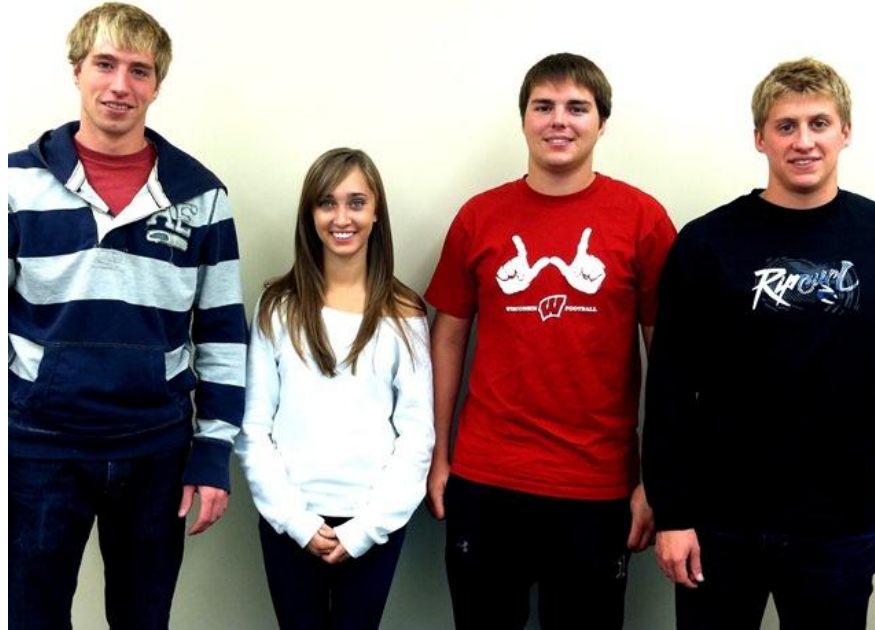


Rat Phantom



Team Members:

Pictured left to right

Darren Klaty

Chelsea Bledsoe

Charlie Rodenkirch

Alex Broderick

Client:

Surendra Prajapati

(Graduate Student)

Thomas “Rock” Mackie

(Director of Medical Devices, WID)



Presentation Overview

- Problem Statement
- Phantom Background
- Design Specifications
- Design Alternatives
 - Design Matrix
 - Final Design
 - Future Work



Problem Statement



CT/PET Scanner at WIMR

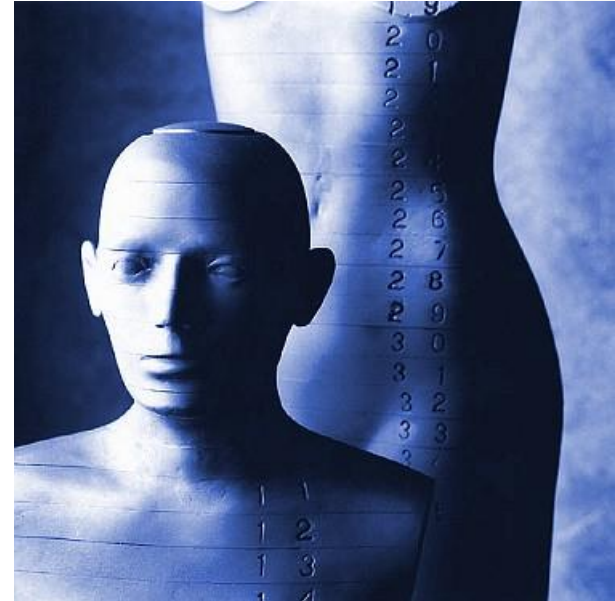
- Rat phantom
- Open source project
 - All information on internet
 - Low-cost, easy to replicate
- Testing of small animal imaging and therapy system
- Combined CT/PET/RT scanner
- Treatment and imaging of rats
- Inserts for radiation detectors and various organs



What are phantoms?

- Uses

- Testing of imaging equipment
- Measuring radiation dosage
- Teaching interventional image guided procedures
- Servicing of equipment



RANDO® Phantoms

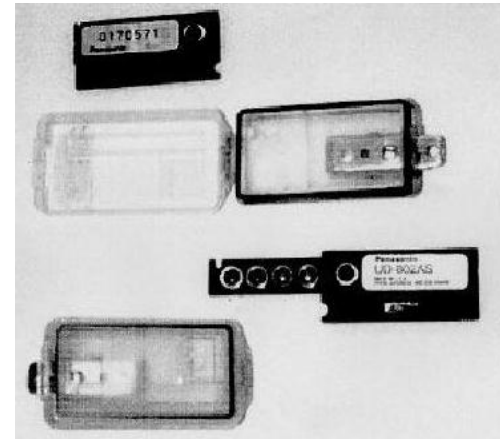
- Specifications

- Various densities for different tissue types
- Solid materials or gels
- Humans, animals, objects



