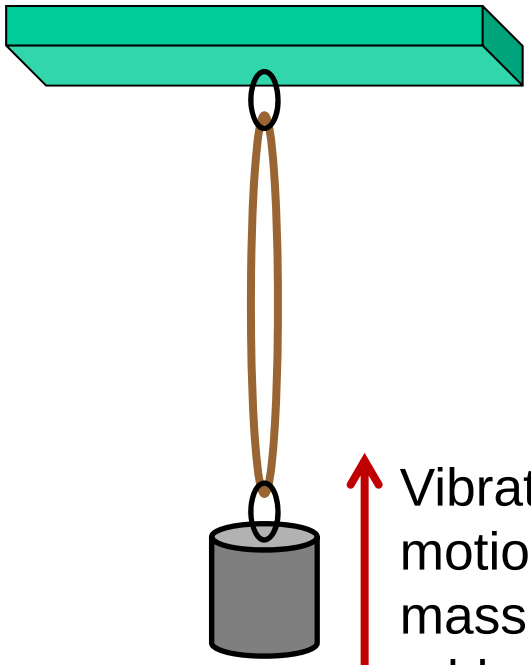
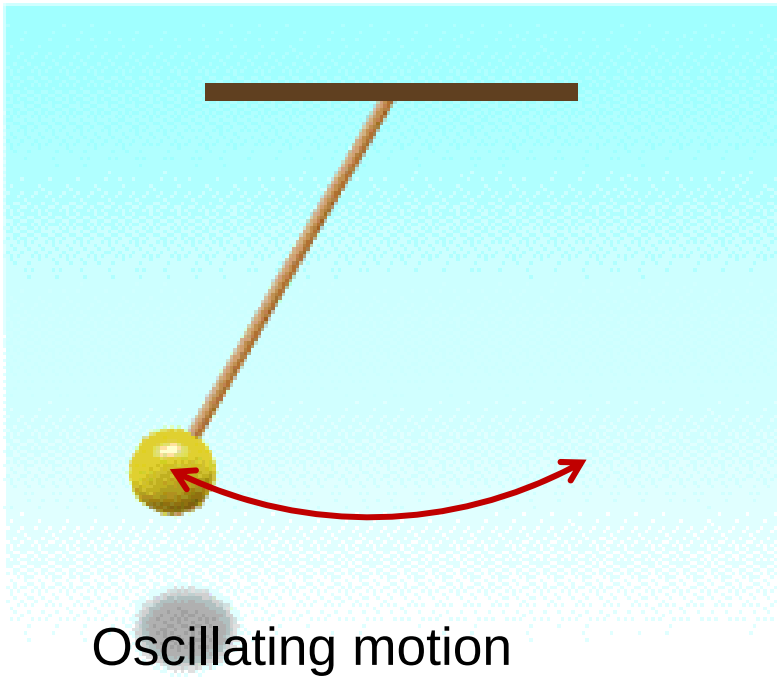
Elastic Vibrations

Vibrations as Cyclic Motion

Vibrations are an example of cyclic motion, like oscillations and rotations.



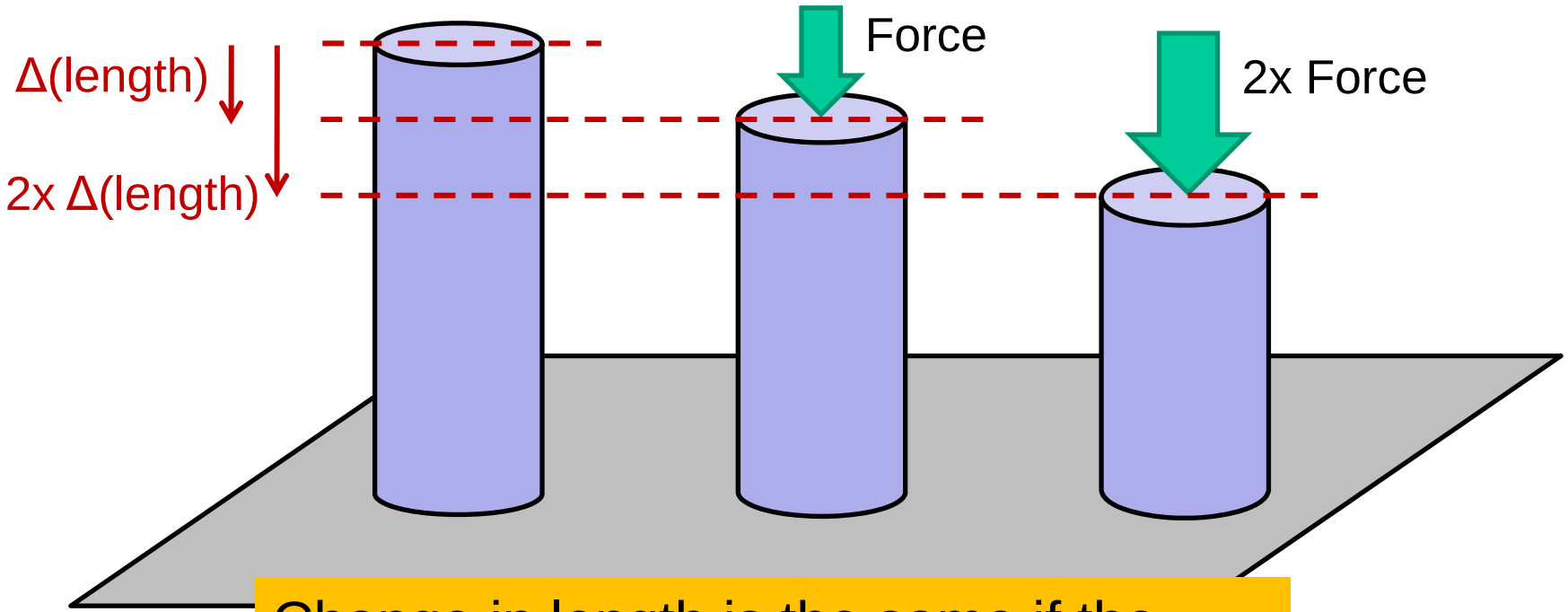
Vibrating motion of a mass on a rubber band



Oscillating motion of a pendulum

Hooke's Law

Elastic objects have a simple relationship between compression and applied force.

