



NCTM Session: Mathematics and Integrative STEM — The Ultimate Photo Finish for Connecting Math and Science

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Why Learn Math in School?

- Make sense of our world.
- Increase Opportunities.
- Experience Beauty.



WHAT?

How a Payday Loan Works

You borrow \$500
The fee is \$75

Source: GAO file photo | www.gao.gov





A Case for the “M” in STEM

In the STEM program if ...

the mathematics isn't on grade level, or

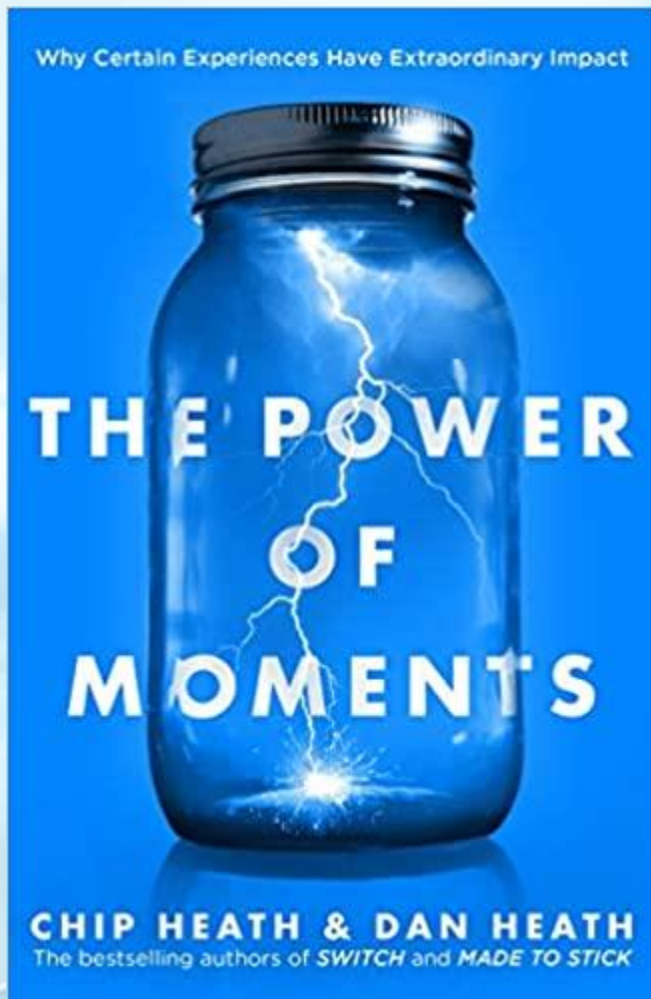
if the mathematics isn't addressed conceptually but rather as a procedural tool to solve various disjointed applications, or

if the mathematics is not developed within a coherent mathematical learning progression,

then the “STEM program” fails...



Experience Joy, Wonder and Beauty



Create moments where students learn, use and apply mathematics to understand something so fully they never forget.





The Ultimate Photo Finish

- Have students use and develop their mathematical understanding to describe the world around them.
- Use this understanding to create the Ultimate photo finish where everyone hits the finish line at the same time.



The Contestants

- Wind up toys that roll, hop, run, walk, jump in a defined direction.
- Variation is good. They can be of different sizes, vintages, motions, etc.
- No remote-control vehicles, steerable vehicles, rev-up vehicles, balls, tops, ...

The Contestants





The Training

Create a rule or set of rules that will allow you, your team, and another person to generate the same prediction for the following.

1. How many winds it will take for your racer to go a given distance.
2. How long it will take your racer to go a given distance with a prescribed number of winds.
3. How far will your racer travel in a set amount of time.



The Training

The Student Generated Rules for their Contestant

The rules need to result in a well-defined answer.

That is if I want the distance for three winds after running for 4 seconds, it will always give me the same answer.

That said, the students can create their rules in any ways.



The Event Rules

1. The judge's decisions are final.
2. No Whining.



The Training Setup

- Students can bring in contestants, but they need to be approved from the Judge. (No whining.)
- Have students create a space to train their contestant.
 - Have them talk about how they are going to figure out what they need.



The Training Setup

Things that might be helpful.

- A starting line.
- A way to measure distance.
- A way to measure time.
- A way to record both (collect data) as the contestant does practice runs.
- Space and time.

Item:

Time							

Winds

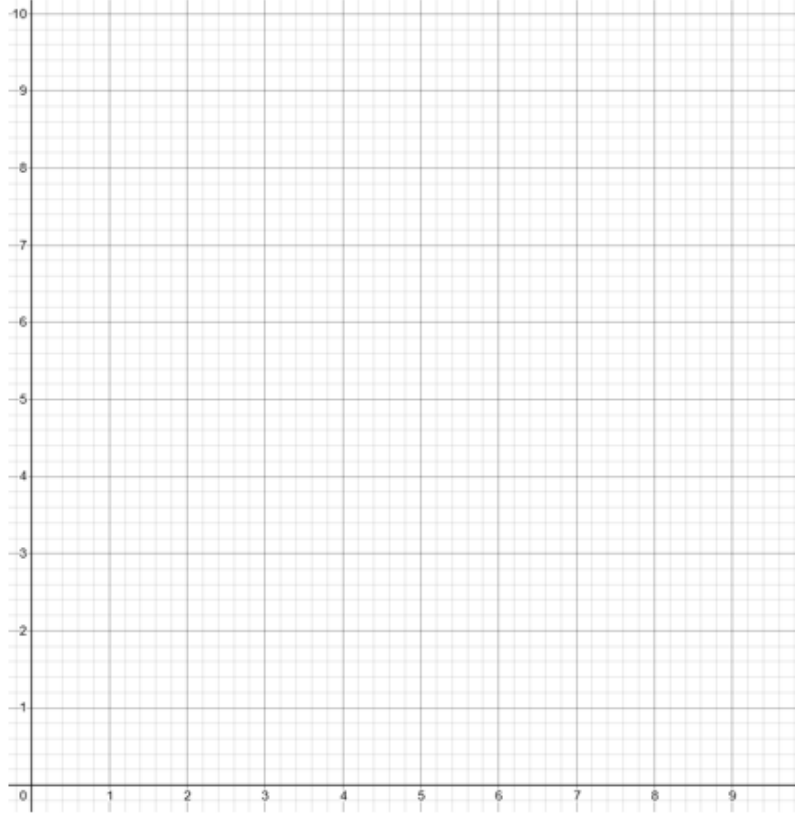
Trial 1

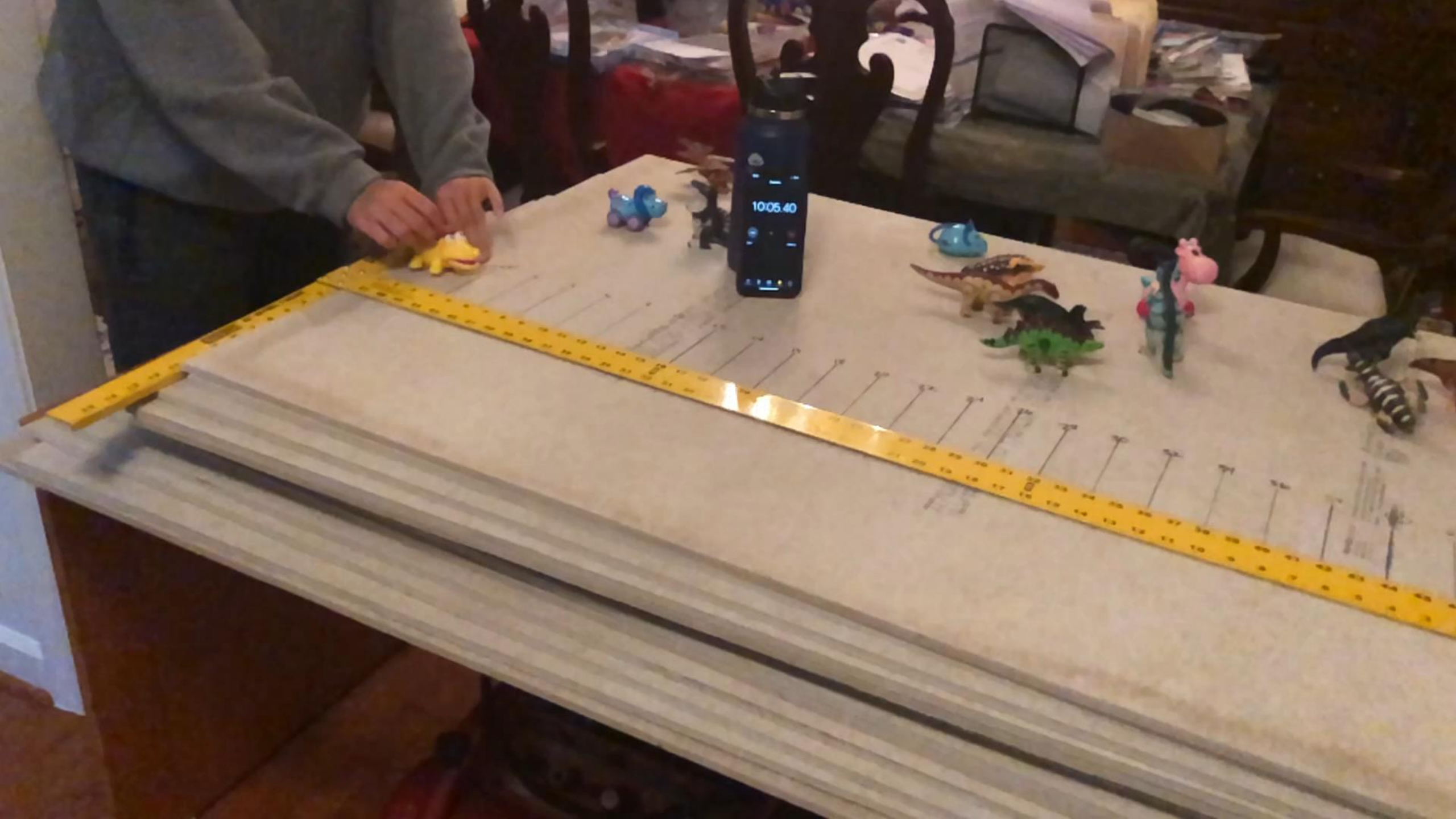
Trial 2

Trial 3

Trial 4