Design Requirements

- Weigh less than 2kg
- 12cm diameter scanner
- Anatomically accurate
- Accurate tissue densities
- Withstand repetitive use
- Indefinite shelf life
- Exposure to radiation without contamination
- 3mm x 3mm x 3mm TLD detector inserts
- Removable slots for organs and tumors



Numerous TLDs
(thermoluminescent
dosimeter)



Additional Specifications

- FDA approval not required
- Open source
- Maintain minimal expenses
- Client flexibility with final design
- Cost-effective compared to competing products



Gammex 464 Phantom
Tests CT Scanners



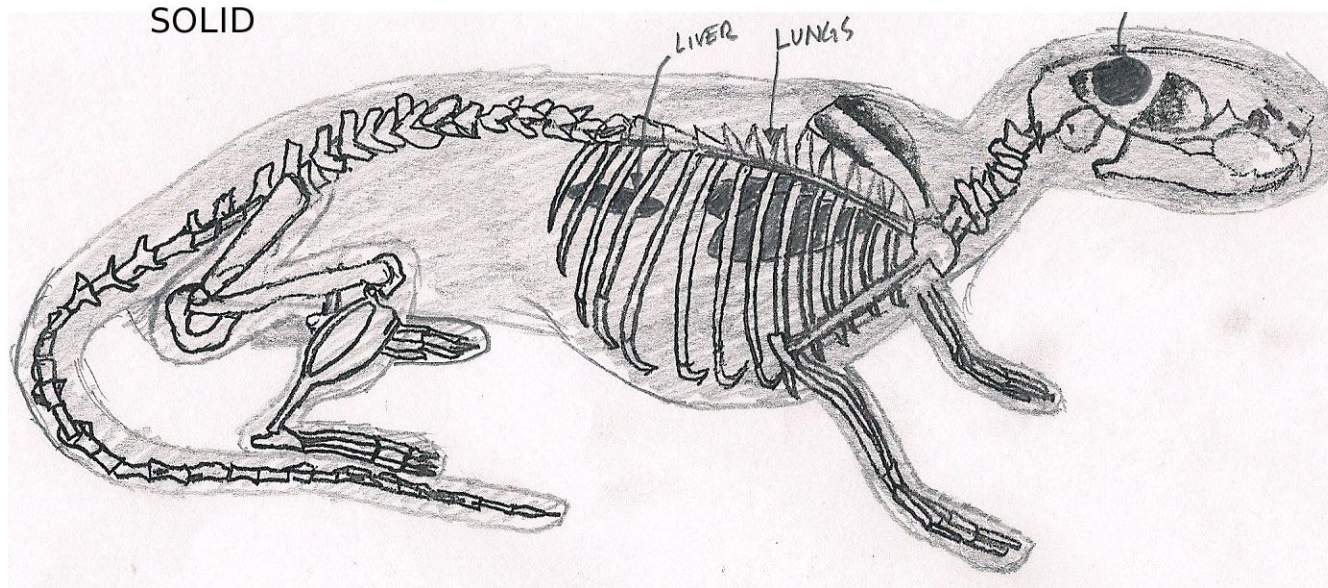
Caliper Mouse
Phantom



JRT Associates
Water-filled Mouse Phantoms



Design Alternatives: Solid Cut



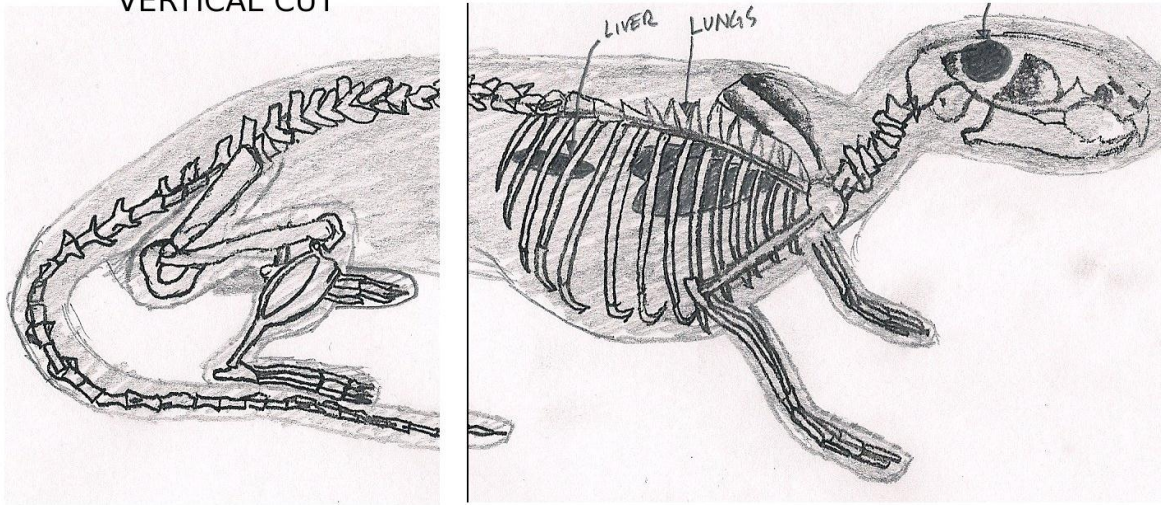
- Completely solid material
- Organs from corresponding Gammex materials
- Muscle from epoxy mix
- TLD slots cut into material after production
- Drop cast around skeleton to form rat body