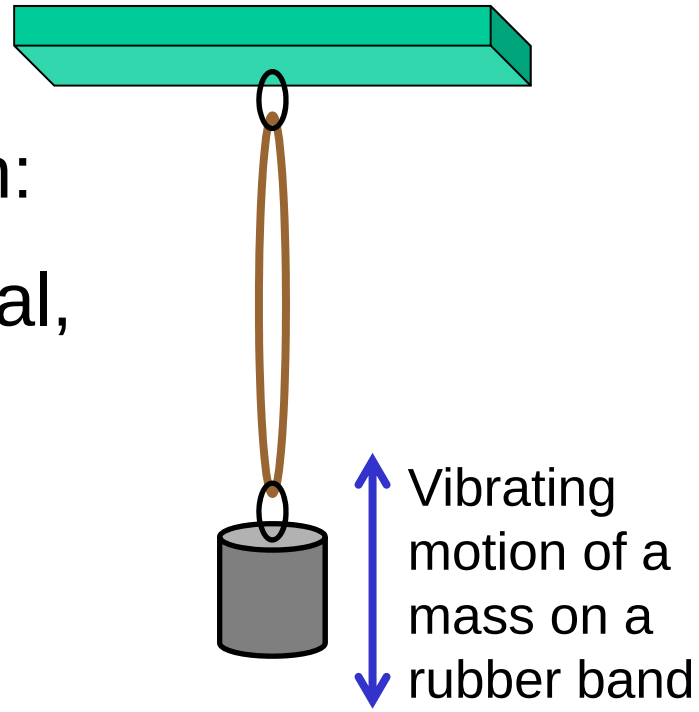


Change in length is the same if the force stretches instead of compresses.

Timing for Elastic Vibrations

Vibration frequency depends on:

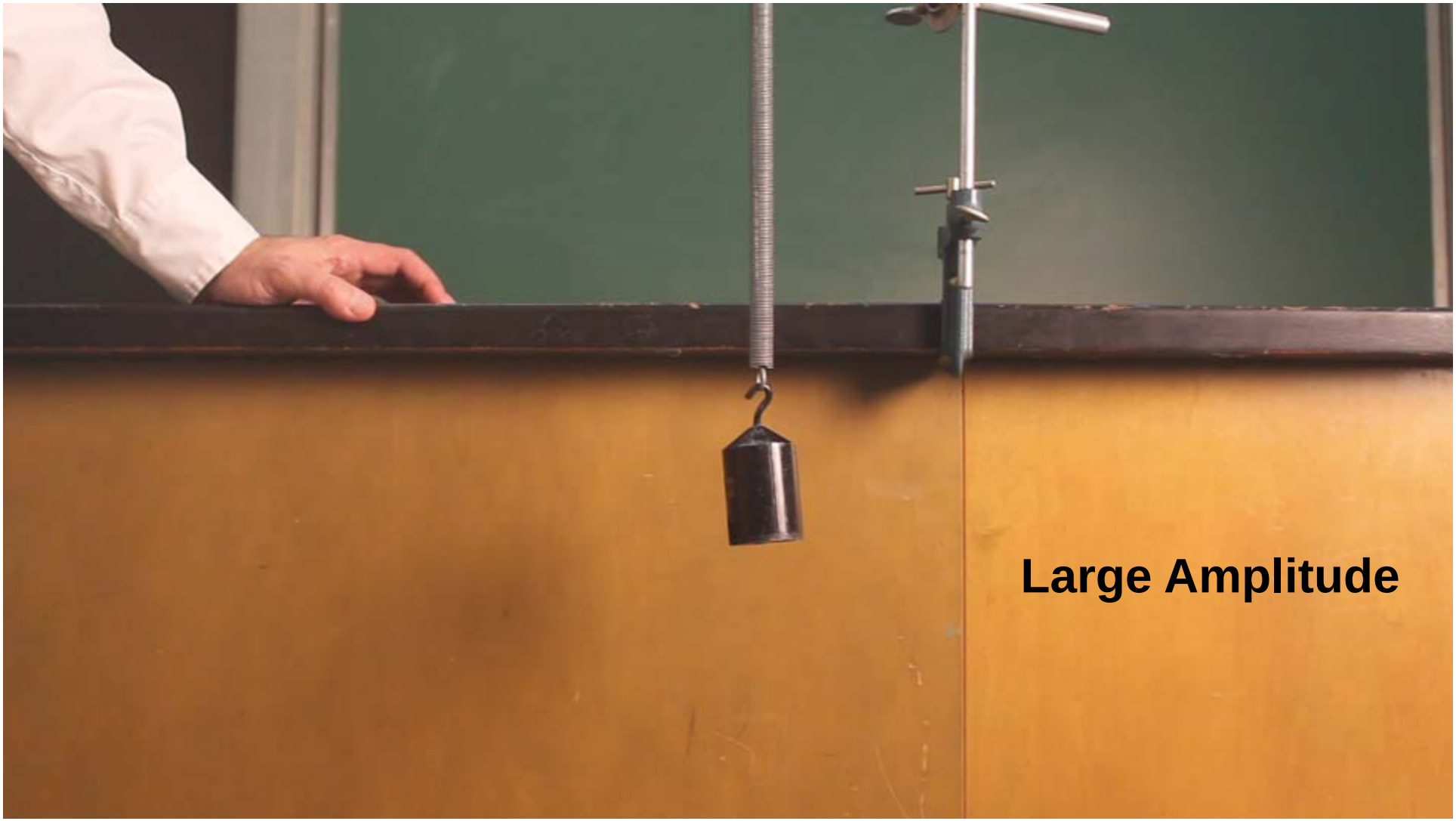
- Stiffness (the stiffer the material, the faster it vibrates)
- Mass (the more mass that's being moved, the slower the vibration)



