



Beethoven

AND THE
SCIENCE OF SOUND
Key Stage 2 Resource Pack

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LOTTERY FUNDED

Supported using public funding by
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WIGMORE HALL

WHO WAS LUDWIG VAN BEETHOVEN?

Beethoven was one of the greatest and most famous composers of European classical music. Born in 1770 in Bonn, a small, sleepy town in what is now Germany, he was one of seven siblings - although only three survived to adulthood. He started piano lessons at age 5 and showed great talent early on - but his first teacher was cruel, sometimes dragging young Ludwig out of bed in the middle of the night to practice.

At 16, he travelled to Vienna, the imperial capital, to study music - but had to return home immediately as his mother was very ill. After her death, Ludwig stayed in Bonn to look after his two younger brothers. It was another six years before he was able to travel again to Vienna to study piano, violin and composition.



Ludwig studied and practised hard and became one of the most skilled pianists of the time.

He was especially well-known as an improviser (someone able to invent music on the spot) and he became a celebrity in the music rooms of Viennese high society, where musicians were pitted against each other in X-factor style contests, to see who could improvise the best.

“MUSIC FOR A LATER AGE”

Beethoven is most famous today as a composer, and his music is loved and performed all over the world, nearly two centuries after his death. He wrote hundreds of works, ranging from solo piano pieces to string quartets, songs to symphonies. He had a completely original musical brain and he created sounds that nobody else had ever imagined. In fact, quite often his music sounded so outlandish and strange that some contemporaries couldn't understand it, and even thought it was ugly.

Composer Louis Spohr called Beethoven's string quartets

“*indecipherable, uncorrected horrors*”

and legend has it that when the Italian violinist Felix Radicati complained that they were

“*not music*”

the composer responded:

“*Oh, they are not for you, but for a later age.*”

HEARING LOSS

From the age of 26, Ludwig's hearing started to decline. In 1800, he wrote to a friend "For the last three years my hearing has grown steadily weaker. I can give you some idea of this peculiar deafness when I must tell you that in the theatre I have to get very close to the orchestra to understand the performers, and that from a distance I do not hear the high notes of the instruments and the singers' voices... Sometimes too I hardly hear people who speak softly. The sound I can hear it is true, but not the words. And yet if anyone shouts I can't bear it."

Beethoven tried to keep this secret from those closest to him. He feared his career would be ruined if anyone realised. "For two years I have avoided almost all social gatherings because it is impossible for me to say to people 'I am deaf'," he wrote. "If I belonged to any other profession it would be easier, but in my profession it is a frightful state."

Doctors tried unusual methods of restoring Ludwig's hearing. He was advised to take a bath of luke-warm river water, or to strap wet tree bark to his upper arms until it dried out and created blisters. None of these treatments worked and Beethoven wrote that "an incurable condition has seized me, worsened by senseless physicians... I have been cheated from year to year in the Hope of improvement, finally compelled to the prospect of a lasting Ailment (whose Curing may perhaps take years or indeed be impossible)."

Ludwig's housekeepers remembered that, as his hearing declined, he would sit at the piano and grip a pencil between his teeth, touching the other end of it to the soundboard of the instrument, to feel the vibration of the note. He ended up wrecking several of his pianos by bashing on the keys as hard as he could, in order to hear any sound at all.

DEPTHS OF DESPAIR, HEIGHTS OF ACHIEVEMENT

Ludwig's hearing gradually declined until by the time he was 44, he was completely deaf. Ries wrote, "As he grew older and deafness overtook him, the negative aspects of Beethoven's personality came to the fore. He was increasingly given to bouts of despair, the difficulties of communication made him more reserved, and he became more suspicious and distrustful of others."

Despite all this, Beethoven continued to compose and conduct, even when he wasn't able to hear the music. He had heard and played music for the first three decades of his life, so he knew how instruments and voices sounded and how they worked together. His deafness was a slow deterioration, rather than a sudden loss of hearing, so he could always imagine in his mind what his compositions would sound like.

His final years saw some of his most amazing, imaginative and original compositions - that still sound outlandish or alien even to 21st century ears.

