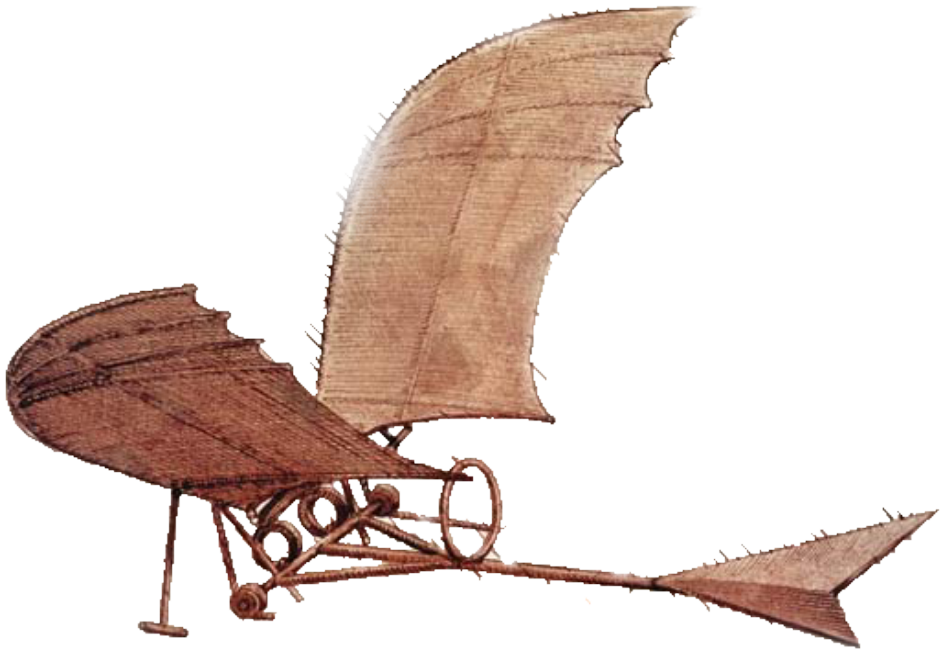
CONCEPT PRESENTATION
EDUROB PRODUCT DEVELOPMENT

MEM435 - 2011

A. Alspach, A. Ryan, S. Saxena, K. Williams, M. Wright

Overview

- Product Vision
- Stakeholders & Stakeholder Needs
  - Who was interviewed
  - Interesting Questions Asked
  - Organization of Needs
- Target Specifications
- Concepts Considered
- **Our Concept**



Product Vision

Develop a low-cost, "biologically inspired" educational device that actively demonstrates the function, performance, and mechanics of a biological system or phenomenon.

Key Goals:

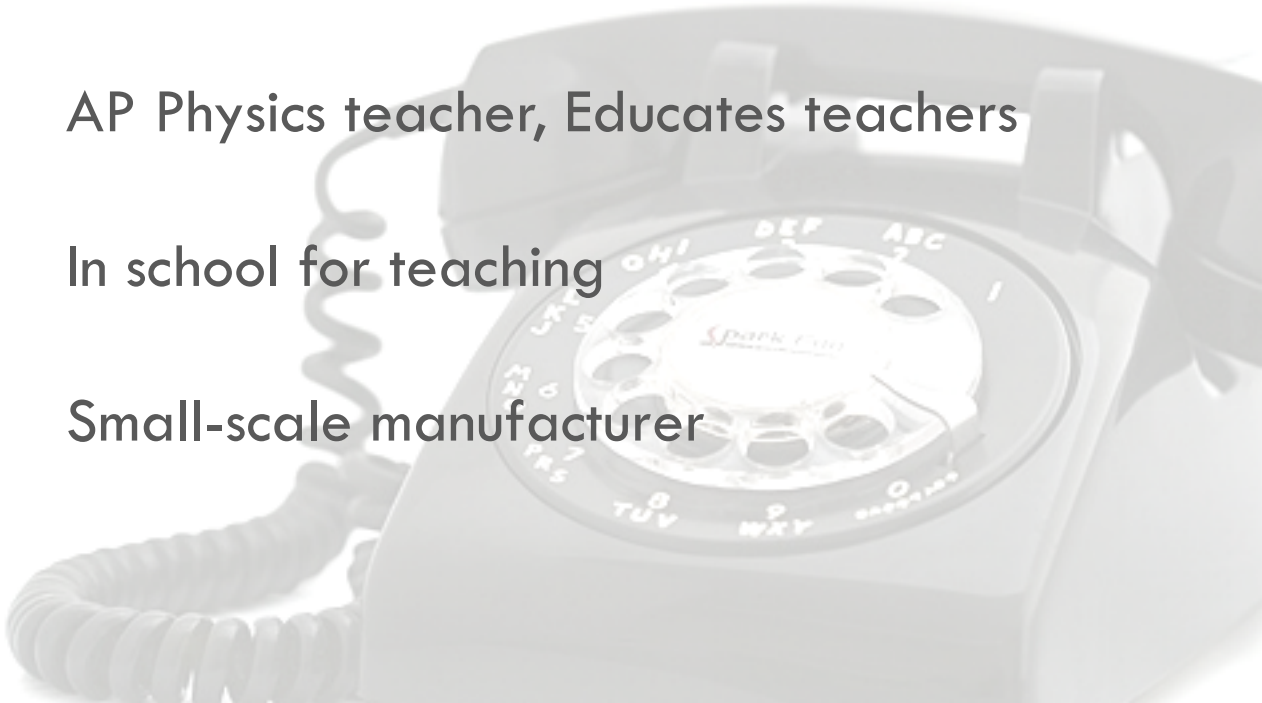
The device should safely be used by high school science students. The device must be complex enough to keep their interest and robust enough to last through years of use. Students should enjoy and learn from and enjoy the device.

The Stakeholders:

- Teachers
- Students
- Parents
- Taxpayers
- School Administration
- Manufacturers
- Distributers
- Retailers
- EDUROB
- Stockholders
- Developers
- MEM435 Peers & Staff
- Competitors

With whom we spoke

- Marianne Lapp — AP Biology teacher at BCHS, Mother
- Margaret Alspach — Art teacher at PJP2, Mother
- Sucharita Karsturi — Physics Department Head at SPV, Author
- Dr. Carey Inouye — AP Physics teacher, Educates teachers
- Alicia Borstad — In school for teaching
- RJ Gross — Small-scale manufacturer



Insightful Answers

- "Don't design a black box. The kids need to be able to see what's going on to understand the underlying concepts" – Dr. Carey Inouye

- "A lot of teachers travel between classrooms. Make sure it packs up into a portable case. And fits on a shelf!" – Margaret Alspach

Organizing the Needs

- Needs are grouped into:
  - Educational Value
  - Safety
  - Design
  - Marketability
  - Distribution
  - Power
  - Aesthetics, User Interface/Experience
- Then sorted by:
  - Primary "Must"
  - Secondary "Should"
  - Tertiary "Could"

Stakeholder Needs

- Educational Value

1P. Must demonstrate (non-human) biological system or phenomenon
2P. Must hold attention of 14-17 yr olds for length of lesson
3P. Accompanying documentation must be well-written and universally understood (multi-lingual)
4P. Must promote analytical skills
5P. Must be versatile to accommodate multiple levels of students/teachers
6P. Demonstrate a concept with underlying math and physics

- Safety

15P. Safe material for use by humans
16P. Must have very little to no toxic material
17P. Safe mechanisms and parts for range of ages (avoid injury)
18P. Safety Warnings/Labels must be present at minimum in manual

- Design/Manufacturing

21P. Must be able to be produced on a large scale
22P. Must be durable to dropping
23P. Must last for 3+ years with constant use (Museum)

