

Jonathan “Jonboy” Silsby

Los Angeles Zoo: Animal Keeper - Enrichment, 2003-2022

Project Highlights During 2020-2022:

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General Duties:

- Advancement / Development & Perishable Skills
- Building / Fabrication / Construction
 - S.T.E.A.M.
- Communication:
 - Animal Care, Conservation, Construction, Curators (Chain of Command), Custodial, Grounds Maintenance, Health Center, Learning & Engagement, Nutrition, Research, Security, Veterinarians
- Conservation Committee
- Design: Exhibits / Devices / Furnishings
- Documentation / Data Collection
- Engineering & Reverse Engineering
- Enrichment Talks: Docents / Schools / Camps
- Estimating: Time / Expenses
- Exhibitory
- Improvements
- Inventor
- Inventory Management / Ordering
- Organizing / Clean Up
- Project Management:
 - Design, Planning, Estimates, Material, Pre-building, Staging, Labor (Volunteer or Keeper), Time Management
- Re-Evaluate
- Research & Development
 - Natural History, Engineering, Prototypes, Material, Technology, Experiments, S.P.I.D.E.R.
- Teaching: Construction / Techniques / Fabrication
- Volunteer Management

Skills:

- Google: Docs, Drawing, Drive, Meet, Sheets, Sketchup, Slides
- Hand Tools
- Materials:
 - Concrete / Stucco
 - Metal
 - Natural
 - Plastic: PVC & Starboard
 - Stainless Steel Hardware
 - Steel, Cold-Rolled
 - Wood
- Power Tools:
 - Drill: Press, Impact, Rotary Hammer
 - Grinders
 - Saws: Band, Chain, Circular, Sawzall, Jig, Hackzall, Chop, Table
 - Table / Hand Belt Sander
 - Wood Router
- Welding:
 - Millermatic 135, 115V Wire Welder (MIG)
 - Oxy-Acetylene: Welding / Cutting / Brazing

BLUE EYED LEMUR

May 2021 - Exhibit Renovation

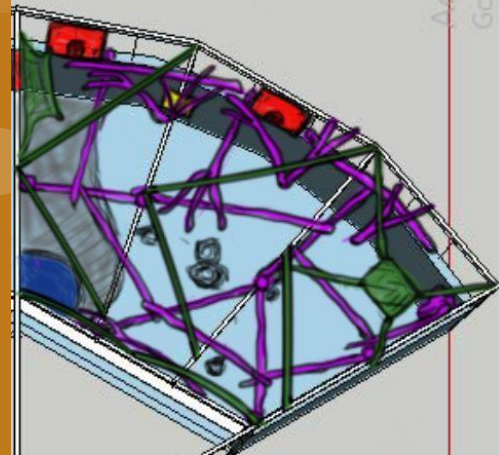
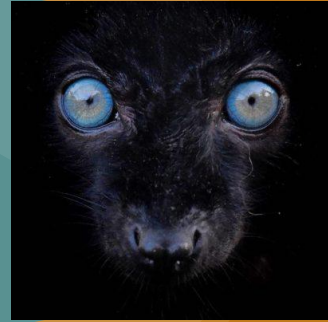
- **Prep Time:** Fifteen Days
- **Install Time:** Three Days
- **Resident Concerns:** Age of Male, not jumping, required connected Perching with climbing options.

Breakdown:

- ~340 Linear Feet of Perching:
 - 6x Posts, new bracket system
 - 13x Horizontal Perching
 - 2x Ramps
 - 11x Filler Perching
- Resecured Nest Box
- ~100 Linear Feet of Firehose:
 - 7x Slings with Dangles
 - Fabric Hammock with Firehose Arms
- 18 various PVC Devices:
 - Simple Design: Trough and Holders

Longevity Estimate:

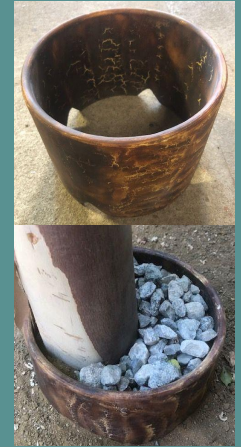
- Posts: 5-10 years
- Horizontals: 3-5 years
- Filler: 1-3 years



Drainage Test To prevent Rot



Design: Arboreal Canopy with continuous connected pathing. Options for male to climb.



Each red arrow is a single piece of new perching.



Devices for Regular Diet:

- Multiple Browse Holders and Cap Cups.
- Testing clear PVC so that the diet is visible to Resident.



PVC Cap Cups



Browse Holder

“Vase” Device



Hanging Shaker



Trough Feeder

CAPUCHIN

June 2022

Modular / Changeable / Easy Repair System:

(Used in non-public facing enclosure)

- 5x Five Feet Slings (one ring)
- 5x Ten Feet Slings (two rings)
- 5x Fifteen Feet Slings (three rings)
- 1x Twenty Feet Sling (four rings)
- 2x Trapeze
- 1x Branches into a Triangle
- 1x Branches into a Square
- 2x Suspension Ladders
- 2x Log Swings
- 1x Foraging Tub
- 6x Browse Holders
- 3x Trough Feeders
- 12x Modular Perching (3', 4' & 5' lengths)

(Updates and suggestions as of 8/5/2022)



Total	make	to do	Capuchins	Balen group
5	5	0	✓ 5ft Sling (cut FH @ 6')	2x Eyebolts 1x Ring
5	1	4	10ft Sling (cut FH @ 11')	2x Eyebolts 2x Rings
5	0	2	15ft Sling (cut FH @ 16')	2x Eyebolts 3x Rings
1	0	1	20ft Sling (cut FH @ 21')	2x Eyebolts 4x Rings
2	1	1	Trapeze	Fit on sides instead of no ends - single legs.
1	1	0	✓ Triangle, horizontal or vertical	
1	0	1	Square, 11' w/ Eyebolts like Trapeze. 16"x16" Pine can be 18"-22" long	
2	0	2	Pine + Fiberglass Suspension Ladder @ 12 ft. (cut FH @ 15') 11' long each @ 1' apart.	
2	1	1	Log Swings	on sides 4"x2" pine 2x long eye screws
3	0	3	Starbanded Platforms 3' x 18"	- curved for Balen - Organic "Bones" - 3 brackets each @ 3' wood
1	1	0	✓ Foraging Tub, hanging	
6	15	0	✓ Fixed Browse Holders, various	- Bring for keeper to choose.
3	3	0	✓ Trough Feeders, horizontal, simple	
12	0	12	Pine Ledges, perching, 3', 4', 5'	2x Eyebolts 2x Suspension Construction?

NOTE: All the Rings should be used up with wheels fixed.

NOTE: Fill on sides instead of no ends - single legs.

NOTE: Pine can be 18"-22" long

NOTE: on sides 4"x2" pine 2x long eye screws

NOTE: - curved for Balen
- Organic "Bones"
- 3 brackets each @ 3' wood

Bonus

NOTE: Call for more quantities, 20' tall, other builds, etc.



