

Spring Fling Physics Demo Show

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Department of Physics and Astronomy

Fulton Chapel

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Dept. of Physics and Astronomy
J.R. Gladden

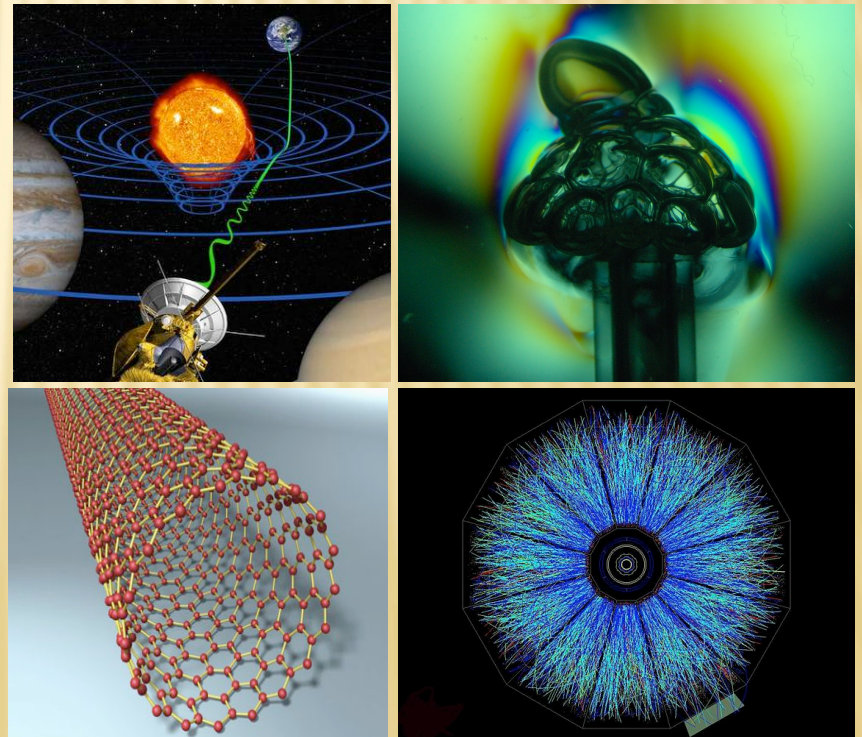
WHAT IS PHYSICS?

physics |'fiziks|

the branch of science concerned with the nature and properties of matter and energy. The subject matter of physics includes mechanics, heat, light and other radiation, sound, electricity, magnetism, and the structure of atoms.

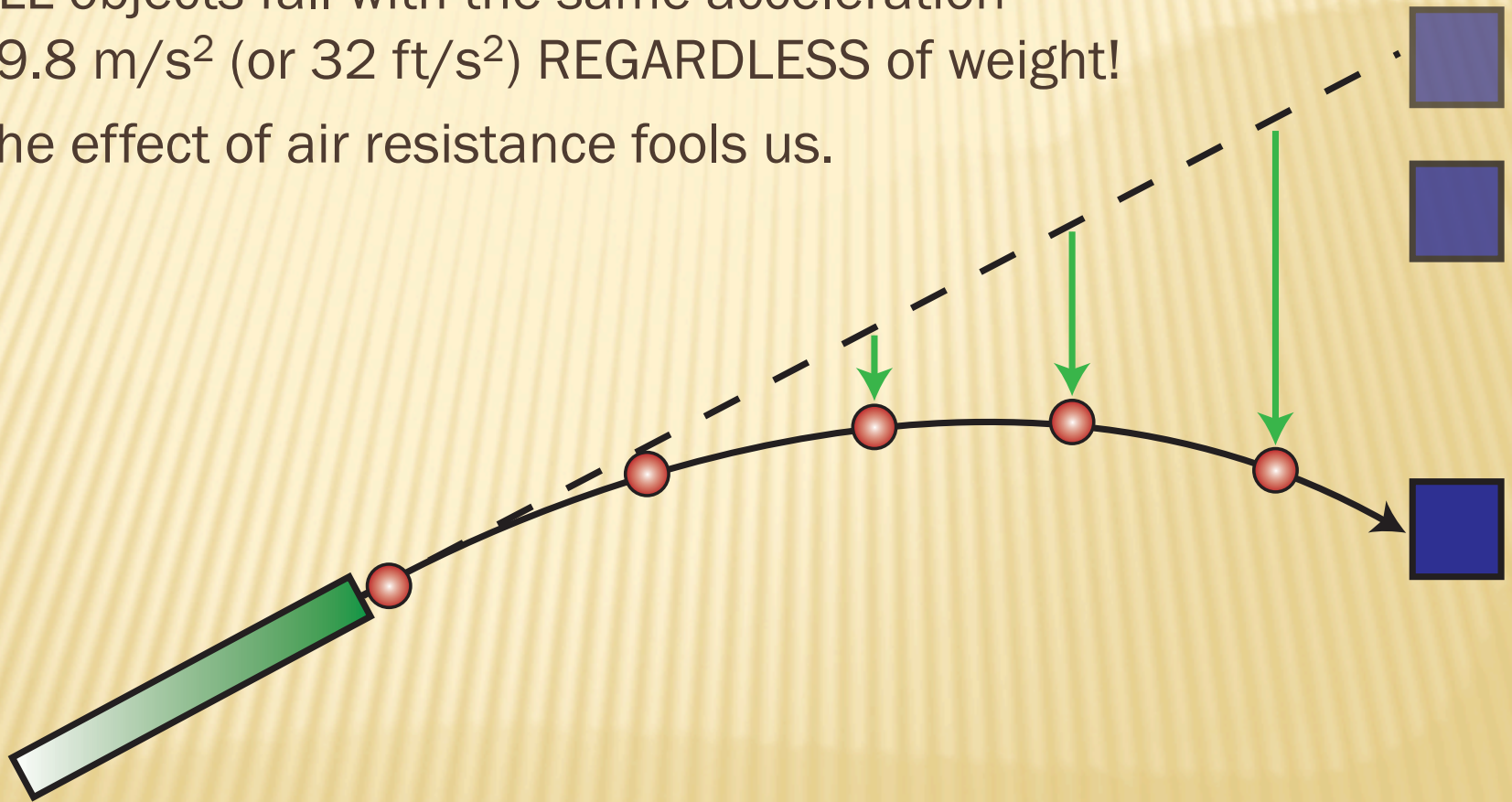
My definition

The study of the what the universe is made of and how those things interact.



