Demonstrating Newton's Laws

HUMBOLDT STATE UNIVERSITY

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Background:

The Laurel Tree Charter School (LTCS) is a institution designed by teachers geared to educate their students for college curriculum by emphasizing sustainability in our environment and coexistence in our mixed diverse society. Located in Arcata, California, grades K through 12 are taught by the teachers that run the whole school's operation. The client, Becca Schuler, the physical science teacher for grades 9 through 12 , desired specific physics demonstrations for her class curriculum and thus these apparatuses were created. The apparatuses will be implemented in the classroom during lab activities in order to help the students understand the fundamentals of Newtonian Physics in a fun way.

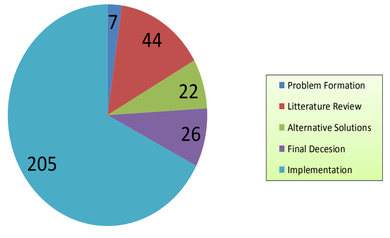
Objective:

The objective of this project is to create fun educational apparatuses that teach Newton's laws of motion. These apparatuses are to be used in future physics experiments at Laurel Tree Charter School.

Criteria:

- Durability
- Mysteriousness
- Safety
- Educational value
- Measurability
- Accuracy and Precision
- Inexpensive
- Storability
- Sustainability

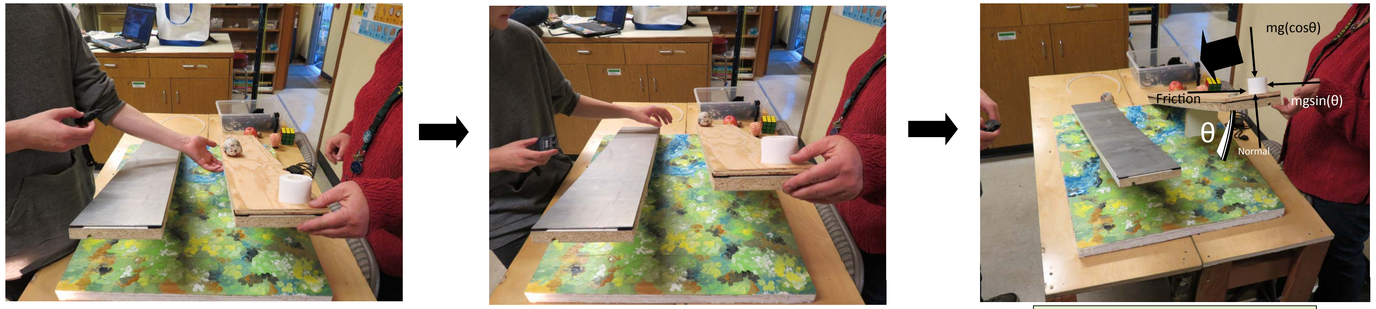
Total Design Hours: 304



Cost Paid	$ 119.11
Retail Cost	$ 191.58

Inclined Planes

Material	Quantity	Actual Cost	Retail Cost
Pinewood 6" by 30" (planes)	2	$ 9.10	$ 9.10
Plywood 4' by 4' (platform)	1	donated	$ 16.37
Hinges	4	$ 17.98	$ 17.98
Metal slate 6" by 30"	1	donated	$ 21.98
Carpeted section 6" by 30"	1	donated	$ 5.79
Plywood stands	4	donated	$ 15.49
Bag of nails and hardware	1	$ 1.99	$ 1.99
Mini aluminum vents	2	$ 3.58	$ 3.58
Wooden plugs	4	$ 0.40	$ 0.40
Metal washers	2	$ 0.60	$ 0.60
Wood glue	1	$ 3.49	$ 3.49
Velcro®	8	$ 3.99	$ 3.99
Total		$ 32.03	$ 100.76



Inertia

Inclined Planes

The Inclined Planes demonstrate Newton's first law by allowing students to solve for different coefficients of friction of materials that can be attached to the planes. This demonstrates that an object at rest will stay at rest unless it's net force is zero.

