EXCELLENCE IN SINGING

multilevel learning and multilevel teaching

VOLUME 1: Beginning the process

CELUMBRA
Redmond, WA

vibrancy of her imagination to translate into vibrancy in her body. (See the discussion under "Connecting the Body To the Voice and Music," in v. 2, ch. 7.)

Breath

The next function of your student's body for singing is to move air in and out of her body—to manage her breath. Her body uses two processes, *inhalation* and *exhalation,* to manage breath. During inhalation, the body brings air rich with oxygen deep into her lungs. There her circulatory system picks up the oxygen and delivers it to the other systems of her body. The circulatory system also dumps carbon dioxide, a by-product of her body's other systems, back into her lungs, which her body empties during exhalation.

Her body performs this function continuously to stay alive—approximately 16 to 20 times a minute, or 25,000 times a day, while at rest. It brings needed oxygen to her blood and picks up waste carbon dioxide from her blood.

Airflow in and out of the Lungs

To move air in and out of the lungs, your student's body manipulates a property of air described in Boyle's law: high-pressure air moves to low-pressure air.[4] The body uses this property of air extensively to produce sound. (See also the discussion under "Air in Motion," in v. 1, ch. 5.)

For inhalation, her body expands her lungs, which lowers the air pressure inside her body relative to the air pressure outside her body. Because of this disparity, the air outside flows in until the air pressures inside and outside equalize. During exhalation, her body

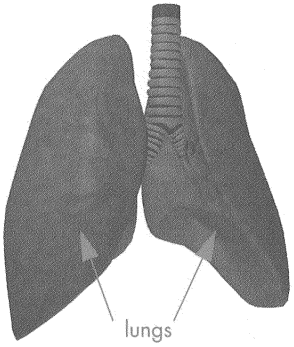
compresses the air in her lungs, raising the air pressure there relative to the air pressure outside. Because the air pressures are once again uneven, the air inside flows outside.

By expanding and contracting the lungs, her body continuously raises and lowers the relative air pressures, reversing the direction of airflow.

- Though your student may feel as though the air comes in first and then her body expands, her body expands first, causing the air to flow in, on its own. This distinction, though subtle, can help your student stop such problems as trying to suck in air to "fill up," gasping, or heaving her shoulders. She can instead learn to expand her lungs and allow the air to pour in effortlessly. (See the exercises "To Inhale Instinctively," "To Work with Different Ways of Inhaling," "To Sip in Air Vigorously," and "To Imagine 100 Noses," in v. 2, ch. 8.)

Major Body Parts in Breathing

Figure 1. The lungs.



Some of the integral body parts involved in breathing are the lungs, diaphragm, rib cage, intercostal muscles, and abdominal muscles.

The lungs

The lungs are composed of soft, spongy, elastic tissue. During breathing, the lungs expand and contract. (See Figure 1 in sidebar and Figure 2 on Plate 2.)

Because the lungs are not muscles, however, they cannot expand by themselves; the surrounding attachments expand them.

On the front, side, and back, the ribs attach to the lungs with two thin membranes, the *visceral pleural lining*, which covers the lungs, and the *parietal pleural lining*, which covers the inside of the rib cage and top of the diaphragm. These two sheaths have a thin liquid film between them that allows them to slide against each other. The pleural membranes bond together with this liquid, much like the effect of soap between plates stacked after washing—the soap holds them together until air gets in between. In the case of pneumothorax, for example, when a puncture wound occurs in the chest wall, air gets in between the pleural membranes and they can separate, causing a lung to collapse.

The *intercostal muscles*—the muscles between the ribs—contract and pull the ribs up and outward, which, because of the bonding between the pleural membranes, expands the lungs.

The *diaphragm,* a large muscle in the middle of the body, attaches snugly along the bottom of the lungs. When it contracts, due to the bonding between the pleural membranes, it expands the lungs downward.

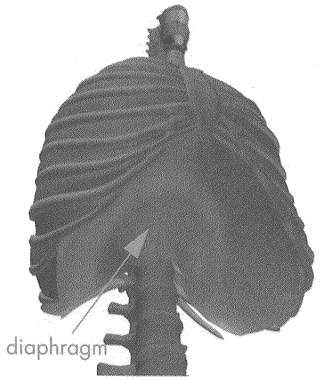
When the external intercostal muscles relax and release the ribs to their resting position and when the diaphragm relaxes, the lungs move back to their normal position because of the elastic pull of their tissues. At rest, the lungs and ribs pull against each other—the lung's tissues pull the ribs inward and the ribs pull the tissues outward—and these two forces balance each other.