Disadvantages

- Difficult organ removal
- Inaccessible TLD slots
- Inaccurate density mixing from epoxy

Design Alternatives: Vertical Cut

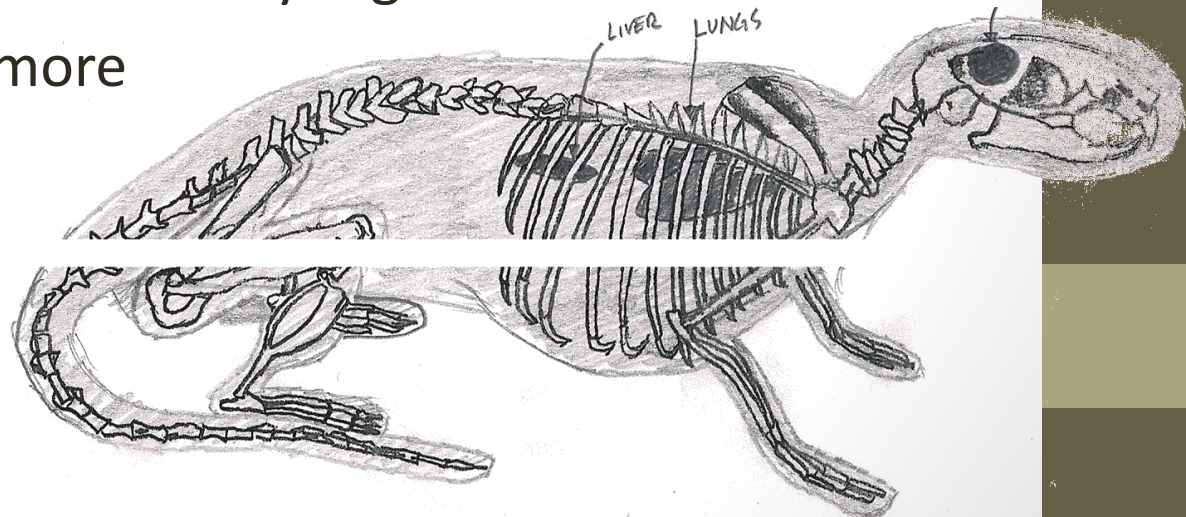
VERTICAL CUT



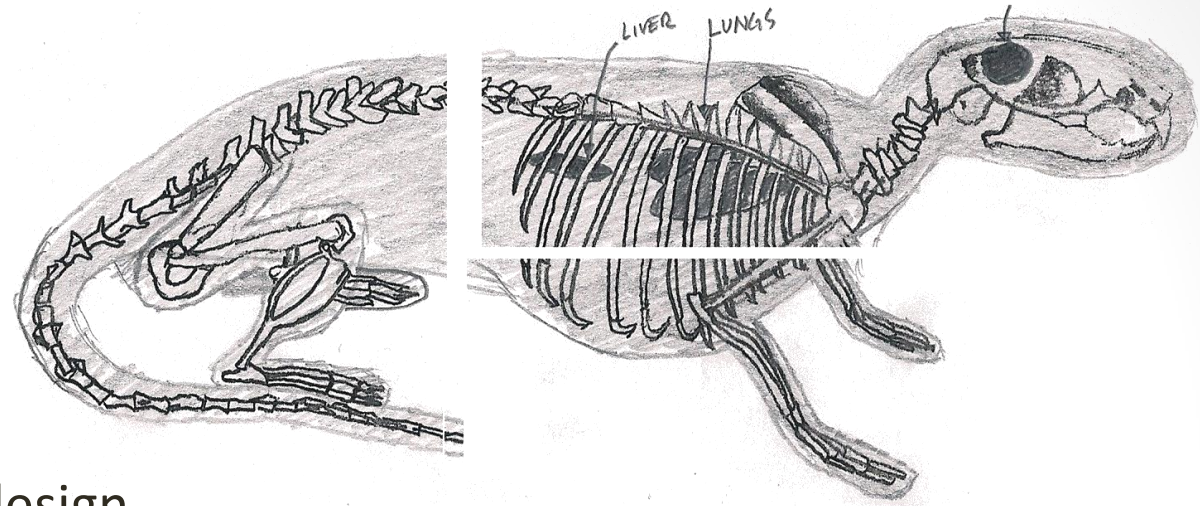
- More flexible design
- Organs made from corresponding Gammex material
- Muscle tissue from ballistic gel mix
 - Ballistics gel imitates animal muscle tissue
- One vertical cut behind ribs
- TLD slots easily cut
- Puzzle piece edging
- **Disadvantage**
 - Gravity will pull sections apart
 - More air gaps = less accurate imaging