Tower, Pressure Treated Lumber



Trapeze



Square Perch



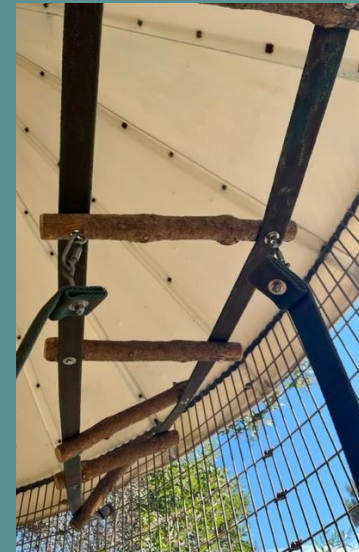
Foraging
Bucket



Platform, Starboard



Trough Feeder, Double Opening



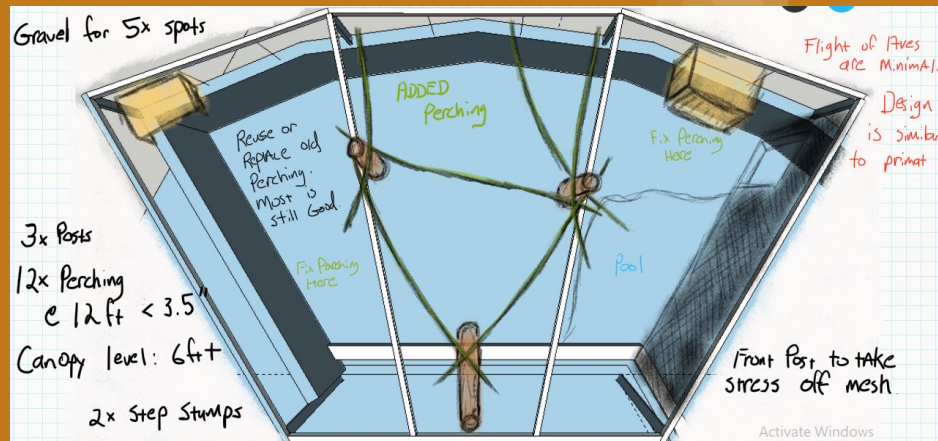
Suspension Ladder

COCKATOO

August 2022 - Repair & Renovate

- **Prep:** 1 week
- **Install:** 1.5 days
- **Residents:**
 - Female: No fly
 - Male: Chooses not to fly
 - Chewers
- **Design:**
 - Similar to a small primate
 - Nestbox, Heat and Water access
 - Short flight paths
- **Goals:**
 - Longevity
 - Replacing Perching easier (chewing)
- **Added ~250 linear feet of Perching:**
 - 3x Posts: Floor to ceiling
 - 10 x Horizontals (main perching)
 - 11x Filler (for chewing)
 - Resecured / Rearrange existing Perching
 - 3x Stepping Stumps
 - 3x Eye Screws (for bird toys)
 - Branch structure in Pool
- **Notes:**
 - Gravel Drainage around Posts

(Sketch does not depict perching already there to reuse.)





Perching to
access Nest,
Heat Lamp
and Water.



Avoided Perching over Water Feature.



Structure for getting out of Water Feature.

COLOBUS

October 2021 - Exhibit Renovate

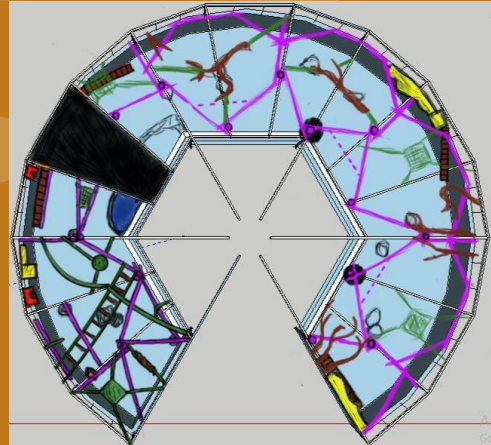
- **Prep Time:** Twenty One Days
- **Install Time:** Five Days
- **Resident Concerns:** Infant safe, adult pathing and juvenile areas

Breakdown:

- ~690 Linear Feet of Perching:
 - 11x Posts
 - 30x Horizontal Perching
 - 3x Dynamic Perching
 - 12x Filler Perching
 - 4x Stepping Stumps
- ~950 Linear Feet of Firehose:
 - 28x Slings with Dangles
 - Firehose and Wood Suspension Ladder
 - 3x Fabric Hammocks with Firehose Arms
- 3x Starboard Platforms
- 2x Ramps (made by Carpenter)
- 15 Diet and Browse Devices:
 - 11x Browse Holders
 - 4x Foraging Tubs

Longevity Estimate:

- Posts: 5-10 years
- Horizontals: 3-5 years
- Filler: 1-3 years





Prep Time-lapse Clips: ~21 days

- Harvesting Perching
- Starboard Spacers for Posts (reduce rot)
- Metal Working: Plates & Brackets
- Starboard Platforms
- Firehose: Processing, Prep & Painting
- Firehose Assemble: Slings with Dangles
- Foraging Containers / Tubs
- Staging at Exhibit



Install Time-Lapse Clips: 1 Week (5 Days)

- Demolition
- Posts
- Horizontals
- Platforms
- Firehose
- Furnishings (Ladder shown)
- Dynamic Perching
- Filler
- Move Out / Cleanup



All red arrows point to every new Perch, Furnishing and Device installed.

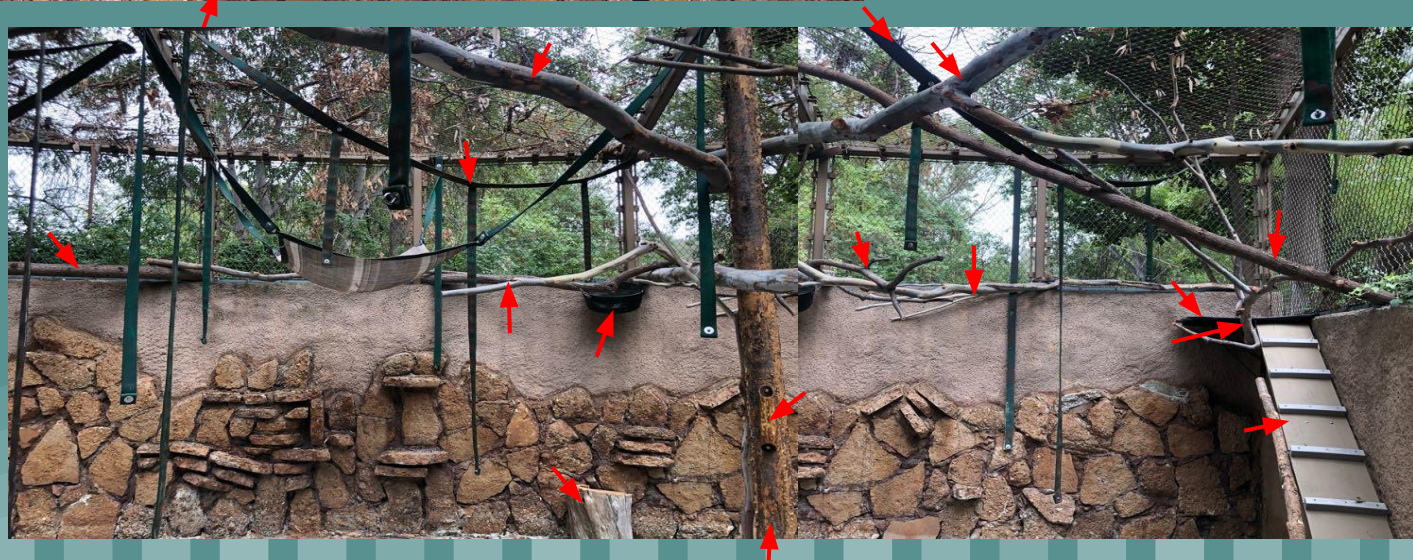




All red arrows point to every new Perch, Furnishing and Device installed.

