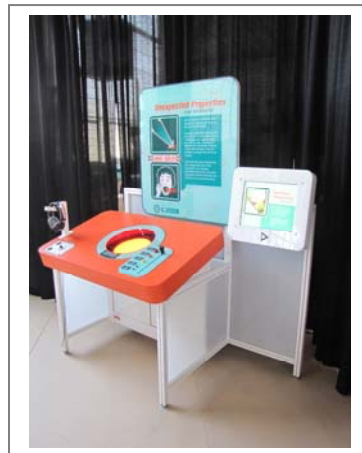# Unexpected Properties

Exhibit Description:

"Unexpected Properties" is an engaging and interactive component featured in the Intro to Nanotechnology exhibit package that demonstrates how materials at the Nanoscale can have very unexpected properties.

The tabletop interactive, Quantum Dots, focuses on the property of color and how a material's color may change when brought down to the Nanoscale. Visitors alter the size of a magnified quantum dot and watch the light that it emits shift from red to blue as it shrinks to a fraction of a nanometer. The copy panel and side monitors explain how unexpected properties are being used in real-world applications of quantum dots and nanoparticles, from medical imaging to consumer goods.

This exhibit component consists of one copy panel, the Quantum Dots interactive, and a flat-screen monitor slideshow that can be updated to keep the exhibit content current and relevant. Like all of the exhibit components in the Intro package, headphone listening stations with both English and Spanish audio description labels are included. These audio labels serve two functions—to explain the "Big Idea" content of the exhibit and to provide illustrative descriptions of the interactive experience.

Exhibit Interface:

Interactive

- Visitor sees a colored glowing circle in the center of the tabletop.

- To the right, a joystick is aligned with a 3D sphere of a corresponding color.

- As the visitor moves the joystick up, the glowing circle grows and the color gradually changes color - the final position being red.

- As the visitor moves the joystick down, the glowing circle decreases and the color gradually changes color – the final position being blue.

- There is no reset mechanism on this unit. The circle will remain on and at the same size and color as the visitor left it.

Side Monitor

The monitor, on the right side of the interactive, displays images of nanotechnology.

- Images self scroll.
- Visitors can press the "Next" button to scroll to the next image.

Audio

- Visitor wares the headphones.
- Visitor chooses to listen to English or Spanish by pressing the "English" or "Espanola" button.
  - Audio starts.
    - Audio explains the content of the exhibit
    - Audio provides instructions of the interactive.
- Visitors can adjust the volume of the audio.

Exhibit Components:

The following lists of components combine to make the exhibit.

Base Cabinet:

- Weighing, 100 lbs.
- Dimension, 57" H x 66" W x 32"D

Graphic Panel:

- Weighing, 20lbs.
- Dimension, 34"H x 38" W x 2"D

Side Monitor:

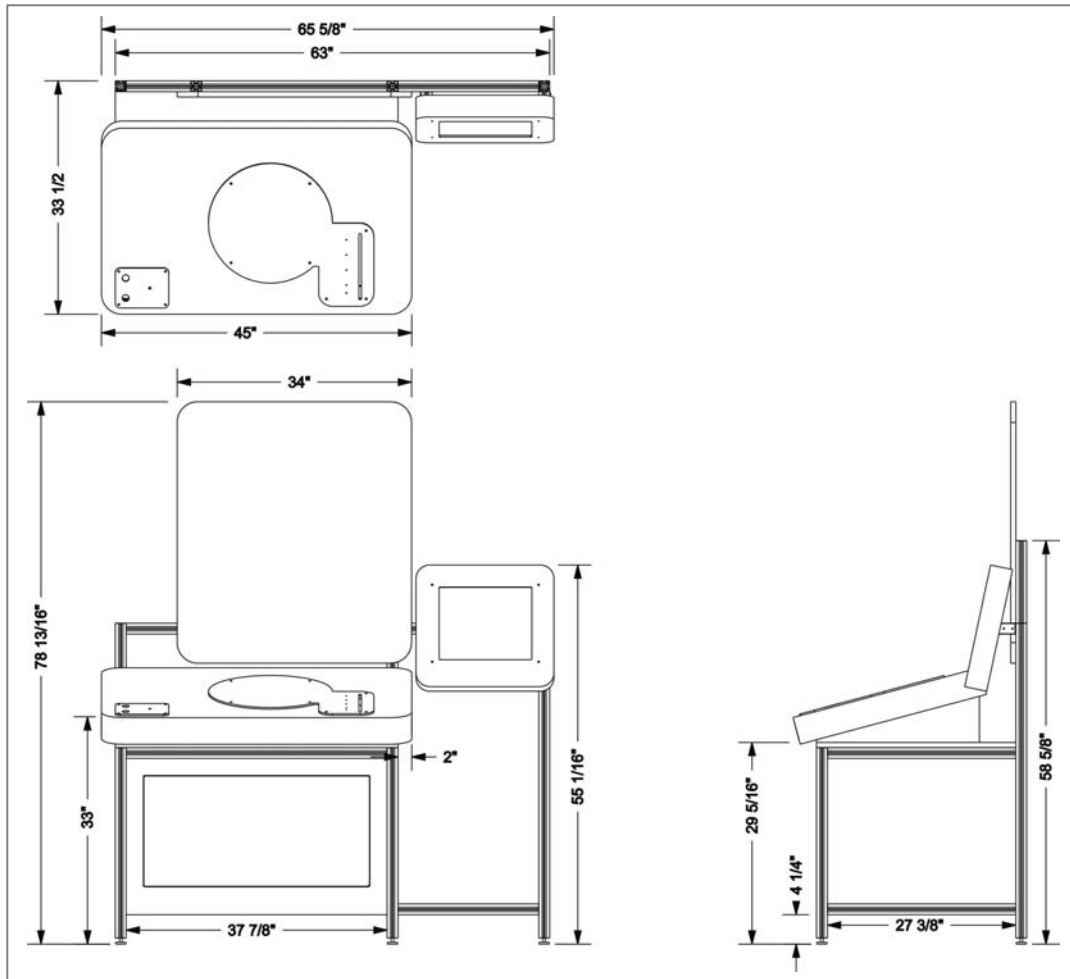- Weighing 10 lbs.
- Dimension, 22"H x 19" W x 6"D

Exhibit Specifications

Dimensions:

- Exhibit Dimensions:
  - 79"H x 66"W x 31"D
- Exhibit Foot Print:
  - 66"W x 31"D
- Recommended Exhibit Floor Space:
  - 72"W x 62.5"D

Power Requirements

- 110-volt, 15-amp.
  - Accessed through the base cabinet of the exhibit

Tools and Hardware:

Tools and Hardware needed for installation, maintenance and repairs to the exhibits.

Key
- 415-A
  - To open base cabinet

Cam Wrench
- Cam locks
  - Securing Side Monitor to exhibit frame
  - Securing exhibit frame

9/64" Allen Wrench
- All ¼ x 20 button head bolts
  - Securing the exhibit monitor to interactive cabinet
  - Securing the Graphic Panel to the exhibit frame

5/32" Allen Wrench
- Security screws
  - Securing all second surface graphic panels

