

Frequency: A Scientific Overview

“Frequency” is one of the most fundamental properties of sound, and science studies it on multiple levels – physical, biological, psychological, and even therapeutic. Here’s a structured summary, kept understandable:

1. Physical Level

- **Frequency (Hz):** the speed of vibration cycles per second. Example: 440 Hz means the air molecules vibrate 440 times per second → this corresponds to the musical note A (a1).
 - **Audible range:** for humans, about 20 Hz – 20,000 Hz, though it narrows with age (higher frequencies are lost first).
 - **Infrasound (<20 Hz):** inaudible, but can be physically felt (vibration, pressure). Research suggests it influences mood (unease, anxiety).
 - **Ultrasound (>20 kHz):** inaudible, but widely used in medicine (imaging), industry, and sometimes therapy.
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2. Biological Level

- The **inner ear (cochlea)** has a vibrating membrane (the basilar membrane) that is “tuned” to frequencies:
 - High frequencies → near the base of the cochlea
 - Low frequencies → deeper, toward the apex
 - This is why the auditory system is described as **tonotopic**: it spatially maps frequency.
 - Frequency perception isn’t only via hearing: vibrations can be sensed through the skin and bones (e.g. bone-conduction hearing aids).
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3. Psychological Level

- **Pitch:** the perceived correlate of frequency, but not linearly. For instance, the difference between 100 Hz and 200 Hz feels larger than the difference between 1000 Hz and 1100 Hz.
 - **Emotional effects of frequencies:**
 - Low frequencies (bass) → strong bodily impact (chest resonance, muscle tension, rhythmic pulse).
 - High frequencies → attention-grabbing, sometimes stress-inducing.
 - **Music systems:** frequency ratios (intervals) are interpreted culturally, but also have physiological bases (simple ratios feel “harmonious”).
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4. Health and Science at the Borderline

- **Measurements:** Certain frequency ranges objectively influence heart rate, blood pressure, and hormonal responses.
 - **Vibroacoustic therapy (VAT):** low-frequency vibrations (20–120 Hz) transmitted through speakers or vibrating beds → studied for pain relief, muscle relaxation, easing Parkinson's symptoms.
 - **Binaural beats:** listening to two slightly different frequencies in each ear (e.g. 200 Hz vs. 210 Hz) produces a perceived 10 Hz “difference tone,” which some studies suggest may influence brainwaves (relaxation, focus). The scientific evidence is mixed.
 - **“Healing frequencies” (e.g. 432 Hz, solfeggio scale):** often cited in spiritual/artistic contexts. Scientifically, no proof that these frequencies are inherently healing; their effects are more likely psychological, aesthetic, cultural, or placebo-like.
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5. Effects of Extreme Frequencies

- **Infrasound:** can trigger strong bodily reactions (dizziness, unease, nausea) – studied near large fans, engines, wind farms.
 - **Ultrasound:** at high intensity it can damage tissue (industrial use), but at controlled lower intensities it can aid healing (e.g. bone regeneration therapy).
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Frequency is a physical phenomenon, but its effects on the human body and psyche are complex:

- **Physical perception** → hearing, vibration
- **Biological processing** → cochlea, nervous system
- **Psychological experience** → pitch, emotional response
- **Therapeutic experiments** → vibroacoustics, sound therapy

Hz dramaturgy example

- *0–20 Hz (infrasound):* inaudible but bodily felt; unsettling, anxious undertones.
- *20–80 Hz:* deep bass; strong physical resonance; 40 Hz especially interesting for brainwave modulation.
- *100–500 Hz:* speech range; connects to human presence.
- *500–2000 Hz:* expressive middle; singing, clarity; potential “musical climax” zone.
- *2000–8000 Hz:* articulation, brightness; often tense or harsh.
- *10,000–20,000 Hz:* piercing high tones; mostly heard by the young; at the edge of perception.
- *>20,000 Hz:* ultrasound; inaudible, returns to “silence” but with transcendent effect.

Audience psychology:

- Start: mysterious bodily unease →
- Bass: grounding, pulsing →
- Mid: human connection, narrative →
- Higher: tension, sensory overload →
- Beyond: release into silence/transcendence.

Parallel: like a classical tragedy arc: invisible tension → embodied vibration → human connection → musical fullness → overload → silence.

Thus: **0 Hz → 20 kHz arc** = from womb-like infrasound to “otherworldly” ultrasound.

Examples: Hodworks, Trajal Harrell, Eszter Salamon, Anne Teresa De Keersmaeker, Ryoji Ikeda (sound artist collaborating with choreographers), Wayne McGregor. Also vibroacoustic performances (Christina Kubisch, Zbigniew Karkowski), somatic practices, CTM Festival in Berlin.

Rhythm is possible in every frequency range – but felt differently:

- Infrasound: bodily pulsing
- Bass: mobilizing, collective
- Mid: communicative, language-based
- High: textural, stimulating
- Very high: flickering, overwhelming

Thus rhythm is the **bridge across frequency ranges**, keeping the audience in time no matter the pitch. For dance, it means the body can transition between sensory worlds yet remain anchored in rhythm – like a migrating heartbeat.