Design:

Each post was spaced in such a fashion so that the average spacing between them and the retaining wall averaged 12 feet. Horizontal Perching was placed in a circular pattern so that a Dynamic Perch can be hung within each circle for juvenile energetics.



Colobus, Small Side: October 2020



Testing new system.

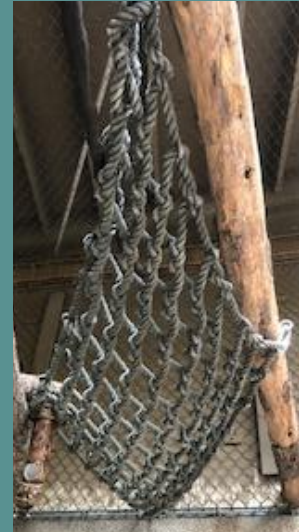


PVC Large Fitting



½ Boomer Ball “Hammock”

Rope Hammock



Dynamic Browse Holder



Foraging Tub



Browse Cuff



Boomer Ball

Ladder



Fabric Hammock



Hanging Shakers

Browse Holders



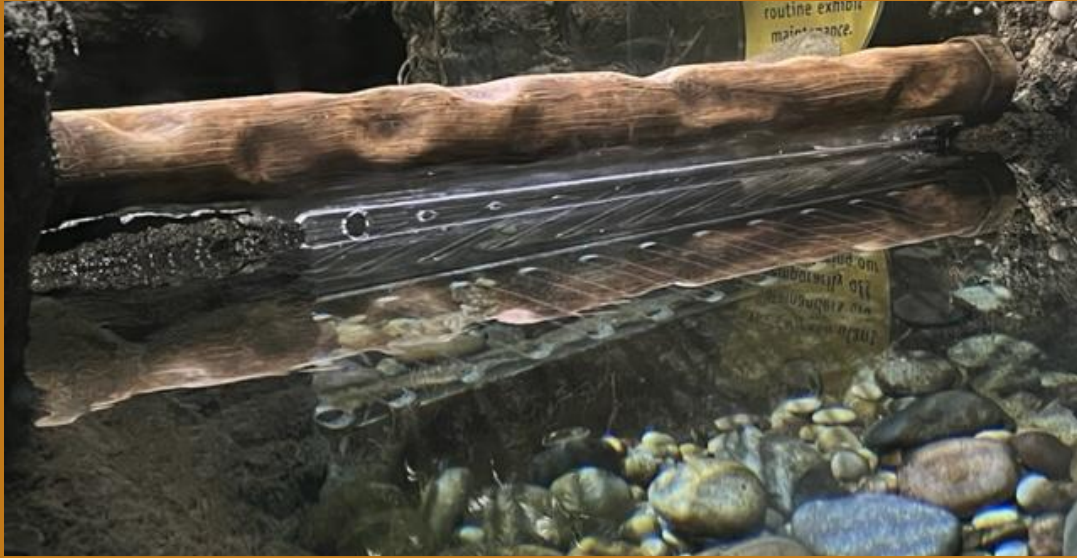
Extra Long Trough Feeder



Starboard Platform, Passing Through Post



GIANT SALAMANDER



For Intros, Altered existing Barrier

- Slot in PVC accommodates a “T” section on top of the Divider Panel.
- PVC was scored to look like “wood grain” and indentations double as Keeper hand holds to lift the panel.
- This keeps the unit light, as it previously had a heavy waterlogged branch.





The Divider Panel was $\frac{3}{4}$ " thick and very heavy. Built a Router Sled to remove material down to $\frac{1}{4}$ ". The outside edge was left at $\frac{3}{4}$ " for the chanel as well as for strength.



It takes roughly 2 min 30 sec for the PVC to become malleable, with a heat gun. A damp rag left in the freezer helped speed up the setting process.

HOWLER MONKEY

December 2020



Challenge:

Unable to attach to mesh or to the four main mesh posts at each corner. Needed to Engineer custom brackets to attach to lower retaining wall.

Areas of Broken Mesh:

- Transition Chute
- Heat Lamp
- Sunning Spots

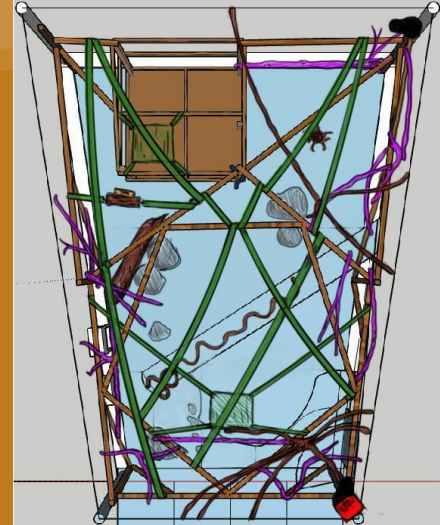


EXHIBIT TIMELINE



One Month Before: SketchUp, prep and prebuilding.

Day 1: Moving Day ~1,400 pounds of Lumber, Tools and Equipment.

Day 2: Holes dug and jackhammered.

Day 3: Learning Curve - 2x Posts and 3x Beams.

Day 4: 3x Posts and 5x Beams.

Day 5: 1x Post, 3x Beams & Pentagon (5x Beams).

Grounds Maintenance hauled in ~750 lbs of Gravel.

Day 6: 5x Perching, ~60 ft of Firehose, 2x Hammocks, 8x Devices. Safety check, clean and remove gear.

Weekend Observations: Identified 5 areas of concern!

Day 7: 10x Perching & ~60 ft of Firehose.

Day 8: Exhibit Done - 2x Starboard Platforms & 2x Perching. Safety check, clean and remove gear.

Day 9: Cushion Day - worked in Uakari.

Day 10: Howler Bedroom & started to clean/remove debris. Allowed Howlers to adjust to new bedroom items.

Day 11: Howler Bedroom (Then Capuchin Bedroom)

Allowed Howlers to adjust to new bedroom items.

Day 12: Other area repairs & minor installs.

Day 13: Move Out Day, all gear and clean up.

Day 14: CORE - Consolidate, Organize, Resupply, Exit report.

Removed ~27 cu ft of Dirt. Replaced with ~750 lbs of Gravel, for Drainage.



After first week, before Weekend Observations.





Total Linear and Square Feet:

- 2x Hammocks add 18 square feet.
- 2x Starboard Platforms add 8 square feet.
- 120 Linear feet of Firehouse adds ~40 square feet.
- 196 Linear feet of Lodgepole Horizontals adds ~82 square feet.
- Total square feet added = ~148.
- Existing House Structure: Bottom has 67 sq ft + Upper has 34 sq ft = ~101 total square feet.
- With house structure = ~249 square feet of aerial space.
 - This does NOT include natural perching installed throughout.



Creative Perching Makes All the Difference

Jonathan E Silsby¹, Jill Werner², Peggy Wu² & Cathleen R Cox²

¹ Enrichment and ² Research Divisions
Los Angeles Zoo and Botanical Gardens



Introduction/Background

As we are all too aware, zoo habitats show progressive wear and tear the longer they are inhabited. The free-standing black howler enclosure in our rainforest area had been constructed in 2014. The howlers frequently suspended themselves from the netting that formed the ceiling and sides of their habitat which increasingly required repairs. We aimed to provide more perching that was placed so that it would provide alternative locations for play, locomotion and rest. This was particularly challenging as the netting was hung from supports that were outside the enclosure. We designed our perching to be self-supporting and visitor views would remain unobstructed. To be able to assess the success of our modification we observed the howlers before and after changes were made.



