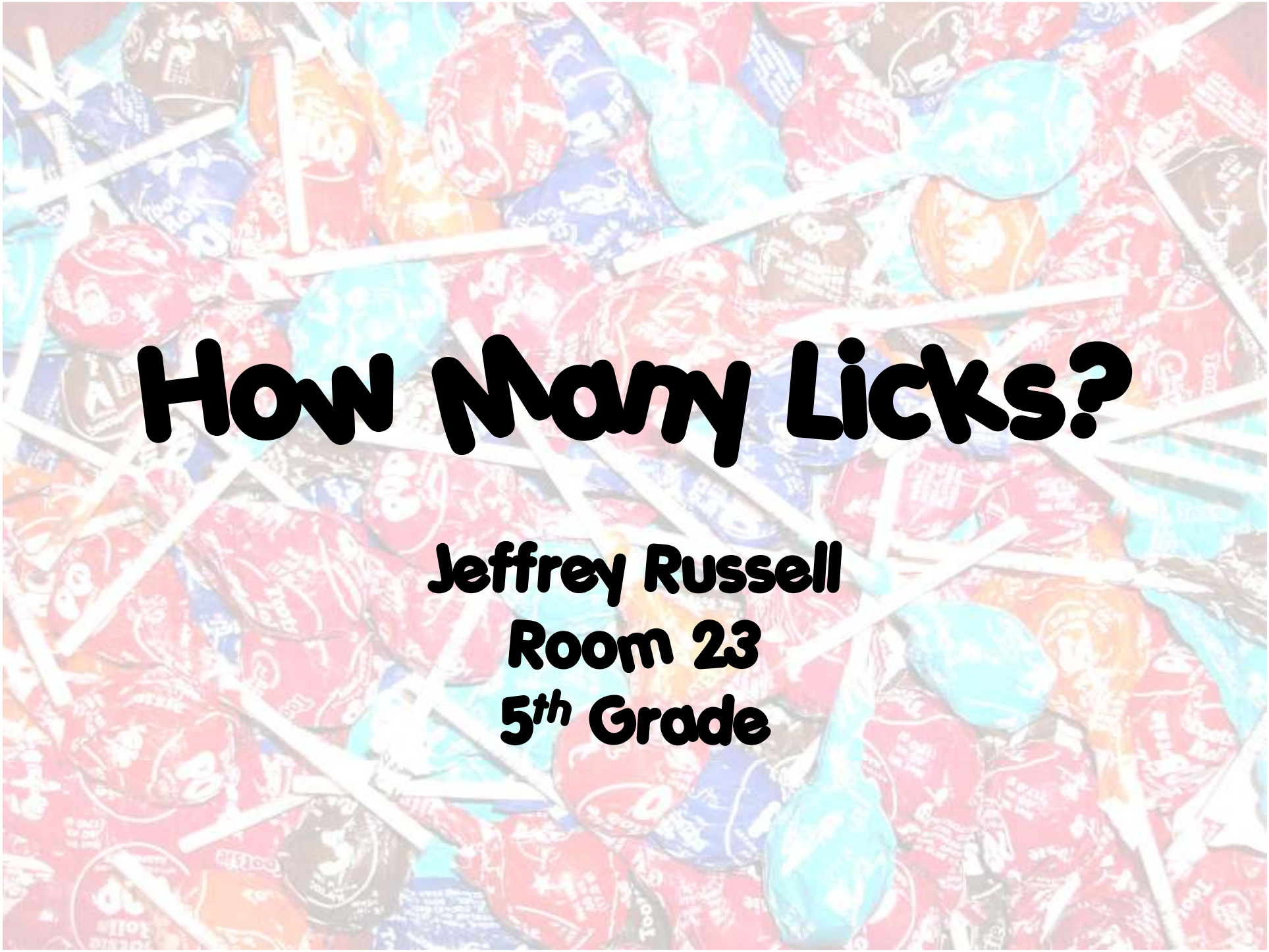
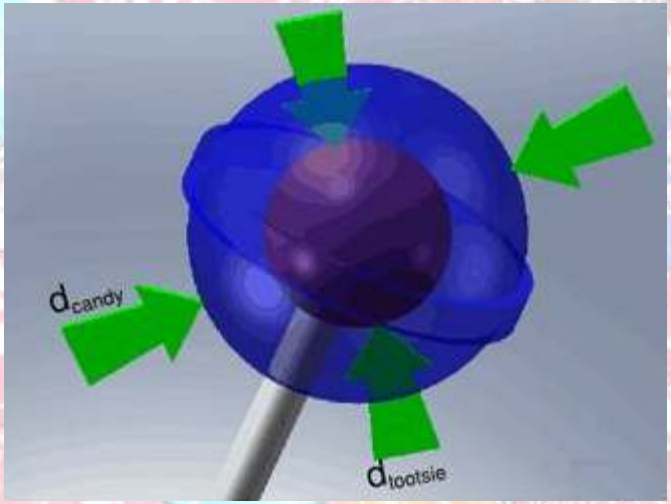