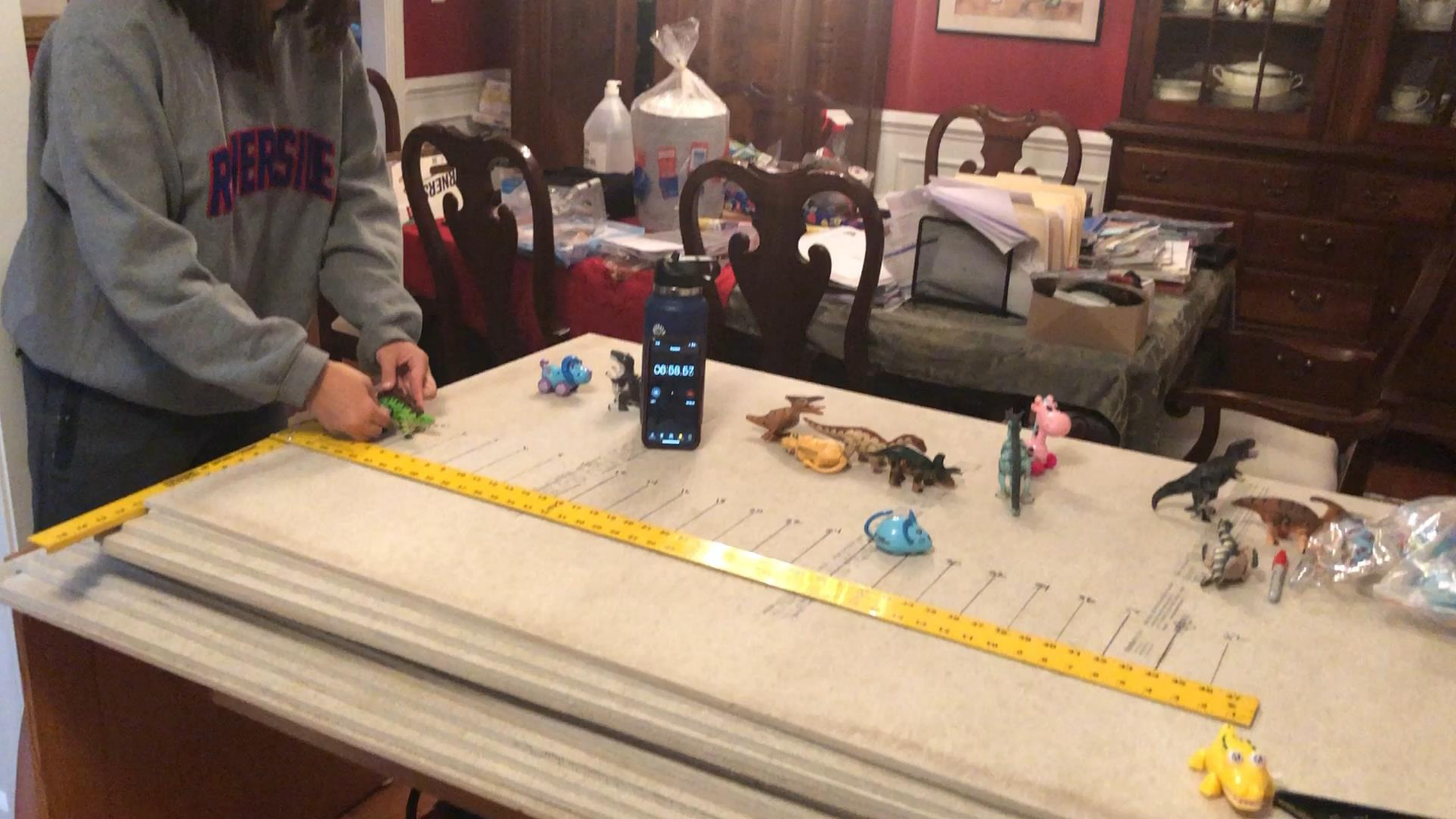
Distance							

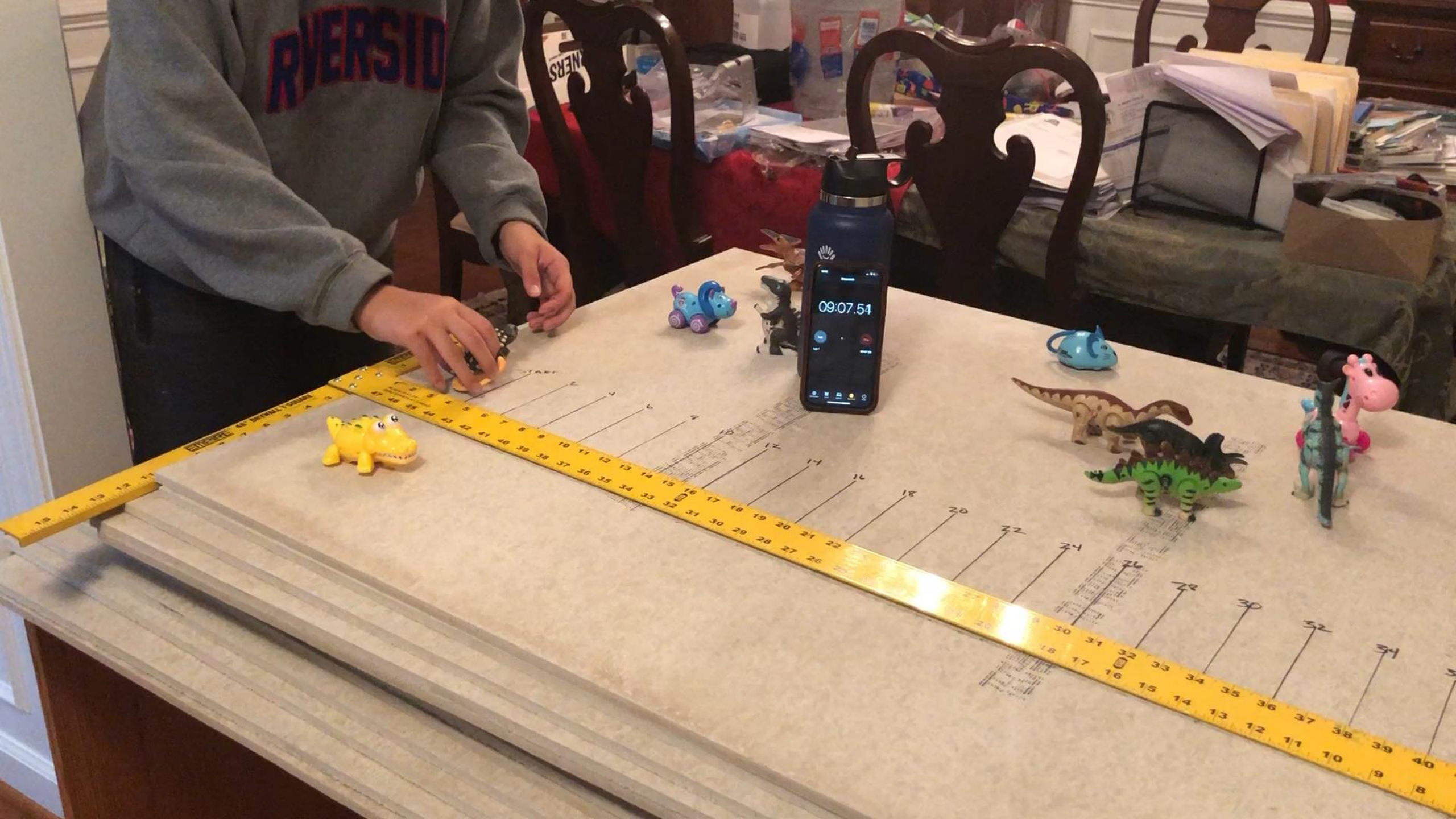








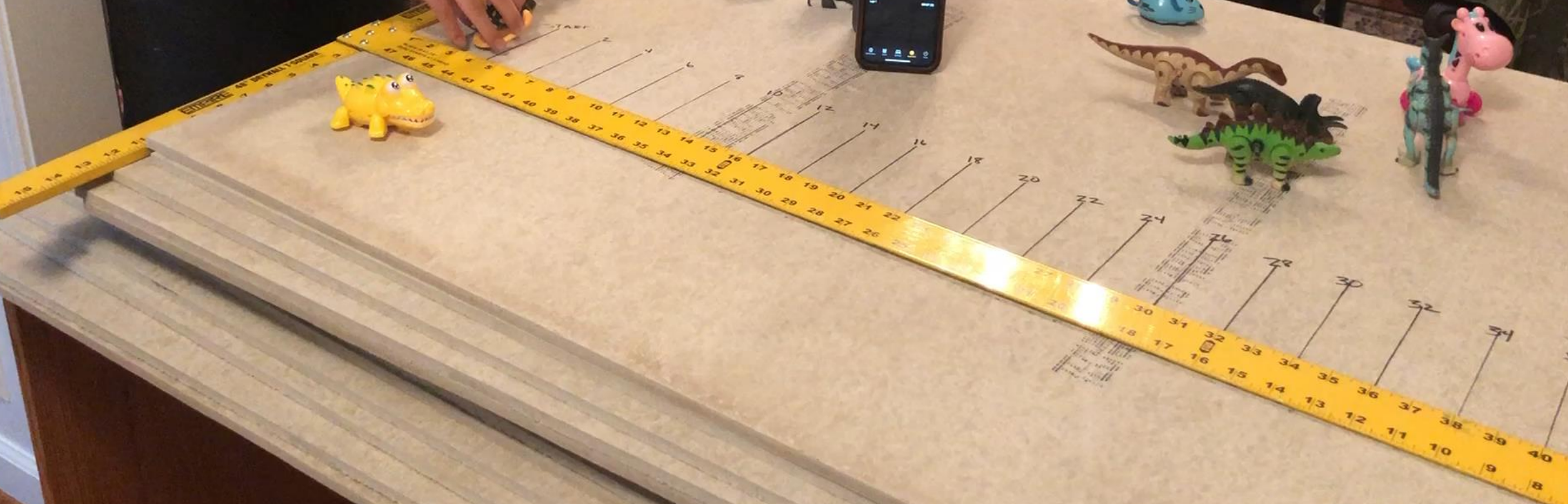