Stakeholder Needs (cont'd)

- Design/Manufacturing

24P. Must be robust to water damage (if spilled on)
25P. Must contain parts that will be available for the life of the product
26P. Must cost less than $200 to develop/manufacture

- Distribution

39P. Must be packed well for shipping to keep product secure/safe
40P. Must cost less than $50 to consumer

- Power

43P. If product needs plugged in, must run on 110 V outlet
44P. If not plugged in, must run on batteries

- Marketability

46P. Must cost less than $50 to consumer

- Aesthetics/User Interface

49P. Must operate quietly
50P. Must have the ability to change speeds or functions of the product

Target Specifications

#	Need Addressed	Metric	Unit	Value	Source
1P	Must demonstrate non human phenomena	Research/Survey/ Testing	Boolean	1	EDUROB
2P	Must hold attention of students	Survey/Testing	Minutes	>50	Teachers
3P	Accompanying Doc must be universally understood	Available Languages	# of relevant widely spoken languages	>5	Teachers
4P	Must promote analytical skills	Post-Lab Analysis	Minutes	>60	Teachers
5P	Versatility for multiple levels of students	Survey/Testing	# of Levels	>/=3 levels	Teachers
6P	Demonstrate concept with math & physics	Research/Testing	Boolean	1	EDUROB
7P	Safe use by humans	Testing	# of incidents / 100 uses	<.1	Teachers, Parents
16P	Toxic Material Present	Material Selec.	Kgs	0	Teachers

Target Specifications

#	Need Addressed	Metric	Unit	Value	Source
17P	Safe mechanisms and parts	Risk Evaluation/ Testing	% injuries	<.2%	Teachers
18P	Safety Warnings must be present	# of Warnings	#	>1	Manufacturer
21P	Able to be produced on a large scale	# of widgets in amount of time	Widgits/day	>100	Manufacturer
22P	Must be durable to dropping	Drop Testing	Mean # of drops before failure	>10	Teachers
23P	Must last for 3+ years	Mechanism Testing, Time to Failure	Years	>3	EDUROB
24P	Must be robust to water damage (if spill on)	Waterproofing	Constant Spray over time, yrs	>1	Teachers
25P	Must contain parts available for life of product	Production Time	Years	>3.5	Teachers

Target Specifications

26P	Must cost less than $200 to develop/manufacture	Money	Dollars	< 200	EDUROB
39P	Must be packed well for shipping	Drop Testing	Mean # of Drops before failure	> 20	Developers
40P	Must cost less than $50 to consumer	Money	Dollars	<$50	EDUROB
43P	If product needs plugged in, must run on 110V outlet	Power	Volts	110	Teachers
44P	If not plugged in, must run on batteries	Type of batteries		AA/AAA Recharg eable	Teachers
49P	Must operate quietly	Sound	Db	< 60	Teachers
50P	Must have the ability to change speeds or functions of the product.	% Power	%	➢ 0-10 0%	Teacher

Concepts Reviewed

- Educational Value
  - Mechanical concepts presented
  - Biological concepts presented
  - Physics concepts presented
- Safety
- Interactivity
- Durability
- Marketability
- Manufacturing
- Distribution
- Power
- Aesthetics/User Interface
- Appropriate complexity of concept, feasibility
- Mechanical concepts presented
- Biological concepts presented
- Physics concepts presented