Vibrations frequency does <u>not</u> depend on amplitude

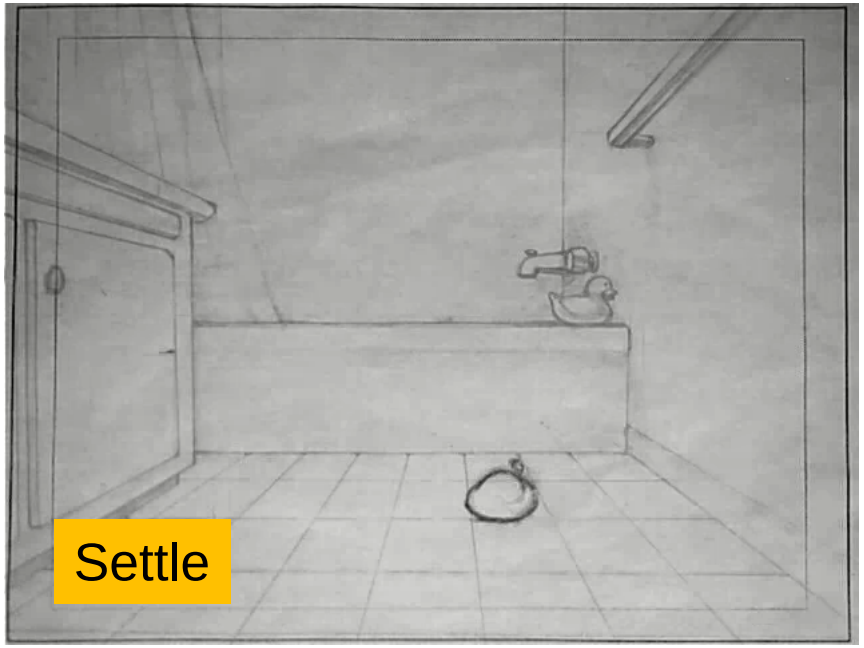
Timing for Elastic Vibrations

Timing for Elastic Vibrations



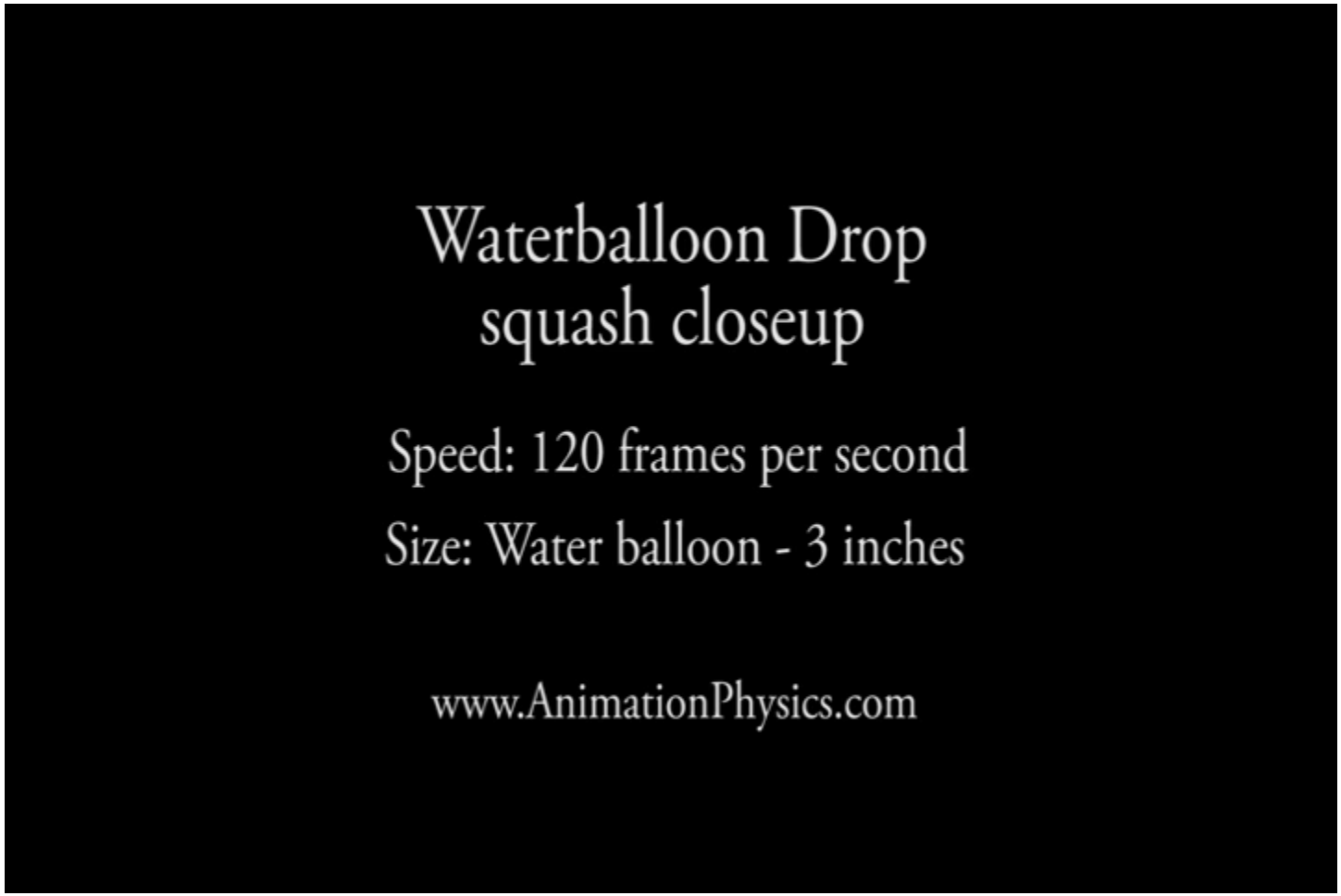