How Many Licks?
Jeffrey Russell
Room 23
5th Grade

Question

- How many licks does it take to get to the tootsie roll center of a Tootsie Pop?



Hypothesis

- I think it will take about 200-300 “licks”

Equipment and Materials

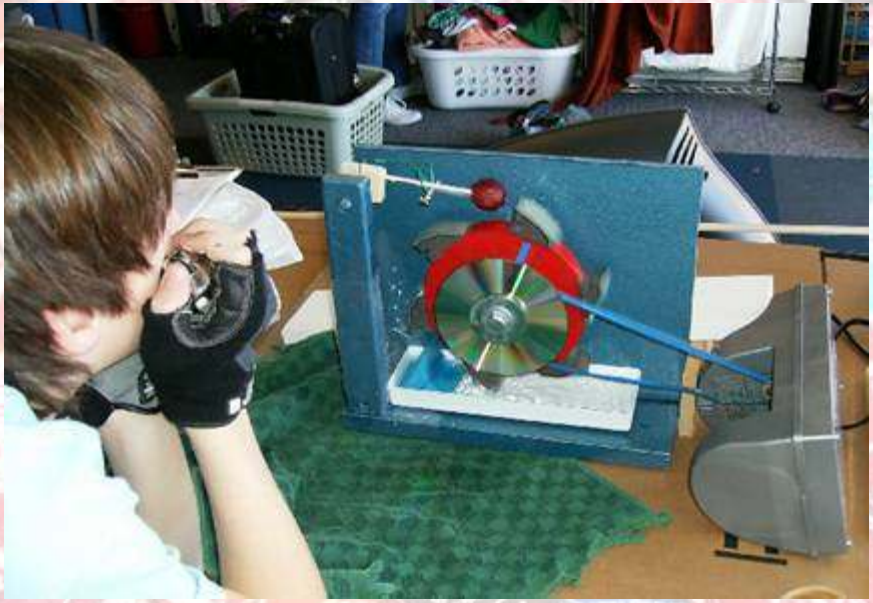
- Human process
  - Tootsie pops
  - Human subject with available tongue
  - Tally counter
- Machine process
  - Tootsie pops
  - Water (represents saliva)
  - Licking machine
    - Motor, wheels, foam, wood structure, bolts and washers, rubber drive belt, suede (simulated tongue surface), and water tub.
  - Tally counter

Procedure

- Human
  - Un-wrap tootsie pop
  - Get tally count & reset to 0 if needed
  - Lick tootsie pop and click tally counter for each lick
  - Periodically check progress, increase frequency closer to center.
  - Once center exposed, stop and record total on tally counter
- Machine
  - Un-wrap tootsie pop
  - Get tally count & reset to 0 if needed
  - Cycle licking machine once to wet suede surfaces
  - Rock tumbler motor (fast): Place tootsie pop on machine, turn on motor, and click tally counter for each turn of the wheel (6 licking surfaces in one cycle).
  - Variable speed drill (slow): Place tootsie pop on machine, pull drill trigger until the wheel turns slowly, and click tally counter for each lick.
  - Periodically check progress, increase frequency closer to center.
  - Once center exposed, stop and record total on tally counter, the multiple by 6 to obtain total lick count (Note: accuracy +/- 6 licks)