Perching/Platforms in Habitat before Additions

Existing "House" Structure:

Floor 57 sq ft

Upper deck 34 sq ft = ~101 sq ft in total
Molded vines ~ 50 linear ft

Work Done in December 2020

One Month Before: SketchUp, prep and prebuilding

Day 1: Moving Day ~1,400 lbs of lumber, tools and equipment

Day 2: Holes dug and jackhammered

Day 3: Learning curve - 2x Posts and 3x beams

Day 4: 3x Posts and 5x beams

Day 5: 1x Post, 3x beams & pentagon (5x beams)

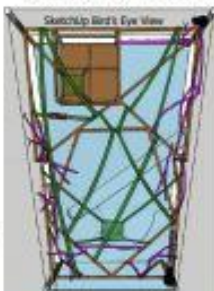
Grounds Maintenance hauled in ~750 lbs gravel

Day 6: 5x Perching, ~60 ft of firehose, 2x hammocks, 8x devices; safety check, clean and remove gear

Weekend Observations: Identified 5 areas of concern!

Day 7: 10x Perching & ~60 ft of firehose

Day 8: 2x Starboard platforms & 2x perching; safety check, clean and remove gear - done!!



Linear and Square Feet Added

2x Hammocks add 18 sq ft

2x Starboard Platforms add 6 sq ft

120 Linear ft firehose add ~62 sq ft

296 Linear ft of Lodgepole horizontals add ~62 sq ft

In total of ~148 sq ft added which more than doubles prior aerial space

Note: This does NOT include local deadfall installed throughout the habitat



Behavioral Observations

Scanning at one-minute intervals using our "Zoo-Wide" protocol (Cox et al., 2017) we documented activity, location and supports utilized by the 2.2 black howlers, *Alouatta palliata*, residing in the habitat. Our pre-modification observations were done in November and early December when the Zoo was open to visitors. In the midst of the renovation the Covid-19 pandemic intensified, and the Zoo was closed to visitors until mid-February. The closure impacted our study in that the initial post-renovation observations had to be done without visitors present. As the presence of visitors can impact animals, we extended the study onto the zoo re-opened. Each observation was of 30-minute duration; morning and afternoon data collection was counter-balanced. In total 74 hours of observation were completed; 23.5 hours pre-renovation, 24.5 hours following renovation but without visitors present, and 26 hours once the Zoo re-opened.

Data Analysis

Multilevel mixed-effects negative binomial regressions for 4 variables, proportion of time spent on new perching, proportion of time suspended from enclosure netting, proportion of time spent in exploration and play (social and non-social), and proportion of time in self-directed activity, were done using Stata, version 17. Because multiple tests were run $p < .01$ was used to determine if results were statistically significant.

Results/Use of Supports

Preference for the new perching was immediately apparent and significant. This preference is persistent and continues now that visitors are present. Use of the netting also declined significantly. Pedro, the youngest howler, had been spending 22% of his time on the netting prior to renovation. In recent months he has been spending just 4% of his time there.

Results/Activity

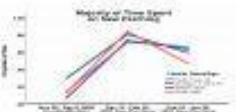
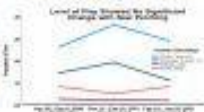
Prior to modification solo exploration/play together with social play was the single activity in which the younger howlers spent the most time and this has not significantly changed. Encouraging is the significant decrease in the amount of time the howlers spent in self-grooming and/or scratching. Self-directed activities are thought to be a reflection of discomfort or stress (Mason/iperi et al., 1992) and their reduction provides encouraging support for the success of the habitat modification.

Conclusion

The modifications made were successful in both reducing the time the howlers spend on the netting and in increasing their comfort. Our work has increased the safety of the monkeys and will increase the longevity of the habitat.

References

Cox, C. B. and Yukunthij, R. 2017. Zoo-wide comparative studies: a widely applicable protocol used to assess effects of zoo surroundings. Poster presentation at annual meeting of International Society of Comparative Psychology, Los Angeles.
Mason/iperi D., Schao G., Auréli F., Trois A. 1992. A modest proposal: displacement activities as an indicator of emotions in primates. *Anim. Behav.* 44, 967-979.



Acknowledgements

Many individuals contributed to the success of the rean project. The support of those listed here is much appreciated. Denise Werner, Beth Schaefer, Candace Silment, Dorothy Belanger, Danica Cremona, Sandy Skoew, Rosane Lorenz, Francisco Moran, Val Kervens, Debbie Salzman, Sara Demme, Kevin Gorowski, Monica Richmond, Greg Robbri, Molly Spriggs, Jackie Johannes, Mike Campos, Kait Smith, Geoff Fischer, Cesar Hercules, Major Williams, Noel Diazal, Angela Glass, Will Martinez, and Ruby Catalano.

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MANDRILL

March 2021 - Exhibit Remodel

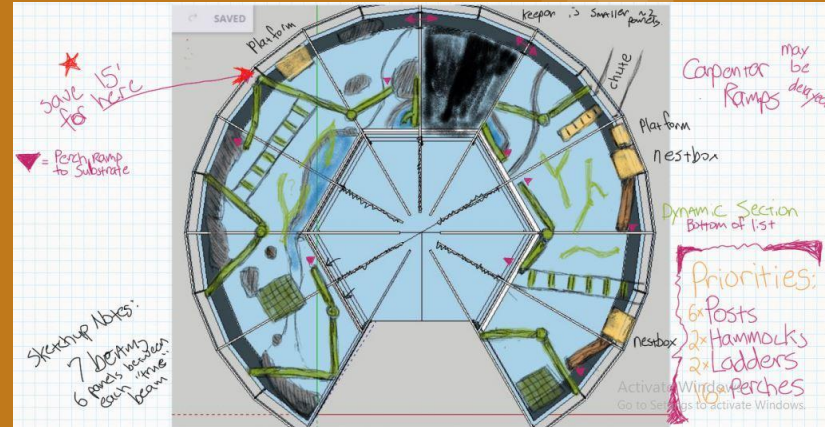
- **Prep Time:** Twenty Eight Days
- **Install Time:** Five Days
- **Resident Concerns:** Areas for juveniles and female, separate from male (mainly terrestrial).

Breakdown:

- 5x Posts (should get more)
- 12x Horizontal Perching
- 4x Dynamic Perching
- 2x Suspension Ladders
- 2x Firehose Hammocks
- Chimes (noise makers)
- Woven Firehose
- Foraging Logs and Slices
- Boomer Ball
- Browse/Hay Bag

Longevity Estimate:

- Posts: 5-10 years
- Horizontals: 3-5 years
- Note: Rotten Firehose was discovered and corrected
 - Construction may need to be upgraded to what's in Rainforest Howler.



Current Exhibit, Small Side (by panel section)

New  Resecured 
Moved  Removed 

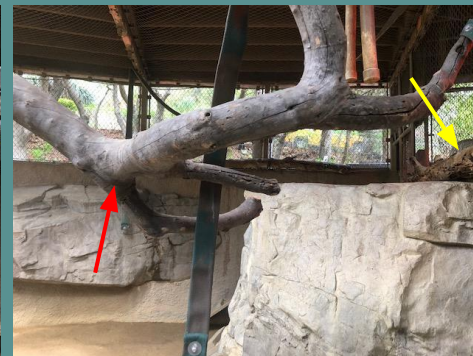


Not visible is a forward Lodgepole Post with two ramps.

Current Exhibit, Large Side: March 3rd - 4th, 2021

Patron Right

New  Resecured 
Moved  Removed 



Large rotten perch removed.