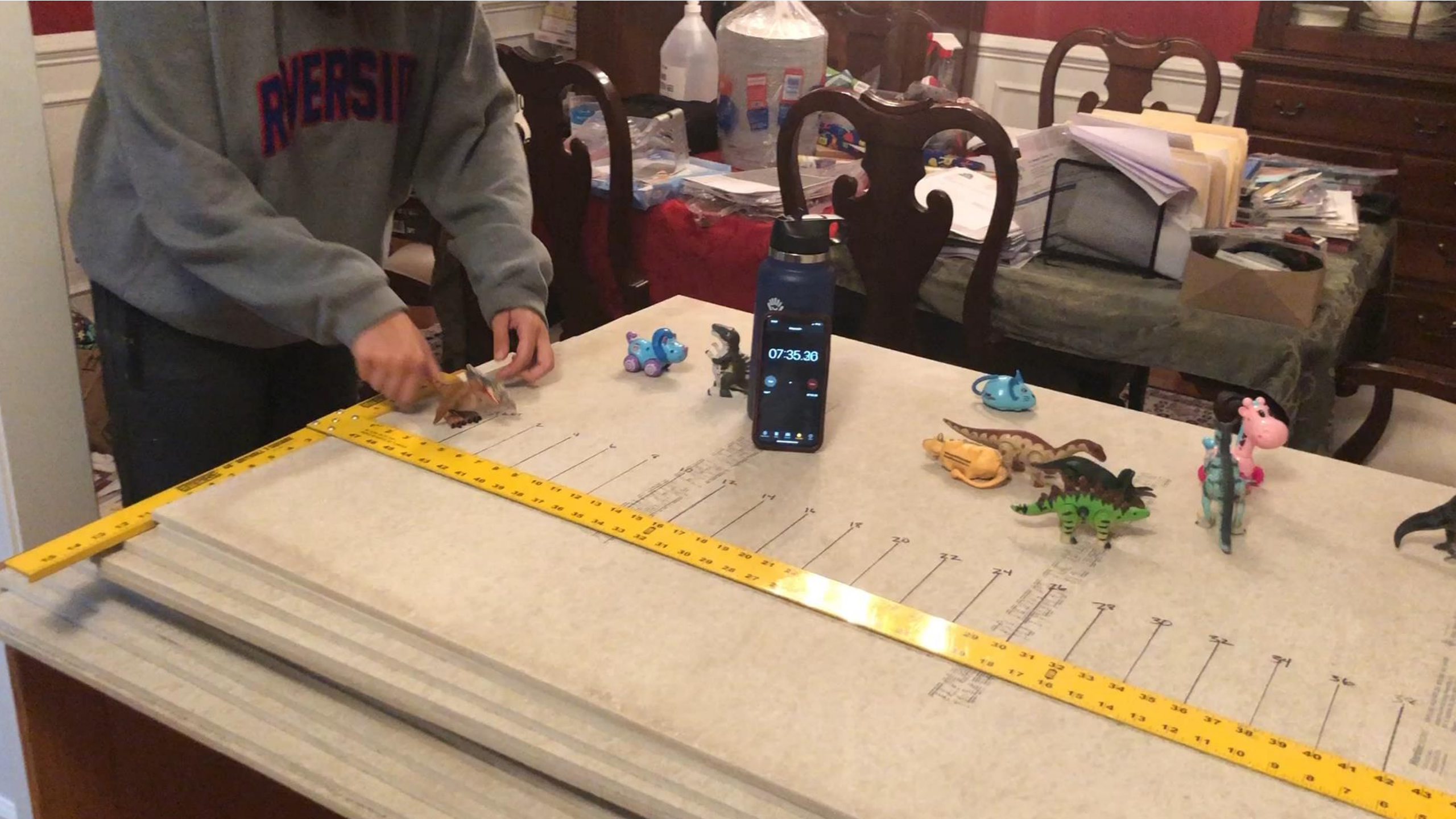


RIVERSIDE

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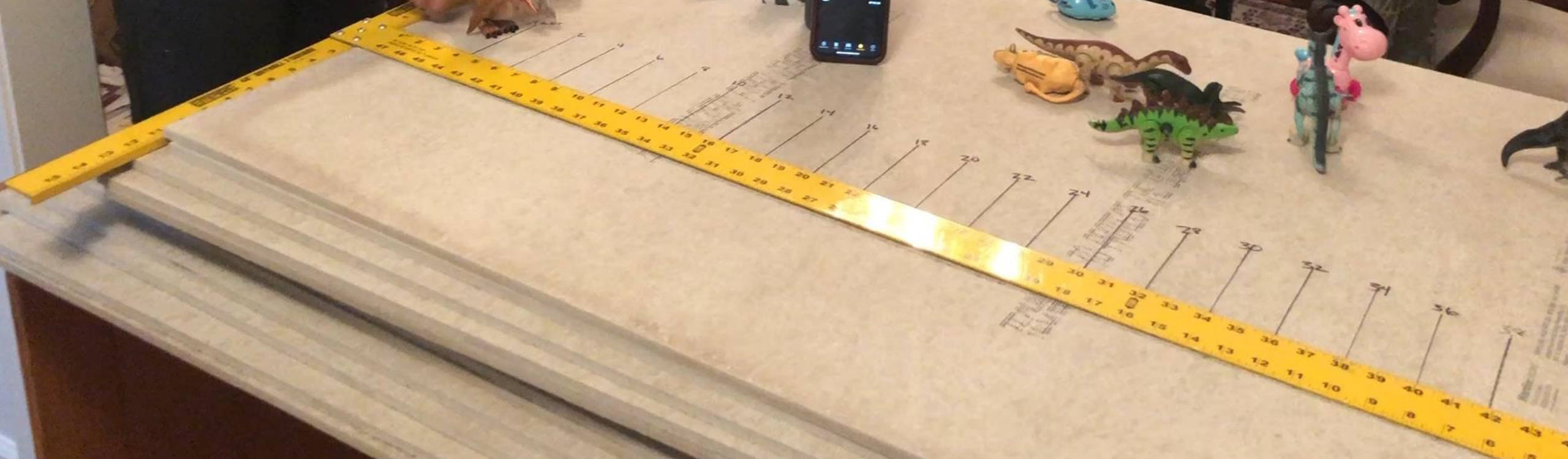