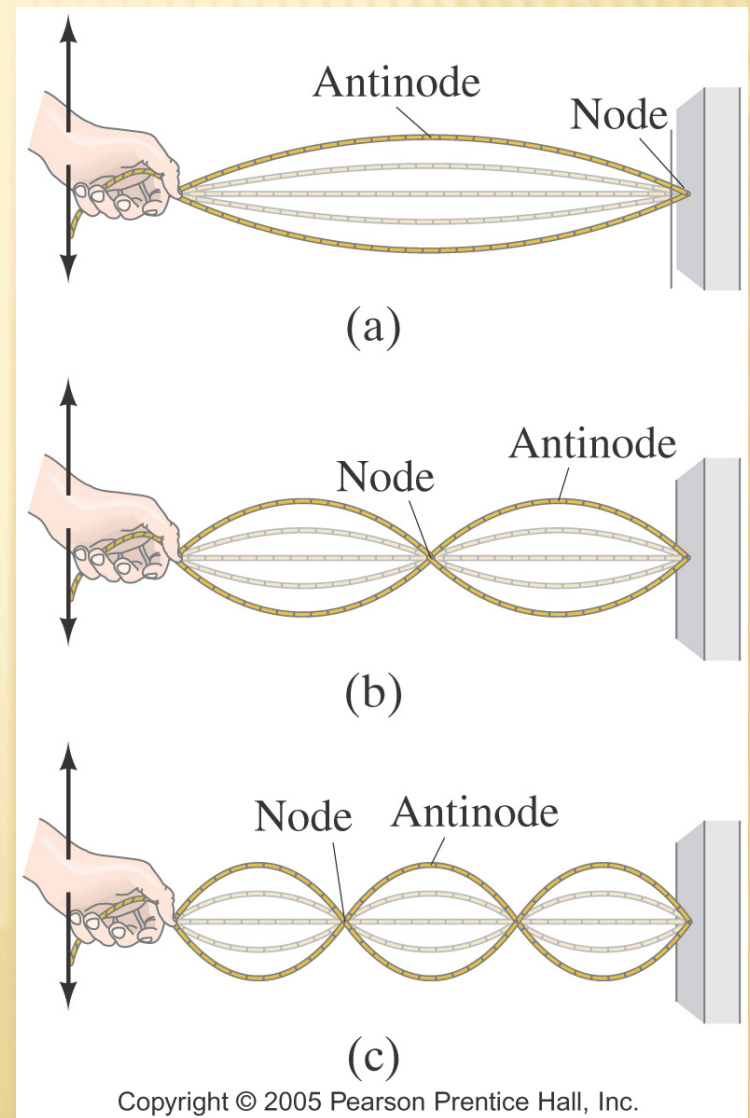
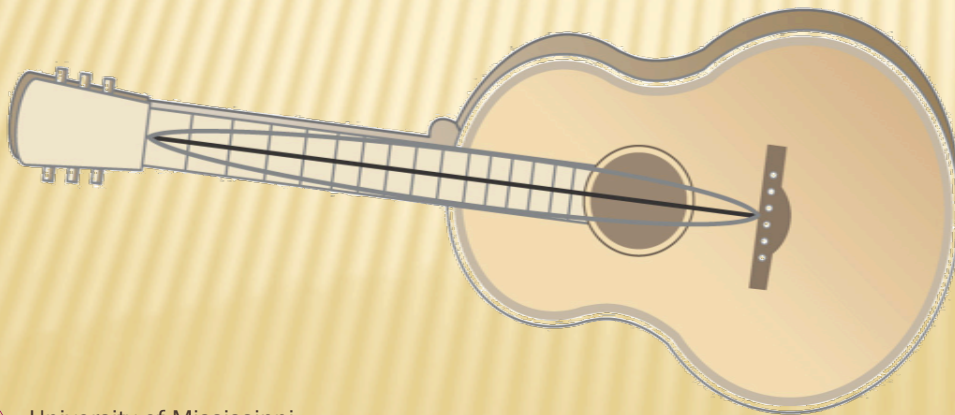
MONKEY AND HUNTER

- ✘ ALL objects fall with the same acceleration 9.8 m/s^2 (or 32 ft/s^2) REGARDLESS of weight!
- ✘ The effect of air resistance fools us.