Not visible is a forward Lodgepole Post.



V.3 Suspension
Ladder



PVC
Chimes



Log Swing



4/19/2022 Hammock: 4'x5', tight
weave, testing hanging with 8 arms
(octuple), positioning and tightening
was easier.



Sling with
Dangles



Dynamic Perch

CURRENT EXHIBIT ITEMS:



Firehose Lanyard: Male enjoys Kong Toys, this is similar in function.



Foraging Logs with indent holes, some have pvc through sleeves.



Boomer Ball w/ Holes next to a self-made foraging pit filled with wood chips.

They will also move rocks around for foraging.
The Male is able to move the larger ones. (weight?)

Chainsaw Chips where left behind from cutting old stumps.
Encouraged foraging behavior,
Fresh & fragrant contributed?



Browse Bag



Made without bar, given loose.

Patron Right has a Double Brush Board, ~3 ft long.
Get info if they are using this.

MANGABEY

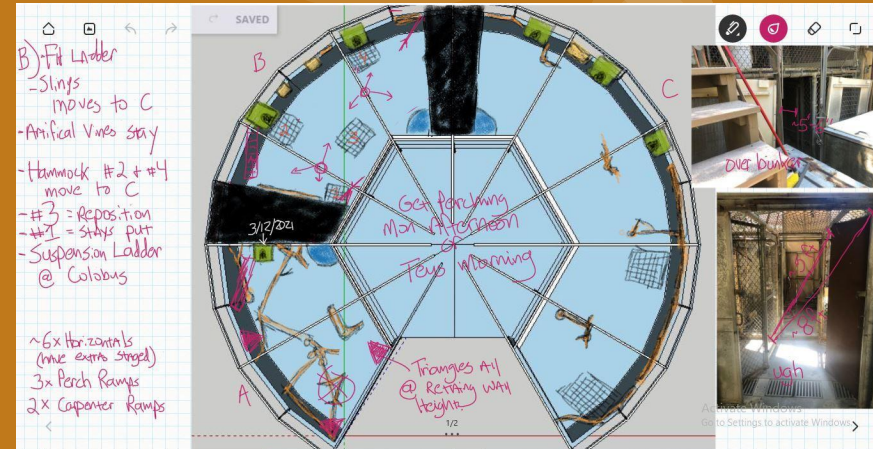
March 2021 - Exhibit Remodel

- **Prep Time:** Two Weeks
- **Install Time:** One Week
- **Resident Concerns:** Medical and Husbandry stations.
Female with Spondylosis.

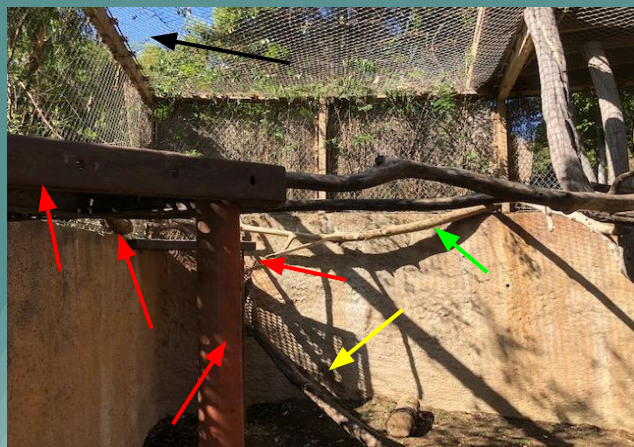


Breakdown:

- 3x Playground Triangles (recycled) with Support Posts
 - One was positioned for medical injections.
- 2x Posts
- 12x Horizontal Perching
- 3x Ramps (carpenter)
- 2x Natural Ramps
- 3x Dynamic Perch
- Firehose Tightrope for Nestbox
- Firehose Slings
- Firehose Hammock



Patron Left
Exhibit "C".

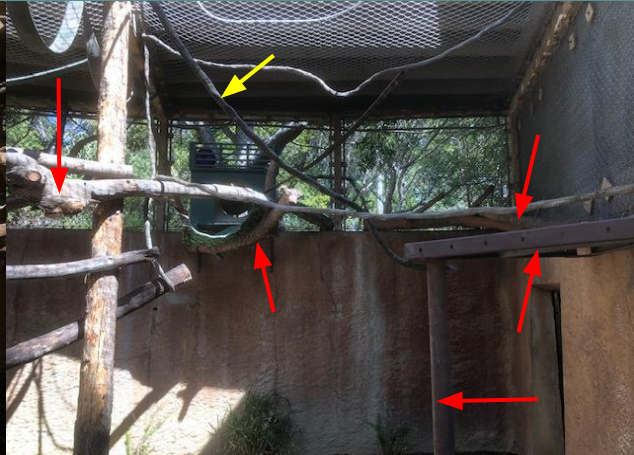




Patron Center
Exhibit "B".



Note: Plants went in
the following week.



Spondylosis Field Test (7/6/2022)

Mangabey, Female has Spondylosis: Age-related type of Arthritis of the spine.

Field Testing types of Physical Therapy:

- a) 10" x 3' long PVC Tube: Intended for the female to lay on belly and stretch for food placed in the back.
- b) 2' tall vertical posts in Perching: Intended for the female to "snake" around for a side-to-side motion.
 - i) Current distance is 3' apart. May continue this on all horizontal perching.
- c) PVC Devices are placed high enough for the female to reach up and stretch (not pictured).

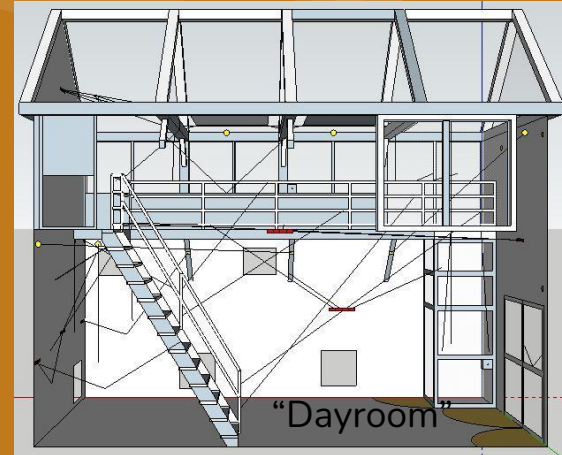


ORANGUTANS

2022



Main Exhibit.
Following Slides are the
off-exhibit Dayroom.





Linear Feet of Firehose Installed =
~600 of primarily 7"
wide, ~40 pieces.
(Does not include old FH
or what's used in the
Hammocks.)

**Amount of Arboreal
Square Feet Gained**
= ~385
(Firehose ~300 +
Hammocks ~85)

Interesting Note:
In my calculations I
found that roughly ~80
feet of FH is just in the
end folding and
connection points.

New





All Brown Firehose is old and did not need to be removed. Along with the ½ Boomer Hammocks.

New ↑





Catwalk Views:
Green Firehose
is new along
with the
hammocks.

Brown is old as
well as the 1/2
Boomer
Hammocks.

Experiment:
New All Rubber
High Capacity
Firehose.