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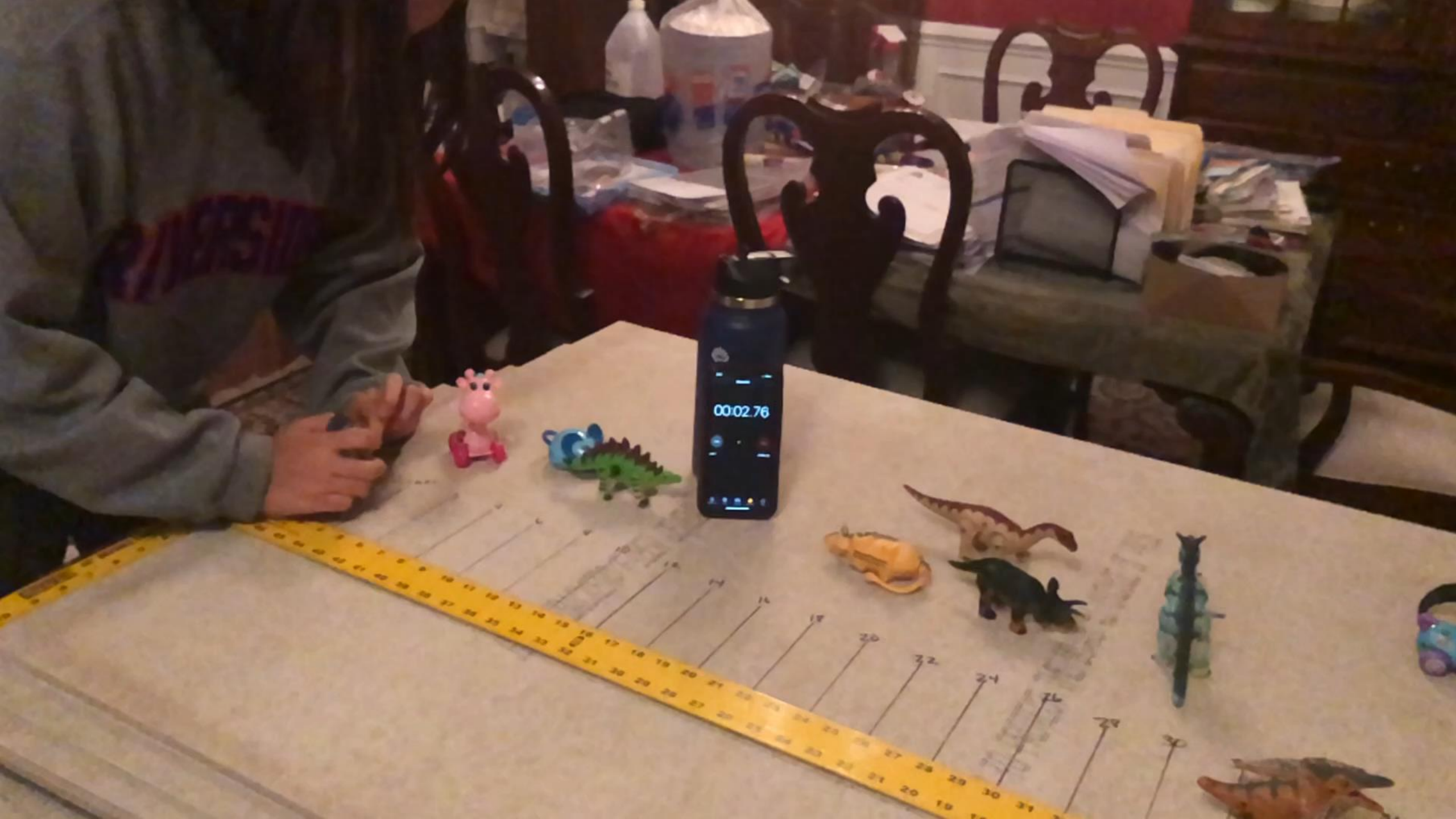




UNIVERSITY

