Drag Racer Lab Report

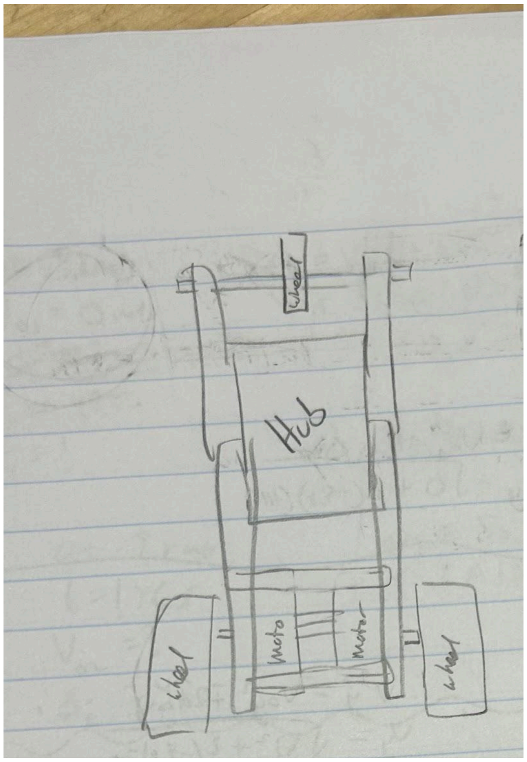
Jack Turk, Christian Niese, Lokesh Gadudasu

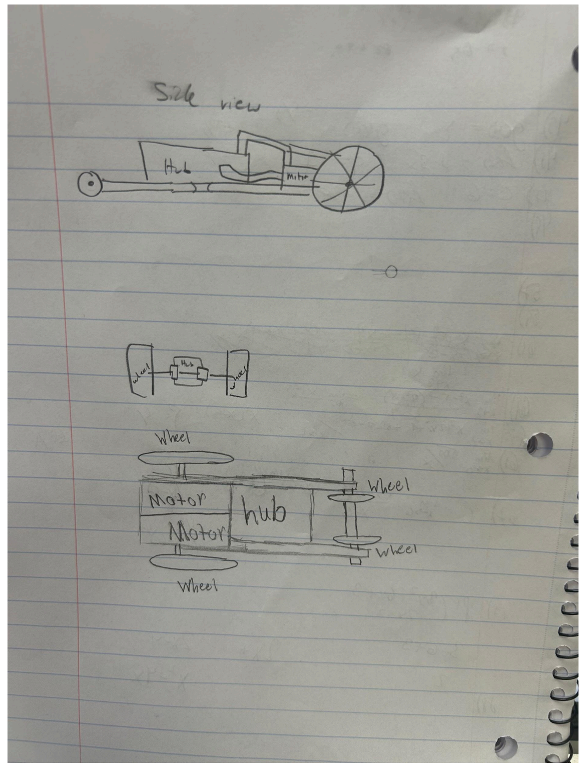
9/9/25

Introduction:

For this lab we were tasked with creating the best possible lego drag racer for a straight 20 foot track as fast as possible. To do this we had to use several different wheel sizes and find the velocity, acceleration, and other values to find out which wheel sizes work better at moving the car the fastest. For this iteration of the lego drag racer we were not allowed to use any gears. The group consisted of Jack Turk, Christian Niese, and Lokesh Gadudasu.

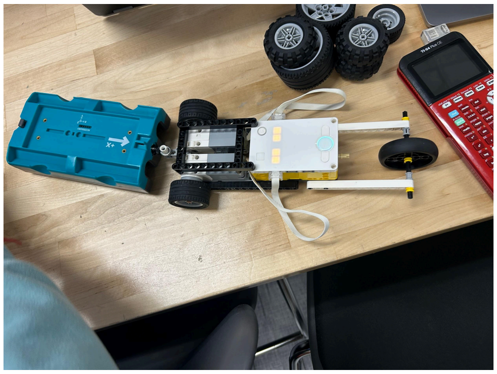
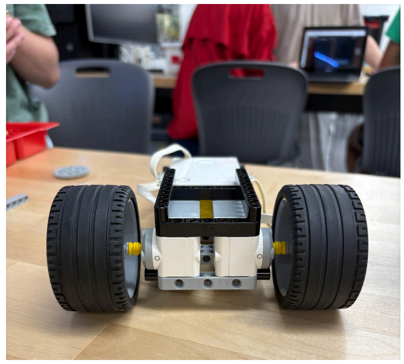
Engineering Notebook:



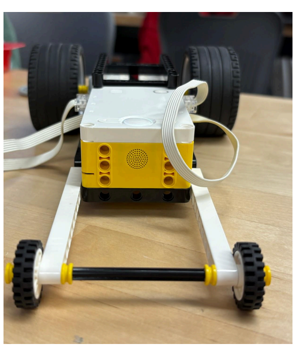
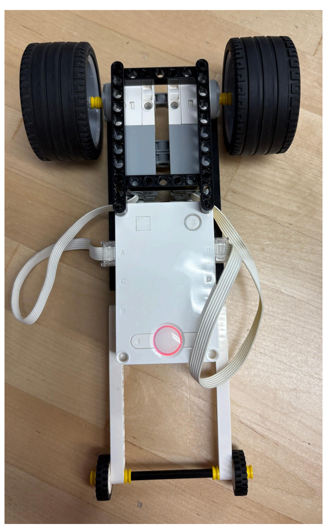
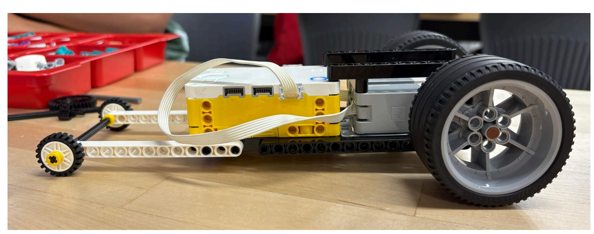


Our ideas started off as a stereotypical car shape. It consisted of a rectangular car frame, and followed that of a real life drag racer with two bigger wheels in the rear and one smaller wheel in the front. We knew a center base was necessary in order to hold the battery hub. We also knew we needed a space near the wheels to hold the motors. We put this space in the back as we believed that the motors should be hooked up to the bigger tires in the back. During our thought process, we believed that one front wheel would work better instead of two as it would have less friction, weight, and pieces in general. Overall we designed a very minimalistic car with rear wheel drive, a single slim front wheel.

Design Process:

Our first design of the car was looking pretty good but we saw some room for improvement. However, we mostly liked the idea of the basic design and wanted to stick with it. One thing we noticed was that our one front wheel design was not ideal as the lack of stability left our car drifting away from the center, and leaving the track. We also experimented with different aerodynamic styles but with the minimal speed and a lack of airflow these additions just added weight and slowed the car down. Finally, we settled on the biggest possible tire we had available in the back, and the smallest possible tires in the front.

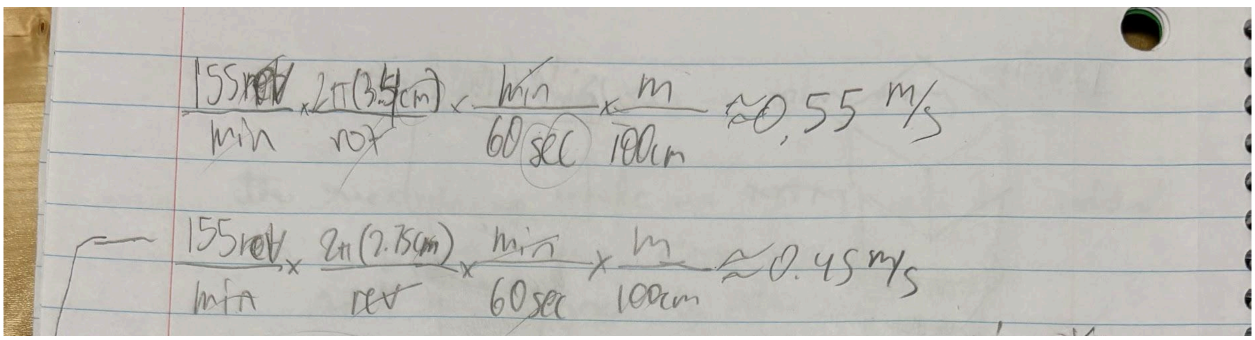




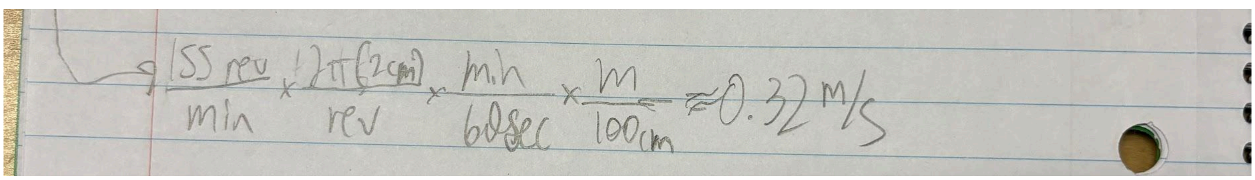
Data and Models:

After we had built the car, we had a few tasks to complete

1. Find theoretical top speed
2. Find actual speed
3. Find actual acceleration
4. Find force of drag racer
5. Find pulling force

