

Name: _____ Date: _____ Period: _____

Unit 1 Project: Newton's Scooters

Introduction:

Imagine what would happen if you and a friend were standing on roller skates and you gave your friend a forward push. What would happen to you? Would you stand still or would you travel backward? The backwards motion that you would experience can be explained by Newton's third law of motion, which states: **"For every action there is an equal but opposite reaction."**

Purpose:

In this project, you will use Newton's third law of motion to design and construct a vehicle. This vehicle must travel forward 1.5 meters, by pushing backwards on the floor, the air, or some other object. In addition to designing and constructing your vehicle, you must also demonstrate your understanding of how your vehicle works with a force diagram, an oral explanation to the class, and a written summary/reflection of your results.

Vehicle Rules

1. First, you will create sketches of 4 possible vehicle designs.
2. Then, you will choose one design and create a vehicle design plan before you begin construction. Your design must be approved by your teacher.
3. Your vehicle must make use of Newton's third law of motion to move forward; the vehicle must move forward by the vehicle pushing backward on the floor, the air, or some other object.
4. Your vehicle must be built from scrap materials – you cannot use a ready-made vehicle or a store-bought kit.
5. The vehicle must go 1.5 meters in distance. Extra credit will NOT be given if it goes further. The testing area will be 1 meter in width. Your vehicle cannot go outside this width.
6. You are not allowed to interfere with the movement of your vehicle. You cannot give your vehicle a push as you launch it, and you cannot help it in any way as it travels from the start line to the finish line.
7. You cannot use any form of electricity. You cannot use the pull of gravity to move your vehicle (downhill ramps cannot be used).
8. You may use a track, such as a toy car track or a string that runs from the starting line to the finishing line to guide your vehicle. This may help reduce friction and also help to keep your vehicle within the boundaries. Your vehicle does not have to move along the ground. If your vehicle moves through the air, you can stretch a track between two chairs to guide your vehicle.
9. Your vehicle must be able to carry one passenger (a raw egg) without harming the passenger (cracking or breaking the egg). A padded seat and/or seatbelt may be provided, but the passenger itself may not be completely padded or wrapped. In other words, the entire egg should be easily viewed and accessible each trial.
10. You are responsible for providing your passenger (one raw egg) the day of testing.

Suggested Materials

- Recycled materials from home
- Toys
- Building blocks
- Balloons
- Springs
- Straws
- Fishing line
- Paper towel rolls
- Rubber bands

Hints

1. Be creative! Don't limit yourself to a car with 4 wheels. Think about other ways you can get your vehicle to move a distance of 1.5 meters. It has to stay within a width of 1 meter, but it can leave the ground.
2. What happens when you inflate a balloon and release it? Can you use Newton's third law to explain this movement? Can you think of any other objects like this that you could use to push your vehicle?

Other Requirements:

Initial Sketches: You will initially draw four sketches of four possible vehicle designs. These sketches should be labeled with possible materials and a brief description of how the vehicle will move forwards with the backwards push.

Force Diagram: From your sketches, you will choose one design and you must create a diagram of your vehicle. On the diagram, you need to label materials used. You must also use labeled arrows to indicate the force of friction and the force of gravity. You should also label or describe how your vehicle pushes backwards and how the vehicle will move forwards with the backwards push.

Class 'presentation': Prior to testing your vehicle, you will briefly explain how you constructed your vehicle, how the vehicle will work according to Newton's third law, as well as the forces working on your vehicle (about 1 minute).

Lab Report: Your vehicle will be tested for a total of three trials. While testing your vehicle you will keep track of the distance achieved as well as any other observations. You will submit the following:

1. a typed data table of your results
2. a list of observations made during testing (3 personal and 3 peer)
3. a typed conclusion in which you reflect on your vehicle's design and construction, possible errors and how you could have improved your vehicle.

Time Line

1. Four Initial Sketches
2. Vehicle Force diagram
3. Vehicle construction completed
4. Presentation/Testing
5. Lab report

Due Date

Friday, November 6
Tuesday, November 10
Tuesday, December 1
Tues. & Wed., December 1 & 2
Friday, December 4 (or earlier)

Grading Rubric

See attached rubric

Grading Rubric: Newton's Scooters

Criteria		4	3	2	1	0	Score
Initial Sketches		Four sketches are provided. Each contains clear labels of materials and a clear description of how the vehicle will work.	Three sketches are provided. Most contain clear labels of materials and a clear description of how the vehicle will work.	Two sketches are provided. Some contain clear labels of materials and a clear description of how the vehicle will work.	One sketch is provided. A few contain clear labels of materials and a clear description of how the vehicle will work.	Initial sketches are not provided. Materials are not described. How the vehicle works is not described.	
	Force Diagram	Vehicle drawing is clear and shows materials used. Friction AND gravity are correctly labeled. Backwards push AND reaction are labeled AND described.	Vehicle drawing is clear and shows materials used. Friction and gravity are labeled. Backwards push AND reaction are labeled OR described.	Vehicle drawing is not clear or doesn't show materials used. Friction or gravity are labeled. Backwards push OR reaction are labeled OR described.	Vehicle drawing is not clear nor shows materials used. Forces are not labeled. Backwards push and reaction are missing.	Force diagram is not completed.	
Vehicle Performance	Design (Counts 2x)	The vehicle's backwards force is used to move vehicle forward. Help is not given to vehicle at any time. [8]	A backwards force is used to move a vehicle forward. Help is not given to vehicle at any time. [6]	A backwards force is used to move a vehicle forward. Help is given to vehicle. [4]	A backwards force is not used to move vehicle forward. [2]	Vehicle is not made [0]	
	Construction	Vehicle is made of scrap materials. Egg is accesible (not padded or wrapped)	Vehicle is made of scrap materials. Egg is not accesible (padded or wrapped)	Vehicle is ready-made or built from a kit. Egg is accesible.	Vehicle is ready-made or built from a kit. Egg is not accesible.	Vehicle is not made	
	Distance	Vehicle's best run travels 1.5 meters or more	Vehicle's best run travels 1.0 to 1.49 m	Vehicle's best run travels 0.5 to 0.99 m	Vehicle's best run travels 0 to 0.5 m	No vehicle constructed.	
	Passenger Survival			Egg does not break	Egg cracks or breaks.	Egg is not supplied by testee.	
Lab Report	Data Table and Observations	Data table includes 3 trials and average in correct format. At least 3 personal and 3 peer observations are included.	Data table includes 3 trials and average in mostly correct format. 4-5 peer and personal observations are included.	Trials or average is missing. Some errors in format are present. 2-3 peer or personal observations are included.	Trials and average is missing. Many errors in format are present. One observation is included.	No data table is included. No observations are included.	

	Conclusion	Purpose and hypothesis are accurately stated. Conclusion is stated and data is used thoroughly to support it. At least two errors and two improvements are addressed.	Purpose and hypothesis are stated. Conclusion is stated and data is used to support it. Two errors and improvements are addressed.	Purpose or hypothesis is stated. Conclusion is stated or data is used to support data. One error and improvement are addressed.	Purpose or hypothesis is stated. Conclusion is stated or data is used to support data. Errors or improvement are addressed.	No conclusion is submitted.	
						Total	34

Note: Point values will count double in the gradebook