Title: Projectile motion

Purpose: To study projectile motion

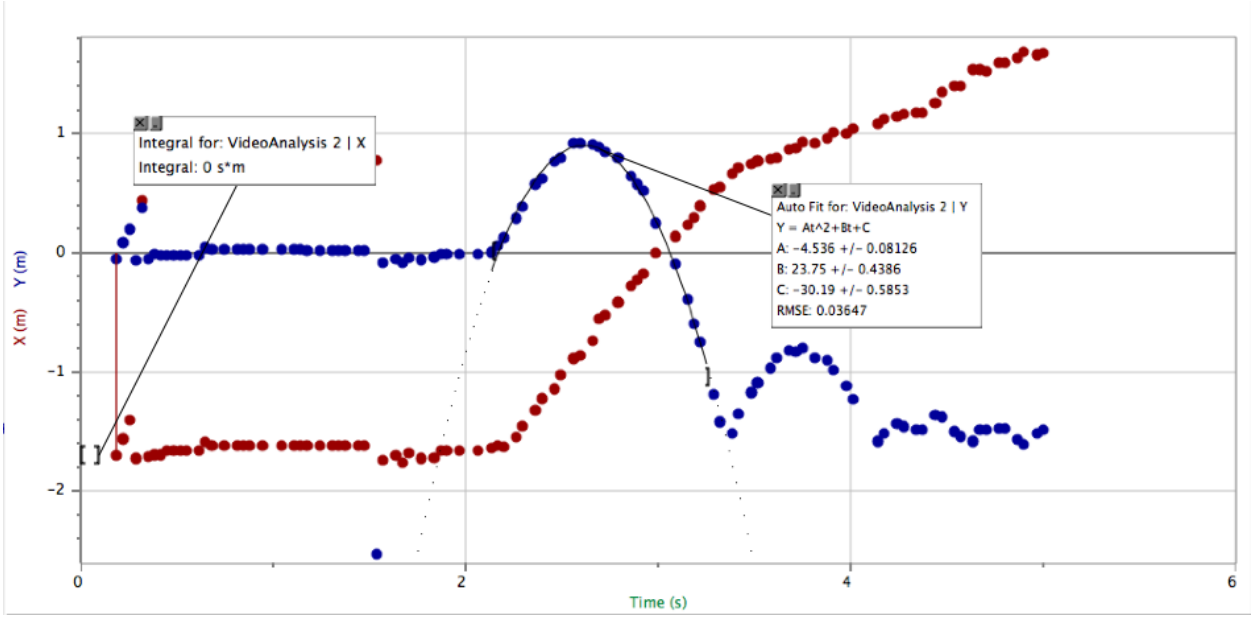
Background: Projectiles are defined as object moving:
1. under the force of gravity
2. no propulsion
3. no wings
4. in ideal situations, we ignore air resistance
5. when graphed over time, it creates a parabolic curve of the form $y=Ax^2$

Material:
- Logger pro
- video capture device
- meter stick
- ball
- thrower
- marking cones

Procedure:
1. choose ball
2. setup camera, including meter stick for calibration
3. start camera capture
4. throw ball
5. stop camera, analyze
6. using logger pro, track with dots
7. analyze the graphs

Data:

	VideoAnalysis					VideoAnalysis 2				
	Time (s)	X	Y	X Velocity	Y Velocity	Time (s)	X (m)	Y (m)	Vx (m/s)	Vy (m/s)
1	0	65	122	242.528	42.883	0.1850	-1.696	-0.05015	3.439	3.239
2	0.01333	70	122	119.624	93.166	0.2183	-1.561	0.08490	4.795	2.350
3	0.04667	72	125	75.704	128.816	0.2517	-1.403	0.1974	4.151	-0.041
4	0.08000	73	131	80.864	134.822	0.2850	-1.726	-0.06516	13.788	1.083
5	0.1133	77	134	83.384	124.742	0.3167	0.4375	0.3786	-0.719	-0.511
6	0.1467	80	138	68.708	140.752	0.3500	-1.709	-0.05130	-16.132	-3.000
7	0.1800	81	144	68.708	151.425	0.3833	-1.695	-0.01028	-5.136	-0.779
8	0.2133	84	149	84.051	155.427	0.4167	-1.695	-0.02395	-1.311	-0.374
9	0.2467	87	154	102.729	156.094	0.4483	-1.655	-0.02395	0.459	-0.012
10	0.2800	91	159	111.401	155.427	0.4817	-1.655	-0.02395	0.131	-0.010
11	0.3133	94	165	124.075	150.758	0.5150	-1.655	-0.02395	0.078	0.050
12	0.3467	100	170	123.408	136.082	0.5483	-1.655	-0.02395	0.165	0.177
13	0.3800	102	174	126.743	109.399	0.6150	-1.655	-0.02395	0.450	0.493
14	0.4133	108	176	139.418	104.063	0.6467	-1.588	0.04440	0.402	0.544
15	0.4467	113	181	124.075	111.401	0.6800	-1.614	0.03073	-0.046	0.054
16	0.4800	116	185	116.070	84.718	0.7450	-1.614	0.03073	-0.020	0.012
17	0.5133	120	186	123.408	58.702	0.8117	-1.614	0.03073	-0.015	-0.008
18	0.5467	124	188	137.416	48.029	0.8450	-1.614	0.03073	0.000	0.000
19	0.5800	129	190	158.096	39.357	0.8783	-1.614	0.03073	0.000	0.000
20	0.6133	136	191	139.418	17.344	0.9433	-1.614	0.03073	0.000	0.000
21	0.6467	138	190	114.532	3.986	1.043	-1.614	0.03073	0.000	-0.007
22	0.6800	142	191	119.347	-2.638	1.108	-1.614	0.03073	0.000	-0.026
23	0.7133	145	190	144.016	-12.456	1.142	-1.614	0.03073	0.000	-0.132
24	0.7483	153	190	138.239	-22.928	1.175	-1.614	0.01706	0.000	-0.099
25	0.7817	155	189	126.600	-37.155	1.242	-1.614	0.01706	0.000	-0.032
26	0.8150	161	188	143.227	-53.950	1.307	-1.614	0.01706	0.000	-0.008
27	0.8483	165	186	137.416	-99.393	1.340	-1.614	0.01706	0.000	0.000
28	0.8817	170	180	123.408	-110.067	1.373	-1.614	0.01706	1.345	-1.431
29	0.9150	173	178	114.736	-102.062	1.438	-1.614	0.01706	3.945	-4.343
30	0.9483	177	174	140.085	-121.407	1.472	-1.614	0.01706	11.713	-12.941



Observations:
1. Threw the ball into the air, the ball decelerated and reached its highest point, and then fell down, accelerated and hit the ground.
2. When the ball hit the ground, the ball bounced. Repeat its motion in third times and then stopped.

Analysis:
1. The ball's motion can be divided into two parts: the ball's ascending and descending.
2. Ascending: Due to the gravity of the Earth, the ball's ascending is a uniformly decelerated motion. Its speed decreased, when it equal to o, the ball reached its highest point.
3. Descending: The ball is free fall now. Because of the acceleration due to gravity, the ball's descending is a uniformly accelerated motion, it reached its biggest speed when it hit the ground.
4. From the data table, the ball's initial velocity is roughly 2.350m/s at t=2. However, the data table is not that accurate since according to the graph, the ball's motion is only from t=2 to t=3.5, the data table does not show all the details between this time interval.
5. From the graph, using the "curve fit" function, there's an equation $y=-4.536(+/-0.08126)t^2 + 23.75(+/-0.4386)t - 30.19(+/-0.5853)$ fit the curve. Since the eqiation of uniform rectilinear motion is $S=Vot + 1/2at^2$. Thus, compared these two equations, the acceleration can be calculated as (-4.536-0.08126)/(1/2)=-9.23, it roughly close to -9.8, the gravity.
6. When the ball hit the ground, ground gave it an upward velocity, so it bounced up.

Conclusion:
This experiment can be said as success. We observed a parabola from the curve of the ball's motion.
But there are many aspects can be improved, such as a better camera, the ball has better elasticity filling with gas instead of the ball used this time.
And the ball should be thrown higher in order to get more data.