# Levels of Inquiry: Learning Sequence Exercise

Using your knowledge of **Levels of inquiry: Hierarchies of pedagogical practices and inquiry processes** (Wenning, C.J. (2005). *Journal of Physics Teacher Education Online,* 2(3), February 2005, pp. 3-11), create your own inquiry spectrum of physics lessons from a single topic area using the examples found below. Be prepared to present and explain your inquiry spectrum to the class.

| | **Discovery Learning** | **Interactive Demonstration** | **Inquiry Lesson** | **Inquiry Lab** |
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| **Work and Power** | Students develop an under-standing of the concept of work (in the physical sense) by lifting objects of different mass different distances. Distinguish between physiological work and physical work. (Is it "work" to hold a non-moving object?) | Develop the mathematical definition of physical work, $W = Fd$. Have students determine the amount of work required to life an object straight up a given distance. Ask questions about simple machines. Do they provide something for nothing? E.g., free work? | Using spring scales, determine the amount of work required to move a cart up different inclined planets at constant speed. Determine the values of $F$ and $d$ to calculate work. Compare. Help students see that work is independent of path moving vertically in the earth's gravitational field from point $d_i$ to point $d_f$. $$W \neq f(path)$$ | Determine the amount of work performed by a DC motor as it lifts a mass $m$ distance $d$ in a gravitational field with strength $g$ and at a constant speed. Next, determine the power required to perform this work in time interval $t$. Compare experiment-al work ($W = mgd$) with theoretical work determined from $P = IV$. Introduce the concept of efficiency, $e$. Determine $e$ for the motor. $$e = \frac{P_{out}}{P_{in}} = \frac{W/t}{IV}$$ |
| | Students develop an under-standing of the concept of power by running and walking up and down stairs. Ask, "Are rates of "exertion" the same? What term might we use to talk about energy expended over time? | Develop the mathematical definition of power, $P = W/t,$ here as well. Power is the rate at which energy is expended. Note work-energy theorem if appropriate. | | |
| **Vibrating Air Columns** | Students are provided with bottles filled with different amounts of water, and asked to produce sound by blowing across the mouths of the bottles. Students work out the concept that the shorter the column of vibrating air, the higher the pitch of the sound generated. Students speculate as the source of the sound. | Students are introduced to various "slider toy" instruments or various brass and woodwind instruments and relate lengths over various open-ended air columns to the frequencies produced. Students compare and contrast the lengths of oscillating air columns and vibrating stings to see the parallels between propagation of oscillations and vibrations. Students use open-ended PVC pipes to play music by rapping pipes on palms of their hands. | Tuning fork held over top of an open-ended PVC pipe with one end immersed in water is used to show resonance phenomena. Students investigate ways to represent the motion of gas particles for standing waves in pipes. This is, they develop waveform representations. | Students use knowledge of waveform representations and an experimental setup consisting of tuning fork (of known frequency) and PVC pipe (open ends on tube with one end immersed in water) to find resonance points to determine the speed of sound in air. Speed of sound in air is derived from the relationship $\lambda f = v$. |

| | Discovery Learning | Interactive Demonstration | Inquiry Lesson | Inquiry Lab |
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| Topic Area: | | | | |
| Real-word Applications | | | | |