“

Art demands of us that we shall not stand still

”

Ludwig died in bed 1827, after a long illness, during a thunderstorm. Legend has it that at the moment of his death, a clap of thunder rang out over the rooftops of Vienna. 20,000 people attended his funeral three days later - 10% of the population of the city - a huge crowd for a much-loved artist.

FRANKENSTEIN AND THE AGE OF ENLIGHTENMENT

The eighteenth century - the "Age of Enlightenment" - was a time of great intellectual and scientific development in Europe. Old beliefs about religion and politics, where people were not expected to question the authority of the church or the kings and queens, were losing their power. Revolution was in the air!

- Philosophers like Voltaire and Rousseau argued that society should be based upon reason and logic, not on religious faith. Others stated that human beings had free will and could choose their own actions. This was a radical idea in a time when many believed that humans were subjects of divine destiny
- English writer Mary Wollstonecraft was one of the first to argue that women and men should be treated equally - another surprisingly radical idea
- There were huge advances in scientific understanding. Luigi and Lucia Galvani discovered that messages inside the body were carried by electrical impulses, when they noticed that the muscles of dead frogs' legs twitched when struck by an electrical spark. What a shock they must have had when this first happened! The experiments of the Montgolfier Brothers enabled them to launch the first ever manned flight, in a hot-air balloon
- Doctors were breaking ground in the field of medicine; breakthroughs during this period included an understanding of blood circulation and the discovery of red blood cells and bacteria

All this intellectual energy was hugely exciting to artists, poets and composers, who in turn contributed to the new ideas bubbling around. Mary Shelley's novel "Frankenstein", written when she was just 18, was inspired by recent developments in science and philosophy, and has given us one of the most famous monsters of all time. Beethoven believed passionately in the Enlightenment concept that all humans were equal, no matter their status. Some people say they can hear in his music all the new ideas of the Age of Enlightenment, struggling to be born.

WHAT IS A STRING INSTRUMENT?

The string family covers instruments of all shapes and sizes from all over the world - from the Greek bozouki to the Chinese erhu, the Indian sitar to the Welsh harp. String instruments produce sound when the player vibrates one of the strings. They can be played in many ways, but the instruments all have a few things in common:

STRINGS

which are stretched tight across a frame. They need to be under tension in order to vibrate. Nowadays the strings are usually made of metal but originally they were made from dried sheep intestines!

A BRIDGE

usually made of wood. The strings rest on the bridge, which carries the vibrations to...

A BOX

again, usually wooden - which amplifies the vibrations so that they are loud enough to hear. These boxes often come in fancy or intricate shapes - for example, the violin, with its scoops and scrolls.

Violins, violas and cellos each have four strings and arrived at their current form in 16th century Italy. They are mostly built in exactly the same way nowadays, although some modern instruments can be plugged in and amplified electrically, similar to an electric guitar.

TWO HANDS - DIFFERENT JOBS

One of the tricky challenges of playing a violin, viola or cello is that your hands have to work together - but doing very different jobs

LEFT HAND

these fingers control which notes are played, by pressing down on the string to shorten the vibrating length, which makes the note higher. But watch out - if the finger presses down in the wrong place, the note will be out of tune!

RIGHT HAND

these fingers are the ones that (usually) actually make the sound. Sometimes by simply plucking or strumming the strings, as with a guitar. Sometimes by stroking them with a 'bow' - which is made from a bundle of horsehair stretched along a sprung wooden stick. Using a bow, the player has the ability to create long smooth notes or short spiky ones, changes in volume and lots of other cool sound effects.

WHAT IS A STRING QUARTET?

A string quartet is a piece of music written for four instruments from the string family: two violins, one viola and one cello. Usually it will come in three or four different sections (or 'movements'), which are contrasting in tempo (speed) and atmosphere. The first string quartets were written in around 1750 and there have been many written by different composers, right up to the present day. Composers often love writing string quartets because the sounds of the instruments blend so well together, and there are enough different voices to create a composition that is both complex and simple at the same time. Beethoven was one of the greatest composers of string quartets - he wrote 16 in total.

'String quartet' is also the name of the group of musicians who play this music. Musicians often love playing quartets - the music can be exciting, intense, peaceful or poignant - it can be like four voices all in agreement, asking and answering questions, or torn apart in furious argument!