Design Alternatives: Horizontal Cut

- More flexible design
- Organs made from corresponding Gammex material
- Muscle tissue from ballistic gel mix
- One horizontal cut down entire extent of body
 - Must cut through numerous bones
- TLD slots easily cut into design
- Gravity will cause sections to stay together
 - Minimal air gaps = more accurate imaging

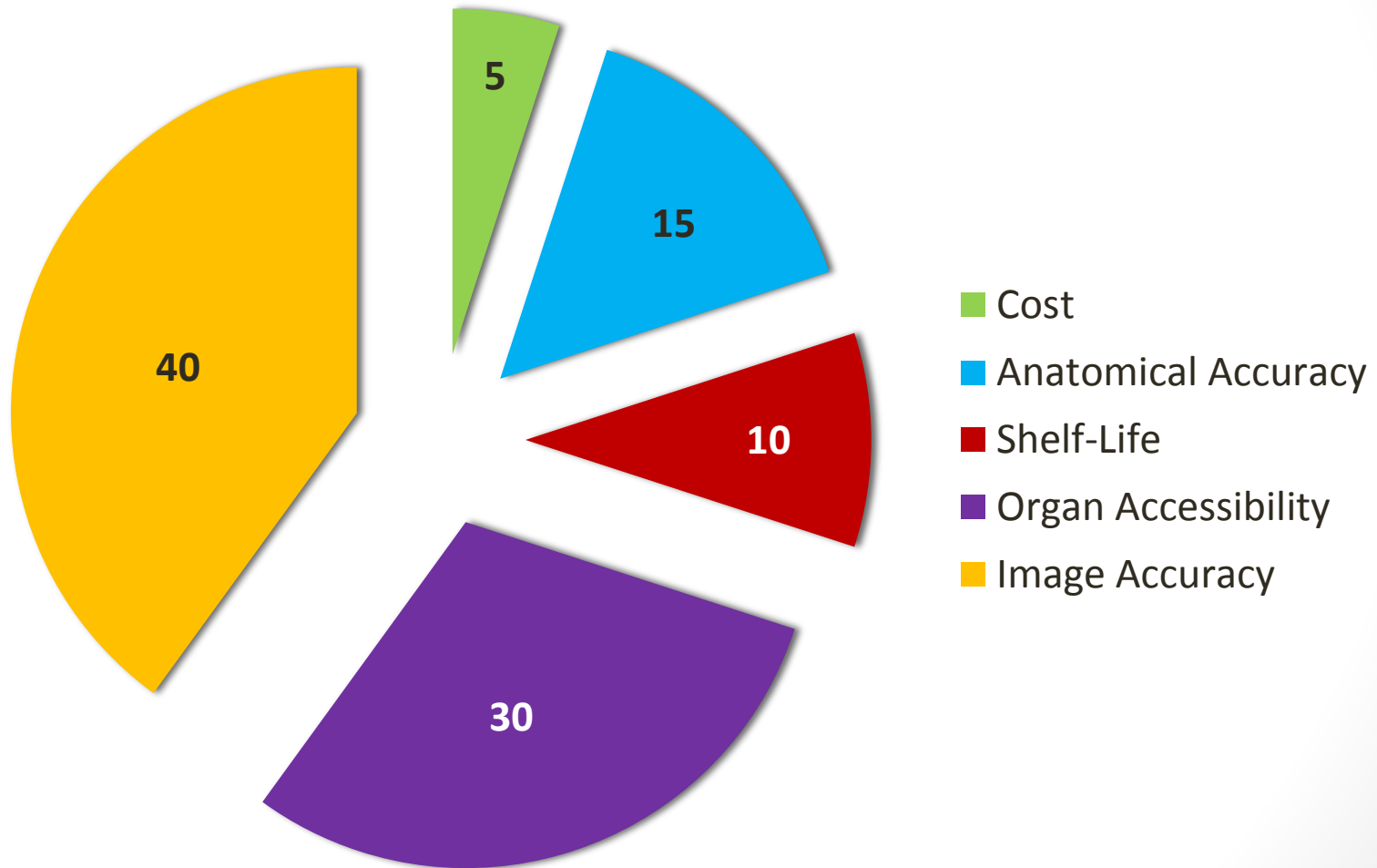