Measuring tongue for machine pads

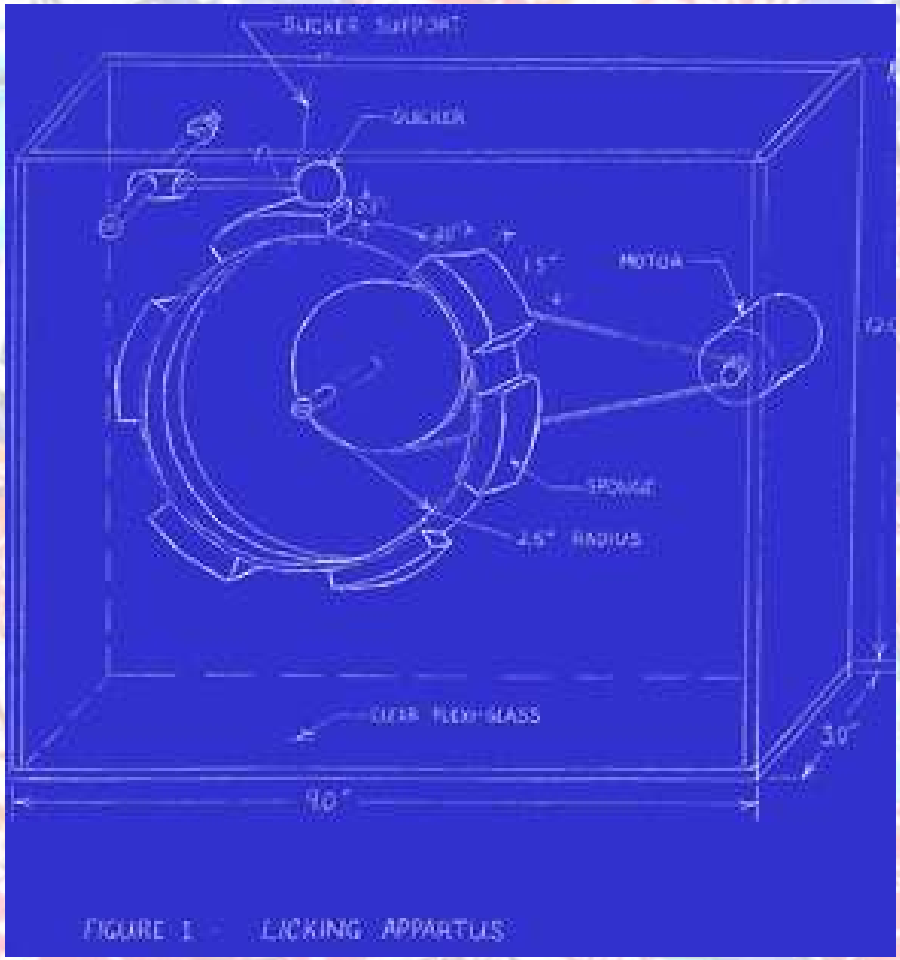
Counting human licks



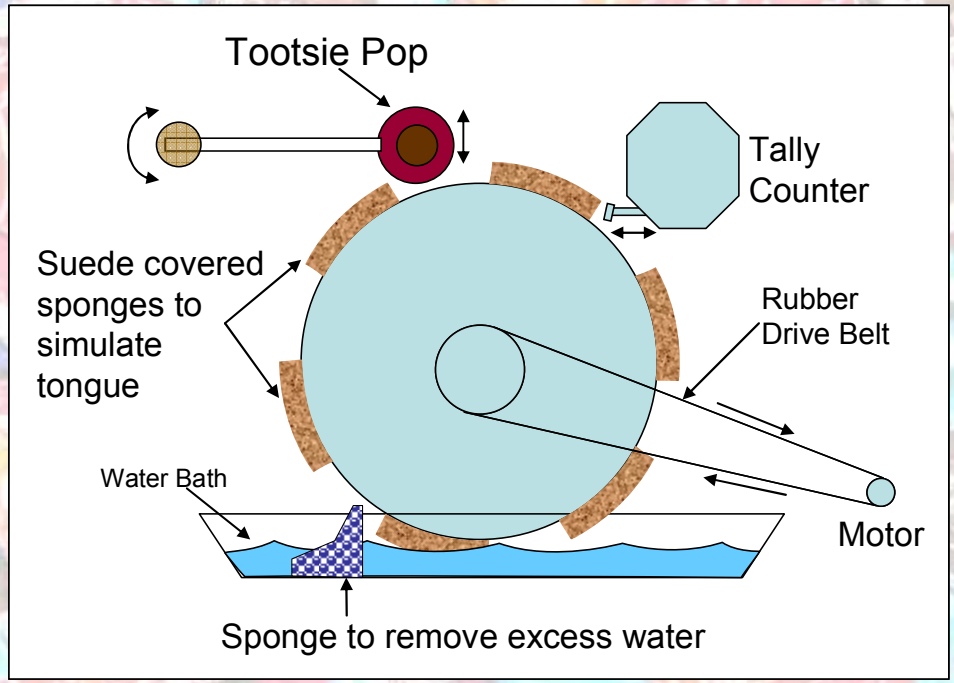
Licking machine in action

Results of normal human licks

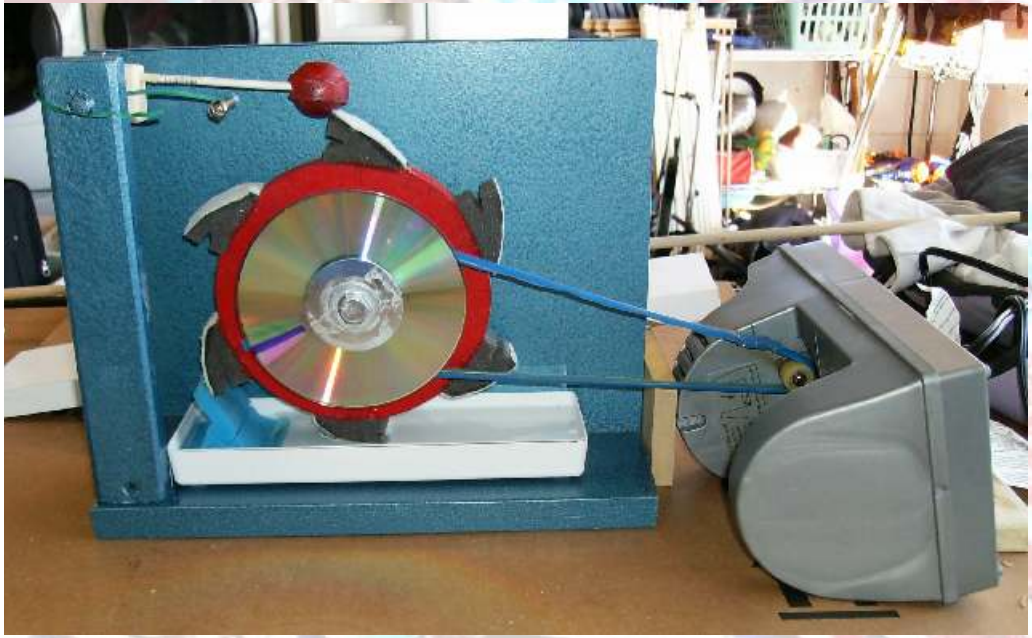
My machine design was influenced by previous studies in the field of Tootsie Pop research



Purdue University licking machine



My licking machine design plans



Rock tumbler motor (fast)

Variable speed drill (slow)

Sponge to remove excess water

Suede covered sponges to simulate tongue

Results

- After performing a few tests it was observed that the human licks were significantly less than the machine licks.
- I guessed that the high speed of the rock tumbler motor machine licks might account for this – so I did the human licks at a much faster pace and got closer to the machine lick count.
- I ran the licking machine at a slow pace using a variable speed drill and found that the slower licks removed more candy surface.

