	TEAM: Green	
	Belgium	Liesl De Keyzer Tine Deschepper Victor Lambrecht Bram Devlaminck
Hit that ball!	France	Rémi Dupau Jean-Baptiste Chaudun
	Italy	Edoardo, Aishe, Ludovica, Daniele, Irene
EXPERIMENT: Throw with different sizes of basketballs		

1. ORIENTATION

1.1. **Research question:**

How do the speed and trajectory change during a throw in a basketball hoop?

Sub question:

How do the weight and size influence this?

1.2. **Hypothesis**

The speed and trajectory of the throw decreases when we increase the weight and size of the balls. We expect this because when the weight of something increases, the force that creates the movement has to increase too to obtain the same arc and velocity when the ball is in the air.

2. PREPARATION

2.1. **Material**:

- 3 to 5 balls with a different weight (for this experiment we use balls that get heavier when they get bigger, so the smallest ball should be the lightest)
- A mobile phone to film the different throws
- A computer with the application *Tracker* on it
- A basketball hoop
- A ruler and some tape to calibrate

2.2. Method:

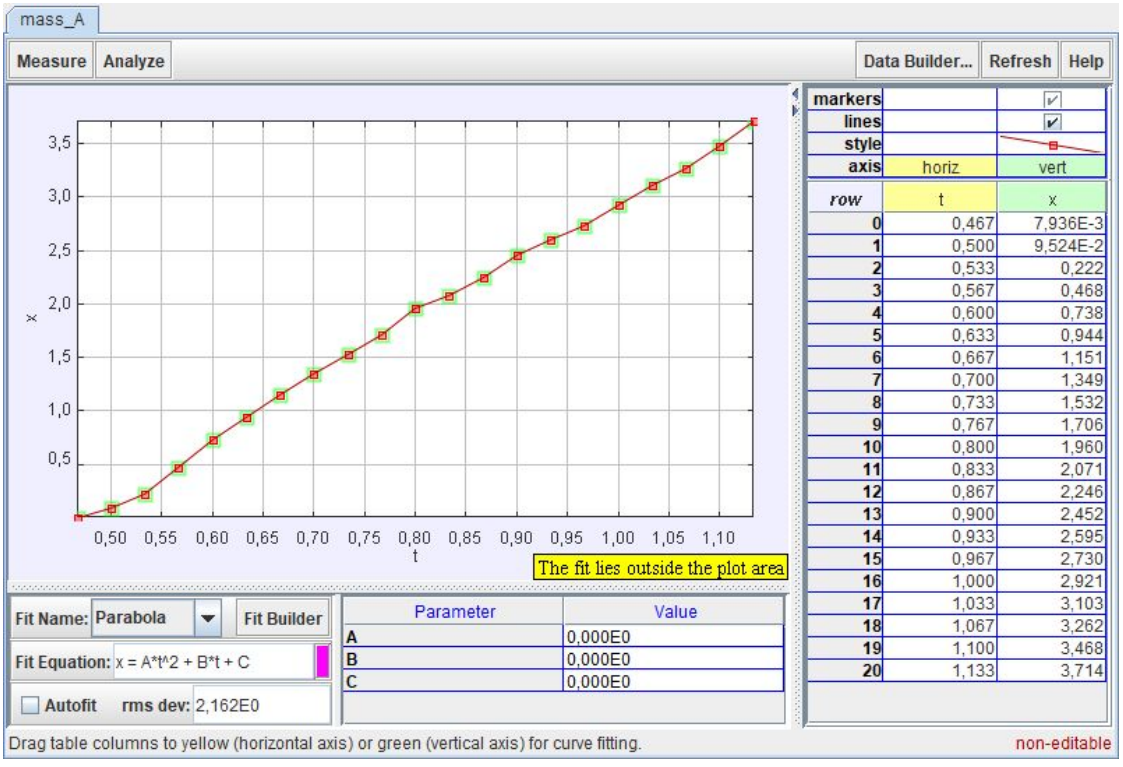
- Calibrate by putting 2 pieces of tape on the wall with 30 cm between them (vertically), make sure this calibration is visible during the entire video
- While filming, don't move your phone. You need a static image to use *Tracker*.
- Let a pupil throw a ball into a basketball hoop, while another pupil films the whole throw. Make sure the whole track of the ball is on the small film for the *Tracker* application.
- Do the same thing for the other weights. It's best if the same pupil throws the balls because the strength will influence the track: the harder you throw, the farther the ball will get.