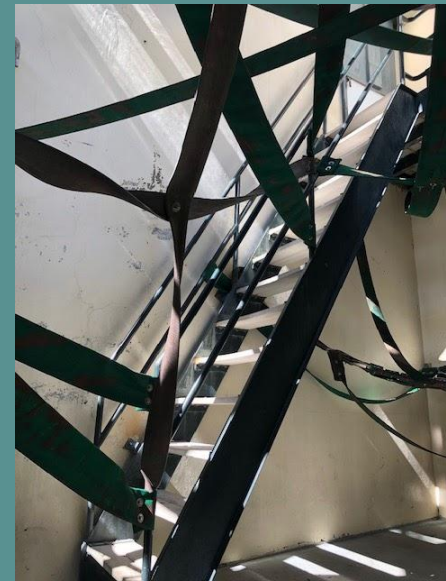


Double Firehose "Tightrope" with above head Guideline.

* Sling perpendicular to window.



Eloise is partially paralyzed from the waist down with limited grip in her lower extremities.



The entire Dayroom was designed with a density of Firehouse. Not only to allow Eloise with multiple options to get around, but also for young infants.



1/2 Boomer Ball



Triangle Hammock: 5'x5'x7'



Firehose Spiderweb



Firehose Hammock: 5'x6'



Bamboo Shakers



Water Filling Experiment Device



Altered Rodent Hide



Foraging Box

DEVICES: HORIZONTAL VARIATIONS
(8 of 22 made from ~126 Possible Designs)



Trough: Base Design



Trough with Bolts



Trough with Bolts
(smaller opening)



Trough with Cleanout
(inserts inside)



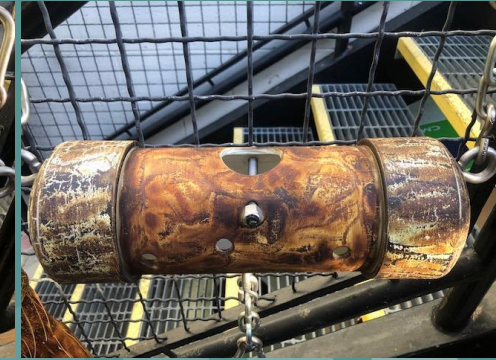
Trough with Sleeve and
Bolts



Double Holes with Tool
Holes



Double Holes with Insert



Single Hole, Bolt and
Tool Holes

DEVICES: VERTICAL VARIATIONS

(1-6: No two are alike | ~192 Possible Designs)



Base Design: Adding Bolt then Anti-Tip.

Base Design with Sleeve: Adding Bolt then Anti-Tip.



PVC Pods: Resident uncrews cleanout. Note: Use in Bedrooms.

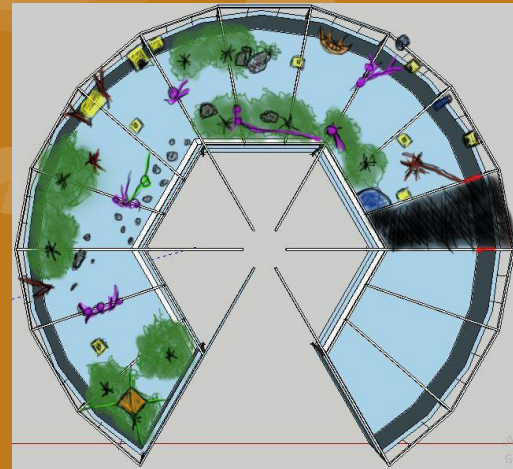


Boomer Ball
with Holes and
Insert

SIFAKA



Browse Holder: Burnt PVC, sealed with Shellac, to blend into surroundings, ease of use and cleaning.





Vertical Perching “Clusters” placed from 5 ft to 15 ft apart.
Goal: More Leaping opportunities and locations.
The height of the exhibit may be hindering a leap distance greater than 8-10 ft.

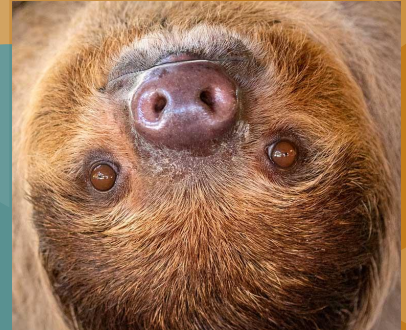


Fabric Hammock



Vertical Perching using custom built ceiling brackets. Easier to install and replace.

TWO-TOED SLOTH & TAMANDUA



Goal: Free-Standing (no wall connections), circular design.

Challenge: High humidity and sprinkler system have created areas of rot. Replaced the trouble spots with Manzanita.

Movable corner units (see next slide): Nestable, also used for Keeper Talks, events and when the Sloth is able to go outside.



Firehose Hammock: 1'x2'



Double Small Black Tubs:
For easy cleaning and
changing.

Nesting Modular Furniture Perching.



UAKARI MONKEY

Challenge:

- All mesh exhibit = Nothing to attach perching to.
- Front section, bolted posts to retaining wall.
- To make installation more efficient, designed and fabricated custom brackets.
- Horizontal perching to stabilize the structure.

This was also a proof of concept for the Howler Exhibit, which has the same challenge.



Looking downhill

Other than the planted tree (center of each photo) all perching, deadfall, furnishings and devices were installed by Enrichment.



Looking uphill

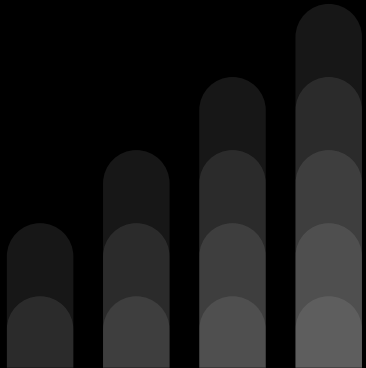
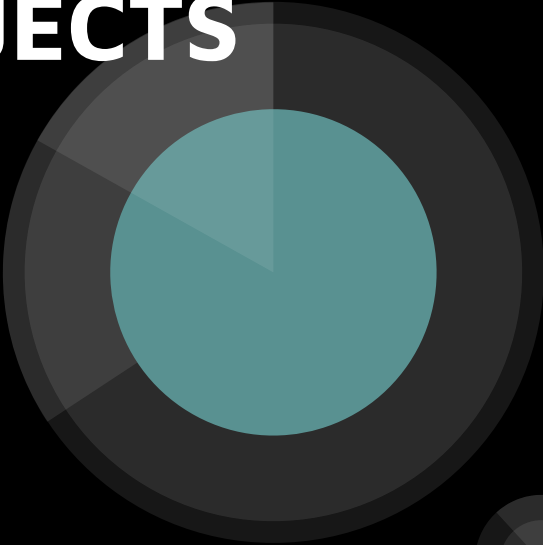
Furnishings & Devices



Ladder: Firehose & Pine
Hammock: Fabric
Platform: Starboard
PVC: Stacking Caps, Cap
Cup, Browse Holder, Trough
Feeder



OTHER PROJECTS

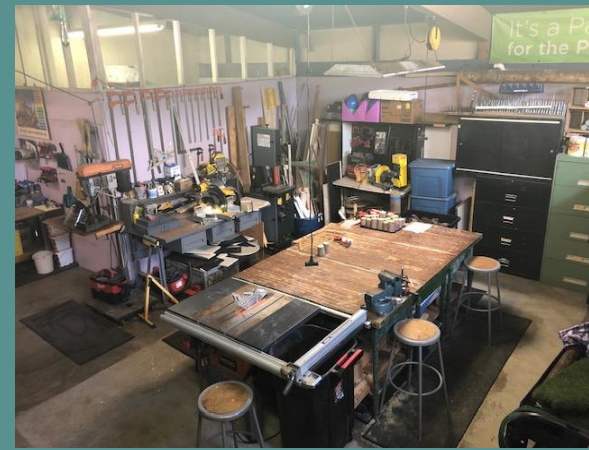




Outside Patio, Receiving/Recycling



Welding Patio, Gardening Supplies



Main Workshop



WORKSHOP

Display Shelves, pre-made examples



Tool Room

Storage Room



Tool Room, Hardware

Scents



PVC Supplies

Novelty Food Storage





Elephant “Blind” Foraging Boxes:

- ¾” Starboard.
- Reinforced edges.
- Mounted inside the Waterfall, each one has a hole which the Elephant trunk can reach through to access the Box.
- Some Boxes have no built in puzzles and utilize hay, foraging material or browse along with diet.
- Others had built in puzzles.
- Two Clear Foraging Boxes were also made for the public viewing area, so that they can see the Proboscis in use.
- Some Boxes were designed with a side opening due to install and Keeper height.