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RIVERSIDE

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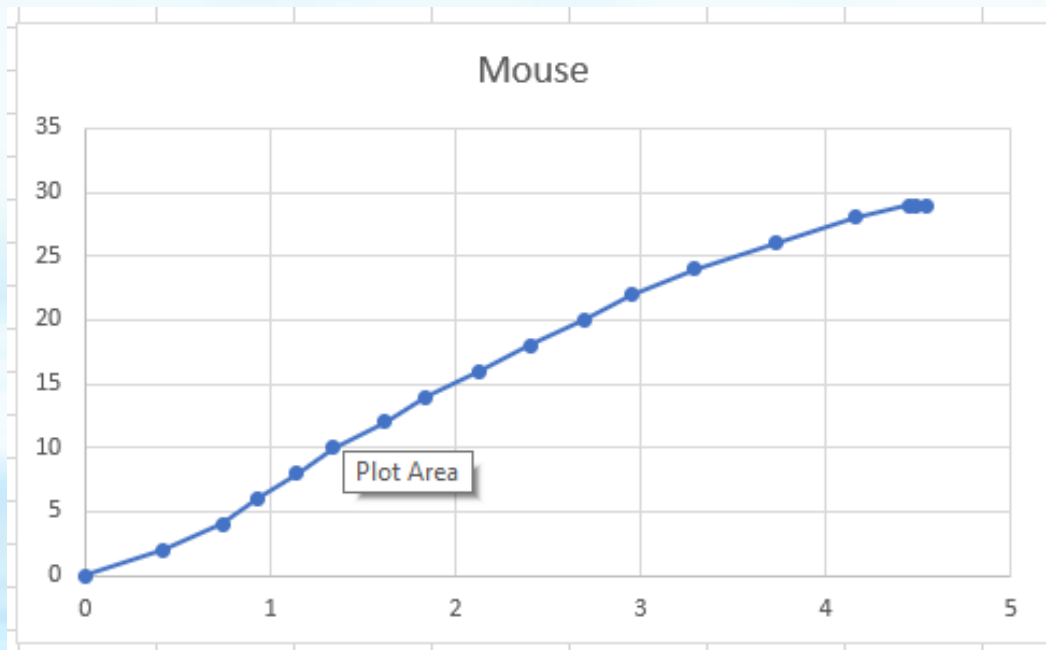


