eTwinning	TEAM: 6	
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Smartphone-accelerations into physics situations	Italy	Ginevra Dalpozzo Giacomo Minotti
EXPERIMENT:		

1. ORIENTATION

1.1. Description

Put your phone or other tracking device in a cylinder. After that, the second step is to build a inclination using a wooden shelf. After that, we will roll the cylinder with the phone in it from the top to the bottom and thus tracking the speed. We will repeat this process a few times, each time with another type of surface.

1.2. Research question:

1.3.

What is the relation between the surface used for rolling an object and the speed of that moving object?

Sub-questions:

- Which material causes the least friction and what is the effect on the speed of the object?
- How big are the differences between the speed of the roll on each one of the surfaces?

1.4. Hypothesis

The paper underground will show the highest, final velocity and thus the highest speed, as it has the smoothest surface with the least amount of irregularities. It will show a huge difference

between the sandpaper and fabric. The fabric will be the worst, because we think that that experiment will prove the existence of a high value of friction. Fabric isn't the most smooth surface, so we think that the roll will be slowed down rapidly. Sandpaper also contains an irregular underground, which will have an impact on the speed of the object. It will all depend on which kind of wood used. If the wooden shelf doesn't contain any wrinkles. However, we think that the relation between the speed of the different undergrounds will be as following: paper > wood > sandpaper > fabric

2. PREPARATION

2.1. **Material**:

- Cylinder tube wide enough to put a phone in
- Wood to let the cylinder roll off
- Wood, fabric, normal white paper and sandpaper used as surfaces on the wooden inclination
- Phone with app of Phyphox
- ruler

-**Method:**

1. Put your phone or tracking device into a cardboard cylinder with a radius of around 5cm.
2. Build an inclination using the wooden shelf at about 25°.
3. Place a piece of white paper on the wooden shelf so that it is entirely covered.
4. Let the cylinder roll from the top of the shelf to the bottom, where you will stop the cylinder (at the bottom). This way, you will measure the speed of the cylinder from the top to the bottom. Do this 3 times in order to receive a most perfect measurement.
5. Repeat this process another 3 times, once with a fabric underground , another time without any extra surface and thus on the wood itself and a last time on sandpaper.
6. This way, you will have done this experiment 4 times, and each surface tested and repeated 3 times. In total: 12 measurements.
7. Put these data into a graph and evaluate the data. Answer on the research question and read the hypothesis another time.

3. DATA ANALYSIS and DISCUSSION

3.1. Observations and Measurements:

1) Paper

Time (s)	Velocity (m/s)	Gyroscope y (rad/s)
0	-0,004887085	-0,122177
0,014285	-0,004589233	-0,114731
0,054691	-0,002841797	-0,071045
0,095126	-0,001862183	-0,046555
0,135532	-0,003097534	-0,077438
0,175967	-0,005228271	-0,130707
0,216373	-0,016690674	-0,417267
0,256809	-0,06795105	-1,698776
0,297244	-0,194163208	-4,854080
0,33768	-0,32894043	-8,223511
0,378085	-0,463121338	-11,578033
0,418521	-0,61984314	-15,496078
0,458926	-0,748186035	-18,704651
0,499362	-0,806434937	-20,160873
0,539798	-0,850025635	-21,250641
0,580234	-0,92557373	-23,139343
0,620639	-1,010369263	-25,259232
0,661075	-1,047227173	-26,180679
0,70148	-1,059711914	-26,492798
0,741885	-0,993154297	-24,828857
0,782321	-1,013820801	-25,345520
0,822726	-1,003423462	-25,085587
0,863162	-0,74588501	-18,647125
0,903598	-0,171068726	-4,276718

2) Fabric

Time (s)	Velocity (m/s)	Gyroscope y (rad/s)
0,095169	0,000195923	0,004898
0,135605	-0,000783691	-0,01959
0,176041	-0,004959717	-0,12399
0,216477	-0,008325806	-0,20815
0,256912	-0,005002441	-0,12506
0,297318	2,56348E-05	0,00064
0,337723	-0,028182373	-0,70456
0,378159	-0,145830078	-3,64575
0,418564	-0,273065796	-6,82664
0,459	-0,386750488	-9,66876
0,499436	-0,494768066	-12,36920
0,539841	-0,654387817	-16,35970
0,580277	-0,771992798	-19,29982
0,620682	-0,790997314	-19,77493
0,661118	-0,796707153	-19,91768
0,701523	-0,793255615	-19,83139
0,741989	-0,851546631	-21,28867
0,782394	-0,983596802	-24,58992
0,82283	-1,11121582	-27,78040
0,863266	-1,321115112	-33,02788
0,903671	-1,396408081	-34,91020
0,944077	-1,396408081	-34,91020
0,984512	-1,175429688	-29,38574
1,024918	-0,215371094	-5,38428
1,065353	0,136592407	3,41481
1,105789	0,067904053	1,69760

3) Without any surface

Time (s)	Velocity (m/s)	Gyroscope y (rad/s)
0	0,001787109	0,044678
0	0,000380859	0,009521
0,038624	-0,000556641	-0,01392
0,07906	-0,001366577	-0,03416
0,119465	-0,000216064	-0,0054
0,15987	0,000465698	0,011642
0,200306	-0,003582153	-0,08955
0,240742	-0,006266479	-0,15666
0,281147	-0,010442505	-0,26106
0,321553	-0,069117432	-1,72794
0,361988	-0,166951294	-4,17378
0,402394	-0,23921875	-5,98047
0,442799	-0,275650635	-6,89127