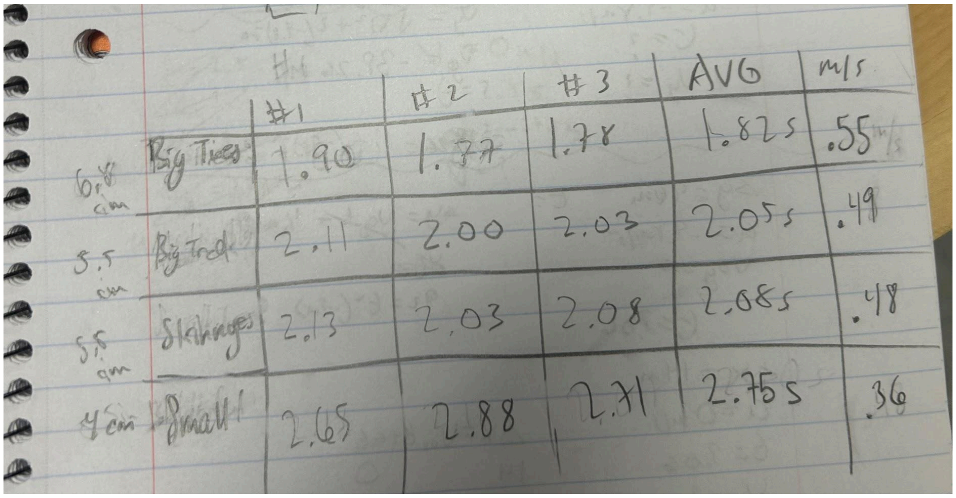
1. Theoretical Top Speed:





To determine the theoretical top speed, we first researched the RPM of the LEGO motor used in our project, and found it to be 155rpm. We then applied dimensional analysis to convert this RPM value into meters per second for each tire size. PS: the 2.75 cm measurement applies to both the large tread and skinny tires.

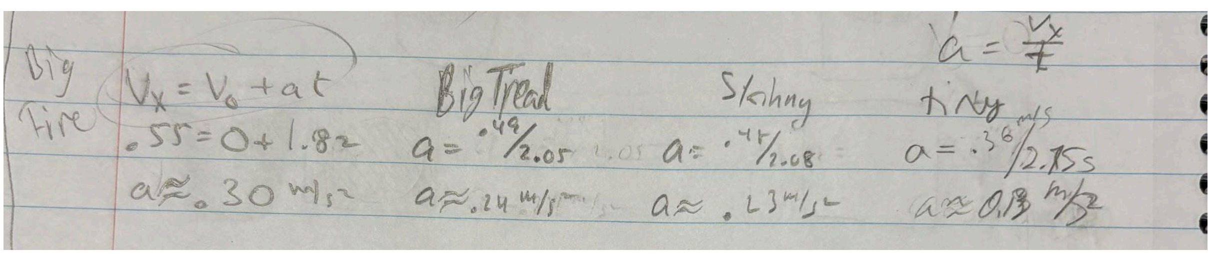
2. Actual speed:



		#1	#2	#3	AVG	m/s
6.8 cm	Big Tires	1.90	1.77	1.78	1.825	.55
5.5 cm	Big Tread	2.11	2.00	2.03	2.05s	.49
5.5 cm	Skinnys	2.13	2.03	2.08	2.08s	.48
4 cm	Small	2.65	2.88	2.71	2.75s	.36

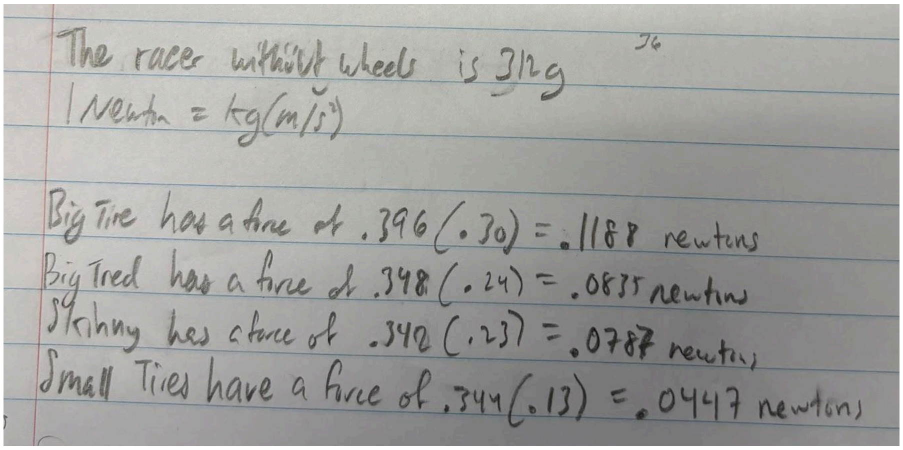
To measure the actual average speed, we timed the drag racer as it traveled one meter three times for each tire type. We then averaged the recorded times for each tire and used the formula $\frac{distance}{time}$ to calculate the real speed. Interestingly, while all the others were about equal to or less than the theoretical speed, we found that the small tire achieved a real speed that exceeded the theoretical top speed. We concluded that this discrepancy might have resulted from human error in perceiving the end of the test, leading to the stopwatch being stopped slightly too early and thus inflating the recorded speed.