3/32" Allen Wrench
- Machine screws that secure Side Monitor shroud

#2 Phillips Screwdriver
- Machine screws
  - Securing Side Monitor shroud back panel
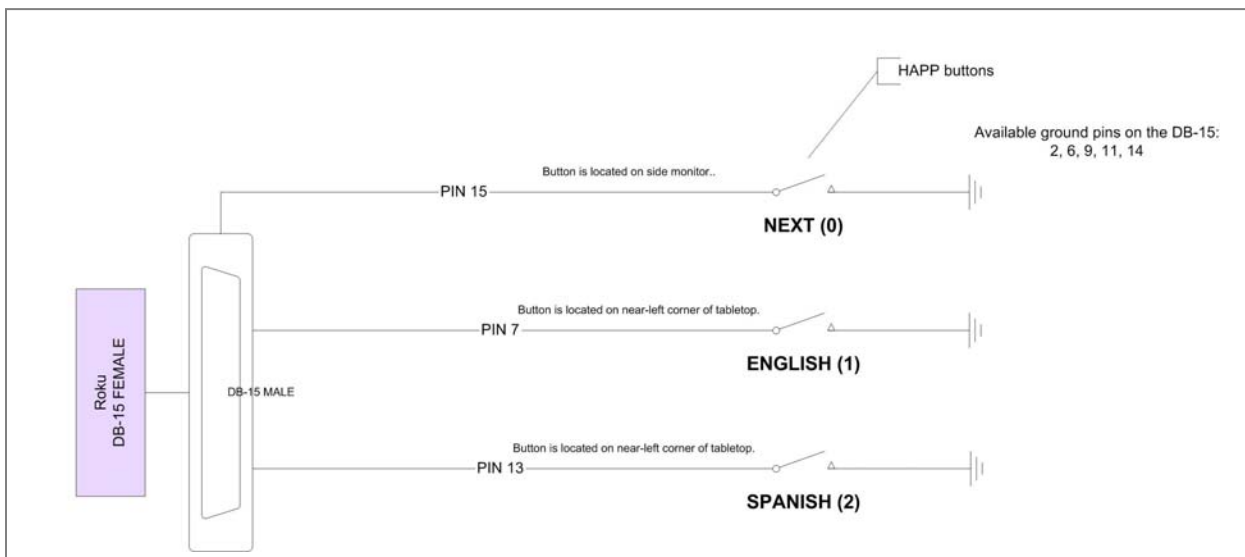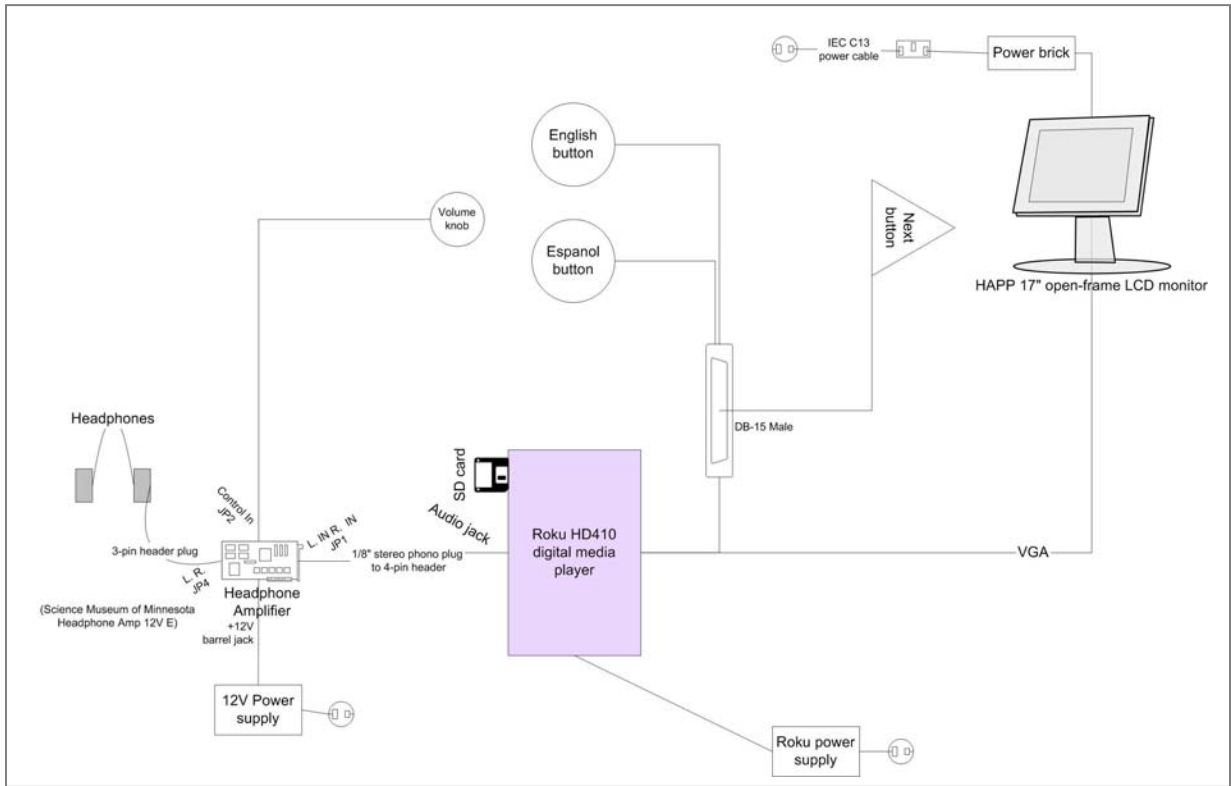
6" Crescent Wrench
- To adjust leveling feet

