

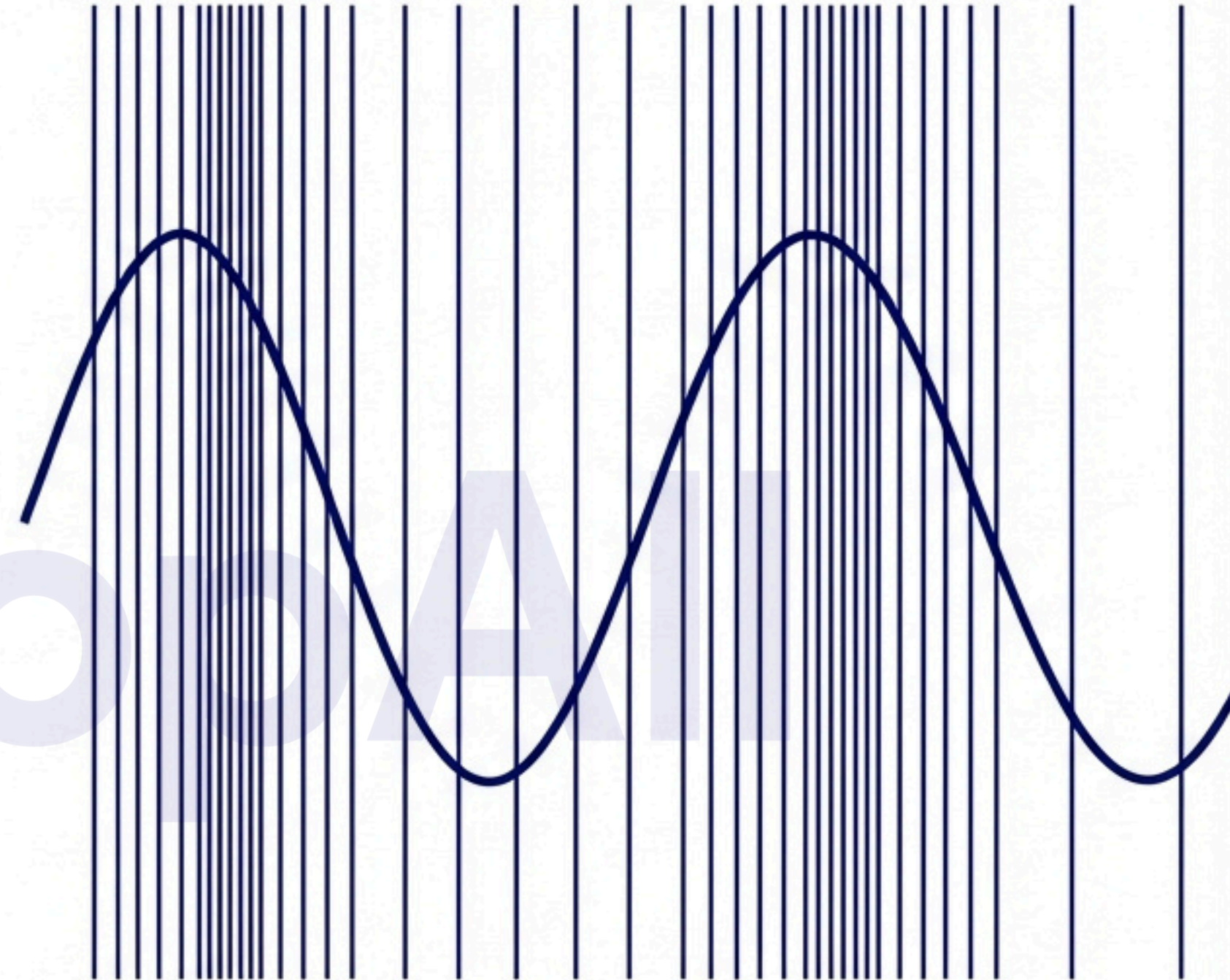


CLASS 11 PHYSICS • CHAPTER 14.2

Transverse & Longitudinal Waves

The fundamental geometry of mechanical wave propagation.

