Aye-Aye Lemur Enrichment Feeding Device

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Design Challenge

- Create a novel enrichment feeding device to be used for aye-aye lemurs housed at the Duke Lemur Center
- Device should:
  - Promote foraging behavior
  - Extend feeding time
  - Encourage chewing and foraging
  - Require aye-ayes to problem solve

Figure 1. *Aye-aye enclosure at the Duke Lemur Center*

Figure 2. *Aye-aye Lemur (Daubentonia madagascariensis)*

Background

Foraging Behavior:

- Aye-ayes utilize an acoustic feedback system by tapping on wood surfaces to listen for cavities in trees that house potential prey
- Aye-ayes break through natural material by gnawing, then retrieve prey using their long, thin fingers

Role of Enrichment:

- Animals in captivity must adhere to U.S. Dept. of Agriculture regulations: Primates must be provided enrichment for psychological wellbeing
- Stimulation prevents development of stereotypies (repetitive, abnormal behaviors), depression, lack of appetite, etc.

Current Solution:

- Simple wooden and metal boxes covered with plywood or closed off with corks
- Limitation: Short feeding time and little variability

Design Criteria

Table 1. *Design criteria*

Design Criteria	Target Value
Cost	<$300
Enrichment Level	Minimum of 2 hours of foraging enrichment per day
Weight	<10 Pounds (for ease of transport and mounting)
Replicability	Average Rating: >3 on user defined scale — Reproducible using store-bought pieces
Setup Time	<15 Minutes

Results

Prototype: A system of winding grooves for mobile feeder worms enclosed in a metal box with a plywood cover.

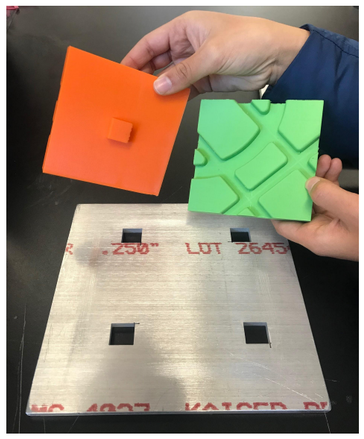

Figure 3. *Peg & plate system*

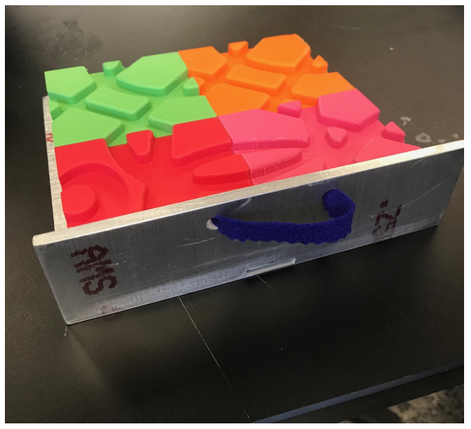

Figure 4. *Sliding tray with plate models*

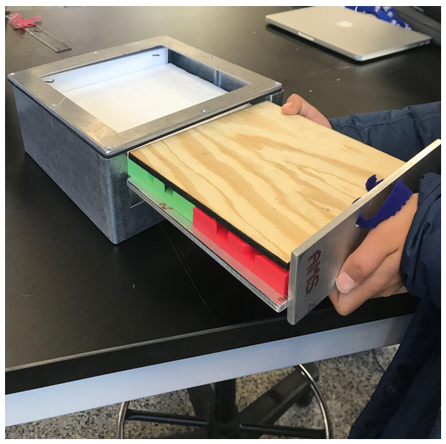

Figure 5. *Assembly process*

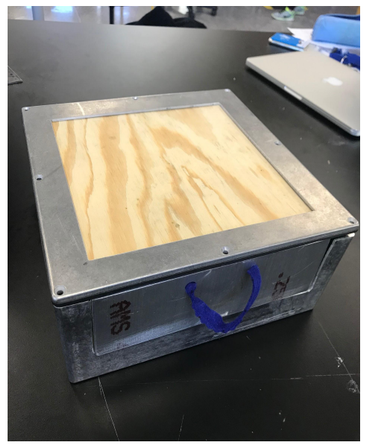

Figure 6. *Assembled device*

Components:

- **Outer case (Fig. 5, 6):**
  - Aluminum box with an open top and front that accommodates **plates**, **tray**, and **plywood cover**
  - Aye-ayes access the device through the top
  - Front opening is closed by a secured latch for safety purposes
- **Grooved plates (Fig. 3, 4, 7) :**
  - Four aluminum plates with maze-like cavities for mealworms that connect on all sides; shape allows aye-ayes to optimize their method of foraging
  - Enables rotation and repositioning for 1000+ possible configurations
- **Sliding tray (Fig. 5, 8):**
  - Grooved plates insert in a thin aluminum plate with square pegs
  - Tray with plates slides into outer case as a single unit to promote ease of assembly and sanitation
- **Plywood cover (Fig. 5, 6):**
  - A sized plywood sheet serves as the natural material the aye-ayes gnaw through
  - Placed on top of grooved plates
- **Mount:**
  - Compatible with infrastructure at the Duke Lemur Center
  - Mounting component will securely attach to a pole to prevent the box from tilting or falling on animals.

Results Cont.

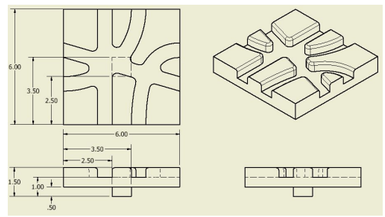

Figure 7. *Sample plate drawing*

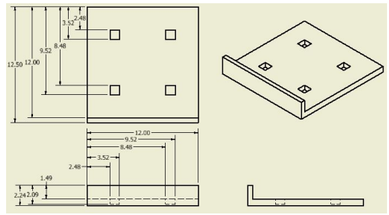

Figure 8. *Bottom tray drawing*

Testing / Assessment

Table 2. *Testing*

Criteria Tested	Test / Method	Result
Cost	Estimate of the sum of material costs and manufacturing costs (estimate)	$95.38
Enrichment Level	Estimated $Time_{Total}$ = $[n_{Holes}*(Time/Hole)]+[n_{Worms}*(Time/Worm)]$	~2.5 hours
Weight	Mean of five measurements with scale	~8 lbs.
Replicability	User defined scale to assess materials	2 of 5
Setup Time	Timed trials setting up the device to completion	8 min*

*Does not take into account locking mechanism

Conclusion

Summary:

- Created an enrichment feeder for aye-ayes in the Duke Lemur Center that is **cheaper** and **more stimulating** than the current device.
- Our design solution is a **rearrangeable metal puzzle feeder** that has a system of tunnels that can be rearranged, creating variability and increasing enrichment.

Future Work:

- Use more durable materials for the device
- Streamline production of more devices
- Shrink box enclosure to cut down on unused space, reducing material, weight, and cost
- Install and test device in the aye-aye enclosure at the Duke Lemur Center

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