STANDING WAVE ON A STRING

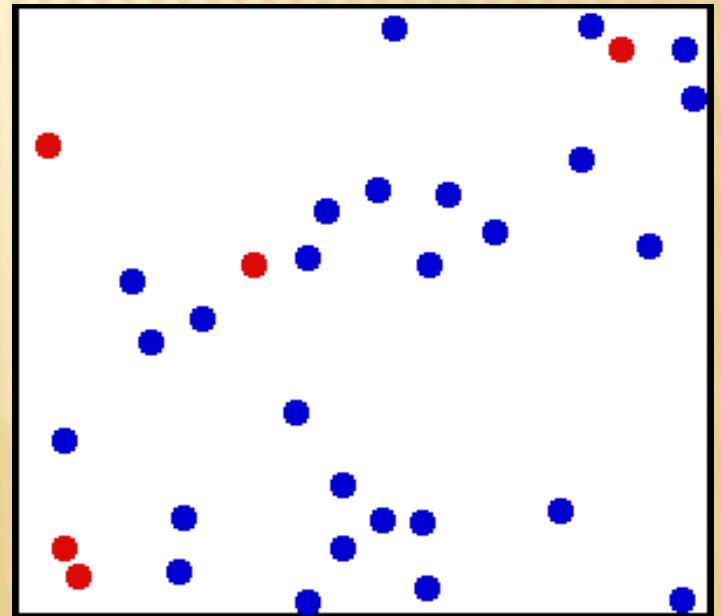
- ✘ If frequency is just right, waves going down and reflected back add together destructively (node) and constructively (anti-node).
- ✘ First mode (one big loop) defines the major tone on a stringed instrument.



TEMPERATURE

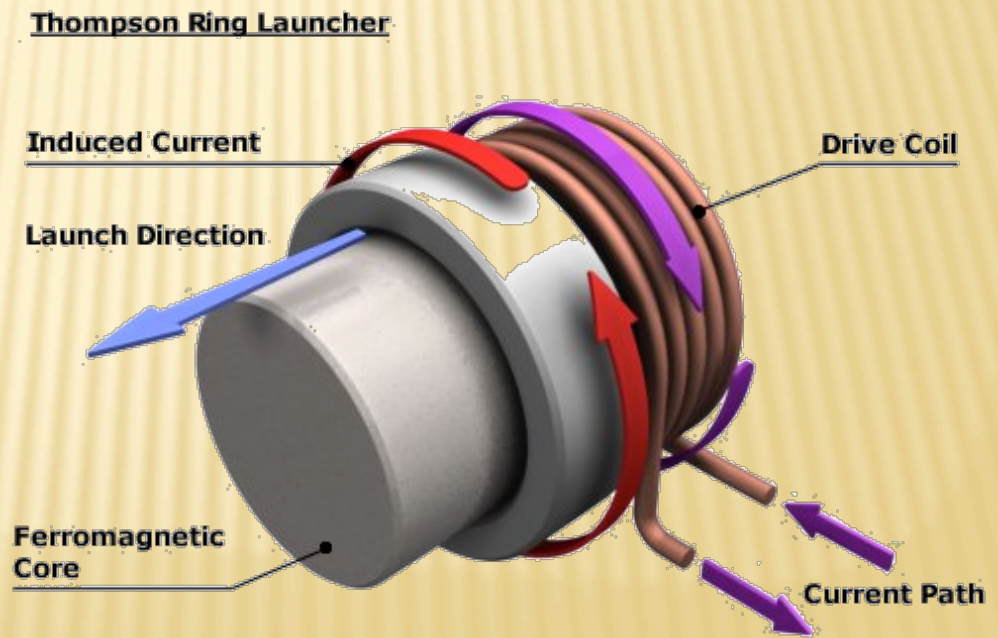
- ✘ Temperature is a measure of how energetically atoms are vibrating in a material.
- ✘ Is there a COLDEST possible temperature – Sure! When the atoms are no longer vibrating at all.
- ✘ We call this special temperature Absolute Zero!
- ✘ Special temperature scale we use is Kelvin where $T=0$ K is absolute zero and water freezes at $T=273$ K.

Great simulation from
PHysics Education Technology (PHET)
from University of Colorado, Boulder
www.phet.colorado.edu



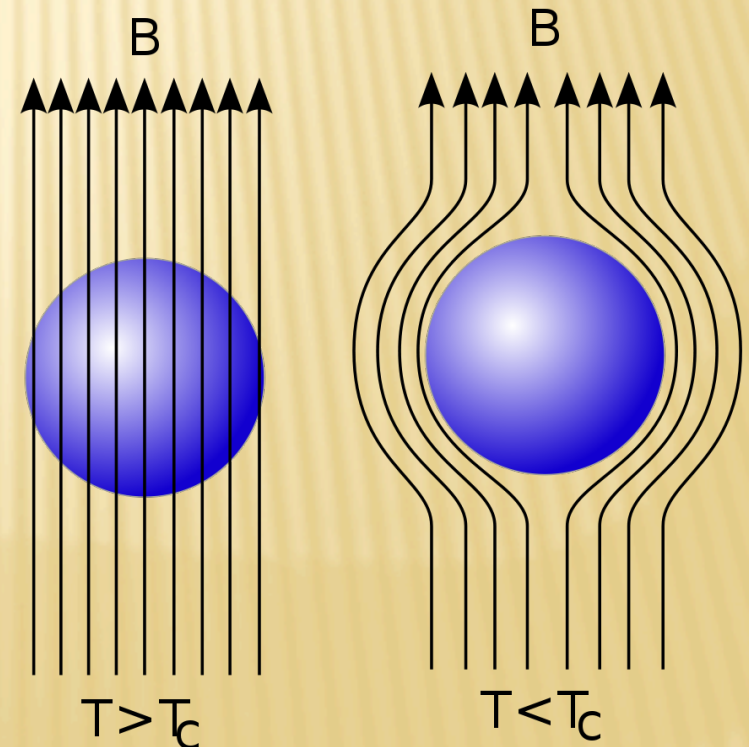
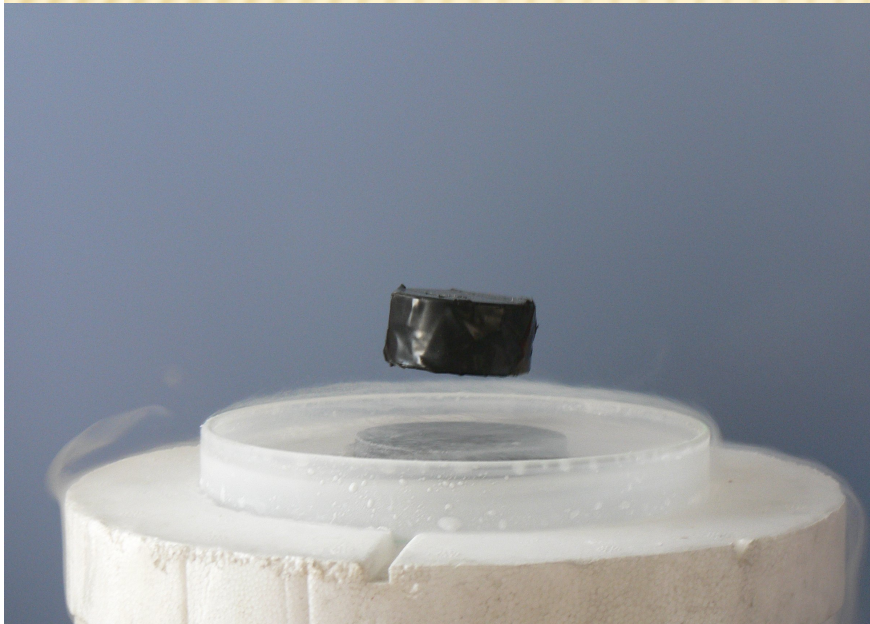
JUMPING RING