Parts:

Parts needed for installation, maintenance and repairs to the exhibit.
- Headphones
  - AKG K77
- Monitor
  - 17" Happ, 49-2603-30
- Media Player
  - Roku HD410
- Amplifier
  - Produced by The Science Museum of Minnesota (SMM)

Media:

Electronics:

The electronics in the Unexpected Properties interactive exhibit consist of:

- A microcontroller board
- A potentiometer which senses the iris size
- Four RGB LED arrays
- An array of 5W resistors
- A 12VDC power supply

The microcontroller board continuously digitizes the output of the iris-size pot and produces three pulse width modulated waveforms; one each for red, green and blue. The PWM waveforms drive three MOSFET transistors which power the red, green and blue LEDs through 5W series resistors. Each LED array has multiple LEDs of each color. All four LED arrays and their series resistors are power in parallel.

As the iris size is changed from smallest to largest hole, the controller adjusts the on/off time ratio of the red, green and blue circuits to produce a spectrum of color from red to blue.

Adjusting or replacing the iris size sensing potentiometer:

The potentiometer used in this assembly is an ETI # SP22G-10K conductive plastic potentiometer with no internal mechanical stop. This information is provided for the replacement or calibration of the potentiometer circuit.

The potentiometer mechanism and electronics are to the right side of the iris assembly, and accessed from below the orange exhibit surface.

The potentiometer is connected across the +5 volt supply, with +5 volts (red wire) to CCW, and control common (GND; black wire) to the CW terminal. The wiper connects to a violet wire.

The lever on the right side of the top of the orange surface operates a rack and pinion gear set that rotates the potentiometer. There is a small hole containing a metal pin in each of the above gears that should line up when the lever is centered. For a mechanic, this will be similar to the way timing gears are aligned. At this point, the potentiometer is 'half way' between the maximum and minimum ranges, which will be, respectively, approx. 4.5 volts and 0.5 VDC, with the center being approximately 2.5 VDC.

There are two adjustments on the circuit board (lower left corner); "-REF" and "+REF". These multi-turn potentiometers set the negative and positive reference points to match the voltages of the negative and positive range of the potentiometer.

To set these adjustments:

Locate the three pin connector on the control circuit board (lower left corner below the iris) with the black, violet, and red wires. Connect a multimeter set to the DC function with the negative (black) lead to the black wire of the three pin connector, and the positive (red) lead to the violet wire of the same connector. When the exhibit lever is pushed all the way up (iris color will be red), measure the voltage, which should be around 0.5 volts. Pull the lever all the way down (iris color will be blue) and measure the voltage again. It should be around 4.5 volts. Note both of these voltages.

With the negative (black) lead still connected to the black wire of the three pin connector, touch the tip of the positive (red) probe to pin 4 of the microprocessor on the control board. Using a small blade screwdriver, adjust the "-REF" potentiometer to set the voltage to approx. 0.1 volts more positive than the voltage measured on the purple wire with the lever at the top. Example: If the measured voltage was 0.42 volts, set the adjustment for 0.52 volts.

Move the red (positive) probe tip to pin 5 of the microprocessor, and adjust the "+REF" potentiometer for a voltage approx. 0.1 volts more negative than the voltage measured pm the purple wire with the lever at the bottom.

Check the operation by moving the lever from the top (iris = red) to the bottom (iris = blue) for a smooth transfer of colors. Note: Due to wavelength compression, the color change between green and blue at the extreme bottom end may appear to be slightly jumpy. This is normal.


Replacing the potentiometer:

The challenge here is to adjust the potentiometer so it is electrically centered when the rack and pinion gears are properly aligned (see above) and with the lever also centered.

With the power off, replace the potentiometer. Be sure to re-solder the three wires in the same positions as they were removed. With the three pin connector unplugged from the control board, set a multlimeter to "ohms" (resistance) and measure between the black and red wires on the connector. You should read around 10K ohms. Divide this number in two. Example: a reading of 10.2K / 2 = 5.1K. Now connect the multimeter between the black and violet wires. You are looking for a reading of 5.1K when the lever is in the middle and the rack / pinion gear set is aligned with the metal pins described above in position adjacent to each other. If the reading is more than 0.3K from half the value of the first reading, adjust the potentiometer shaft the required direction to correct this, and repeat the procedure.