Design Alternatives: Combo of Cuts

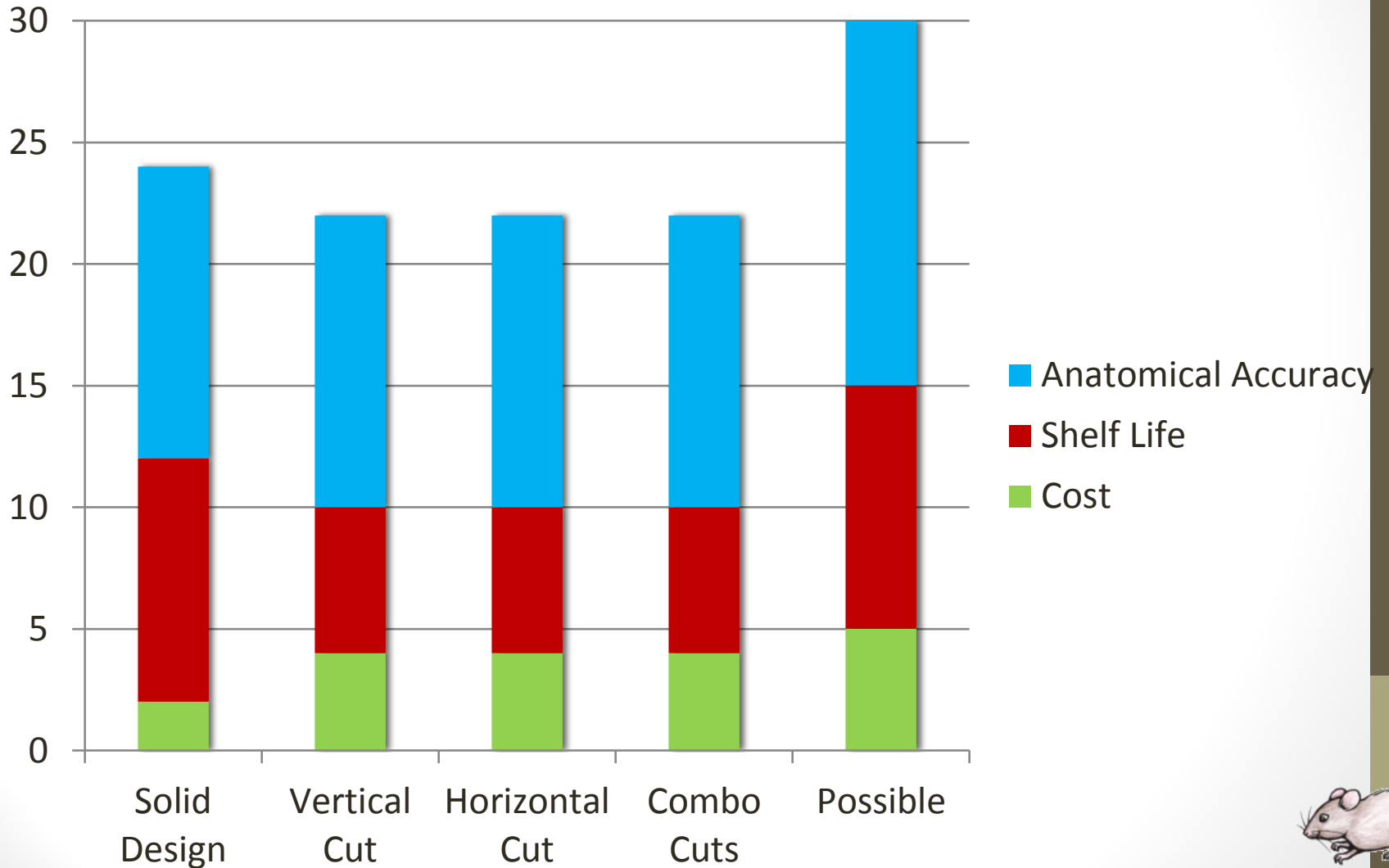


- Very flexible design
- Organs made from corresponding Gammex material
- Muscle tissue from ballistic gel mix
- Two cuts into design
 - One vertical below ribs
 - One horizontal behind ribs
- Gravity will help the pieces stay together on horizontal cut
- Puzzle edging on vertical cut
- Numerous access points for TLD slots and organs