The diaphragm

The diaphragm is the largest muscle in the body and is primarily responsible for inhalation. When it contracts, it moves downward and flattens, which causes the chest cavity to lengthen. The lungs thereby expand downward, which, in turn, expands the air

column—creating the uneven pressure that causes the air to flow in. (See Figure 2 in sidebar and Figure 3 on Plate 2.)

Figure 2. The diaphragm, under the lungs.



The diaphragm flattens when it contracts because of its unusual structure and attachments. It is shaped something like a large, upside-down bowl that covers the abdominal viscera (See the heading "The abdominal viscera," on page 163.) At its *rim*—the circumference of its lower edge—the diaphragm attaches to the ribs on the sides, to the sternum in front, and to the spine in back.

- Though generally shaped like a bowl, the diaphragm has a curving top (sometimes referred to as a "double-dome").

The top of the diaphragm consists of the central tendon, which is firmer than the muscle. Muscle fibers run from the central tendon downward to the rim. Because the central tendon is freer to move than the more stable ribs and spine, when the fibers contract, the central tendon is pulled downward, causing the diaphragm to lower and flatten.

Excellence in Singing offers exercises to help your student learn many distinctions about how her diaphragm moves. (See the exercises in "To Bark Like a Dog," "To Pant Like a Dog," "To Use Stop-Plosive Consonants," "To Sip in Air Vigorously," "To Punch with the Arms," "To Practice the Sniff–Puff Breath," and "To Release into The Next Inhalation," in v. 2, ch. 8.)

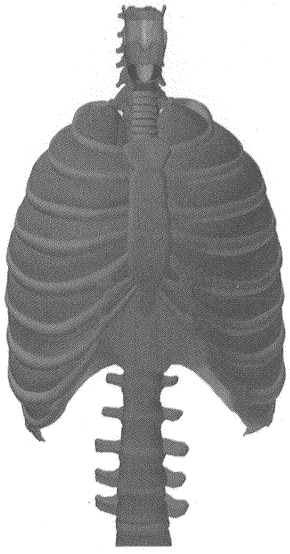
The rib cage

Twelve pairs of ribs, the sternum, and the spine create your student's rib cage, a protective enclosure for her lungs that also plays a significant role in pushing, pulling, and shaping the air inside her body. The sternum—the breastbone—is the long, flat,

vertical structure of bone and cartilage at the front and center of her chest. The spine is the long, flexible series of vertebrae connected by fibrocartilage and ligaments. Her ribs attach to her spine in back, and seven pairs of the ribs attach to her sternum in front, forming her rib cage.

Because your student's ribs attach to the front, sides, and back of her lungs, her rib cage moves her lungs horizontally when it moves. This action moves the air inside her body and produces the uneven pressure that stimulates the air to move in and out of her body for inhalation and exhalation. (See Figure 3 in sidebar and Figure 3 on Plate 2.)

Figure 3. The rib cage at rest.



The intercostal muscles

The intercostal muscles move your student's ribs. They are the small muscles between her ribs. They exist in two layers, the *external intercostals* and the *internal intercostals*. When they contract, they shorten the distance between the ribs. (See Figure 4 and Figure 5 on Plate 2.)

The external intercostals. When the external intercostals contract, they cause her ribs to move upward and outward. As her ribs move upward and outward, they move her sternum forward, away from the spine. This motion causes her chest cavity to expand. She can feel this motion by placing her hands on her ribs and inhaling deeply.

When the external intercostals relax, they allow her ribs to return to their resting position. This motion allows her chest cavity to shrink to its normal resting size. She can feel this motion by placing her hands on her ribs and sighing.

The internal intercostals. When the internal intercostals contract, they pull her ribs inward, which shrinks her chest cavity further.

She can feel this motion of her ribs by trying to blow the very last puff of air from her lungs.

Excellence in Singing offers exercises to help your student learn many distinctions about how her intercostals move her ribs. (See the exercises in "To Stimulate Fuller Breathing Using the Three-Way Stretch," "To Expand the Breath With Body Positions," and "To Pause During the Recovery Phase of Breathing," in v. 2, ch. 8.)

Abdominal muscles

Your student's abdominal muscles also play a significant role in moving air into and out of her body. The abdominals wrap around the front of her body in four layers. They extend from the arch of her pubic bone up to her ribs and sternum. Among their many functions, they support her viscera.