- ✘ Changing magnetic fields near a conductor can induce (create) electric current.
- ✘ The electric current produces another magnetic field.
- ✘ These two fields interact to produce forces.
- ✘ The quicker the change, the bigger the current, ... and bigger the force!
- ✘ Lowering the resistance of the conductor also increases the current and force!



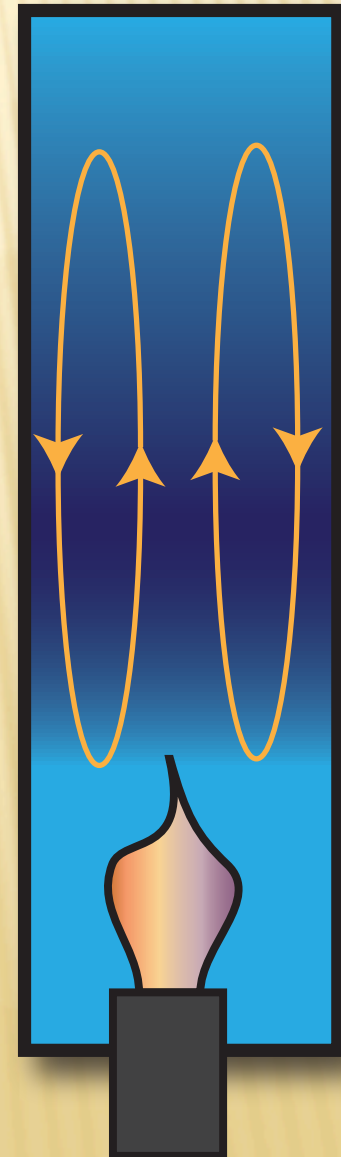
SUPER CONDUCTIVITY

- ✘ Conduction of electricity with NO resistance!
- ✘ About 6.5% of electrical energy is lost between the power station and your house due to resistance in transmission wires.
- ✘ Meissner Effect: No magnetic field lines can penetrate.
 - + STABLE magnetic levitation