3. DATA ANALYSIS and DISCUSSION

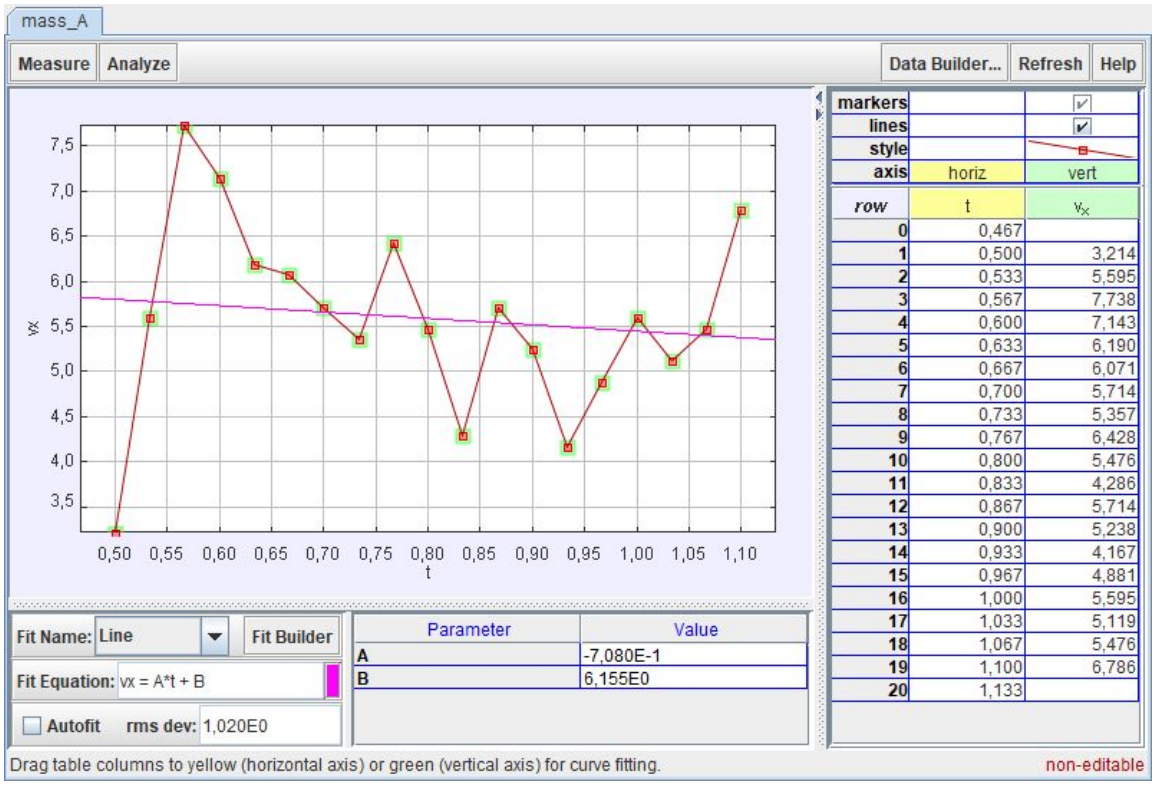
3.1. Observations and Measurements:

Belgian experiment (analysed by Belgian team)

Throw with a tennis ball (60 grams)

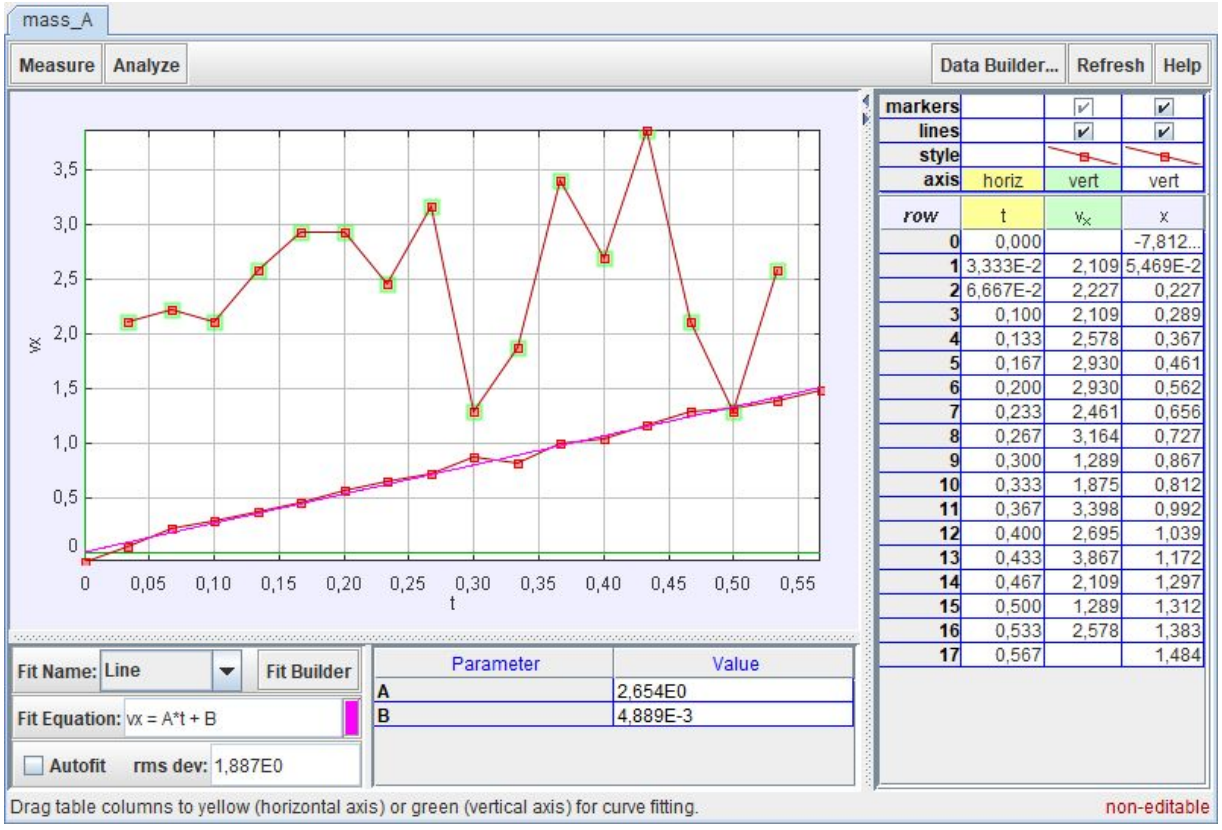


markers		☑
lines		☑
style		
axis	horiz	vert
row	t	x
0	0,467	7,936E-3
1	0,500	9,524E-2
2	0,533	0,222
3	0,567	0,468
4	0,600	0,738
5	0,633	0,944
6	0,667	1,151
7	0,700	1,349
8	0,733	1,532
9	0,767	1,706
10	0,800	1,960
11	0,833	2,071
12	0,867	2,246
13	0,900	2,452
14	0,933	2,595
15	0,967	2,730
16	1,000	2,921
17	1,033	3,103
18	1,067	3,262
19	1,100	3,468
20	1,133	3,714