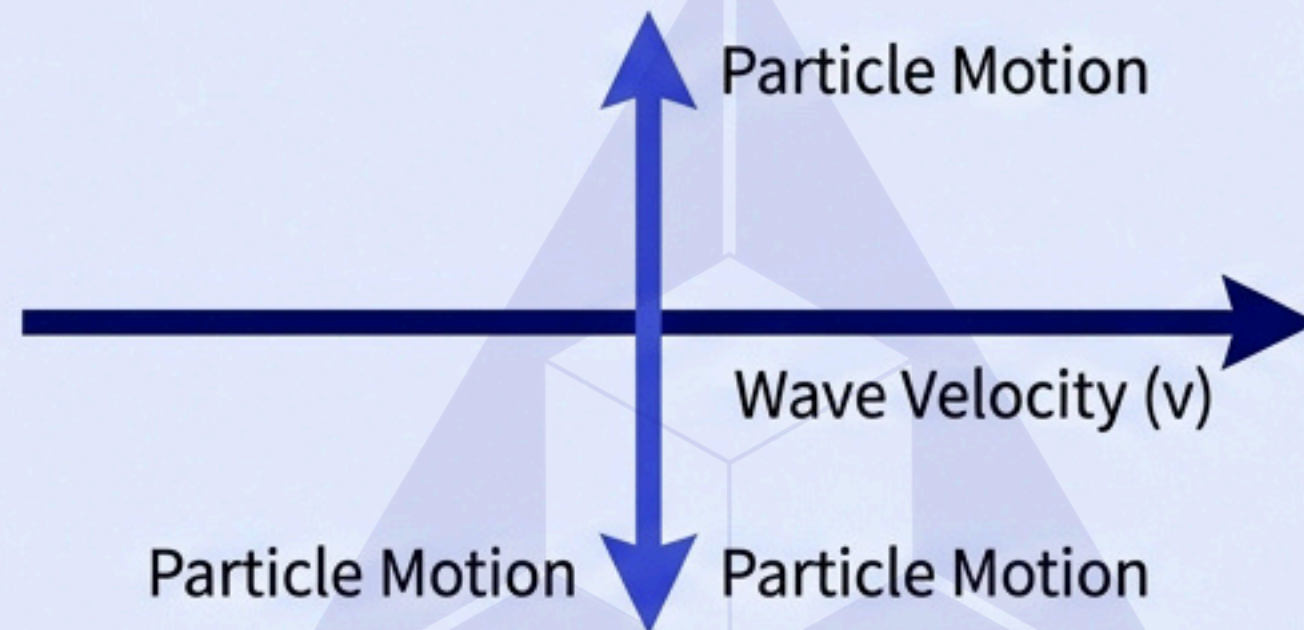
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Speaker Note: Welcome to Chapter 14.2. Today we explore how energy travels through a medium without moving the matter itself, focusing on the two fundamental geometries of mechanical waves.

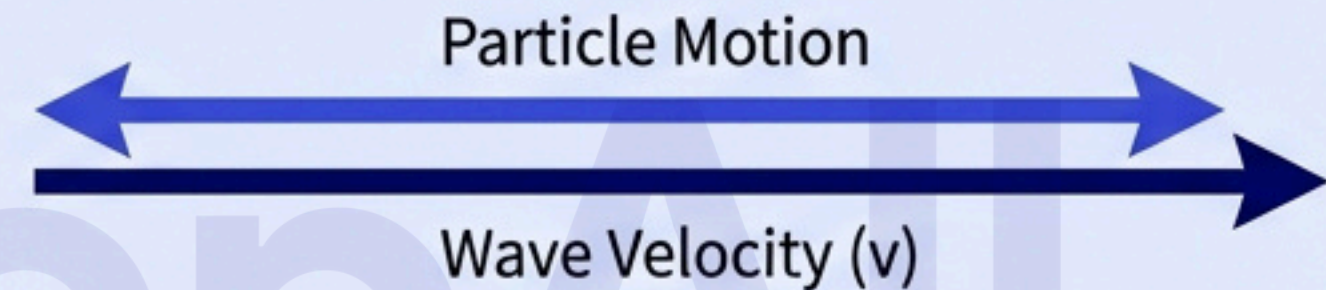
The Geometry Of Motion

TRANSVERSE WAVES



- Particles oscillate perpendicular ($\perp$) to the direction of wave propagation.