Brainstorm
Present
Discuss
Vote

Concepts Considered

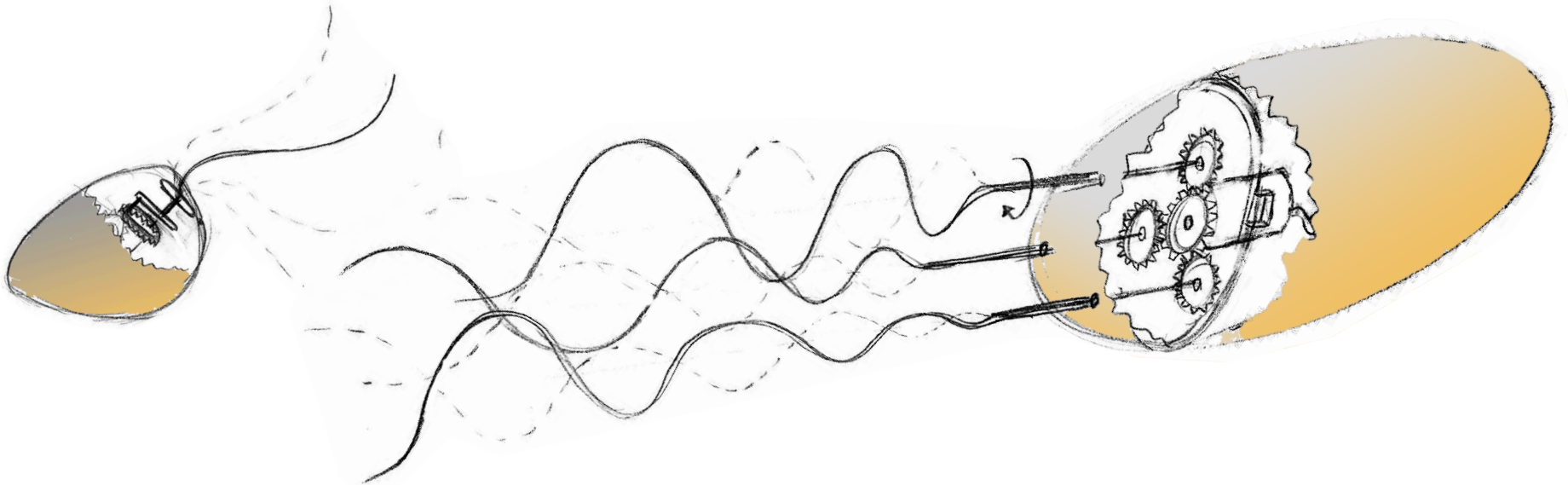
- Bacterial Propulsion Device
- Ocular Disorder Model
- Kangaroo Jumping Model
- Animal Biting Force Model

Bacterial Propulsion Device

- Bacterium would feature replaceable tail-end
- Modular design would introduce the benefits or disadvantages of flagella versus cilia and variations in positioning and count when travelling in water
- Simple, visible mechanisms would help students to understand differences in actuation

Design Goals

- Able attach separate tails
- Each tail moves in water similar to how actual bacteria move

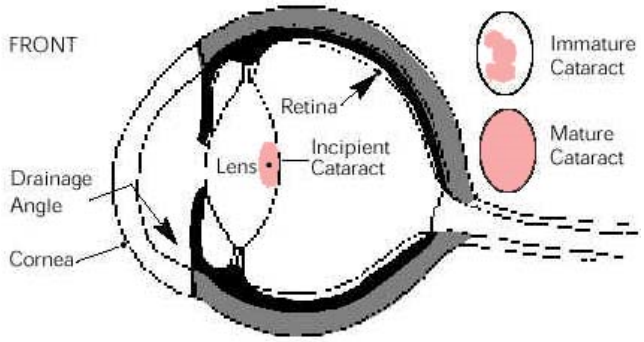


Ocular Disorder Model

- Utilizing a moveable lens and film overlays students can look through the eye model to see what it looks like for an animal with an eye disorder.
- Profile will feature a section view of the eye, describing how each part of the eye functions
- Physics lab could use product to demonstrate focal point movement and focusing.