As the exhibit shipped from OMSI in April of 2009, the pot read 0.494VDC at the red end and 4.50 VDC at the blue end. The negative and positive reference voltages were set at 0.394 and 4.60 VDC, respectively.

Inside the upper cabinet is a short cable which can be plugged into a connector on the controller board marked" PROGRAM." The other end of the cable has a DB-9 connector to go to a computer serial port. The controller will transmit the digitized iris size (handle position) several times per second, at 9600 baud, no parity, 8 data bits, 1 stop. At ship time, that output reported 5 with the handle at the red end and 249 at the blue end. This is the range of values the code expects to see. Any values outside of this range will display all red or blue.
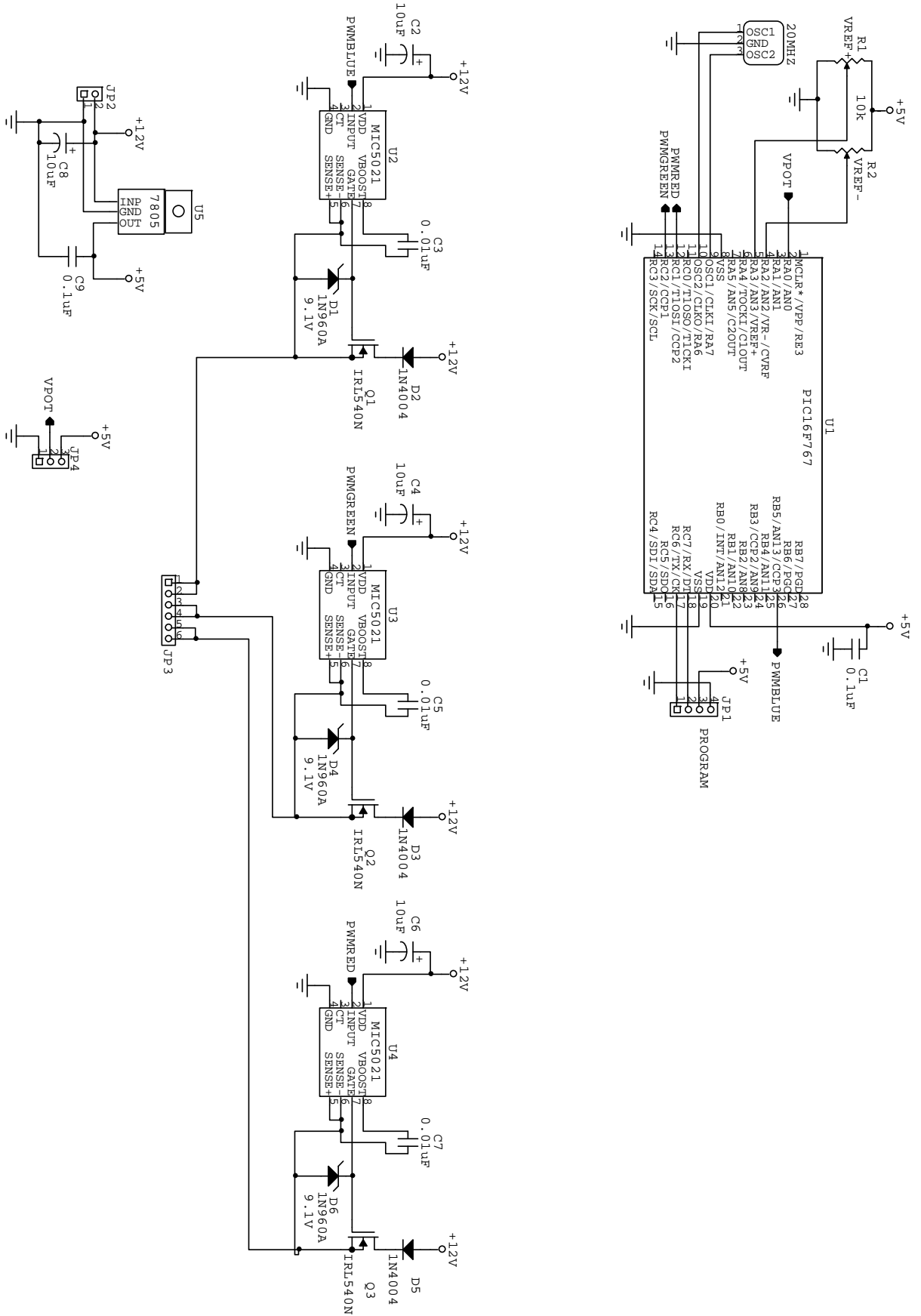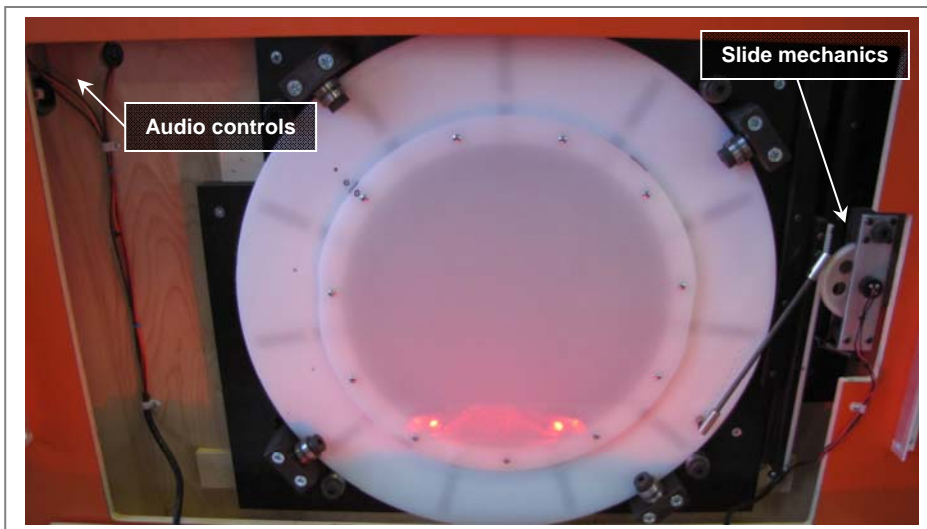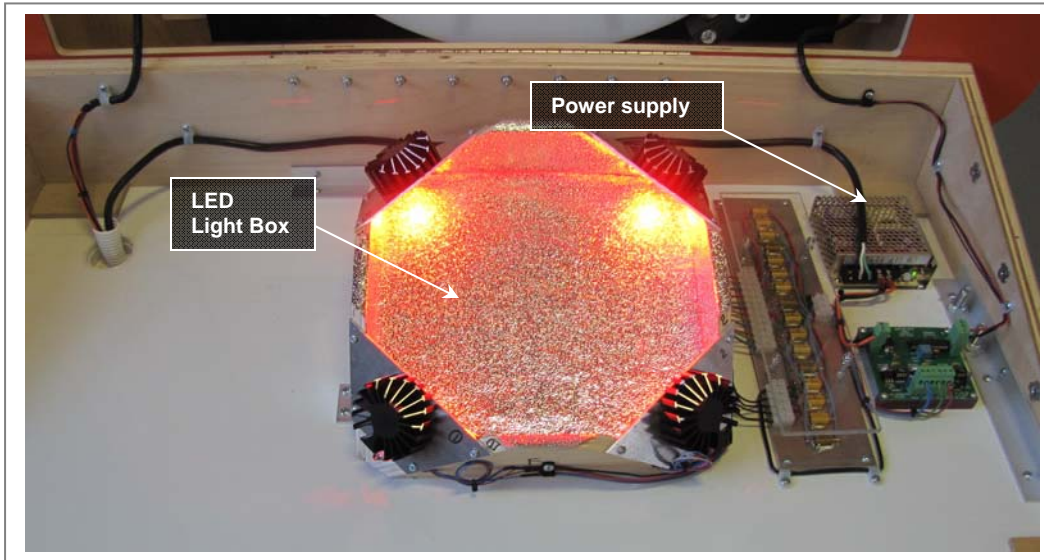
Service Access