Data Collection

Test	Lick Application	Speed of Licks	Number of licks to Chewy Center	Observations
1	Human	Normal	507	some smaller licks than others
2	Human	Normal	223	long licks
3	Human	Normal	400	nothing special
4	Machine	Fast	1320	lots of center exposed
5	Machine	Fast	1080	center just showing
6	Machine	Fast	1380	
7	Human	Fast	1035	
8	Human	Fast	1147	
9	Human	Fast	812	hit air bubble that exposed center
10	Machine	Slow	166	
11	Machine	Slow	306	
12	Machine	Slow	616	small center

Human Slow Average	**376.7**
Machine Slow Average	**362.7**
Human Fast Average	**998.0**
Machine Fast Average	**1260.0**

Slow Avg: 370 Licks

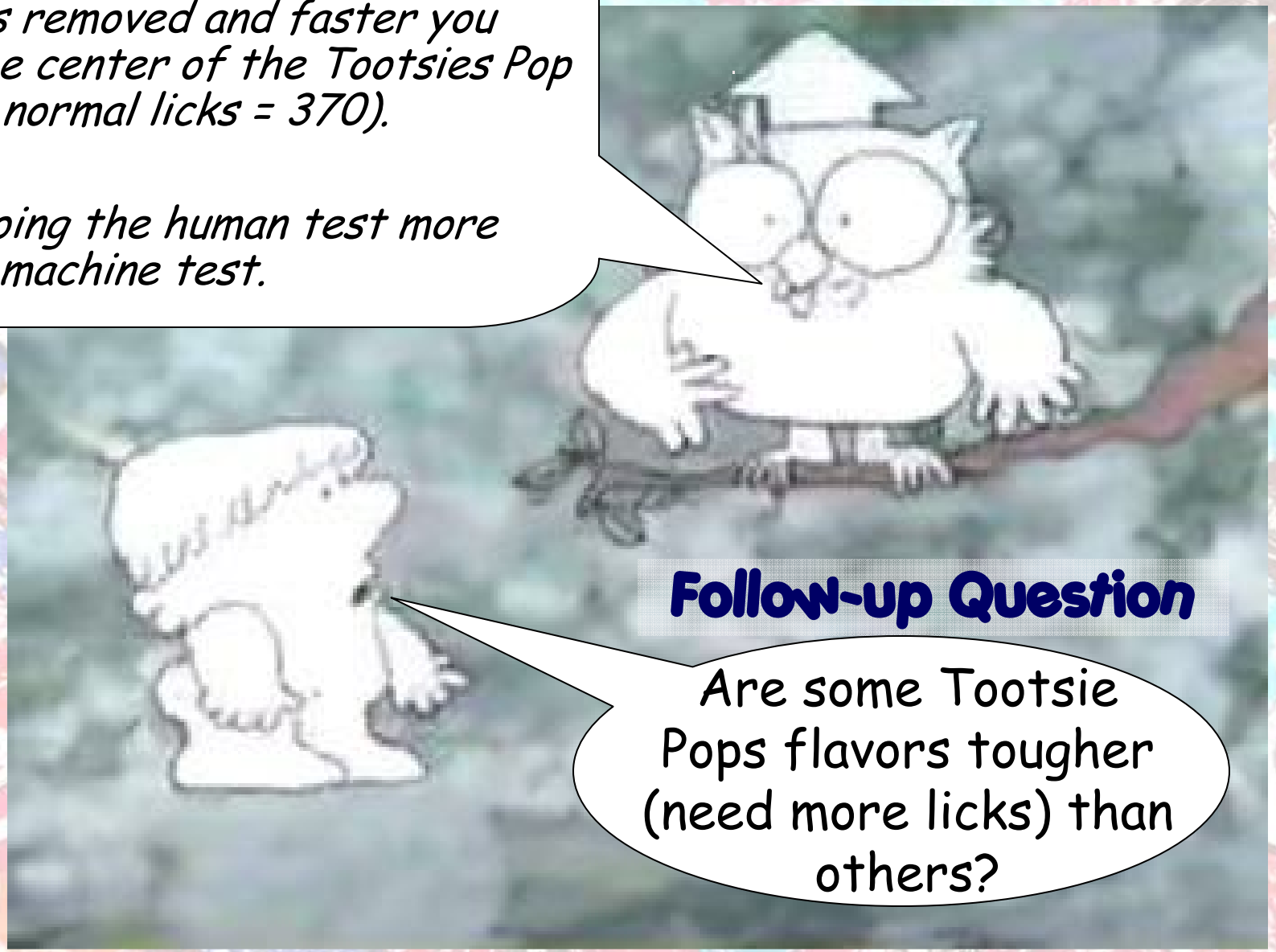
Fast Avg: 1129 Licks

Overall Avg: 749 Licks

Conclusions

The slower you lick the more candy coating is removed and faster you get to the center of the Tootsies Pop (average normal licks = 370).