Water Balloon Settle

The balloon vibrates as it rolls until it finally settles to rest.



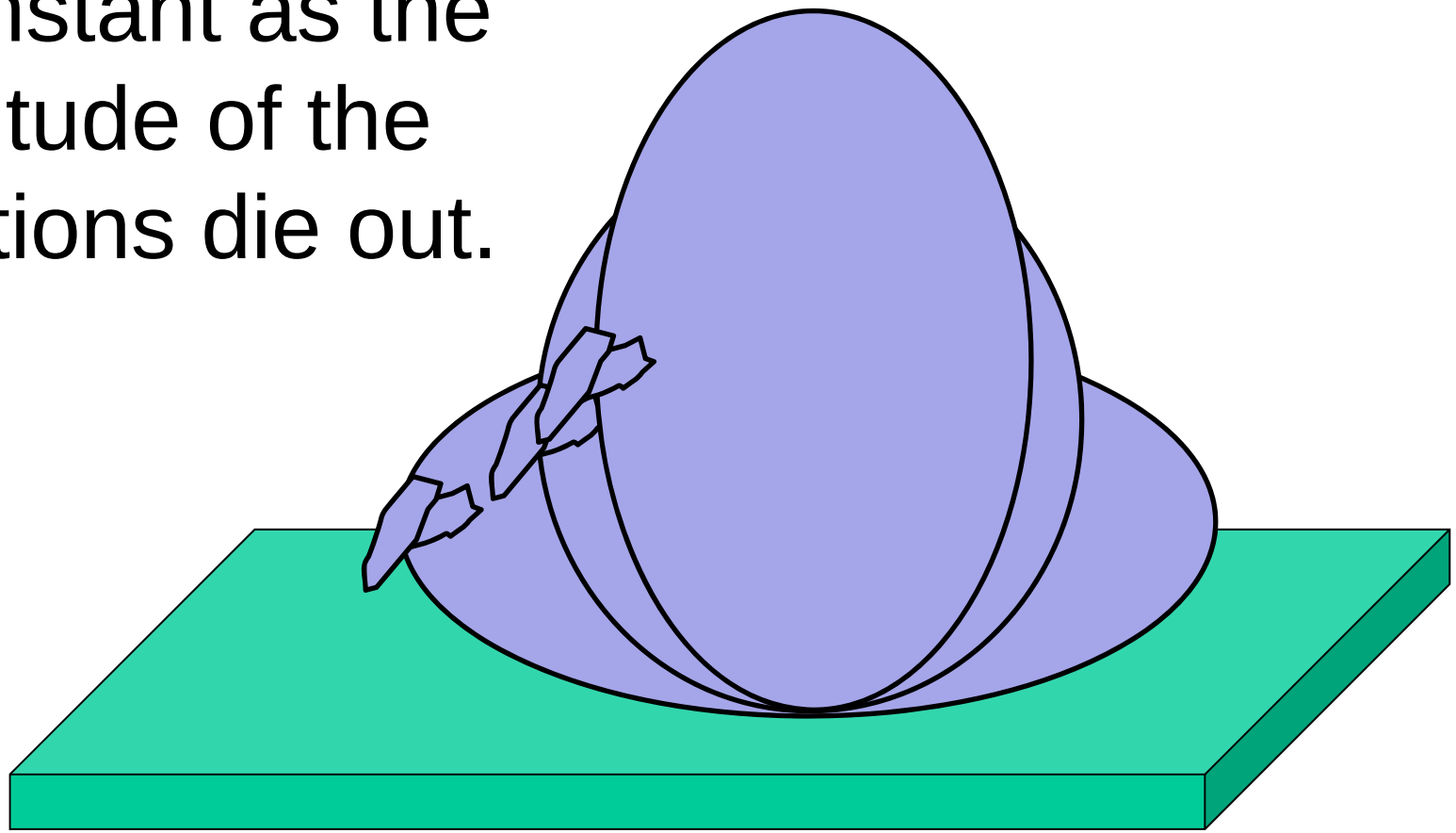
Water Balloon Reference

Carefully watch the vibrations during the settle.