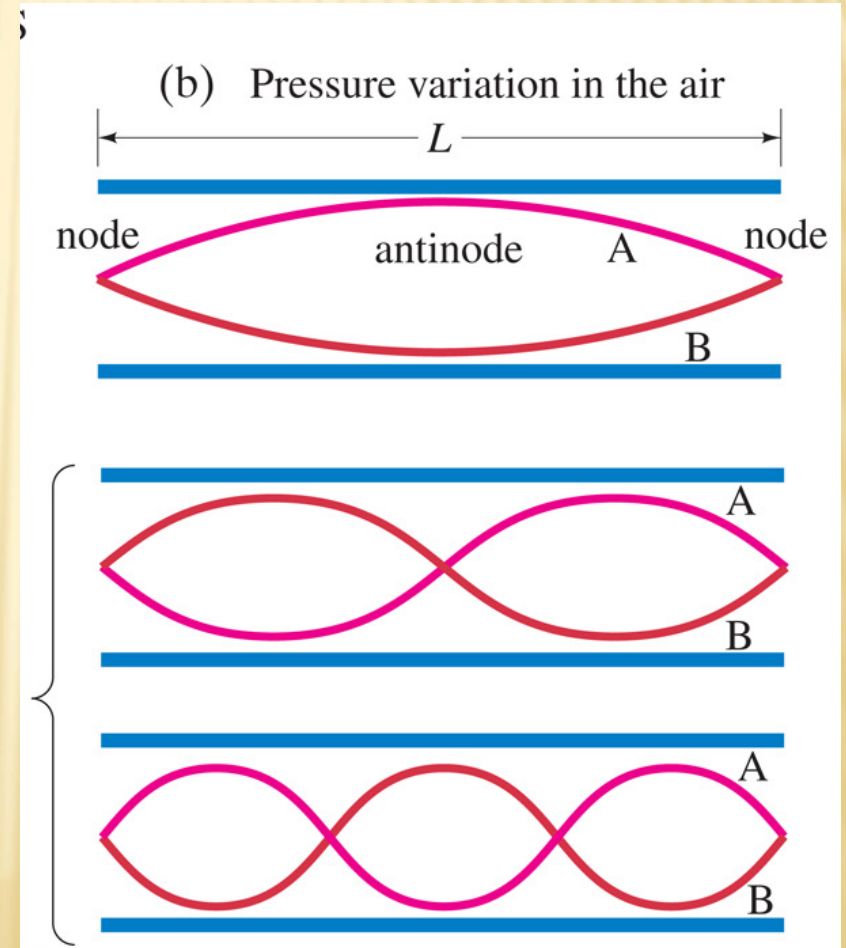
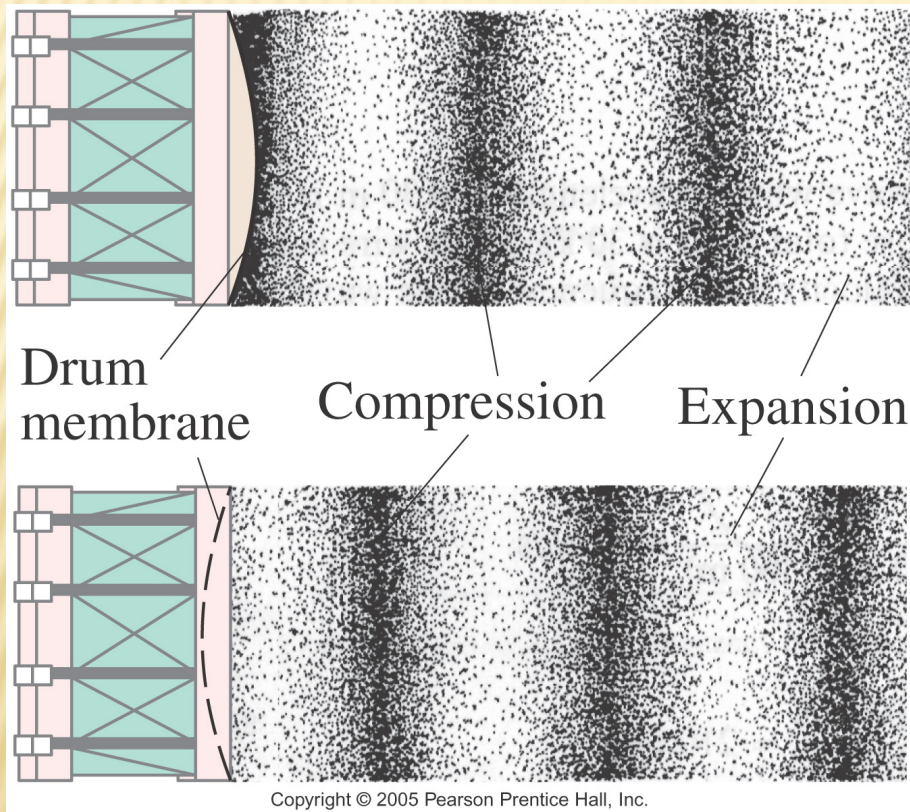


RIJKE TUBE – HEAT AND SOUND

- ✘ Heat source expands air making it rise.
- ✘ Gravity sets up convection currents
 - + cooler, denser air sinks along walls
 - warmer, less dense air rises in center
- ✘ All this motion of air in the tube excites an acoustic resonance in the tube.

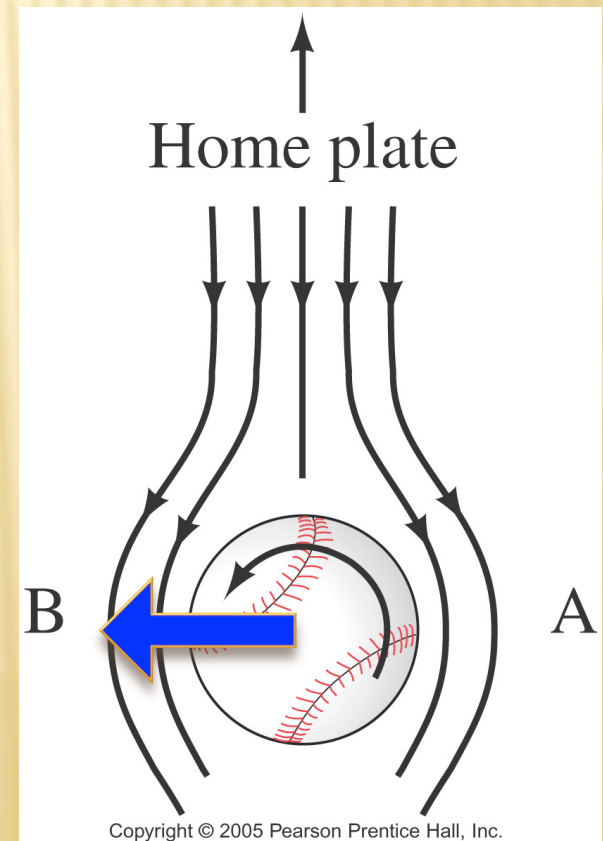
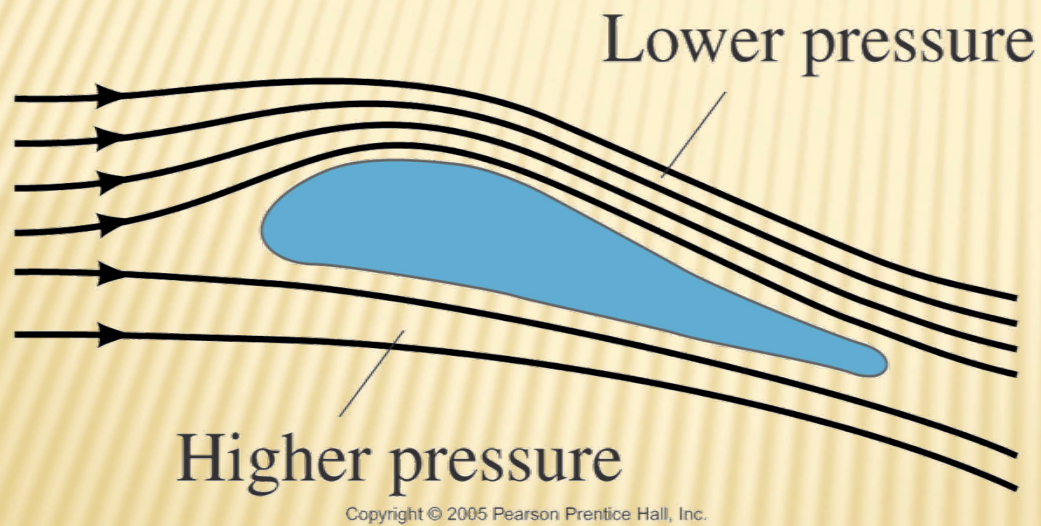