Design Matrix



Anatomical Accuracy, Shelf-Life, & Cost



Organ Accessibility

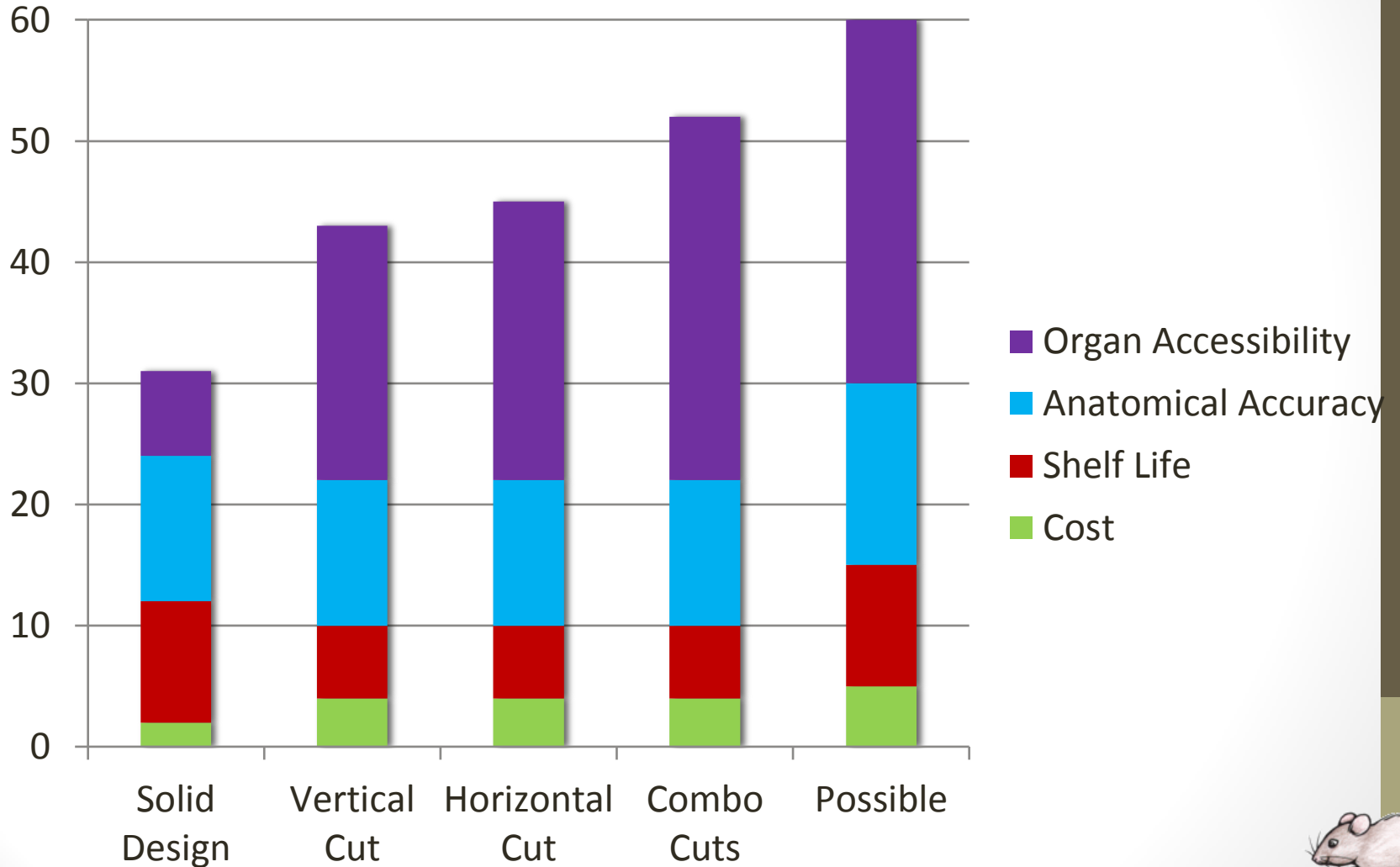