LONGITUDINAL WAVES



- Particles oscillate parallel ($\parallel$) to the direction of wave propagation.

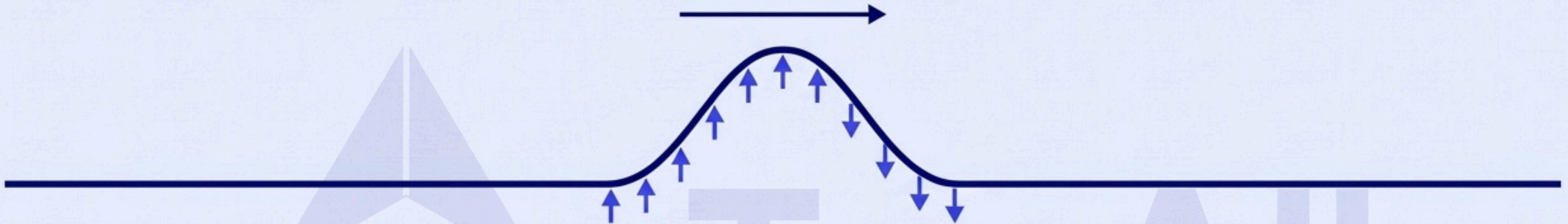
In both cases, the disturbance moves, but the material medium as a whole does not.

Single Disturbance: Pulse On A String

FIG. 14.2

TRANSVERSE

PULSE



- Created by a single, sudden up-and-down jerk.
- The disturbance (wave) propagates forward along the x-axis.
- Individual string elements only oscillate up and down along the y-axis.

Speaker Note: A pulse is the simplest way to visualize a transverse wave. Notice how an individual piece of string never moves forward; it only moves up and then returns to equilibrium.



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$$E=mc^2$$



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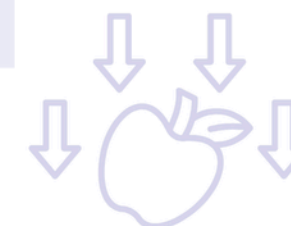
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Key Highlights

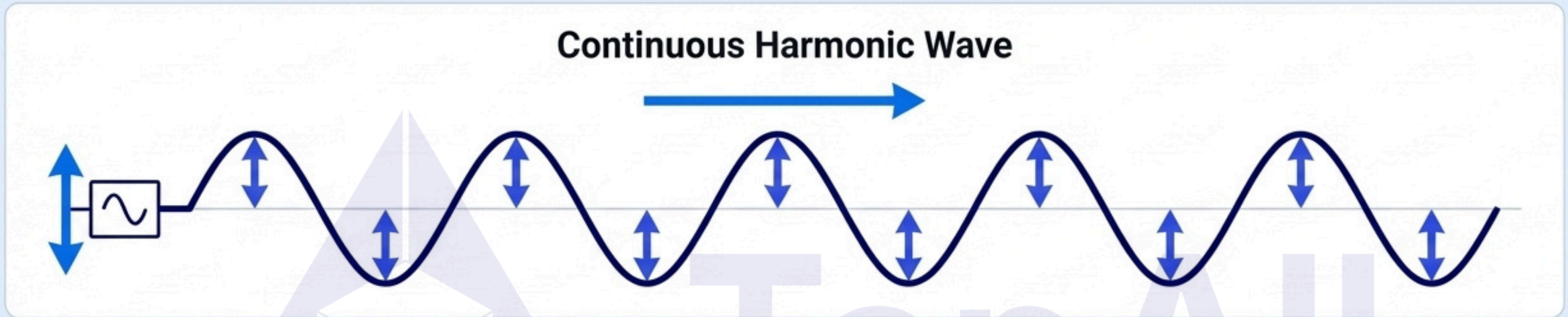
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H1 Continuous Disturbance: Harmonic Wave

FIG. 14.3

SINUSOIDAL



- Created by a continuous, periodic sinusoidal jerk.
- Elements oscillate about their equilibrium mean position.