v_x= -7,08t+ 6,155

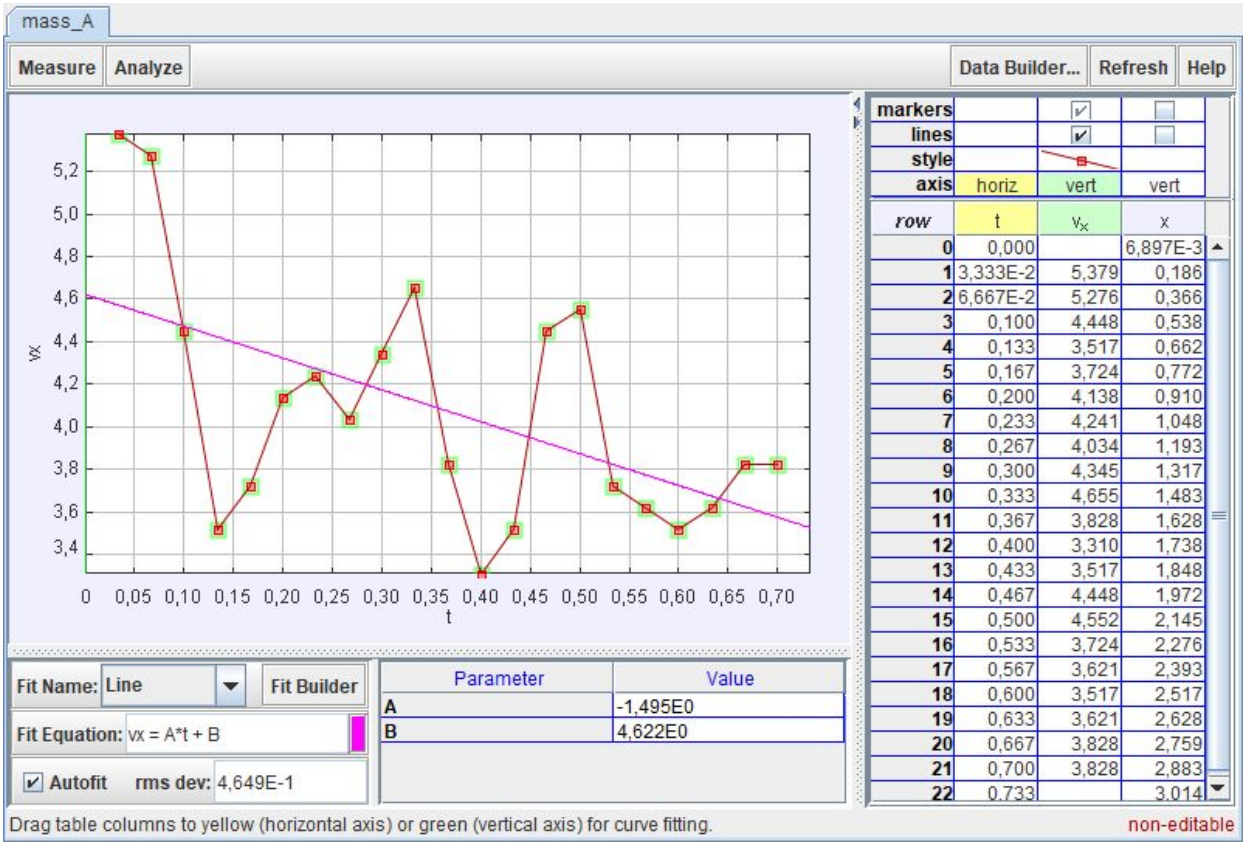
Throw with a power ball (5 kilograms)