To solve for coefficient of Friction:

Assume F= μN
F= mgsin(q)
N= mgcos(q)
using substitution in the equation F= μN,
mgsin(q)= μmgcos(q)
So, μ= tan(q)

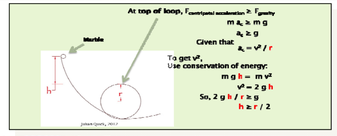
Loop de Loop Rollercoaster

Material	Quantity	Actual Cost	Retail Cost
Foam pipe insulation	1	$ 3.98	$ 3.98
1.25 "PVC pipe support segments	6	$ 3.56	$ 3.56
Plywood 2.5' by 1'	2	donated	$ 5.37
E6000 (Adhesive)	1	$ 7.49	$ 7.49
4ft cedar (1" x 1.25") garden stakes	3	$ 1.23	$ 1.23
Sandpaper	2	$ 1.08	$ 1.08
Wood glue	1	donated	$ 3.49
Bag of nails and hardware	1	donated	$ 1.99
Bag of marbles	1	$ 2.99	$ 2.99
Total		$ 20.33	$ 31.18

F=ma

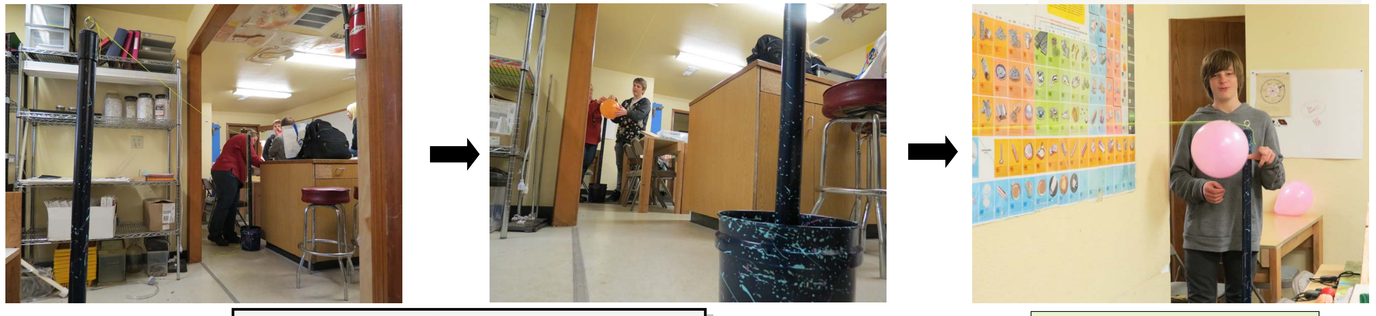
Loop de Loop Rollercoaster

The Loop de Loop Rollercoaster demonstrates Newton's second law of motion, F=ma, by using it to solve for the initial height a marble needs to make roll through the loop de loop without falling.



Balloon Rocket

Material	Quantity	Actual Cost	Retail Cost
4 ft. 1.25" PVC pipe sections	2	$ 5.49	$ 5.49
Buckets (6 gal)	2	$ 13.98	$ 13.98
1.25" PVC coupling	2	$ 2.98	$ 2.98
Eye hook	2	$ 3.98	$ 3.98
1.25" PVC plug	2	$ 2.99	$ 2.99
Spool of chalk string (50 ft)	1	$ 8.99	$ 8.99
Pack of balloons (25 Qt)	1	$ 2.97	$ 2.97
Drinking straws	1	donated	$ 1.99
Washers	4	$ 0.80	$ 0.80
Spray paint	2	$ 9.98	$ 9.98
Bag of concrete (40lbs)	1	$ 5.49	$ 5.49
Total		$ 57.65	$ 59.64



Action=Reaction

Rocket balloon

The Rocket Balloon demonstrates Newton's third law by launching a balloon through a string track connected by two posts grounded in concrete filled buckets. Students are able to use basic calculus to solve for the balloon's terminal velocity.

Find the average velocity:

Measure the distance (D) and time (t).

V=D/t

http://www.appropedia.org/Laurel_Tree_Charter_School_Newton%27s_laws_of_motion_apparatuses