EXAM TIP

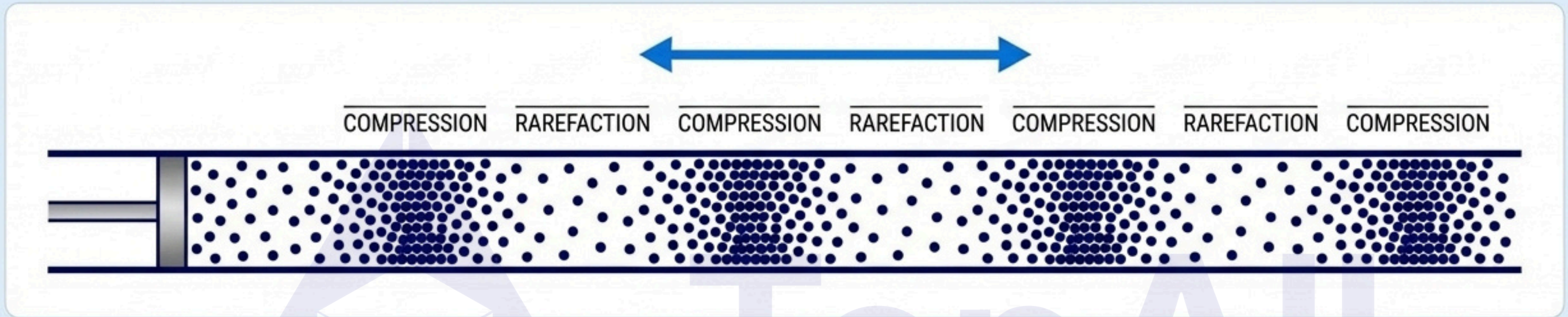
Transverse waves subject the medium to shearing strain. Therefore, they can only propagate in media that sustain shearing stress (solids, and surface of water, but not the body of fluids).

Speaker Note: If we keep shaking the string periodically, we get a harmonic wave. The key takeaway here for exams is the "shearing strain" constraint—this is why transverse mechanical waves don't travel through the body of liquids or gases.

H1 Sound Waves In A Pipe

FIG. 14.4

LONGITUDINAL



- Generated by the continuous push-pull of a piston.
- Creates a propagating pulse of compressions (higher density) and rarefactions (lower density).

EXAM TIP

Involves compressive strain, meaning these waves can propagate in all elastic media (solids, liquids, and gases).

Speaker Note: Sound is our classic longitudinal example. Because fluids can be compressed (unlike shearing), sound waves happily travel through air, water, and steel.

H1 Conceptual Comparison Matrix

Feature	Transverse Waves	Longitudinal Waves
Particle Motion	Perpendicular ($\perp$) to wave 	Parallel ($\parallel$) to wave 
Wave Structure	Crests and Troughs	Compressions and Rarefactions
Strain Type	Shearing strain	Compressive strain
Sustaining Media	Solids only (and water surface)	All media (Solids, Liquids, Gases)

Speaker Note: This is your high-yield cheat sheet. If you memorize one slide before your exam, **make it this one**. Understanding the link between strain type and the sustaining media is critical.

Chapter 14.2 Summary

KEY TAKEAWAYS

- **Waves transfer energy, not matter.** The disturbance moves, the medium stays.
- **Transverse waves** ($\perp$) rely on **shearing strain** (e.g., strings).
- **Longitudinal waves** ($\parallel$) rely on **compressive strain** (e.g., sound in air).

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Speaker Note: You now have a solid grasp of the geometries of wave motion. The next step is to apply these constraints to real-world problems. Let's practice.



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