I liked doing the human test more that the machine test.



Follow-up Question

Are some Tootsie Pops flavors tougher (need more licks) than others?


How Many Licks?
Question
Hypothesis
Data Collection
Equipment and Materials
Results
Procedure
Conclusions
Jeffrey A. Russell
HUMAN
MACHINE
Tootsie POPS


Back up slides

Conclusions

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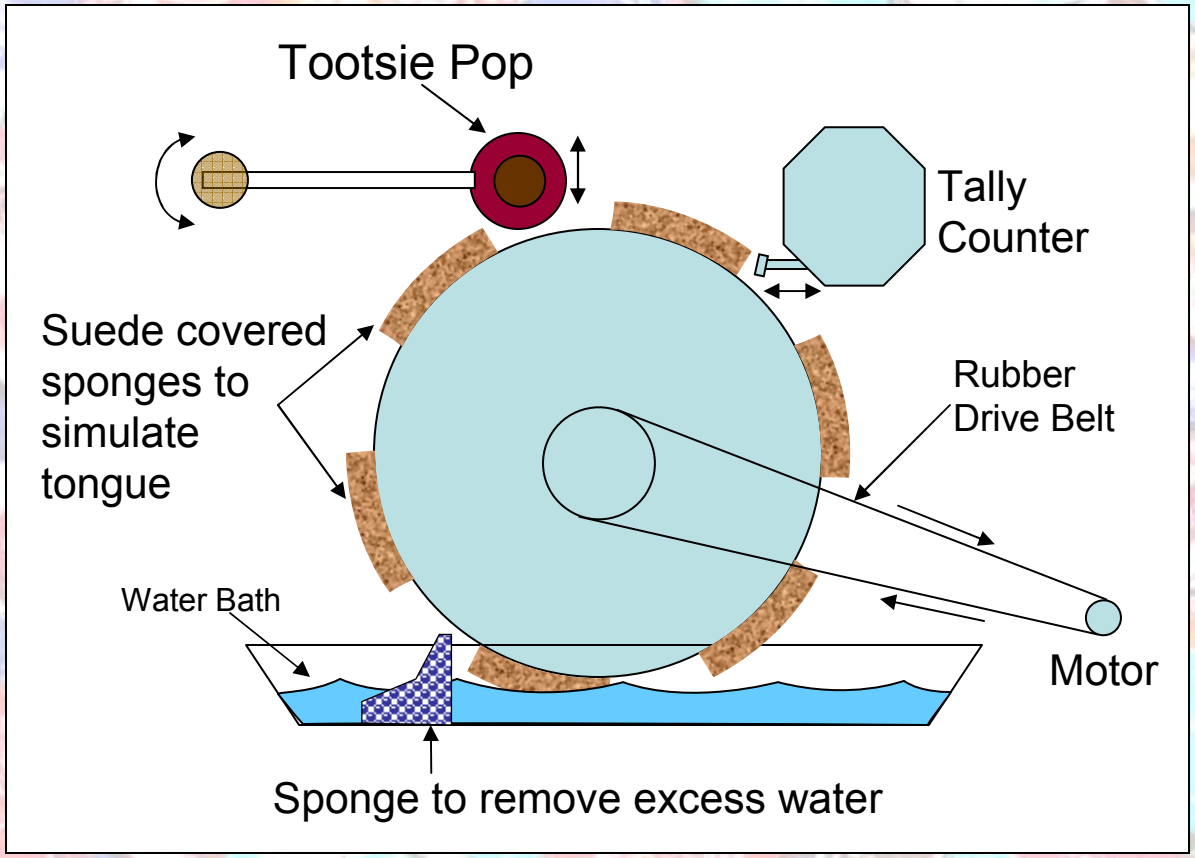
Tootsie Pop
Tally Counter
Suede covered sponges to simulate tongue
Rubber Drive Belt
Water Bath
Motor
Sponge to remove excess water