Join Us In the Live Room!

- Share the graphs, the setups, and
- Run the race!
- Connections to STEM.

Mouse	5:41:51 AM	5:41:93 AM	5:42:25 AM	5:42:44 AM	5:42:65 AM	5:42:85 AM	5:43:13 AM	5:43:35 AM	5:43:64 AM	5:43:91 AM	5:44:21 AM	5:44:46 AM	5:44:80 AM	5:45:24 AM	5:45:67 AM	5:45:96 AM	5:46:00 AM	5:46:50 AM
3 turns	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	29	29	29
	1.51	1.93	2.25	2.44	2.65	2.85	3.13	3.35	3.64	3.91	4.21	4.46	4.8	5.24	5.67	5.96	6	6.05
	0	0.42	0.74	0.93	1.14	1.34	1.62	1.84	2.13	2.4	2.7	2.95	3.29	3.73	4.16	4.45	4.49	4.54
	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	29	29	29
	0	0.42	0.74	0.93	1.14	1.34	1.62	1.84	2.13	2.4	2.7	2.95	3.29	3.73	4.16	4.45	4.49	4.54
	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	29	29	29

Time	distance
0	0
0.42	2
0.74	4
0.93	6
1.14	8
1.34	10
1.62	12
1.84	14
2.13	16
2.4	18
2.7	20
2.95	22
3.29	24
3.73	26
4.16	28
4.45	29
4.49	29
4.54	29



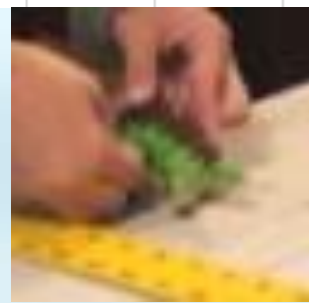
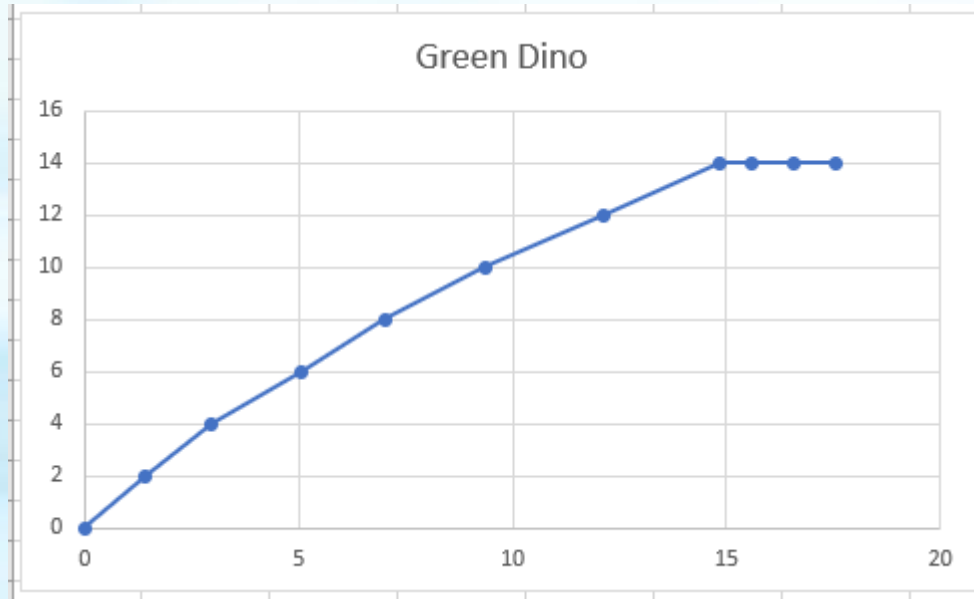
Mouse
(0,0) (4,28)

$$d = t * 7$$



Green din	59.43	0.84	2.4	4.5	6.45	8.78	11.57	14.27	15	16	17
	0	2	4	6	8	10	12	14	14	14	14
Time	0	1.41	2.97	5.07	7.02	9.35	12.14	14.84	15.57	16.57	17.57
distance	0	2	4	6	8	10	12	14	14	14	14