FLAME TUBE - ACOUSTIC RESONANCE

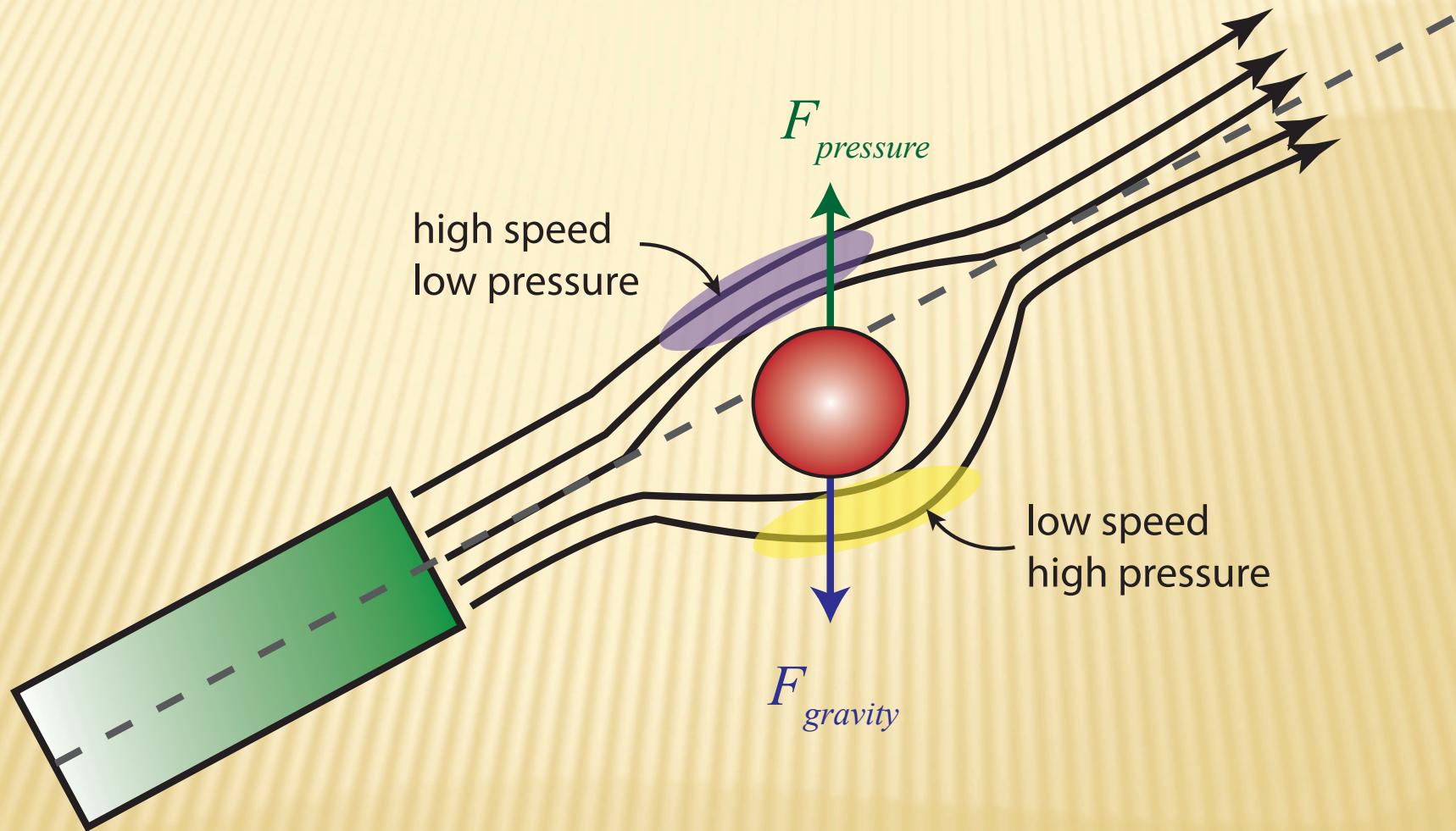


BERNOULLI'S PRINCIPLE

- ✘ Pressure is lowered when a fluid moves faster.
- ✘ How airplanes fly and curve balls curve!