Heath Quartet photographed by Kauko Kikkas

GOOD VIBRATIONS

Every sound that you hear - from a squeaky floorboard, to a human voice, to the roar of a jet engine - is produced by objects vibrating. That's right! Sometimes, if the vibrations are deep enough, it's possible to feel them - try putting your hand on the outside of a vacuum cleaner and see if you can notice the vibrations start and stop when the machine is switched on and off.

In order to reach your ears, the vibrations (or soundwaves) need to travel through something - usually, in our case, air, although sound also travels through water and solid objects such as walls, floors and ceilings.

When the soundwaves arrive at your ear, they bounce onto the tympanum (also known as your ear-drum) - a tightly-stretched membrane, like a drum skin, which picks up the vibrations and transmits them to your inner ear. Then, your brain translates the sound signals and works out what's making the noise. All of this happens inside a fraction of a second!

Sound travels much faster and further through water than air - because the water molecules are packed much more tightly together, and so the vibrations are passed on much more efficiently. Have you ever noticed how the world sounds different when you go underwater when swimming?

In air, sound travels at about 330 metres per second - approximately one mile every five seconds. Using this information and counting the seconds between seeing a lightning flash and hearing the thunderclap, it is possible to calculate how far away the lightning strike was.

Underwater, sound can travel at up to 1 mile every second. Researchers believe that humpback whales can communicate at distances of up to 100 miles in the open ocean!

EXPERIMENT: BUILD A STRING TELEPHONE

This amazing experiment demonstrates how sound can travel along a piece of string - but only if it's tightly stretched. You will need:

- A long piece of string (long enough to stretch right across the room)
 - Two empty yoghurt pots or two plastic cups, washed out
 - A drawing pin
 - A pencil
1. Using the drawing pin, make a hole in the centre of both the cups (or yoghurt pots) that you are using. Use a pencil to make the hole bigger. Make sure you stay safe - you might need an adult to help or supervise. Make sure the holes are only large enough to put the string through and no larger.
 2. Pass the string through the hole and into the bottom of one cup. Tie a knot in the end of the string that is inside the cup. When you're done, pull the string tight so the knot rests in the bottom of the cup. You might need to tie a double or triple knot in order to make sure it won't slip back through the hole.
 3. Place the untied end of the string through the bottom of the other pot or cup. Tie a knot, as before, and pull the string tight.
 4. Give one cup to your partner and hold the other one yourself. Move away from each other until the string is tight. Place the open end of one cup over your ear and have your partner speak quietly into the open end of the other cup. If you've made it correctly, you should hear your friend speak, even if it is a long piece of string!
 5. Now, take a half-step towards each other so that the string is slack. Repeat the experiment. Does it still work?

HOW DOES IT WORK?

When you speak into the empty cup, your voice creates soundwaves which make the cup vibrate. The vibrations travel all the way along the string. When they reaches the other end, the empty cup acts as amplifier - just like the box of a violin or cello - and makes the sound loud enough to hear again.

Ta-daa!

19TH CENTURY SCIENCE: THE MARVELLOUS METRONOME

A metronome is a machine used by musicians and composers to communicate exactly how fast a piece of music should be played. Metronomes are calibrated in beats per minute (bpm). If a piece is marked "60 bpm", that means one beat every second. If it's "120bpm", that's 2 beats per second.

The original mechanical version was invented during Beethoven's lifetime, by the Dutch mechanic Dietrich Nikolaus Winkel (although his idea was copied by Johann Nepomuk Mälzel, who became widely known as the true inventor). Nowadays, most musicians use digital metronome apps.

Before the invention of the metronome, composers used Italian terms like allegro (fast), andante (walking pace) and lento (slow) to indicate the tempo (or speed) of the music - but you can see that these terms are very much open to interpretation. Beethoven hated the idea of his music being ruined by musicians playing it at the wrong tempo. He was very excited by this new technology, writing to a friend in 1817 "I have long been thinking of abandoning these nonsensical terms allegro, andante, adagio, presto, and Mälzel's metronome gives us the best opportunity to do so. I give you my word here and now that I will never use them again in any of my new compositions."



HOW DOES A MECHANICAL METRONOME WORK?