Three abdominal muscle layers lie horizontally and obliquely in layers at the front of her body. A fourth layer weaves vertically through her other abdominal muscles.

Because of their complex design, your student's abdominal muscles can pull in several directions at once, a feature she can exploit to control her breath for singing. The four layers of muscle pull inward from all directions—up and down, side to side, diagonally upward, and diagonally downward.

- The innermost layer, the *transverse abdominus,* is a pair of muscles with fibers that run from the sides of her body toward the center, across her abdomen. The muscles pull from the sides inward.
- The next layer, called the *internal oblique,* has fibers that run obliquely upward from the sides to the middle. This pair of muscles pulls upward and inward at an angle.

- The next layer of muscle, the *rectus abdominus,* fits inside a pocket of the transverse abdominus at the bottom and extends vertically from the pubic bone. It is almost completely enclosed within a sheath, which is formed by the abdominal aponeurosis, a ribbon-like sheet of connective tissue that is similar to a tendon. The rectus abdominus has four separate sections, called bellies, which can contract independently or together—an ability belly dancers use to bounce a coin up and down their abdomens. The rectus abdominus can exert a highly complex, vertical pull that causes your student's abdominal contents to move inward, pushing upward against the bottom of her diaphragm.
- The outermost layer, called the *external oblique,* has fibers that run obliquely downward from the sides to the middle. When contracted, this pair of muscles pulls downward and inward at an angle.

In combination with the external intercostals and the diaphragm, the four layers play a central role in controlling the outflow of air for singing. (See the heading "Opposing pressure," on page 165.)

Excellence in Singing offers many exercises to help your student learn many distinctions about how her abdominals move and affect her breath. (See the exercises "To Bark Like a Dog," "To Pant Like a Dog," "To Use Stop-Plosive Consonants," and "To Release into The Next Inhalation," in v. 2, ch. 8.)

The abdominal viscera

The abdominal viscera are the internal organs of your student's body, including her liver, stomach, and intestines. Though passive, they play a role in how the abdominal muscles control the outflowing air.

The viscera form a large mass that fits in the cavity outlined by the diaphragm and the sheet of abdominal muscles. Consequently, the viscera move every time the diaphragm moves. When the diaphragm and abdominal muscles both contract, the viscera are squeezed together, forming a solid mass that the diaphragm and abdominals can push against.

- ❄ A full stomach hinders the lowering of the diaphragm, which is why singers usually sing on an empty stomach.

Optimizing Breathing for Singing

To meet the demands of singing, your student needs to refine the movements of her diaphragm, intercostal muscles, and abdominal muscles and coordinate them for singing. She needs to

- bring air deep into her lungs, without unnecessary tension
- ensure a steady stream of air pressure during exhalation
- increase or decrease the pressure smoothly at will

In *Excellence in Singing*, you can find many exercises for teaching these skills. (See "Teaching and Learning Flexible Breath," in v. 2, ch. 8.") In the exercises in that chapter, you help your student master two principles: *muscle antagonism* and *opposing pressure*.

Muscle antagonism

To better control movement, your student needs to contract two muscle groups to pull against each other. This process is called "muscle antagonism."

Your student can feel an example of muscle antagonism by linking her hands together at her chest and pulling outward. If she pulls both hands evenly, neither hand moves. But she achieves a sense of balance and control because she can gradually relax the pull of one hand and increase the pull of the other to move smoothly.

During exhalation, the two muscles that need to pull against each other are the external intercostals and the abdominals.

By contracting her external intercostals—and keeping them contracted—your student achieves a sturdy rib cage that the abdominals can pull against at the top. Because the abdominals are attached to the ribs at the top and the pelvic bone at the bottom, the force from her abdominals' contraction pushes steadily upward and inward, against her viscera, against her diaphragm, and finally against the bottom of her lungs. If your student does not contract her external intercostals antagonistically, she loses the stable support against which her abdominals need to pull.

Opposing pressure

Your student can also contract two groups of muscles to create opposing pressure to stabilize and control movement. To give your student a sense of opposing pressure, you can ask her to push both hands against each other. With even pressure, her hands don't move. But your student can easily move one way or another by smoothly yielding one hand to the other.

For a normal breath, your student's diaphragm contracts downward to inhale and simply relaxes upward to exhale. In breathing for singing, her diaphragm contracts, as it does for a normal inhalation, but it then remains contracted as she begins singing. Her abdominal muscles also contract, pushing her viscera upward, opposing the downward force of her diaphragm. Her diaphragm then gradually yields to her abdominals, creating a