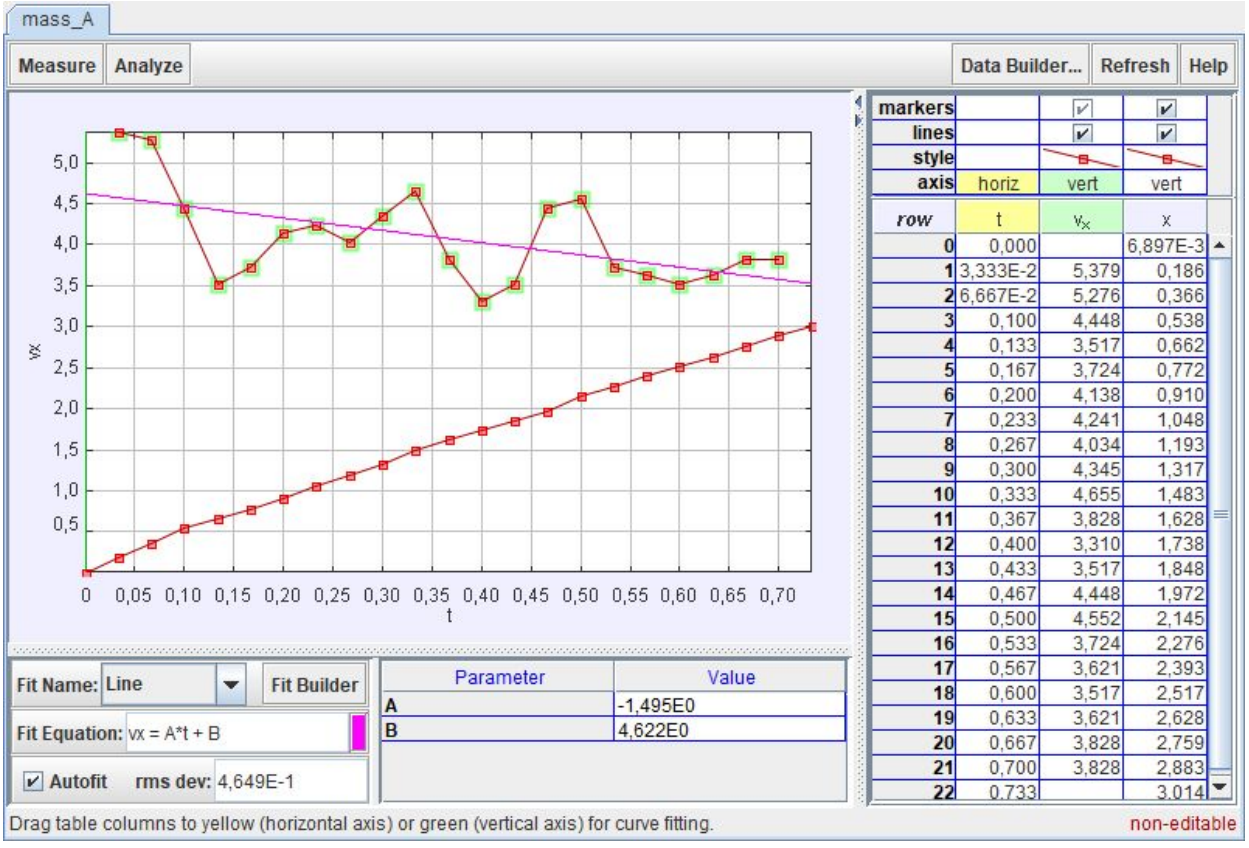
v_x = 2,65t + 4,89

Experiment

throw with a volleyball (260 grams)



markers		☑	☐
lines		☑	☐
style			
axis	horiz	vert	vert
row	t	v_x	x
0	0,000		6,897E-3
1	3,333E-2	5,379	0,186
2	6,667E-2	5,276	0,366
3	0,100	4,448	0,538
4	0,133	3,517	0,662
5	0,167	3,724	0,772
6	0,200	4,138	0,910
7	0,233	4,241	1,048
8	0,267	4,034	1,193
9	0,300	4,345	1,317
10	0,333	4,655	1,483
11	0,367	3,828	1,628
12	0,400	3,310	1,738
13	0,433	3,517	1,848
14	0,467	4,448	1,972
15	0,500	4,552	2,145
16	0,533	3,724	2,276
17	0,567	3,621	2,393
18	0,600	3,517	2,517
19	0,633	3,621	2,628
20	0,667	3,828	2,759
21	0,700	3,828	2,883
22	0,733		3,014