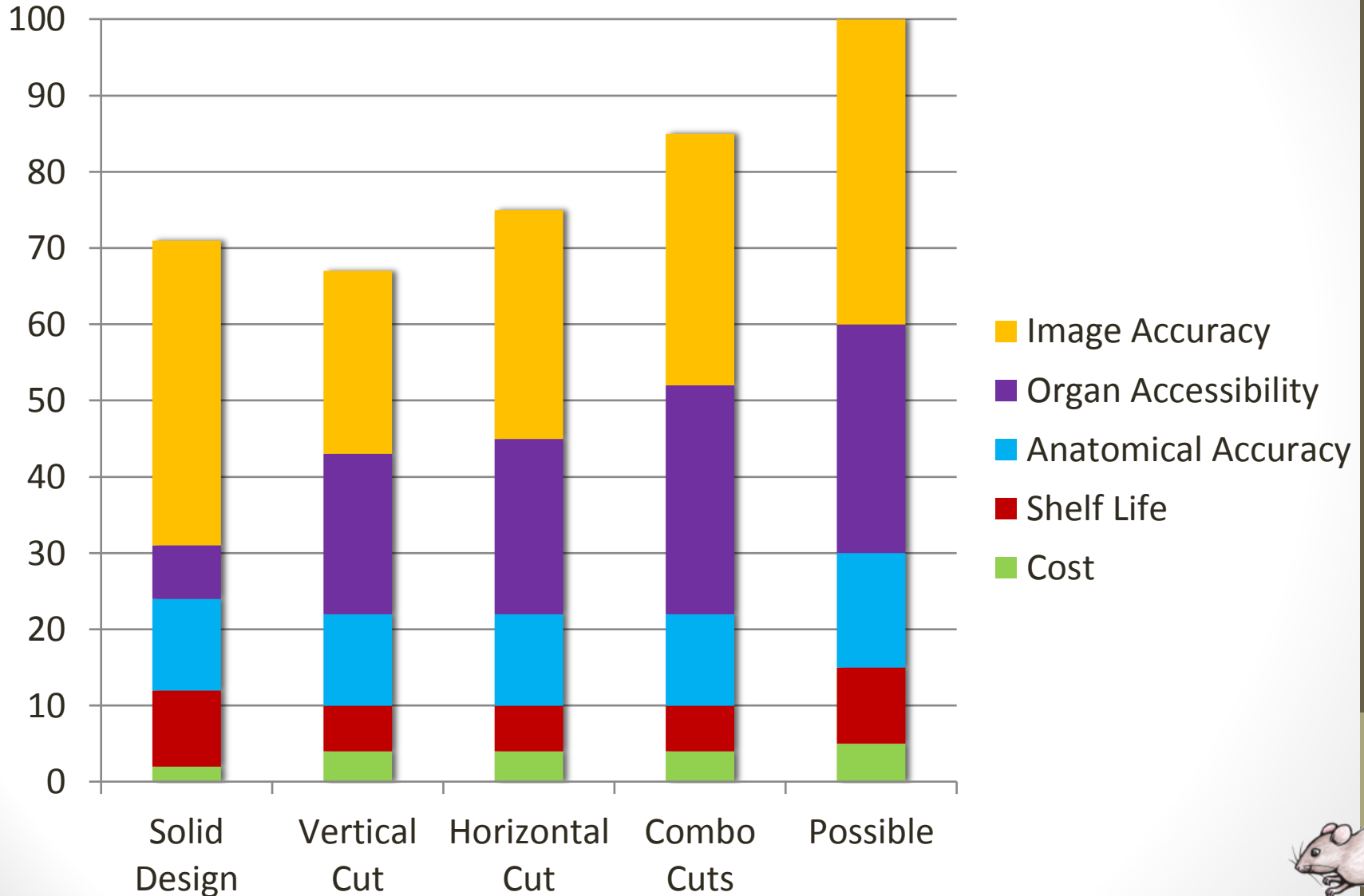
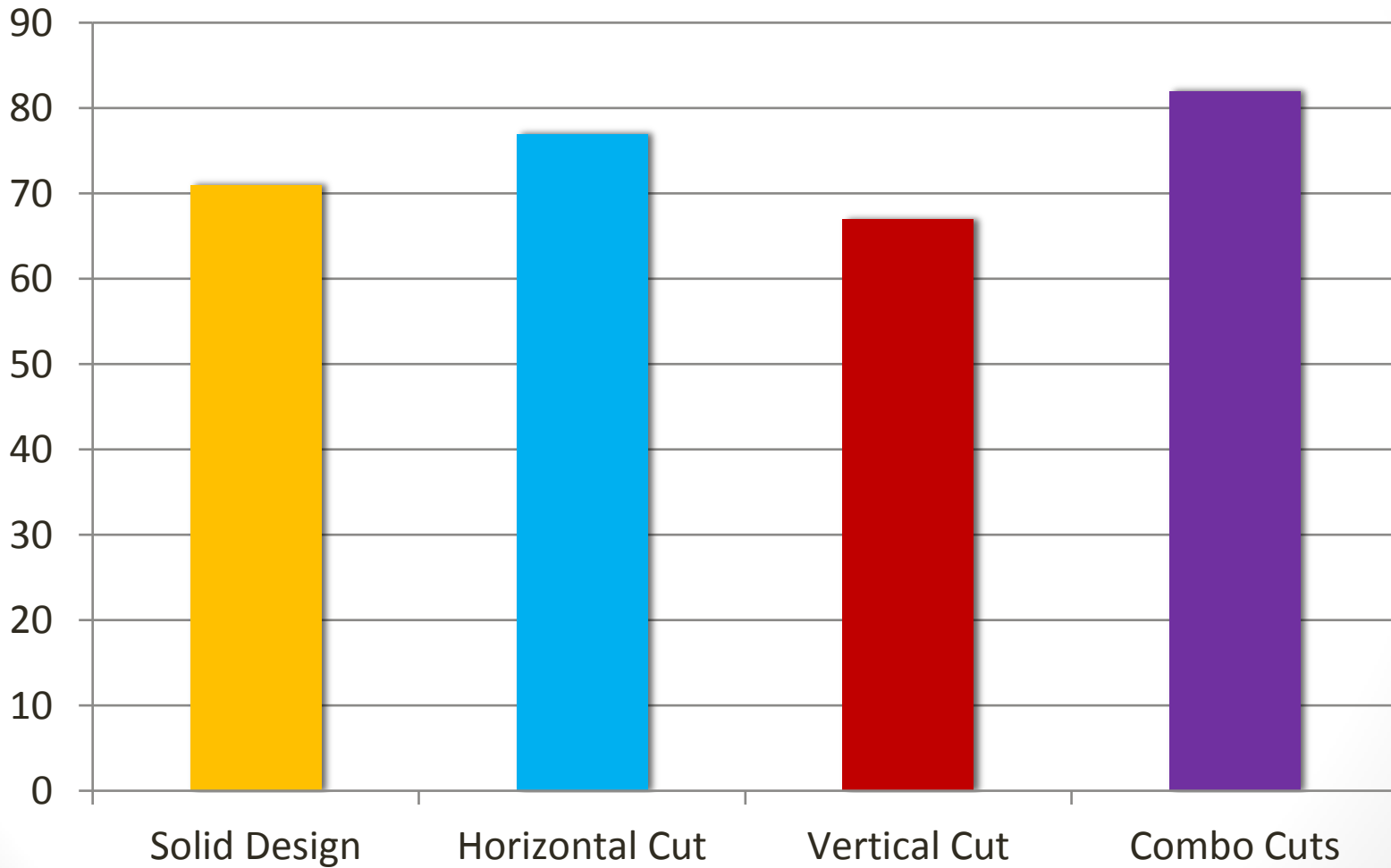


