from the lungs. It first evolved as a structure to keep food and water from entering the lungs. See section I of the [larynx and phonation web page](http://www.unc.edu/~jlsmith/ling520/larynx.html) for diagrams of the major cartilages and muscles of the larynx.

   (1) From the Mitchell model and the Sinav X-ray graphic, be able to locate on a diagram of the larynx:
   
   (a) the thyroid cartilage
   
   (b) the cricoid cartilage
   
   (c) the arytenoid cartilage(s)

   (2) From the Norman drawings under “Actions of laryngeal muscles” (scroll down), try to get a sense of how the cartilages listed in (1) are involved in the opening and closing of the vocal folds.

2. **Vocal-fold vibration and voiced sounds**

According to the myoelastic-aerodynamic theory of phonation, there are two major components of voicing: the aerodynamics of moving air, and the action of the glottal muscles. See section II of the [larynx and phonation web page](http://www.unc.edu/~jlsmith/ling520/larynx.html) for photos and videos of vibrating vocal folds, especially the schematic cross-sectional diagram link, which illustrates steps A–D below. See also V&C Ch 2, section 2.3 and Ch 13 for photos of the vocal folds.

**How voicing is achieved:**

A. The vocal folds are held together by muscle action (but not pressed tightly together).

B. Air is forced through the vocal tract from the lungs. If there is a small opening between the vocal folds, then the fast-moving air rushing between them causes a pressure drop in the space between them (the Bernoulli effect). Since the vocal folds are soft, they end up being sucked together.

C. Airflow from the lungs continues, but now the vocal folds are closed, so air pressure builds up below the closed glottis.

D. However, the vocal folds are still only being held together loosely by muscle action. So when the subglottal air pressure is high enough to overcome the effects of the aerodynamic "sucking together" of the vocal folds, they blow apart and air escapes. As air escapes, the difference in pressure above and below the glottis evens out, so the vocal folds are no longer being blown apart, and they return to their state in step 1.
This cycle is repeated over 100 times per second in a person with a deep voice, and several hundred times per second in a person with a higher voice. The faster the vocal folds vibrate, the higher the fundamental frequency — and therefore the perceived pitch — of the resulting sound.

(3) Be able to explain the role of laryngeal muscles in vocal-fold vibration. For example, to increase the $f_0$ of the glottal source, does a speaker use the laryngeal muscles to pull the vocal folds open and push them closed at a faster rate?

3. Phonetics and typology: Some consequences for voiced oral stops

In order for an oral stop to be voiced, vibrating air must pass through the glottis while the oral tract is completely blocked.

(4) Some languages have [b] as their only voiced (oral) stop. Other languages have [b d] but not [ɡ]. Can you use the myoelastic-aerodynamic theory of phonation to explain this fact?