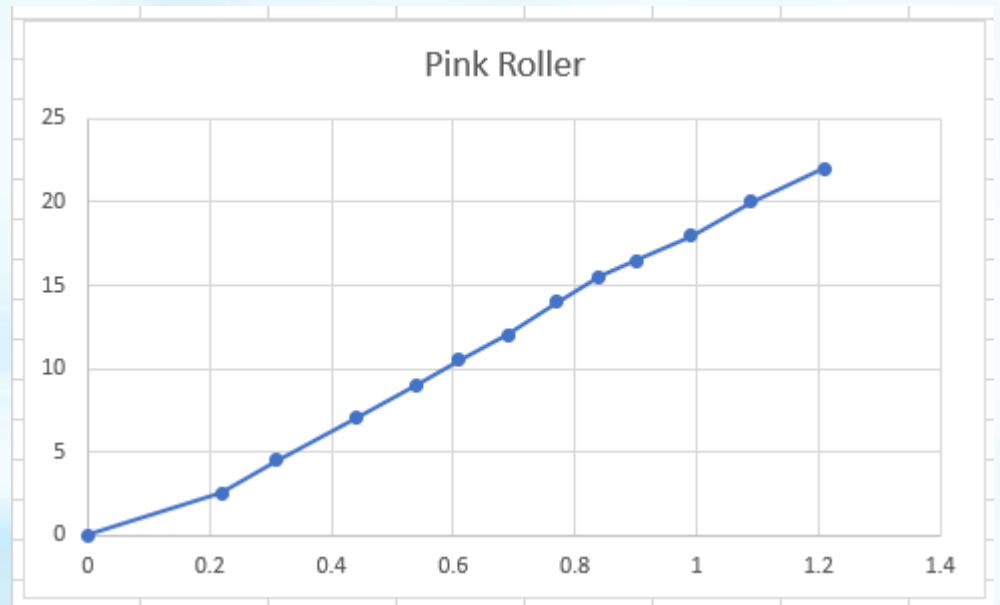
Green Dino	
Time	distance
0	0
1.41	2
2.97	4
5.07	6
7.02	8
9.35	10
12.14	12
14.84	14
15.57	14
16.57	14
17.57	14



- $d = \frac{1}{3}t$ $t < 3$
- $d = 14$ $t > 15$
- $d = \frac{10}{12}(t-3) + 4$ $3 < t < 15$

Pink Roller														
Time	46.43	46.65	46.74	46.87	46.97	47.04	47.12	47.2	47.27	47.33	47.42	47.52	47.64	47.75
Distance	0	2.5	4.5	7	9	10.5	12	14	15.5	16.5	18	20	22	24
Time	0	0.22	0.31	0.44	0.54	0.61	0.69	0.77	0.84	0.9	0.99	1.09	1.21	1.32
Distance	0	2.5	4.5	7	9	10.5	12	14	15.5	16.5	18	20	22	24

Pink Roller	
Time	Distance
0	0
0.22	2.5
0.31	4.5
0.44	7
0.54	9
0.61	10.5
0.69	12
0.77	14
0.84	15.5
0.9	16.5
0.99	18
1.09	20
1.21	22

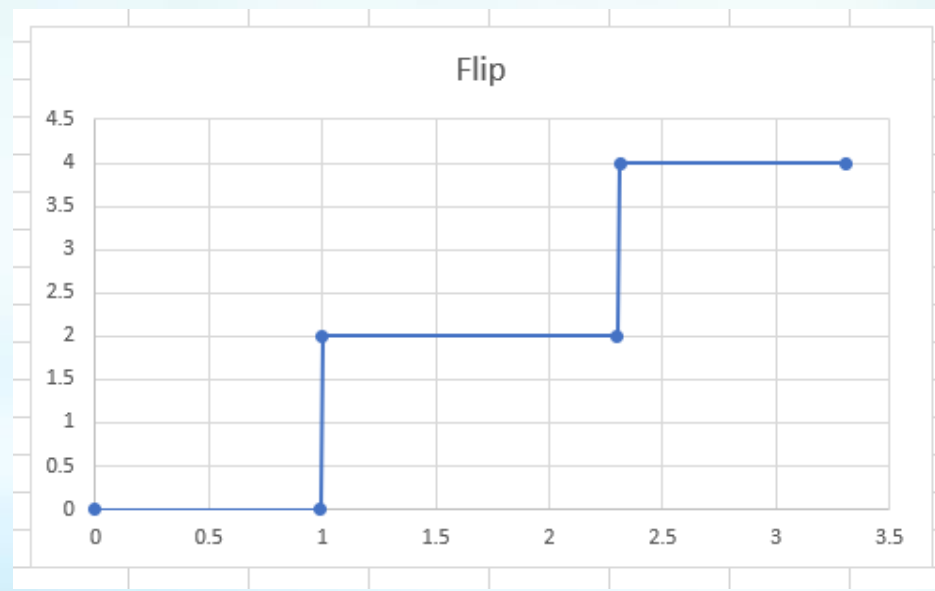


Too Fast!



Flip						
Time	7.97	8.96	8.97	10.27	10.28	11.28
Distance	0	0	2	2	4	4

Flip	Time	Distance
	0	0
	0.99	0
	1	2
	2.3	2
	2.31	4
	3.31	4



- Flip
- 0 $t < 1$
 - 2 $1 < t < 2.5$
 - 4 $2.5 < t$





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The Race!



Possible Race!

- Count down race.
- N second race. What N makes sense?
- M inches race. What M makes sense?
- Last step race. Last step is at the finish line.



Questions, Comments, Thoughts

**And Thank You
Katelyn
for being a part of this session!**



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