HOW THE VOICE WORKS

The voice is basically a wind instrument, like a flute or a pennywhistle, with one fundamental difference – you don't just play your instrument, you ARE your instrument. Because it literally comes from you, nothing can express the inner soul like the human voice. As a singer you have the potential to reach deep inside the hearts of your listeners in a way that no other musician can.

All wind instruments have three basic components that work together to produce the sound.

For the voice these are:

- **The power source** – the breathing system composed of the lungs and respiratory muscles
- **The sound source** – the larynx, which changes the breath into a sound wave
- **The amplification source** – the resonators - throat, nose and mouth. Here, the sound is amplified, shaped and turned into what you recognize as your voice.

**POWER SOURCE:**

**The Breath**

When we want to sing or speak the brain sends signals to the breathing muscles, and in particular, to every singer's favorite muscle – the diaphragm. The diaphragm is a thick, dome shaped muscle that divides the body into two halves. Above it are the heart and lungs and below it are the stomach and other organs such as the liver, kidneys and intestines.

At rest the diaphragm sits in the middle of the body like an upside down soup bowl. When you breathe in, it contracts and flattens, and the soup bowl becomes a plate. As it flattens, the diaphragm pulls the chest cavity downward with it and air is sucked into the lungs. This movement pushes the chest cavity down against the abdomen, causing the abdominal organs to move slightly outward. You feel the middle of your body gently expanding and contracting with your breathing. It feels as if the air is flowing into your belly. It isn't. The only place the air goes is into the lungs.
When it has finished its descent the diaphragm relaxes back up towards the bottom of the lungs, pushes the air out and then the whole cycle begins again.

While the diaphragm may do most of the work when you breathe in, the muscles between the ribs are also active. One set of these pulls the lower ribs up and out, rather like handles on a bucket. This action helps expand the chest cavity and sucks air into the lungs. You can feel this action if you put your hands over your lower ribs and breathe for a while. The ribs lift and the air goes in; the ribs fall and the air goes out.

When you are not doing anything in particular, small movements of the diaphragm and rib muscles are all you need to maintain your life's breath. Your body is efficient. It won’t work harder than it needs to.

When you sing, however, things are quite different. The diaphragm descends farther, the rib muscles expand the ribcage more vigorously, and you take more air into the lungs. Then, when your lungs are as full as they need to be, the breathing muscles carefully manage how the air is driven back out of the lungs and up to the larynx. The diaphragm and the rib muscles squeeze out exactly the right amount of air for each note.

Good singing depends upon this exquisite balance of forces in the breathing system. For example higher, louder notes take more air; softer, lower notes take less. A whole host of other things - like lung volume, phrase length and consonant articulation will affect the amount of work required of the breathing muscles. The equation is staggeringly complex and fortunately the brain figures it out as we go. However, breathing for singing is a learned skill. The more accomplished you are as a singer, the more efficiently your body makes these calculations.
SOUND SOURCE: The Larynx

There is only one way into and out of the lungs and that is through the windpipe. The entrance to the windpipe is the voice box, or larynx (pronounced lar-inks). Everyone is pretty familiar with the front view of the larynx; it is the Adam’s Apple (technically known as the thyroid cartilage). This bone-like structure protects the larynx and provides an attachment point for the front of the vocal folds.

From the inside, the larynx is definitely unfamiliar territory to most of us. There is no way you can see inside your own larynx without special mirrors, a lot of practice, and a very weak gag reflex.

Deep inside the larynx are the vocal folds – 2 strips of muscle covered with a white mucosal membrane that flaps in the breeze when they vibrate. The vocal folds are small – somewhere around 1 centimeter in women and up to 1 1/2 centimeters in men – and positioned horizontally in the throat, parallel with the floor. The vocal folds and the area between them would roughly fit inside a postage stamp. Quite frankly, the vocal folds look like pretty insignificant, nondescript structures and it is hard to imagine they are responsible for producing the beautiful sounds that some people make.

The vocal folds are joined at the front and stretch back across the opening to the windpipe. At the back, each fold attaches separately to a cartilage. These cartilages tilt and swivel to change the length and position of the folds. When you are breathing quietly, the folds are in a “V” shape that allows air to pass through them. If you have just run up 4 flights of stairs and are gasping for air, they open a lot wider. When you sing or speak, the vocal folds come together to meet in the midline, close enough to be vibrated by the air from the lungs.

![Figure 4: Larynx](image-url)
The Vocal Folds and the Voice:

When they are in this midline position, almost touching each other, the vocal folds are ready to produce the voice. The air flows up from the lungs and the vocal folds begin to vibrate in a rapid, complex, rippling motion, chopping the airstream into little puffs. This turns the direct current of air into an alternating current of sound.

The pitch of the voice depends upon the number of times the vocal folds vibrate per second - the faster the vibration, the higher the pitch. For a man’s voice in speaking range, the vocal folds vibrate, on average, around 100 – 130 times per second; for a woman’s voice it is in the range of 180 – 220 times per second. For guys, when you are singing in falsetto, the vocal folds could be vibrating up to 500 or so times per second, and when a classical soprano sings a high C, her vocal folds are vibrating at over 1000 times per second!