Brush Holder: Primarily designed for **Takin**. The amount of brushes that they went through during molt required an easier solution for replacing quickly and frequently.

(Takin version has a bar and lock system.)



Various PVC Device Designs



Rotation dispenses Food/Pellets.

PVC Shakers



Spinning Feeder



Prototype Trough Feeder

Nesting Caps



"Ice" Cooling PVC

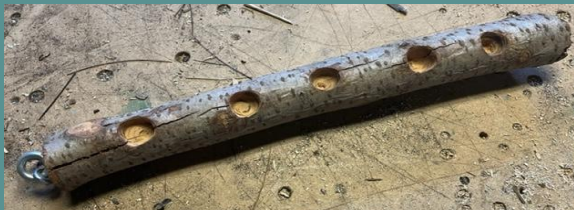


Suspended Device / Perch



Woven Natural Material

Gum Arabic Stuff-It Stick





Upcycling Sparkletts Bottles: Horizontal, Vertical or changeable between the two directions.





Frog Platforms: Holes hold a specific leaf for egg laying.



Snake Board for Education

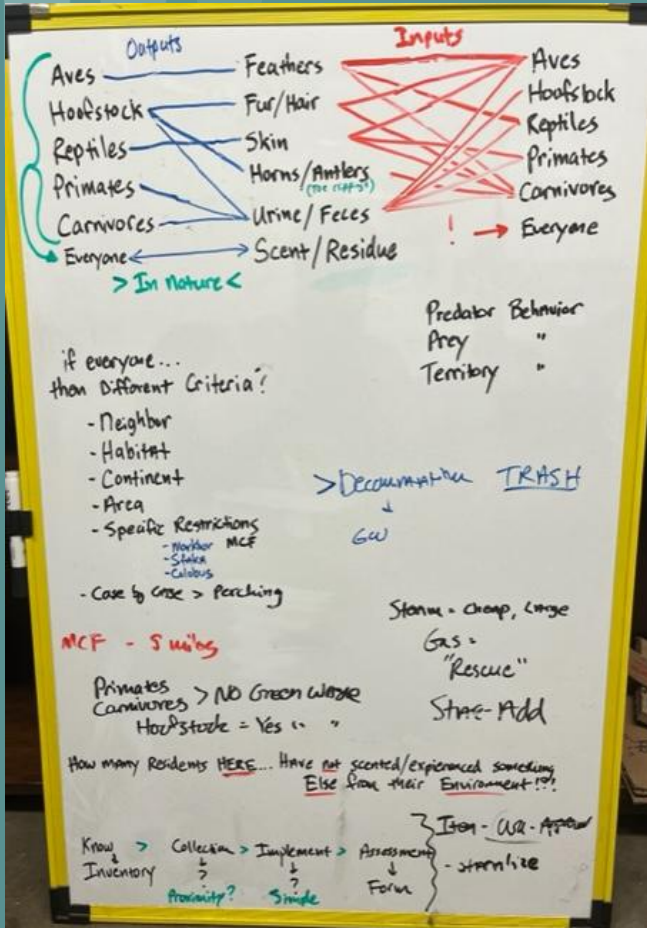


"Round" Ladder for Capuchins



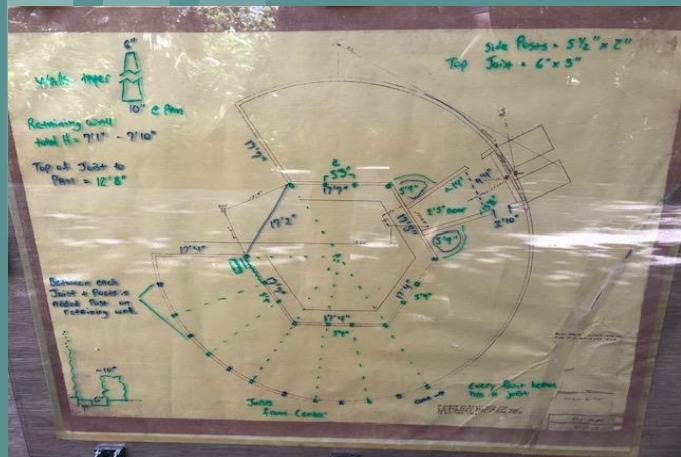
Summer Camp Device Ideas

Draft: Cross-Species-Sharing

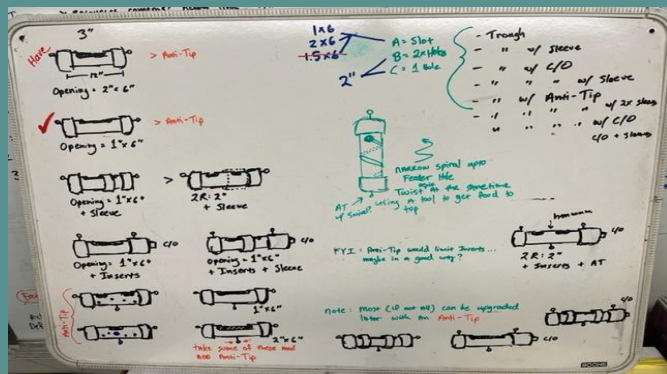


Personal Art Development/Design Department

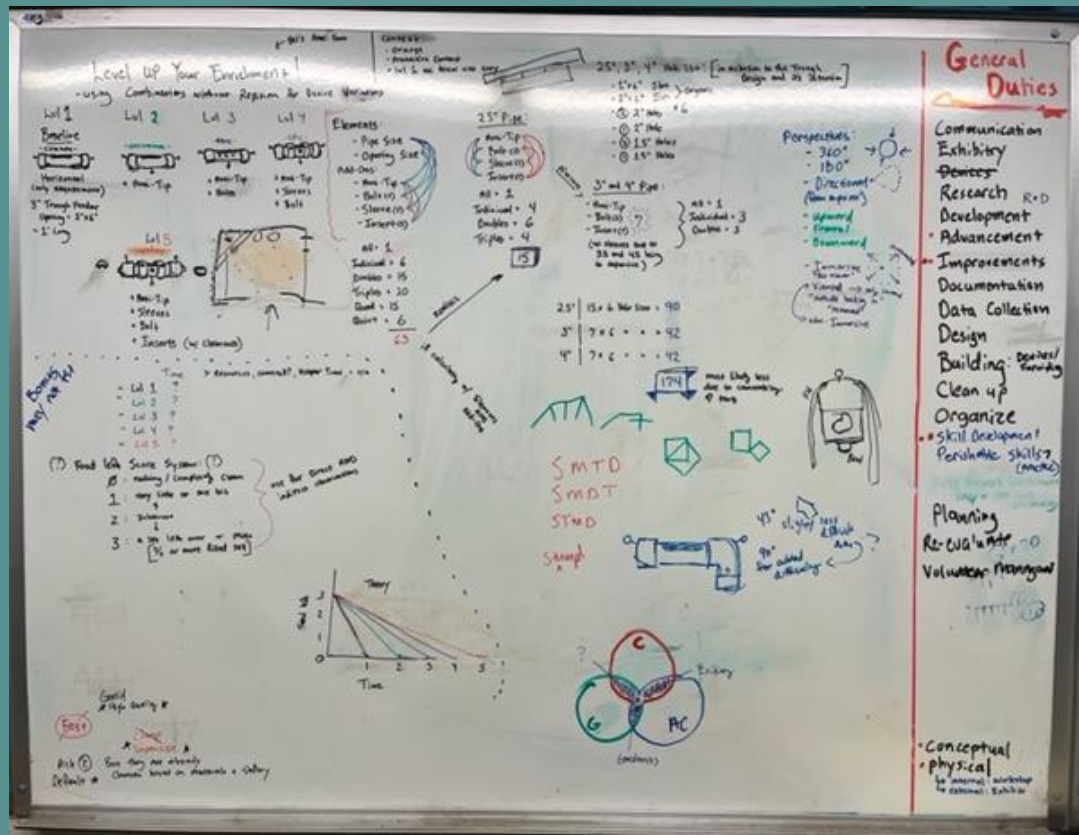




Blueprint Holder for Onsite Measuring.



First Draft: Leveling Up Enrichment



5 Levels to Device Complexity and other ideas/notes.

General Duties

- Communication
- Exhibitory
- Demos
- Research R+D
- Development
- Advancement
- Improvements
- Documentation
- Data Collection
- Design
- Building: research/learning
- Clean up
- Organize
- skill development
- Personal skills (practice)

- Planning
- Re-cultivate
- Volunteer Management

- Conceptual
- physical
- to internal workshop
- to external exhibit

Construction

Shiny Star

Deadly Kefaly

Pending Life Cycle

STEAM



Animal Care

5 Feedback Share Data Dinner

13/17 = 76.5%

Injury



Carpenter



Research

History "Lighthouse" Technology Database

SPIDER



Colobus

RF Monitor

Fix Monitor Monitor

Monitor system

Playback

Sticks

Education



AIA

Palaces

Financial Realities

Calendar

Cake Sheet

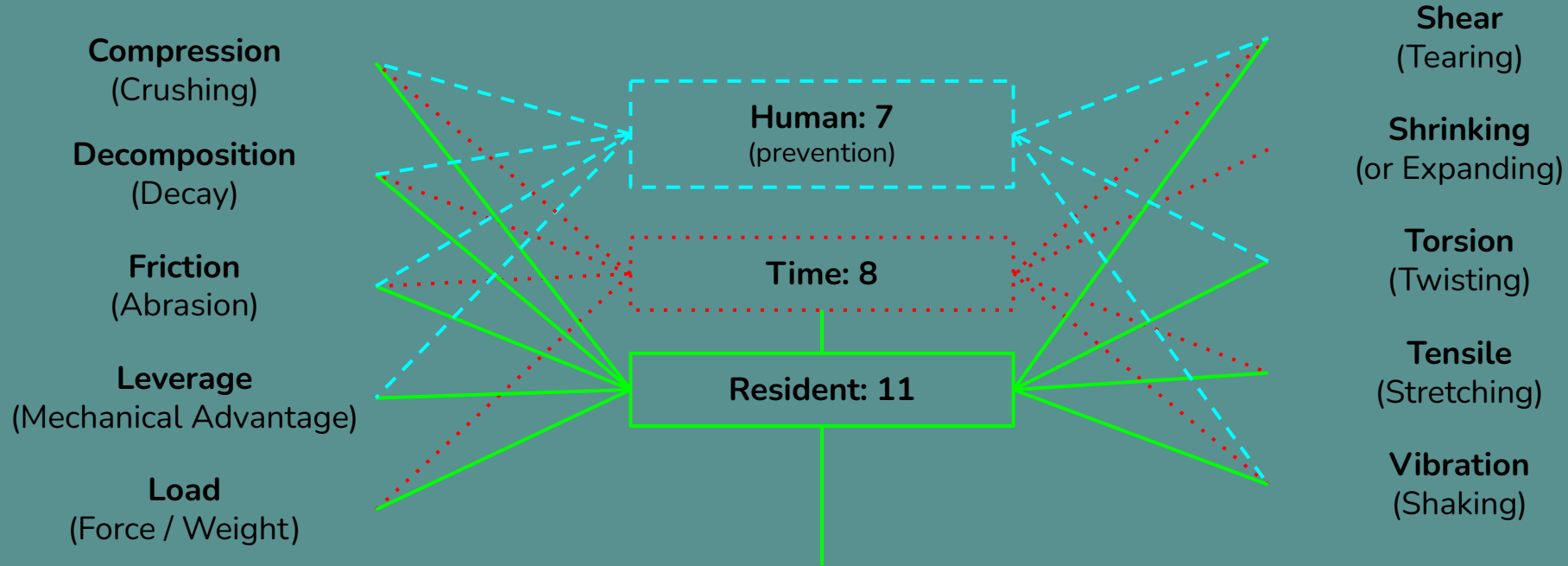
Assessment

Draft for C.A.R.E.