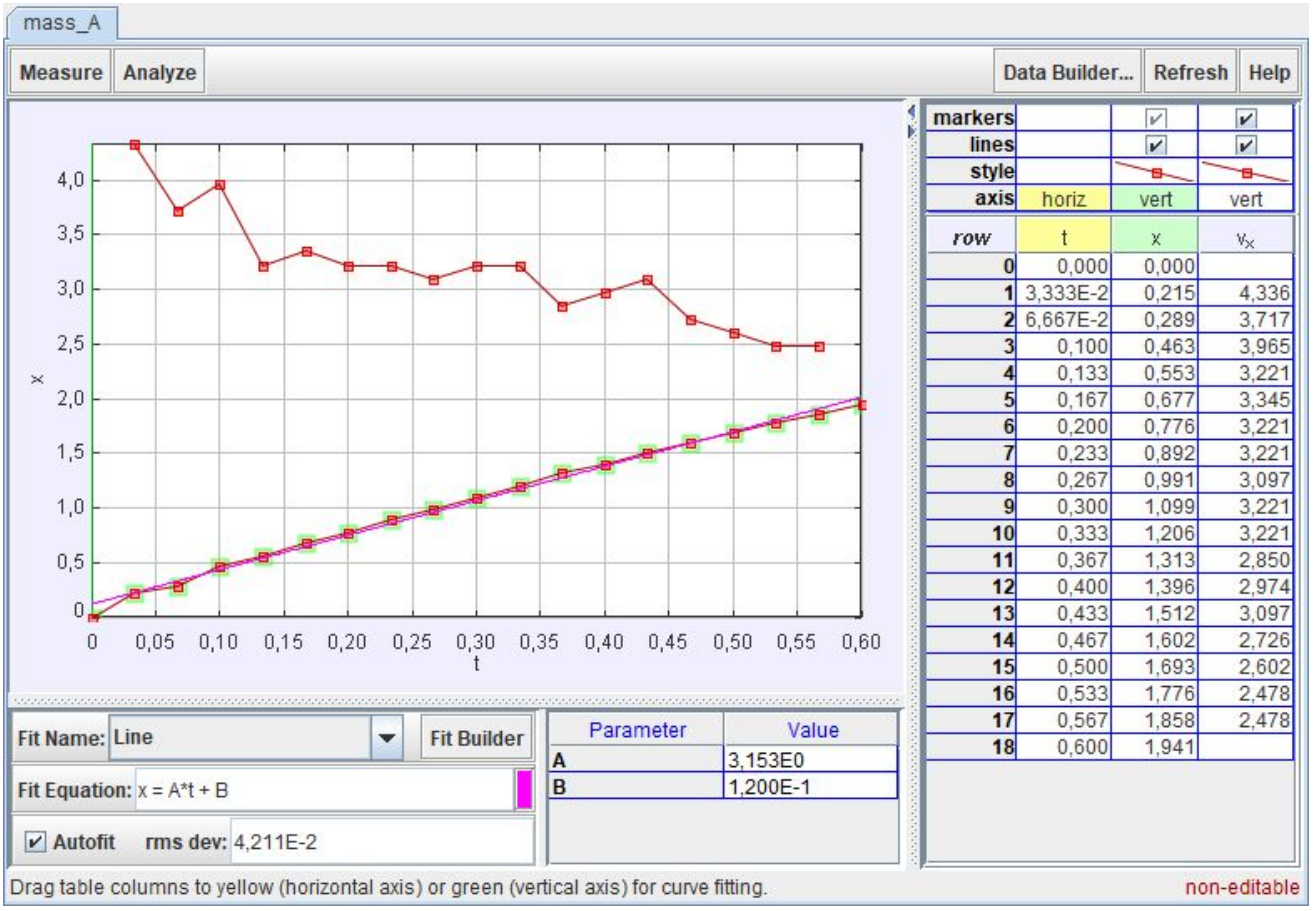


markers		☑	☑
lines		☑	☑
style			
axis	horiz	vert	vert
row	t	v_x	x
0	0,000		6,897E-3
1	3,333E-2	5,379	0,186
2	6,667E-2	5,276	0,366
3	0,100	4,448	0,538
4	0,133	3,517	0,662
5	0,167	3,724	0,772
6	0,200	4,138	0,910
7	0,233	4,241	1,048
8	0,267	4,034	1,193
9	0,300	4,345	1,317
10	0,333	4,655	1,483
11	0,367	3,828	1,628
12	0,400	3,310	1,738
13	0,433	3,517	1,848
14	0,467	4,448	1,972
15	0,500	4,552	2,145
16	0,533	3,724	2,276
17	0,567	3,621	2,393
18	0,600	3,517	2,517
19	0,633	3,621	2,628
20	0,667	3,828	2,759
21	0,700	3,828	2,883
22	0,733		3,014

v_x= -1.495*t + 4.622

Experiment

throw with a basketball (560 grams) (Belgian experiment)

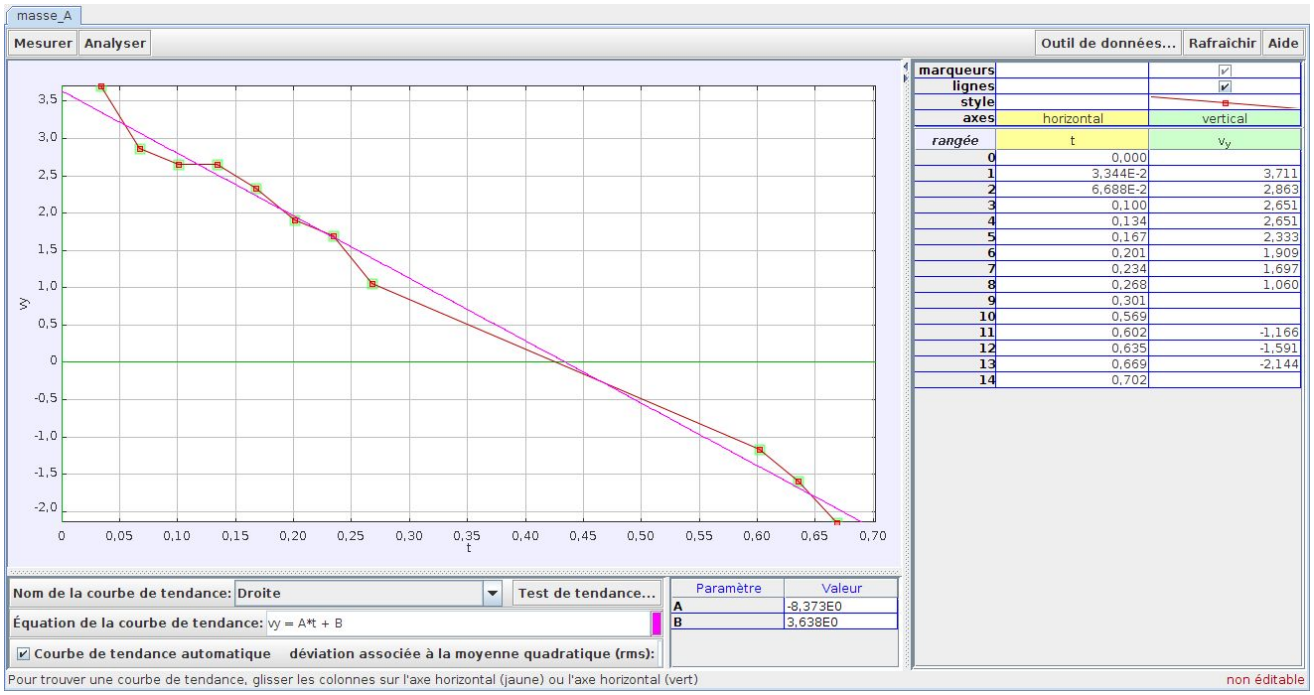


markers		☑	☑
lines		☑	☑
style			
axis	horiz	vert	vert

row	t	x	v_x
0	0,000	0,000	
1	3,333E-2	0,215	4,336
2	6,667E-2	0,289	3,717
3	0,100	0,463	3,965
4	0,133	0,553	3,221
5	0,167	0,677	3,345
6	0,200	0,776	3,221
7	0,233	0,892	3,221
8	0,267	0,991	3,097
9	0,300	1,099	3,221
10	0,333	1,206	3,221
11	0,367	1,313	2,850
12	0,400	1,396	2,974
13	0,433	1,512	3,097
14	0,467	1,602	2,726
15	0,500	1,693	2,602
16	0,533	1,776	2,478
17	0,567	1,858	2,478
18	0,600	1,941	