Design Goals

- Able to look through eye to see what different eye disorders look like
- Able to change lens/film for each separate eye disorders



Kangaroo Jumping Model

- Three segment leg model would feature McKibben artificial muscles and extension springs to approximate muscles and highly elastic tendons
- Design would include **anatomically correct muscle positioning** with the ability to **change springs, connecting position and muscle force** to approximate different animals
- Could be used to demonstrate **conservation of energy** during gate and **efficiency** when parameters are altered

Design Goals

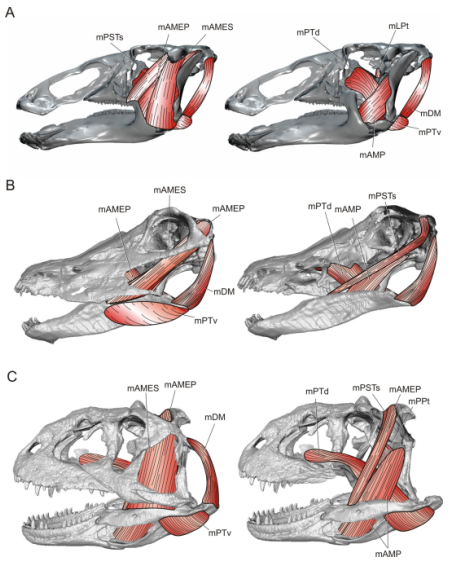
- Have air compressing system to compress and decompress muscles in cyclic pattern so it can "hop"
- Have ability to change into different animals muscle position

Animal Biting Force Model

- The jaw will have several pegs the McKibben artificial muscle can attach to, each representing different animal jaw structures
- Students will be able to measure forces for the different jaw structures, and will have a better understanding of how jaw muscles work and how evolution has made some animals jaws more appropriate for their needs

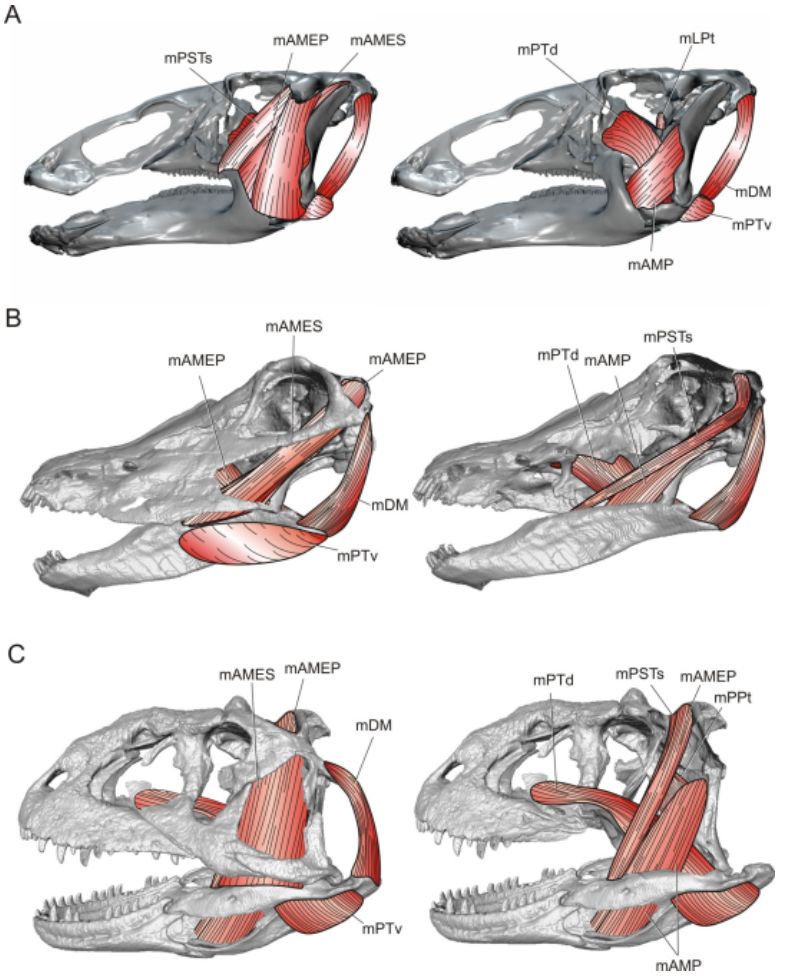
Design Goals

- Able to bite down and measure force of bite
- Air compressing system to turn on and off muscles
- Different pegs to attach muscles too for different jaw structures

