NO PREP

The Physics of Fear

Includes: Student reading, case study, differentiated questions, teacher key

Name: Period: Date:

The Physics of Fear

Fear and the Human Body

Fear might feel like an emotion, but it is also a physical reaction triggered by the laws of physics. When startled in a haunted house or watching a horror movie, the body undergoes rapid changes: heart rate increases, breathing quickens, pupils dilate, and muscles tense. These are all part of the fight-or-flight response, controlled by the sympathetic nervous system. But what begins the process? Usually, it is a physical stimulus—like a sudden noise or flash of light—that physics can explain. Sound waves play a central role. A sound is simply a vibration traveling through the air as compressions and rarefactions. When the frequency or amplitude changes suddenly, it disrupts the brain's sense of safety. Loud sounds (high amplitude) deliver bursts of energy that the eardrum and inner ear detect instantly, activating the startle reflex. Infrasound, frequencies below 20 Hz, creates vibrations that are felt rather than heard. These vibrations resonate in the chest cavity and even the eyeballs, producing unease. Studies show that exposure

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The Science of Startle Responses

Jump scares, those moments when a quiet scene explodes into noise, rely on physics. The contrast in sound intensity (decibels) tricks the nervous system, which is primed to detect sudden changes. A jump from 40 decibels (quiet background) to 90 decibels (slamming door) is enough to jolt the body into panic. Light works similarly. Strobe lights flash rapidly, interrupting the brain's ability to process continuous images. This takes advantage of the persistence of vision, where the brain holds onto one image for a fraction of a second before replacing it. Rapid flashes confuse the visual system, increasing tension. Low lighting reduces the number of photons entering the eye, forcing the retina to switch from cone cells (color vision) to rod cells (low-light vision). This makes edges blur, shadows lengthen, and movement harder to track. Those are the perfect conditions for fear.

Fear as a Designed Experience

From a survival standpoint, these physical triggers are useful. Our ancestors who reacted instantly to rustling bushes or sudden movements were more likely to escape predators. Today, haunted houses and films exploit the same sensory systems. By manipulating sound frequencies, light intensity, and sudden motion, designers transform physics into emotional experiences. Fear is therefore both an ancient survival tool and a modern form of entertainment—rooted not just in psychology, but in the measurable laws of physics.

Key Information: Table: Physical Triggers of Fear

Trigger	Physics Involved
Sudden loud sound	High amplitude sound waves trigger startle reflex
Infrasound	Vibrations below 20 Hz resonate in the body
Darkness	Reduced photons force rod-cell vision, reducing detail
Strobe lights	Rapid flashes overwhelm persistence of vision
Sudden motion	High-speed change in position detected instantly by retina

Case Study: Sound Frequency and Horror Movie Jump Scares

Filmmakers often manipulate frequencies to intensify fear. Many horror films use infrasound (below 20 Hz), which humans cannot consciously hear but can physically sense as vibrations. Scientists have recorded subjects reporting chills, dizziness, and feelings of dread during exposure to these low frequencies. In movies such as "Paranormal Activity," low-frequency tones build anxiety until a sudden burst of sound, sometimes reaching over 100 decibels, triggers the startle reflex. Physics explains why this works: sound waves with large amplitudes carry more energy, creating a stronger physical impact on the body. Light and timing also matter. Sudden flashes of light at around 10–15 hertz can create disorientation, even mild nausea, because the brain struggles to interpret the rapid input. By combining sound and light triggers, horror creators "hack" sensory processing, forcing the brain into an adrenaline-driven state. This case shows that fear is not only psychological—it is a measurable response to physical energy in the environment.

1. How do infrasound vibrations affect the human body even when they cannot be heard?

2. Why does combining low-frequency rumbling with sudden loud sounds create stronger fear responses?

Multiple Choice

1. What physical property of sound explains why loud noises cause fear?

    a) Speed of sound

    b) Wavelength of the wave

    c) Amplitude of the wave

    d) Frequency of the wave

2. Which cells in the eye take over vision in very dark environments?

    a) Cone cells

    b) Ganglion cells

    c) Hair cells

    d) Rod cells

3. What is the term for sounds below 20 Hz that humans can feel but not hear?

    a) Ultrasound

    b) Infrasound

    c) Resonance

    d) Echo

Matching

Write the letter of the correct definition on the line next to each term.

Term	Definition
1. ___ Loud sound	A) Rod cells take over, reducing detail
2. ___ Infrasound	B) High amplitude sound waves jolt the body
3. ___ Darkness	C) Flashes confuse persistence of vision
4. ___ Strobe lights	D) Retina detects rapid changes instantly
5. ___ Sudden motion	E) Vibrations resonate in the chest cavity

Fill-in-the-Blank

1. A sudden increase in sound intensity is measured in _____.

2. The eye struggles with rapid flashes because of _____ of vision.

3. The body's rapid fear response is called the _____ reaction.

Short Answer

Answer each question in 2-4 complete sentences.

1. How do amplitude and frequency combine to affect fear responses to sound?

_____

_____

_____

2. Why might low light increase fear in survival situations as well as haunted houses?

_____

_____

_____

3. How does the study of physics help explain emotions that seem purely psychological?

_____

_____

_____