- Construction
- Animal Care
- Research
- Education

11 Forces Exerted on Your Exhibit

- Human vs Time vs Resident -



Activity Level

- Demeanor
- Age
- Group Size

Baseline for Stainless Steel Hardware (Engineering)

Weight of Resident x2

- < 41
- 42 - 63
- 64 - 79
- 80 - 109

Gauge

#6
#8
#10
#12

Weight of Resident x2

- 110 - 143
- 144 - 349
- 350 - 639
- 640 - 1,503
- 1,504 - 2,727

Gauge

1/4"
3/8"
1/2"
3/4"
1"

Notes

Breaks at 20 lbs of Torque
Breaks at 40 lbs of Torque
Optional: Welded. Unable to break with Torque by hand
Recommended: Welded
Recommended: Oxy-acetylene & Welded

Computed by finding the minimum yield and tensile strength:

Yield Strength (ksi) x Tensile Strength (ksi) x Stress Area (sq in) of the Product Size Diameter (in).

*PDF "Stainless Steel Fasteners", The Specialty Steel Industry of North America (SSINA)

Application, Material, Design and Function will also determine your Hardware size.

Above, based on weight is considered your "minimum".

Note that the Math suggests using 1/2" for Orangutans and Gorillas. However, we have long lasting successful installs using 3/8". Theory: Actively Level is considered low.

Deflection

Calculated by using the Website: [Engineering.com](https://www.engineering.com)

- Insert double the weight of the heaviest individual.
- Insert a Diameter of a Perch (I start at 3”).
- Change the Length of the Perch until you have a Deflection of ~0.5”.
- Continue to change the Diameter and Length, record each set of numbers.

1. Perching: (HD = Horizontal Deflection)
 - a. Use Working Load (double wgt) for all calculations.
 - b. Threshold: $HD = <0.5''$
 - c. Activity Level & Group Size: May change your distances when installing Perching. I.e. the “X” inch diameter perch may reach further than listed or shorter, depending.
 - i. 3 in Dia x ? ft (HD = 0.?)
 - ii. 4 in Dia x ? ft (HD = 0.?)
 - iii. 5 in Dia x ? ft (HD = 0.?)
 - iv. 6 in Dia x ? ft (HD = 0.?)