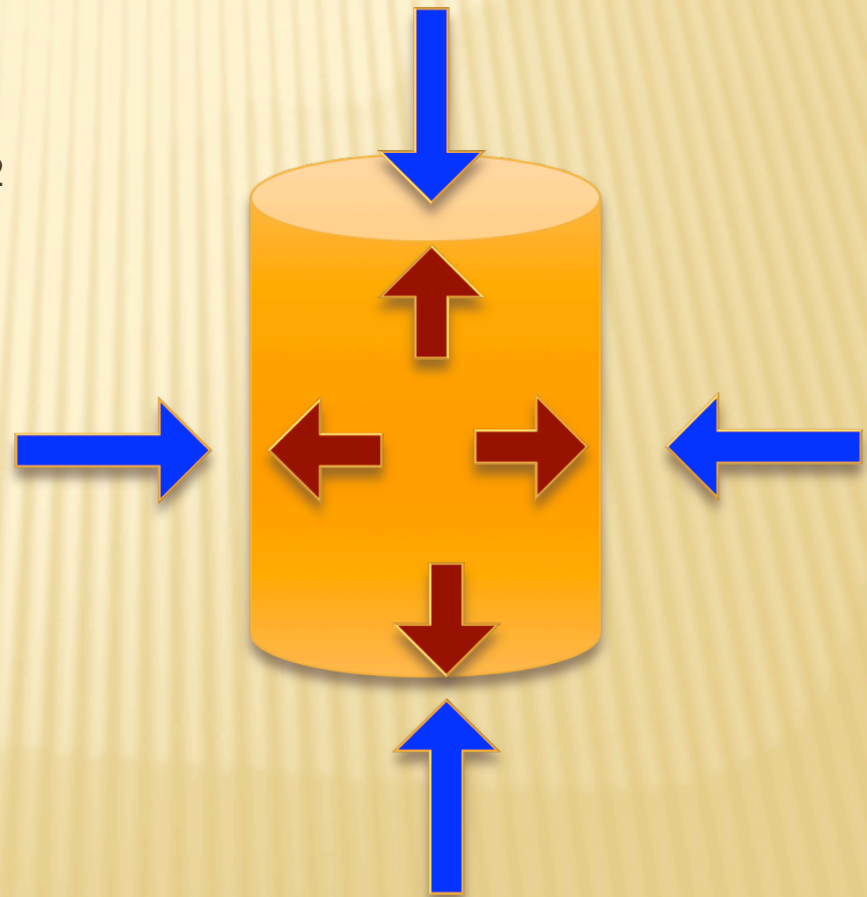
LEAF BLOWER AND BEACH BALL



CRUSHING A 55 GALLON STEEL DRUM

- ✘ Total force exerted on drum if internal pressure is 0:

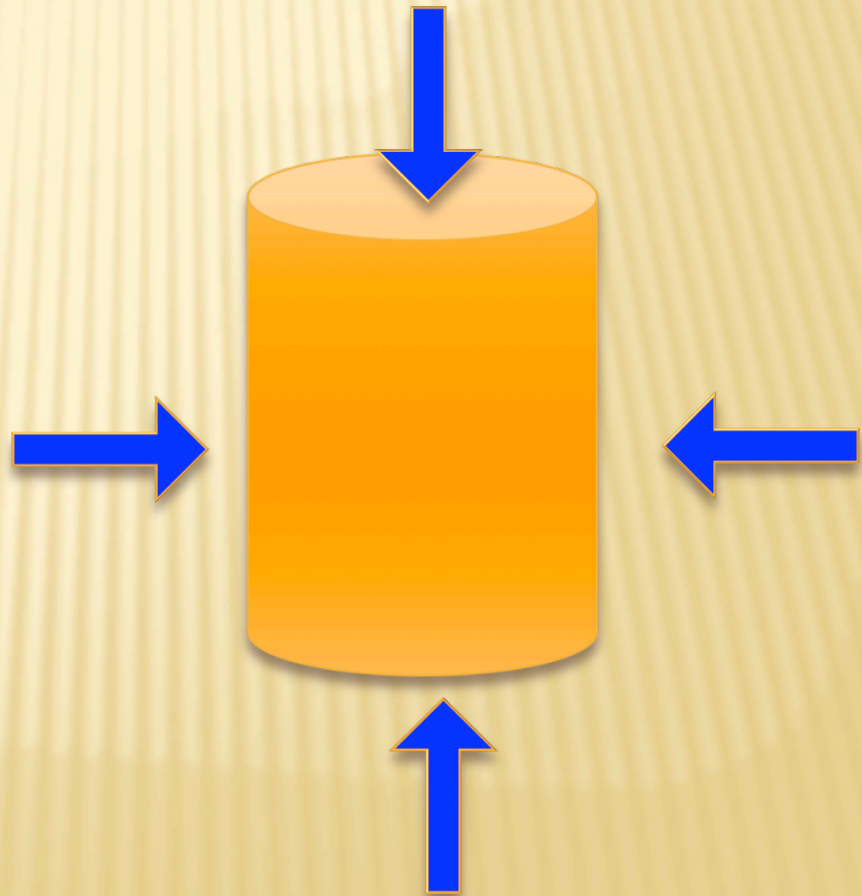
$$\begin{aligned}\text{Force} &= \text{Pressure} \times \text{Area} \\ &= 100,000 \text{ N/m}^2 \times 2.0 \text{ m}^2 \\ &= 200,000 \text{ N} \\ &= 44,000 \text{ pounds!}\end{aligned}$$