*A metal rod swings back and forth, clicking every time it goes.
The rod is powered by a spring which can be wound up.
There is a weight attached to the rod, which you can slide up and down to adjust the tempo. When the weight is nearer the end of the rod, the metronome clicks more slowly. When the weight is near the pivot point, the tempo increases*

EXPERIMENT: BUILD YOUR OWN STRING METRONOME

You will need:

- string, 60 - 70 cm long
- a weight, around 100g, which you can attach to the string. A lump of sticky tack or plasticine would do
- a table
- sticky tape
- a ruler
- a timer

1. Tape one end of the string to the side of the table
2. Attach the weight to the other end of the string. Make sure it can swing freely without knocking into anything
3. Measure the length of string between the table (pivot point) and the weight. Note it down
4. Pull the weight off centre by about 45° from vertical. Let it go and count how many times it swings back and forth in ten seconds. Multiply this number by six to calculate the bpm
5. Now, remove the weight and re-attach it to the string halfway up. Measure the new distance to the pivot point and repeat the experiment. Are the results the same? Can you make a hypothesis about how the tempo will change when you move the weight again?
6. Now try the same experiment but with a heavier weight. Does this make a difference to the results?

Artsmark Status and Arts Award

Did you know that taking part in projects, concerts and workshops can contribute towards both?

Artsmark is Arts Council England's flagship programme to enable schools and other organisations to evaluate, strengthen and celebrate their arts and cultural provision.

For more information including how to apply for Artsmark status visit www.artsmark.org.uk.

Arts Award supports young people to deepen their engagement with the arts, to build creative and leadership skills, and to achieve a national qualification.

For more information on how your students might take part and how to become an Arts Award centre visit www.artsaward.org.uk.

Wigmore Hall Learning is a proud supporter of Artsmark and Arts Award. If taking part in a project, workshop or concert with us has contributed to your Artsmark status or your students' Arts Award please tell us!

YOU CAN CONTACT US ON 020 7258 8240 OR BY EMAILING US AT LEARNING@WIGMORE-HALL.ORG.UK.

Wigmore Hall Learning

Connecting people through music

Since 1994, Wigmore Hall's renowned Learning programme has been giving people of all ages, backgrounds and abilities opportunities to take part in creative music making, engaging a broad and diverse audience through innovative creative projects, concerts, workshops and online resources.

We are passionate about the impact music can have on our lives and on our society, and three core values lie at the heart of our programme: creativity, collaboration and equality. These values reflect the spirit of chamber music, and we embody them through quality, co-created music making, through which every voice is heard and equally valued.

We collaborate with a range of community, education, arts, health and social care organisations, working in partnership to engage people who might not otherwise have the opportunity to take part.

OUR PROGRAMME...

Schools includes schools concerts; teacher training; projects with hospital schools; and our innovative Partner Schools Programme, in which we work in partnership with schools and Music Education Hubs to co-produce activity over three years, creating a creative whole school plan for music.

Family invites families to Wigmore Hall to take part in inspiring, interactive workshops and concerts for families with babies, children in their early years and children aged 5+.

Young People offers a range of projects, offers and events including a growing programme for young people with Autism Spectrum Conditions; our free ticket scheme Chamber Zone, and Young Producers, which invites 14 – 18 year-olds to programme, plan, promote and present their own concert at Wigmore Hall.

Community Partnerships includes Music for Life, our extensive programme for people living with dementia and their families, friends and carers; and projects with the Cardinal Hume Centre, which enables people to gain the skills they need to overcome poverty and homelessness.

Pathways is a range of schemes and events which provides a platform for emerging artists, supporting the next generation of musicians and leaders. It includes our annual Trainee Music Leader, Royal Academy of Music / Wigmore Hall Fellowship Ensemble and RPS / Wigmore Hall Apprentice Composer schemes, as well as Bechstein Sessions, a new series of informal performances which showcase emerging talent.

Behind the Music is a programme of study events including talks, lecture-recitals, masterclasses, study groups and Come and Sing. days

WIGMORE HALL
Learning

In 2018/19 we led 700 Learning events, engaging 28,484 people through 40,000 visits to the programme

For further details about Wigmore Hall
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The Wigmore Hall Trust.
Registered Charity No 1024838

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