$v_x = 3,15t + 1,2$

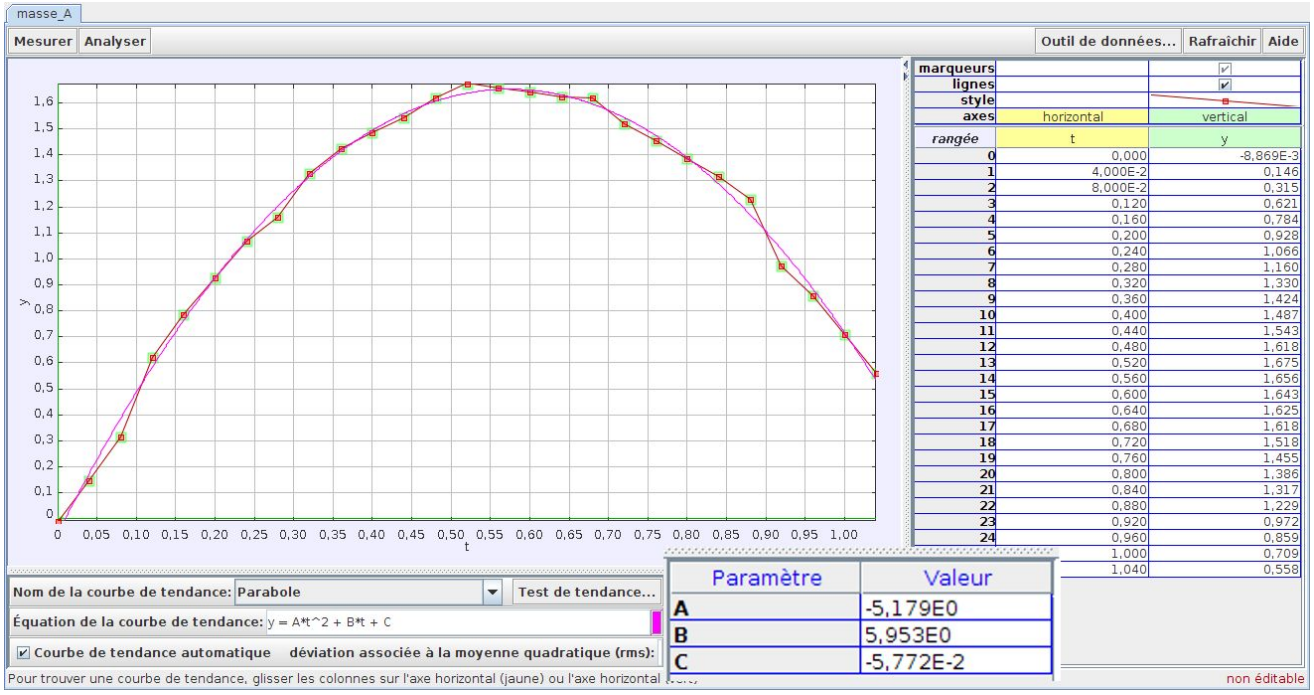
Experiment



marqueurs		
lignes		
style		
axes	horizontal	vertical
rangée	t	v_y
0	0,000	
1	3,344E-2	3,711
2	6,688E-2	2,863
3	0,100	2,651
4	0,134	2,651
5	0,167	2,333
6	0,201	1,909
7	0,234	1,697
8	0,268	1,060
9	0,301	
10	0,569	
11	0,602	-1,166
12	0,635	-1,591
13	0,669	-2,144
14	0,702	

