SCIENCE OF SOUND: **OPERATIC VOICES**

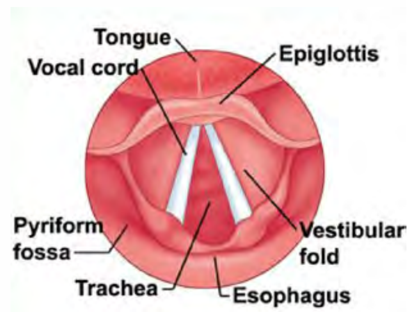
Singing in Europe and America is now generally divided into two categories: classical and popular. What most people think of as operatic or classical singing developed in Europe hundreds of years ago. This style flourished during the seventeenth century as opera became a popular form of entertainment and operatic music increased in complexity. The most recognizable characteristics of a classically trained voice are:

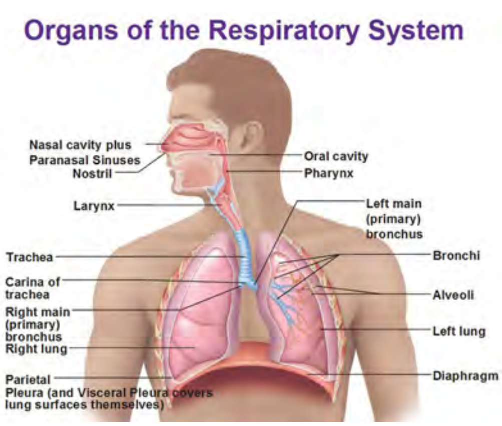
- an extensive range (the ability to sing both high and low)
- varying degrees of volume (loud and soft)
- resonance in the chest and sinus cavities (produces a "hooty", full or round sound)
- an ability to project or fill a large space without amplification

Very few people are born with the capability to sing this way. Classical singers take voice lessons about once a week and practice every day for many years in order to develop a beautiful operatic sound. In fact, most trained voices are not mature enough to perform leading roles on a big stage until they're at least 28 years old. Compare that with the most popular singers on the radio today who could release their first albums as teenagers!

THE VOCAL CORDS

Science tells us that all sound is made by two things vibrating together. The same concept applies when we talk or sing. The sounds we make are really just the vibration of two little strands of tissue called the vocal chords. The vocal chords are held in the larynx, which is sometimes called the voicebox or (in boys) the Adam's Apple. When you want to say something, your brain tells your vocal chords to pull together until they're touching lightly. Then, air pushes through them, and the vocal chords begin to vibrate, opening and closing very quickly. This vibration creates a sound. The pitches you sing are dependent on the speed at which the chords vibrate. A faster vibration creates a higher pitch. The length of the chords also affects the pitch of the voice. Longer chords equal a lower voice.





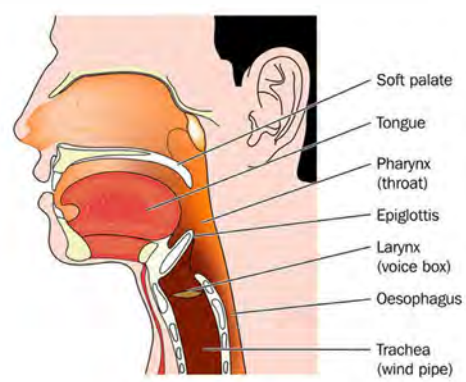
BREATHING/SUPPORT

In order to sing long phrases with a lot of volume and a good tone, singers must breathe in a specific manner, making use of the whole torso area (lungs, ribs, diaphragm and viscera). As they breathe in, each part of this network does its job: the lungs fill up, which forces the ribs to expand and the diaphragm (a flat muscle below the lungs) to move down. As the diaphragm descends, the viscera (stomach, intestines and other organs) are forced down and out. Expelling the air, or singing, is essentially a slow and controlled movement of those muscles. If all of the air escapes from the lungs quickly, the tone of the voice will sound breathy and will lack intensity. Successful opera singers must be able to isolate the diaphragm and ribs, controlling the rate at which they return to their original positions. This allows for a consistent stream of air that travels from the lungs, through the larynx and out of the mouth.

