**Learning Goals:** Students will be able to:

* Identify/explain the variables that affect the natural frequency of a mass spring system.
* Explain how the driver variables interact with the natural frequency of a system.
* Explain the distinction between transient and steady-state behaviour in a driven system, and
* Identify which variables affect the duration of the transient behaviour.
* Recognize the phase relationship between the driving frequency and the natural frequency, especially how the phase is different above and below resonance.
* Give examples the application of real-world systems to which the understanding of resonance should be applied and explain why.

**Abstract:**

For advanced undergraduate students: Observe resonance in a collection of driven, damped harmonic oscillators. Vary the driving frequency and amplitude, the damping constant, and the mass and spring constant of each resonator. Notice the long-lived transients when damping is small, and observe the phase change for resonators above and below resonance.

**Initial drafts below**

Learning goals:

1. What is resonance?
2. What affects the resonance frequency of a system? (mass and spring constant for this system, in general “material” and mass.)
3. How does the frequency of a driver interact with the natural resonance of a system?
4. What is damping? What effect does damping have?
5. What effect does gravity have?
6. Explain the distinction between transient and steady-state behaviour in a driven system.

Some answers

When the driving frequency matches the natural frequency, the mass has high velocity and amplitude

The amount of response depends on the damping indirectly.

As the frequency of the driver is further from the natural frequency, there is less motion.

Gravity slowly reduces the motion.