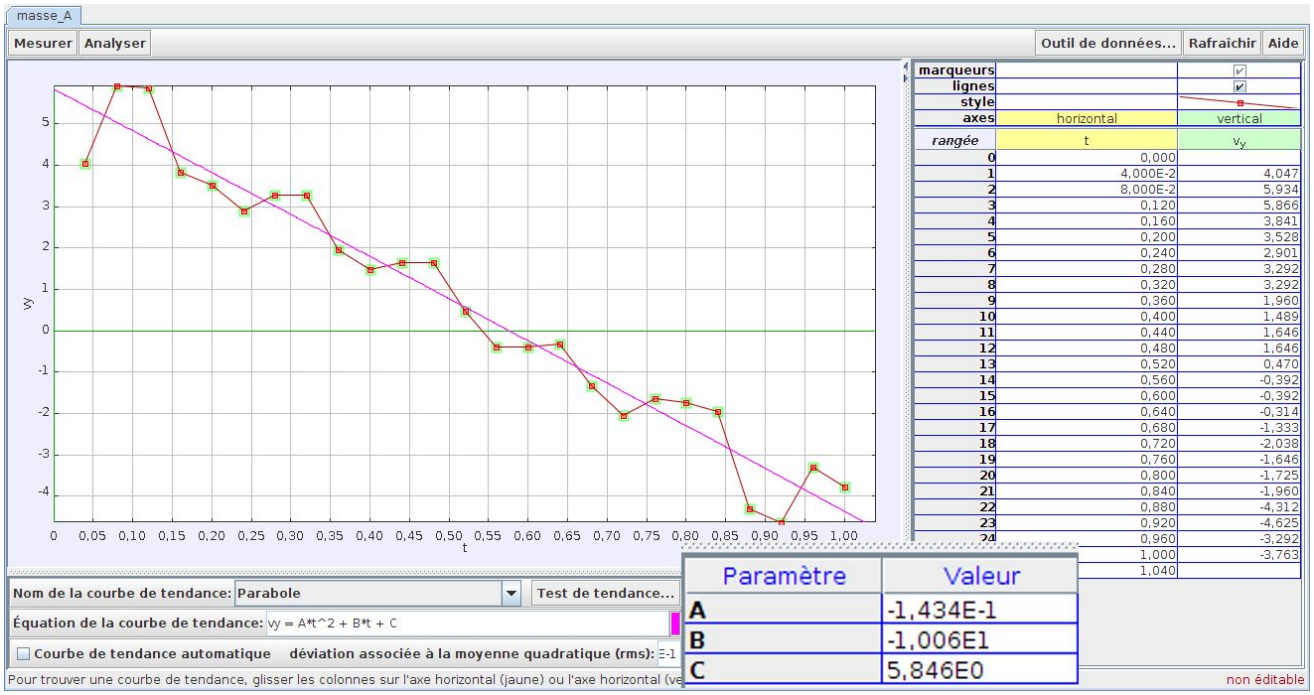
v_x= -8.373*t+3.638

Professional player shot analysed by French



marqueurs		
lignes		
style		
axes	horizontal	vertical
rangée	t	y
0	0,000	-8,869E-3
1	4,000E-2	0,146
2	8,000E-2	0,315
3	0,120	0,621
4	0,160	0,784
5	0,200	0,928
6	0,240	1,066
7	0,280	1,160
8	0,320	1,330
9	0,360	1,424
10	0,400	1,487
11	0,440	1,543
12	0,480	1,618
13	0,520	1,675
14	0,560	1,656
15	0,600	1,643
16	0,640	1,625
17	0,680	1,618
18	0,720	1,518
19	0,760	1,455
20	0,800	1,386
21	0,840	1,317
22	0,880	1,229
23	0,920	0,972
24	0,960	0,859
	1,000	0,709
	1,040	0,558