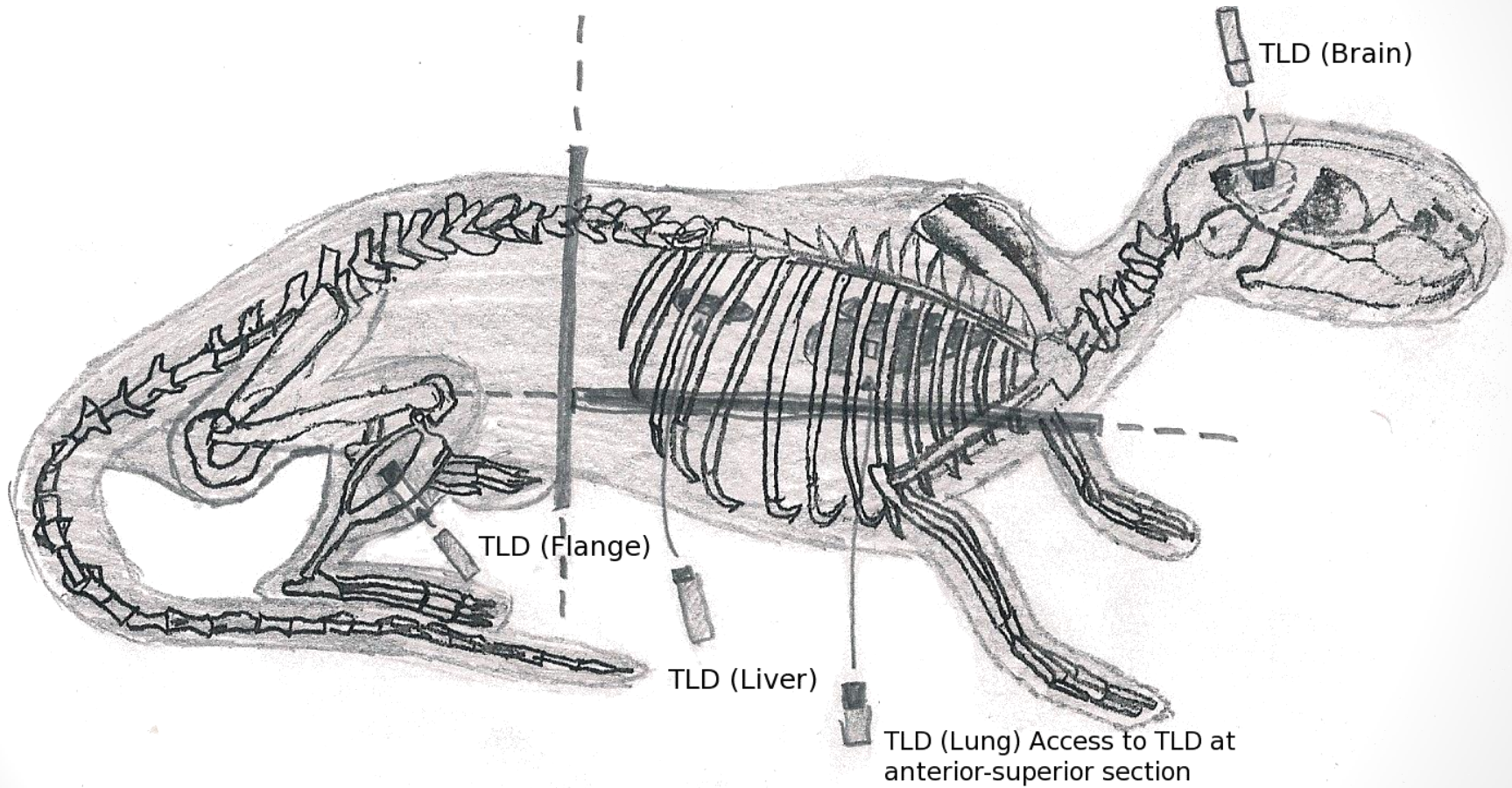
Image Accuracy



Totals



Final Design: Combo Cuts



Future Work

- Rat CT scan (Mo)
 - Scale scan to skeleton size
 - Create TLD and organ inserts
- Obtain materials
- Create prototype
 - Mold materials to cast
 - OR machine materials directly
- Testing with CT/PET scanner