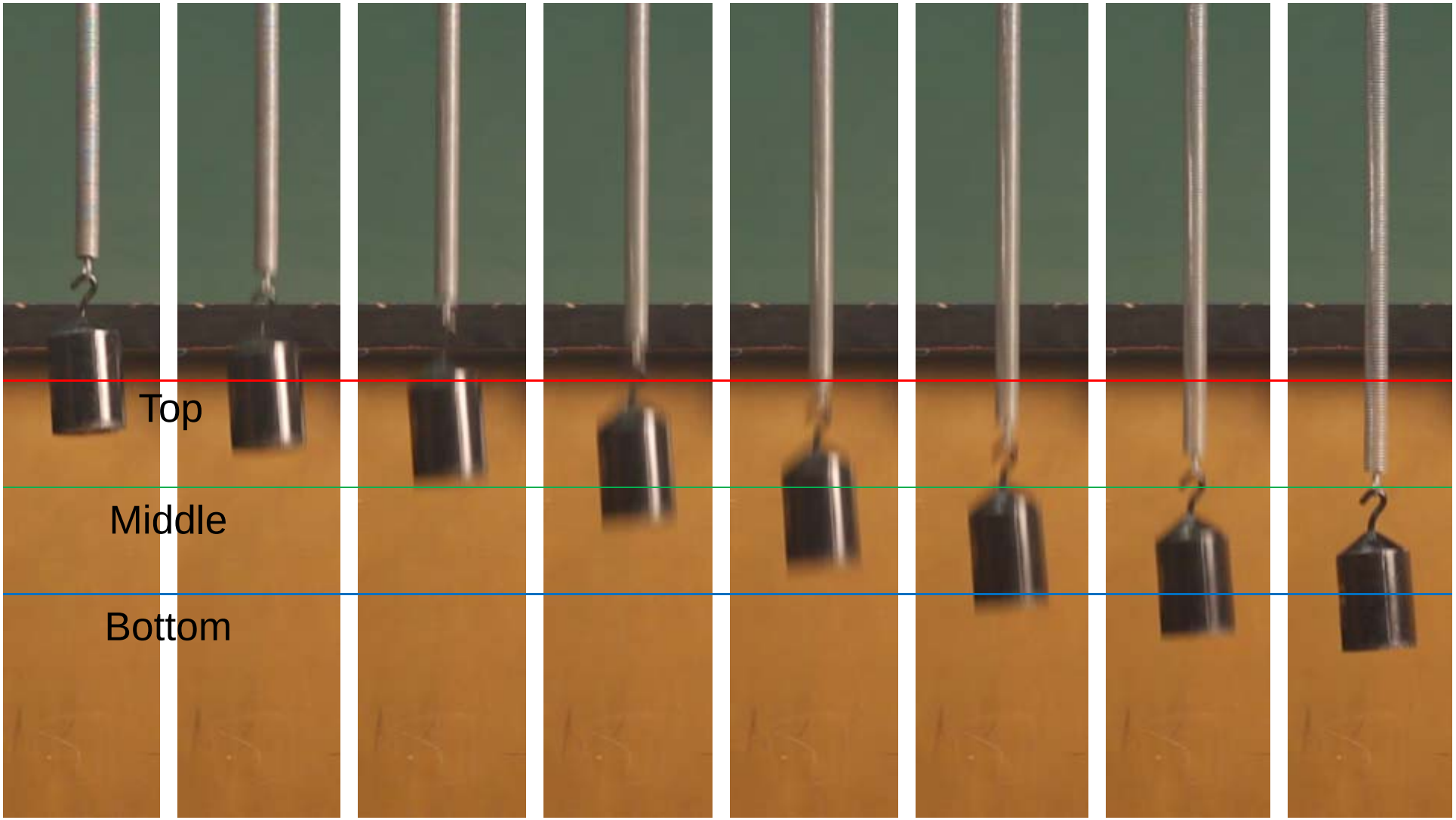


Vibrations during Settle

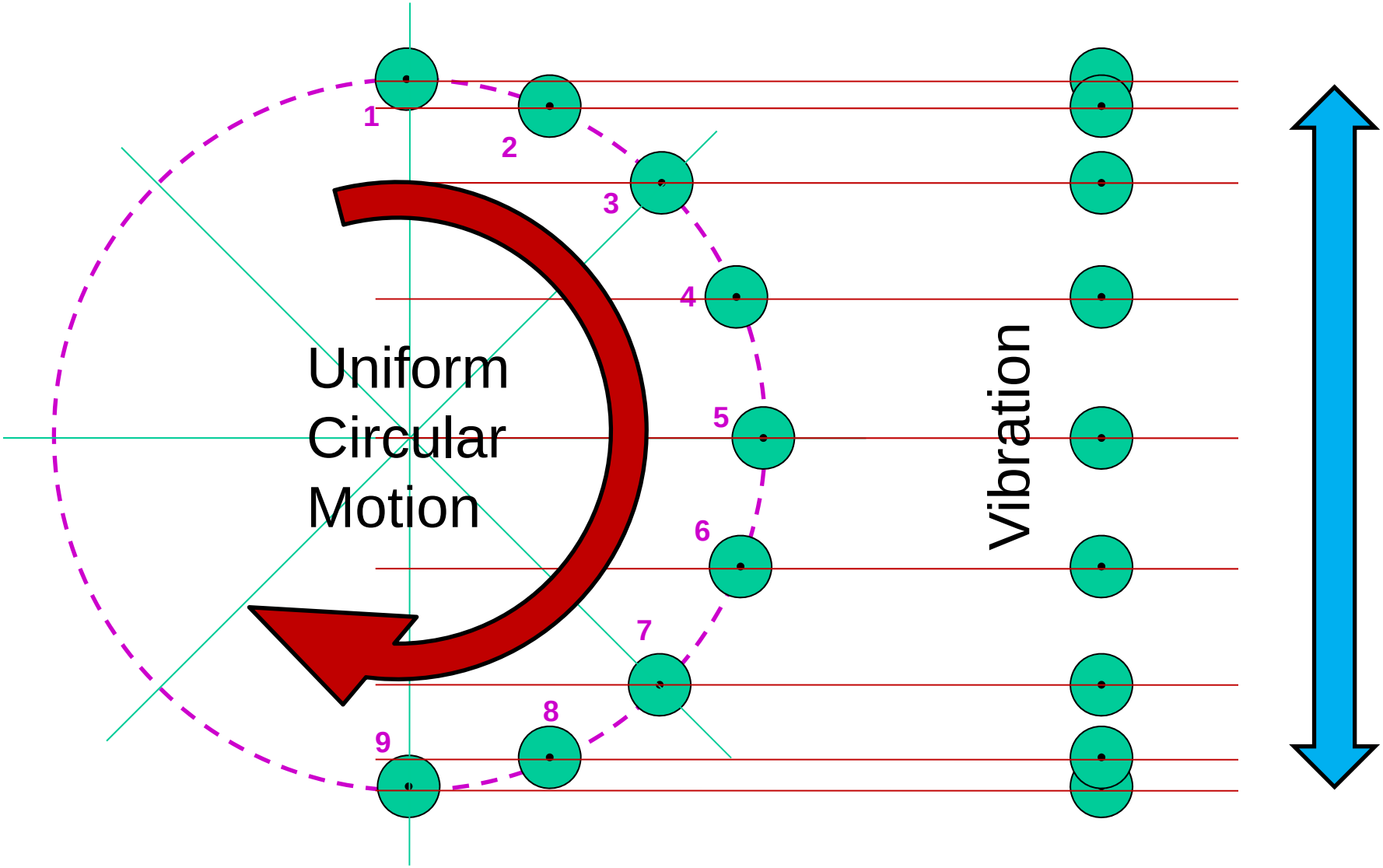
Vibration frequency is constant as the amplitude of the vibrations die out.