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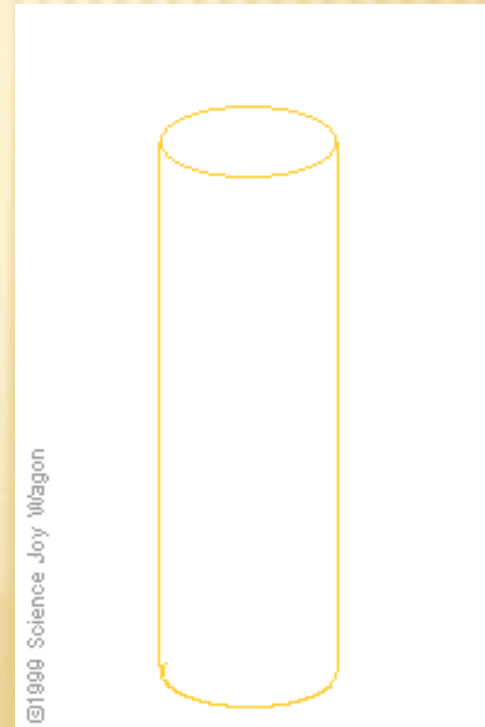
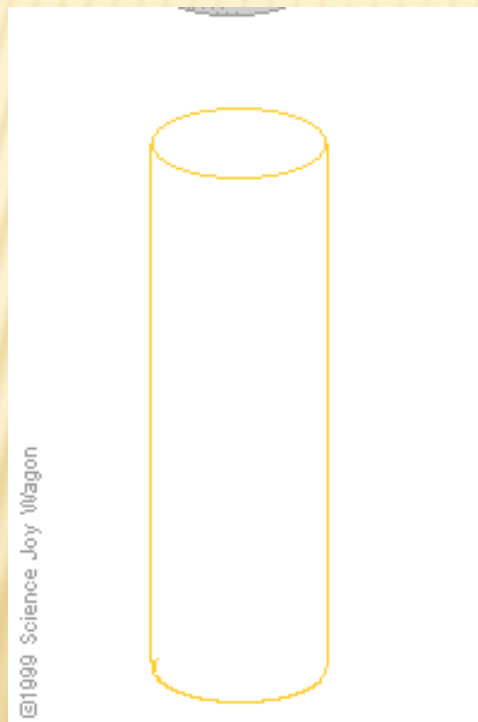
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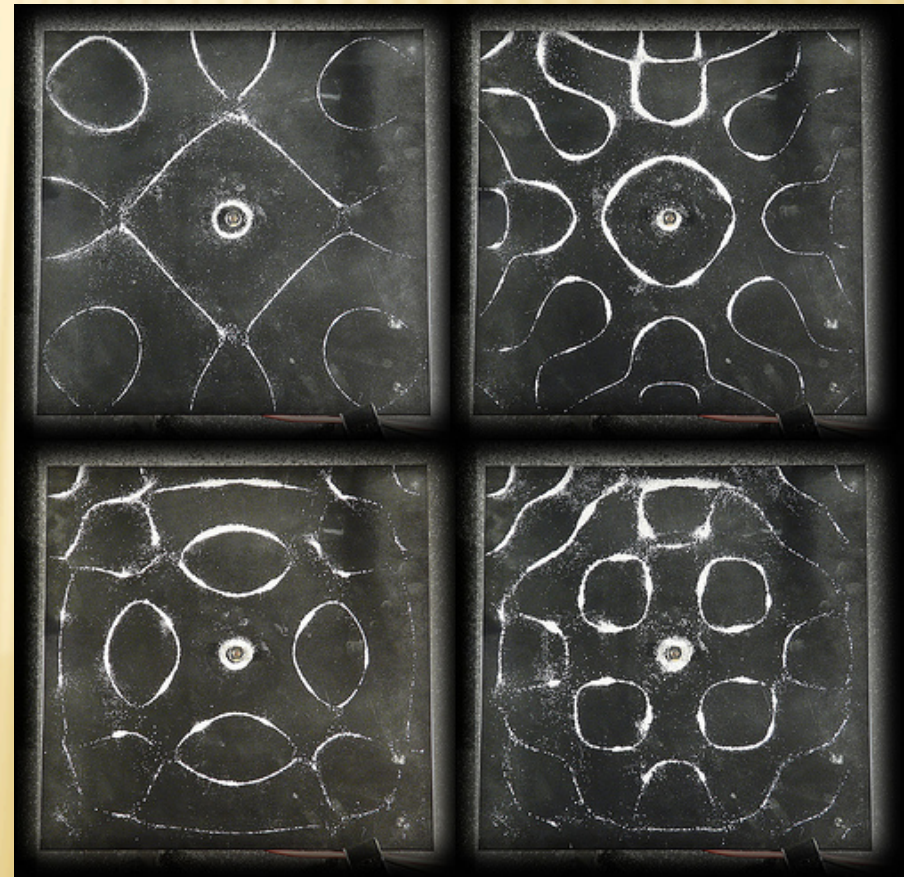
LENZ TUBE – CURRENTS AND MAGNETIC FIELDS

- ✘ Falling magnet induces an electric current around the tube.
- ✘ This induced current produces it's own magnetic field which opposes that of the magnet and slows it down.



CHLADNI PLATES

- ✘ Vibrating plates also have resonances – characteristic frequencies or tones.
- ✘ Think of a symbol on a drum set – bigger symbol means lower tone.
- ✘ Nodes: no vibrations
Anti-nodes: largest vibrations
- ✘ Granular material (like salt) migrates to nodal lines, showing the vibration pattern.



VACUUM CANON

- ✘ Air is pumped out so pressure inside is ~ 0 .
- ✘ Air RUSHES in when foil is punctured.
- ✘ NO air in front – no air resistance!
- ✘ Max speed about 600 mph!



THANKS TO THE TEAM!

- ✘ Thomas Jamerson, UM Lab Physicist
- ✘ Bradley Goodwiller, Graduate student
- ✘ Phil Bloom, Graduate student
- ✘ Ananya Debnath, Graduate student
- ✘ Rasheed Adebisi, Graduate student
- ✘ Guangyan Li, Graduate student
- ✘ Sumudu Tennakoon, Graduate student
- ✘ Sumedhe Karunathne, Graduate student

And special thanks to all
of you for coming out!



NOW ... GET UP CLOSE TO SOME DEMOS!

- ✘ There are about 10 demos set up on the floor for you to come see.
- ✘ Students are there to help explain the physics behind each one.
- ✘ PLEASE! Ask them questions!
- ✘ ALSO PLEASE! Ask them what you can and can not touch.

List of Demos

Lenz tube

Standing wave on a string

Chaotic Pendulum

Chladni Plates

Monster Fluid

Cloud Chamber

Magnetic Fields

and more!