Of course, in the human body, nothing is simple. This vocal fold vibration is very complex - the folds meet from back to front, bottom to top, and the mucosal membrane flows over each fold like a wave rippling on the seashore. Other things affect the way vocal folds vibrate. The amount of air pressure from the lungs, how tightly the folds are approximated, and the set of the muscles around the larynx all can alter the way the folds meet and part.

You can imagine that a sound generator this complex produces an equally complex sound wave, full of potential harmonics that add richness and character to the voice. You can also see that there can be a huge amount of variation in how well the system works. Even a small amount of extra tension around the vocal folds can affect the way they vibrate. And because the folds vibrate SO MUCH, a small amount of
tightness can have a big effect. You can also begin to see how your vocal folds' health can be affected by things like:

- how much you use your voice
- how hard the impact is when the vocal folds meet
- whether the folds are well lubricated or dry

**The Larynx and Swallowing:**

Some singers might disagree, but the most important function of the larynx is actually not to produce the voice, but to protect the lungs. Every time we swallow it acts as a valve, squeezing tightly shut.

The only thing that should go into your lungs is air. The lungs do not like foreign objects. If anything goes down the wrong way you know about it. You double over, coughing and gasping, until you have got rid of the offending morsel. You will also have given a very neat demonstration of the other two basic functions of the larynx:

1. to protect the airway during swallowing
2. to act like a valve so that you can cough out the stuff that shouldn't have got down there in the first place

**So how does a swallow actually work?**

Food, drink and air all share the same passage through the mouth and upper throat, down to the level of the larynx, then things get a little complicated. When you swallow:

- the larynx rises and the vocal folds shut firmly together.
- other muscles on top of the larynx shut tightly and seal off the entrance to the windpipe.
- whatever was in your mouth is propelled into passages on either side of the larynx, and thence down into the esophagus.

The main biological function of the larynx is to act as a gatekeeper to the lungs: air down the centre, lunch round the sides. The reason I am mentioning this is to let you know that your throat has some pretty strongly wired biological functions and is well equipped with muscles that act as a valve. They tighten, squeeze, and close.
Tighten - squeeze - close … possibly familiar feelings when you sing? The swallowing muscles are strong and used to acting on automatic pilot. When you are speaking and singing you want them to stay uninvolved and neutral so the larynx can act as a vibrator and not a valve. Training the throat muscles to allow vibration without constriction is part of what good voice technique is all about.

AMPLIFICATION SOURCE: The Resonators

If you take a larynx that someone doesn’t need any more, mount it in a frame and drive air through it, the vocal folds will vibrate. The sound they make is thin and quiet. It doesn’t sound like a human voice at all, which is hardly surprising when you consider that the whole top of the vocal tract is missing. The upper vocal tract is the final part of the voice production system, and it makes dramatic changes to the sound.

The rich, complex sound wave produced in the larynx travels upward into the cavities of the throat, mouth and nose. Here the sound behaves as it would in any large, empty place: it resonates. It takes on the character of the space it is echoing around in. Some frequencies are amplified, some are damped, and by the time the sound wave hits your lips it has been profoundly altered. It has been turned into your voice rather than someone else’s. Everyone’s voice is unique, just like everyone’s fingerprints, and differences in the resonance system have a lot to do with this.

The resonance system also makes your voice louder without any added work on your part. By simply passing through the relatively large cavities of the mouth and throat the sound is automatically amplified. As a singer you can actually “tune” your resonating system to give you a louder, richer sound – all without straining your voice! When you do this, you get a big buzzy feeling in your face and your throat feels open and relaxed. It feels great and it is very powerful.
The mouth, nose and throat are the only resonators that shape the voice directly, because the sound wave actually passes through them on its way outside. But the sound wave produces sympathetic vibrations throughout the body. It will vibrate in hard structures like bones and open spaces like the chest cavity or sinuses. When singers talk about “chest voice” or “head voice” they are referring to these resonance sensations. Even though these kinds of resonance don’t directly affect the sound, they can give you valuable, instant feedback about how you are producing your voice.

**TURNING THE VOICE INTO WORDS**

So far we have been talking just about the voice – the sound/noise component of speech. At the back of your throat the voice is simply raw sound but by the time it leaves your lips it has been transformed into speech. In between, the voice is stopped, started, amplified, squeezed, aerated, exploded and narrowed. It is turned into words by a series of precise, high-speed maneuvers. This shape-changing is done by the muscles in the walls of the mouth and throat and also by the articulators: the tongue, lips, jaw, and soft palate. Speech scientists have recorded all this on x-ray film, and it is wonderful to watch the beautifully timed, precise dance of the vocal tract in action.

So producing the voice and speech is one of those paradoxes. It is so simple we aren’t conscious of doing it and so complex that - if we had to do it consciously - we would never get it done at all.