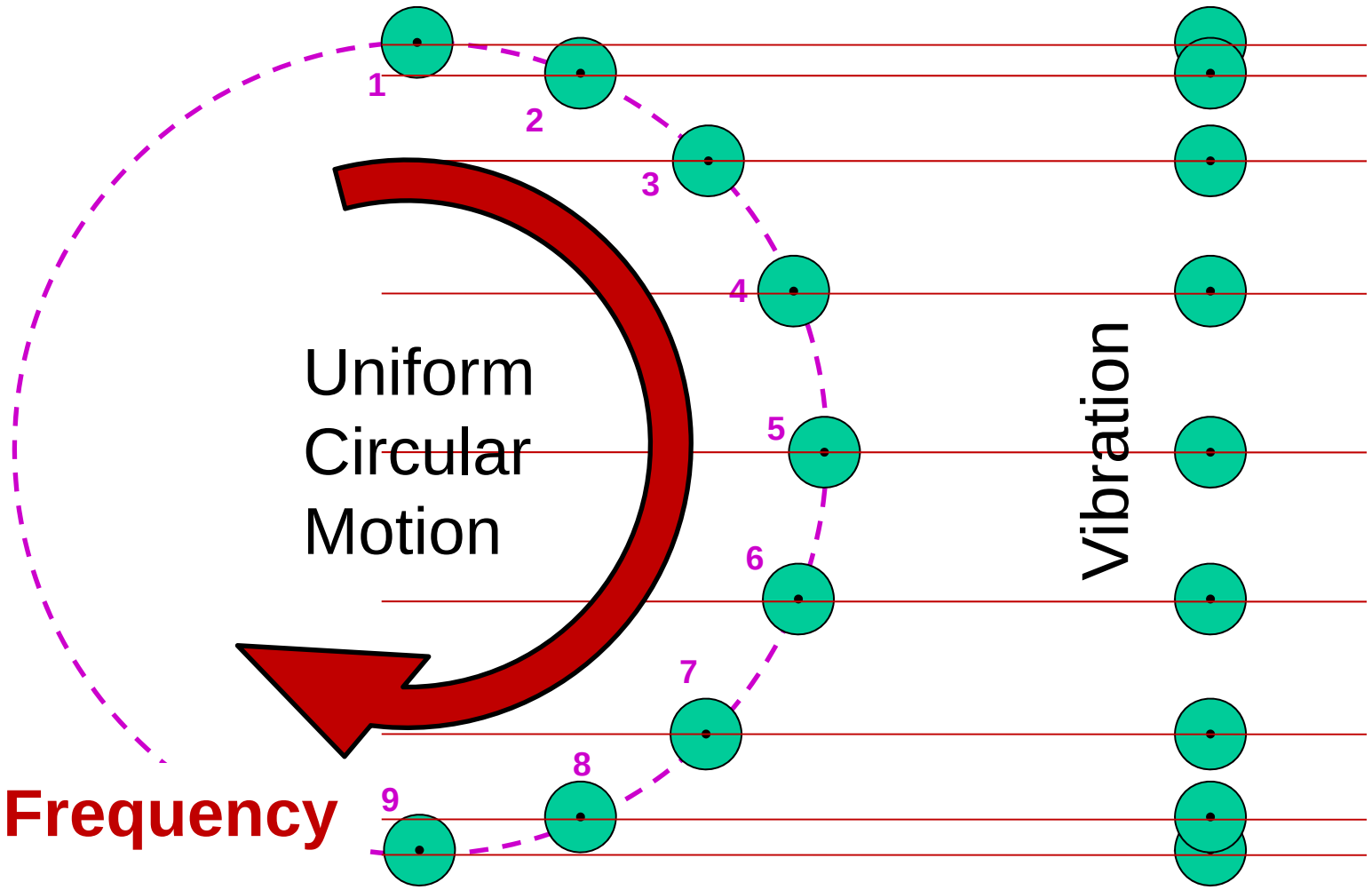
Spacings for Elastic Vibrations



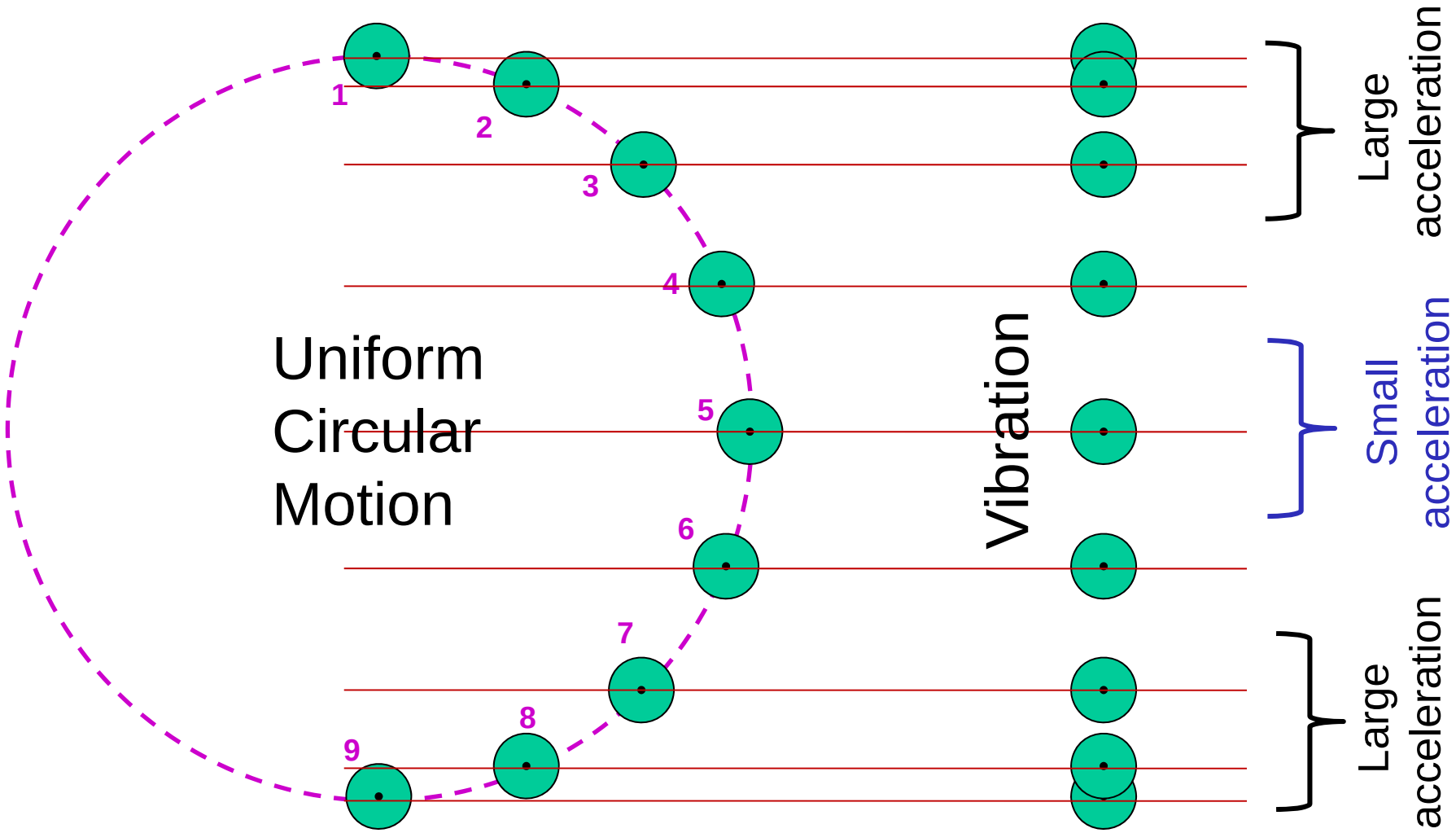
Vibrations & Circular Motion



Vibrations & Circular Motion

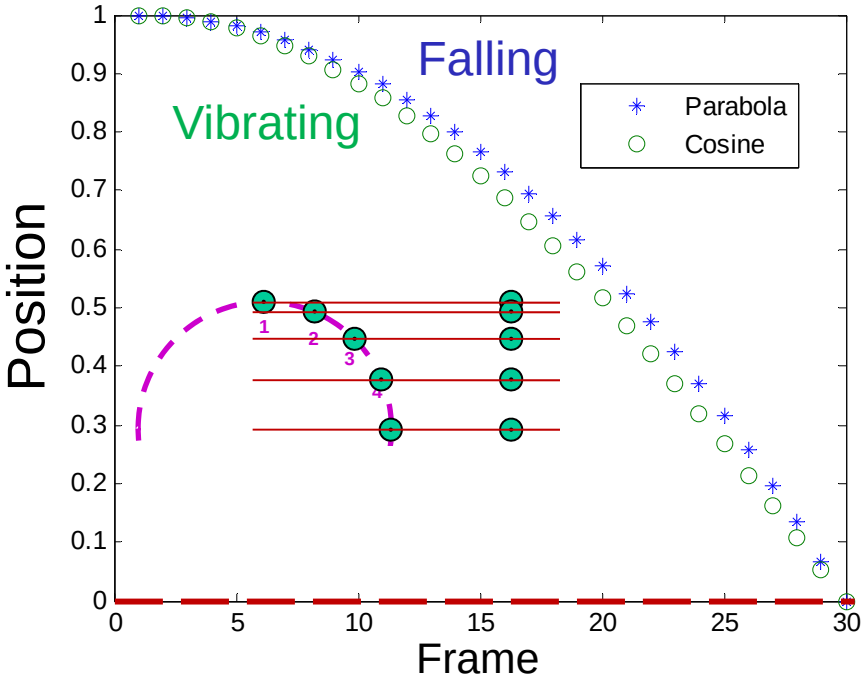


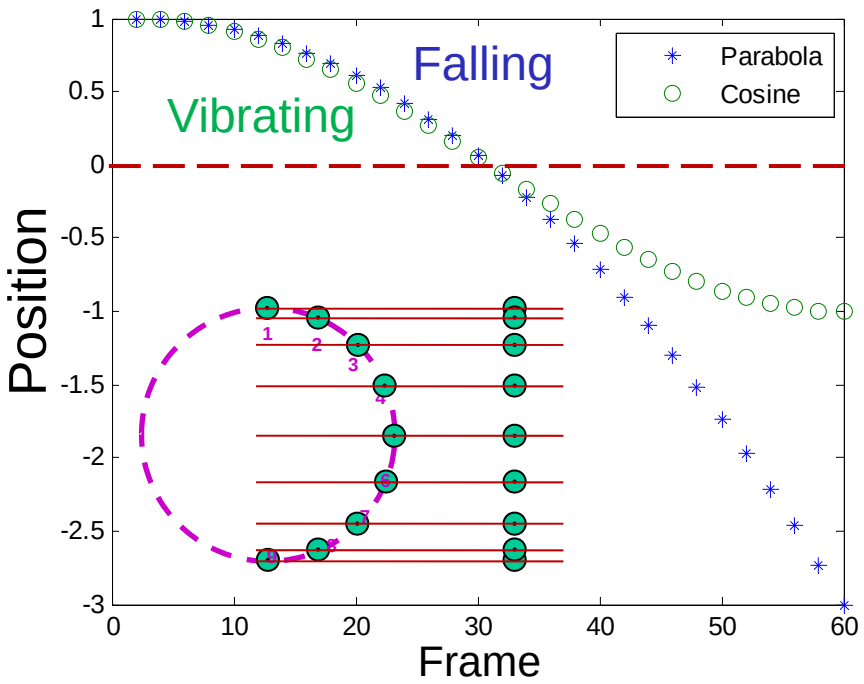
Vibrations & Circular Motion



Vibration vs. Falling

Motion curves for vibrating motion and simple falling