Base cabinet Access

- Accessed with a 415-A key
- Contains
  - Power outlet strip
  - Media player
  - Audio amplifier
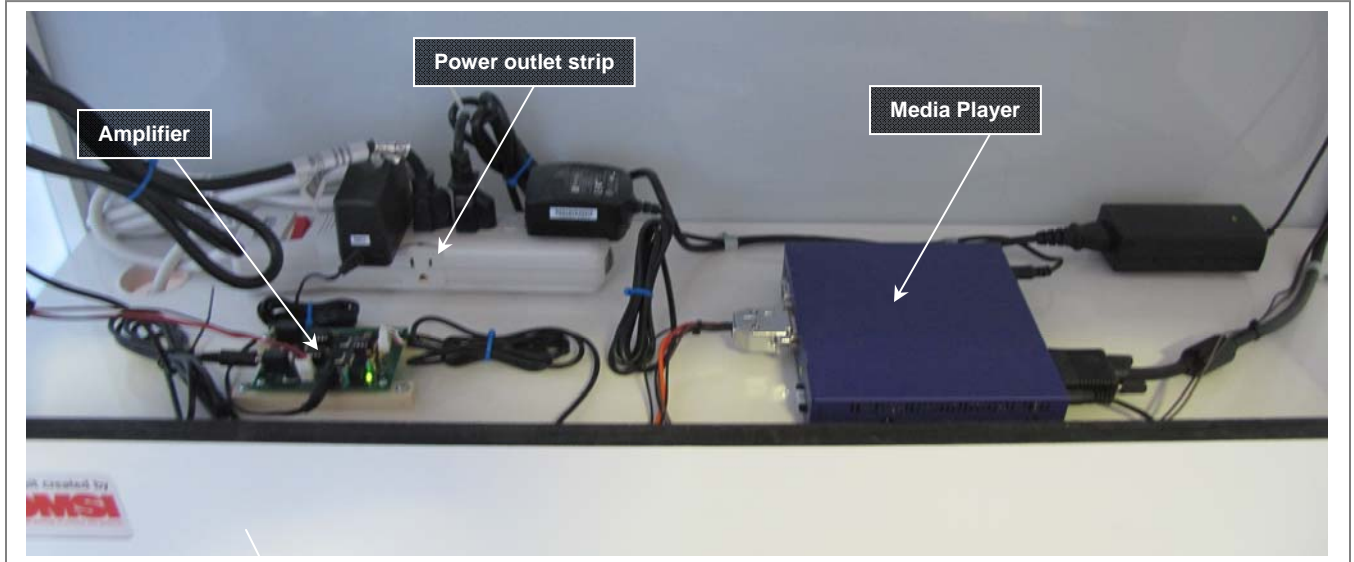
Interactive Access

- Accessed with 9/64" Allen Wrench, 6 bolts secure the top
- Contains
  - Interactive Circuit Boards
  - Interactive, LED Light Box
  - Interactive Mechanics
  - Interactive Power Supply

Trouble-Shooting

Interactive:
- Center does not light on power up.
  - Ensure there is power to the exhibit.
  - Ensure power strip is switched to the "ON" position.
  - Check to ensure all power plugs are securely connected.
- ➲ **If the above conditions are met the interactive power supply may be faulty, replace as needed.**

Side Monitor:
- No Picture.
  - Ensure there is power to the exhibit.
  - Ensure power strip is switched to the "ON" position.
  - Check to ensure all power plugs are connected to power strip and to the back of the Monitor.
  - Check to ensure source plug is connected to the media player and to the back of the Monitor.
  - Check to ensure media card is securely inserted into the media player.
- ➲ **If the above conditions are met the media card, Headset, media player, or side monitor may be faulty, replace as needed.**

- Pictures do not advance when prompted.
  - Check to ensure all plugs are securely connected to the "NEXT" and button and the signal cable is securely connected to the media player.
  - Check to ensure media card is securely inserted into the media player.
- ➲ **If the above conditions are met the media card, media player, or buttons may be faulty, replace as needed.**

Audio:
- No Sound
  - Check to ensure all plugs are securely connected to the Amplifier.
  - Check to ensure plugs are securely connected to the "ENGLISH" and "ESPANOLA" buttons and the Signal cable is securely connected to the media player.
  - Check to ensure media card is securely inserted into the media player.
- ➲ **If the above conditions are met the media card, or buttons may be faulty, replace as needed.**