3. Real acceleration:



To find the real average acceleration of the drag racer, we used the kinematics formula $v = v_0 + \alpha t$. We considered $v_0 = 0$ because we're not giving it a push at the start. Then we rearranged the variable to get $a = \frac{v}{t}$. We have v and t, so now we can calculate average acceleration.

4. Find force of drag racer



The racer without wheels is 312g

1 Newton = kg(m/s²)

Big Tire has a force of .396(.30) = .1188 newtons

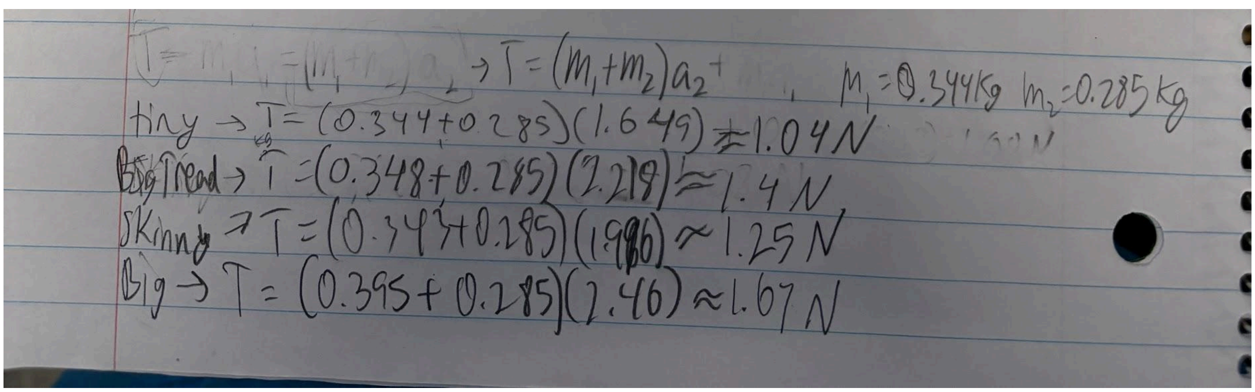
Big Tred has a force of .348(.24) = .0835 newtons

Skinny has a force of .342(.23) = .0787 newtons

Small Tires have a force of .344(.13) = .0447 newtons

To find the force of the drag racer, we used the $F = ma$ equation for each tire to solve for force. We use the information that we've procured over all of this experimentation and calculation(mass from weighing the drag racer and acceleration from the calculation).

5. Find pulling force



$T = m_1a_1 = (m_1+m_2)a_2 \rightarrow T = (m_1+m_2)a_2$ $\quad m_1 = 0.344\,kg \quad m_2 = 0.285\,kg$

tiny → $T = (0.344+0.285)(1.649) \approx 1.04\,N$

Big Tread → $T = (0.348+0.285)(2.219) \approx 1.4\,N$

Skinny → $T = (0.343+0.285)(1.986) \approx 1.25\,N$

Big → $T = (0.395+0.285)(2.46) \approx 1.67\,N$

To calculate the pulling force of the drag racer, we utilized an external force: the cart. We attached the cart to the drag racer and connected it to Vernier graphing analysis software on a laptop. After starting the drag racer, we measured its maximum acceleration(a_n) while pulling the cart. With all the necessary data collected, we applied the equation $T=(m_1+m_2)a_n$ to calculate the pulling force, T.

Conclusion:

For this lab we created the fastest possible drag racer for a 20 foot course without any gears. Through much deliberation and experimentation during the design process, we decided on a rear wheel drive car with 2 big rear wheels and 2 small front wheels. Our group worked together very well, with each person having their specialty and therefore major commitment area to the project. We were very successful in gathering all the necessary data for our calculations, including velocity, acceleration, and pulling force. One thing we plan to improve upon going into the second version of this project is the speed of our car. Due to our car not having gears yet, it lost out in the race to most other cars. We hope to change this in the coming week. One thing we may do differently if we could attempt this project again is make our hub more accessible in the car. We struggled with charging the battery because the hub was fully inside of the car, and we thus had to disassemble the car to reach it. Overall we experienced plenty of success in this project and we are happy with our results.