RESONANCE

One of the most obvious characteristics of an operatic voice is a full, resonant tone. Singers achieve this by lifting their soft palate. This is a part of the mouth that most people don t ever think about and it can be difficult to isolate. Here are some simple exercises to feel where it is and hear the resonance in your voice when you lift it: Start to yawn. Feel that lifting sensation in the back of your mouth? That is the soft palate going up. With a relaxed mouth, slide your tongue along the roof of your mouth, from your teeth back toward your throat. You should feel your tongue go up, then down (that's your hard palate), then back up again. That soft, fleshy area at the very back is your soft palate. Say the word "who" like you would say it in normal conversation. Now, say "hoooo" like a hoot owl. Can you hear the difference?

Say the sentence "How do you do?" as if you were an old British woman. Lifting the soft palate is the foundation for the resonance in a singer's voice. With a lot of practice, a singer can lift his or her palate as soon as they begin to sing, without even thinking about it.



SCIENCE OF SOUND: **OPERATIC VOICES**

If you sing in a choir at school, you're probably already familiar with the different types of voices. We have the same kinds of voice types in opera, but there are a few differences:

Butterfly from *Madama Butterfly*

Sopranos are the highest female voice type, with a range similar to a violin. In opera, they usually sing roles like the daughter, the girlfriend or wife. They can be princesses and good girls, but they can also have some tricks up their sleeves!

Mezzo-sopranos are similar to your choral altos. Their sound is darker and warmer than a soprano. They often play older women, sometimes they play evil women, and sometimes they even play young boys! They can be witches but they can also be attractive – sometimes both at the same time.

Carmen from *Carmen*

Faust from *Faust*

Tenors are the highest male voice type – they often sing roles like the hero, the prince, the boyfriend. They can sound like a trumpet in both range and color. Tenors can be athletic and energetic and they can also be sensitive and emotional. They get all the good high notes and a lot of the applause!

Figaro from *The Barber of Seville*

Baritones fit between choir tenors and basses – not as high as the tenors, but not as low as the basses. They can play both good and bad characters: sometimes they're the boyfriends or brothers – or the ringleader for some comedic shenanigans – but in serious operas they can sometimes be the bad guys.

Basses are the lowest male voice type – they can sound like a bassoon, tuba or low trombone. In a serious opera they can represent age and wisdom (and sometimes evil geniuses), in a comic opera they can make you laugh. Sometimes they steal the show with their super low notes and provide a comforting presence with their warm rumbly tones.

Sarastro from *The Magic Flute*

Photos by Tim Wilkerson, Ken Howard, and Jeff Roffman.

Think of your favorite story, movie or television show. If that story was to be turned into an opera, what kind of voice types would be best for each of the characters?

You can hear different kinds of voice types in popular music too. Think about your favorite singers – do they have high voices or low voices? What do you like best about the way they sing?

SCIENCE OF SOUND:
HOW SOUND IS MADE

YOUR SENSE OF SOUND: ENERGY & EQUIPMENT

Sound is important to human beings because it helps us to communicate with each other. Your sense of sound also helps you to enjoy music like opera. Musicians use sounds to communicate thoughts or feelings. But what is sound exactly? How do we hear it?


Photo by Raftermen

THE ENERGY: HOW SOUND IS MADE

Sound is vibrating air. Sounds can vibrate in different patterns. These patterns are called sound waves. The different patterns change the sound we hear. Listen to traffic on a busy street. Noise like this is disorganized sound. Now listen to a piece of music. Music is sound and silence that is organized into patterns.

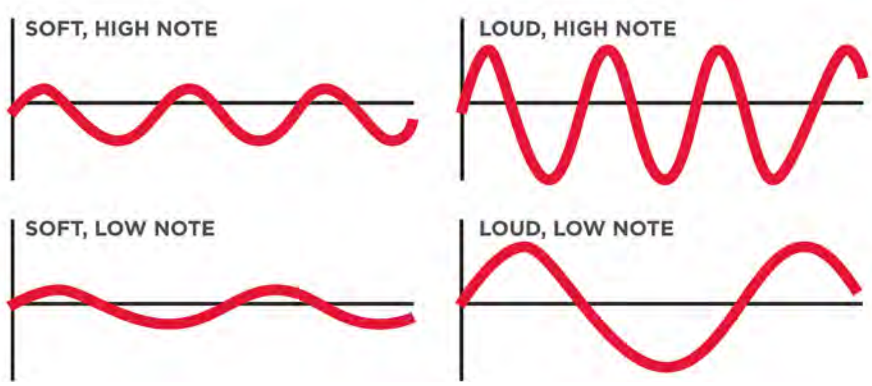
THINK ABOUT IT!

