Wave behaviors

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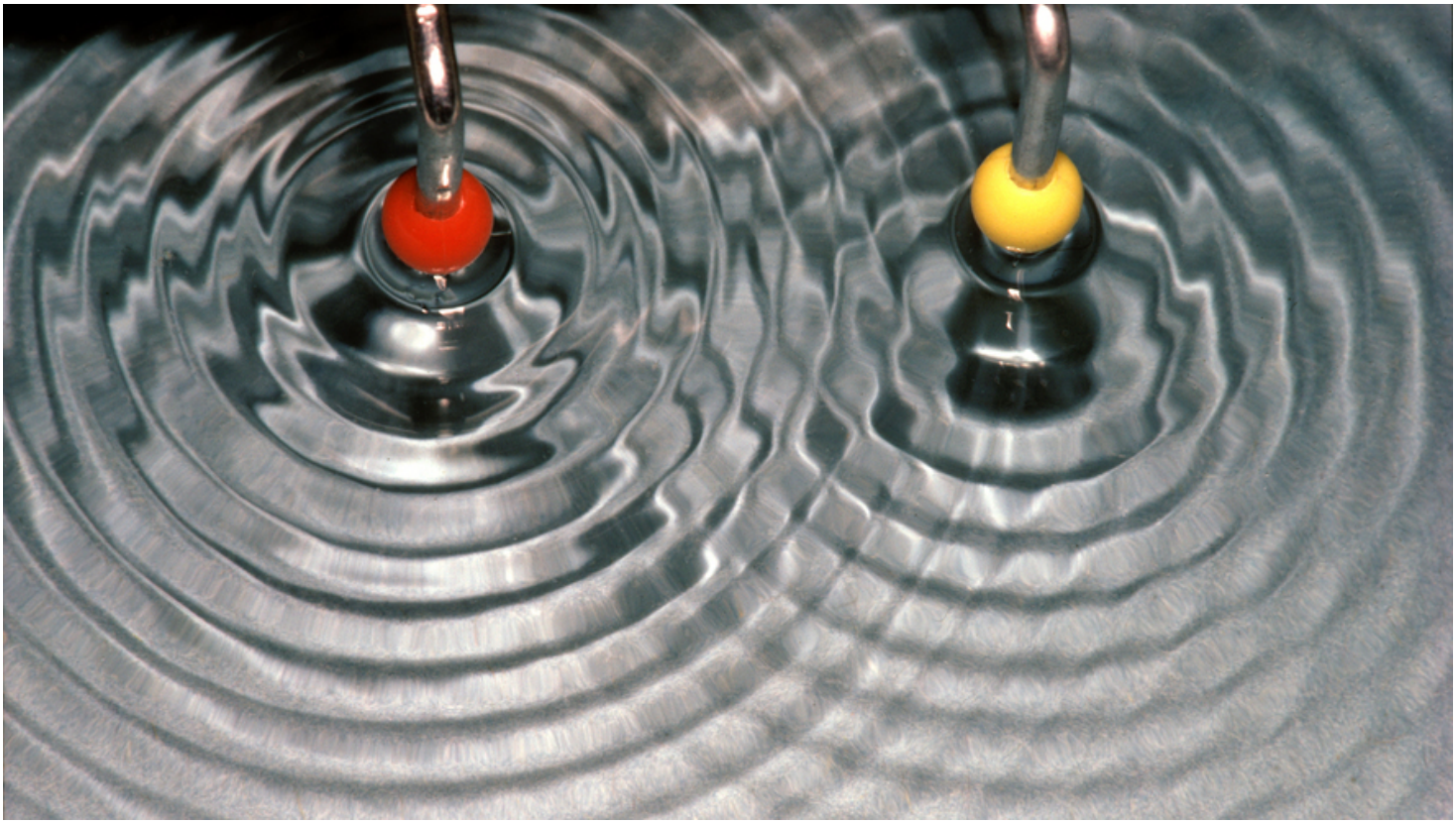


Image 1. A wave interference pattern. Waves from two sources (two balls) are interacting with each other. At the point where a wave peak from one hits a wave peak from another, they reinforce each other. This is known as constructive interference. Image credit: ER Degginger/Science Source

Waves behave in predictable ways. For example, a wave will behave differently when it encounters a smooth, hard surface than when it enters a liquid. The movement of a wave through a medium depends largely on the properties of the medium.

Reflection

Reflection occurs when a wave encounters an obstacle and is cast back, or bounces off, in the direction from which it originated. For example, sound waves striking a wall may reflect back, producing an echo. Light waves striking a hard surface may reflect back, depending on the properties of the surface. The degree to which a wave is reflected depends on the angle of incidence — the angle at which the wave strikes the surface — as well as the properties of the surface.

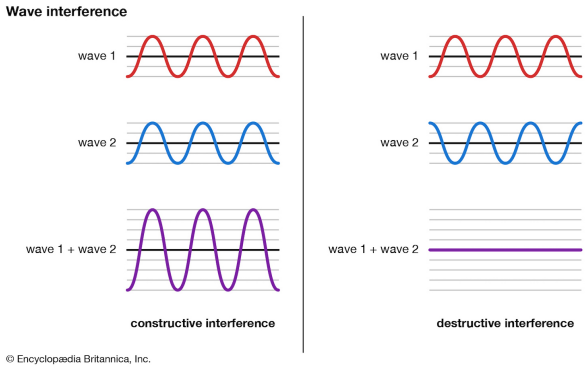
Refraction

Refraction is a phenomenon in which a wave changes direction as it moves from one medium to another. This change in direction occurs because the wave bends, or refracts, when it enters the new medium. The wave bends because waves travel at different speeds in different mediums. For example, sound travels faster through water than through air. The amount of refraction is related to differences in the speed of the wave in the materials — the greater the differences in speed, the more the wave refracts.

Diffraction

When a wave encounters a small obstacle or a small opening in a barrier, the wave can bend around the obstacle or pass through the opening and then spread out. This bending or spreading out is called diffraction.

Interference



Waves display particular behaviors when interacting with other waves. The interaction of two waves is called interference.

To understand how interference occurs, consider two sources producing waves of the same wavelength and cycle that are traveling toward each other from opposite directions. When the crests of the waves arrive at the same point at the same time, they combine to form a new, larger wave. This is called constructive interference. Similarly, the troughs arrive simultaneously and become deeper. The amplitude of the new wave equals the combined amplitudes of the two original waves. When the waves separate again, each will have its original amplitude and will continue to move in its original direction.

For constructive interference to occur, the crests and troughs of the two waves must align perfectly. However, if the crest of one wave meets up with the trough of the other wave, the energy of one wave is subtracted from the energy of the other wave, forming a smaller wave. This is called destructive interference. If the original waves had different amplitudes, the resultant new wave will have a smaller amplitude than either of the original waves. If the two waves had identical amplitudes, they will cancel each other out completely.