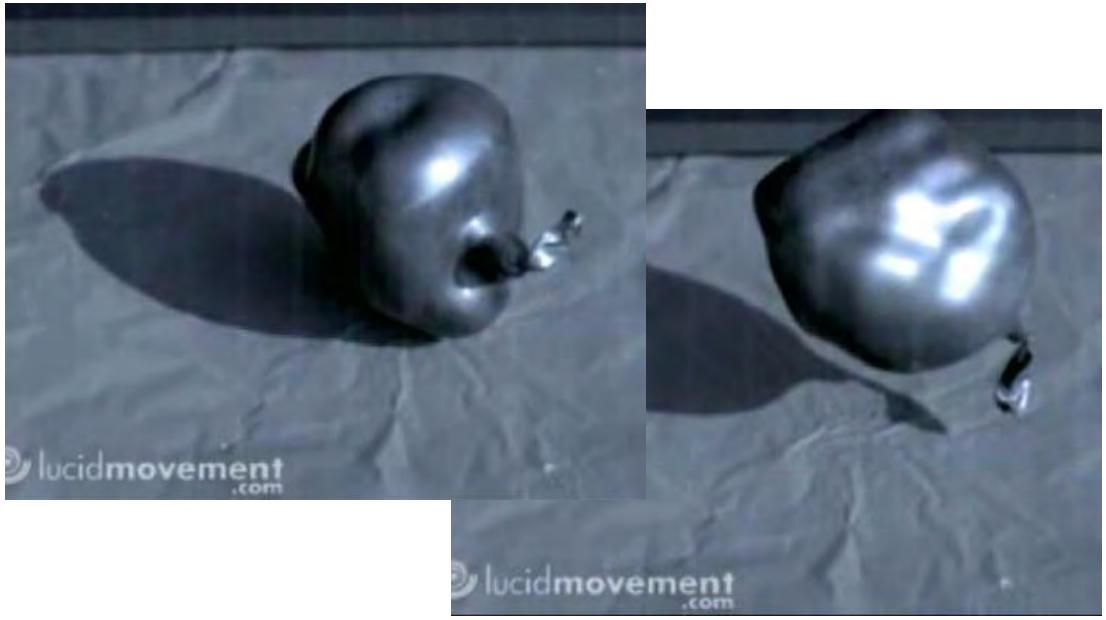


Slowing out from apex is similar to falling motion

Noticeable difference after the mid-point

Surface Waves

An impact on an elastic object often causes wave motion on its surface.



Summary

- Vibrational motion is another example of cyclic (or periodic) motion.
- Elastic materials vibrate with a frequency that depends on the stiffness and the mass.
- The frequency of elastic vibrations does *not* depend on the amplitude of the motion.
- The spacings for elastic vibrations are closely related to those of uniform circular motion.
- As with swinging motion, the texture in the timing is most noticeable near the extremes.