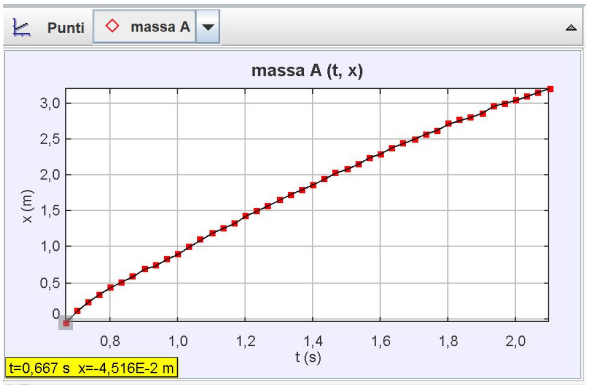
Experiment



Paramètre	Valeur
A	-1,434E-1
B	-1,006E1
C	5,846E0

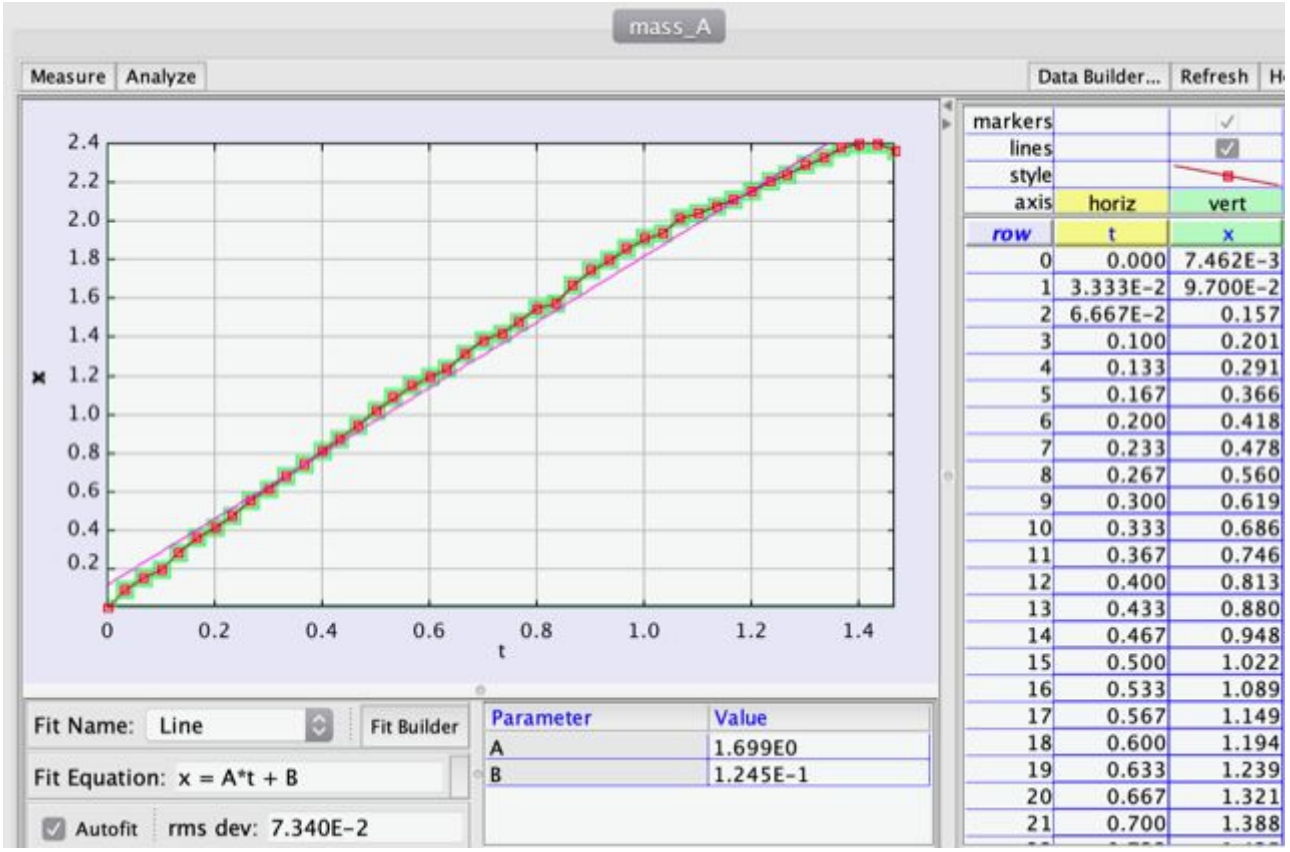
Experiment

Belgian experiment (analysed by Italian team)



Dati | massa A

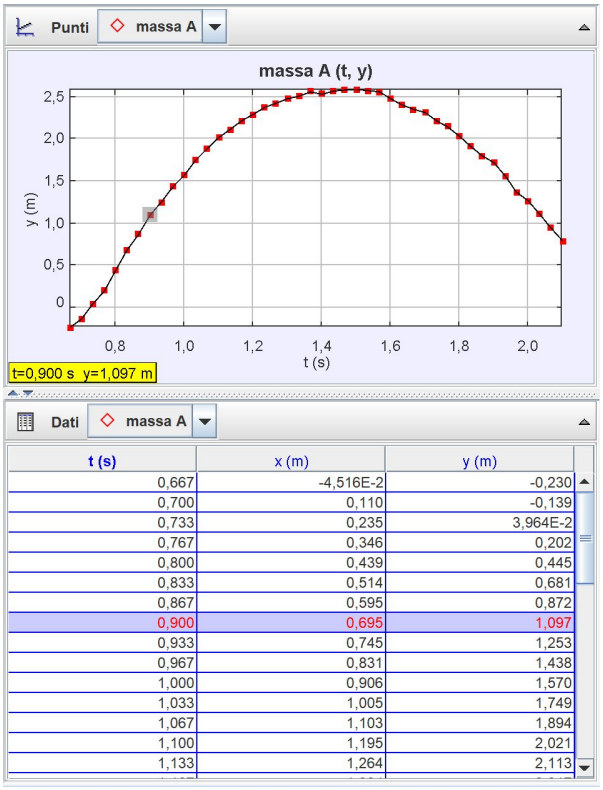
t (s)	x (m)	y (m)
0,667	-4,516E-2	-0,230
0,700	0,110	-0,139
0,733	0,235	3,964E-2
0,767	0,346	0,202
0,800	0,439	0,445
0,833	0,514	0,681
0,867	0,595	0,872
0,900	0,700	1,176
0,933	0,745	1,253
0,967	0,831	1,438
1,000	0,906	1,570
1,033	1,005	1,749
1,067	1,103	1,894
1,100	1,195	2,021
1,133	1,264	2,113



markers		✓
lines		✓
style		
axis	horiz	vert
row	t	x
0	0.000	7.462E-3
1	3.333E-2	9.700E-2
2	6.667E-2	0.157
3	0.100	0.201
4	0.133	0.291
5	0.167	0.366
6	0.200	0.418
7	0.233	0.478
8	0.267	0.560
9	0.300	0.619
10	0.333	0.686
11	0.367	0.746
12	0.400	0.813
13	0.433	0.880
14	0.467	0.948
15	0.500	1.022
16	0.533	1.089
17	0.567	1.149
18	0.600	1.194
19	0.633	1.239
20	0.667	1.321
21	0.700	1.388

Horizontal displacement of the Belgian shot: x (t) = 1,70 t + 0,124

Experiment



t (s)	x (m)	y (m)
0,667	-4,516E-2	-0,230
0,700	0,110	-0,139
0,733	0,235	3,964E-2
0,767	0,346	0,202
0,800	0,439	0,445
0,833	0,514	0,681
0,867	0,595	0,872
0,900	0,695	1,097
0,933	0,745	1,253
0,967	0,831	1,438
1,000	0,906	1,570
1,033	1,005	1,749
1,067	1,103	1,894
1,100	1,195	2,021
1,133	1,264	2,113

Vertical displacement of the Belgian shot y=

3.2. Discussion of Italian by Belgian team:

Newton's 3rd law says: F = m*a

As we threw approximately with the same force, and the mass of the ball increases, a should decrease. As we don't really see the differences in acceleration with different masses, we can't say anything about our research questions. We can, however, tell something about the difference in speed in a throw. In these graph, it looks like the speed in a throw decreases. When the ball is at its highest point, v=0. From then, the speed will continue to increase as the

a. Discussion by French team on Italian analysis of Belgian experiments

y=2.63t-1.7

y

4. REFLECTION

4.1. **Conclusion**:

4.2. **Comparison** of the results of the different countries

Experiment

4.3. Reflection:

We think the measurements of our experiment aren’t really reliable as we can’t be sure that the students threw with the exact same force.

5. REFERENCES