4) Sandpaper

Time (s)	Velocity (m/s)	Gyroscope y (rad/s)
0	-0,00403	-0,08064
0,008686	-0,00701	-0,14029
0,049092	-0,00861	-0,17224
0,089527	-0,00989	-0,19781
0,129933	-0,02805	-0,56107
0,170368	-0,08089	-1,61781
0,210804	-0,15445	-3,08894
0,25124	-0,09122	-1,82448
0,291645	-0,02134	-0,42685
0,332081	-0,14608	-2,92169
0,372486	-0,31552	-6,3103
0,412922	-0,47477	-9,49544
0,453358	-0,61762	-12,3525

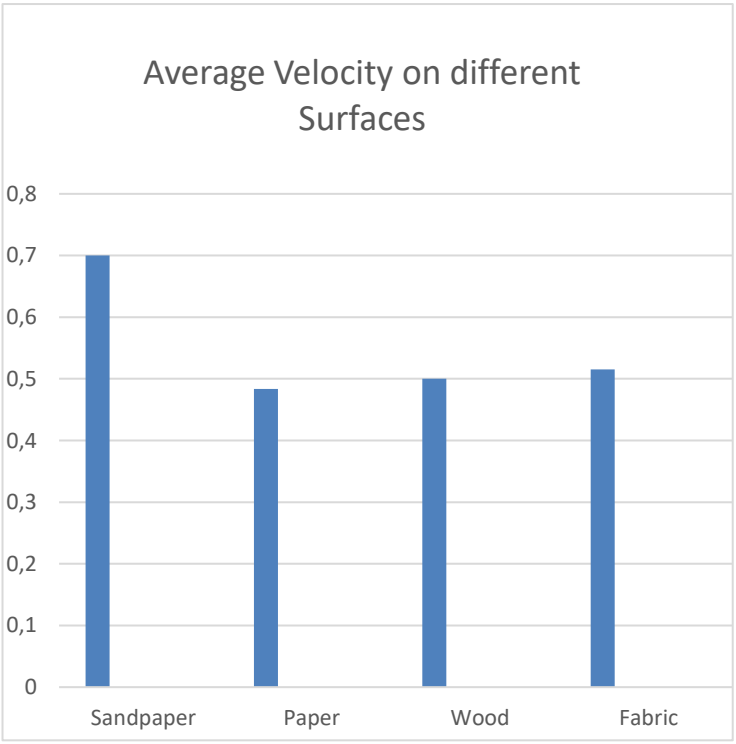
Experiment

0,483235	-0,308843994	-7,7211
0,523671	-0,358187256	-8,95468
0,564076	-0,444942627	-11,1236
0,604481	-0,57026001	-14,2565
0,644917	-0,721271973	-18,0318
0,685322	-0,866488647	-21,6622
0,725727	-1,033139038	-25,8285
0,766163	-1,206436157	-30,1609
0,806599	-1,279641113	-31,991
0,847004	-1,233237915	-30,8309
0,88741	-1,245424805	-31,1356
0,927845	-1,357319946	-33,933
0,968251	-1,396351318	-34,9088
1,008686	-1,392005005	-34,8001
1,049122	-1,031732788	-25,7933
1,089558	-0,419248047	-10,4812
1,129963	0,051854248	1,296356
1,170369	0,074011841	1,850296

0,493763	-0,80287	-16,0575
0,534199	-0,9673	-19,3459
0,574604	-1,00772	-20,1545
0,61504	-1,0351	-20,702
0,655445	-1,31122	-26,2243
0,695881	-1,37838	-27,5677
0,736317	-1,26349	-25,2699
0,776753	-1,24799	-24,9599
0,817158	-1,41274	-28,2547
0,857563	-1,72358	-34,4716
0,897999	-1,70723	-34,1446
0,938404	-1,7443	-34,886
0,97884	-1,6113	-32,2261
1,019245	-1,43559	-28,7117
1,059681	-1,26312	-25,2624
1,100117	-0,33373	-6,67462
1,140553	0,349743	6,994858
1,180958	0,148833	2,976669

3.2. Discussion:

Now that we have all the measurements, we can calculate the average speed the phone had before it came to a stop. The results can be found in the table below. We didn't see much results. The different velocities lay close to one another. Sandpaper had the most rough surface. This results in a rather bizarre value, as we see that it shows the highest speed of them all, 0.7 m/s. The other velocities all lay close to 0.5 m/s. Paper showed almost no rough surface; the same with wood, but fabric was rather resistant.



Experiment

Paper	Fabric	Wood	Sandpaper
-0,48363 m/s	-0,51544 m/s	-0,500303 m/s	-0,700213 m/s

4. REFLECTION

4.1. Conclusion: According to the averages that we calculated in 3.2, the phone went the fastest on sandpaper, followed by the fabric, then the wood and it was the slowest on paper.

4.2. Comparison of the results of the different countries

4.3. Reflection: We think the wooden plank was a bit too short and the inclination was also a bit too steep. The experiment went as we planned, we didn't have any complications during it. We thought the diagram would show this result: paper > wood > sandpaper > fabric. This is not true. Sandpaper showed the highest speed of them all. This is very strange, as we think it would cause the most friction. We see the exact opposite order: sandpaper > fabric > wood > paper. We lay the problem in the fact that the plank was too short. Also the inclination was too high. This causes the cylinder to roll so fast, that the little friction would not cause any resistance for that matter.

5. REFERENCES