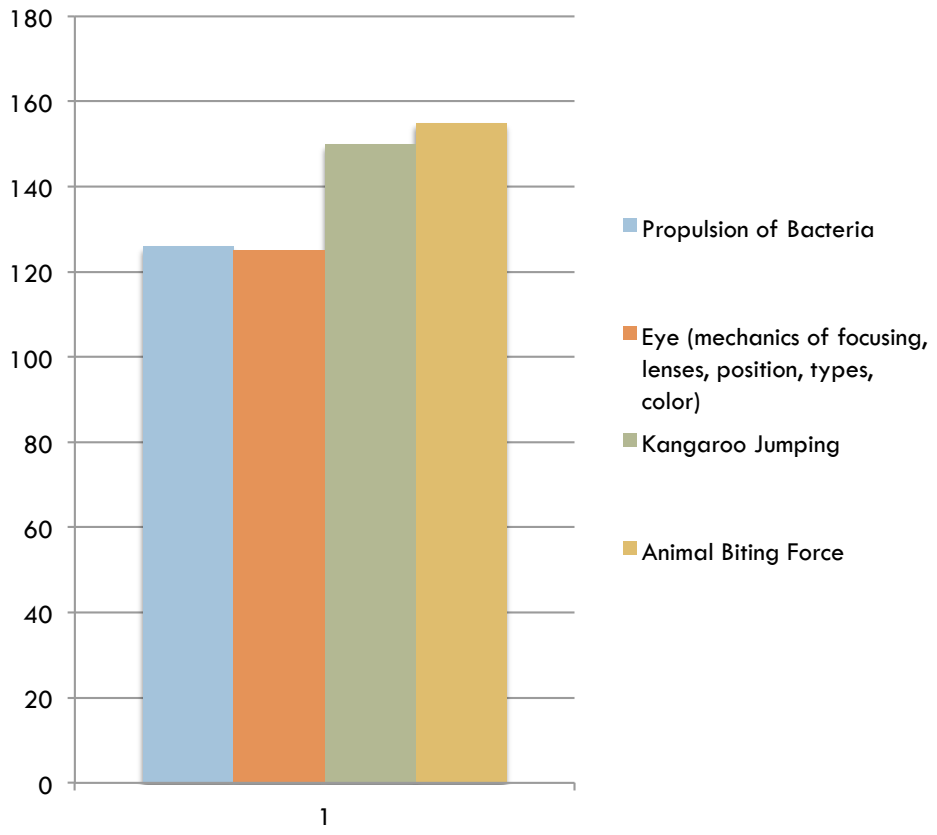


Concept Selection

Final Decision – Animal Biting Force Model



Justification of Selection



- Meets all primary and majority of secondary needs
- Easily identifiable use of physical concept
- Versatility to accommodate multiple age groups

Justification of Selection

- Disadvantages of other Concepts
  - Bacterial propulsion
    - Hard to manufacture
    - Expensive replacement parts
    - Lack of durability
  - Kangaroo Jumping Model
    - Hard to design and manufacture the pneumatics
    - Does not directly relate to the syllabus
  - Ocular Disorder Model
    - Lack of Durability
    - Hard and expensive to manufacture

Any Questions?

Any Questions?

Thank You!

References

- http://www.gamemeca.com
- http://www.rcuniverse.com/
- http://www.signsbyyou.com/
- http://www.shadowrobot.com/
- http://www.somethingyoushouldread.com
- http://www.eyecareforanimals.com/
- http://www.animaleyecare.net/
- http://web.missouri.edu/
- http://animalsversesanimals.yuku.com/