How are the sounds of traffic and music different? How does each sound make you feel? Can traffic sound like music? Can music sound like traffic?

Sound waves can vibrate many times in one second. The number of times a sound wave vibrates in one second is called its frequency. The frequency tells how high or low the sound will be. This is called pitch. High-pitched notes vibrate at a fast rate, so they have a fast frequency. Low-pitched notes have a slow frequency. In opera, the highest pitches are usually sung by women. Very low pitches are sung by men.

Just as the speed of the sound wave determines the pitch, the shape of the wave determines how loud or soft the sound will be. This is called volume.

This is what sound waves look like:

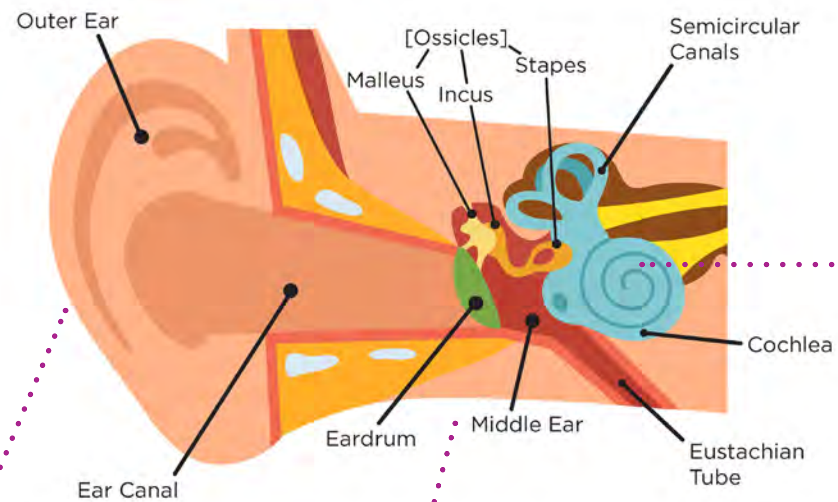


TRY THIS

Stretch a rubber band between your thumb and forefinger on one hand. Pluck it a few times. Can you see and feel the vibrations? What happens if you pluck the rubber band harder? Softer? Change the shape of the rubber band by making it longer and thinner. What do you hear?

ACTIVITY

SCIENCE OF SOUND:
HOW SOUND IS MADE



THE OUTER EAR

This is the only part of your ear that you can see. Your outer ear has two jobs: to collect the sound and protect the rest of the ear. Invisible sound waves travel through the air and enter the outer ear through the canal. The canal is the opening in your ear. The outer ear also makes earwax.

THE MIDDLE EAR

After sound waves travel through the canal, they reach your middle ear. The middle ear turns the sound waves into vibrations before it sends them to the inner ear. Sound passes through your eardrum and three tiny bones called ossicles. Each ossicle has a name. They are the malleus (hammer), the incus (anvil), and the stapes (stirrup). The eardrum is a thin piece of skin attached to the hammer. The hammer is attached to the anvil and the anvil is attached to the stirrup. When these three tiny bones vibrate, sound is passed on to the inner ear.

THE INNER EAR

Once vibrations enter your inner ear, they travel to the cochlea. The cochlea is a small, curled tube. It is shaped like a snail's shell. It is filled with liquid and lined with millions of tiny hairs. Vibrations cause the liquid and the hairs to move. Then the hairs change the sound into nerve signals for your brain. The brain interprets the nerve signals and tells you what sound you are hearing.

DID YOU KNOW?
Earwax (the yellowish stuff that forms in your ears) is your friend!

It protects the rest of the parts of your ear from getting dirt in them.

DID YOU KNOW?
The ossicles are the three smallest bones in your body.

The stapes is the tiniest of all!

THE BALANCING ACT

Your ears do more than just hear... they also help keep you standing upright! Three small loops are located directly above the cochlea. The loops are called the semi-circular canals. They help us maintain our balance. The semi-circular canals tell your brain the position of your head – is it looking up? Turned to the left? Your brain determines where your head is and then keeps the rest of your body in line.

Try this! Fill a cup halfway with water. Move the cup around a bit, then stop. Notice how the water keeps swishing around even after the cup is still. Sometimes this happens in your semi-circular canals when you spin around very fast. The fluid that continues to move around in your ear is what makes you feel dizzy!